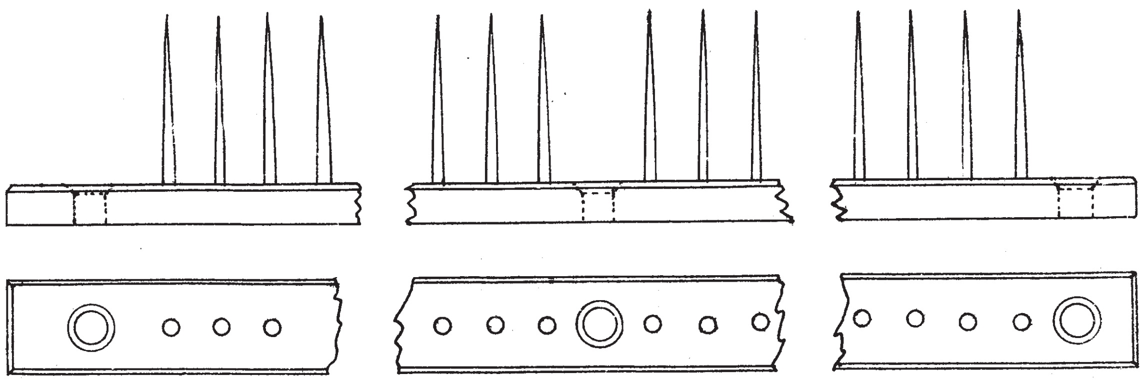
DRAWING GILLS.

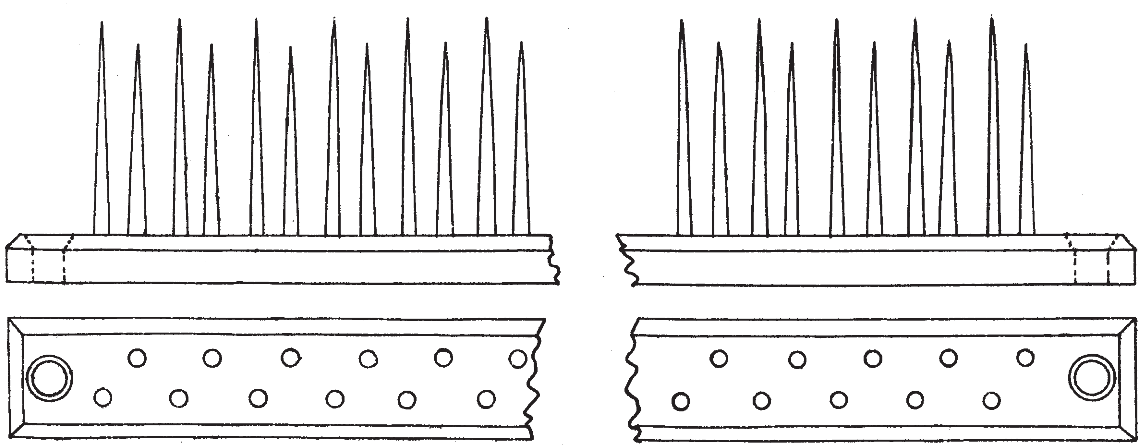


CIRCULAR DRAWING GILL.

$18\frac{1}{2}'' \times \frac{1}{2}'' \times \frac{1}{4}''$ Brass.

$3\frac{1}{2}$ pins per inch.

$17\frac{1}{4}''$—1—60—No. 15, $1\frac{1}{8}''$. Rivet No. 8, $1\frac{1}{4}''$.



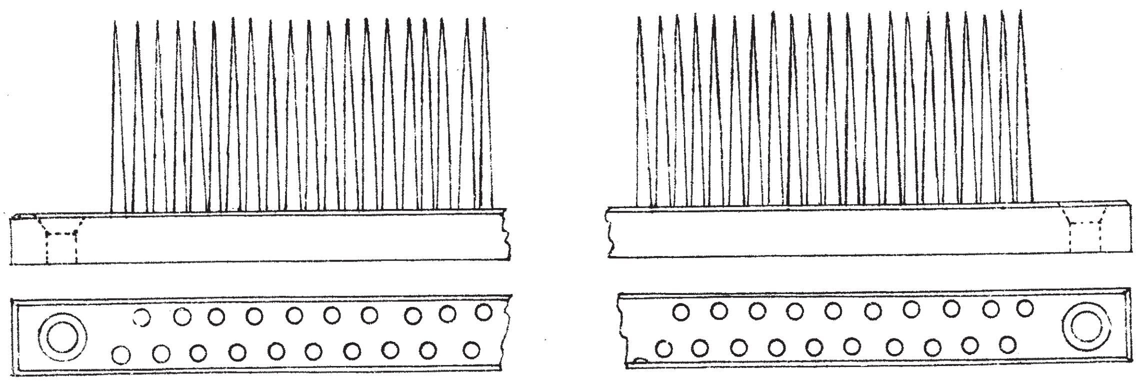
FIRST PUSH BAR DRAWING GILL.

$8'' \times \frac{5}{8}'' \times \frac{1}{4}''$ Brass.

$2\frac{1}{2}''$ pins per inch.

7″—2—18—No. 14, $1\frac{3}{8}''$ and $1\frac{1}{4}''$. Rivet No. 8, 1

DRAWING GILLS.

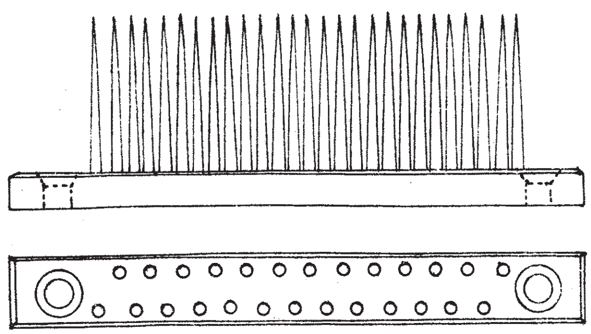


SECOND DRAWING SPIRAL.

$7'' \times \frac{13}{32}'' \times \frac{1}{4}''$ Brass.

5 pins per inch.

$6''$—2—30. No. 16—$1\frac{1}{4}''$. Rivet No. 10, $1\frac{1}{8}''$.



$10'' \times 5''$ Roving Gill.

$2\frac{7}{8} \times \frac{3}{8}'' \times \frac{7}{32}$ Brass.

6 pins per inch.

$2\frac{1}{8}''$—2—13. No. 16, $1''$.

Gill Rivet, $1''$, No. 11.

SPECIFICATION AND PARTICULARS OF DRAWING AND ROVING GILLS FOR HESSIAN YARNS.

The student will note as to the arrangement of the dimension.

Push Bar Drawing Gills.

$8'' \times \frac{3}{8}'' \times \frac{1}{4}''$ brass.

rows. pins.
$7''$, 2, 18, No. 14, $1\frac{3}{8}$ and $1\frac{1}{4}$ — $2\frac{1}{2}$ pins per inch.

NOTE.—That front row of pins are $\frac{1}{8}$th shorter than back row.

Circular Drawing.

$18\frac{1}{2}'' \times \frac{1}{2}'' \times \frac{1}{4}''$ brass.

rows. pins.
$17\frac{1}{4}''$, 1, 60, No. 15, $1\frac{1}{8}''$, $3\frac{1}{2}$ pins per inch.

Second Drawing Spiral.

$7'' \times \frac{13}{32}'' \times \frac{1}{4}''$ brass.

rows. pins.
$6''$, 2, 30, No. 16, $1\frac{1}{4}$, 5 pins per inch.

Roving $10'' \times 5''$ *Pitch.*

$2\frac{7}{8}'' \times \frac{3}{8}'' \times \frac{7}{32}''$ brass.

rows. pins.
$2\frac{1}{8}''$, 2, 13, No. 16, — $1''$, 6 pins per inch.

Gill Rivets Push Bar—No. 8, $1''$.
,, ,, Circular Bar—No. 8, $1\frac{1}{4}''$.
,, ,, Second Spiral—No. 10, $1\frac{1}{8}''$.
,, ,, Rovings $10'' \times 5''$—No. 11, $1''$.

GILLS FOR HESSIANS.

(Recommended by Fairbairn).

1st Push Bar Drawing,	No. 15 w.g.,	21 pins per row of	7 ins.
2nd Spiral ,,	No. 15 w.g.,	30 ,, ,,	6 ins.
Spiral Roving	No. 16 w.g.,	14 ,, ,,	$2\frac{1}{8}$ ins.

GILLS FOR WARPS.

1st Push Bar Drawing,	No. 15 w.g.,	18 pins per row of	7 ins.
2nd Push Bar Drawing,	No. 15 w.g.,	25 ,, ,,	7 ins.
Spiral Roving,	No. 16 w.g.,	12 ,, ,,	$2\frac{1}{8}$ ins.

GILLS FOR WEFTS.

1st Push Bar Drawing,	No. 14 w.g.,	16 per row of	7 ins.
2nd ,, ,,	No. 15 w.g.,	22 ,,	7 ins.
Spiral Roving,	No. 15 w.g.,	11 ,,	$2\frac{1}{2}$ ins.

FLUTING OF DRAWING ROLLERS.

The Drawing Rollers of first and second drawings and also the rovings are fluted to a certain pitch, so many flutes in the circumference. These are not all of the same pitch, hence the term irregular fluted roller. The reason for making the flutes irregular in the pitch is that when made so, this irregularity of flute prevents the pressing roller becoming fluted by the pressure of the pressing roller. If the pressing roller is allowed to work until it is fluted and working into the flutes of drawing roller, this makes the sliver smaller than is intended, and for the same reason if this takes place at the roving small rove will be the result. Automatic motions are fitted on the drawing rollers of rovings and spinning frames to move the drawing rollers on end ; this prevents the drawing rollers getting grooved at one part of the roller, and of course makes the drawing rollers last out much longer.

32	Flutes in	2″	Roller	Preparing Drawing Rollers.
34	,,	$2\frac{1}{8}$″	,,	
36	,,	$2\frac{1}{4}$″	,,	
38	,,	$2\frac{3}{8}$″	,,	
40	,,	$2\frac{1}{2}$″	,,	
48	,,	3″	,,	
64	,,	4″	,,	Spinning Drawing Rollers.
66	,,	$4\frac{1}{8}$″	,,	

16 flutes per inch diameter.

DIAGRAM OF PUSH BAR DRAWING.

Pressing and Drawing Roller—hard-to-hard. SCALE 3″ TO ONE FOOT.

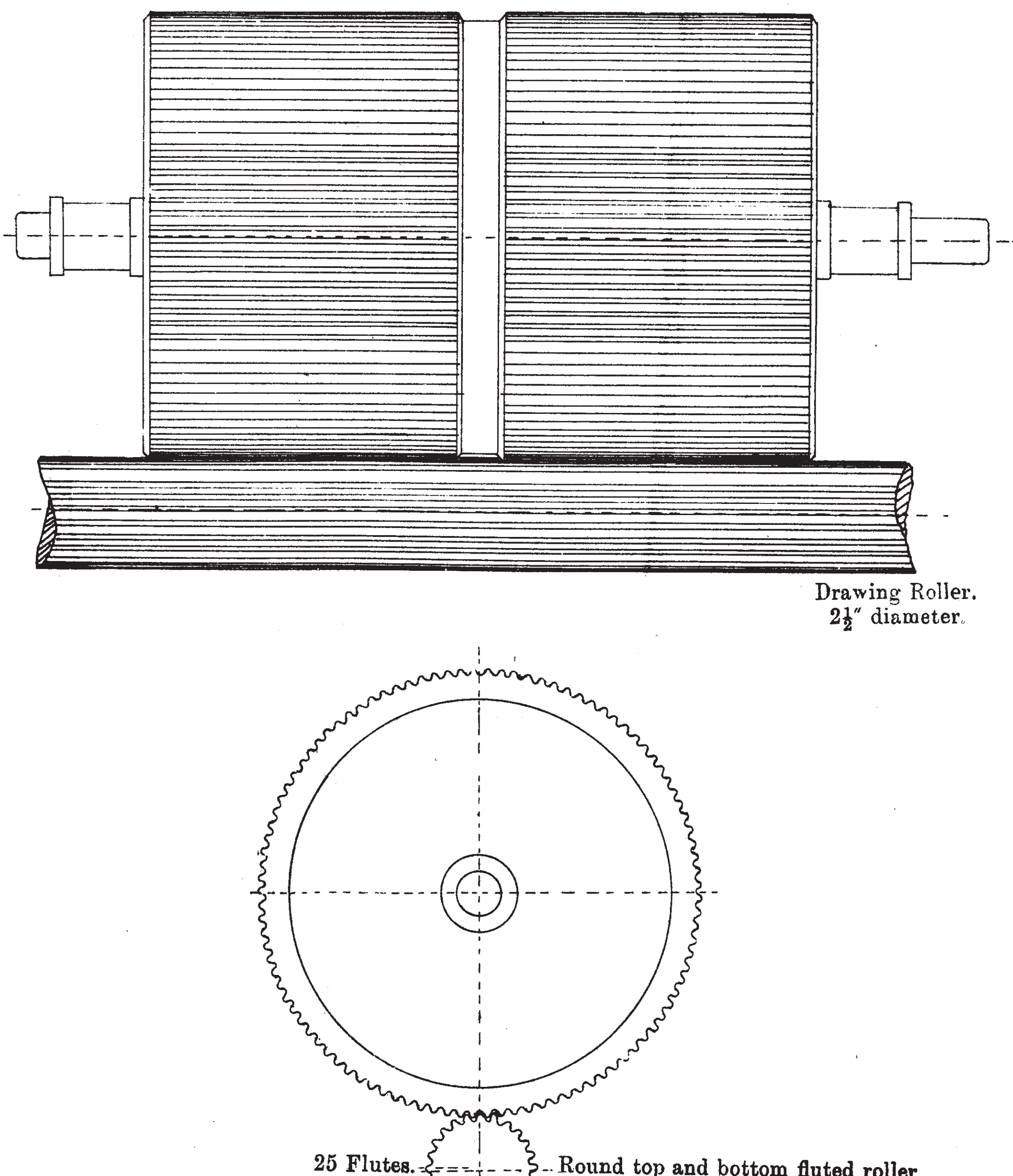
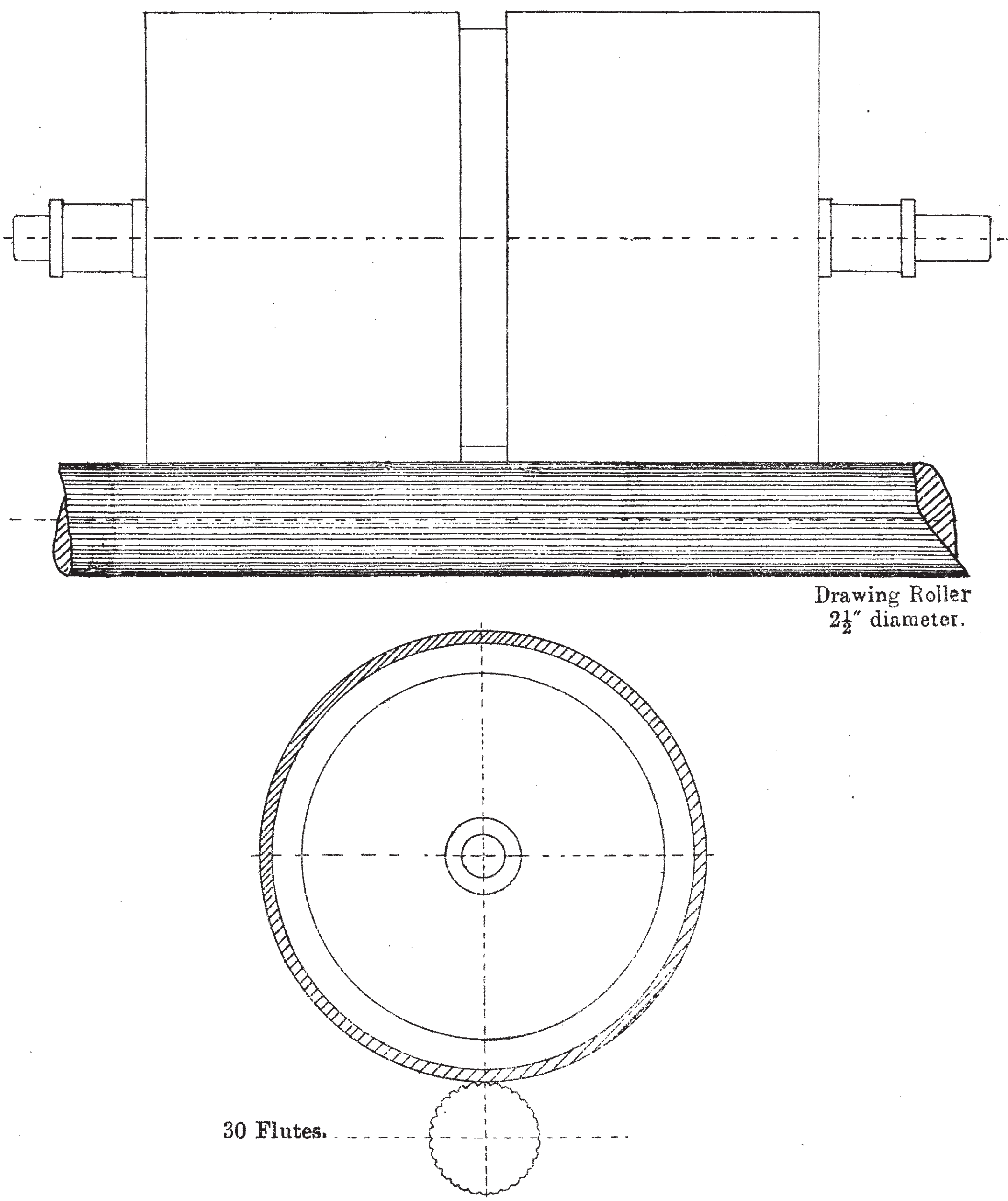


DIAGRAM OF PUSH BAR DRAWING.

Pressing and Drawing—Leather covered Pressing Roller.

SCALE 3″ TO ONE FOOT.



V Flute.

ROVING.

Roving.—The cans being taken in setts of eight each from the second drawing, are put up at the back of the roving, one end over each gill, and are delivered on to the rove bobbin in front of roving. On the roving there are four change pinions—first, the twist pinion; second, the draft or grist pinion; third, the traverse pinion; and, fourth, the rack pinion. For a rove of 70/75 lbs. per spindle, the twist pinion is 35, with $2\frac{1}{4}$ drawing roller; rack pinion, 15; and traverse pinion, 28 teeth.

Note.—Roving Rack Pinion.—A mark on the side of one of the teeth in the pinion is put there for a guide. When you put on a rack pinion, the top catch should be into the marked tooth, after the rack is wound up.

Arrangement of Clock, which is driven from Drawing Roller.—This Clock shows the quantity taken off on a day or week.

Drawing roller $= 2\frac{1}{4}''$ diam. $= 7{\cdot}06$ circumference.

$$\frac{1 \times 59 \times 60 \times 60 \times 60 \times 60 \times 46}{1 \times 10 \times 10 \times 10 \times 10 \times 12 \times 24 \times 1} = 732780 = \text{revolutions of roller for one round of clock.}$$

$732780 \times 7{\cdot}06 = 5173426{\cdot}80$ inches, and

$5173426{\cdot}80 \div 36 = 143706{\cdot}3$ yds.

$143706{\cdot}3 \div 14400 = 9{\cdot}97$ spyndles per spindle, and

$9{\cdot}97 \times 56 = 558{\cdot}32$ spyndles in one round of clock.

Note.—That the dial of roving clock is marked off in 40 points 10 parts marked 4, 8, 10, 16, 20, 24, 28, 32, 36, and 40.

The following are the Roving, Twist, and Draft arrangements.

Draft arrangement—

$$\frac{A}{B} \times \frac{C}{D} \times \frac{E}{F} \times \frac{G}{H}$$

In this case—

A = Diameter of Drawing Roller

B = Pinion on „

C = „ on back shaft.

E} F} = Double intermediate at opposite end of roving.

G = Wheel on retaining roller in gear with F.

H = Diameter of drawing roller.

Thus—

$$\frac{2\frac{1}{4} \times 36 \times 70 \times 70}{38 \times 24 \times 24 \times 1\frac{15}{16}} = 9 \cdot 35 \text{ draft between drawing roller and retaining roller}$$

Grist or Change pinion. $$\frac{2\frac{1}{4} \times 36 \times 70 \times 70}{C. \times 24 \times 24 \times 1\frac{15}{16}} = \cdot 2599 = \text{constant number.}$$

Twist Arrangement.—Drawing roller, $2\frac{1}{4}$ in. dia. = 7·06 circumference.

$$\frac{A}{B} \times \frac{C}{D} \times \frac{E}{F} \times \frac{\ }{G} = \text{twist per inch.}$$

In this case—

A = Drawing roller wheel.

B = Twist Pinion.

C = Pinion on driving shaft of roving, driving D, the pinion on end of spindle driver shaft.

D = Pinion on end of spindle driver shaft.

E = Bevel pinion on spindle shaft, driving G, the pinion in spindle.

F = Pinion on spindle.

G = Circumference of drawing roller

Thus—

$$\frac{60 \times 44 \times 21}{36 \times 22 \times 14 \times 7 \cdot 06} = \cdot 75 \text{ twists per inch.}$$

$$\frac{60 \times 44 \times 21}{\text{Twist pinion } 22 \times 14 \times 7 \cdot 06} = 25 \cdot 4 = \text{constant number for twists per inch.}$$

SPEED SPINDLES.—Roving shaft, 215 revolutions per minute; Preparing shaft, 160; Drum, 24″ diameter; Pulleys, 18″ diameter.

$$\frac{160 \times 24}{18} = 213{\cdot}33.$$ Say 215 revs. per minute of Main Shaft Roving.

In this case—

$$\frac{A}{} \times \frac{B}{C} \times \frac{D}{E} = \text{speed spindles.}$$

A = Speed, main shaft of roving.

B = Pinion on ,, ,,

C = Pinion on end of spindle shaft of roving.

D = Bevel pinion on spindle ,,

E = Pinion on spindle.

Thus—

$$\frac{215 \times 44 \times 21}{22 \times 14} = 645$$ Revolutions of spindle per minute.

With the above arrangement of draft, twist, and speed of spindles, the roving will make 28/30 shifts in 10 hours, or 21/22 points on the clock dial, in a week of 56 hours. This, by the clock, means rather more than five spyndles per spindle, per week of 56 hours.

Draft and Twist Plate attached to 10″ × 5″ spiral roving, with drawing roller 2¼″ diameter.

Draft.		Pinion.	Twist.		Pinion.
5	...	20	1·5	...	17
5½	...	22	1·25	...	21
6	...	24	1·	...	26
6½	...	26	·9	...	29
7 .	...	28	·8	...	52
7½	...	30	·7	..	37
8	...	32	·6	...	43
8½	...	34	·5	...	52
9	...	36			
9½	...	38			
10	...	40			

*When changing a roller from 2¼ to 2$\frac{3}{16}$″ diameter, put on a 37 pinion on drawing roller, and for every $\frac{1}{16}$th smaller the roller wears. When it is turned up, allow one-tenth less on the drawing roller pinion. This will keep the draft plate correct. Example:—

Teeth.

2¼″ : 2$\frac{3}{16}$″ : : 38 : 37 almost.

*NOTE.—A full sized Drawing Roller, that is 2¼″ diameter, has on it a 38 teeth pinion.

SPIRAL DISC ROVING FRAME, 10″ × 5″ BOBBIN.

Sectional elevation showing gearing at end opposite to the driving pulleys.

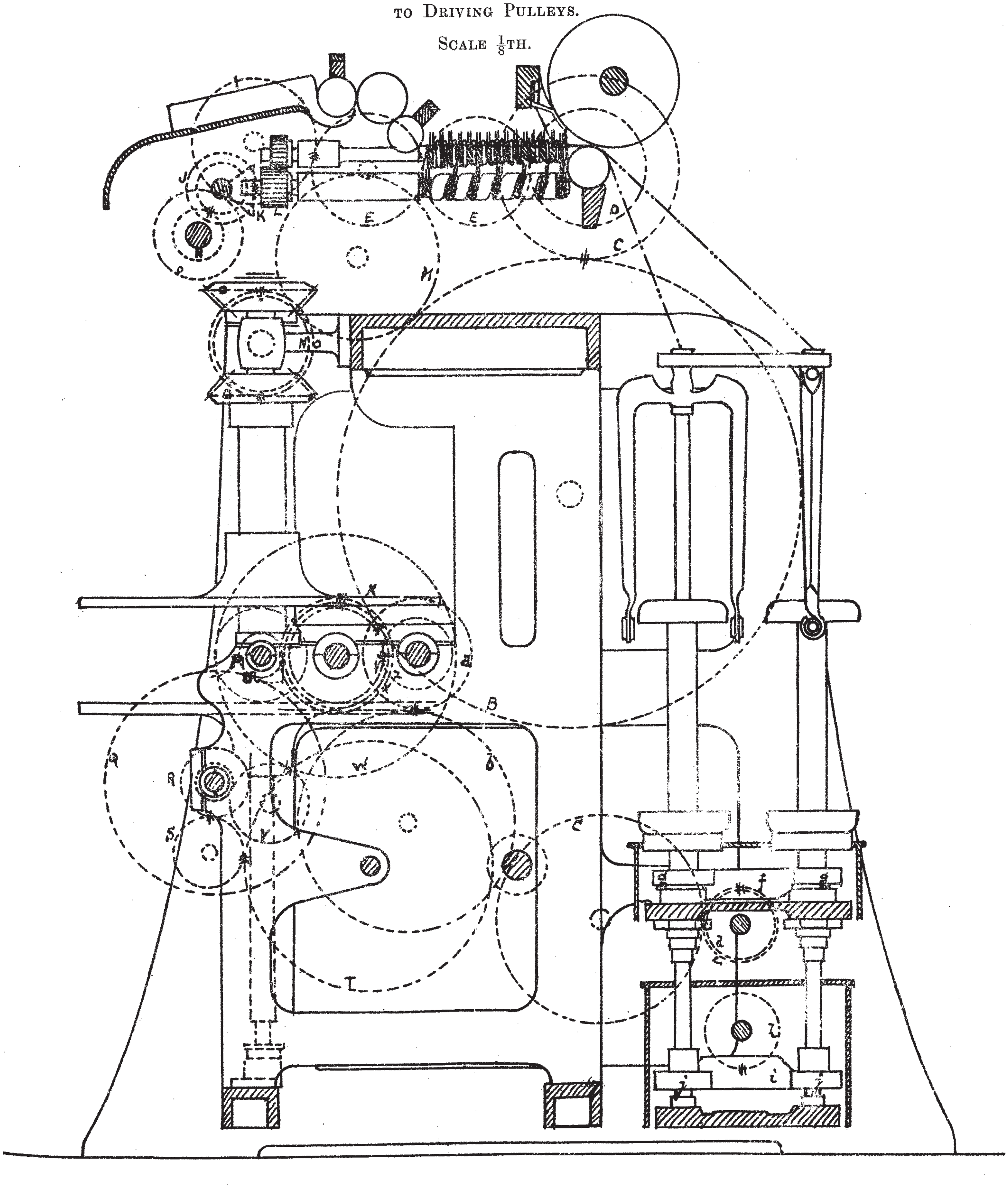
SCALE $\frac{1}{8}$TH.

A	Twist Changes (on driving shaft), ...	17 to 52 teeth.
B	Intermediate, ...	150 teeth.
C	Twist Wheel (on drawing rollers), ...	60 teeth.
D	Drawing roller wheel, ...	38 teeth.
E E	Intermediates, ...	36 teeth.
F	Intermediate, ...	40 teeth.
G	Draught Changes (on back shaft), ...	20 to 40 teeth.
H	Wheel for driving single back shaft (separate for each head), ...	22 teeth.
I	Wheel on single back shaft, ...	22 teeth.
J	Bevel wheel for driving screws, ...	24 teeth.
K	Bevel pinion on bottom screw, ...	16 teeth.
L L	Wheels for driving top screw, ...	14 teeth.
M	Intermediate, ...	54 teeth.
N	Wheel on countershaft for driving discs, ...	30 teeth.
O O O	Mitres for driving discs, ...	28 teeth.
P	Pinion on end of bowl shaft, ...	20 teeth.
Q	Wheel on short countershaft, ...	96 teeth.
R	Traverse Changes, ...	20 to 40 teeth.
S	Intermediate, ...	32 teeth.
T	Wheel on mangle wheel pinion shaft, ...	108 teeth.
U	Pinion for driving differential wheel, ...	12 teeth.
V	Intermediate, ...	27 teeth.
W	Differential Wheel, ...	78 teeth.
X X X	Differential bevels, ...	30 teeth.
Y	Wheel on pap of differential bevel, ...	30 teeth.
Z	Wheel on countershaft, ...	24 teeth.
a	Wheel on countershaft, ...	48 teeth.
b	Intermediate, ...	96 teeth.
c	Intermediate, ...	92 teeth.
d	Wheel on bobbin shaft, ...	30 teeth.
e	Bevel wheel on bobbin shaft (one for every two spindles), ...	21 teeth.
f	Spur and bevel intermediate, ...	28 teeth.
gg	Bobbin pinions, ...	14 teeth.
h	Bevel wheel on pinion shaft (one for every two spindles, ...	21 teeth.
i	Spur and bevel intermediate, ...	28 teeth.
j	Spindle pinions, ...	14 teeth
k	Rack pinion (for traversing bobbins), ...	20 teeth

SPIRAL DISC ROVING FRAME.

SECTIONAL ELEVATION SHOWING GEARING AT END OPPOSITE TO DRIVING PULLEYS.

SCALE $\frac{1}{8}$TH.



SPIRAL DISC ROVING FRAME, 10″ × 5″ BOBBIN.

Sectional elevation showing gearing at pulley end.

SCALE $\frac{1}{8}$TH.

A	Wheel for driving single back shaft (separate for each head), ...	22 teeth.
B	Wheel on single back shaft, ...	22 teeth.
C	Bevel wheel for driving screws, ...	24 teeth.
D	Bevel pinion on bottom screw, ...	16 teeth.
E E	Wheels for driving top screw, ...	14 teeth.
F	Back shaft pinion, ...	24 teeth.
G	Intermediate, ...	30 teeth.
H	Stud Wheel, ...	70 teeth.
I	Stud Pinion, ...	24 teeth.
J	Retaining roller wheel, ...	70 teeth.
K K K	Wheels for driving lower retaining roller, ...	24 teeth.
L	Wheel on driving shaft, ...	44 teeth.
M M	Intermediates, ...	84 teeth.
N	Wheel on spindle shaft, ...	22 teeth.
O	Bevel wheel on spindle shaft, ...	21 teeth.
P	Spur and bevel intermediate, ...	28 teeth.
Q Q	Spindle Pinions, ...	14 teeth.
R	Bevel Wheel on bobbin shaft, ...	21 teeth.
S	Spur and bevel intermediate, ...	28 teeth.
T T	Bobbin Pinions, ...	14 teeth.
U	Mangle wheel pinion, ...	5 teeth.
V	Mangle wheel, ...	72 teeth.
W	Rack pinion (for traversing bobbins), ...	20 teeth.

DRAFT ARRANGEMENT—

$$\frac{2\frac{1}{4}'' \times 36 \times 70 \times 70}{38 \times 24 \times 14 \times 1\frac{15}{16}} = 9{\cdot}35 \text{ draft.}$$

$$\frac{2\frac{1}{4}'' \times \text{C.P.} \times 70 \times 70}{38 \times 24 \times 24 \times 1\frac{15}{16}} = {\cdot}2599 \text{ constant No. for draft.}$$

TWIST ARRANGEMENT—

$$\frac{60 \times 44 \times 21}{36 \times 22 \times 14 \times 7{\cdot}06} = {\cdot}75 \text{ twists per inch.}$$

$$\frac{60 \times 44 \times 21}{\text{C.P.} \times 22 \times 14 \times 7{\cdot}06} = 25{\cdot}495 \text{ constant No. for twist.}$$

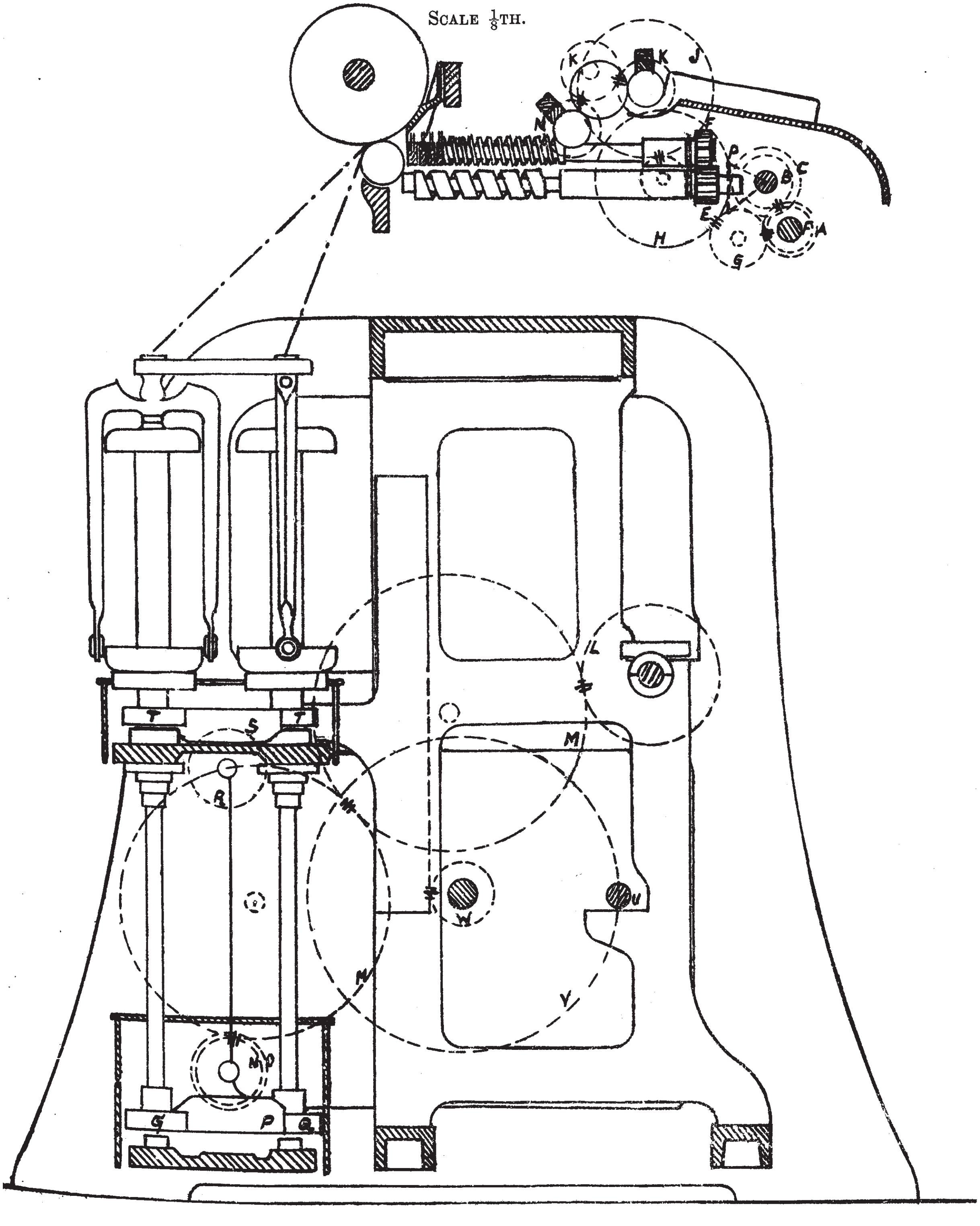
Speed Spindle = Speed Main Shaft Roving × 3. Main Shaft Roving, 215 revolutions per minute.

$\frac{44 \times 21}{22 \times 14} = 3.$ Thus, 215 × 3 = 645 revolutions per minute.

SPIRAL DISC ROVING FRAME.

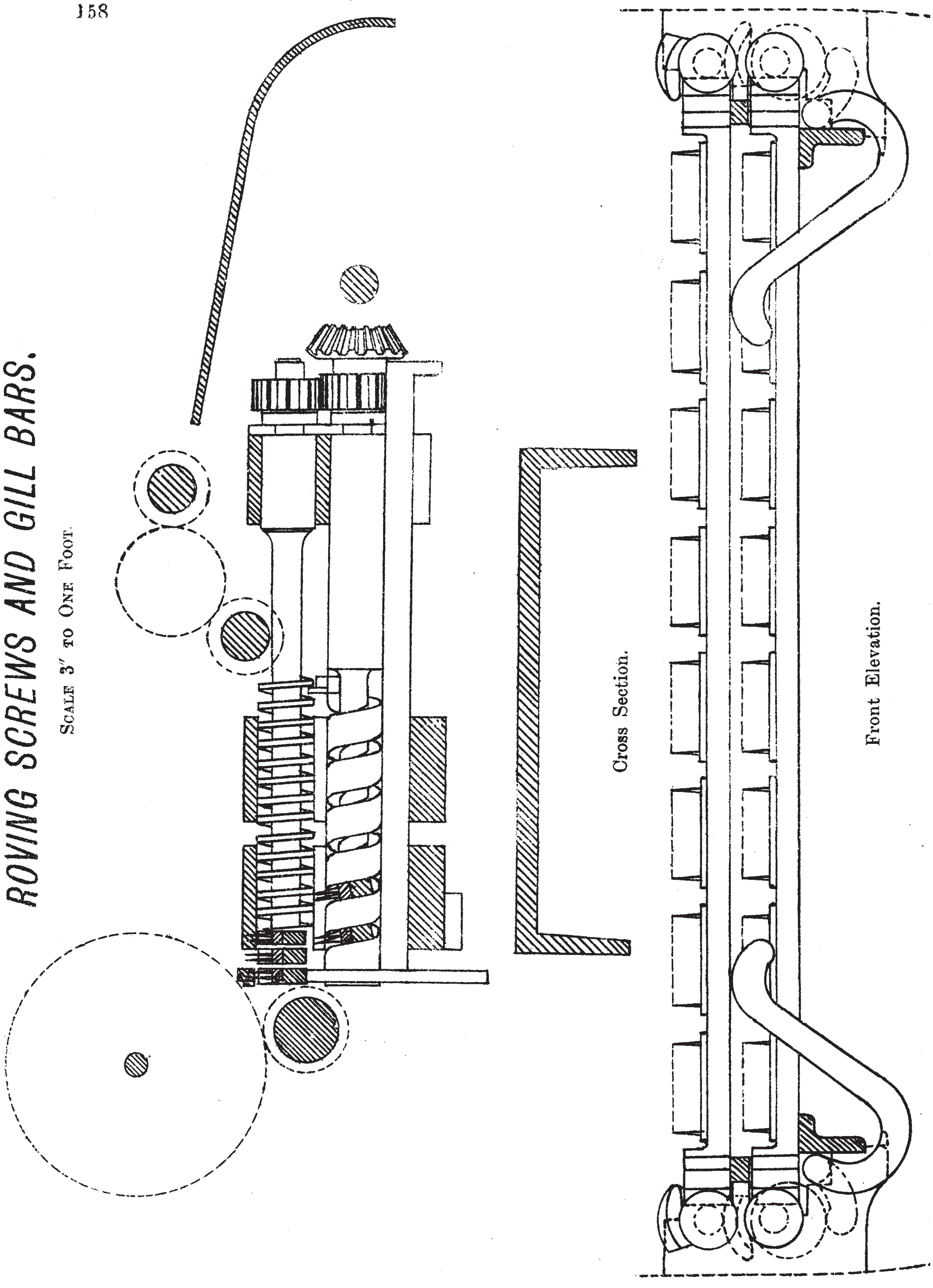
SECTIONAL ELEVATION SHOWING GEARING AT PULLEY END.

SCALE $\frac{1}{8}$TH.



ROVING SCREWS AND GILL BARS.

Scale 3″ to One Foot.

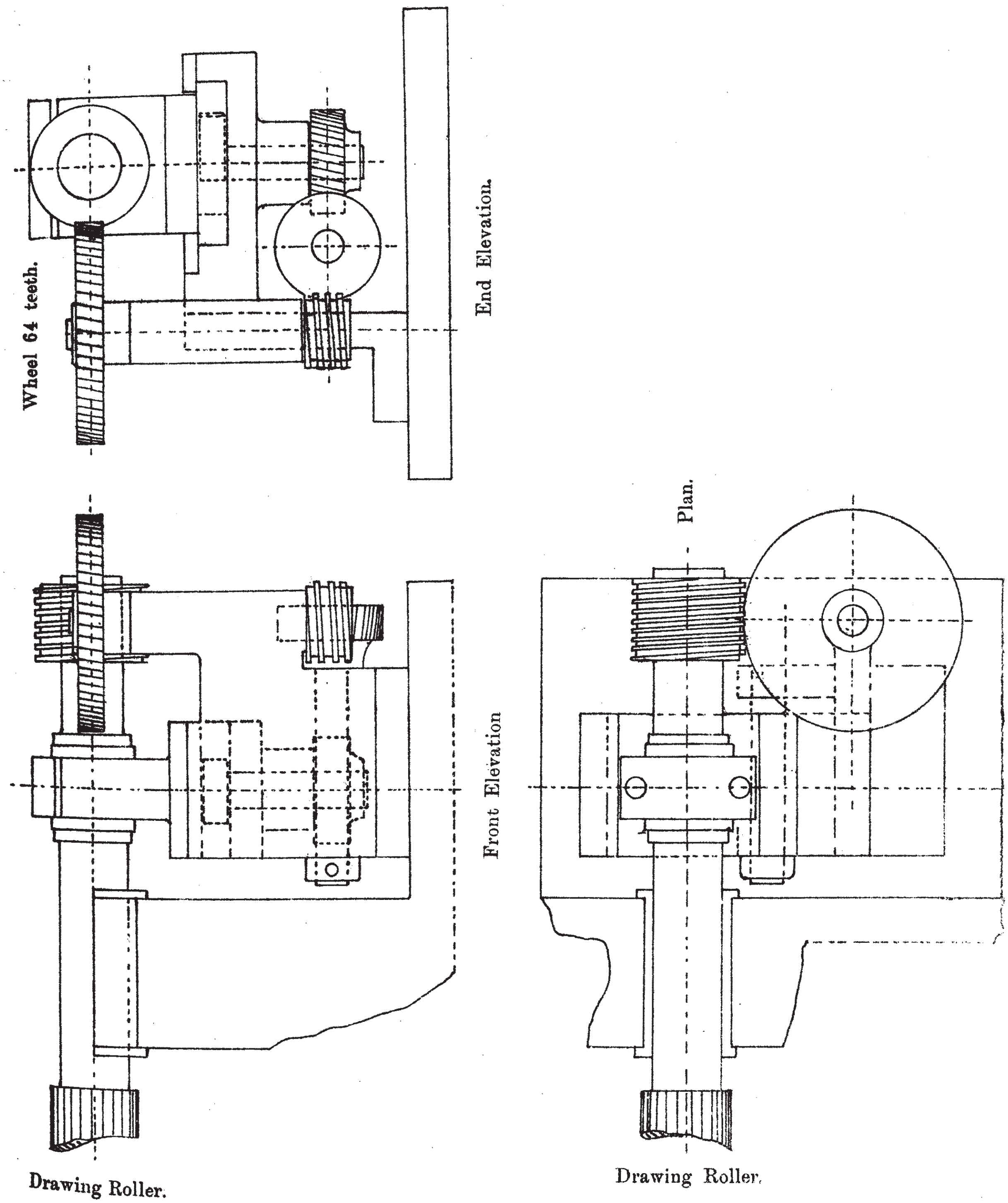


Cross Section.

Front Elevation.

Automatic Motion for Roving Frame Drawing Roller.

Scale 3″ to One Foot.



PARTICULARS OF AUTOMATIC MOTION FOR ROVING DRAWING ROLLER.

(For Diagram see page 159).

Wheel in gear with worm (single thread) on Drawing Roller, 64 teeth.

Two pinions each 36 teeth in gear, with single thread worms, as shown on diagram. Thus—

$$\frac{1}{64} \times \frac{1}{36} \times \frac{1}{36} = \frac{1}{82944}$$

Movement of eccentric $1\frac{1}{2}$ inches—that is $\frac{3}{4}''$ to the right and $\frac{3}{4}''$ to left side.

Then—

$$\frac{1\frac{1}{2}}{82944} = \frac{\frac{3}{2}}{82944} = \frac{3}{2} \times \frac{1}{82944} = \frac{3}{165888} = \frac{1}{55296}$$ of an inch of travel of the eccentric for each revolution of the drawing roller.

GENERAL INSTRUCTIONS AS TO WORKING OF ROVING.

There is no doubt that the roving is one of the most important machines in a jute mill. Two parts of this machine require continual attention, namely, the differential motion and traverse gear, and the screws working the gill bars.

First, in reference to the differential motion, a description of this having been given by Mr Joseph Hovell, which has been much appreciated by those interested in jute machinery, it is not necessary to go into this in detail; only a diagram of this part of the roving frame is therefore given, and the calculations stated, so that the student will have the particulars ready to hand as a reference.

The second part of the machine which is of importance is the gill bars and screws actuating same. If a large and steady production is wanted of the roving, this part of it will require constant and careful attention by those in charge. I have already stated my opinion as to their repair and upkeep; and can only repeat here, that the importance of this part of the roving cannot be overstated—the gill bars must be kept thoroughly clean, the gill pins sharp and well sett up. All this can only be done by so many heads of bars being taken out each day and cleaned, the screws also cleaned and picked, the collar for pitch pin being carefully kept in order. Never allow the hole in collar for pitch pin to become wide at the edge next the pinion, or the pin will bend round between the collar and pinion, instead of breaking clean off, and when this occurs, will sometimes drive the carriage or head of bars in a jerky way, thus making thin parts on the rove, may not be noticed until the roves are on the spinning frame—small rove and small yarn being the result. All this may be avoided by care and attention, combined with a knowledge of the proper working of the gill bars and the screws actuating them.

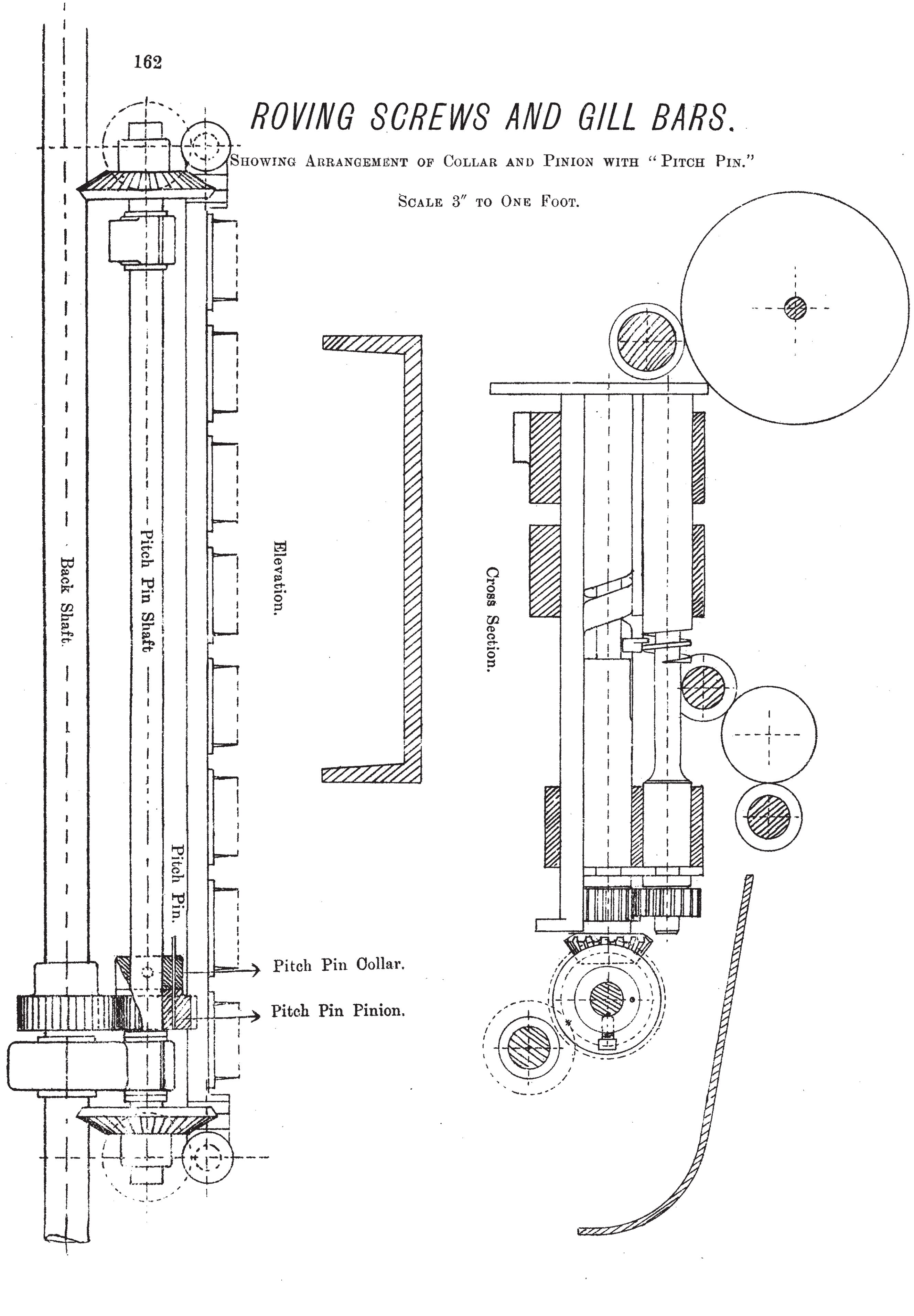
One other point may be mentioned, and that is never allow the crown wheels, as they are usually called, that drive the bobbin drivers to be too much worn and round in the teeth, as this also tends to make the rove soft and irregular, and consequently unfit for spinning purposes.

Make sure that the mangle wheel is in good order at the turning pins, and the bracket-carrying mangle wheel pinion is kept firm. With due attention to these details, there will not be much wrong with the roves, and you will have a chance to get a fair quantity of them from the roving.

ROVING SCREWS AND GILL BARS.

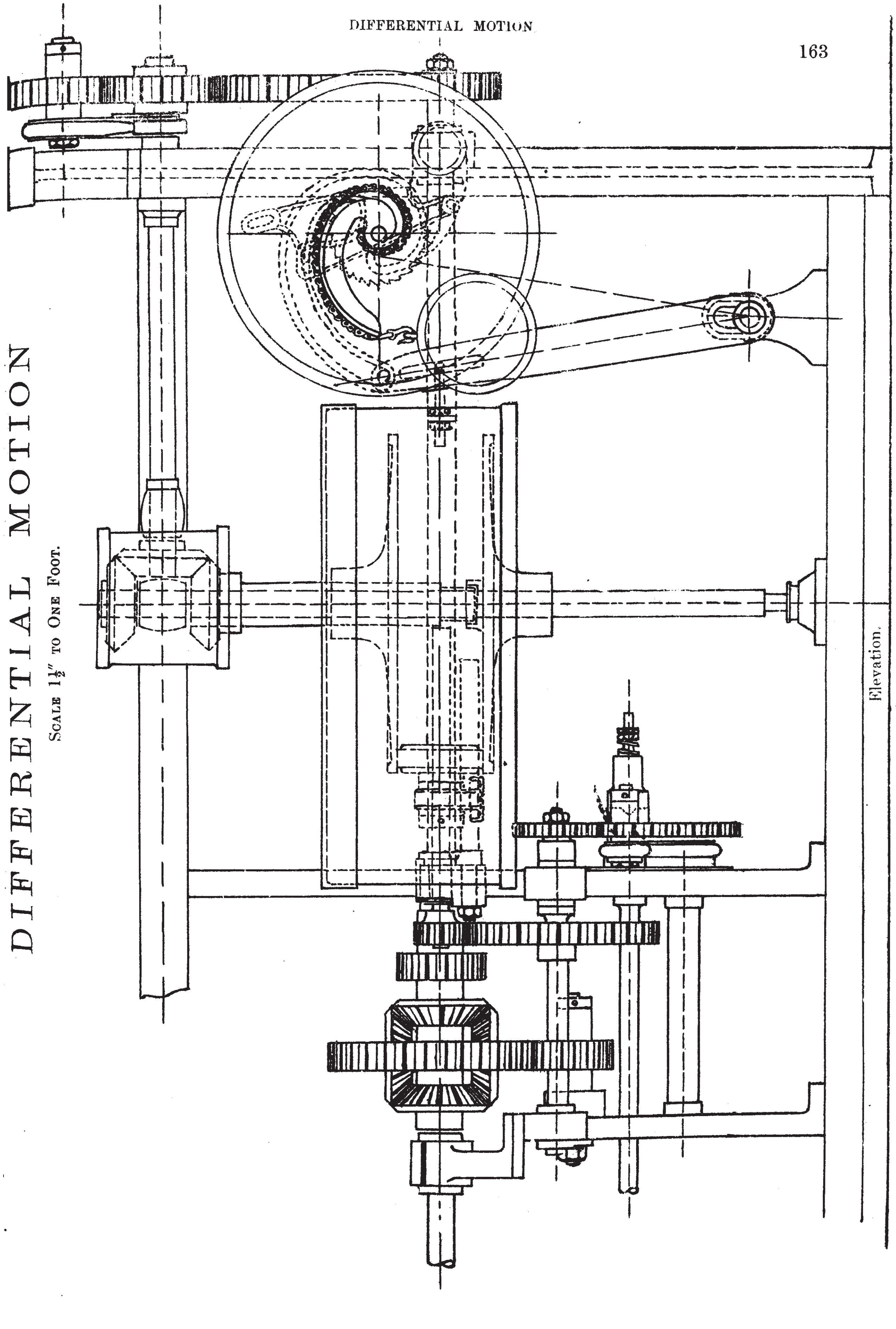
Showing Arrangement of Collar and Pinion with "Pitch Pin."

Scale 3″ to One Foot.



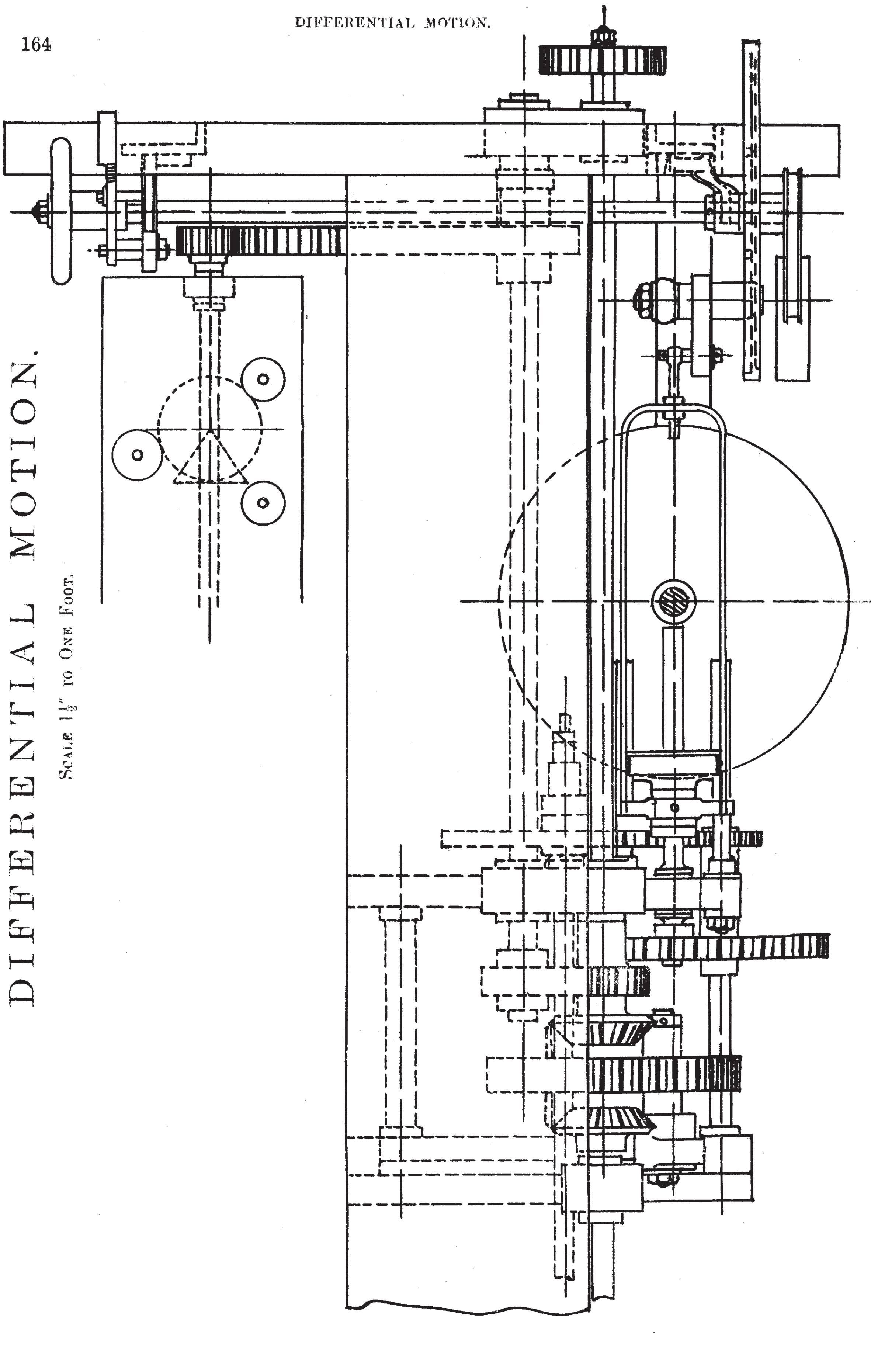
DIFFERENTIAL MOTION

SCALE 1½" TO ONE FOOT.



DIFFERENTIAL MOTION.

Scale $1\frac{5}{8}''$ to One Foot.



PLAN.

DESCRIPTION OF THE DISC AND DIFFERENTIAL MOTION ON A ROVING FRAME

The following formula shows how to calculate the position of the bowl between the disc plates for any diameter of bobbin or drawing roller, but *note* that in the calculation the number of teeth in the differential wheel is taken at *half of the actual number* for the reason that one revolution of the differential wheel has a double effect on the wheel which it controls.

Working dia. on discs for full bobbin—5·85.	Diameter of full bobbin—5″.
,, ,, empty ,, 19·5	,, empty bobbin shank—$1\frac{1}{2}$″.

$$\frac{\text{Drawing Roller Wheel} \times \text{Diameter on disc} \times \text{Pinion on end of bowl shaft} \times \text{Pinion on short shaft} \times 3^* \times \text{Diameter of bobbin shank}}{\text{Wheel on end of counter shaft for driving disc plates} \times \text{Diameter of bowl} \times \text{Wheel on end of short shaft} \times \text{differential wheel} \times 1^* \times \text{Diameter of drawing roller}} = 1.$$

*The figures here 3 to 1 express shortly the net result of the train of wheels from driving shaft to spindles, and also from the loose running bevel wheel controlled by the differential motion wheel to bobbin.

Wheel upon shaft driving spindle driver shaft ...	44 teeth.	$\frac{44 \times 21}{22 \times 14} = \frac{3}{1}$
Pinion upon spindle shaft	22 ,,	
Bevel pinion upon spindle driver shaft	21 ,,	
Spur pinion upon spindle	14 ,,	

Formula for full bobbin $\frac{60 \times 5{\cdot}85 \times 20 \times 12 \times 3 \times 5''}{30 \times 5 \times 96 \times (\frac{7{\cdot}8}{2})\, 39 \times 1 \times 2\frac{1}{4}''} = 1.$

,, empty ,, $\frac{60 \times 19{\cdot}5 \times 20 \times 12 \times 3 \times 1\frac{1}{2}''}{30 \times 5 \times 96 \times (\frac{7{\cdot}8}{2})\, 39 \times 1 \times 2\frac{1}{4}''} = 1.$

$$\frac{60 \times A \times 20 \times 12 \times 3 \times B}{30 \times 5 \times 96 \times (\frac{7{\cdot}8}{2})\, 39 \times 1 \times 2\frac{1}{4}} = 29{\cdot}25 \text{ Constant No.}$$

From this Constant No. you can find the diameter of bobbin, and the working diameter for friction ball upon the disc plate as follows:—

A Working diameter of friction ball upon disc plate.

B Diameter of bobbin

Full bobbin 5″ diameter $\frac{29{\cdot}25}{5} = 5{\cdot}85''$ working dia. of ball upon disc.

Working dia. of ball upon plate $\frac{29{\cdot}25}{5{\cdot}85} = 5''$ dia. of bobbin when ball is working 19 5″ disc plate.

S

The position of the bowl between the discs will not practically be quite the same as the calculations because an allowance must be made for contraction of the rove by the twist.

The figures used in above calculations are taken from the rovings made by Messrs Fairbairn, Naylor, Macpherson, & Co., Leeds, at the present day.

To find the speed of the empty bobbin $1\frac{1}{2}''$ diameter, and say $2\frac{1}{4}''$ diameter, the same diameter as the drawing roller, and also when full, say 5″ diameter.

Speed of roving main shaft 218 revolutions per minute.
,, ,, spindles 654 ,, ,,
,, ,, drawing roller 127·16 ,, ,,
Twist pinion 35 teeth.
Bobbin Shank $1\frac{1}{2}''$ diameter = 4·71″ circumference.
,, $2\frac{1}{4}$,, = 7·06 ,,
Bobbin when full 5 ,, = 15·70 ,,

$$\frac{127{\cdot}16 \times 60 \times 19{\cdot}5 \times 20 \times 12}{30 \times 5 \times 96 \times (\frac{78}{2})\,39} = 63{\cdot}58 \text{ revolutions of differential wheel.}$$

which subtract from the speed of the roving shaft 218—63·58 = 154·42 and

$$\frac{154{\cdot}42 \times 30 \times 48 \times 21}{24 \times 30 \times 14} = 463{\cdot}26 \text{ revolutions of bobbin.}$$

which subtract from the speed of the spindles 654—463·26 = 190·74 and

190·74 × 4·71 = 898·38 inches of rove laid on per minute.

Again when the bobbin is say $2\frac{1}{4}''$ diameter the same as the drawing roller.

$$\frac{127{\cdot}16 \times 60 \times 13 \times 20 \times 12}{30 \times 5 \times 96 \times (\frac{78}{2})\,39} = 42{\cdot}38 \text{ revolutions of the differential wheel.}$$

which subtract from the speed of the roving shaft 218—42 38 = 175·62 and

$$\frac{175{\cdot}62 \times 30 \times 48 \times 21}{24 \times 30 \times 14} = 526{\cdot}86 \text{ revolutions of bobbin.}$$

which subtract from the speed of the spindles 654—526·86 = 127·14 and

127·14 × 7·06 = 897·60 inches of rove laid on per minute.

Again when the bobbin is full say 5″ diameter.

$$\frac{127{\cdot}16 \times 60 \times 5{\cdot}85 \times 20 \times 12}{30 \times 5 \times 96 \times (\frac{78}{2})\,39} = 19{\cdot}07 \text{ revolutions of differential wheel.}$$

which subtract from the speed of the roving shaft 218—19·07 = 198·93 and

$$\frac{198{\cdot}93 \times 30 \times 48 \times 21}{24 \times 30 \times 14} = 596{\cdot}79 \text{ revolutions of bobbin.}$$

which subtract from the speed of the spindles 654—596·79 = 57·21 and

57·21 × 15·70 = 898·19 inches of rove laid on per minute.

Arrangement to find the speed of Roving Traverse when the bobbin is empty and full, that is $1\frac{1}{2}''$ *and* 5″ *diameter, or* 4·71 *and* 15·70 *inches in circumference.*

Speed of Drawing Roller 127·16 revolutions per minute; Traverse Pinion 22 teeth for 75/80 lb. rove.

when empty $$\frac{127{\cdot}16 \times 60 \times 19{\cdot}5 \times 20 \times 22 \times 5}{30 \times 5 \times 96 \times 108 \times 73} = 2{\cdot}88 \text{ speed of traverse.}$$

when full $$\frac{127{\cdot}16 \times 60 \times 5{\cdot}85 \times 20 \times 22 \times 5}{30 \times 5 \times 96 \times 108 \times 73} = {\cdot}864 \quad \text{,,}$$

$$\frac{127{\cdot}16 \times 60 \times C \times 20 \times 22 \times 5}{30 \times 5 \times 96 \times 108 \times 73} = {\cdot}1478 \text{ Constant No.}$$

There is no method of calculating what traverse pinion should be used. This is not a question of length, but a question of the thickness of each size of rove; on this roving we find a 22″ teeth pinion gives the proper build for a 75 lb. rove.

When the bobbin is empty (that is 4·71 inches in circumference), the drawing roller moves 127·16 revolutions per minute, and the traverse 2·88 per minute, which is equal to 44 to 1, and the circumference of the roller 7″; therefore 308 inches are delivered for each up and down movement of traverse, and

$$\frac{308}{4{\cdot}71} = 65{\cdot}39 \text{ layers of rove.}$$

For a thicker rove the traverse would have to go faster, and for a finer a little slower.

When the rove is full (that is 15·70 inches circumference), the drawing roller moves 127·16 revolutions per minute, and the traverse ·864 per minute, which is equal to 147 17 to 1, and the circumference of the roller being 7″; therefore 1030·19 inches are delivered in each up and down of the traverse.

$$\frac{1030{\cdot}19}{15{\cdot}70} = 65{\cdot}6 \text{ layers of rove,}$$

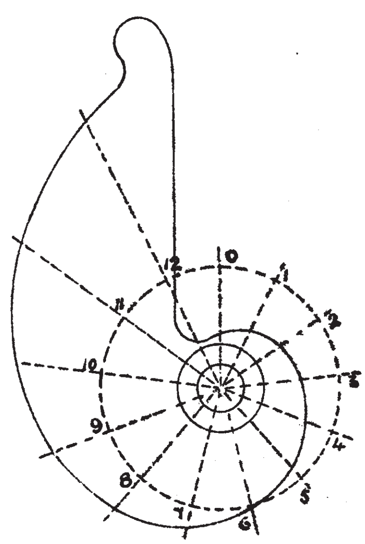
The pinions upon the traverse shaft of this roving are 20 teeth, No. 6 pitch, and therefore equal to $3\frac{5}{16}''$ diameter at pitch lines. One revolution of this pinion is 10·40 inches, but the pinion, owing to the shape of the turning points of the mangle wheel, only moves the traverse of the bobbin board 10″ up and 10″ down.

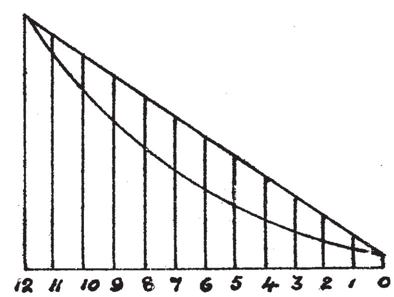
You will therefore observe that when the bobbin is empty it goes slower and the traverse faster, and *vice versa* when the bobbin is full; the speed of the bobbin is always opposite to the speed of the traverse.

SNAIL.

(Old Style).

Scale 3″ to One Foot.





ROTARY DRAWING AND ROVINGS.

I do not feel called upon to say much about these machines. Their use for hessian yarn is limited to a small portion of the trade. The gills are fixed upon a shaft placed close up to the drawing roller. An illustration is given of drawing and also of roving showing the arrangement and the relation of the speed of gill to retaining and drawing roller. All the other parts of the machines are much the same as in spiral machinery. For heavy wefts, a rotary roving will be found very convenient—you can take off a good production of rove, and make a good job, as sliver is light; but you can make up the weight, owing to the shortness of the draft required in a rotary roving. *I have given an arrangement with rotary roving, and have also given an example for hessian wefts—say, from 8/12 lbs. per spyndle. As in the case of spiral machinery, it is important that the gills be kept clean, and the gill pins sharp and carefully sett up. If this is not done, the tendency is for the rotary gill to "lap," and this causes irregularity in the rove. If this roving is, however, kept clean and in good order, not much trouble will be experienced in doing the work of an arrangement such as is given in a few pages further on.

Rotary Roving.—For heavy rove, 200 to 250 lbs., if made from poor stuff, and from which sacking wefts are to be spun, rotary rovings are generally employed. An illustration on page 170 shows the centres of gills and rollers; three different sets of wheels and pinions are given. This allows of the reach between centre of gill shaft and retaining rollers being set in three different positions, according to the rove being made. If the material is weak, the retaining roller should be closer upon the gill than when it is strong. When the jute is strong, the retaining roller must not be too near the gills, or the sliver will not draw at the pressing roller.

*See page 185 for arrangement of Machinery Making Rove 105 lbs. per spyndle, from which is to be spun 20 lbs. Weft.

The following are particulars of two arrangements of Rotary Gills:—

First drawing rotary, $7\frac{1}{2}'' \times 3'' \times \frac{1}{4}''$ brass, $3\frac{1}{2}$ pins per inch, set over $6\frac{5}{8}''$, 30 rows, 24 pins, No. 14—$\frac{3}{4}''$, $\frac{1}{2}''$ out ; or,

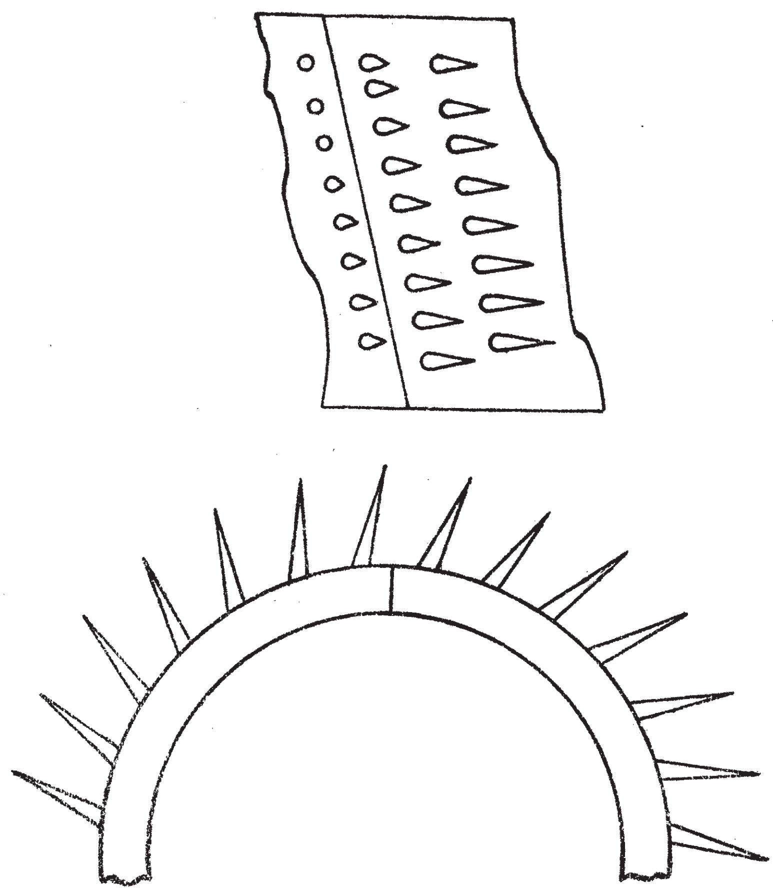
Second drawing rotary, $6'' \times 3'' \times \frac{1}{4}''$ brass, $3\frac{1}{2}$ pin per inch, 30 rows, 21 pins, No. 14—$\frac{3}{4}''$, $\frac{1}{2}''$ out ;

Rotary roving gill, $2'' \times 3''$ dia. brass, 28 rows, 8 pins, No. 14—$\frac{3}{4}''$, set over $1\frac{1}{2}''$, 5 pins per inch, and $\frac{1}{2}''$ out ;

First drawing rotary, $7'' \times 3'' \times \frac{1}{4}''$ brass, 5 pins per inch, 30 rows, 30 pins, No. 15—$\frac{3}{4}''$, $\frac{1}{2}''$ out ; to work with

Roving rotary, $1\frac{5}{8}'' \times 2\frac{1}{4}'' \times \frac{1}{4}''$ brass, $5\frac{1}{2}$ pins per inch, 26 rows, 7 pins, No. 16—$\frac{5}{8}''$, $\frac{3}{8}''$ out.

ROTARY ROVING GILLS.

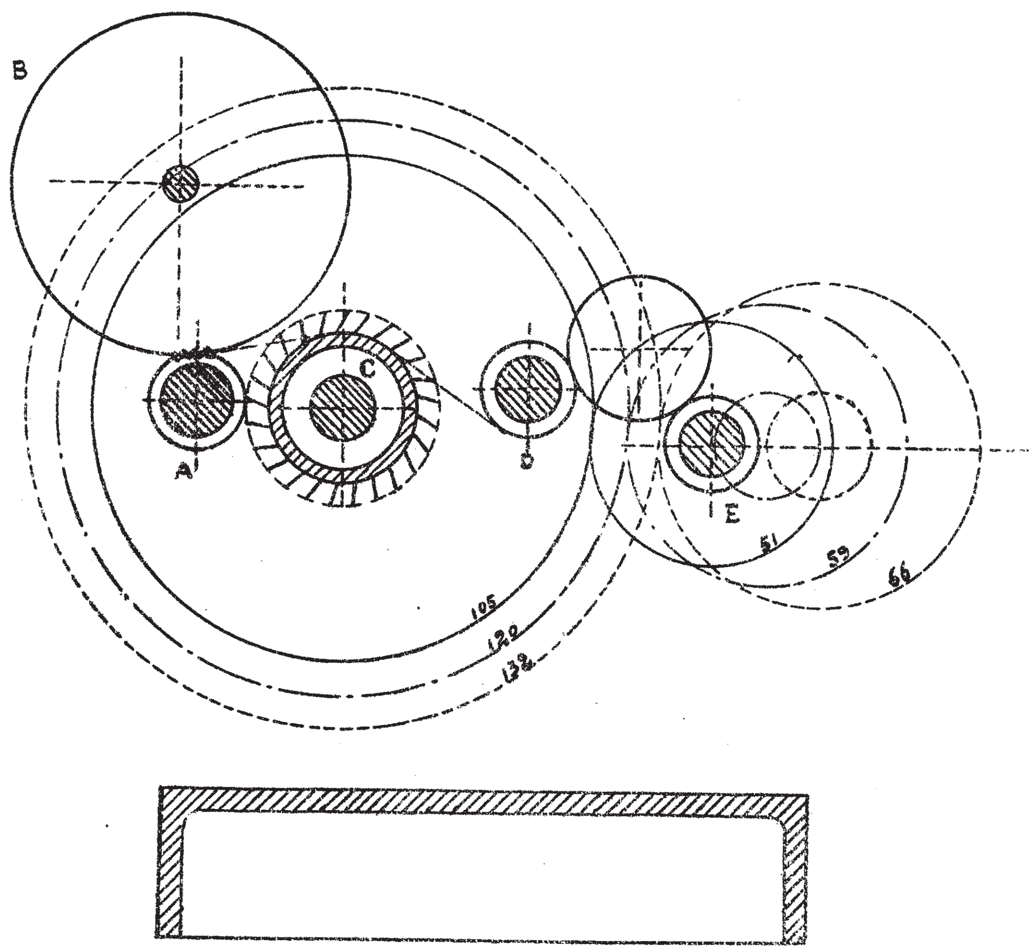


ROTARY ROVING FRAME.

SCALE $\frac{1}{8}$TH.

Diagrams showing Three Sets of Wheels and Pinions for altering "Reach" between Retaining Roller and Gill Shaft.

A = Drawing Roller. C = Gill Shaft.
B = Pressing ,, D and E = Retaining Rollers.

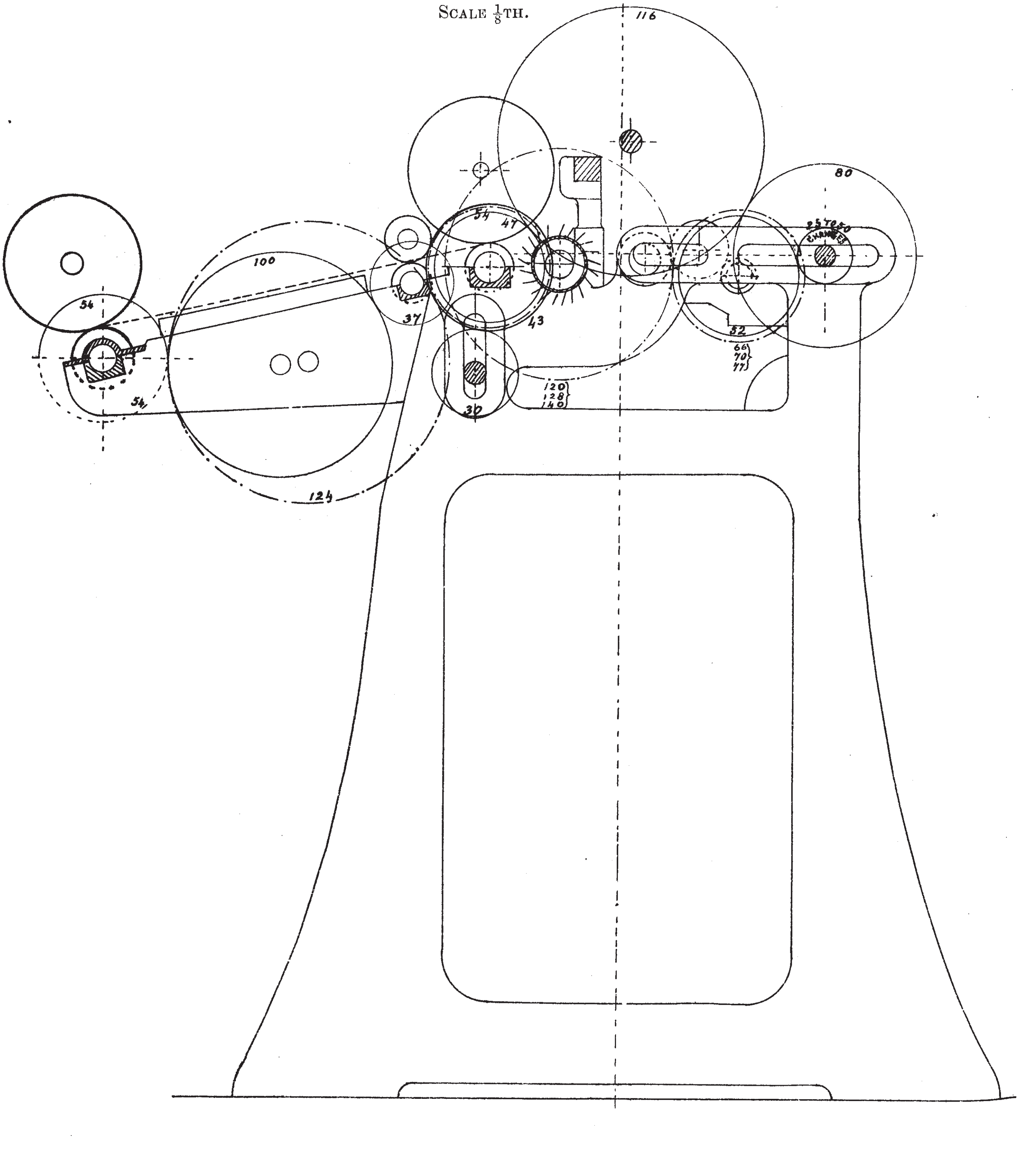


NOTE.—The surface speed of the Rotary Gill at the point of the pin is almost equal to the surface speed of the Retaining Roller.

ROTARY DRAWING FRAME.

ARRANGEMENT OF DRAFT GEARING.

SCALE $\frac{1}{8}$TH.



ROTARY DRAWING FRAME.

Draft Arrangement.

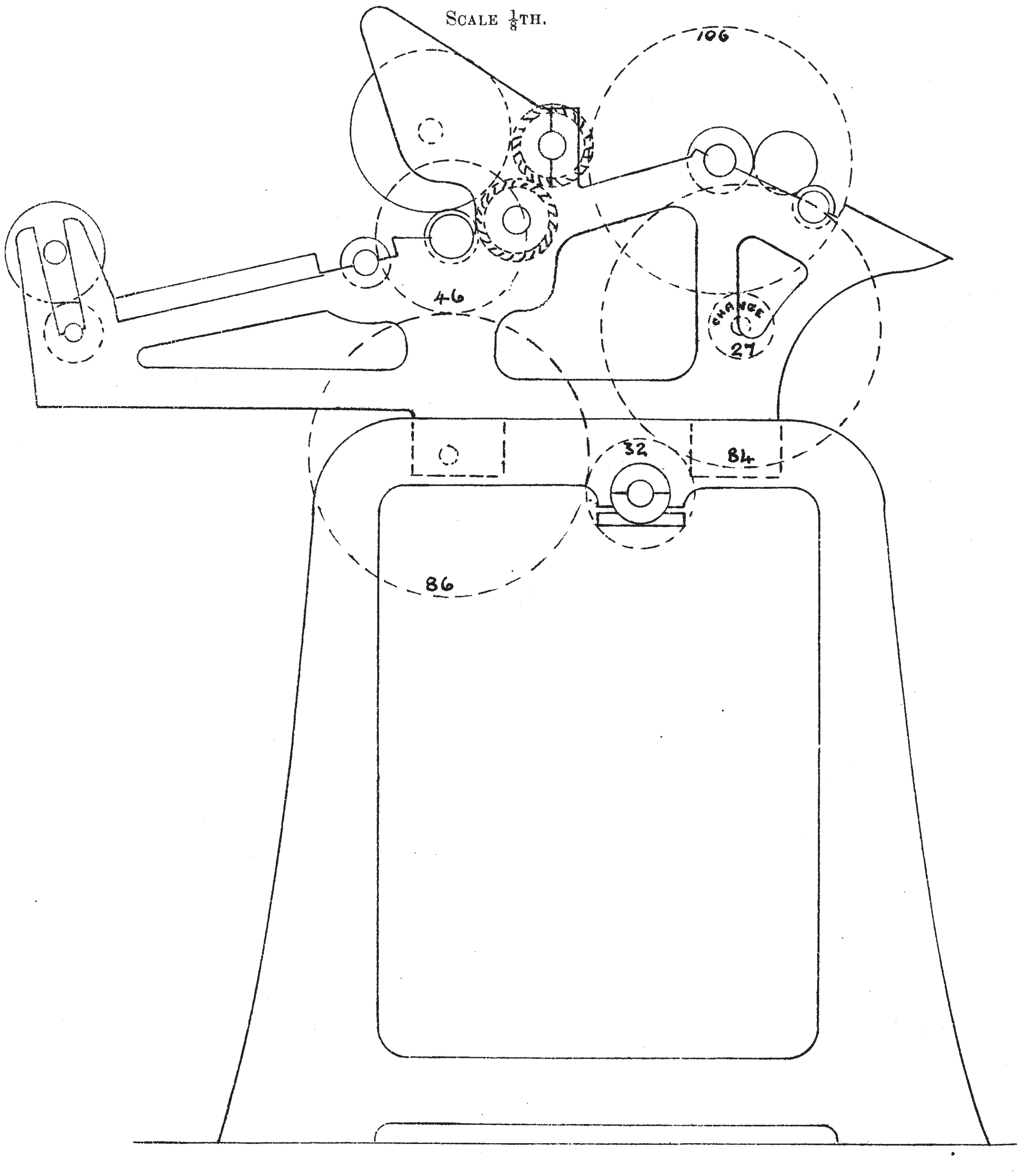
Back Roller Wheel,	... ...	52 teeth.
Change Pinion,	... ...	25 teeth.
Stud Wheel	... ...	80 teeth.
Front Roller Wheel,	... ...	47 teeth.
Working diameter of Front Roller,	... ...	3·4 inches.
,, ,, Back Roller,	... ...	2 ,,

$$\frac{52 \times 80 \times 3{\cdot}4}{25 \times 47 \times 2} = 6 \text{ draft.}$$

DOUBLE ROTARY DRAWING FRAME.

ARRANGEMENT OF DRAFT GEARING.

SCALE $\frac{1}{8}$TH.



DRAFT GEARING FOR DOUBLE ROTARY FRAME.

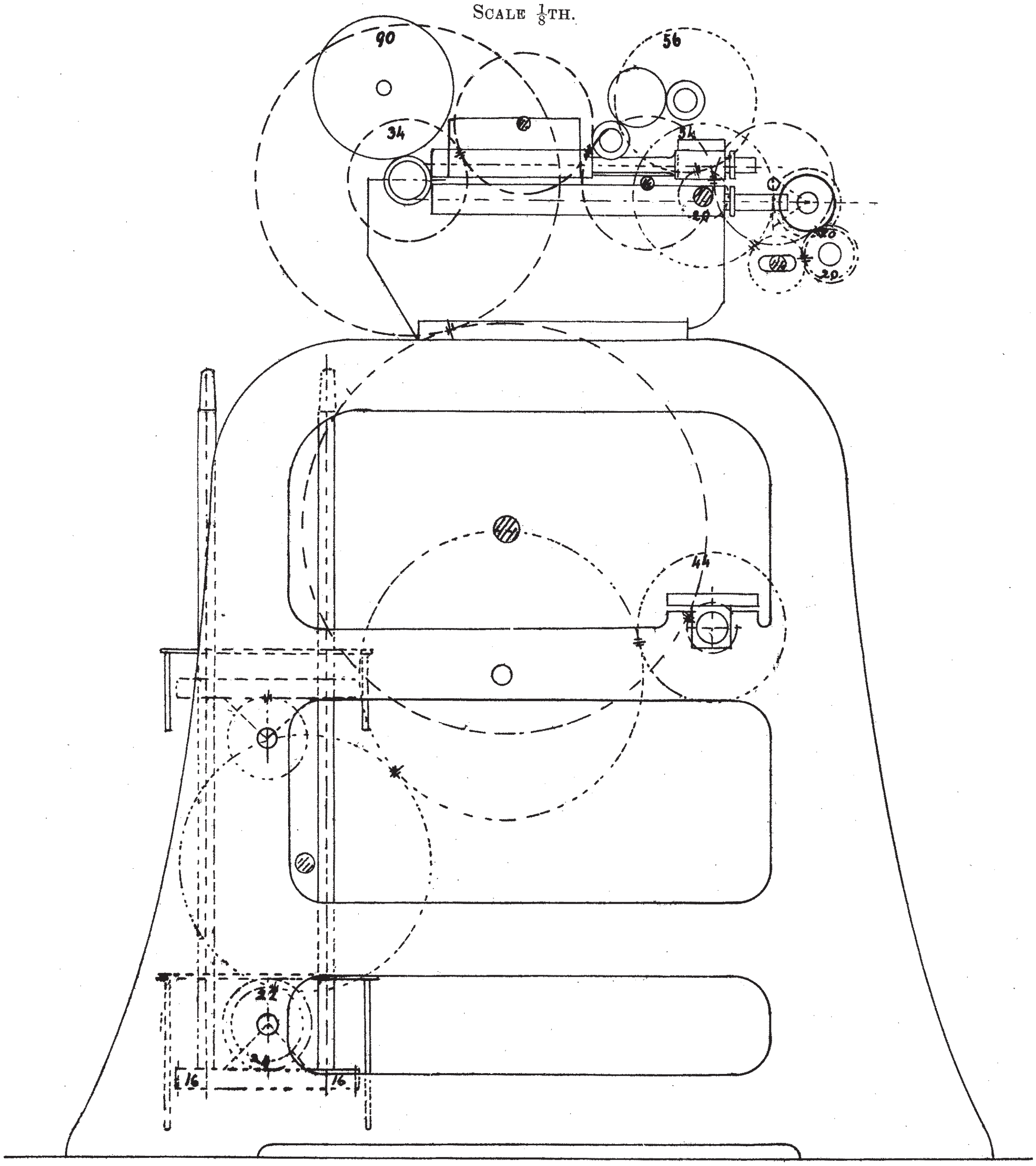
Back Roller Wheel, ...	106 teeth.
Draft Pinon, ...	27 ,,
Stud Wheel, ...	84 ,,
Drawing Roller Wheel, ...	46 ,,
Diameter of Drawing Roller, ...	$2\frac{1}{2}''$.
,, Retaining Roller, ...	$3''$

$$\frac{106 \times 84 \times 2\frac{1}{2}}{27 \times 46 \times 3} = 6 \text{ draft.}$$

SPINNING ROVING FRAME.

ARRANGEMENT OF DRAFT AND TWIST GEARING FOR ROVING, BOBBIN 8″ × 4″.

SCALE $\frac{1}{8}$TH.



SPINNING ROVING FRAME, 8″ TRAVERSE.

DAFT ARRANGEMENT—

Retaining Roller Wheel,	... ...	56 teeth.
Drawing Roller Pinion,	... ...	34 ,,
Double Intermediate,	... ...	54 and 20 ,,
Back Shaft Pinion,	... ...	20 ,,
,, ,, Change,	... ...	20 ,,

Diameter of Drawing Roller and Retaining Roller, 2″ and $1\frac{3}{4}$″.

$$\frac{56 \times 54 \times 20 \times 2''}{20 \times 20 \times 34 \times 1\frac{3}{4}''} = 5 \text{ draft.}$$

$$\frac{56 \times 54 \times \text{C.P.} \times 2''}{20 \times 20 \times 34 \times 1\frac{3}{4}''} = \cdot 254 \text{ Constant for draft.}$$

TWIST ARRANGEMENT—

Drawing Roller Wheel,	... ...	90 teeth.
Wheel on Main Shaft of Roving,	... ...	44 ,,
Bevel Pinion on Spindle Shaft,	... .	24 ,,
Twist Pinion,	... ...	14 ,,
Pinion on end of Spindle Shaft,	... ...	22 ,,
,, on Spindle,	... ...	16 ,,

Diameter of Drawing Roller, 2″ = 6·28 circumference.

$$\frac{90 \times 44 \times 24}{14 \times 22 \times 16 \times 6{\cdot}28} = 3 \text{ Twist per inch.}$$

$$\frac{90 \times 44 \times 24}{\text{Twist Pinion.} \times 22 \times 16 \times 6{\cdot}28} = 43 \text{ Constant Number.}$$

Speed Roving Spindles, $\frac{44}{22} \times \frac{24}{16} = 3.$

Speed Spindles = Speed Main Shaft of Roving × 3.

The Speed of Spindles of Roving Spinning 48/60 lbs. weft yarn is about 1050 revolutions per minute.

SPEEDS OF JUTE SPINNING MACHINERY.

(Recommended by Fairbairn, Naylor, Macpherson, & Co., Ltd., Leeds).

4 ft. × 6 ft. Shell Breaker Card.

Cylinder, 190 revolutions per minute; Surface Speed, 2485 ft. over points of pins.

7″ Workers, 24 revolutions per minute; Surface Speed, 54 ft. over points of pins.

11″ Strippers, 133 revolutions per minute; Surface Speed, 443 ft. over points of pins.

Change pinion on Cylinder, 48 teeth.

4 ft. × 6 ft. Circular Finisher Card.

Cylinder, 190 revolutions per minute; Surface Speed, 2470 ft. over points of pins.

7″ Workers, 15 revolutions per minute; Surface Speed 33 ft. over points of pins.

11″ Strippers, 147 revolutions per minute; Surface Speed, 490 ft. over points of pins.

Change Pinion on Cylinder, 56 teeth.

1st and 2nd Spiral Drawings.

150 to 160 Drops of Gill Bars per minute.

Push Bar or Slide Drawing.

350 Drops of Gill Bars per minute.

1st Circular Drawing.

306 Drops of Gill Bars per minute.

Spiral Rovings, 10″ × 5″ Bobbins.

Speed of Spindles, 540 revolutions per minute.

Drops of Gill Bars will vary with the Twists and Drafts, but the bars can be run at the same speed as for Spiral Drawing.

SPEED OF SPINNING FRAME SPINDLES.

6″	Traverse,	1500	revolutions	per minute.
$5\frac{1}{2}$″	,,	1600	,,	,,
5″	,,	1800	,,	,,
$4\frac{1}{2}$″	,,	2000	,,	,,
$4\frac{1}{4}$″	,,	2200	,,	,,
4″	,,	2600	,,	,,
$3\frac{3}{4}$″	,,	2800	,,	,,
$3\frac{1}{2}$″	,,	3000	,,	,,
$3\frac{1}{4}$″	,,	3200	,,	,,
3″	,,	3400	,,	,,
$2\frac{3}{4}$″	,,	3400	,,	,,

REMARKS ON PREPARING MACHINERY.

Before finishing this chapter upon preparing machinery, let me make a few general remarks. If work of a fair quality and quantity is to be made, the machinery must be kept clean and in good mechanical order; the breaker and finisher workers, strippers, &c., should be regularly picked and cleaned in a thorough manner during the meal hours; and once every three months the setting of the rollers should be tried, to see if they are correct, and adjusted where necessary; all the pins in cylinder, &c., kept in good order; the drawings and rovings cleaned thoroughly once every six weeks or two months at least, and the cleaning should be done as much as possible in the day time, so that the condition of the machines can be thoroughly seen and examined, and little things can then be put right—wheels and pinions, &c., renewed, where necessary. If all this is done in an orderly and systematic manner, the machinery will run without much trouble or annoyance to the workers, and quality and quantity will be ensured; without this there will neither be the one nor the other, but continual worry and annoyance will be the daily result.

Dimensions of Sliver Cans in use for Preparing Machinery:—

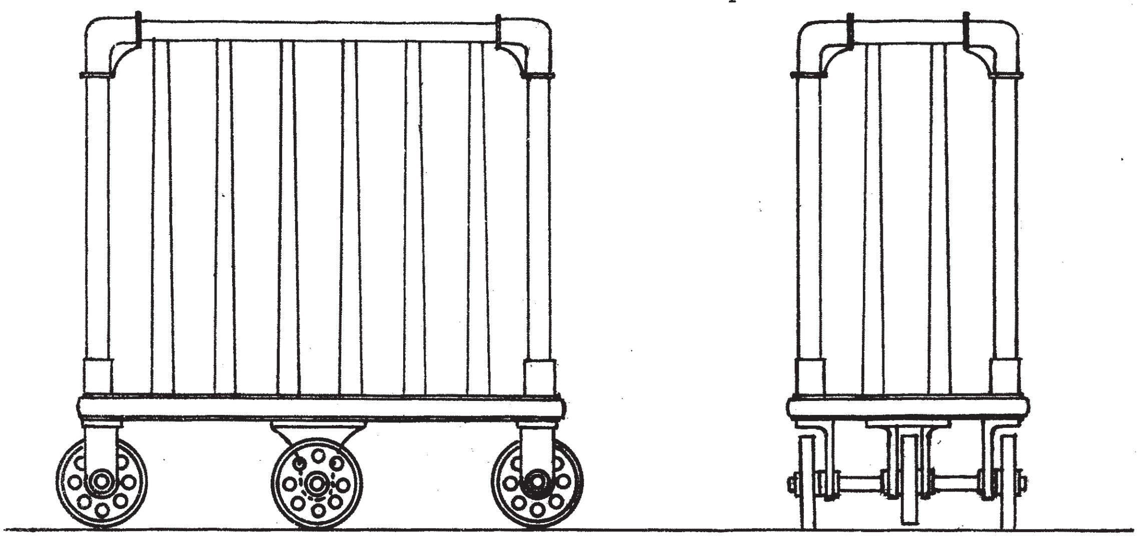
Breaker Cans,	13″ × 11″ × 36″.	Oval.
Finisher ,,	12″ × 9″ × 36″.	,,
Drawing ,,	12″ × 9″ × 36″.	,,
Roving ,,	10″ × 7″ × 36″.	,,

NOTE.—Sometimes the breaker, finisher, and drawing cans are made oblong, the roving cans are always made oval.

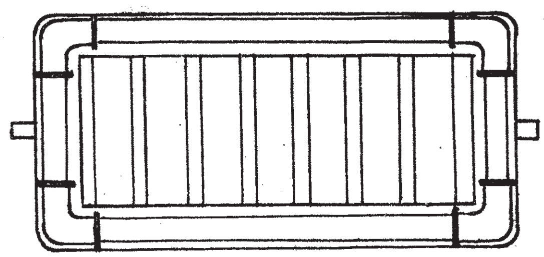
All the calculations and illustrations in this chapter are off machines made by Messrs Fairbairn, Naylor, Macpherson, & Co., Limited, Leeds, who stand first as makers of jute machinery, their attention to the many intricate details, as well as to the general finish and fitting up of this class of machinery, having secured for them a world wide reputation. Without their kind assistance and permission it would have been impossible to illustrate the various machines. The calculations for machines by other makers are worked out by the same methods.

ROVE BARROW.

SCALE $\frac{3}{4}''$ TO ONE FOOT.



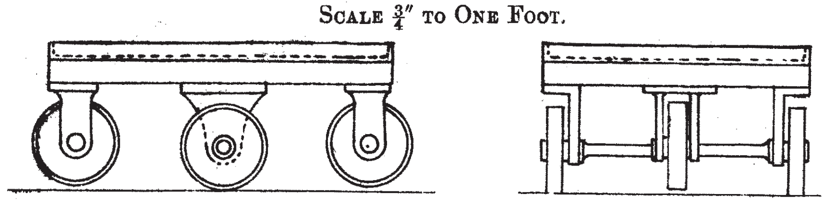
Front Elevation. End Elevation.

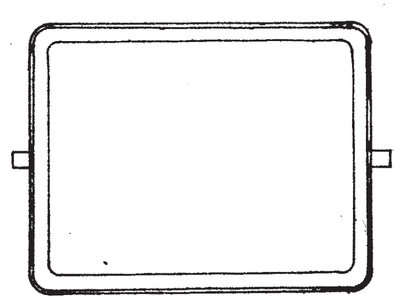


This Barrow holds one shift—
56 roves × 10″ × 5″ roving.

BARROW FOR BOXES WITH SPINNING BOBBINS.

SCALE $\frac{3}{4}''$ TO ONE FOOT.





ARRANGEMENT TO PRODUCE ROVE FOR 9/12 LBS. WEFT AND WARP HESSIAN QUALITY.

WEIGHT OF ROVE WANTED $72\frac{1}{2}$/75 LBS. PER SPYNDLE.

Breaker Single Doffer—Cylinder, 190 revolutions per minute; cylinder pinion, 46 teeth.

Dollop, 33 lbs.; clock, 13·13, calculated from feed roller $10\frac{3}{4}''$ diameter = 33·77 inches circumference.

Draft between feed and drawing roller—

$$\frac{4 \times 80 \times 110 \times 110}{52 \times 26 \times 20 \times 10\frac{3}{4}} = 13{\cdot}32 \text{ draft.}$$

Finisher, 10 ends into 1; Cylinder, 190 revolutions per minute; cylinder pinion, 56 teeth.

Draft between feed and drawing roller—

$$\frac{4 \times 104 \times 96 \times 96}{75 \times 32 \times 28 \times 4} = 14{\cdot}26 \text{ draft.}$$

Speed pulleys, 180 revolutions per minute.

Push bar drawing, 4 ends into 1; pulley pinion, 34 teeth.

Leather pressing roller—

$$\frac{160 \times 16}{14} = 182\tfrac{6}{7} \text{ revolutions pulley per minute.}$$

$$\frac{2\frac{1}{2} \times 56 \times 74 \times 50 \times 23 \times 32}{52 \times 20 \times 34 \times 39 \times 40 \times 1\frac{15}{16}} = 3{\cdot}5$$

Pulleys, 160 revolutions per minute.

Second drawing spiral, 2 ends into 1; pulley pinion, 30 teeth—

$$\frac{160 \times 16}{16} = 160 \text{ revolutions of pulleys per minute.}$$

$$\frac{2\frac{1}{2} \times 34 \times 68 \times 69}{43 \times 25 \times 25 \times 1\frac{15}{16}} = 7{\cdot}65 \text{ draft.}$$

Roving, 1 end into 1—Speed pulleys, 225 revolutions per minute.

$$\frac{2\frac{1}{4} \times 32 \times 70 \times 70}{38 \times 24 \times 24 \times 1\frac{15}{16}} = 8{\cdot}31 \text{ draft.}$$

The following example will show arrangement and weight of rove in this system:—

Breaker dollop, 33 lbs.
,, clock, 13·13 yards.
„ draft, 13·32.

13·32 × 13·13 = 174·89 yards delivered at front of breaker, weighs 33 lbs.

Finisher, 10 ends into 1.

Draft, 13·32.

$\frac{33 \times 10}{13 \cdot 32} = 24 \cdot 77$ lbs. weight of 174·89 yards at front of finisher.

Push bar drawing, 4 ends into 1.

Draft 3·5

$\frac{24 \cdot 77 \times 4}{3 \cdot 5} = 28 \cdot 31$ lbs. weight of 174·89 yards at front of 1st drawing.

Second drawing spiral, 2 ends into 1.

Draft.

$\frac{28 \cdot 31 \times 2}{7 \cdot 65} = 7 \cdot 40$ lbs. weight of 174·89 yards at front of 2nd drawing.

Roving Spiral—56 spindles, 10″ × 5″ pitch—675 revs. of spindles per minute.

Draft 8·31.

$\frac{7 \cdot 40}{8 \cdot 31} = \cdot 890$ lbs. weight of 174·89 yards at front of Roving.

174·89 : 14400 : : ·890 : 73·2 lbs. per spyndle.

The actual weight of this rove was 72½ lbs.

ARRANGEMENT TO PRODUCE ROVE FOR 7/8 LBS. WARP.

WEIGHT OF ROVE WANTED 67½ LBS.

Breaker Double Doffer—cylinder, 190 revolutions per minute; cylinder pinion, 44 teeth.

" clock, calculated from feed roller 20¼″ diameter = 12·95 yards.

" draft, 9·7; dollop, 22 lbs.

12·95 × 9·7 = 125·6 yards delivered at front of breaker in one round of clock.

Finisher single doffer—10 ends into 1; cylinder, 190 revs. per minute.

Draft cylinder pinion, 56 teeth.

$\frac{22 \times 10}{14 \cdot 26} = 15 \cdot 42$ lbs. weight of 125·6 yards at front of finisher.

Push Bar Drawing, 4 ends into 1; draft, $3\frac{1}{2}$; leather pressing rollers; pulley pinion, 34 teeth.

$\frac{160 \times 16}{14} = 182\frac{6}{7}$ revolutions pulleys per minute.

$\frac{15{\cdot}42 \times 4}{3\frac{1}{2}} = 17{\cdot}62$ lbs. weight of 125·6 yards at front of 1st drawing.

Second Drawing Spiral, 2 ends into 1.

Draft, 7·65.

$\frac{17{\cdot}62 \times 2}{7{\cdot}65} = 4{\cdot}60$ lbs. weight of 125·6 yards at front of 2nd drawing.

Roving Spiral, 1 end into 1—Speed Spindles 675 revs. per minute.

Draft, 8.

$\frac{4{\cdot}60}{8} = {\cdot}575$ lbs. weight of 125·6 yards at front of roving.

125·6 : 14400 : : ·575 : 65·9 lbs. per spyndle.

Actual weight of this rove, 65/67½ lbs.

Roving, - - - -	
Twist Pinion, - - -	32
Grist ,, - - -	31
Traverse ,, - - -	28
Rack ,, - - -	17

These three examples are sufficient for the explanation of this part of the subject. Different arrangements are in operation to do the same thing. Many of them are based upon the opinion and experience of those in charge, others are in a measure based upon convenience. The production required from the system also determines to a certain extent the arrangement. Theory in this matter has often —within limits, of course—to give way to what is best in practice.

ARRANGEMENT TO PRODUCE ROVE FOR 16/24 LBS. WEFT OF ORDINARY HESSIAN QUALITY.

ROVE TO BE 105/110 LBS.

Breaker Single Doffer—cylinder, 195 revolutions per minute; cylinder pinion, 46 teeth.

Dollop, 33 lbs.; clock—13·16 yds., calculated from feed roller $10\frac{3}{4}''$ dia. = 33·77 inches.

Draft between feed and drawing roller—

$$\frac{4 \times 80 \times 110 \times 110}{52 \times 26 \times 20 \times 10\frac{3}{4}} = 13 \cdot 32 \text{ draft.}$$

Draft between doffer and drawing roller—

$$\frac{4}{23} \times \frac{54}{26} \times \frac{88}{15\frac{1}{2}} = 2 \cdot 05 \text{ draft.}$$

This is only shown as a draft that is necessary for delivery of material from doffer to drawing roller. This draft is not necessary in working out the total draft of breaker.

Finisher Single Doffer—cylinder, 195 revolutions per minute; cylinder pinion, 64 teeth.

Finisher, 10 ends into 1.

Draft between feed and drawing roller—

$$\frac{4}{75} \times \frac{104}{32} \times \frac{96}{32} \times \frac{96}{4} = 12 \cdot 48 \text{ draft.}$$

Circular Drawing—pulley pinion, 32 teeth.

$$160 \times \frac{21}{14} = 240 \text{ revolutions per minute.}$$

Pressing and drawing roller, hard to hard ($3\frac{1}{2}''$)—

$$\frac{3}{22} \times \frac{120}{50} \times \frac{27}{15} \times \frac{15}{3} = 3 \cdot 43 \text{ draft.}$$

4 ends into 1.

Second drawing spiral—pulley pinion, 30 teeth.

Leather pressing rollers—

$$160 \times \frac{16}{16} = 160 \text{ revolutions per minute.}$$

$$\frac{2\frac{1}{2} \times 34 \times 68 \times 69}{32 \times 25 \times 25 \times 1\frac{5}{16}} = 10 \cdot 32 \text{ draft.}$$

2 ends into 1.

Roving—Rotary, 48 spindles; $10'' \times 5''$ pitch.

Speed spindles—

$$160 \times \frac{25}{18} \times \frac{44}{22} \times \frac{21}{14} = 666\frac{2}{3} \text{ revolutions of spindles per minute.}$$

Twist arrangement—

$$\frac{60 \times 44 \times 21}{42 \times 22 \times 14 \times 7{\cdot}06} = {\cdot}60 \text{ twist on rove.}$$

$$\frac{60 \times 44 \times 21}{C \times 22 \times 14 \times 7{\cdot}06} = 25{\cdot}495$$

Grist arrangement—

$$\frac{2\frac{1}{4}}{44} \times \frac{80}{25} \times \frac{60}{1\frac{15}{16}} = 4{\cdot}69 \text{ draft between retaining drawing roller.}$$

$$\frac{2\frac{1}{4} \times 80 \times 60}{44 \times C \times 1\frac{15}{16}} = 126{\cdot}686 \text{ constant number.}$$

The following example will show the way to find weight of rove in this system—

Breaker dollop, 33 lbs.
,, clock, 13·13 yds.
,, draft, 13·32 ,,

13·32 × 13·13 = 174·89 yards delivered at front of breaker, weighs 33 lbs.

Finisher, 10 ends into 1.

Draft, 12·48.

$\frac{33 \times 10}{12{\cdot}48}$ = 27·24 lbs. weight of 174·89 yards delivered at front of finisher

Circular—1st drawing, 4 ends into 1.

Draft—

$\frac{27{\cdot}24 \times 4{\cdot}}{3{\cdot}43}$ = 31·76 lbs., weight of 174·89 yards delivered at front of 1st drawing.

Second drawing—spiral 2 ends into 1.

Draft, 10·32.

$\frac{31{\cdot}76 \times 2}{10{\cdot}32}$ = 6·15 lbs., weight of 174·89 yards delivered at front of second drawing.

Roving rotary, 1 end into 1—draft.

Draft—4·69.

$\frac{6{\cdot}15}{4{\cdot}69}$ = 1·31 lbs., weight of 174·89 yards delivered at front of roving.

174·89 : 14400 : : 1·31 : 107·8 lbs. per spyndle.

The actual weight of this rove was 105/106 lbs.

Roving twist pinion, 42 teeth.
,, grist ,, 25 ,,
,, rack ,, 11 ,,
,, traverse ,, 36 ,,

This roving made 44 shifts in 10 hours, and produced rove at 105 lbs. per spyndle, and kept three frames 72 spindles each, 4 in. pitch, 5 in. traverse, spinning 20 lbs. weft. The production from these three frames was 242 spyndles in 10 hours, this average being taken over a period of three months.

		Tons.	Cwts.	Qr.	Lbs.
242 × 20 = 4840 lbs.	=	2	3	1	6.

Spinning frame—Particulars of speed spindle.

$$\frac{220 \times 28 \times 10}{14 \times 1\frac{3}{4}} = 2514{\cdot}2 \text{ revs. of spindles per minute.}$$

To find speed of spindle—

$$\frac{A \times B \times D}{C \times E}$$

A = Speed Driving Shaft.

B = Drum upon Driving Shaft.

C = Pulleys on Cylinder Arbor of Frame.

D = Diameter of Cylinder.

E = Diameter of Spindle Wove.

Cylinder 10″ diameter; Drawing Roller Wheel 120 teeth.

Twist Wheel and Pinion 90 and 76 teeth.

Spindle Werve $1\frac{3}{4}$″ diameter.

Drawing Roller $4\frac{1}{8}$″ diameter.

Retaining „ $1\frac{1}{2}$″ „

„ „ Wheel 75 teeth.

Double Intermediate 80/86. Draft arrangement.

Twist arrangement—cylinder pinion, 34 teeth; drawing roller, $4\frac{1}{8}$″ dia. = 12·95 circumference.

$$\frac{10 \times 90 \times 120}{1\frac{3}{4} \times 34 \times 76 \times 12{\cdot}95} = 1{\cdot}84 \text{ twist per inch upon this yarn.}$$

Grist arrangement—Drawing Roller Pinion or Grist Pinion 35 teeth.

$$\frac{4\frac{1}{8} \times 80 \times 75}{35 \times 86 \times 1\frac{1}{2}} = 5{\cdot}4 \text{ draft.}$$

80 spyndles from 72 spindles =

$$\frac{80}{72} = 1\frac{1}{9} \text{ spyndles per spindle in 10 hours.}$$

DOUBLINGS AND DRAFTS.

7 TO 12 LBS.

Breaker—30 lbs. dollop—to 12 yards clock—draft 12.
Finisher—10 ends into 1—circular—draft 16.
1st drawing—4 ends into 1—push-bar—draft 4.
2nd drawing—2 ends into 1—spiral—draft $6\frac{1}{2}$.
Roving, - - - ,, draft 8.
Will give 72 lbs. rove—exclusive of allowance for waste.

DOUBLE DOFFER CARDS.

Breaker—22 lbs. dollop—to 12 yards clock—draft 10.
Finisher—10 ends into 1—circular—draft 14.
1st drawing—4 ends into 1—push-bar—draft 4.
2nd drawing—2 ends into 1—spiral—draft $6\frac{1}{2}$.
Roving, - - - ,, draft 8.
Will give $72\frac{3}{4}$ lbs. rove—exclusive of allowance for waste.

DOUBLINGS AND DRAFTS.

7 TO 12 LBS.

Rotary System.

Breaker 30 lbs. dollop to 12 yards clock, ...	Draft 14.
Finisher, 10 ends into 1—circular, ...	,, 21.
1st Drawing, 4 ends into 1, ...	,, $4\frac{1}{4}$.
2nd ,, 2 ,, 1, ...	,, $5\frac{1}{4}$.
Roving, ...	,, 6.

Will give $73\frac{1}{2}$ lbs. rove—exclusive of allowance for waste.

SACKING WEFT—AVERAGE 32 LBS.

Breaker 28 lbs. dollop to 12 yards clock, ...	Draft 13.
Finisher, 10 ends into 1—half circular, ...	,, 16.
1st Drawing, 4 ends into 1—push bar, ...	,, $3\frac{1}{2}$.
2nd ,, 2 ,, 1 ,, ...	,, $4\frac{1}{4}$.
Roving—spiral, ...	,, 7.

Will give 126 lbs. rove—exclusive of waste allowance.

The results given above will be the same whether the finisher card be fed from laps or cans, provided the same number of ends be put up in each case.

The machines and draft arrangements for Sacking Warps are precisely the same as for Hessian Yarns, the only difference being that the quality of jute is lower in the former case, and the yarn is frequently harder twisted.

SACKING WARP ARRANGEMENT.

Dollop 32 lbs. .. Breaker Clock = 10 yds.

Breaker Draft Arrangement.

$$\frac{4'' \times 72 \times 120 \times 120}{72 \times 18 \times 24 \times 9\frac{1}{2}''} = 14 \text{ draft.}$$

$14 \times 10 = 140$ yds. at front of breaker.

Finisher—10 ends into 1.

$$\frac{4'' \times 72 \times 120 \times 120}{72 \times 18 \times 22 \times 9\frac{1}{2}''} = 15{\cdot}31 \text{ draft.}$$

$32 \times 10 \div 15{\cdot}31 = 20{\cdot}9$ lbs. weight of 140 yards at front of finisher.

1st Drawing (Lawson) 8 ends into 1.

$$\frac{3\frac{3}{16} \times 40 \times 70 \times 23}{23 \times 20 \times 53 \times 2''} = 4 \text{ draft.}$$

$15{\cdot}31 \times 8 \div 4 = 30{\cdot}62$ lbs. at 1st Drawing.

2nd Drawing (Push Bar) one into one.

$$\frac{2\frac{1}{2}'' \times 56 \times 74 \times 50 \times 23 \times 35}{60 \times 20 \times 34 \times 39 \times 40 \times 1\frac{15}{16}} = 4\frac{1}{2} \text{ draft.}$$

$30{\cdot}62 \div 4{\cdot}5 = 6{\cdot}8$ lbs. at 2nd Drawing.

Roving (Lawson Spiral) one into one.

$$\frac{2\frac{1}{4}'' \times 36 \times 56 \times 63}{48 \times 24 \times 24 \times 1\frac{3}{4}''} = 5{\cdot}9 \text{ draft.}$$

$6{\cdot}8 \div 5{\cdot}9 = 1{\cdot}15$ lbs. at roving.

140 : 14,400 : : 1·15 : 118 lbs. weight of rove.

Rove actually weighs 115/120 lbs.

From this is spun 10/14 lbs. Warp.

SACKING WEFT ARRANGEMENT.

Dollop 32 lbs. Breaker Clock = 10 yds.

Breaker Draft Arrangement.

$$\frac{4'' \times 72 \times 120 \times 120}{72 \times 15 \times 28 \times 9\frac{1}{2}''} = 12{\cdot}03 \text{ draft.}$$

12·03 × 10 = 120·30 yds. at front of breaker.

Finisher—10 ends into 1.

$$\frac{4'' \times 72 \times 120 \times 120}{72 \times 18 \times 26 \times 9\frac{1}{2}''} = 12{\cdot}95 \text{ draft.}$$

32 × 10 ÷ 12·95 = 24·71 lbs. weight of 120·30 yds. at front of finisher.

1st Drawing (Lawson's Link Gill) 8 ends into 1.

$$\frac{3\frac{3}{16} \times 40 \times 70 \times 23}{23 \times 20 \times 53 \times 2''} = 4 \text{ draft.}$$

24·71 × 8 ÷ 4 = 49·42 lbs. at 1st Drawing.

2nd Drawing (Push Bar) one end into one.

$$\frac{2\frac{1}{2}'' \times 56 \times 74 \times 50 \times 23 \times 35}{67 \times 20 \times 34 \times 39 \times 40 \times 1\frac{15}{16}} = 4 \text{ draft.}$$

49·42 ÷ 4 = 12·35 at 2nd Drawing.

Roving (Rotary) one into one—(Lawson Roving).

$$\frac{2\frac{1}{4}'' \times 144 \times 74}{72 \times 20 \times 3''} = 5{\cdot}55 \text{ draft.}$$

12·35 ÷ 5·55 = 2·22 lbs. at roving.

120·30 : 14,400 : : 2·22 : 265 lbs. weight of rove.

Actual weight of rove is 240 lbs. From this we spin from 32 lbs. up to 44 lbs.

V

JUTE SPINNING.

When the rove bobbins are filled at the roving, they are taken off and put into a rove barrow. They are then taken to the spinning department, put upon the spinning frames, and it is here that the operation of spinning commences.

The spinning operation is performed by one machine. This machine is called a spinning frame. Spinning frames are very much of the same construction, they only vary in the size of the spindle and the pitch of the spindles. By the pitch of the spindle is meant the distance between the centre of each spindle; and in speaking of a spinning frame, we usually speak of the frame as being of 4 inch pitch, 4 inch traverse, 4½ inch pitch, 4½ inch traverse, and so on as the case may be. As already mentioned, the pitch of the frame is the distance between the centre of the spindles; and by the traverse is meant the length of the bobbin which is to be filled upon the frame. In the spinning of hessian warps and wefts three sizes of bobbins are commonly in use—3¾ inch, 4 inch, and 5 inch. The 3¾ inch bobbin is used to spin from 7 to 8 pounds warp; the 4 inch bobbin, from 9 to 12 pounds, and sometimes 16 pounds. The 5 inch bobbin is used to spin from 16 to 24 pounds per spyndle. In the plan of the mill in this book the frames are all given 72 spindles, 4 inch pitch; but in a mill of from 5000 to 6000 spindles it is better to have a certain proportion of the spindles 3¾ inch, 4 inch, and 5 inch traverse; when this is the case, care should be taken to have all the frames made the same length, or nearly so, over all. This will keep up the uniform width of the passes from north to south, and to a considerable extent facilitate the regular traffic as well as add to the general appearance of this part of the mill.

The successful production of the yarn from a spinning frame depends more upon the worker in attendance (called a spinner) than any other machine in the mill. The frame may be in perfect order and mechanically correct, but everything will depend upon the ability of the spinner to produce good work, and a fair quantity of it. This ability can only be attained by long experience at this class of work.

There are three motions on the spinning frame:—

First, - -	The twist arrangement.
Second. - -	The grist arrangement.
Third, - -	The traverse arrangement.

The twist arrangement of wheels fixes the amount of turns or twists per inch to be put upon the yarn being spun. The grist arrangement of wheels fixes the weight of the yarn—say, 7, 8, 9, or 10 pounds per spyndle of 14,400 yards, usually termed a spyndle. Whatever the size of yarn may be given, it is always understood that the spyndle contains 14,400 yards (see yarn table in reeling chapter). The traverse arrangement, consisting of heart and heart motion wheel and pinion on the end of retaining roller, by the action of the lever from the heart (which is a form of eccentric or cam) to the traverse pulleys, which are fixed upon the traverse shaft, chains attached to these pulleys, and also to lever which is actuated by the eccentric or cam—commonly termed the heart motion—moves the bobbin board up and down. If the frame is for 4″ bobbins, that means the traverse of the bobbin up and down will be 4 inches up and 4 inches down, and so on alternately. The form of the heart determines the shape of the bobbin. The usual practice is to shape the heart so that the bobbin will be thickest in the centre, and this makes the bobbin build better while filling. An illustration of the heart motion and arrangement of the traverse pulleys and chains is given, and also the calculation for the traverse.* The same heart or eccentric is used for 3¾″, 4″, 4½″, and 5″ traverse, the difference being made in the lever and pulleys for each of these sizes. In the spinning frame it is of the utmost importance that the bands, or lists, as they are commonly termed, be kept in good order. If this band which drives the spindle is not kept uniformly tight, slack-twisted yarn will be the result. The broader the band you can work with the better; for 3¾ inch spindles the band should be 1¾ in. broad, 4 inch spindles 2 inches broad, and 4½ to 5 ins. 2¼ in. bands; the length of band required in an ordinary frame, 4 inch pitch, 4 inch traverse, is 65 inches. The pressing rollers should also have great care and attention bestowed upon them; and the frames in a large mill should be systematically gone over day by day, and the rollers carefully examined, and the bad ones—that is, those that are chipped or "off the truth"—taken out and turned in a turning lathe. The remaining point of importance to be mentioned is the adjustment of the rove plate over which the rove passes as it comes from the retaining roller to the drawing roller.

* See page 207 for illustration of Heart Motion and Traverse Arrangement.

INSTRUCTIONS AS TO THE WORKING OF ROVE PLATE ON JUTE SPINNING FRAME (See Page 213).

First, let it be understood that the movement backward and forward of the rove plate and conductor in a spinning frame is intended either to open out the twist of the rove or to keep it in for a certain length of time while the rove is passing between the retaining and drawing rollers. The slower the rove passes down from the retaining roller the longer time will be taken for the twist to come out of the rove; hence the reason for keeping the rove forward by the plate, and keeping the top half of conductor well back when the rove is passing quickly between retaining and drawing rollers, as in a heavy size more freedom is required by the rove to allow the twist to come out of it quickly, otherwise the rove "will run."

Again, when spinning a light size of yarn, 7 to 8 lbs. per spyndle, you wish to keep the twist on the rove while passing between retaining and drawing rollers as long as you possibly can—within limits, of course—as in a light size, if you open up the twist of the rove too quickly as it comes off the rove plate to the bite of pressing and drawing rollers, it will tend to breakage of the yarn—particularly weft yarn.

Thus, for yarn, say, 8 lbs. weft, to allow the twist being kept on the rove, set the rove plate so that rove will rest easy on the front of conductor. This eases the strain down to the bite of pressing and drawing rollers, and saves the yarn from breaking where there is not much twist being put on, as in weft of the lighter weights.

Then, for 8 lbs. warp yarn, bring forward the plate a little, to allow the twist to come off the rove a little quicker than in the previous case. This will allow the yarn to draw more equally, and it will take on the twist better; and there is not so much danger of the yarn breaking with the twist that is put on warp yarns.

Then, for, say, from 12/14 lbs. warp and weft yarns, bring forward the rove plate about a $\frac{1}{4}$ of an inch from the position referred to in above instructions for 8 lbs. weft and warp, and let the rove touch the plate across its whole breadth. This putting forward the plate is intended to make the rove tighter between the retaining roller and conductor, and tends to keep the rove from "running," as it is termed. Then put back the rod from which the conductor is hung, so that the rove while passing through the conductor will only touch the back of its lower half, the upper half of the length of conductor being kept about $\frac{3}{16}''$ clear of the rove as it comes over the rove plate. This position of rove plate, conductor rod, and conductor, allows the twist to come out off the rove in sufficient time to allow the drawing roller to put on the proper draft without breakage to the yarn or the "running" of the rove. Then, say, for 16/24 lbs. yarn, as the rove will in these sizes be heavier, and also be passing still faster through between retaining roller and drawing roller the distance forward of rove plate will have to be slightly increased, and the conductor rod also put a little further back, than in the case of the 12/14 lbs. yarn.

A new arrangement of gear attached to the rove plate of spinning frames made by Messrs Fairbairn, Naylor, Macpherson, & Co., Limited, saves much time. All the rove plates are fixed upon one rod, and by the movement of a handle placed at driving end of frame the rove plates across the whole length of frame are moved at one time, and can be readily set to the position required for the yarn being spun. An illustration is given (see page 213).

*With reference to the pressure on the pressing rollers, you will require more pressure on the rollers for 24 lbs. than for 8/12 lbs.; but one cannot be too careful as to the pressure put upon the pressing rollers. If more pressure is being put on the rollers than is absolutely necessary, this means more horse-power, which, in a mill of 5/6000 spindles, might be—and, I believe, often is—a very serious thing in regard to consumpt of coal, oil, &c. This pressing of the rollers is one of the things that must be learned by care, attention, and experience.

EXPLANATION OF THE TERM THE ROVE "RUNNING"

If the twist is not entirely out of the rove by the time it is actually at the bite of the drawing and pressing rollers, the rove will "run"—that is, the rove will be caught by the pressing and drawing rollers and dragged down at the surface speed of the drawing roller. The pressure on the retaining roller will not keep it back. This, of course, is owing to the strength of the rove, the twist not being out of it. By the time the rove is in the bite, it must be in the form of a thin sliver. The causes for this "running" may be various. If the pressing roller against the retaining roller gets out of order this would cause it; but it mostly happens when the rove plate and conductor are not properly set for the size of the yarn being spun. For example if you attempted to spin, say 20 lbs. with rove plate and conductor set to spin 8 lbs., the rove would certainly "run." This, of course,

* See pages 210 and 211 for illustrations of the methods adopted to apply pressure to pressing rollers

will be readily gathered from what has been said as to the setting of rove plate and conductor, for the different sizes; and in the extreme case which we have taken as an example, the running of the rove would in that case be caused by the increased speed of the rollers drawing the rove down before the twist was properly out; and this, in a certain degree, is more or less always the cause of the rove "running"—always, of course, making certain that the pressing roller, drawing roller, &c., are in proper working order.

SPEED OF SPINNING FRAME SPINDLES.

So far as the speed of the spindles is concerned, very much depends upon the size of them, if a fair speed is to be kept upon the frame without damage to the spindles. Very many of the spindles are made too light both in the haft and in the blade. A heavy collar or neck, fitted tight into the spindle rail, will also conduce very much to the life of the spindle, if a fair speed is being put upon it, and if that speed is to be kept on continuously without damage. Whenever any lift is noticed upon the spindle, the neck should be knocked down, to take the lift off. Nothing will damage the spindles more than the neck slack in the neck rail, or the cone of the spindle being allowed to wear in the neck until the spindle has a lift between the neck and the step. It is imperative that the neck be kept close down on the cone—this is the secret of the life of the spindle. The following speeds are given to show what is the regular speed to be put upon the different sizes of spindles for the different sizes and twists of yarn being spun.

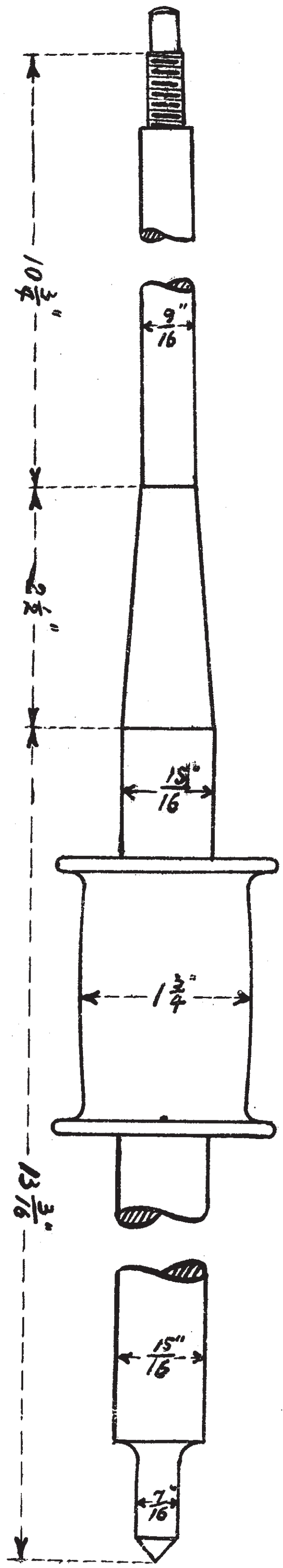
$3\frac{3}{4}''$ spindle, spinning 8 lbs. hard warp, say, $5\frac{1}{2}$ to 6 turns per inch, speed spindle = 3,300 revolutions per minute.

$3\frac{3}{4}''$ spindles, spinning 8 lbs. starching warp, say, $4\frac{3}{4}$ turns per inch = 3,100 revolutions per minute.

4″ spindles, spinning 8 to 10 lbs. weft = 2,700 revolutions per minute.

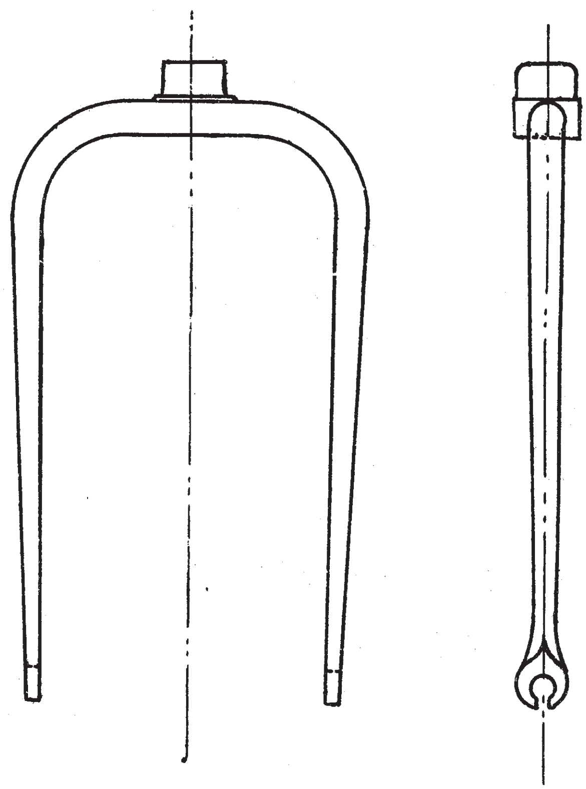
12 tc 16 pounds = 2,600 revolutions per minute.

18 to 24 ponnds weft = 2,500 revolutions per minute.



SPINNING SPINDLE AND FLYER.

4″ Traverse—Half Size.



4″ Bobbin.

THE PRODUCTION FROM THE SPINNING FRAMES.

So far as the production of the spinning frames is concerned, everything here, as in the roving in the preparing flat, depends upon the organization, steadiness, care, and attention of the workers, from the overseer onwards. Without organization, perseverance, and the individual attention of the workers, the production will suffer. As in every department of the mill, cleanliness here is of the utmost importance. Without cleanliness you cannot be doing much good in the spinning department. If you are clean in this department you may not be doing all that you might desire to do; but if you are dirty you may rely upon it, you cannot be doing very much good.

The question of production in this department is considered by many the most important in the mill. I think, however, that the production from the preparing machinery is quite as important as the production from the spinning machinery. We very seldom hear anything of what the production of the preparing machinery is. The production from a roving frame is of quite as much importance as the production of a spinning frame. Many things go to decide the question of production in the spinning department. First, the question of twist is an important factor in the production. If a mill be spinning a large proportion of weft yarns, the result will, or ought to be, a much larger production than from a mill working a large proportion of warp yarn. The cause of this difference of production is, of course, owing to the difference between weft and warp twist. A frame which would do 60 spyndles of 8 or 9 pounds hessian weft, the same frame spinning warps of the same quality would not do much more than 50 spyndles. While it is perfectly true that the twist plays an important part in the question of production, there are other causes which will add to it, and the want of which will just as readily tend to the loss of production. In speaking of production in this department, it is great folly to speak of what is the best that can be done in the course of a day, a week, or even a month. The only correct average for the production of a spinning department is to take the average over a year. We very seldom here what the production for a year is, but we often hear of what we have done in a day—shall we say a very fine day, with the weather and everything else in favour of a good result. Strangely enough, we never hear how much production has been taken off in the morning. If a fair production is being made—say, 4 to 4⅛ spyndles per spindle, in a mill spinning warps and wefts, the whole of which is to be woven in a factory which may be a part of the same works, an average of 4 to 4⅛ spyndles per spindle for all the year round will be a fair production; and to do this, will require the jute not only to be of the quality indicated in the chapter upon batching, but it will require all the points which the reader's attention was directed to in the introductory chapter—namely, punctuality, cleanliness, and organization. Without determination to be punctual the production suffers, and without the same determination to be clean, you will not have much chance to get this production; and without organization, which should be the constant care and attention of those in charge of this department, you will not have very much chance of the daily and weekly output being of any regularity worthy of the name. But given these points, and if attention and consideration be bestowed upon them by all those interested, a very fair and reasonable production, day by day, may be looked for; and will, with perseverance, give to a mill an average for a year which will compare favourably with the ordinary run of a jute spinning mill. While we have said all this on the question of production, no one, not even an expert, can very well speak upon the production of a jute mill without thoroughly understanding the kind of work that is being done. The production of a spinning department might seem to an outsider fairly good; and if investigated by an expert, there would be nothing special about it. This, you will see, might be the case from what has already been said as to the twist being put upon the yarn; while it is also true that the production of a mill might seem to an outsider a very ordinary one—they might say it was very poor, but which, upon investigation, might be very good; this being also to some extent depending upon the class of yarn being spun. The real success, so far as production is concerned, will be found by every one who is personally interested doing every day their very best, and if all do this, the best results will be sure to follow.

When the bobbins have been filled they are put into boxes and wheeled away on a bobbin barrow to either the cop-winding, the warp-winding, or the reeling departments. To see that the empty bobbins are kept steadily on the road back from these departments to the spinning frames is not the least important point to be kept before the people in charge of the spinning department. Every empty bobbin should be set up in its place ready to be handled by the shifters when they come to shift the frames. If this is not done endless annoyance and confusion, not to say anything of loss of time, will be the result.

Illustrations are given of spinning frames by two makers. The Messrs Low, of Monifieth, make almost a speciality of this machine; and as makers of frames, they stand in the front rank. I am indebted to them for their kindness in giving me permission to illustrate their spinning frame. The following pages give the particulars of gearing for twist, and draft calculations by both makers. There is also given the heart and traverse motion arrangement by both firms. The diagrams will be of much service in showing the whole arrangement of this part of a spinning frame, which is so important to the proper filling of the bobbin.

TWIST OF HESSIAN YARNS.

The twist of these yarns may vary according to the quality of the jute and the quality of the hessian being made; but for a good standard hessian, in a mill where it is the aim and intention to produce the same all the year round, there should be no necessity for varying the twist; and I am convinced, from experience, that it is unnecessary and should never be permitted on any consideration. Twist is money, and this should never be lost sight of. But apart from that, tampering with the twist of the yarn, either warp or weft, means tampering with the quality and appearance of the cloth. You will not have any suggestion as to softening the twist, it will always be the other way—"harden it up." This, of course, reacts upon the finish of the cloth, and may lead to serious trouble, on the delivery of the goods. But, as has been already said, if there is an effort all round to keep the quality of the batch as equal as possible, there will not be any necessity to tamper with the twist, which can only lead to loss of production in the first place, and trouble as to the quality of the goods manufactured from the same.

The following twists are given as an illustration of the twist put upon these yarns when they are to be worked into cops and wound on a bobbin warp winding machine, and woven at once in a factory adjoining a mill. If the yarns, weft and warp, are to be reeled and bundled, they must be coped and wound again; a little more twist may sometimes be necessary, but not much—say, not more than 3% on the weft, and 2% on the warp pinion.

Weft.	Twists per inch.	Starching Warp.	Twists per inch.	Hard Warp.	Twists per inch.
7	3·80	7	4·49	8	$5\frac{3}{4}$ to 6
8	3·44	8	4·23	10	4·87
9	3·14	9	4·	14	3·81
10	2·89	10	3·81		
12	2·58	12	3·65		
14	2·40	14	3·13		
16	2·19				
20	1·90				
24	1·68				

Usual weft sizes for hessians, 7/14 lbs.
,, warp ,, 7/9 lbs.

Spinning frame, 4″ pitch, 4″ traverse (Fairbairn).

Twist arrangement and calculations—

Diameter of drawing roller, 4″.
Cylinder pinion, 28 teeth.

$$\frac{A}{B} \times \frac{C}{D} \times \frac{E}{F \times G} = \text{twist per inch}$$

In this case—

A = diameter of cylinder.
B = ,, spindle werve.
C = wheel of double intermediate, on which is twist pinion.
D = cylinder pinion.
E = drawing roller wheel.
F = twist pinion.
G = circumference of drawing roller.

Diameter, D. Roller.

4″ $$\frac{10}{1\frac{3}{4}} \times \frac{90}{28} \times \frac{120}{60 \times 12{\cdot}56} = 2{\cdot}92 \text{ twists per inch.}$$

$$\frac{10}{1\frac{3}{4}} \times \frac{90}{28} \times \frac{120}{\text{Twist pinion} \times 12{\cdot}56} = 175{\cdot}484 \text{ constant number for twist.}$$

$3\frac{15}{16}$″ $$\frac{10}{1\frac{3}{4}} \times \frac{90}{29} \times \frac{120}{\text{Twist pinion} \times 12{\cdot}37} = 178{\cdot}179 \text{ constant number.}$$

$3\frac{7}{8}$″ $$\frac{10}{1\frac{3}{4}} \times \frac{90}{28} \times \frac{120}{\text{Twist pinion} \times 12{\cdot}17} = 181{\cdot}107 \text{ constant number.}$$

$3\frac{13}{16}$″ $$\frac{10}{1\frac{3}{4}} \times \frac{90}{28} \times \frac{120}{\text{Twist pinion} \times 11{\cdot}97} = 184{\cdot}133 \text{ constant number.}$$

Diameter, D. Roller.

$3\frac{3}{4}''$ $\quad \frac{10}{1\frac{3}{4}} \times \frac{90}{28} \times \frac{120}{\text{Twist pinion} \times 11{\cdot}78} = 187{\cdot}103$ constant number.

$3\frac{11}{16}''$ $\quad \frac{10}{1\frac{3}{4}} \times \frac{90}{28} \times \frac{120}{\text{Twist pinion} \times 11{\cdot}58} = 190{\cdot}335$ constant number.

$3\frac{5}{8}''$ $\quad \frac{10}{1\frac{3}{4}} \times \frac{90}{28} \times \frac{120}{\text{Twist pinion} \times 11{\cdot}38} = 193{\cdot}680$ constant number.

$3\frac{9}{16}''$ $\quad \frac{10}{1\frac{3}{4}} \times \frac{90}{28} \times \frac{120}{\text{Twist pinion} \times 11{\cdot}19} = 196{\cdot}968$ constant number.

$3\frac{1}{2}''$ $\quad \frac{10}{1\frac{3}{4}} \times \frac{90}{28} \times \frac{120}{\text{Twist pinion} \times 10{\cdot}96} = 200{\cdot}553$ constant number.

Spinning frame 4″ pitch, 4″ traverse (Fairbairn).

Twist arrangement and calculations—

Diameter of drawing roller, 4″.

Cylinder pinion, 34 teeth.

Diameter, D. Roller.

$4''$ $\quad \frac{10}{1\frac{3}{4}} \times \frac{90}{34} \times \frac{120}{\text{Twist pinion} \times 12{\cdot}56} = 144{\cdot}516$ constant number.

$3\frac{15}{16}''$ $\quad \frac{10}{1\frac{3}{4}} \times \frac{90}{34} \times \frac{120}{\text{Twist pinion} \times 12{\cdot}37} = 146{\cdot}734$ constant number.

$3\frac{7}{8}''$ $\quad \frac{10}{1\frac{3}{4}} \times \frac{90}{34} \times \frac{120}{\text{Twist pinion} \times 12{\cdot}17} = 149{\cdot}147$ constant number.

$3\frac{13}{16}''$ $\quad \frac{10}{1\frac{3}{4}} \times \frac{90}{34} \times \frac{120}{\text{Twist pinion} \times 11{\cdot}97} = 151{\cdot}639$ constant number.

$3\frac{3}{4}''$ $\quad \frac{10}{1\frac{3}{4}} \times \frac{90}{34} \times \frac{120}{\text{Twist pinion} \times 11{\cdot}78} = 154{\cdot}085$ constant number.

$3\frac{11}{16}''$ $\quad \frac{10}{1\frac{3}{4}} \times \frac{90}{34} \times \frac{120}{\text{Twist pinion} \times 11{\cdot}58} = 156{\cdot}746$ constant number.

$3\frac{5}{8}''$ $\quad \frac{10}{1\frac{3}{4}} \times \frac{90}{34} \times \frac{120}{\text{Twist pinion} \times 11{\cdot}38} = 159{\cdot}501$ constant number.

$3\frac{9}{16}''$ $\quad \frac{10}{1\frac{3}{4}} \times \frac{90}{34} \times \frac{120}{\text{Twist pinion} \times 11{\cdot}19} = 162{\cdot}209$ constaut number.

Diameter, D. Roller.

$$3\tfrac{1}{2}'' \quad \frac{10}{1\frac{3}{4}} \times \frac{90}{34} \times \frac{120}{\text{Twist pinion} \times 10{\cdot}99} = 165{\cdot}161 \text{ constant number.}$$

Spinning frame, 4″ pitch, 4″ traverse (Fairbairn).

Draft arrangement—

Diameter of drawing roller, 4″.

,, retaining roller, $2\frac{1}{2}''$.

Double intermediate, $\frac{80}{44}''$,

$$\frac{A}{B} \times \frac{C}{D} \times \frac{E}{F} = \text{draft.}$$

In this case—

A = diameter of drawing roller.

B = drawing roller pinion or grist pinion.

$\left.\frac{C}{D}\right\}$ = double intermediate.

E = retaining roller wheel.

F = diameter of retaining roller.

Thus—

Diameter, D. Roller.

$$4'' \quad \frac{4}{45} \times \frac{90}{44} \times \frac{111}{2\frac{1}{2}} = 9{\cdot}08 \text{ draft between drawing roller and retaining roller.}$$

$$\frac{4}{\text{Grist pinion}} \times \frac{90}{44} \times \frac{111}{2\frac{1}{2}} = 363{\cdot}272 \text{ constant number for draft.}$$

$$3\tfrac{15}{16}'' \quad \frac{3\frac{15}{16}}{\text{G. p.}} \times \frac{90}{44} \times \frac{111}{2\frac{1}{2}} = 357{\cdot}596 \text{ constant number.}$$

$$3\tfrac{7}{8}'' \quad \frac{3\frac{7}{8}}{\text{G. p.}} \times \frac{90}{44} \times \frac{111}{2\frac{1}{2}} = 351{\cdot}920 \text{ constant number.}$$

$$3\tfrac{13}{16}'' \quad \frac{3\frac{13}{16}}{\text{G. p.}} \times \frac{90}{44} \times \frac{111}{2\frac{1}{2}} = 346{\cdot}244 \text{ constant number.}$$

$$3\tfrac{3}{4}'' \quad \frac{3\frac{3}{4}}{\text{G. p.}} \times \frac{90}{44} \times \frac{111}{2\frac{1}{2}} = 340{\cdot}568 \text{ constant number.}$$

$$3\tfrac{11}{16}'' \quad \frac{3\frac{11}{16}}{\text{G. p.}} \times \frac{90}{44} \times \frac{111}{2\frac{1}{2}} = 334{\cdot}892 \text{ constant number.}$$

Diameter, D. Roller.

$3\frac{5}{8}''$ $\frac{3\frac{5}{8}}{\text{G. p.}} \times \frac{90}{44} \times \frac{111}{2\frac{1}{2}} = 329{\cdot}215$ constant number.

$3\frac{9}{16}''$ $\frac{3\frac{9}{16}}{\text{G. p.}} \times \frac{90}{44} \times \frac{111}{2\frac{1}{2}} = 323{\cdot}539$ constant number.

$3\frac{1}{2}''$ $\frac{3\frac{1}{2}}{\text{G. p.}} \times \frac{90}{44} \times \frac{111}{2\frac{1}{2}} = 317{\cdot}863$ constant number.

Spinning frame, 4″ pitch, 4″ traverse (Fairbairn).

Draft arrangement—

Diameter of drawing roller, 4″.

,, retaining roller, $2\frac{1}{2}''$.

Double intermediate, $\frac{80}{60}''$.

Diameter, D. Roller.

$4''$ $\frac{4}{\text{G. p.}} \times \frac{90}{60} \times \frac{111}{2\frac{1}{2}} = 266{\cdot}4$ constant number.

$3\frac{15}{16}''$ $\frac{3\frac{15}{16}}{\text{G. p.}} \times \frac{90}{60} \times \frac{111}{2\frac{1}{2}} = 262{\cdot}237$ constant number.

$3\frac{7}{8}''$ $\frac{3\frac{7}{8}}{\text{G. p.}} \times \frac{90}{60} \times \frac{111}{2\frac{1}{2}} = 258{\cdot}075$ constant number.

$3\frac{13}{16}''$ $\frac{3\frac{13}{16}}{\text{G. p.}} \times \frac{90}{60} \times \frac{111}{2\frac{1}{2}} = 253{\cdot}912$ constant number.

$3\frac{3}{4}''$ $\frac{3\frac{3}{4}}{\text{G. p.}} \times \frac{90}{60} \times \frac{111}{2\frac{1}{2}} = 249{\cdot}750$ constant number.

$3\frac{11}{16}''$ $\frac{3\frac{11}{16}}{\text{G. p.}} \times \frac{90}{90} \times \frac{111}{2\frac{1}{2}} = 245{\cdot}587$ constant number.

$3\frac{5}{8}''$ $\frac{3\frac{5}{8}}{\text{G. p.}} \times \frac{90}{60} \times \frac{111}{2\frac{1}{2}} = 241{\cdot}425$ constant number.

$3\frac{9}{16}''$ $\frac{3\frac{9}{16}}{\text{G. p.}} \times \frac{90}{60} \times \frac{111}{2\frac{1}{2}} = 237{\cdot}262$ constant number.

$3\frac{1}{2}''$ $\frac{3\frac{1}{2}}{\text{G. p.}} \times \frac{90}{60} \times \frac{111}{2\frac{1}{2}} = 233{\cdot}1$ constant number.

DRY SPINNING FRAME.

Sectional elevation showing gearing at end opposite to the driving pulleys.

SCALE $\frac{1}{16}$th.

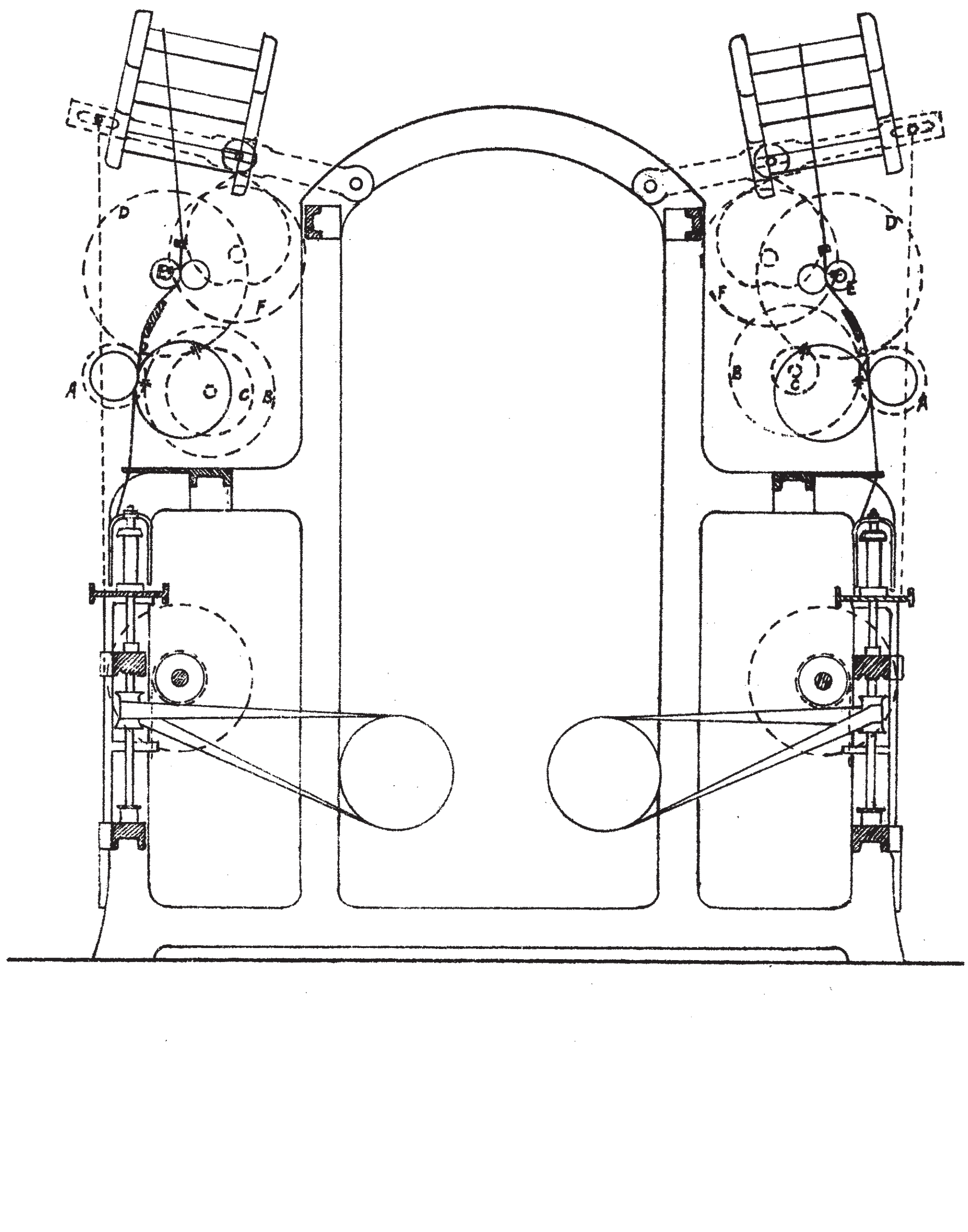
(For Diagram see page 204).

A A	Drawing roller wheels, ...	44 teeth.
B B	Stud wheels, ...	90 teeth.
C C	Draught changes, ...	33 to 60 teeth.
D D	Retaining roller wheels, ...	111 teeth.
E E	Pinions on retaining rollers for driving heart wheels, ...	11 teeth.
F F	Heart wheels, ...	120 teeth.

DRY SPINNING FRAME.

SECTIONAL ELEVATION SHOWING GEARING AT END OPPOSITE TO THE DRIVING PULLEYS.

SCALE $\frac{1}{16}$th.



DRY SPINNING FRAME.

Sectional elevation showing gearing at pulley end.

SCALE $\frac{1}{16}$th.

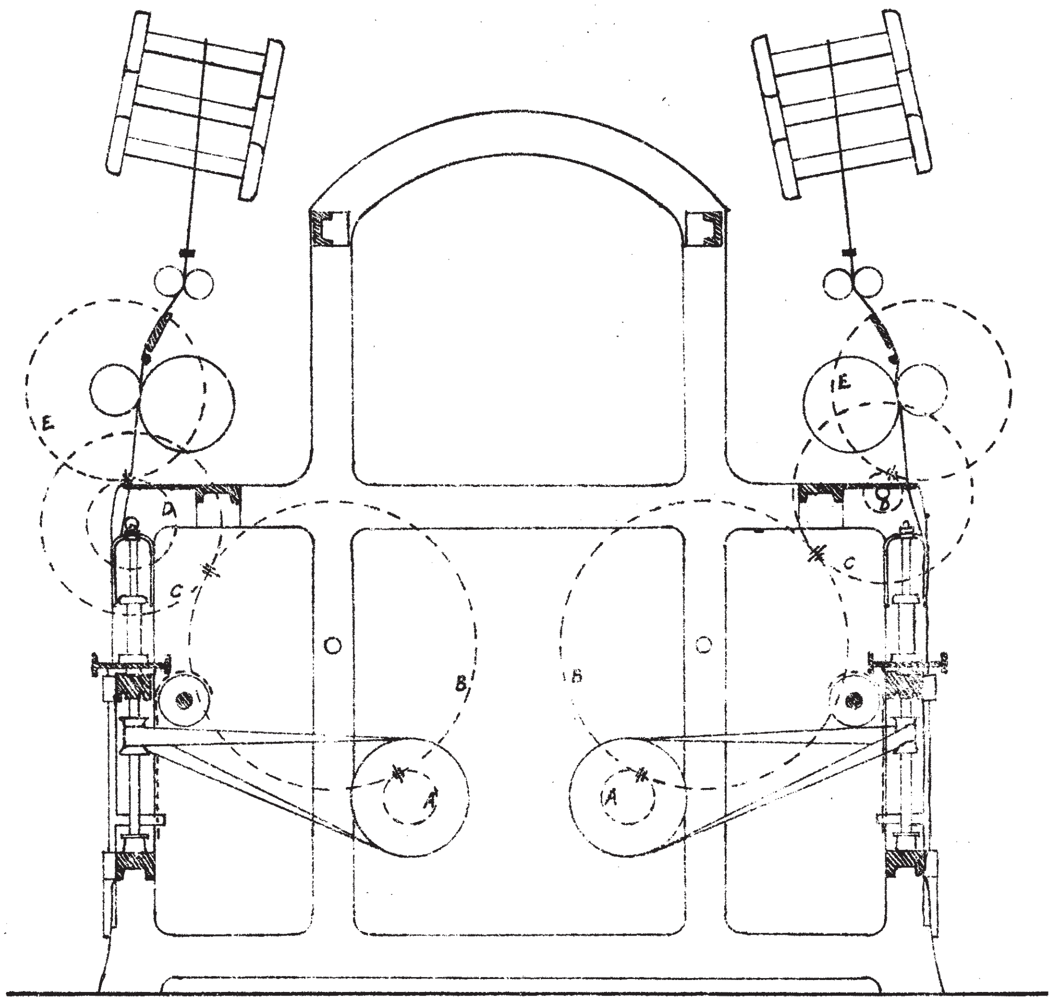
(For diagram see page 206).

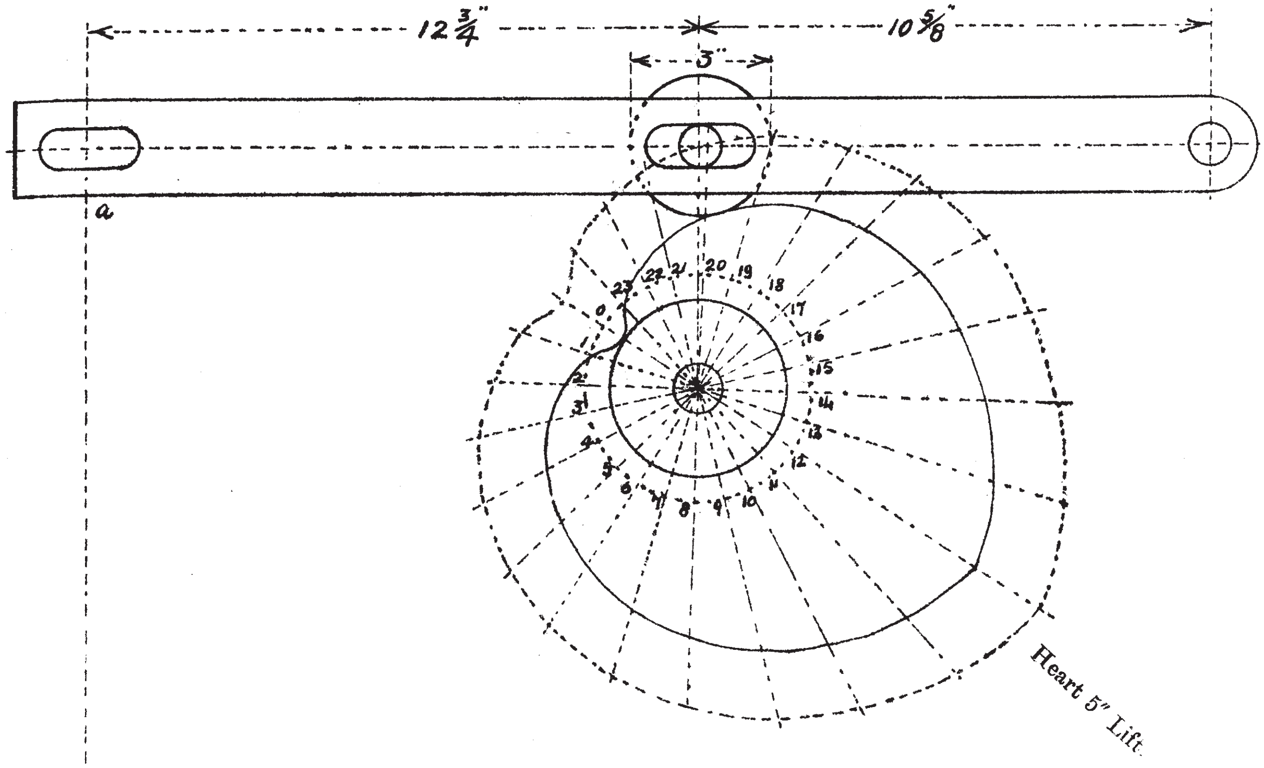
A A	Cylinder pinions, ...	28 teeth.
B B	Intermediates, ...	144 teeth.
C C	Twist wheels, ...	90 teeth.
D D	Twist changes, ...	26 to 60 teeth
E E	Drawing roller wheels, ...	120 teeth.

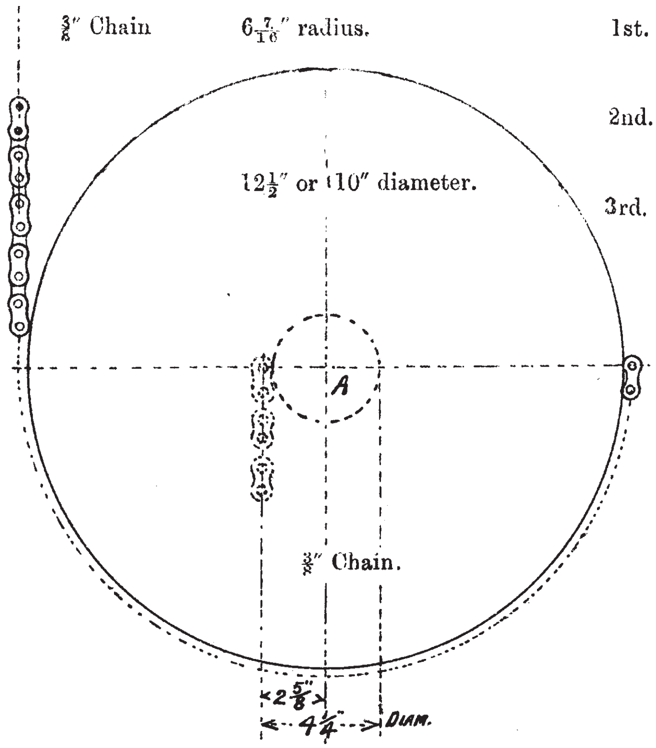
DRY SPINNING FRAME.

SECTIONAL ELEVATION SHOWING GEARING AT PULLEY END.

SCALE $\frac{1}{16}$th







1st. Traverse of Lever at A—

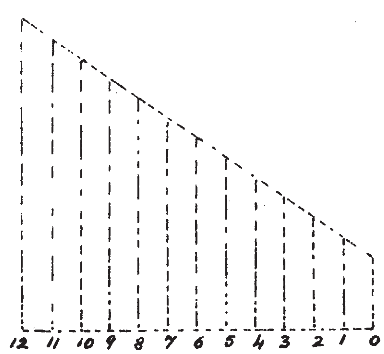
$10\frac{5}{8}'' : (12\frac{3}{4} \times 10\frac{5}{8}) :: 5'' : 11''$ at A.

2nd. Traverse of Lever at B—

$6\frac{7}{16}'' : 2\frac{5}{16}'' :: 11'' : 3{\cdot}9514$—say 4″.

3rd. With pulley 10″ diameter, traverse at B—

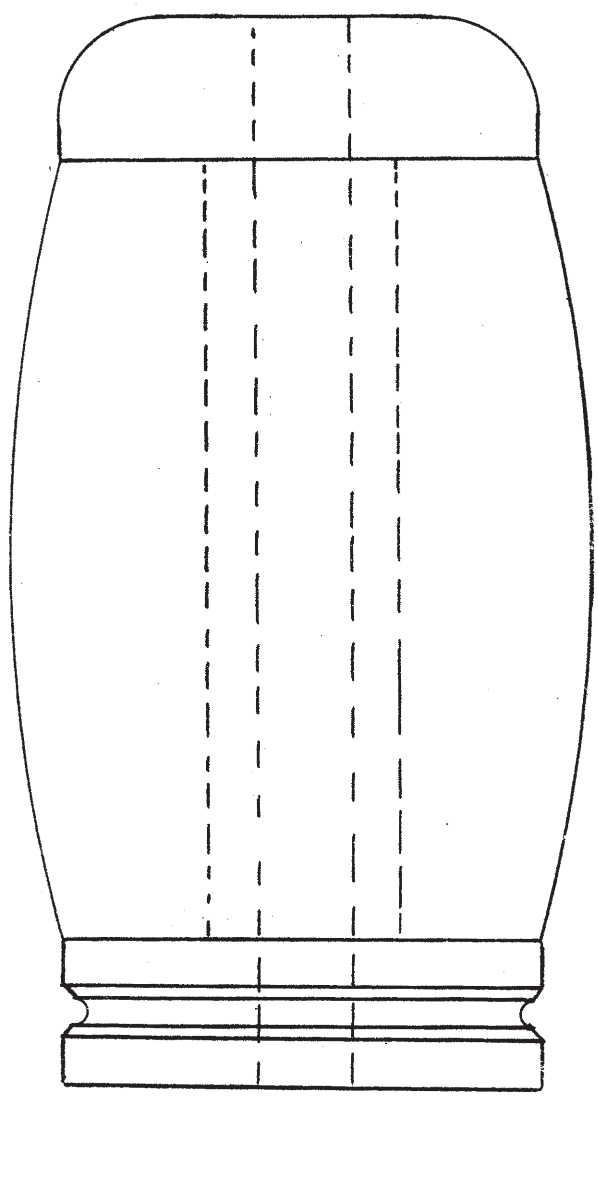
$5\frac{3}{16}'' : 2\frac{5}{16}'' :: 11'' : 4{\cdot}9$—say 5″.



Scale of Heart.

BOBBIN.

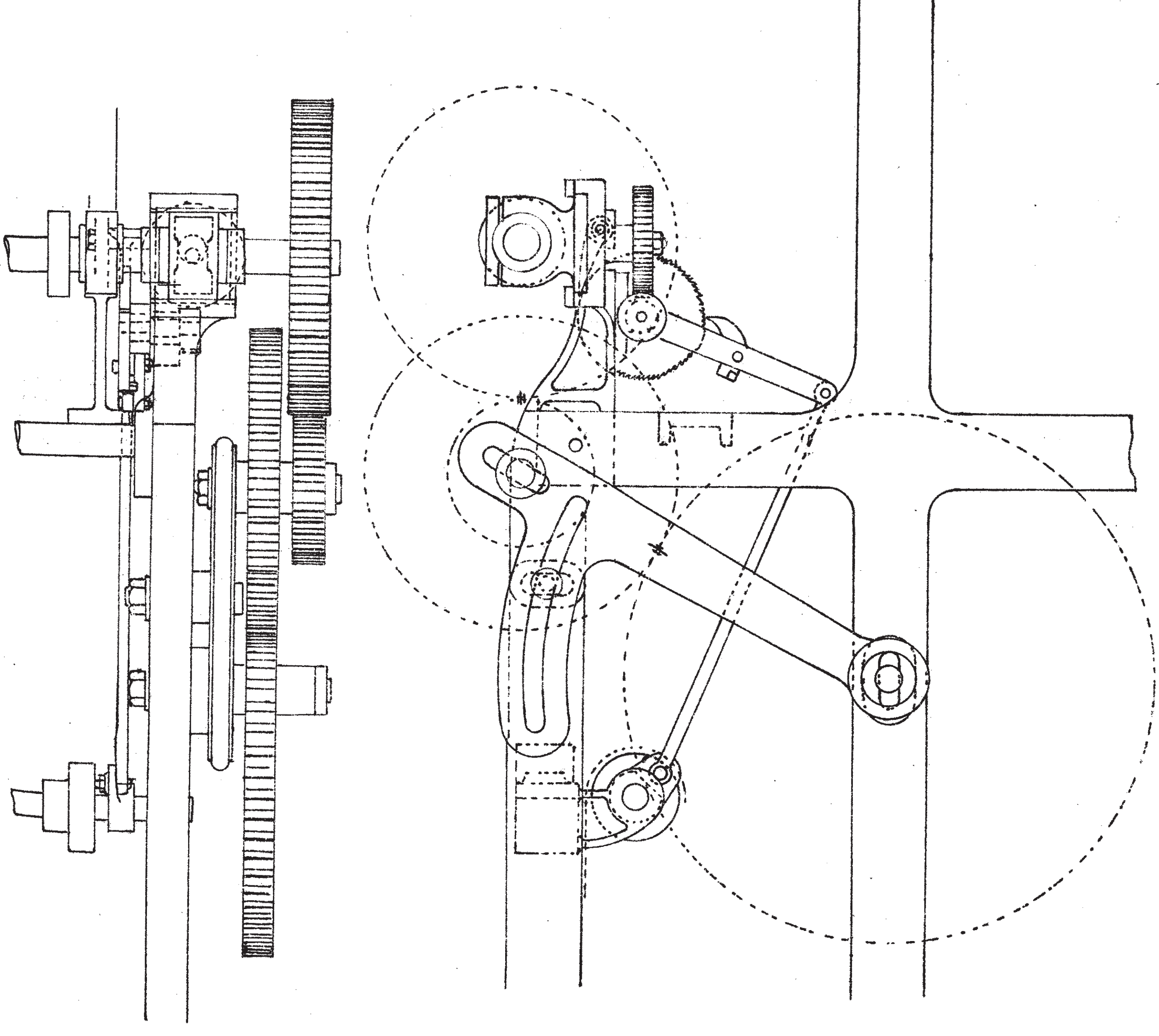
4″ Traverse (Full Size)—Showing Shape of Bobbin when full.



AUTOMATIC MOTION FOR DRAWING ROLLERS OF DRY SPINNING FRAMES.

(*Fairbairn*).

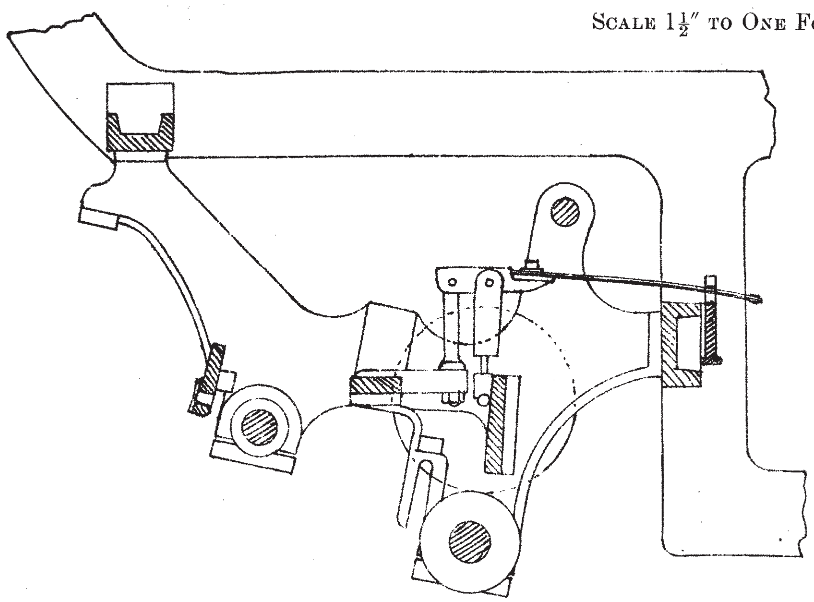
SCALE 3″ TO ONE FOOT.



NOTE.—The movement of drawing roller end ways is $\frac{1}{4}''$ in each direction.

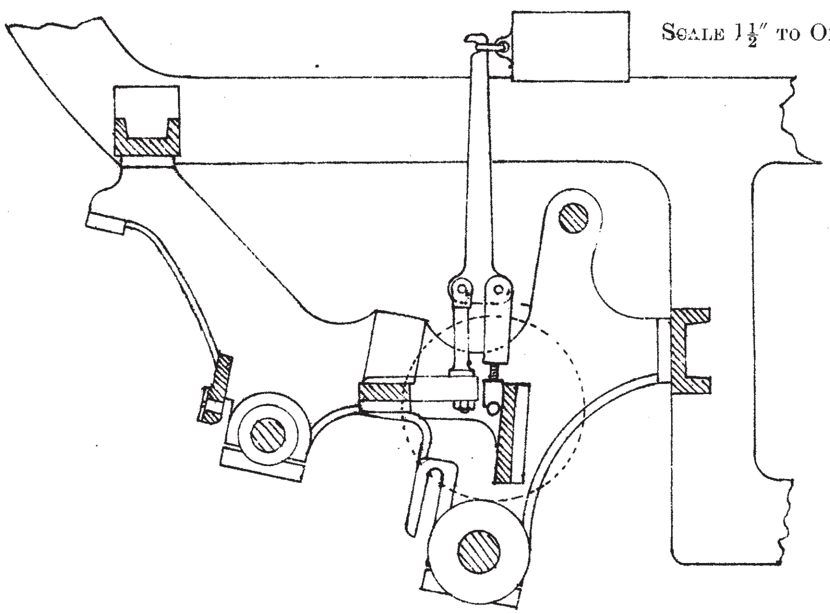
ARRANGEMENT OF SPRING FOR PRESSING ROLLER SPINNING FRAME.

SCALE $1\frac{1}{2}''$ TO ONE FOOT.



ARRANGEMENT OF LEVER AND WEIGHT FOR PRESSING ROLLER OF SPINNING FRAME.

SCALE $1\frac{1}{2}''$ TO ONE FOOT.



For pressure on pressing roller. Proportion of levers—

Arm of pressing roller $= 1\frac{1}{2}''$. Arm of weight $= 10''$.

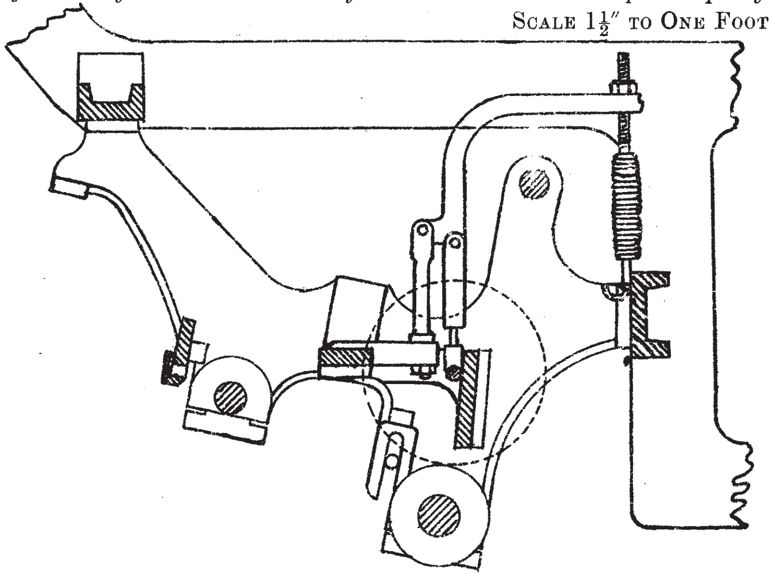
Ratio $\frac{1\frac{1}{2}}{10} = \frac{1}{6 \cdot 6}$ and if weight is 12 lbs. then—

$12 \times 6 \cdot 6 = 79 \cdot 2$ lbs. = pressure upon two balls.

ELEVATION OF SPINNING FRAME BEND.

Showing Drawing Roller and Pressing Roller with Lever and Spiral Spring

SCALE $1\frac{1}{2}''$ TO ONE FOOT



For pressure on pressing roller. Proportion of levers—

Arm of pressing roller $= 1\frac{1}{2}''$. Arm of spring $= 8\frac{1}{2}''$.

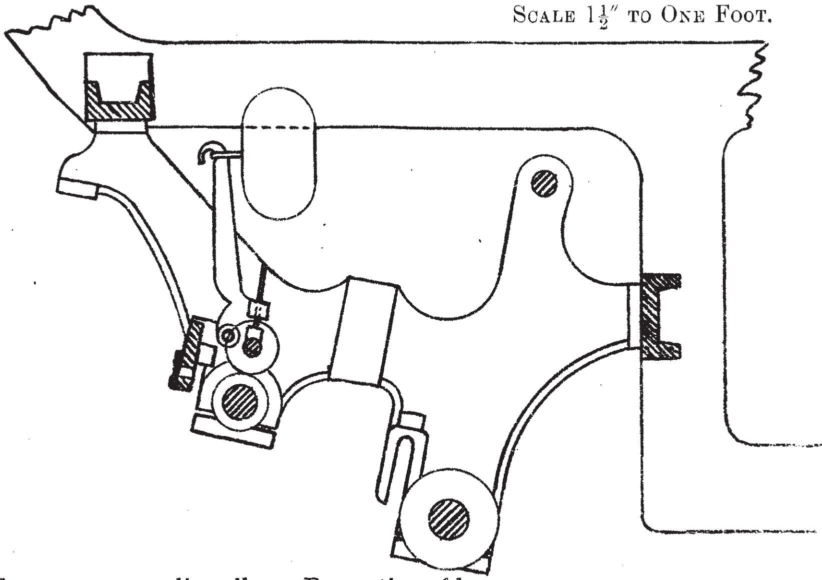
Ratio $\dfrac{1\frac{1}{2}}{8\frac{1}{4}} = \dfrac{1}{5\cdot6}$ and if pull of spring $= 12$ lbs. then—

$12 \times 5\cdot6 = 62\cdot2$ lbs. $=$ pressure upon two balls.

ELEVATION OF SPINNING FRAME BEND.

Showing Retaining Roller and Slip Roller with Lever and Weight.

SCALE $1\frac{1}{2}''$ TO ONE FOOT.



For pressure on slip roller. Proportion of levers—

Arm of slip roller $= 1\frac{1}{8}''$. Arm of weight $= 7\frac{1}{2}''$

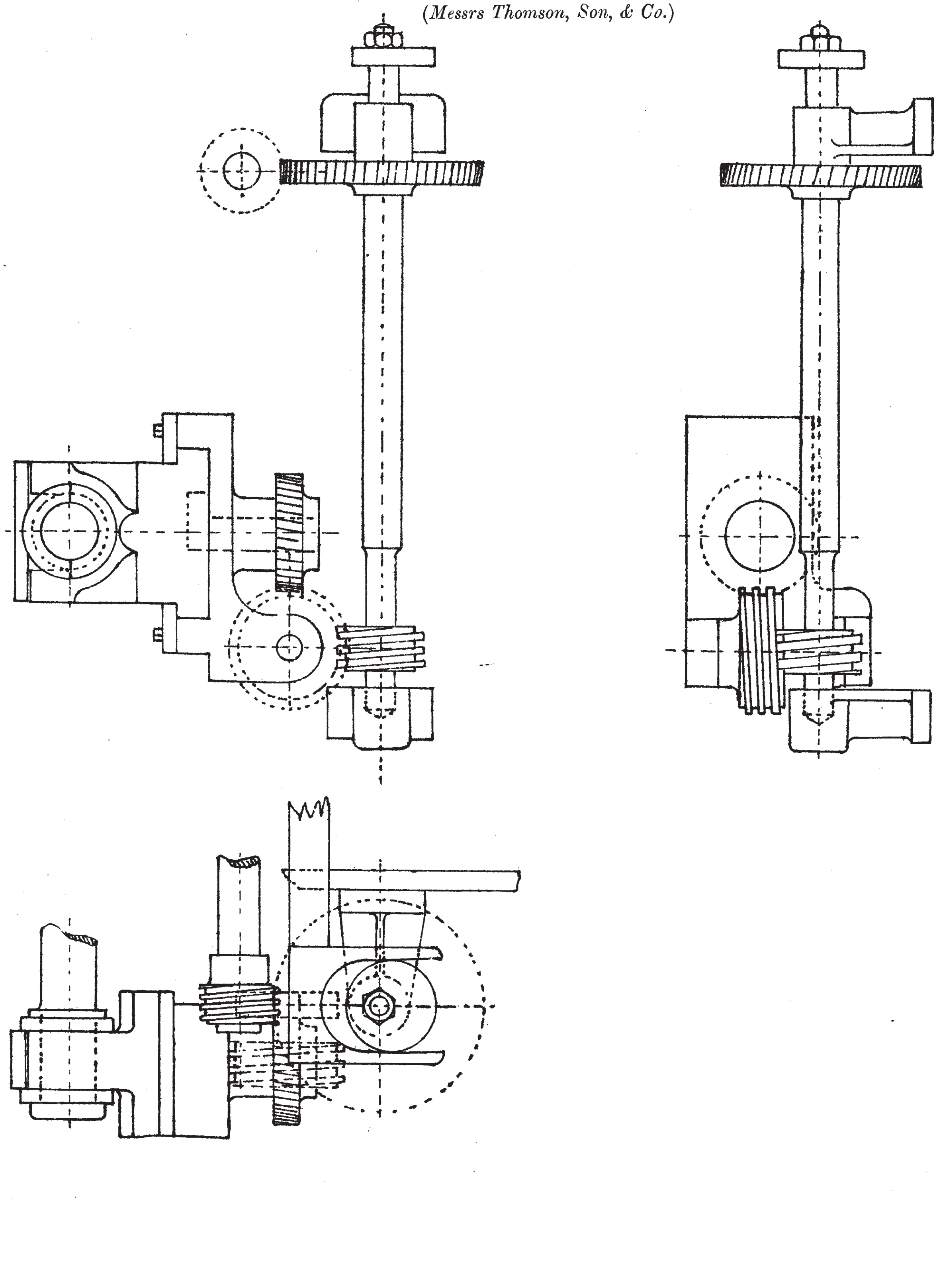
Ratio $\dfrac{1\frac{1}{8}}{7\frac{1}{2}} = \dfrac{1}{6\cdot6}$ and if weight is 6 lbs. then—

$6 \times 6\cdot6 = 39\cdot6$ lbs. $=$ pressure upon two balls.

AUTOMATIC MOTION FOR SPINNING FRAME DRAWING ROLLERS.

SCALE 3″ TO ONE FOOT.

(*Messrs Thomson, Son, & Co.*)

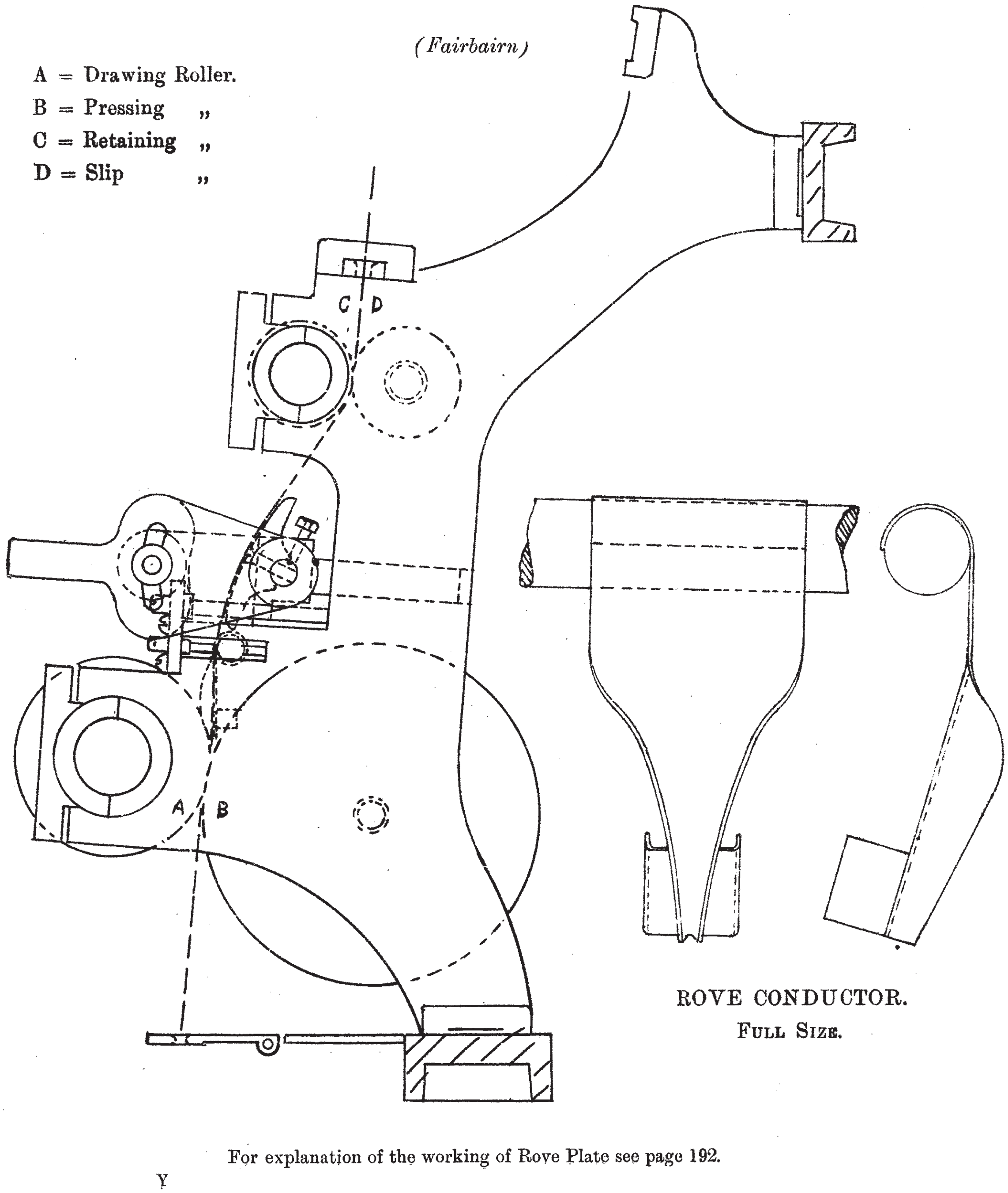


ROVE PLATE ARRANGEMENT.

SCALE 3″ TO ONE FOOT.

(Fairbairn)

A = Drawing Roller.
B = Pressing „
C = Retaining „
D = Slip „

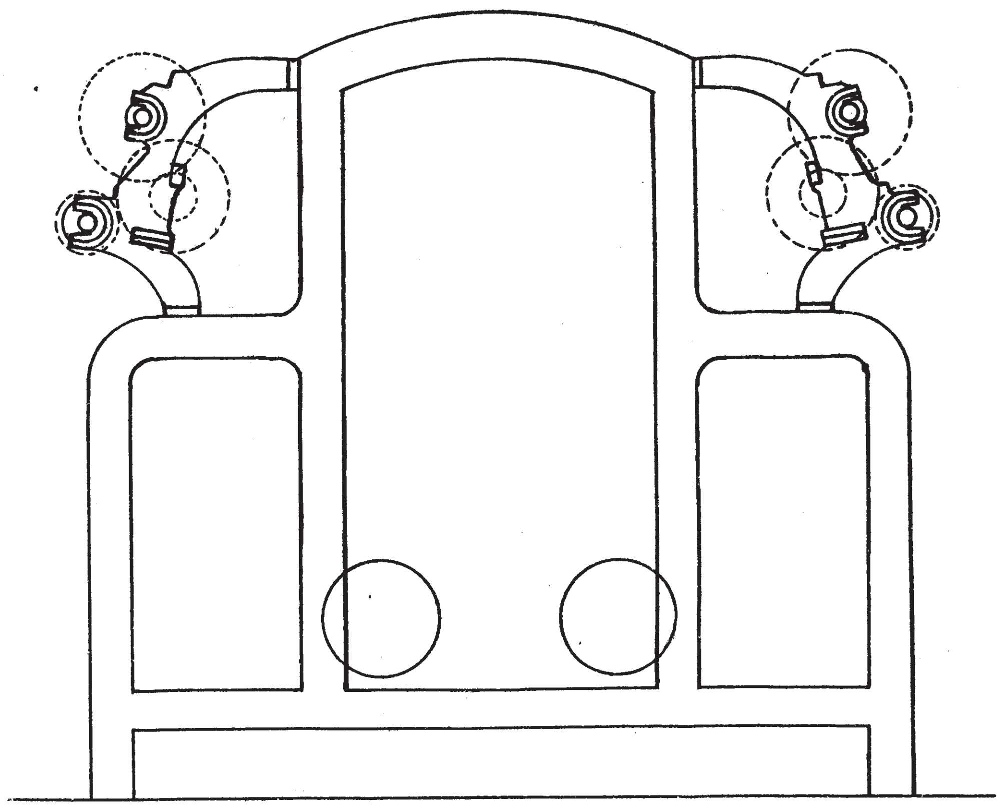


ROVE CONDUCTOR.
FULL SIZE.

For explanation of the working of Rove Plate see page 192.

SPINNING FRAME.

4″ Traverse—(*Low, Monifieth*)



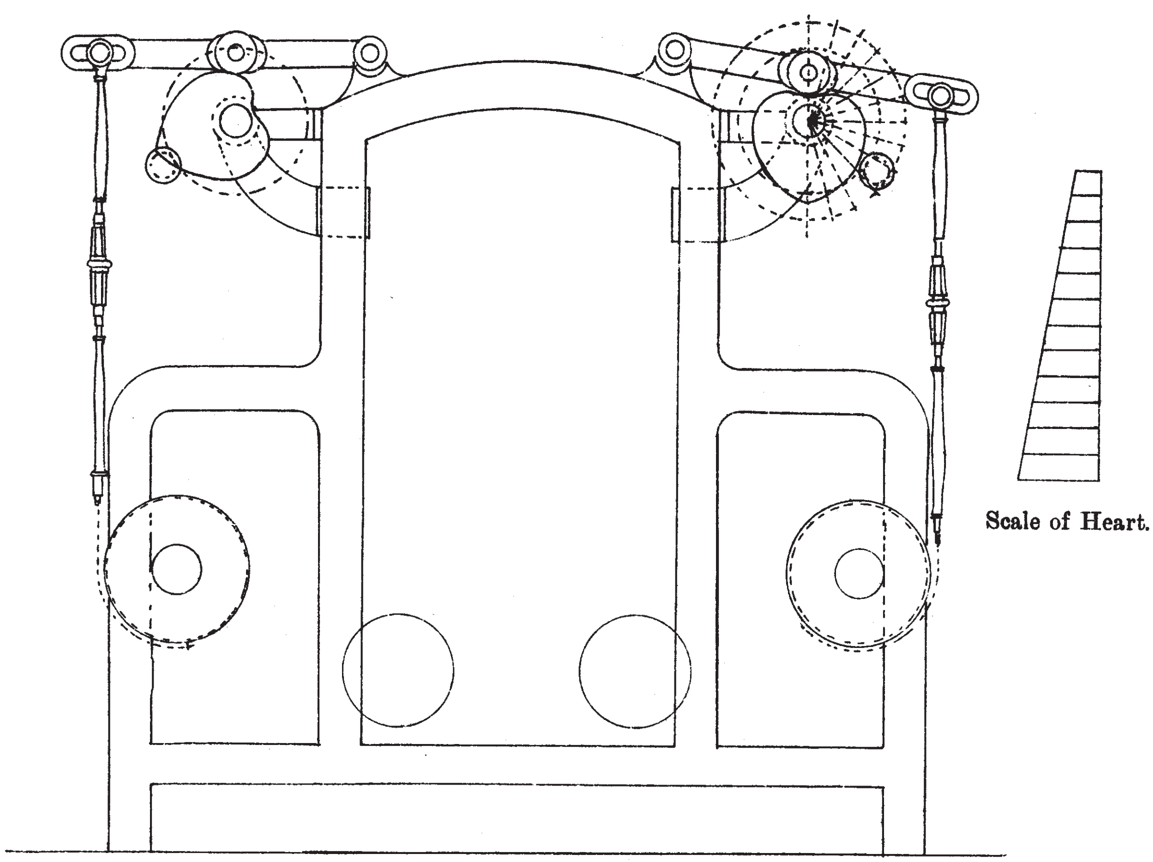
Elevation Pass End showing Grist Gearing.

Scale $\frac{1}{16}$th.

Diameter of Drawing Roller,	...	...	...	4″
„ Retaining Roller,	...	...	...	2½″
Pinion on Drawing Roller,	...	...	...	30 teeth.
Wheel on Retaining Roller,	...	...	...	80 teeth.
Double Intermediate,	...	...	...	70/35 teeth.

SPINNING FRAME.

4″ Traverse—(*Low, Monifieth*).

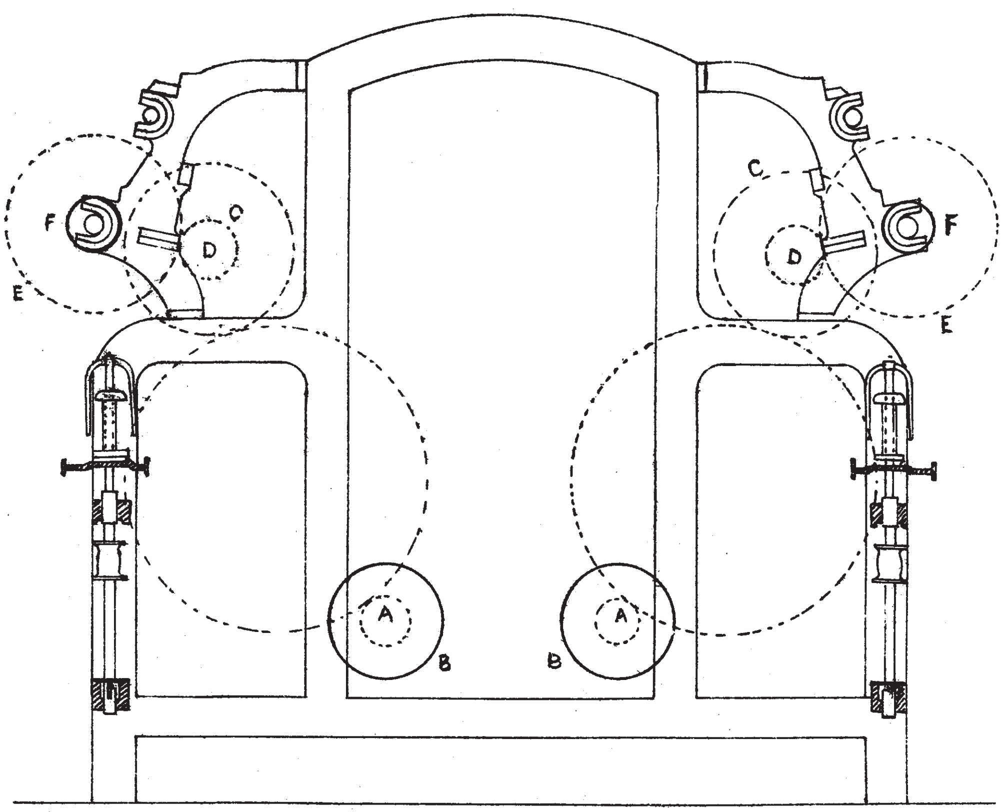


Elevation Pass End showing Heart Motion Arrangement for Traverse of Bobbin.

Scale $\frac{1}{16}$th.

SPINNING FRAME.

4″ Traverse—(*Low, Monifieth*).



Elevation Driving End showing Twist Gearing.*

Scale $\frac{1}{16}$th.

A = Cylinder Pinion.

B = Diameter of Cylinder.

C = Wheel of double intermediate.

D = Twist Pinion.

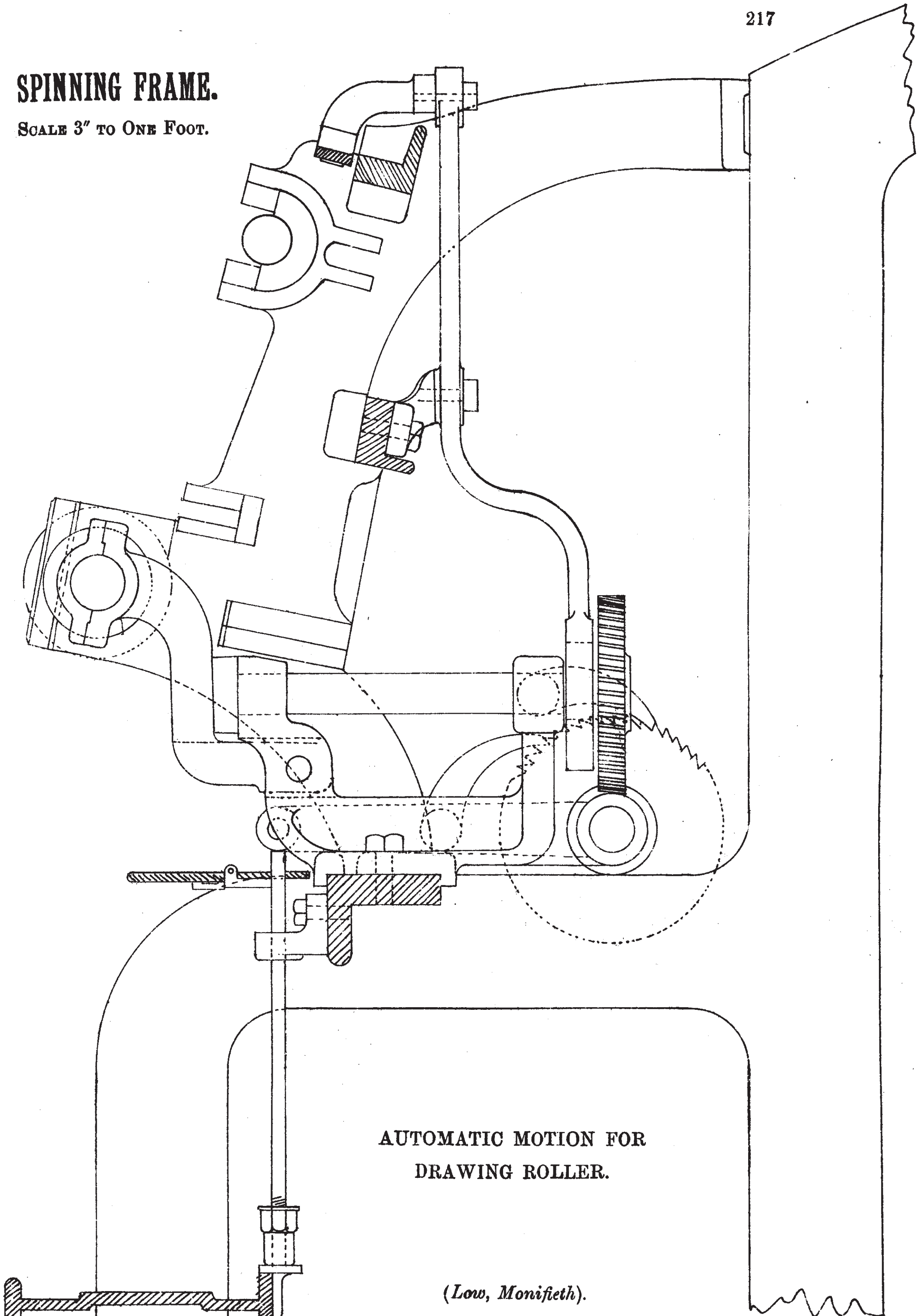
E = Drawing Roller Wheel.

F = Diameter of Drawing Roller.

* See page 220.

SPINNING FRAME.

Scale 3″ to One Foot.



AUTOMATIC MOTION FOR
DRAWING ROLLER.

(*Low, Monifieth*).

SPINNING FRAMES.

The following particulars show the general practice as to gearing, &c., followed by Messrs Low, Monifieth, in the construction of their Spinning Frames :—

For 4″ traverse frames they have to vary some of the parts considerably, to meet different requirements, and they have gable patterns 5′ 3″—5′ 6″ and 5′ 8″ wide.

Then for Twist—The Spindle Werve is $1\frac{5}{8}$″ and sometimes $1\frac{3}{4}$″ diameter.
Cylinder, 9″ or 10″ diameter.
Cylinder Pinions, 24—28—30 teeth.
Intermediate Stud Wheel, 150 or 156 teeth.
Twist Wheel, 80 teeth.
Changes, from 25 to 50 teeth.
Drawing Roller Wheel, 114 teeth.
Drawing Roller Boss, 4″ diameter.

The above is their ordinary practice, and the drawings are made to it—but they sometimes make the Twist Wheel 90 teeth, and Drawing Roller Wheel 120 teeth, which increases the size of the Cylinder Pinion somewhat, and this is on the right side.

For the Draft—Drawing Roller Boss, 4″.
Changes at pass end, 25 to 50 teeth.
Stud Wheel, 70 teeth.
Changes on nave of do., 25 to 50 teeth.
Retaining Roller Wheel, 80 teeth.
Retaining Roller Boss, $2\frac{1}{2}$″ diameter.

The above is for a 10″ Reach Bend, but when 9″ reach is used, they generally put in the Stud Wheel 60 teeth instead of 70, as the latter fills up the shorter space rather too much.

For the Heart or Lifter Motion—Pinion of 11 teeth on Retaining Roller, with 128 or 132 teeth on nave of Heart.

The Chain Pulley on Lifter Shaft is $11\frac{1}{2}$″ diameter, and the Bosses on this Shaft are $3\frac{3}{4}$″ to 4″ diameter.

DRAFT ARRANGEMENT.

Spinning Frame, 4″ pitch, 4″ Traverse. Low, Monifieth.
Frame, 10″ reach.
Diameter of drawing roller, 4″.
,, ,, retaining ,, $2\frac{1}{2}$″.
Pinion on drawing ,, change.
Wheel on retaining ,, 80 teeth.
Double intermediate ,, $\frac{70}{35}$ or $\frac{70}{45}$.

$$\frac{A}{B} \times \frac{C}{D} \times \frac{E}{F} = \text{draft.}$$

A = Diameter of Drawing Roller.
B = Grist or Change Pinion.
$\left.\frac{C}{D}\right\}$ = Double Intermediate.
F = Wheel on Retaining Roller.

$$\frac{4}{30} \times \frac{70}{45} \times \frac{80}{2\frac{1}{2}} = 6{\cdot}68 \text{ draft.}$$

$$\frac{4}{C} \times \frac{70}{45} \times \frac{80}{2\frac{1}{2}} = 199{\cdot}1 \text{ constant number for draft.}$$

$$\frac{3\frac{15}{16}}{C} \times \frac{70}{45} \times \frac{80}{2\frac{1}{2}} = 196 \quad ,, \quad ,, \quad ,,$$

$$\frac{3\frac{7}{8}}{C} \times \frac{70}{45} \times \frac{80}{2\frac{1}{2}} = 192{\cdot}88 \quad ,, \quad ,, \quad ,,$$

$$\frac{3\frac{13}{16}}{C} \times \frac{70}{45} \times \frac{80}{2\frac{1}{2}} = 189{\cdot}77 \quad ,, \quad ,, \quad ,,$$

$$\frac{3\frac{3}{4}}{C} \times \frac{70}{45} \times \frac{80}{2\frac{1}{2}} = 186{\cdot}6 \quad ,, \quad ,, \quad ,,$$

$$\frac{3\frac{11}{16}}{C} \times \frac{70}{45} \times \frac{80}{2\frac{1}{2}} = 183{\cdot}55 \quad ,, \quad ,, \quad ,,$$

$$\frac{3\frac{5}{8}}{C} \times \frac{70}{45} \times \frac{80}{2\frac{1}{2}} = 180{\cdot}44 \quad ,, \quad ,, \quad ,,$$

$$\frac{3\frac{9}{16}}{C} \times \frac{70}{45} \times \frac{80}{2\frac{1}{2}} = 177{\cdot}33 \text{ constant number for draft.}$$

$$\frac{3\frac{1}{2}}{C} \times \frac{70}{45} \times \frac{80}{2\frac{1}{2}} = 174{\cdot}22 \quad ,, \quad ,, \quad ,,$$

Double intermediate, $\frac{70}{35}$

$$\frac{4}{C} \times \frac{70}{35} \times \frac{80}{2\frac{1}{2}} = 256 \text{ constant number for draft.}$$

$$\frac{3\frac{15}{16}}{C} \times \frac{70}{35} \times \frac{80}{2\frac{1}{2}} = 252 \quad ,, \quad ,, \quad ,,$$

$$\frac{3\frac{7}{8}}{C} \times \frac{70}{35} \times \frac{80}{2\frac{1}{2}} = 248 \quad ,, \quad ,, \quad ,,$$

$$\frac{3\frac{13}{16}}{C} \times \frac{70}{35} \times \frac{80}{2\frac{1}{2}} = 244 \quad ,, \quad ,, \quad ,,$$

$$\frac{3\frac{3}{4}}{C} \times \frac{70}{35} \times \frac{80}{2\frac{1}{2}} = 240 \quad ,, \quad ,, \quad ,,$$

$$\frac{3\frac{11}{16}}{C} \times \frac{70}{35} \times \frac{80}{2\frac{1}{2}} = 236 \quad ,, \quad ,, \quad ,,$$

$$\frac{3\frac{5}{8}}{C} \times \frac{70}{35} \times \frac{80}{2\frac{1}{2}} = 232 \quad ,, \quad ,, \quad ,,$$

$$\frac{3\frac{9}{16}}{C} \times \frac{70}{35} \times \frac{80}{2\frac{1}{2}} = 228 \quad ,, \quad ,, \quad ,,$$

$$\frac{3\frac{1}{2}}{C} \times \frac{70}{35} \times \frac{80}{2\frac{1}{2}} = 224 \quad ,, \quad ,, \quad ,,$$

TWIST ARRANGEMENTS.

Spinning Frame, 4″ pitch, 4″ traverse. Low, Monifieth.
Cylinder, 10″ diameter.
Spindle Werve, $1\frac{3}{4}$″.
Cylinder Pinions, 24—28—30 teeth.
Twist Wheel, 80 teeth, or Double Intermediate.
Drawing Roller Wheel, 114 teeth.
Diameter of Drawing Roller, 4″.

$$\frac{A}{B} \times \frac{C}{D} \times \frac{E}{F \times G} = \text{Twists per inch.}$$

A = Diameter of Cylinder
B = ,, Spindle Werve.
C = Twist Wheel.
D = Cylinder Pinion.
E = Drawing Roller Wheel.
F = Twist Pinion.
G = Circumference of Drawing Roller.

Diameter of Drawing Roller.			
4″	$\frac{10''}{1\frac{3}{4}} \times \frac{80}{24} \times \frac{114}{50 \times 12{\cdot}56''}$	= 3.45 Twists per inch.	
4″	$\frac{10}{1\frac{3}{4}} \times \frac{80}{24} \times \frac{114}{\text{Twist pinion} \times 12{\cdot}56}$	= 172·88 Constant No. for Twist.	
$3\frac{15}{16}$″	$\frac{10}{1\frac{3}{4}} \times \frac{80}{24} \times \frac{114}{\times 12{\cdot}37}$	= 175·54	,, ,,
$3\frac{7}{8}$″	$\frac{10}{1\frac{3}{4}} \times \frac{80}{24} \times \frac{114}{\times 12{\cdot}17}$	= 178·42	,, ,,
$3\frac{13}{16}$″	$\frac{10}{1\frac{3}{4}} \times \frac{80}{24} \times \frac{114}{\times 11{\cdot}97}$	= 181·40	,, ,,
$3\frac{3}{4}$″	$\frac{10}{1\frac{3}{4}} \times \frac{80}{24} \times \frac{114}{\times 11{\cdot}79}$	= 184·17	,, ,,
$3\frac{11}{16}$″	$\frac{10}{1\frac{3}{4}} \times \frac{80}{24} \times \frac{114}{\times 11{\cdot}58}$	= 187·51	,, ,,
$3\frac{5}{8}$″	$\frac{10}{1\frac{3}{4}} \times \frac{80}{24} \times \frac{114}{\times 11{\cdot}38}$	= 190·81	,, ,,
$3\frac{9}{16}$″	$\frac{10}{1\frac{3}{4}} \times \frac{80}{24} \times \frac{114}{\times 11{\cdot}19}$	= 194·04	,, ,,
$3\frac{1}{2}$″	$\frac{10}{1\frac{3}{4}} \times \frac{80}{24} \times \frac{114}{\times 10{\cdot}99}$	= 195·76	,, ,,

Twist Arrangement—Cylinder Pinion, 28 teeth.

Diameter of Drawing Roller.				
4″	$\frac{10''}{1\frac{3}{4}} \times \frac{80}{28} \times \frac{114}{\text{Twist pinion} \times 12{\cdot}56}$	= 148·18	Constant No. for Twist.	
$3\frac{15}{16}''$	$\frac{10}{1\frac{3}{4}} \times \frac{80}{28} \times \frac{114}{\quad \times 12{\cdot}37}$	= 150·45	,,	,,
$3\frac{7}{8}''$	$\frac{10}{1\frac{3}{4}} \times \frac{80}{28} \times \frac{114}{\quad \times 12{\cdot}17}$	= 152·93	,,	,,
$3\frac{13}{16}''$	$\frac{10}{1\frac{3}{4}} \times \frac{80}{28} \times \frac{114}{\quad \times 11{\cdot}97}$	= 155·49	,,	,,
$3\frac{3}{4}''$	$\frac{10}{1\frac{3}{4}} \times \frac{80}{28} \times \frac{114}{\quad \times 11{\cdot}79}$	= 158·03	,,	,,
$3\frac{11}{16}''$	$\frac{10}{1\frac{3}{4}} \times \frac{80}{28} \times \frac{114}{\quad \times 11{\cdot}58}$	= 160·72	,,	,,
$3\frac{5}{8}''$	$\frac{10}{1\frac{3}{4}} \times \frac{80}{28} \times \frac{114}{\quad \times 11{\cdot}38}$	= 163·55	,	,,
$3\frac{9}{16}''$	$\frac{10}{1\frac{3}{4}} \times \frac{80}{28} \times \frac{114}{\quad \times 11{\cdot}19}$	= 166·32	,,	,,
$3\frac{1}{2}''$	$\frac{10}{1\frac{3}{4}} \times \frac{80}{28} \times \frac{114}{\quad \times 10{\cdot}99}$	= 169·35	,,	,,

Twist Arrangement—Cylinder Pinion, 30 teeth.

Diameter of Drawing Roller.				
4″	$\frac{10''}{1\frac{3}{4}} \times \frac{80}{30} \times \frac{114}{\quad \times 12{\cdot}56}$	= 138·30	Constant No. for Twist.	
$3\frac{15}{16}''$	$\frac{10}{1\frac{3}{4}} \times \frac{80}{30} \times \frac{114}{\quad \times 12{\cdot}37}$	= 140·43	,,	,,
$3\frac{7}{8}''$	$\frac{0}{1\frac{3}{4}} \times \frac{80}{30} \times \frac{114}{\quad \times 12{\cdot}17}$	= 142·73	,,	,,

Diameter of Drawing Roller.		
$3\frac{13}{16}''$	$\frac{10}{1\frac{3}{4}} \times \frac{80}{30} \times \frac{114}{\times 11{\cdot}97}$	$= 145{\cdot}12$ Constant No. for Twist.
$3\frac{3}{4}''$	$\frac{10}{1\frac{3}{4}} \times \frac{80}{30} \times \frac{114}{\times 11{\cdot}79}$	$= 147{\cdot}34$,, ,,
$3\frac{11}{16}''$	$\frac{10}{1\frac{3}{4}} \times \frac{80}{30} \times \frac{114}{\times 11{\cdot}58}$	$= 150{\cdot}01$,, ,,
$3\frac{5}{8}''$	$\frac{10}{1\frac{3}{4}} \times \frac{80}{30} \times \frac{114}{\times 11{\cdot}38}$	$= 151{\cdot}77$,, ,,
$3\frac{9}{16}''$	$\frac{10}{1\frac{3}{4}} \times \frac{80}{30} \times \frac{114}{\times 11{\cdot}19}$	$= 155{\cdot}24$,, ,,
$3\frac{1}{2}''$	$\frac{10}{1\frac{3}{4}} \times \frac{80}{30} \times \frac{114}{\times 10{\cdot}99}$	$= 158{\cdot}06$,, ,,

TWIST ARRANGEMENT.

Spinning Frame, 4″ pitch, 4″ traverse. Low, Monifieth.

Cylinder, 10″ diameter.

Spindle Werve, $1\frac{3}{4}''$ diameter.

Cylinder Pinions, 28—30 teeth.

Twist Wheel, 90 teeth.

Drawing Roller Wheel, 120 teeth.

Diameter of Drawing Roller, 4″

Diameter of Drawing Roller.		
4″	$\frac{10}{1\frac{3}{4}} \times \frac{90}{28} \times \frac{120}{\times 12{\cdot}56}$	$= 175{\cdot}48$ Constant No. for Twist.
$3\frac{15}{16}''$	$\frac{10}{1\frac{3}{4}} \times \frac{90}{28} \times \frac{120}{\times 12{\cdot}37}$	$= 178{\cdot}17$,, ,,
$3\frac{7}{8}''$	$\frac{10}{1\frac{3}{4}} \times \frac{90}{28} \times \frac{120}{\times 12{\cdot}17}$	$= 181{\cdot}10$,, ,,
$3\frac{13}{16}''$	$\frac{10}{1\frac{3}{4}} \times \frac{90}{28} \times \frac{120}{\times 11{\cdot}97}$	$= 184{\cdot}13$,, ,,

Diameter of Drawing Roller.			
$3\frac{3}{4}''$	$\frac{10}{1\frac{3}{4}} \times \frac{90}{28} \times \frac{120}{\times 11{\cdot}79}$	$= 187{\cdot}10$	Constant No. for Twist.
$3\frac{11}{16}''$	$\frac{10}{1\frac{3}{4}} \times \frac{90}{28} \times \frac{120}{\times 11{\cdot}58}$	$= 190{\cdot}33$	,, ,,
$3\frac{5}{8}''$	$\frac{10}{1\frac{3}{4}} \times \frac{90}{28} \times \frac{120}{\times 11{\cdot}38}$	$= 193{\cdot}68$	,, ,,
$3\frac{9}{16}''$	$\frac{10}{1\frac{3}{4}} \times \frac{90}{28} \times \frac{120}{\times 11{\cdot}19}$	$= 196{\cdot}96$	,, ,,
$3\frac{1}{2}''$	$\frac{10}{1\frac{3}{4}} \times \frac{90}{28} \times \frac{120}{\times 10{\cdot}99}$	$= 200{\cdot}55$	,, ,,

Twist Arrangement—Cylinder Pinion, 30 teeth.

Diameter of Drawing Roller.			
$4''$	$\frac{10}{1\frac{3}{4}} \times \frac{90}{30} \times \frac{120}{\times 12{\cdot}56}$	$= 163{\cdot}78$	Constant No. for Twist.
$3\frac{15}{16}''$	$\frac{10}{1\frac{3}{4}} \times \frac{90}{30} \times \frac{120}{\times 12{\cdot}37}$	$= 166{\cdot}30$	,, ,,
$3\frac{7}{8}''$	$\frac{10}{1\frac{3}{4}} \times \frac{90}{30} \times \frac{120}{\times 12{\cdot}17}$	$= 169{\cdot}03$	,, ,,
$3\frac{13}{16}''$	$\frac{10}{1\frac{3}{4}} \times \frac{90}{30} \times \frac{120}{\times 11{\cdot}97}$	$= 171{\cdot}85$	,, ,,
$3\frac{3}{4}''$	$\frac{10}{1\frac{3}{4}} \times \frac{90}{30} \times \frac{120}{\times 11{\cdot}79}$	$= 174{\cdot}48$	,, ,,
$3\frac{11}{16}''$	$\frac{10}{1\frac{3}{4}} \times \frac{90}{30} \times \frac{120}{\times 11{\cdot}58}$	$= 177{\cdot}64$	,, ,,
$3\frac{5}{8}''$	$\frac{10}{1\frac{3}{4}} \times \frac{90}{30} \times \frac{120}{\times 11{\cdot}38}$	$= 180{\cdot}76$	,, ,,

Diameter of Drawing Roller.				
$3\frac{9}{16}''$	$\frac{10}{1\frac{3}{4}} \times \frac{90}{30} \times \frac{120}{\times 11{\cdot}19}$	$= 183{\cdot}83$	Constant No. for Twist.	
$3\frac{1}{2}''$	$\frac{10}{1\frac{3}{4}} \times \frac{90}{30} \times \frac{120}{\times 10{\cdot}99}$	$= 187{\cdot}18$	„	„

Twist Arrangement—Cylinder Pinion, 24—28—30 teeth.

Cylinder, 9″ diameter.

Spindle Werve, $1\frac{5}{8}''$ diameter.

Cylinder Pinions, 24—28—30 teeth.

Twist Wheel, 80 teeth.

Drawing Roller Wheel, 114 teeth.

Diameter of Drawing Roller, 4″.

Diameter of Drawing Roller.				
$4''$	$\frac{9}{1\frac{5}{8}} \times \frac{80}{24} \times \frac{114}{\times 12{\cdot}56}$	$= 167{\cdot}56$	Constant No. for Twist.	
$3\frac{15}{16}''$	$\frac{9}{1\frac{5}{8}} \times \frac{80}{24} \times \frac{114}{\times 12{\cdot}37}$	$= 170{\cdot}13$	„	„
$3\frac{7}{8}''$	$\frac{9}{1\frac{5}{8}} \times \frac{80}{24} \times \frac{114}{\times 12{\cdot}17}$	$= 172{\cdot}93$	„	„
$3\frac{13}{16}''$	$\frac{9}{1\frac{5}{8}} \times \frac{80}{24} \times \frac{114}{\times 11{\cdot}97}$	$= 175{\cdot}82$	„	„
$3\frac{3}{4}''$	$\frac{9}{1\frac{5}{8}} \times \frac{80}{24} \times \frac{114}{\times 11{\cdot}79}$	$= 178{\cdot}50$	„	„
$3\frac{11}{16}''$	$\frac{9}{1\frac{5}{8}} \times \frac{80}{24} \times \frac{114}{\times 11{\cdot}58}$	$= 181{\cdot}74$	„	„
$3\frac{5}{8}''$	$\frac{9}{1\frac{5}{8}} \times \frac{80}{24} \times \frac{114}{\times 11{\cdot}38}$	$= 184{\cdot}93$	„	„
$3\frac{9}{16}''$	$\frac{9}{1\frac{5}{8}} \times \frac{80}{24} \times \frac{114}{\times 11{\cdot}19}$	$= 188{\cdot}07$	„	„

Diameter of Drawing Roller.		
$3\frac{1}{2}''$	$\frac{9}{1\frac{5}{8}} \times \frac{80}{24} \times \frac{114}{\times 10{\cdot}99}$	$= 191{\cdot}50$ Constant No. for Twist.

Twist Pinion—Cylinder Pinion, 28 teeth.

Diameter of Drawing Roller.		
$4''$	$\frac{9}{1\frac{5}{8}} \times \frac{80}{28} \times \frac{114}{\times 12{\cdot}56}$	$= 143{\cdot}62$ Constant No. for Twist.
$3\frac{15}{16}''$	$\frac{9}{1\frac{5}{8}} \times \frac{80}{28} \times \frac{114}{\times 12{\cdot}37}$	$= 145{\cdot}83$,, ,,
$3\frac{7}{8}''$	$\frac{9}{1\frac{5}{8}} \times \frac{80}{28} \times \frac{114}{\times 12{\cdot}17}$	$= 148{\cdot}22$,, ,,
$3\frac{13}{16}''$	$\frac{9}{1\frac{5}{8}} \times \frac{80}{28} \times \frac{114}{\times 11{\cdot}97}$	$= 150{\cdot}70$,, ,,
$3\frac{3}{4}''$	$\frac{9}{1\frac{5}{8}} \times \frac{80}{28} \times \frac{114}{\times 11{\cdot}79}$	$= 153{\cdot}00$,, ,,
$3\frac{11}{16}''$	$\frac{9}{1\frac{5}{8}} \times \frac{80}{28} \times \frac{114}{\times 11{\cdot}58}$	$= 155{\cdot}78$,, ,,
$3\frac{5}{8}''$	$\frac{9}{1\frac{5}{8}} \times \frac{80}{28} \times \frac{114}{\times 11{\cdot}38}$	$= 158{\cdot}51$,, ,,
$3\frac{9}{16}''$	$\frac{9}{1\frac{5}{8}} \times \frac{80}{28} \times \frac{114}{\times 11{\cdot}19}$	$= 161{\cdot}21$,, ,,
$3\frac{1}{2}''$	$\frac{9}{1\frac{5}{8}} \times \frac{80}{28} \times \frac{114}{\times 10{\cdot}99}$	$= 164{\cdot}14$,, ,,

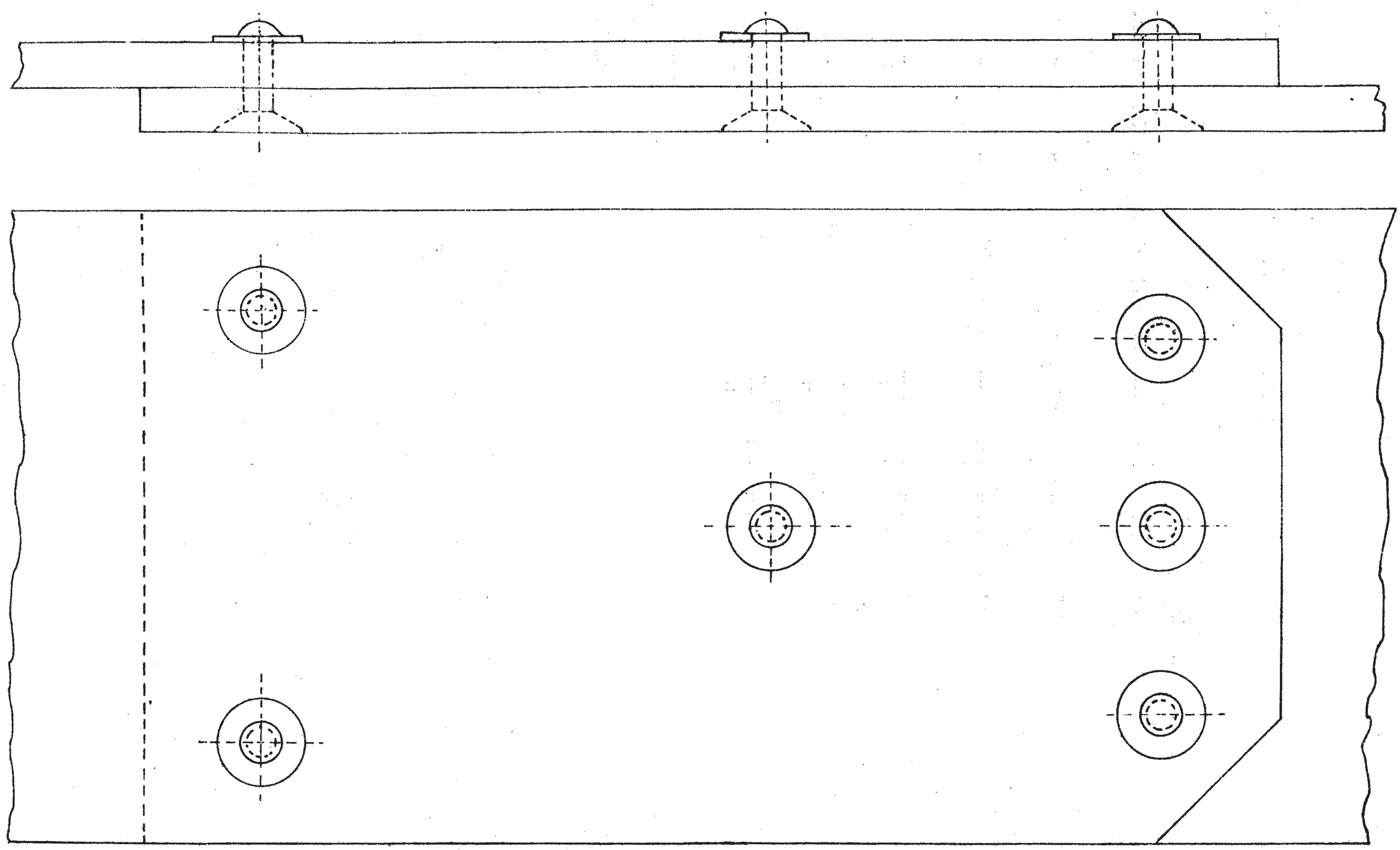
Twist Pinion—Cylinder Pinion, 30 teeth.

Diameter of Drawing Roller.		
$4''$	$\frac{9}{1\frac{5}{8}} \times \frac{80}{30} \times \frac{114}{\times 12{\cdot}56}$	$= 134{\cdot}05$,, ,,

Diameter of Drawing Roller.		
$3\frac{15}{16}''$	$\frac{9}{1\frac{5}{8}} \times \frac{80}{30} \times \frac{114}{\quad \times 12{\cdot}37}$	$= 136{\cdot}11$ Constant No. for Twist.
$3\frac{7}{8}''$	$\frac{9}{1\frac{5}{8}} \times \frac{80}{30} \times \frac{114}{\quad \times 12{\cdot}17}$	$= 138{\cdot}34$,, ,,
$3\frac{13}{16}''$	$\frac{9}{1\frac{5}{8}} \times \frac{80}{30} \times \frac{114}{\quad \times 11{\cdot}97}$	$= 140{\cdot}48$,, ,,
$3\frac{3}{4}''$	$\frac{9}{1\frac{5}{8}} \times \frac{80}{30} \times \frac{114}{\quad \times 11{\cdot}79}$	$= 142{\cdot}80$,, ,,
$3\frac{11}{16}''$	$\frac{9}{1\frac{5}{8}} \times \frac{80}{30} \times \frac{114}{\quad \times 11{\cdot}58}$	$= 145{\cdot}39$,, ,,
$3\frac{5}{8}''$	$\frac{9}{1\frac{5}{8}} \times \frac{80}{30} \times \frac{114}{\quad \times 11{\cdot}38}$	$= 147{\cdot}95$,, ,,
$3\frac{9}{16}''$	$\frac{9}{1\frac{5}{8}} \times \frac{80}{30} \times \frac{114}{\quad \times 11{\cdot}19}$	$= 150{\cdot}46$,, ,,
$3\frac{1}{2}''$	$\frac{9}{1\frac{5}{8}} \times \frac{80}{30} \times \frac{114}{\quad \times 10{\cdot}99}$	$= 153{\cdot}20$,, ,,

COTTON BELT JOINT.

SHOWING METHOD ADOPTED FOR FIXING—Rivets used $\frac{5}{8}''$, No. 6.



THE DRIVING OF THE SPINNING FRAME.

The steadiness of the drive to the Spinning Frame Spindles is of much importance, and it will always be observed that when a pair of engines are working together driving a mill, the driving will be much steadier than when working with a single engine. A 72 Spindle Frame, 4 inch pitch, 4 inch traverse, will require a belt 4 inches broad and 80 feet long, according to the plan of mill given in this book. At one time all the belts used in jute mills were made of leather, but this is not now the case. Many mills work cotton belting. This belt has many advantages over leather for driving jute mill machinery; not only is it cheaper, but it runs much smoother, owing to the absence of joints. There is only one joint in the belt. This joint is made very easily, and in a much shorter time than you can make a sewed joint The cost of the six copper rivets and washers is trifling compared with the price of belt laces. This is a diagram showing the form of joint used largely for Spinning Frame Belts made of cotton solid woven (*see diagram page* 228).

These belts will drive the Frame, and not require to be kept so tight as leather belts. They do not require nearly so much attention and upkeep as leather belts do, the laces for which are a serious matter, as the average life of a belt lace of good quality is only about 2½/3 months. A cotton belt will run for about 6/8 months without anything being done to the joint, and it will run from 4/5 years with very little trouble and without much expense. At the end of that time there will not be more than two or three joints in the belt. During that period a leather belt will have cost *something*, if it is *still running*, in the shape of laces, and there will be *rather more* than two or three joints in it. It should be always borne in mind whether the belt is made of leather or cotton, that the guide pulleys should be properly set to the driving drum and to the driving pulleys of frame. On this depends in a great measure the life of a belt. Much destruction is caused to belts by the guides being improperly set, throwing an unnecessary strain and consequent wear upon the edges. This, of course, ruins the belt whether of leather or cotton. If the guide pulleys are correctly set to the driving pulley the "belt fork" will never touch the belt except when required to shift it from one pulley to another. When the belt is running on either pulley it should be quite free, and should not press against the side of belt fork. This can be easily accomplished if the guide is set as described.

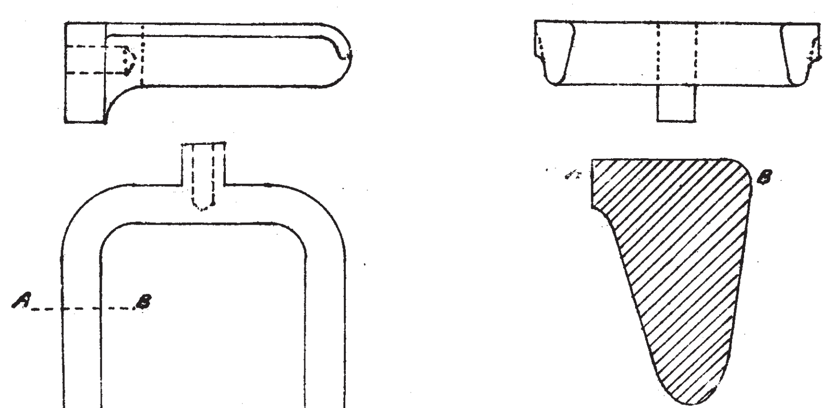
INSTRUCTIONS FOR SETTING GUIDE PULLEYS FOR SPINNING FRAME BELTS.

(See Diagram page 231).

In this diagram the arrow at A shows the direction the belt is running on the drum D. This is called the "leading side" of the belt The edges of the guide pulley from which the belt is running on the drum should be set in line with the edge of the drum. If the guide is 4 inches broad and the drum six inches broad, the edge of pulley should be set to throw belt one inch from edge of drum, and when the belt is running on drum, it will be one inch within each side of it. Second—the guide pulley should be set so that a plumb line from the circumference of guide pulley should fall between the two pulleys at P as dotted line. This insures that the fork will have the same pressure on the belt edge when putting on as when you put it off. Third—a line from the edge of each guide pulley to a point at a distance equal to half the width of guide pulley from the circumference of cylinder pulley will set the guide pulley to the angle required to keep the belt running fair. If attention be given to these three points and the guide pulley frame is set parallel to the driving shaft, there is no fear but the belt will run without damage to its edges. Belt forks are often made of round iron $\frac{5}{8}$ inches or $\frac{3}{4}$ inches diameter. This is not a good thing for any kind of belt. This diagram shows a fork which will be found very easy upon the belts and is supplied by Fairbairn to all their Spinning Frames.

DIAGRAM OF BELT FORK FOR SPINNING FRAME.

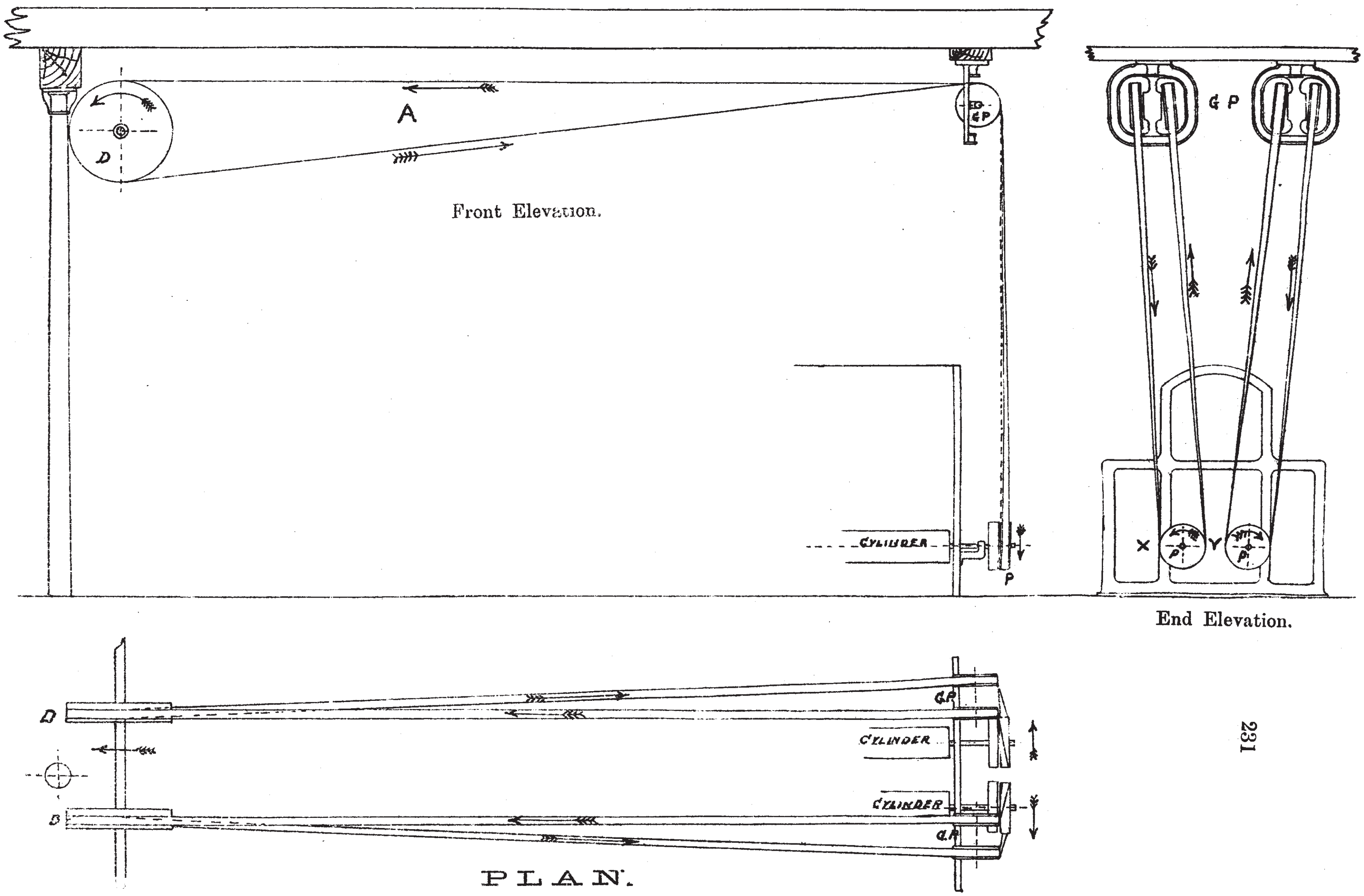
Scale 3″ to One Foot.



Plan. Cross Section at A B. Full Size.

ARRANGEMENT OF GUIDE PULLEYS FOR DRIVING SPINNING FRAME.

Scale $\frac{1}{4}''$ to One Foot.



COP WINDING.

If the weft which has been spun upon the frames is to be made into cops, it is taken to the cop-winding department. Here it is wound upon the cop machines into cops, according to the size of the shuttles in which the weft is to be used in the process of weaving. Usually, hessian cops are made 9 inches long, and $1\frac{1}{2}$ inches in diameter. Sometimes they are made 9 inches by $1\frac{5}{8}$ inches; but if the looms are being driven fast, I think a 9 inch by $1\frac{1}{2}$ inch cop is preferable, as there is less tendency to make waste. Illustrations of three different types of cop machines are given—the original machine of Combe, Barbour, & Company; Messrs Lee, Croll, & Company; and Messrs Charles Parker, Son, & Company. The last two mentioned are very much of the same construction. The cop cone in these two machines is in an inverted position from the former machine. This will be readily understood from a reference to the diagrams given. All the machines do their work equally well. My experience has, however, been confined to the machine of Messrs Combe, Barbour, & Company. It is sometimes said of this machine that it is difficult to keep up—that is to say, that it is difficult to keep in mechanical order. I cannot, however, say I have found it very much trouble; that, however, is a matter of opinion. I am inclined to think that Messrs Combe, Barbour, & Company's machine can be driven at a greater speed than the others mentioned. In a mill, the workers get accustomed to either of them; and, of course, both employers and employees make use of what they have been accustomed to. Particulars, arrangement of speeds, &c., are given. The cops when taken of the spindles are either put into pans or bags. If they are to be used at once in a factory, they are very often put into pans; if they are to be sent a distance, they are always put into bags. It is of importance that the pan or bag be made the exact breadth of the length of cop. This is not to allow the cops to shift about and get broken; as, if they are in any way knocked about, they are apt to become soft, and this will always lead to unnecessary waste in the weaving department. The cop pan is usually made 16 inches long, 11 inches deep, and $9\frac{1}{2}$ inches broad. The bag—to hold about 56 to 60 pounds weight—is made 22 inches broad, 10 inches wide, and 22 inches deep. The waste in this department is a matter which requires continual attention. My experience is, that for ordinary hessian wefts the waste will average about ·4 per cent., the cop machine of 54 spindles will require three winders, and they will wind into cops, on an average, 60 spyndles of 8 or 9 lbs. in 10 hours. When the size is from 10 to 12 pounds, it will depend to some extent upon the ability of the winder as to whether she will be able to wind the production of a 72 spindle frame. This, of course, is a matter for arrangement when it happens in the department.

PARTICULARS OF COP MACHINE GEARING.

(*Parker, Son, & Co.*)

Spindle driving wheel (a) 46 teeth.

,, ,, pinion (b) 16 teeth.

Travelling cloth pulley (c and d) each $7\frac{1}{2}''$ dia.

Worm, single thread, right hand (e).

Worm Wheel 24 teeth, right hand (f).

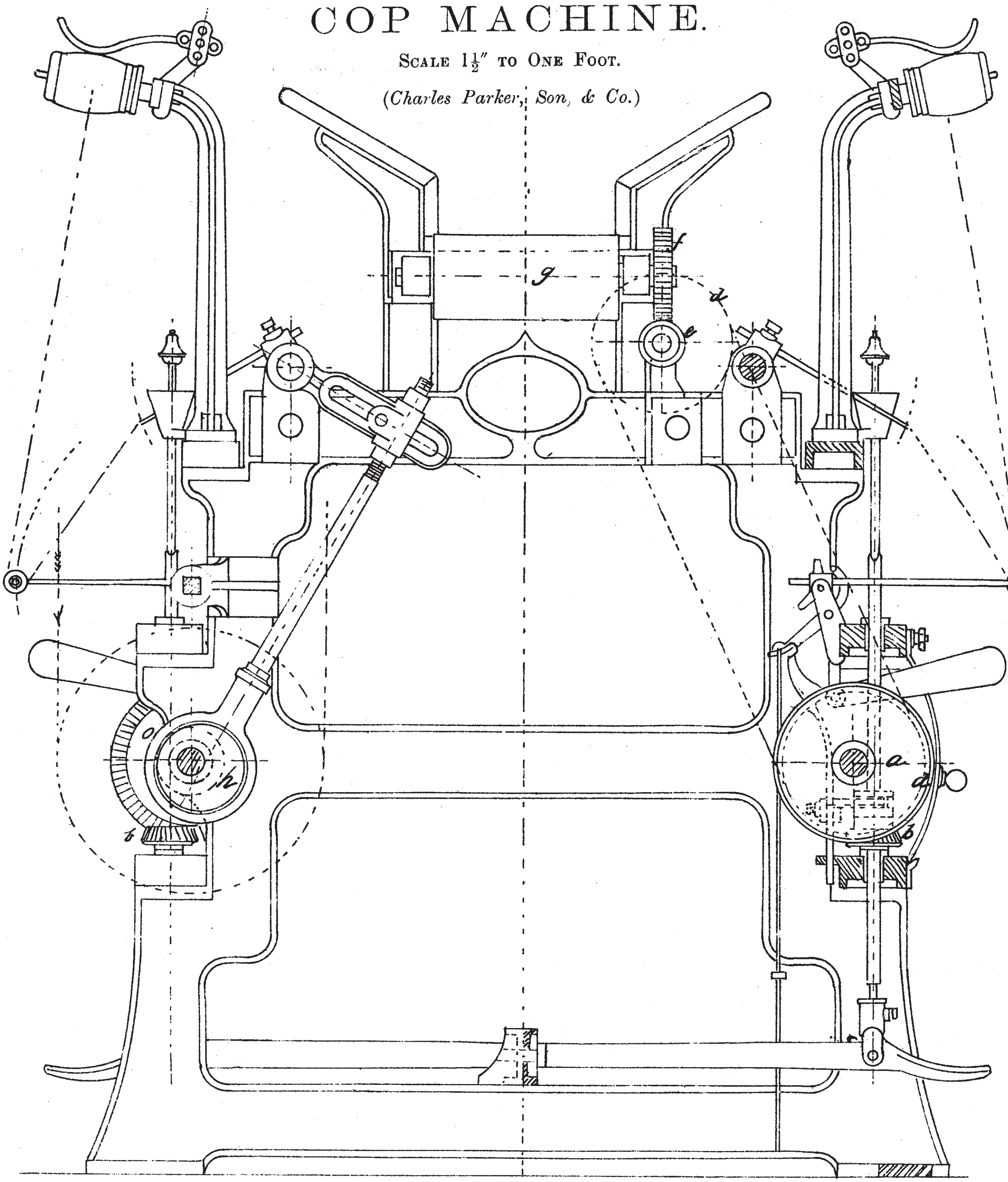
Cloth roller $4\frac{1}{2}''$ dia. (g).

Driving Pulleys (P) generally $15''$ dia. $\times$ $3\frac{1}{2}''$, and run 260 revolutions for ordinary jute hessian cops.

COP MACHINE.

SCALE $1\frac{1}{2}''$ TO ONE FOOT.

(Charles Parker, Son, & Co.)

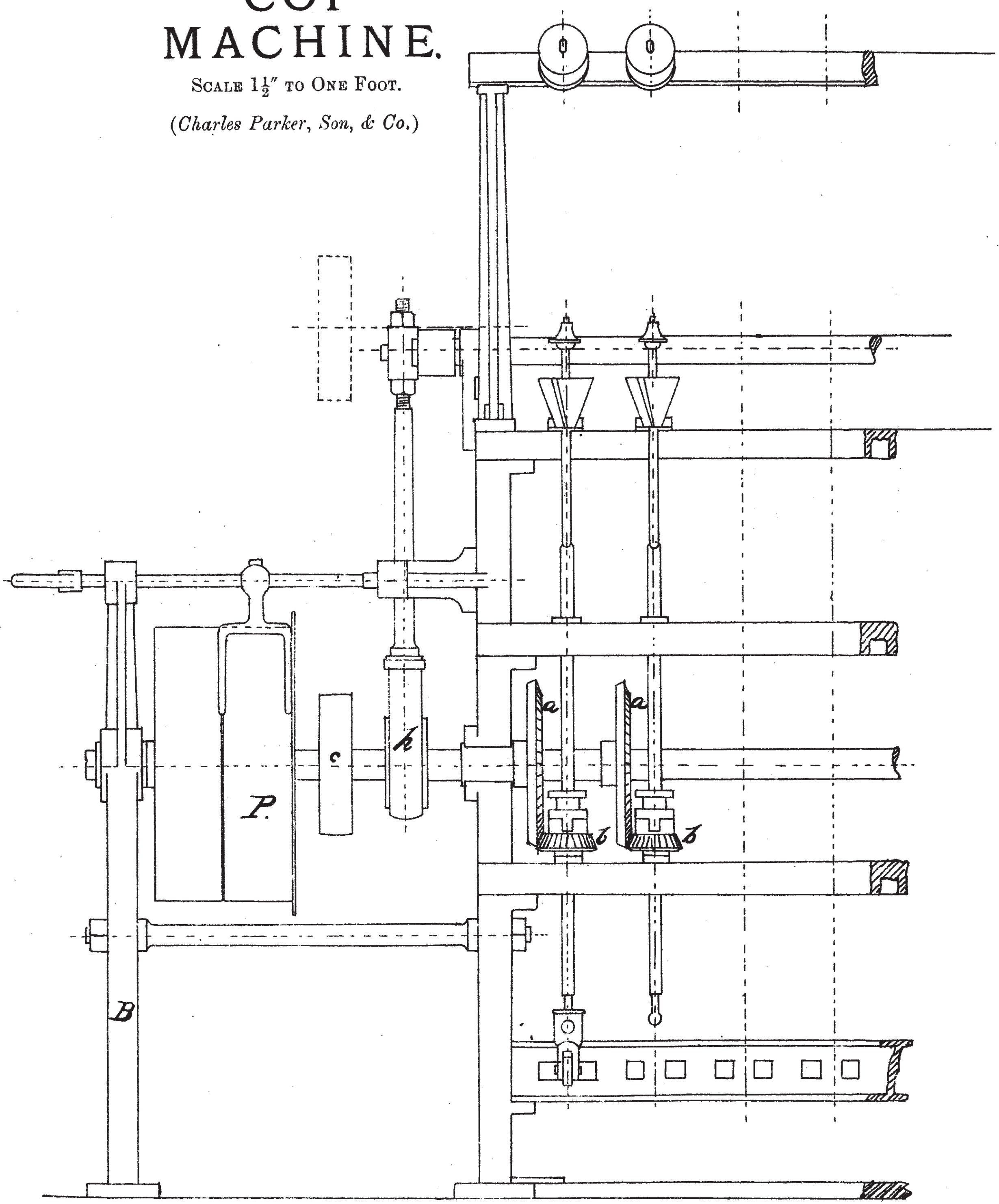


HALF END ELEVATION HALF SECTIONAL ELEVATION

COP MACHINE.

SCALE 1½″ TO ONE FOOT.

(*Charles Parker, Son, & Co.*)

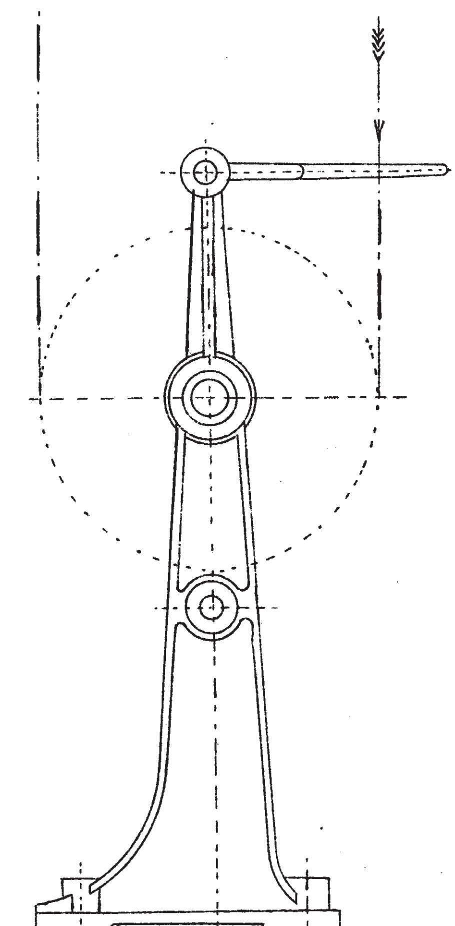


FRONT ELEVATION.

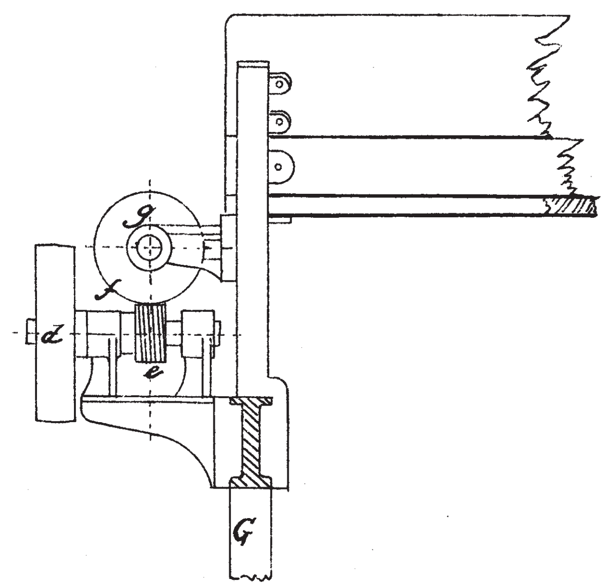
COP MACHINE.

SCALE $1\frac{1}{2}''$ TO ONE FOOT.

(Charles Parker, Son, & Co.)



SIDE VIEW OF OUTER CARRIER B.

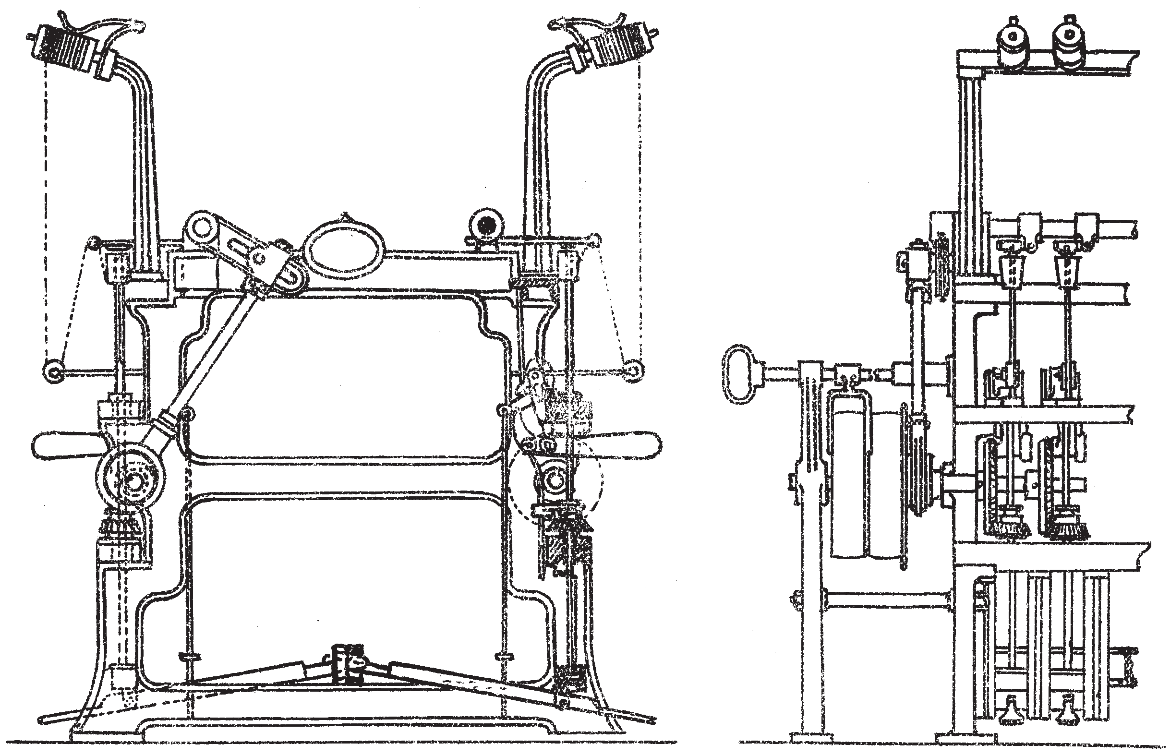


COP MACHINE.

Scale $\frac{3}{4}''$ to One Foot

(*Thomson, Son, & Co.*)

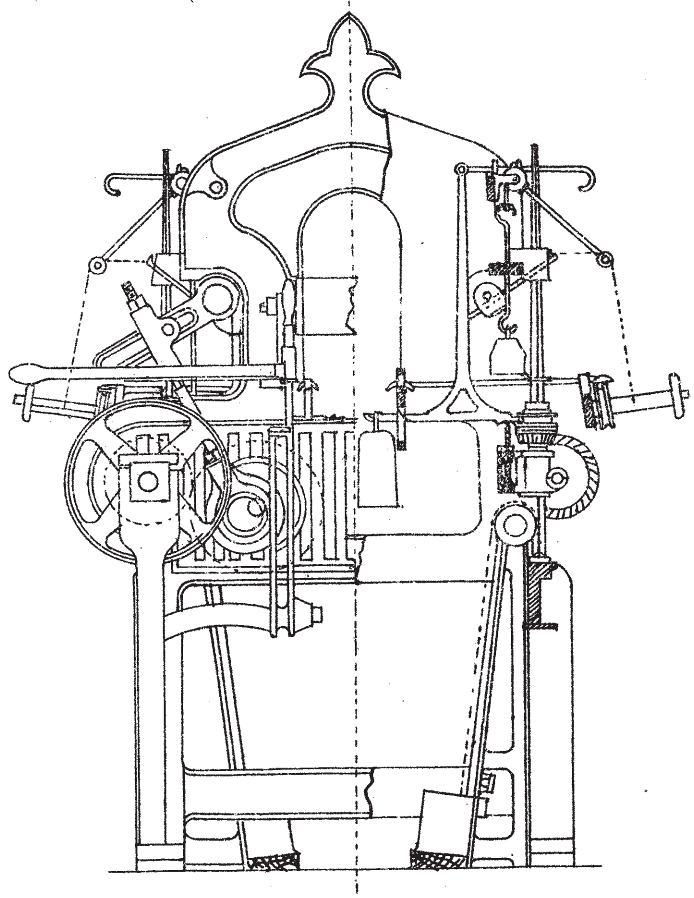
Speed pulleys 528 revolutions per minute.



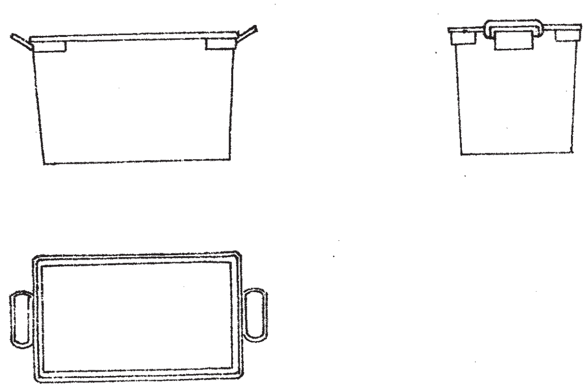
COP MACHINE.

Scale $\frac{3}{4}''$ to One Foot.

(Coombe, Barbour, & Coombe.)



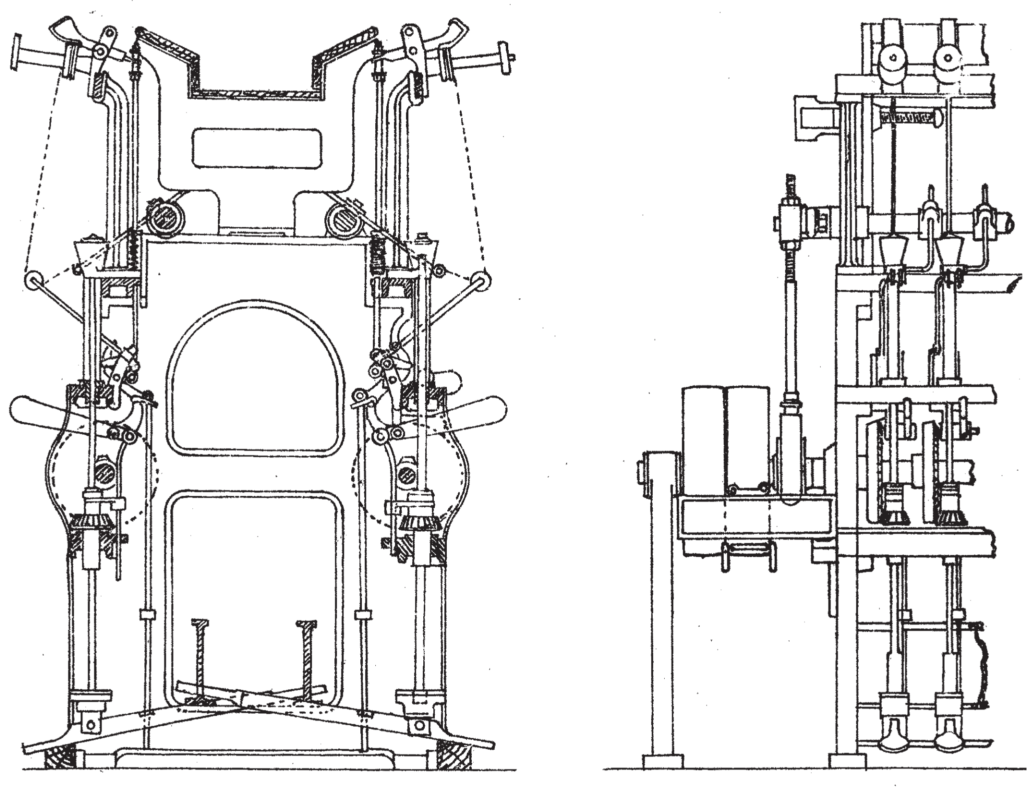
COP PAN



COP MACHINE.

SCALE $\frac{3}{4}''$ TO ONE FOOT.

(*Lee, Croll, & Co.*)



COP MACHINE.

Spindle Pinion 16 teeth.

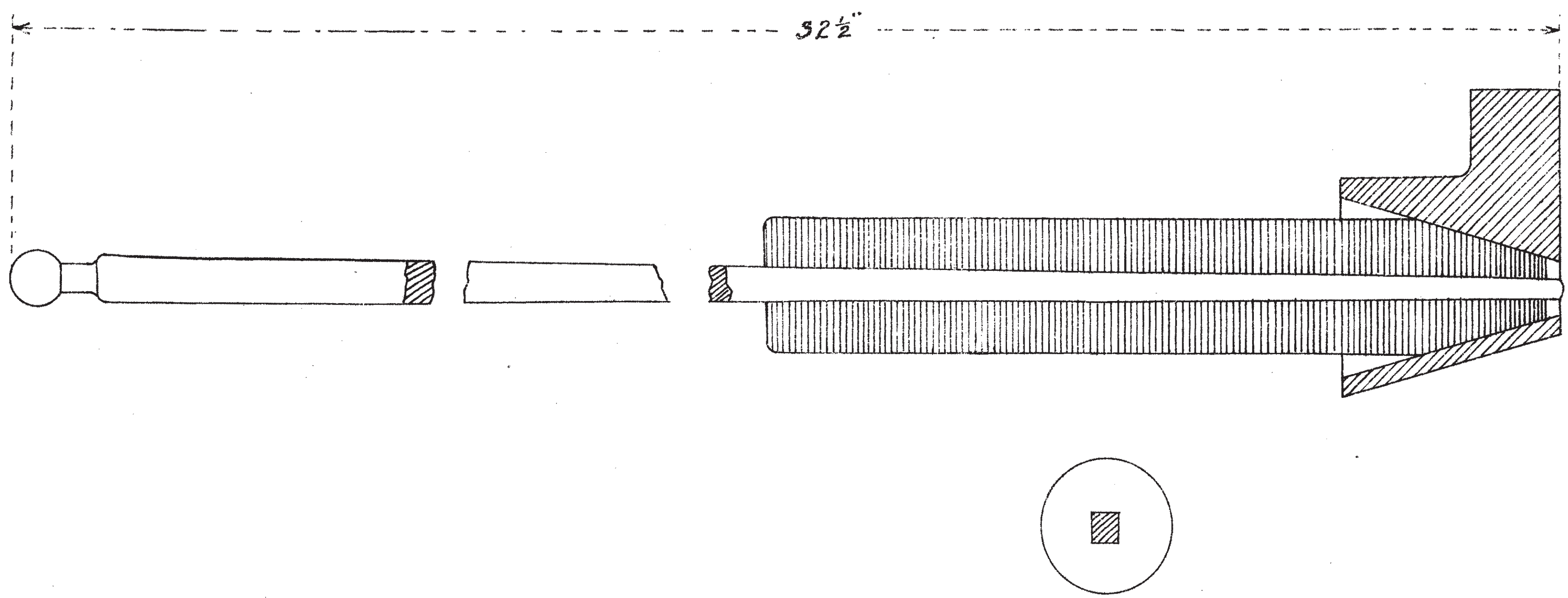
Wheel on Driving Shaft 46 teeth.

Pulleys usually about 16″ diameter.

Speed of Spindles from 800 to 1000 revolutions per minute.

SPINDLE AND COP WITH CONE FOR COP WINDING MACHINE.

(*Coombe, Barbour, & Coombe.*) SCALE HALF SIZE. Usual Size of Cop 9″ × 1½″.



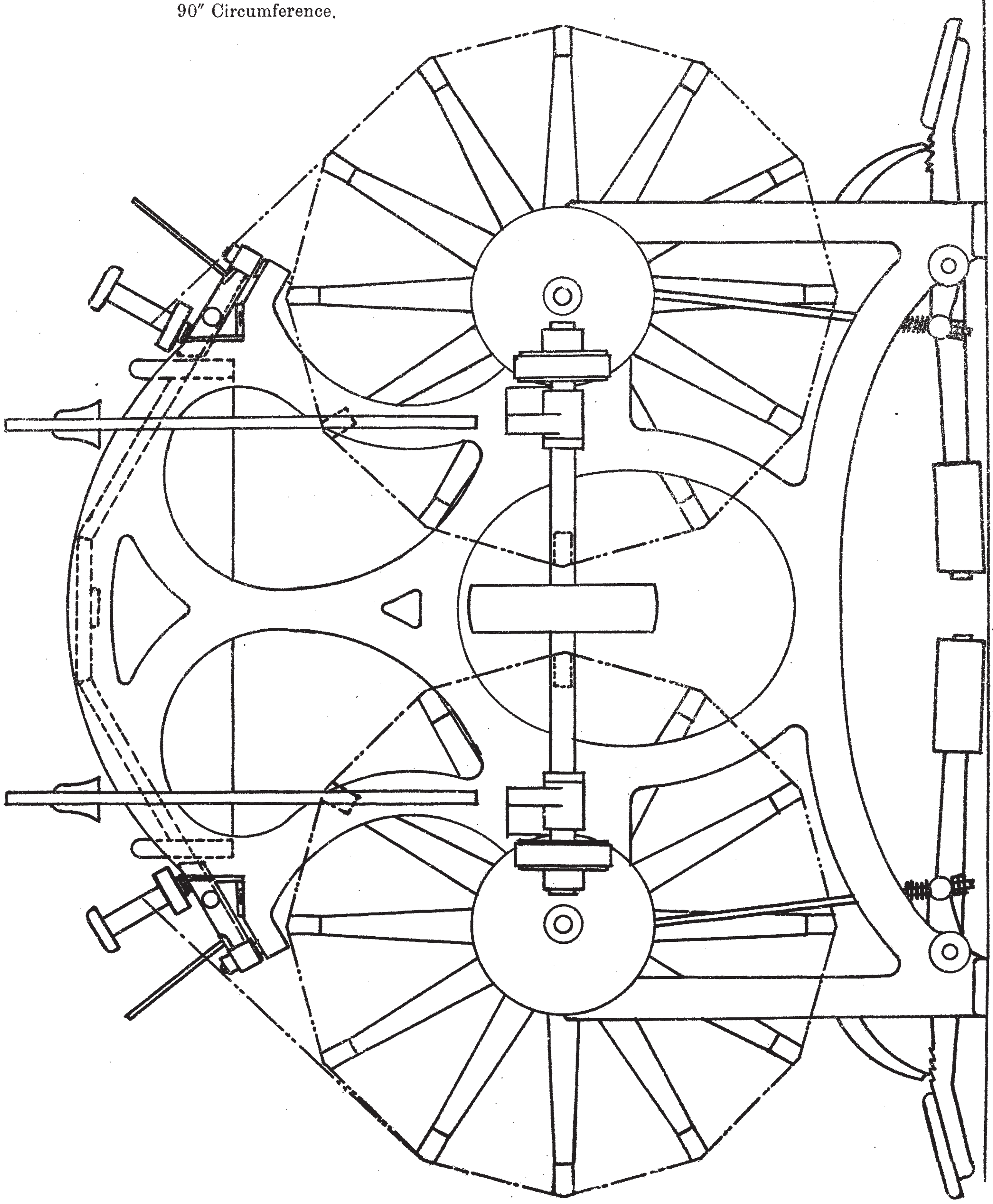
REELING AND BUNDLING.

Here the yarn which has been spun, either warp or weft, which is to be delivered in the bundle, is brought to be reeled—that is, that the yarn is reeled round the barrel, or swift, as it is more usually termed. Upon this barrel or swift a certain number of threads are tied up into cuts, heers, hanks, and spyndles (see yarn table). When the yarn is taken of the reels, it is taken and weighed, or sized is the term generally in use. So many spyndles are put into a bundle, according to the size of the yarn. In this department much care and attention is necessary by the workers and by those in charge. It is of much importance that the tell of the yarn should be correct. By the term "tell." is meant the number of threads and yards in a "cut." 120 threads are in each "cut," the tell wheel for 7 to 9 lbs. will have 125 teeth; and for 10 to 20 lbs., 123 teeth. This enables the reeler, with ordinary care, to put in the correct number—120 threads into each cut. By care and attention in the reeling department, very much can be done to keep the yarn regular upon the weight After the yarn is reeled and sized, it is handed over to the bundlers, who lay first one hank and then another upon a bundling stool (see illustration), so many bands being put round it. The bands are tied round, and knotted up with a "bundling pin," and the yarn is then laid in the yarn warehouse to wait such time at required to deliver it. It is essential to the look of the yarn, while is is being bundled, that the bundlers display taste and some degree of pride in the making up of the bundles. No matter how well the yarn may have been spun and reeled, if it is carelessly and slovenly bundled, this will tend to detract from its appearance; and I almost venture to say, from the market value of the yarn.

POWER REEL

End Elevation showing Driving End—Scale $\frac{1}{8}$th.

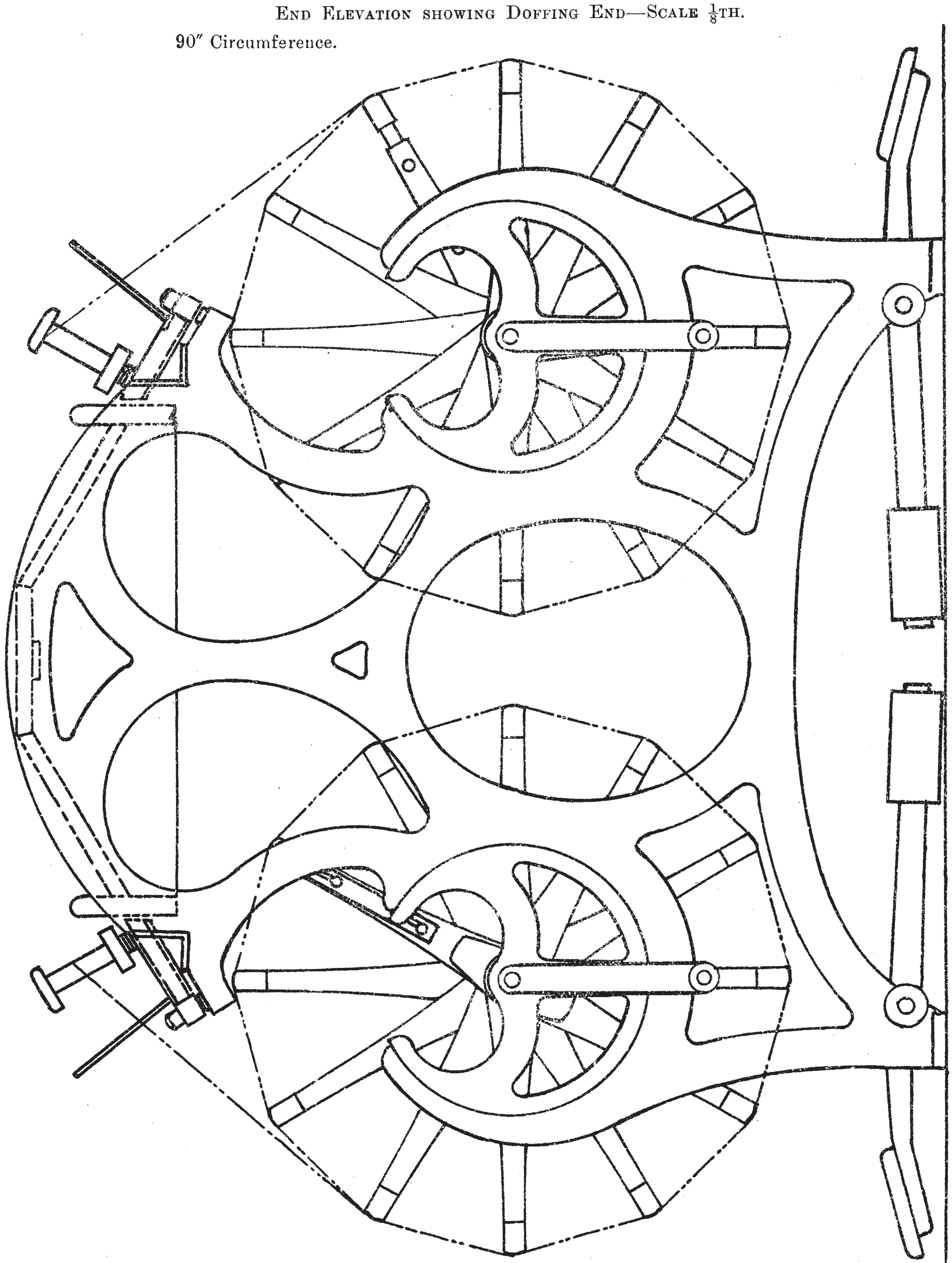
90″ Circumference.



POWER REEL

End Elevation showing Doffing End—Scale $\frac{1}{8}$th.

90″ Circumference.



INSTRUCTIONS AND PARTICULARS AS TO THE REELING OF THE YARNS.

The reel is 12 ft. 4 in. long, and 90 in. in circumference; and the rails upon which the yarns are reeled are attached to spokes. In a Fairbairn reel there are 12 spokes in the swift, as the reel is sometimes called. By a reference to the illustration, it will be seen that these spokes make the yarn, when on the reel, in the form of a 12-sided figure. This is to allow the yarn to come off without trouble. And when the reel or swift has been filled, an arrangement is provided to make part of the swift or barrel collapse; and the reeler has then to draw the yarn all to the one end, and by turning the wheel provided for the purpose, she can lift off the yarn and hang it on the hook at the end of her reel. From thence it is taken to the bundling department, when it is made into the size of bundles required. These bundles are commonly made a certain size for a certain weight of yarn (see table); but sometimes special sizes of bundles are made, according to the order in hands.

7/12 lbs.	yarn is reeled	in hands	of	6	cuts each.
13/24	,,	,,	,,	4	,,
25/32	,,	,,	,,	3	,,

TABLE SHOWING THE NUMBER OF SPYNDLES IN A BUNDLE OF THE DIFFERENT SIZES OF YARN.

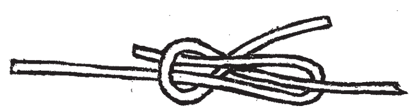
Lbs.	Spls.	Weight of Bdl.	
7	8	56 lbs.	Bundles are made up in hanks of half a spl.
8	7	56 ,,	,, ,, ,, ,,
9	6	54 ,,	,, ,, ,, ,,
$9\frac{1}{2}$	6	57 ,,	,, ,, ,, ,,
10	6	60 ,,	,, ,, ,, ,,
11	5	55 ,,	,, ,, ,, ,,
12	5	60 ,,	,, ,, ,, ,,
13	4	52 ,,	,, ,, ,, of a third of a spl.
14	4	56 ,,	,, ,, ,, ,,
15	4	60 ,,	,, ,, ,, ,,
$15\frac{1}{2}$	$3\frac{3}{4}$	$58\frac{1}{8}$,,	Bdls. are made up in 11 hanks and 4 cuts.
16	$3\frac{1}{2}$	56 ,,	,, 10 hanks and 8 cuts.
19	$3\frac{1}{2}$	$59\frac{1}{2}$,,	,, ,, ,,

Lbs.	Spls.	Weight of Bdl.	
18	3	54 lbs.	Bdls are made up in 9 hanks of a third of a spl. each.
19	3	57 ,,	,, ,, ,, ,,
20	3	60 ,,	,, 18 hanks of a $\frac{1}{6}$ of a spl. each.
21	$2\frac{3}{4}$	$57\frac{3}{4}$,,	,, 16 hanks of a $\frac{1}{6}$ of a spl. and 4 cuts.
22	$2\frac{1}{2}$	55 ,,	,, 15 hanks of a $\frac{1}{6}$ of a spl.
24	$2\frac{1}{2}$	60 ,,	,, 15 ,, ,,
28	2	56 ,,	,, 12 ,, ,,
29	2	58 ,,	,, 12 ,, ,,
30	2	60 ,,	,, 12 ,, ,,
32	$1\frac{3}{4}$	56 ,,	,, 14 ,, of an $\frac{1}{8}$ of a spl.

The "bands" of the bundles are included in the quantity given in above particulars of hanks. The bands are usually reeled to a size that will make them manageable for the tying up of the bundle. In 7 lbs. yarn the bands are reeled in 6 cuts; and for 20 lbs., are reeled in 2 cuts. This is a matter of convenience to some extent.

An illustration of an ordinary bundling stool and also a small bundling press is given. This press is used for making small bundles, generally twisted yarns—that is, yarn in the ply.

Every attention should be given by the reelers, and by those in charge of the reeling department, to see that the proper knot is made on the yarn. This knot is usually termed a "weaver's knot." This is a representation of it—



SCOTTISH YARN TABLE.

$2\frac{1}{2}$	yards	= 1 thread.
120	threads	= 1 cut.
300	,,	= 1 cut or lea.
600	,,	= 1 heer.
3,600	,,	= 1 hank.
7,200	,,	= 1 hesp.
14,400	,,	= 1 spyndle.

ENGLISH YARN TABLE.

$2\frac{1}{2}$	yards	= 1 thread.
300	,,	= 1 lea.
3,000	,,	= 1 hank.
60,000	,,	= 1 bundle.

The grist or fineness of the heavy linen and jute yarns is estimated by the weight of a spyndle per lb. avoirdupois—the finer qualities by leas, of which the following is the table and the rule for finding the same:—

TABLE.

Leas per lb.	Weight per spindle. lbs.	oz.	dr.	Leas per lb.	Weight per spindle. lbs.	oz.	dr.
1	48	0	0	50	0	15	5¾
2	24	0	0	55	0	13	5½
3	16	0	0	60	0	12	12¾
4	12	0	0	65	0	11	13
5	9	9	9½	70	0	10	15½
6	8	0	0	75	0	10	3¾
7	6	13	11½	80	0	9	9½
8	6	0	0	85	0	9	0½
10	4	12	12¾	90	0	8	8½
12	4	0	0	95	0	8	1¼
14	3	6	13¾	100	0	7	10¾
16	3	0	0	110	0	6	15½
18	2	10	10½	120	0	6	6½
20	2	6	6½	130	0	5	14½
22	2	2	14½	140	0	5	7¾
25	1	14	11½	150	0	5	1¾
28	1	11	6¾	160	0	4	12¾
30	1	9	9½	170	0	4	8¼
35	1	5	15	180	0	4	4½
40	1	3	3	190	0	4	0⅞
45	1	1	1	200	0	3	13½

Rule.—Divide the leas in a spyndle by the number of the lea yarn. Thus, for 16 lea yarn—

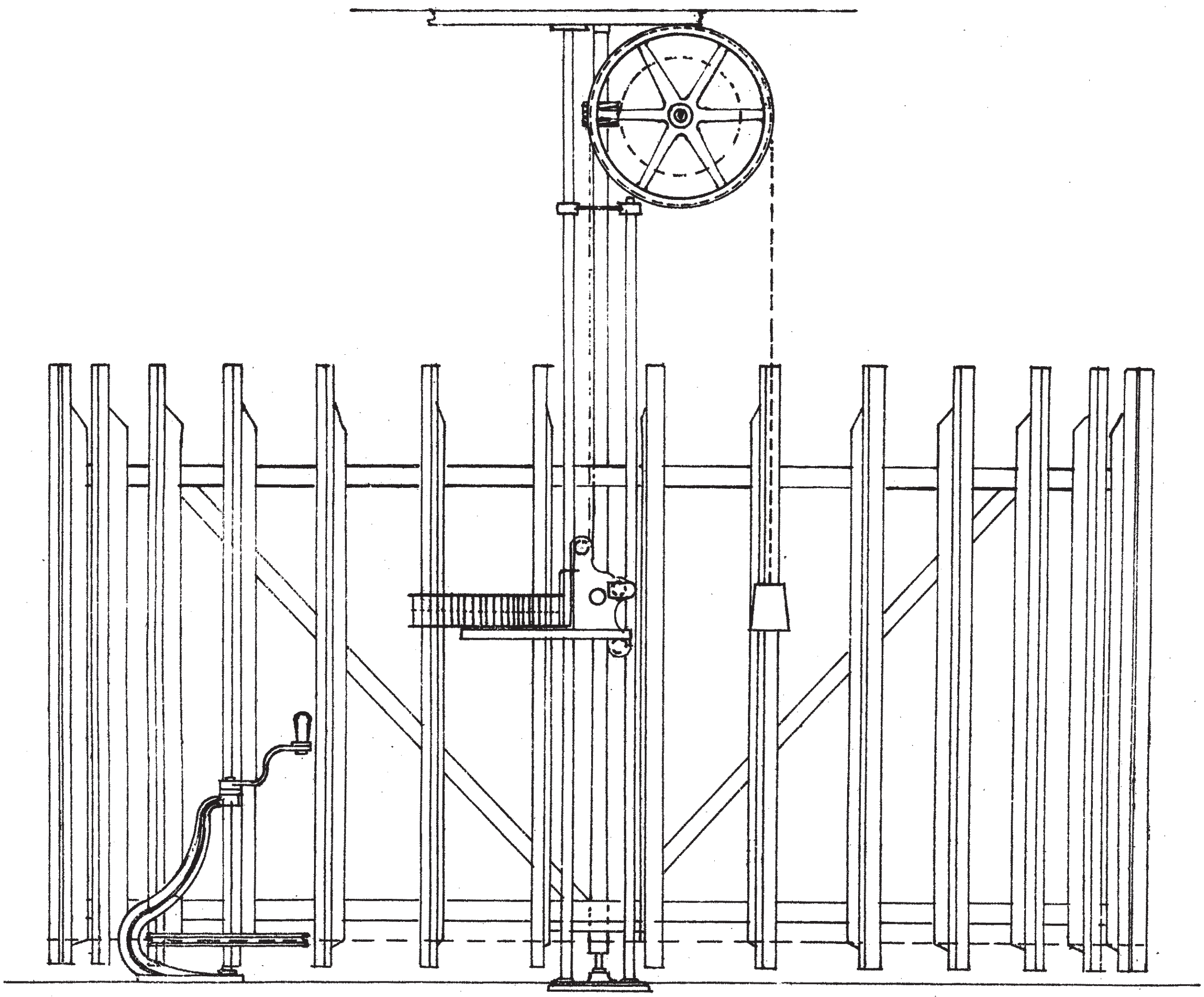
16)48(3 lb. yarn.
48

WARPING MILL*

SCALE $1\frac{1}{2}''$ TO ONE FOOT. Circumference = 13 yards.

ELEVATION SHOWING DRIVING WHEEL, HAKES, GUIDES, AND TRAVERSE MOTION.

Worm, single thread, $\frac{5}{8}''$ pitch, $3\frac{1}{2}''$ diameter.
Worm wheel 46 teeth, $\frac{5}{8}''$ pitch. Chain Wheel 25″ diameter.
Revs. of Chain wheel for one rev. of Warp Mill $= \frac{1}{46} \times 1 = \frac{1}{46}$ of a rev.
Traverse of Hake per rev. of Warp Mill $= \frac{1}{46} \times 25 \times 3{\cdot}1416 = 1{\cdot}707.''$

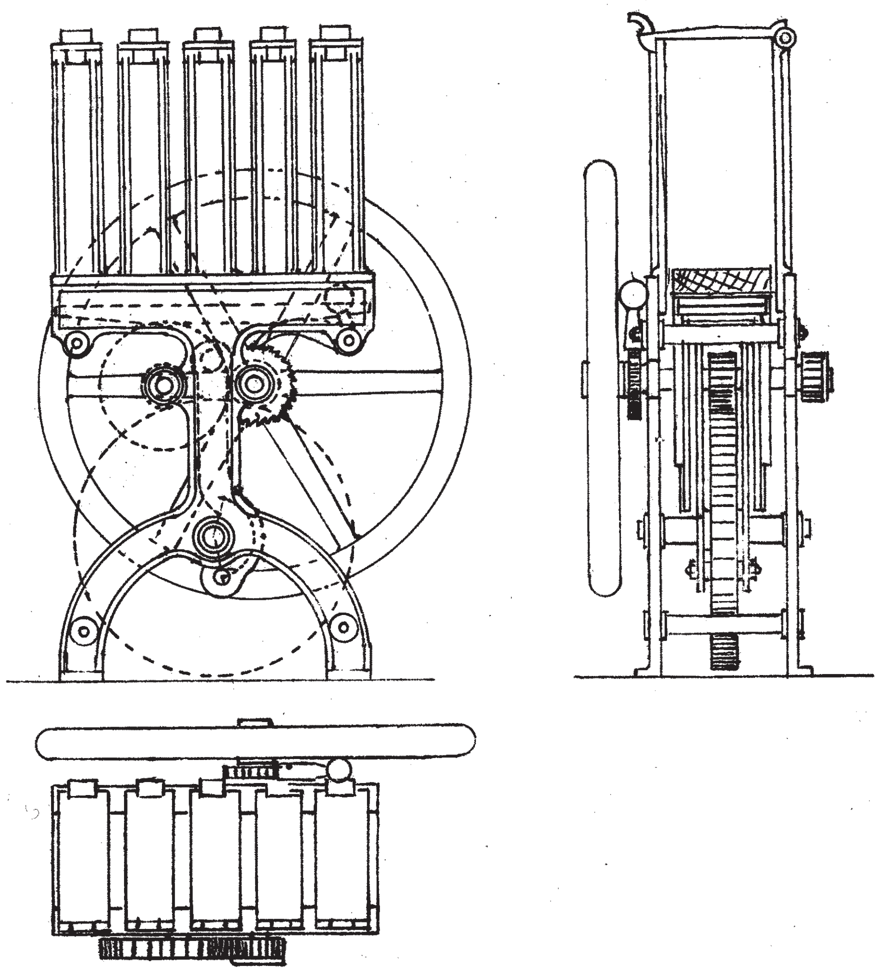


* For Description of the process of Warping see "Art of Weaving."

BUNDLING PRESS.

Scale $\frac{3}{4}''$ to One Foot.

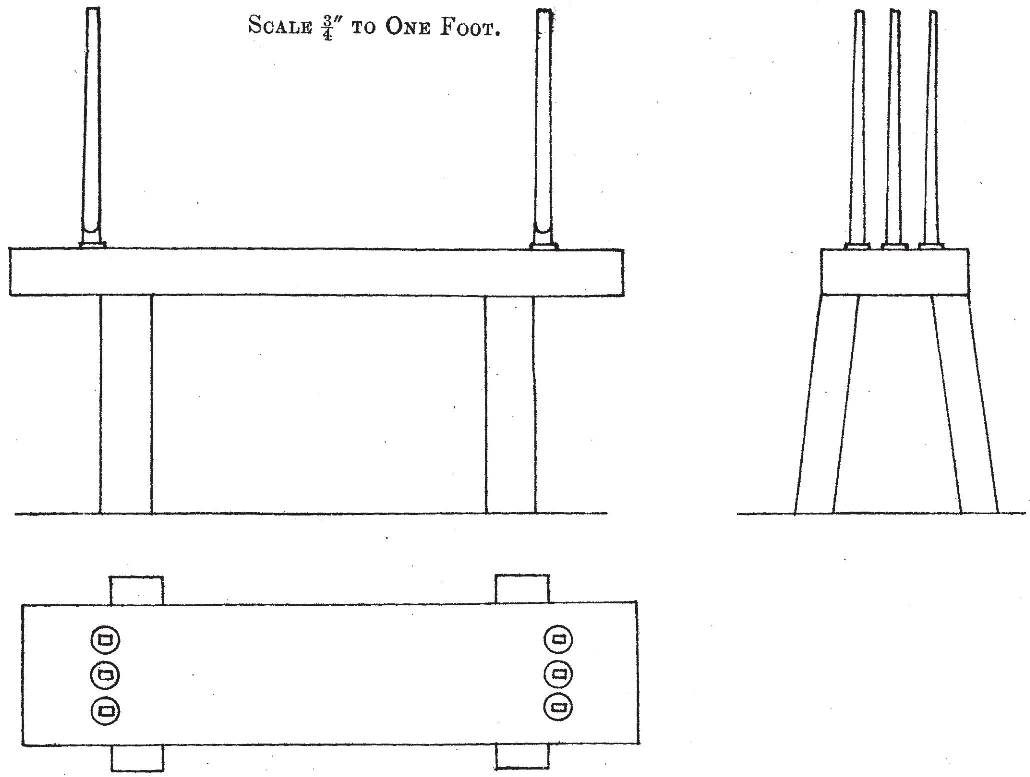
Hand Wheel 36″ diameter. Pinion 13 teeth.
Wheel 32 teeth. Pinion 10 teeth.
Break Wheel 66 teeth.



* This Press is used for making small bundles—say from 8/16 lbs. each

BUNDLING STOOL.

SCALE $\frac{3}{4}''$ TO ONE FOOT.



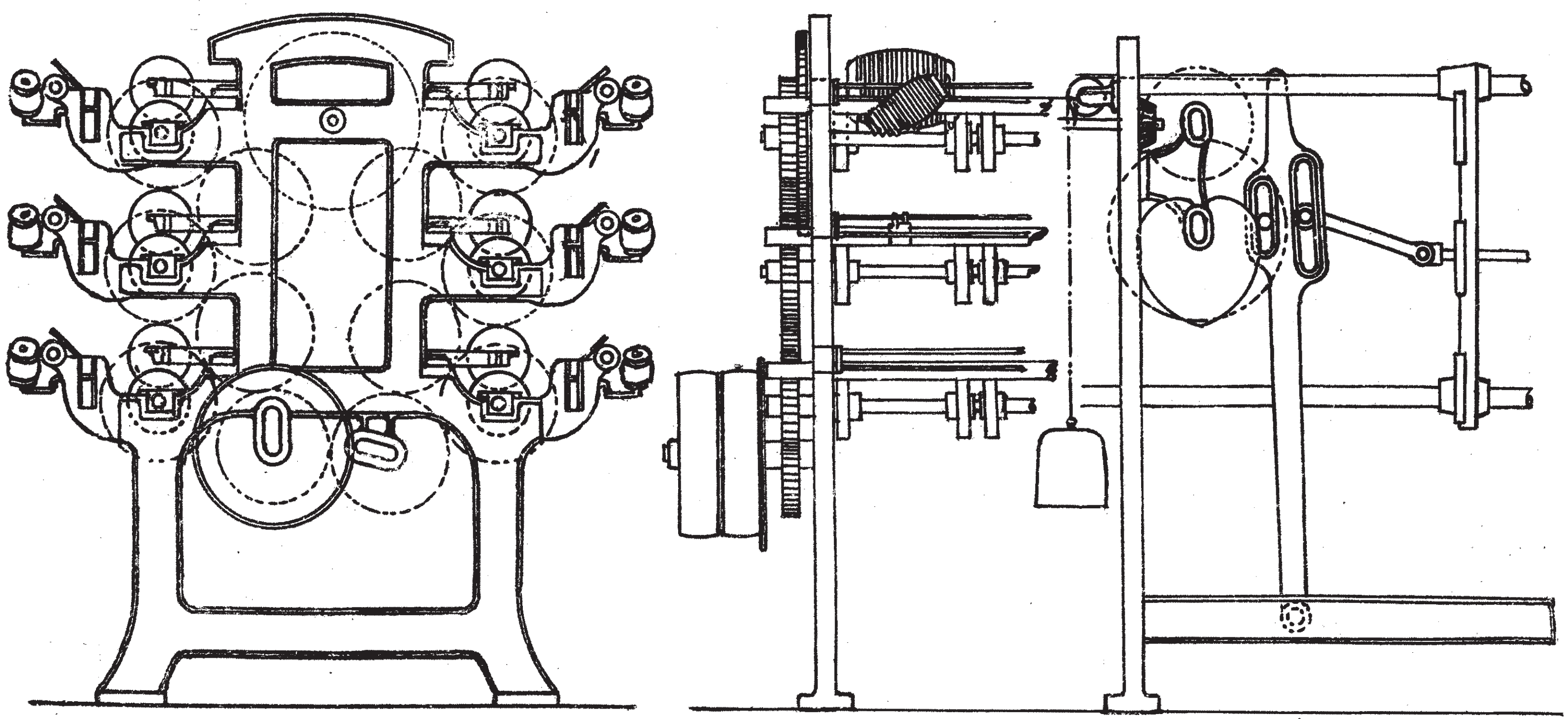
WARP WINDING.

If the warp yarn which has been spun is to be sent into the factory, it is taken to the warp-winding department. Here the spinning bobbins are wound upon a large bobbin—usually 8 inch by 5 inch—preparatory to being sent to the dressing machines. The machine illustrated is made by Messrs Thomson, Son, & Co. Three winders are usually employed upon each side; and one machine of the description illustrated will wind about 2,000 spyndles per week. The particulars of speed, &c., of this machine are also given. Here I may say that the yarns, both weft and warp, being winded from the spinning frames, should be carefully sampled three times each day, to ensure that the yarn is being kept to the weight required.

In the Cop and Warp Winding departments the cops and warp bobbins are weighed when taken from the winders—this should always be done with care and attention, as the winders in these departments are paid according to the weight of yarns wound by them.

BOBBIN WARP WINDING MACHINE.

8″ TRAVERSE. SCALE $\frac{3}{4}$″ TO ONE FOOT. (*Messrs Thomson, Son, & Co.*)



Pulleys 14″ diameter. Pulleys Pinion 48 teeth. Pinion on end of Bobbin Drum Shaft 48 teeth.

$220 \times \frac{17}{14} = 267$ speed pulleys $267 \times \frac{48}{48} = 267$ revs. of bobbin drum per minute.

Traverse Arrangement—Heart 6″ lift. $267 \times \frac{48}{48} \times \frac{30}{120} \times \frac{19}{60} \times \frac{19}{120}$ = speed of heart for traverse.

CONCLUDING REMARKS.

WASTE—These pages would not be complete and would not fulfil their purpose if the author said nothing as to the question of the quantity of waste made, or that may be expected to be made, in the different departments during the various operations from batching to reeling, etc. Waste and dirt always tend to make more waste and dirt, hence the necessity to do all that can be done to make as little dirt and waste as possible. It is the attention that is bestowed upon the seemingly small details that go to make the whole arrangement and organization complete, and in reference to this question of waste too much attention can hardly be given to it until you have been able to impress every one in charge with the importance of the matter. When the making of waste is tolerated you may be sure the tendency to make waste will always be on the increase, followed in every case by indifference and neglect. The waste in the batching, that is the dirt and root as it falls through the softener rollers to the floor, will be found to be about ·3052 %, but it is waste you want to get rid of, and you can only minimize this by as much care and attention as possible to the selection of the jute suitable for the yarn required.

The waste or droppings from the breakers and finishers to a certain extent is also what you wish to be rid of, but if there is inattention to the staves, if they are not kept sharp and regularly set in their proper relation to one another, you will make for a certainty more waste than is necessary, and the more waste you make here than is absolutely necessary, you are, of course, always adding to the cost of the batch you have laid down at the commencement. If the drawings and rovings are thoroughly swept out *every day* this will keep steadily before your eye what is being done in the matter of waste—from this the following is about the proportion of waste that will be made: 1st. From breaker about 1·36 %, from finishers about ·696 %. Of course the droppings from breaker and finishers will require to be shaken in a waste cleaner, and there will be 1·25 % of dust and ·5 % of pickings, the latter of which may be used for some of the coarser qualities of yarn. The waste from the Drawing and Rovings will be about ·435 % of the quantity of rove made.

The waste from the spinning department, taking the average size at 9 lbs. per spyndle, two-thirds of which will be weft and one-third warp, will be about 2·10 % on the yarn produced, and the reader will bear in mind that on this question of waste I am referring to the class of jute described in the chapter upon batching as necessary for the production of Hessian cloth of good standard quality, the jute for which has been carefully selected for the purpose intended.

To speak in a general way as to the total waste made during the manipulation of jute into yarn would not have much value. A statement, therefore, as to the quantity of jute put over the machinery involved in the process, showing at the same time the per cent. of waste made at each class of machinery, is necessary:—

BATCHING.

60 bales of jute (400 lbs. each), to which is added 3 % of oil and 15 % damp, was put over the softener in ten hours—a fair day's work, based upon the speed of the machine given in the chapter on batching.

60 bales, 400 lbs. each = ...	cwt.	214	1	4
+ 3 % of oil	,,	6	1	20
	,,	220	2	24
—Ropes taken from bales ...	,,	2	3	7
	,,	217	3	17

From this was got 62½ lbs dry and 35 lbs. wet refuse—say altogether 74½ lbs. dry—equivalent to ·3052 %.

PREPARING.

The following is based on the results of two working days, or 20 hours, producing 140 cwt rove and 3 cwt. 2 qrs. 10 lbs. waste :—

1 Double Doffer Breaker—

Dollop 22 lbs., 2 deliveries of 22 lbs each for one round of clock.
Cylinder making 185 revolutions per minute.
Cylinder Pinion, 44 teeth.
Worker ,, 33 ,,
Draft ,, 34 ,,
3½ tons can be put over this breaker in 10 hours, supplying

2 Single Doffer Finishers—

Cylinder making 193 revolutions per minute.
Cylinder Pinion, 60 teeth.
Worker ,, 58 ,,
Draft ,, 31 ,,
Each finisher supplies 1 push bar drawing.

2 Push Bar Drawings of 2 heads each—

Speed of Pulleys, 145 revolutions per minute
Pulley Pinion, 32 teeth.
Draft. ,, 54 ,,
Each push bar drawing supplies 1 spiral 2nd drawing.

2 Spiral 2nd Drawings of 2 heads each—

Speed of Pulleys, 170 revolutions per minute.
Pulley Pinion, 28 teeth.
Draft ,, 43 ,,
Each 2nd drawing supplies 1 roving of 56 spindles.

2 Roving of 56 spindles, 10″ × 5″ bobbin, make 35 cwt. of rove, 72½/75 lbs. per spindle each, in 10 hours—say 140 cwt. in 20 hours—

Speed of Pulleys, 220 revolutions per minute.
Twist Pinion, 35 teeth.
Grist ,, 36 ,,
Traverse ,, 28 ,,
Rack ,, 15 ,,

The waste made ...	cwt.	3	2	10
The rove made ...	,,	140	0	0
	,,	143	2	10

The waste made at each class of machine was as follows :—

1 Breaker—

Dust ...	210 lbs.		
Pickings	10 ,,		
	220 ,,	=	1·3680 °/。

2 Finishers—

Dust ...	28 ,,		
Pickings	84 ,,		
	112 ,,	=	·6964 °/。

4 Drawings and 2 Rovings—

Dust ...	30 lbs.		
Pickings	40 ,,		
	70 ,,	=	·4352 °/。

Total Dust ...	268 ,,	= 1·6664 °/。	
,, Pickings	134 ,,	= ·8332 ,,	2.4996 °/。
	402		

SPINNING.

The yarn spun from this rove was $\frac{2}{3}$ weft and $\frac{1}{3}$ warp, and the average weight per spyndle 9 lbs.; waste = 2·1069 °/₀ in the spinning process.

REELING AND COPPING.

The percentage of waste made in the reeling and copping departments are ·5853 and ·3809 °/₀ respectively; and if the production of the mill is to be two-thirds reeled and one-third copped, the overhead rate would be ·5172

$\frac{2}{3}$	·5853	=	3902
$\frac{1}{3}$	·3809	=	·1270
			·5172 °/₀

SUMMARY OF WASTE PERCENTAGE.

Batching and Softening	·3052 °/₀
Preparing, Breakers, and Finishers	2·0644
,, Drawings and Rovings	·4352
Spinning	2·1069
Reeling and Copping	·5172
Total	5·4289 °/₀

These results are borne out by experience over a whole year, and can therefore be relied on.

The value of the different kinds of waste made in relation to the value of the raw material will be found to be as follows:—

The value of dust is equal to	4·1 °/₀	of the original cost of the raw material.				
,, pickings	25·0	,,	,,	,,	,,	
,, spinners' waste	29·1	,,	,,	,,	,,	
,, reelers' ,,	58·3	,,	,,	,,	,,	
,, copping ,,	58·3	,,	,,	,,	,,	

Speed to be put upon the Machinery.—I have in the chapter upon preparing machinery alluded to this as a question upon which there is much difference of opinion. While this is so, as to the surface speed of Card Cylinders, the speed of a breaker or finisher or any other of the machines in the various processes, is in a great measure a question of production. If a large production is wanted, the speed must be put upon the machines to bring it off; it is sometimes said that to much speed upon the machines will destroy the material, but if the speed put upon the machinery is beyond the possible limit, you will destroy the machines long before you spoil the material. In the case of the preparing machinery it is not the speed put upon the machines that will make rove to produce bad yarn, it is the *overloading* of the different machines, that is—the putting on the Breaker in one round of the clock more weight of jute than the length of the Cylinder or other Roller pins will come up through, and also the overloading of the other machines in the same direction. If a moderate quantity is put on the machines the speed, although on the fast side, will do no harm to the material; and to the machinery, the speed if on the quick side, of course means more mechanical expense and attention on the part of those in charge of it, and the same remarks apply to the other machines in the preparing department. The question of speed is, therefore, in a great measure, to be determined by the amount of mechanical attention and expense you are prepared to give for the utmost production that can be taken out of the machine. Of course, the reader will see at a glance that if the machinery is being kept on the fast side, more expense in the shape of oil and all other furnishings will be incurred. Against this, of course, you have the larger production than if you drive the machinery on the slow side. It is a question that need not be pursued further here. I merely wish to bring to the notice of the reader that increased speed of the preparing machinery is done at the expense of the machine and not at the expense of the material, as is often supposed. Experience will often prove that where the machinery is being driven slow it is no guarantee that it is being kept in better order than when it is being driven on the fast side. Rather the opposite will, as a rule, be found to be the case If the limit of speed is being attained on the machinery experience will also prove that the machinery is being kept in good order, in fact, it must be so, if you are to keep it going.

The above remarks will only apply, to a limited extent, to the spinning frame. Here the spindles and flyers will only stand a certain speed, and they determine the speed of the other parts of the frame. If the flyers are driven beyond this speed by the centrifugalforce, the legs of the flyer will fly out, and break one another; but all the same, there may be a good speed upon the spindle without going to the extreme alluded to in the above remarks. Here again it is a question of up-keep. More oil, spindle bands, &c., will be necessary. To put it shortly, instead of oiling the spindle necks twice a day, you will require to oil them three times a day. To oil 6,000 necks twice a day will require about three-quarters of a gallon of oil, and a half more of this quantity means an extra cost of about 4d per 10 hours day—not a large item if you are taking the production out of the machine.

Up keep of Jute Preparing and Spinning Machinery.—Jute Preparing and Spinning Machinery, owing to the sandy and gritty nature of the jute fibre, is liable to much wear. The dirt and sand finds its way in every direction through the machinery; the consequence is that the mechanical attention required to keep the machinery in good order is considerable, and on the mechanical energy displayed in the mill will greatly depend the general production and the working conditions of the different machines. All the details of the machinery must be kept as near as possible the same as when the machine was new. When a wheel or pinion is broken it should be replaced by a new one, and the new one should be a casting from the maker of the machine, if not from the maker at least of the same pattern. In the case of wheels and pinions this is of great importance. To repair wheels and pinions by putting pins in them for teeth or to repair brackets and other parts of the machines by patches of plates is perfect folly, and nothing will in the end lead so much to the total deterioration of a mill than to pursue a course such as described. To give force, spirit, and éclat to the whole mill is to keep the machinery in the very best order, and you thereby will have at your command effective tools for the work to be done. The same remarks apply to all the smaller details, furnishings, as they are generally called, belts, spindle bands, and many other small things which we need not specify further.

Bobbins.—Bobbins in large quantities should always be kept in hand; if this is done you will have them well seasoned and in good working order. A very important point in the preparing and spinning departments—sometimes the full bobbins accumulate in the cop, reeling, and winding departments, and this will happen occasionally no matter how well you try to avoid it but while this is so there should always be enough bobbins at hand to cop with the emergency. There should on no account be a stoppage of the flow of full bobbins either from the preparing or spinning departments. In a mill, owing to the number of people employed, any stoppage of the flow of production very quickly increases the cost, hence the absolute necessity of removing every obstacle that will in any way impede the steady run of the work in every department. Each department should be conducted on such lines as will make those who are responsible feel they themselves have the making of the production in their own hands. But while saying all this as to the general benefits to be derived from keeping everything in good mechanical order, and also the details up to the mark in every way, there is no necessity for extravagance, and no countenance should be given to it. Experience will prove that when those in charge know that it is necessary to keep everything in effective condition ready for immediate use, the result is always to strive to keep everything in order without unnecessary waste or extravagance. Nothing will sooner utterly destroy the production of a jute mill more thoroughly than the knowledge creeping into the minds of those in authority that the necessary repairs will not be allowed to be made upon the machinery for the making of good work—paralysis sure and certain will take possession of the spirit and working energy of the people.

Accidents to the Machinery.—Accidents to the machinery do happen, and will continue to happen, no matter how much care and attention has been taken to avoid them, but you can expect no spirit nor heart in those who are responsible if the machinery is allowed to run until it stops through sheer mechanical neglect. Inferior production, inferior everything in fact, can only be the result.

When the machinery is in want of repairs get the trained mechanic to do it, and on no account let others who have neither the mechanical knowledge nor the training necessary for this class of work attempt it. The "handy" man amongst machinery is very often the "expensive" man in the end. He should be kept strictly at the work which he has been engaged to perform. As a rule, he will have enough to do, and sometimes more than enough, if he tries to do it well.

Temperature of the Mill.—This is a matter that should engage the attention of those in charge. For a mill, as shown on the plan, four lines of heating pipes will be necessary—one line of pipes in batching house, one line in front of finisher cards, one line between first and second line of spinning, and the fourth line of pipes between the end of third line of spinning and the cop and warp winding machinery. These pipes should all be run into a receiver at the north side of mill, and as near the centre of that side as possible, and the waste water or condensed steam, should then be returned to the boilers.

It is of great importance that the mill be made comfortable for the workers in the cold mornings. If the temperature be below 70° the material will not work well, neither will the workers be able to work with freedom the different machines at which they are engaged; but the temperature should not be over 70°, and there should always be care taken to provide fresh air and plenty of ventilation.

When the mill is built on the shed principle, the temperature varies very much, and if attention is not given to this question of heating arrangement, much loss of production and waste will ensue.

SAMPLING THE YARN.—This is a matter of great importance. The yarn that is to be wound into cops or upon warp bobbins for Dressing or Beaming Machines should be sampled three times a day. This is done by reeling 12 cuts upon a 90″ reel, with 120 teeth "tell" wheel—that is a quarter spyndle. If a number of frames are spinning the same size of yarn, more than one sample should be taken—no allowance for loss of weight should be made on the yarn when sampled. The correct weight of yarn as it comes from the frame should be written into the book kept for the purpose. If the making of an allowance upon the yarn when sampled is encouraged, it only leads to the yarn being spun above the weight The yarn should be spun and should weigh the size it is, namely—if you are spinning 8 lbs. yarn it should weigh 8 lbs. in the sample, neither more nor less—to make it so it should be the aim of all interested. It will help very much to keep the yarn upon the weight if the same frames are always supplied from the same rovings. This will sometimes require a little attention and arrangement to enable this to be carried out, but the result will be worth any trouble that may be taken to ensure this being done.

NOTE—That the reel upon which the samples are reeled should be kept for sample purposes.

FINISHING THE WORK FOR THE DAY.—When the work for the day is finished, the mill should be left clean and tidy, and everything in perfect order. When this is done, it will be found of great service to the making of a good start in the morning. The floor should be cleaned up thoroughly, no roves nor rove bobbins, boxes, or anything of the kind left lying about—in short, the cleaner and smarter you leave everything, the better able are you to cope with the work at the start; and these remarks apply with equal force all through the works—boiler shed, engine-room, &c., &c.

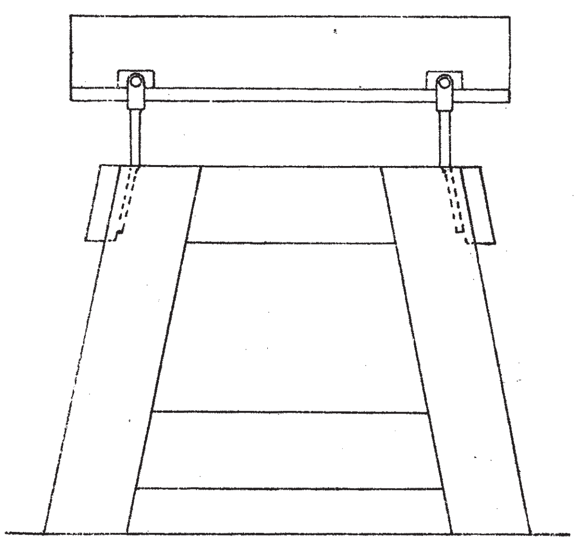
ARRANGEMENTS FOR EXTINGUISHING FIRE.—All the tools in connection with the apparatus kept for the extinguishing of fire should be seen to every night when the works are stopped. The fire-cocks should have bends and keys fitted on, and everything left so that in an emergency it can be used without fuss or trouble, and when those in charge arrive at the works, everything will be found in readiness to cope with whatever may happen. It is the unexpected that always happens, and everything that can be done to provide against accident should always be attended to as fully as the resources of the works will allow.

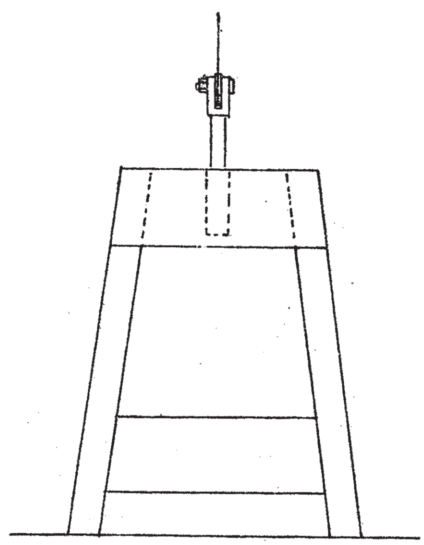
I have now described the various machines, and the operations that are gone through during the conversion of jute in the bale into yarn; and we have followed it to each of the departments, to be made into cops, wound in warp bobbin for dressing machine, and also reeled in the bundle. While this may have been done somewhat imperfectly, enough has been said to enable the student to follow the different processes. The author of these pages has found the writing and preparation of them congenial work; and now that the work is done, he can only hope that they will supply what he believes to be a want in connection with the jute trade; and also that they will prove of interest, stimulate and encourage the young men to learn their business with thoroughness and with some degree of interest in the working of the machinery in whatever department of the mill they may be employed. In this book the writer does not for one moment pretend to have told everything; he has, however, explained many things which, from his own experience while learning his business, he is sure will be very helpful to those anxious to know something of their work, and the proper way to set about the doing of it. The reader by this time will fully understand my motive in publishing these pages; and in offering them to the general public, however imperfectly they have been written, they will, I trust, be of service, and fulfil the purpose for which they were intended.

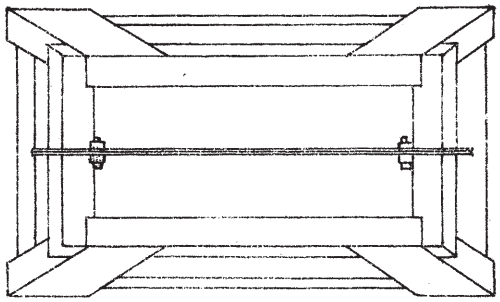
APPENDIX.

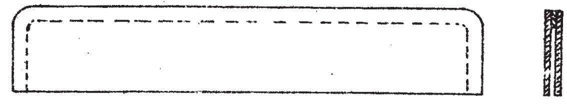
JUTE SNIPPER.

This machine, which we have illustrated by a plan and elevation, is not so much used now as it was some years ago. It is used to snip or comb off the root ends of the jute, and it did this, without doubt, very well, but the cost was too great. It not only took off the roots, but also made a great amount of tow. The very least taken off the streak of jute after it came through the machine, being about 15%; this tow was very inferior, and, of course, when you deducted the value of the 15% lost (or nearly so, comparatively speaking) this increased the cost of the jute left, and the machine is now not much used. It is found by the trade to be much better to cut the roots off with a knife or blade of steel, about 36″ long × 6″ broad, fixed to a wood frame. This is often done when a yarn is wanted of fine quality and free from root. When the roots are taken off this way there is not nearly the same loss as with the snipper, and the roots can always be used without making the loss that was done by the snipper, the tow from which it was impossible to use up profitably without damage to the yarn it was put in. The following is an illustration of steel blade showing attachment to wood frame (Scale $\frac{3}{4}$″ to One Foot).









Sheath for Knife.

SNIPPING MACHINE FOR JUTE.

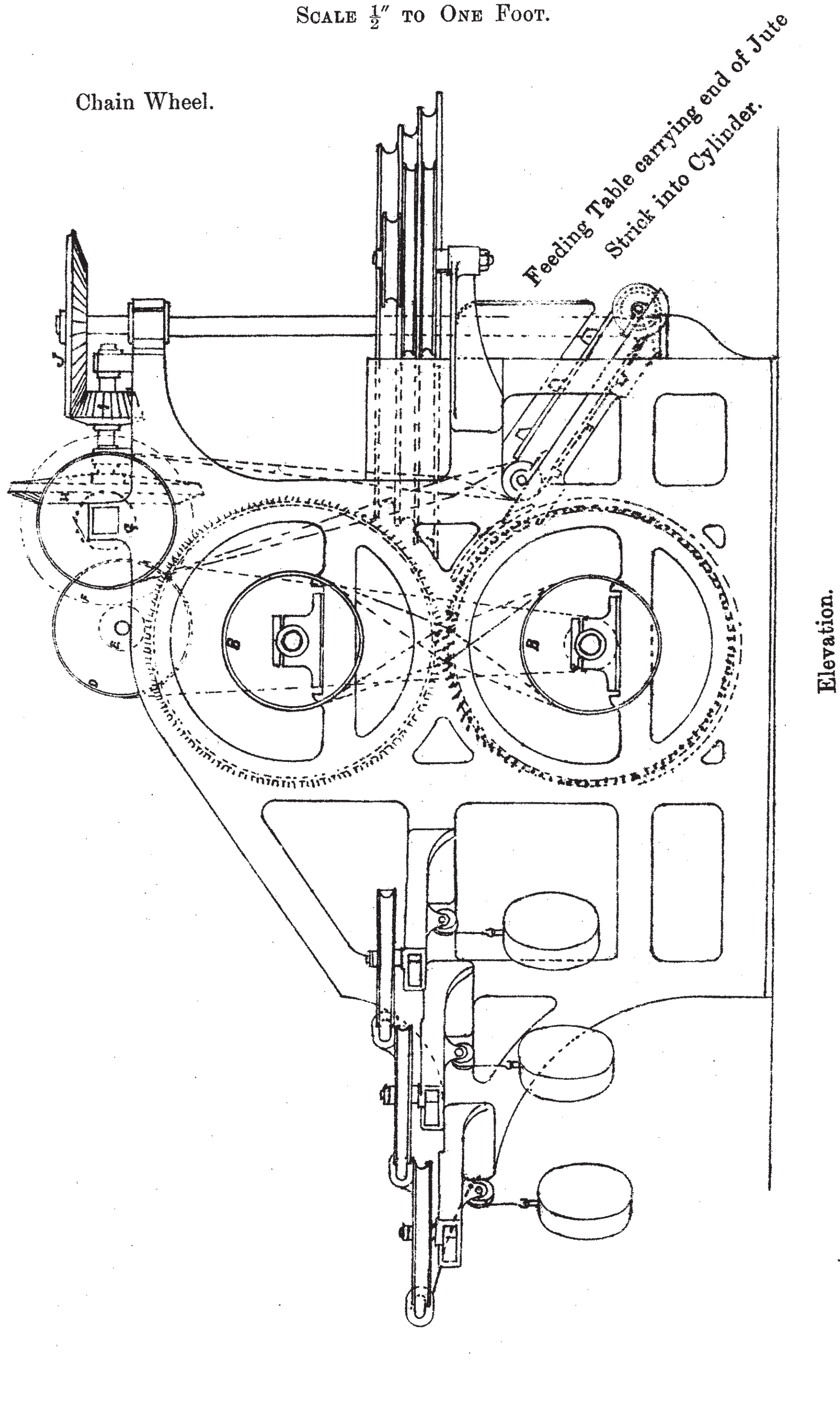
SCALE $\frac{1}{12}$th.

(For Diagram see Page 262).

AA	Driving Pulleys,	... ...	20" dia.
BB	Pulleys for driving top cylinder,	... ...	18" dia.
C	Pulley for driving chain wheel,	... ...	6" dia.
D	Pulley carrying spur pinion,	... ...	18" dia.
E	Spur Pinion.	... ...	35 teeth.
F	Spur wheel on driving shaft,	... ...	144 teeth.
G	Bevel pinion on driving shaft,	... ...	18 teeth.
H	Bevel wheel on intermediate shaft,	...	64 teeth.
I	Bevil pinion on intermediate shaft,	...	18 teeth.
J	Bevel wheel on chain wheel shaft,	...	64 teeth.
K	Pulley on driving shaft,	... ...	18" dia.
L	Pulley on sheet roller shaft,	... ...	5" dia.
MM	Endless chains for holding the jute.		

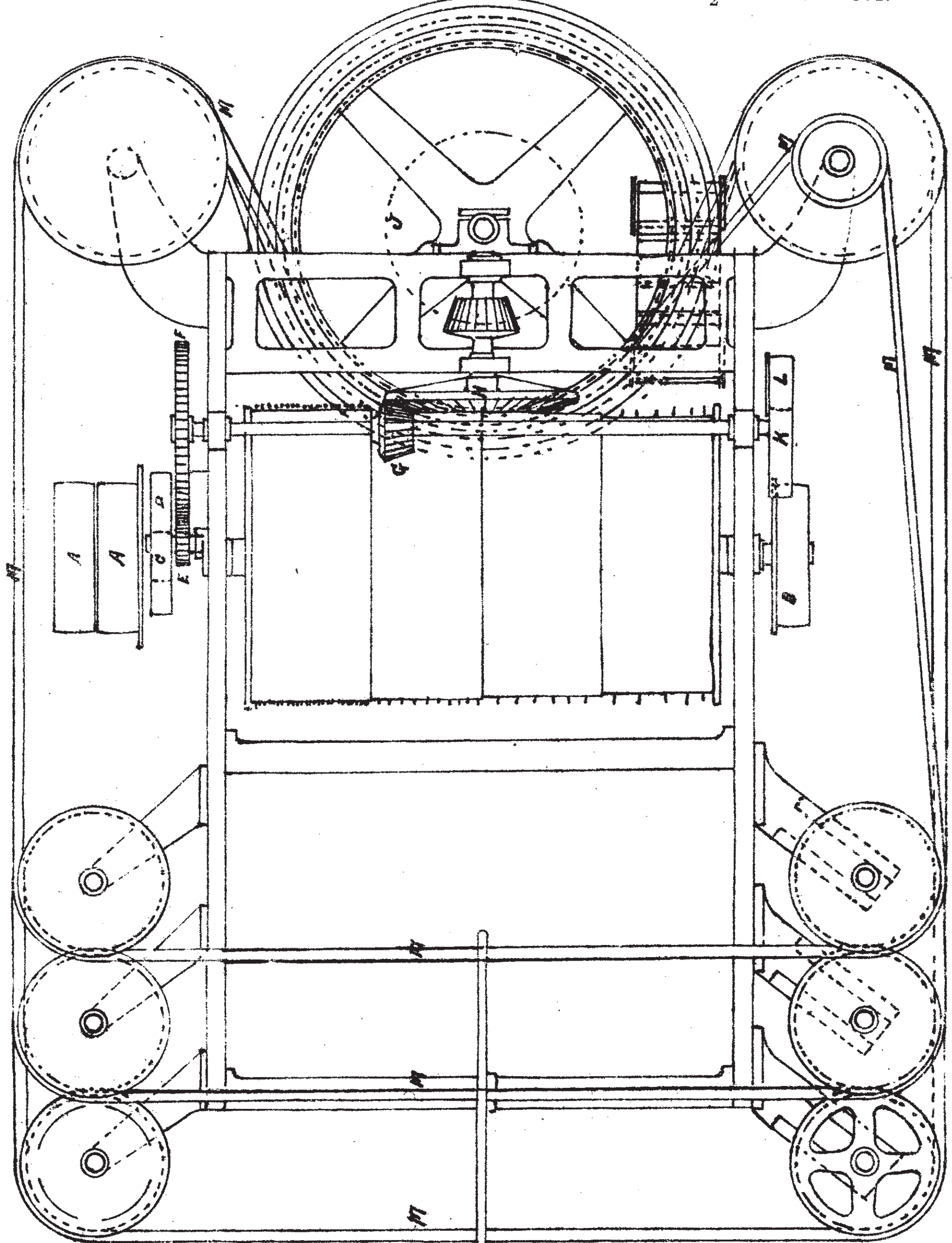
JUTE SNIPPER.

SCALE ½″ TO ONE FOOT.



JUTE SNIPPER.

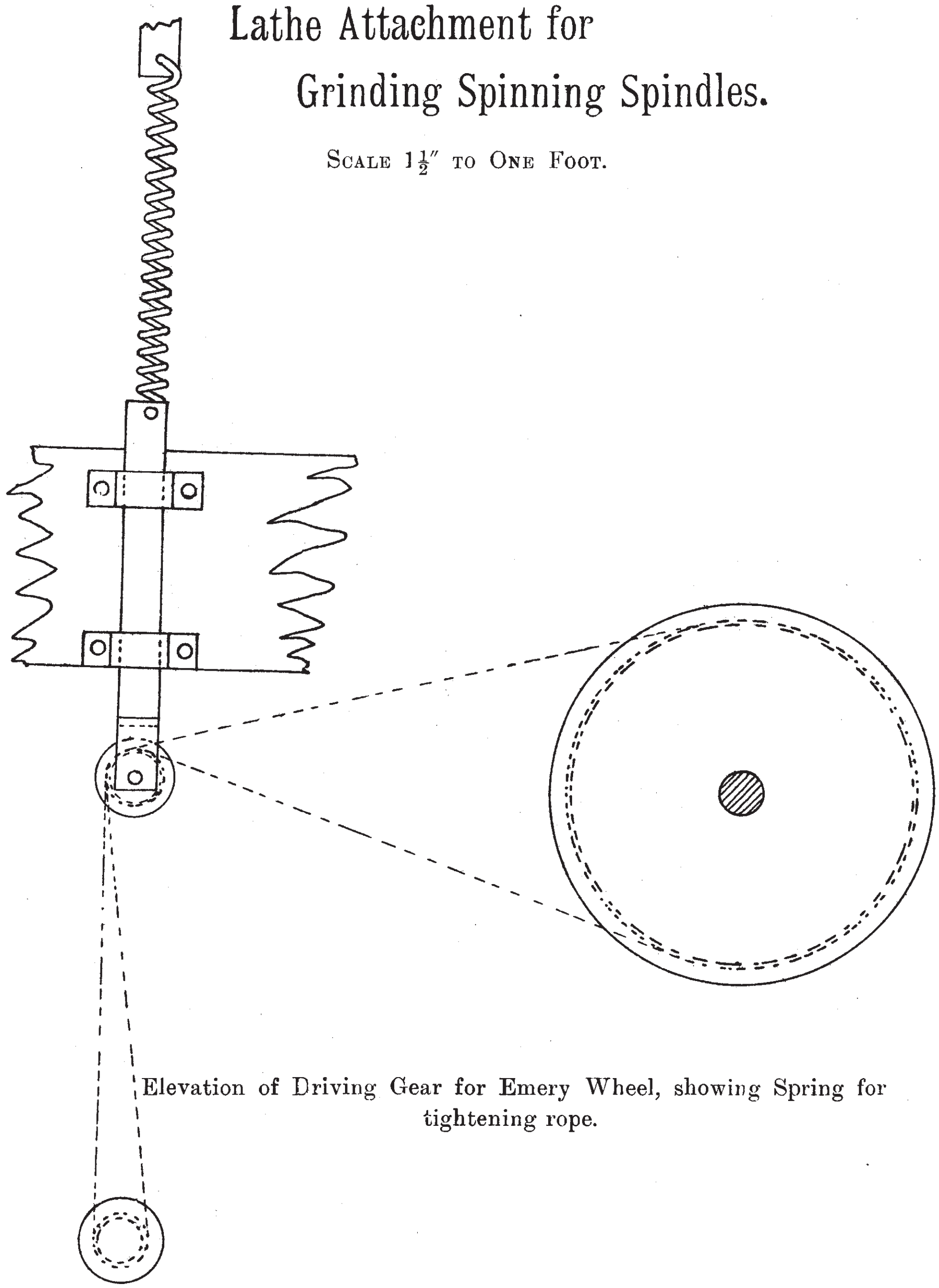
SCALE $\frac{1}{2}''$ TO ONE FOOT.



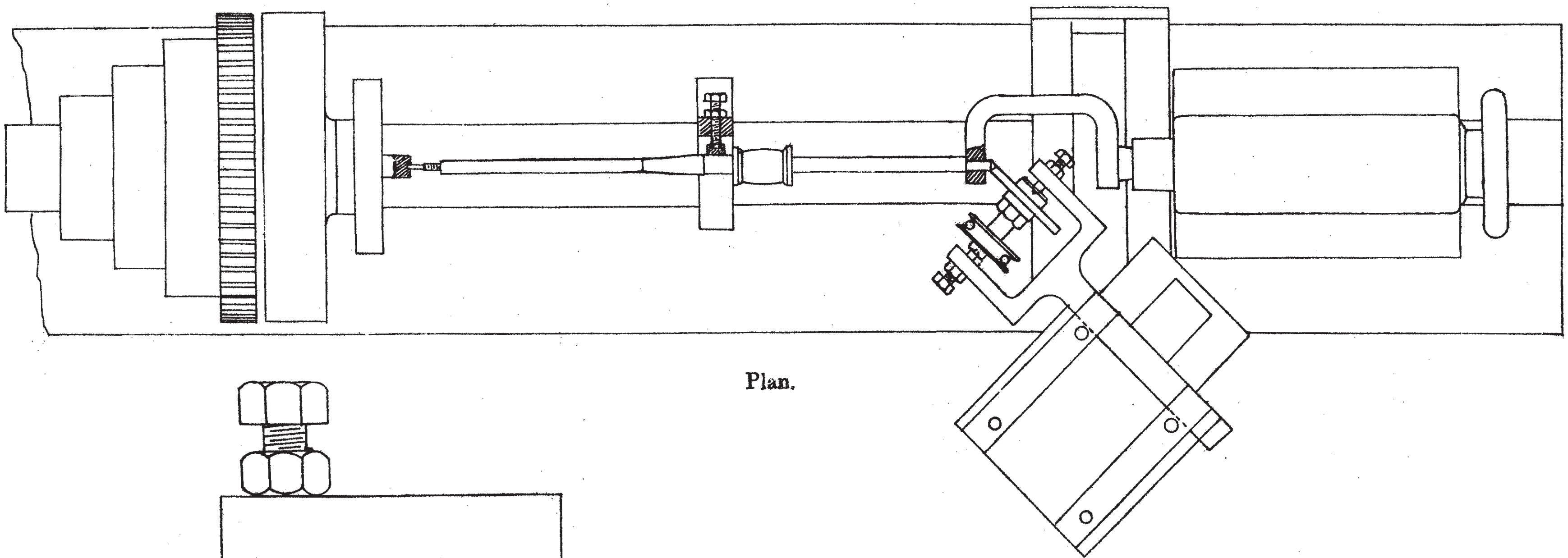
For particulars of Staves for Snipper Cylinder see page 111.

Lathe Attachment for Grinding Spinning Spindles.

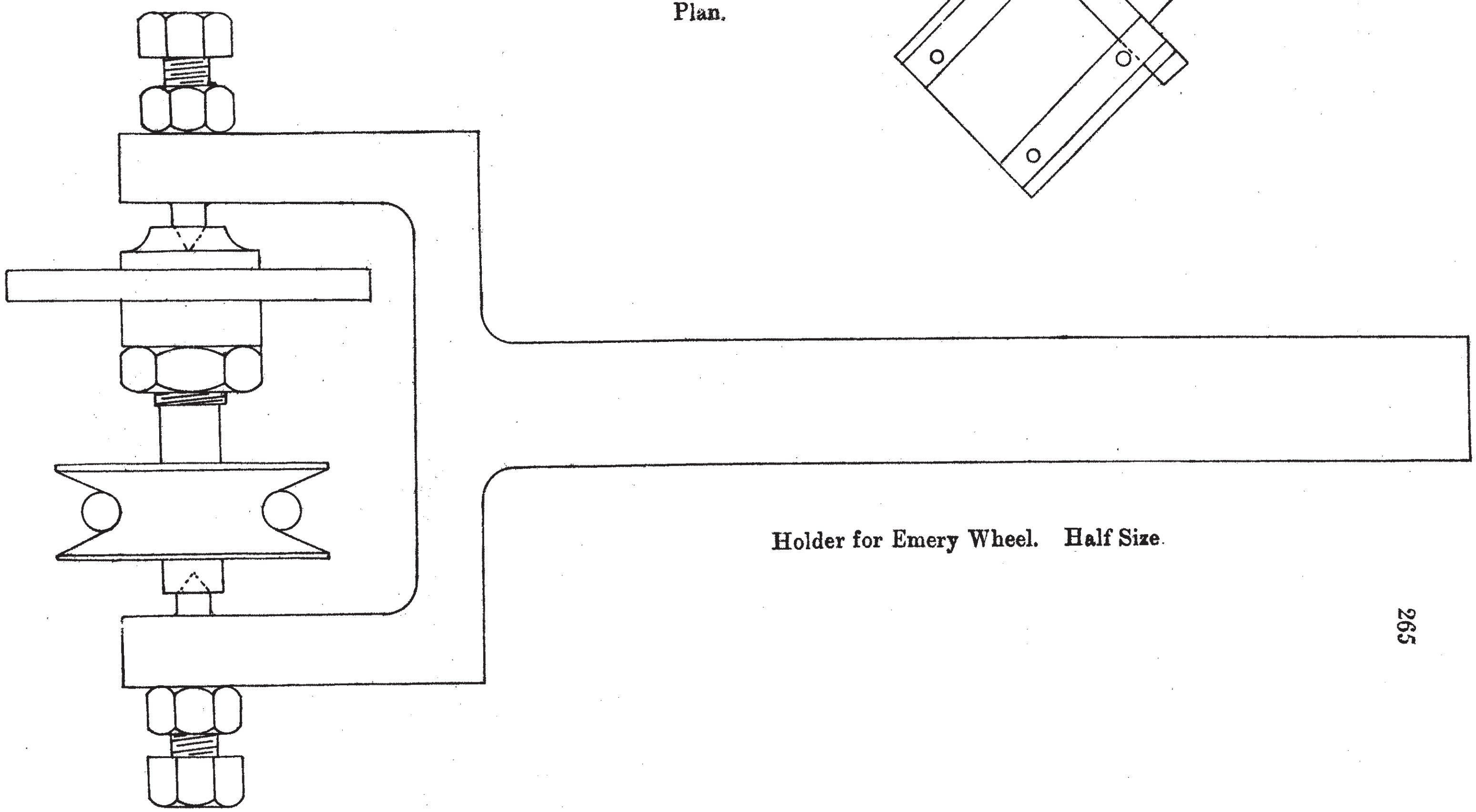
SCALE $1\frac{1}{2}''$ TO ONE FOOT.



Elevation of Driving Gear for Emery Wheel, showing Spring for tightening rope.



Plan.

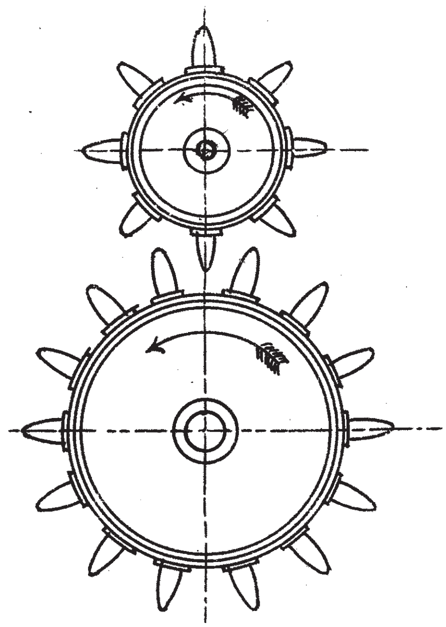


Holder for Emery Wheel. Half Size.

WASTE CLEANER.

This machine is used for cleaning the waste made at Breaker and Finisher Cards.* The waste is laid upon the feed cloth A and a quantity fed into the machine—this is allowed to remain in from a minute to a minute and a half, the dust falling through a circular grating below cylinder. The waste fibre is allowed to pass out of the machine by the lifting of a flap cover at B, the dust drops into a bag at C, and the waste into a bag at D. The machine cleans the waste thoroughly, and the fibre or pickings, as previously explained in the chapter on Waste, can be utilised for the coarser qualities of yarn.

SCALE $\frac{3}{4}''$ TO ONE FOOT.

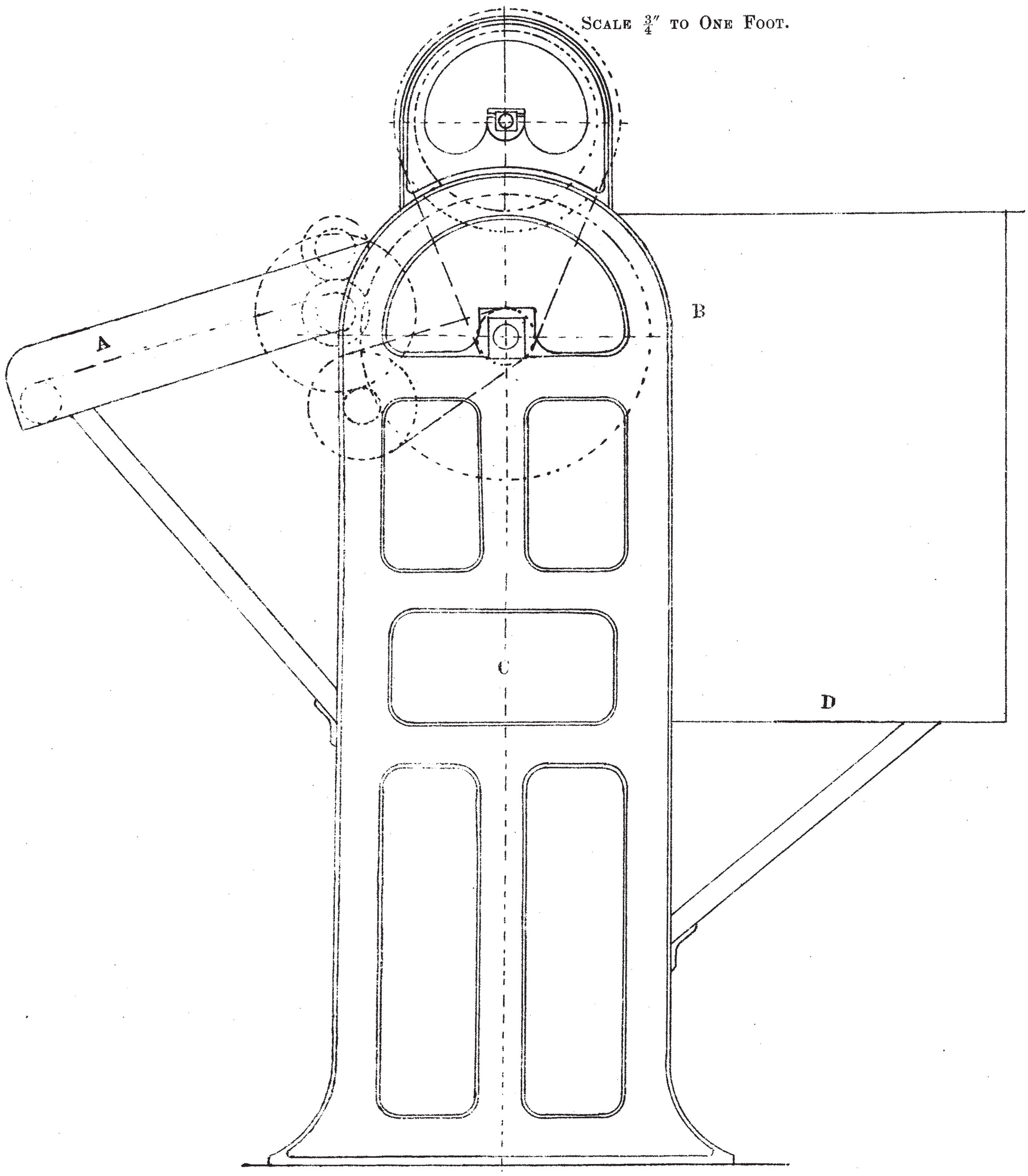


Section of Cylinders.

* The Waste made at Drawings and Rovings may also be cleaned in this Machine.

WASTE CLEANER

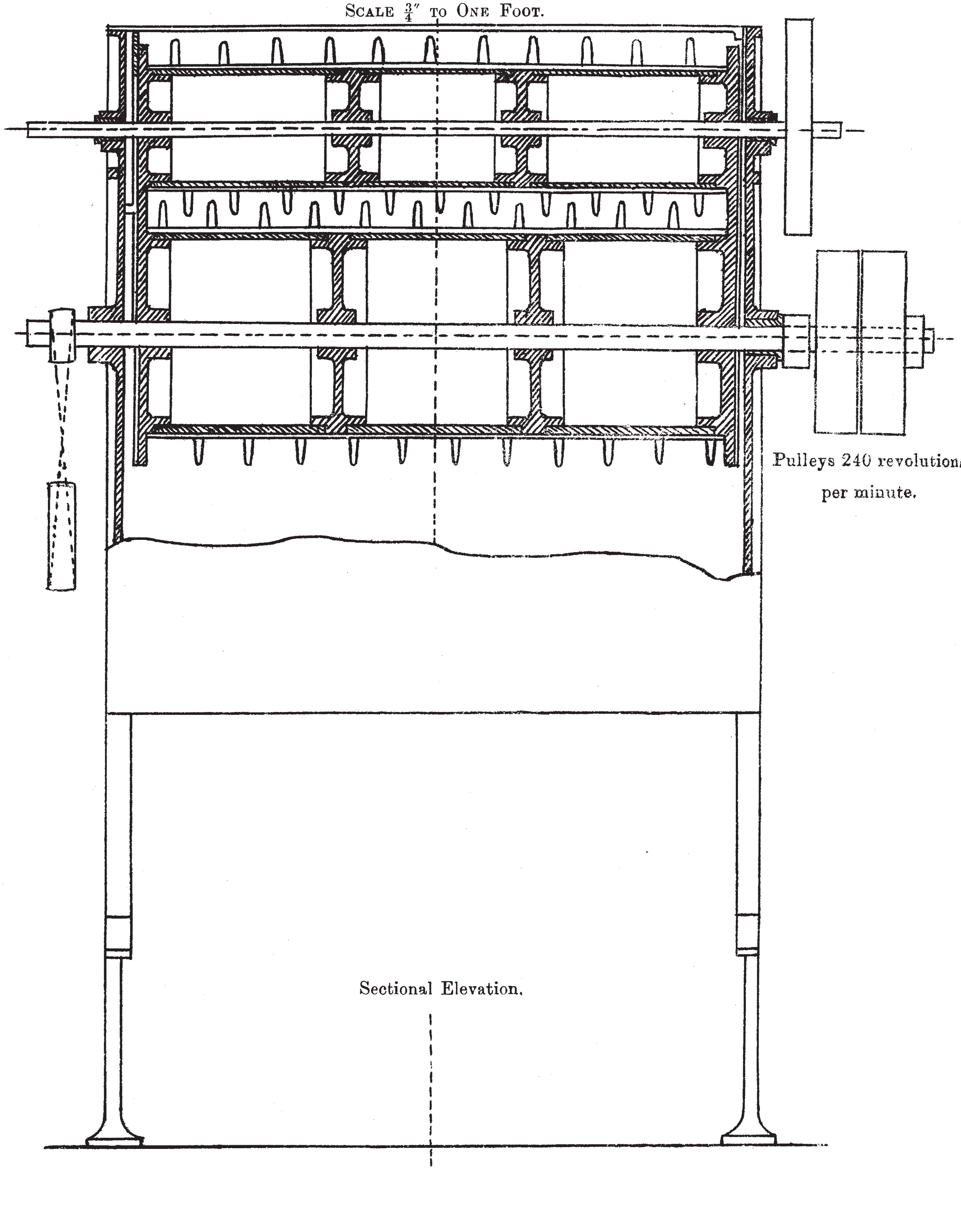
SCALE $\frac{3}{4}''$ TO ONE FOOT.



End Elevation.

WASTE CLEANER.

SCALE $\frac{3}{4}''$ TO ONE FOOT.



Sectional Elevation.

THE ADJUSTMENT OF THE BREAKER SHELL.

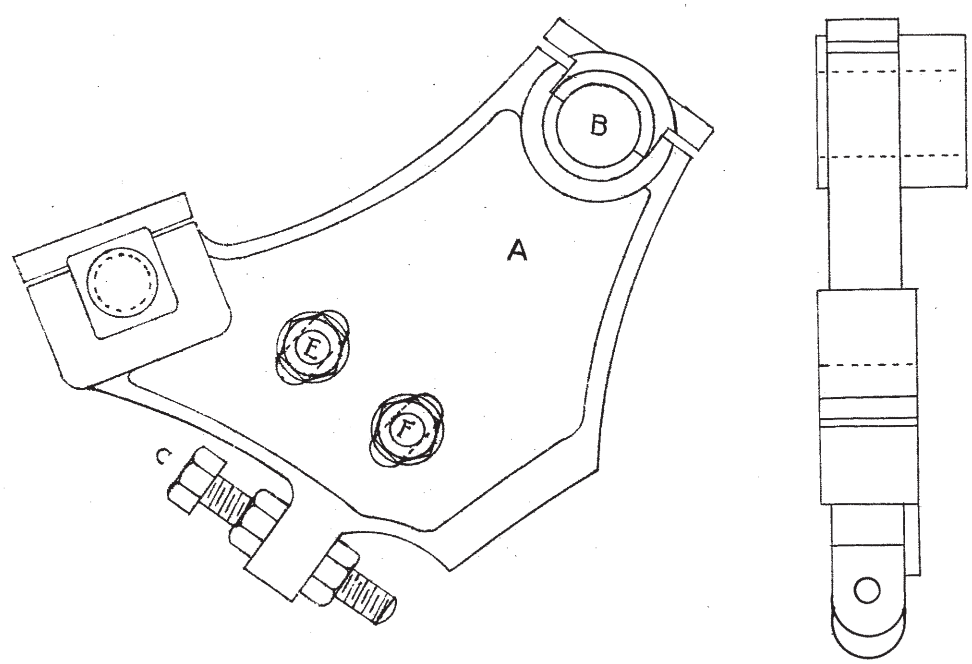
This illustration is given to show how the shell is hung from the feed roller arbor, it being often necessary to move the shell either closer to, or farther away from the cylinder according to the jute being used. This can be done in a few minutes when required if the fixing of the shell is properly understood.

A radial bracket A is hung from feed roller arbor B, a sett screw C is provided for adjusting the distance of front of shell D from cylinder pins, two bolts E and F fix the shell to the radial bracket. In a breaker the shell is usually set $\frac{1}{8}''$ from feed roller, and is seldom moved from that position. The position of front of shell to cylinder pins is usually about $\frac{3}{8}''$, but may be varied and often is so from a $\frac{1}{4}''$ to a $\frac{1}{2}''$, according to the quality and weight of material being put over a breaker in one round of breaker clock.

In illustration the fixing of one end only of the shell is shown both ends being alike.

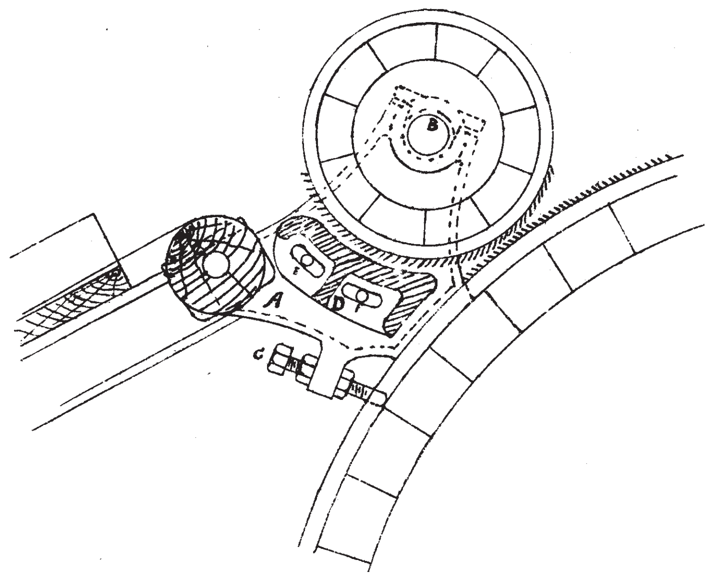
DETAIL OF RADIAL BRACKET CARRYING SHELL.

SCALE 3″ TO ONE FOOT.

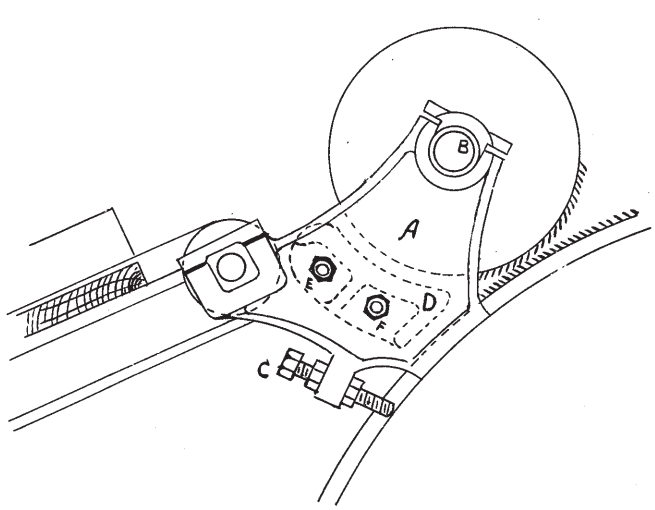


ARRANGEMENT OF RADIAL BRACKET FOR ADJUSTING SHELL TO CYLINDER.

SCALE $1\frac{1}{2}''$ TO ONE FOOT.



Cross. Section.



End Elevation.

ADDENDA.

SEE PAGES 181 to 186.

Single Doffer Breaker Worker Pinion,	...	...	60 teeth.
Double ,, ,, ,, ,,	..	...	32 ,,
Single ,, ,, Finisher ,,	...	...	46 ,,
Single Doffer Breaker Change Pinion for Draft between Doffer and Drawing Roller,	...	...	26 ,,
Ditto for Double Doffer Breaker, ...	...	...	28 ,,
,, Single ,, Finisher ...	...	...	28 ,,

PAGE 194.

To find the speed of Spinning Frame Spindles:—

Driving Shaft,	...	220 revolutions per minute.
Drum on Shaft,	...	32″ diameter.
Pulleys on Cylinder,		15″ ,,
Cylinder, ...	...	10″ ,,
Spindle Werve,	...	$1\frac{3}{4}$″ ,,

$$\frac{220 \times 32}{15} \times \frac{10}{1\frac{3}{4}} = 2681{\cdot}9 \text{ revolutions of spindles per minute.}$$

PAGE 201.

If the grist pinion on end of drawing roller is 36 teeth, and is producing 9 lbs. yarn, what pinion will be required to produce 10 lbs or 12 lbs.?

Then—9 : 10 : : 36 : 40 the pinion required; or

9 : 12 : : 36 : 48 ,, ,,

SAMPLING WEIGHT OF ROVE.

The rove should be sampled once every week to insure that the weight of rove wanted is being produced. This may be done as follows:—

Take one rove of each head of roving, reel 30 threads off each rove (90″ reel)—$8 \times 30 = 240$ threads in sample, weigh this, and, for example, say it weighs 3 lbs. (that is 48 ounces)—then 48×3 and $\div 2$ will equal the weight of rove in lbs. per spindle.

NOTE.—You take 8 roves and 30 threads off each, multiply the weight of sample in ounces by 3, and divide by 2, and the answer will always be weight of rove being produced in lbs. per spyndle of 14,440 yards.

To prove this—5760 threads in one spyndle of 14,400 yards—

```
Threads. Threads.    Ozs.
  240  :  5760  : :  48
    1  :    24
            48
          ----
           192
           96
          ----
      16)1152
          ----
            72 lbs. per spyndle = weight of rove; or

   16 : 24 : : 48
    2 :  3 : : 48
                3
              ---
            2)144
              ---
               72 lbs. per spyndle = weight of rove.
```

If the rove weighs 70 lbs. per spyndle, and you wish to spin 10 lbs. yarn this means a draft of 7 will be required on the Spinning Frame.

A TABLE CONTAINING
THE CIRCUMFERENCES AND AREAS OF CIRCLES.

Circumferences and Areas of Circles from $\frac{1}{16}$ of an inch to 10 inches, advancing by $\frac{1}{16}$ of an inch; and by an $\frac{1}{8}$ of an inch, from 10 inches to 100 inches Diameter.

Diameter.	Circum.	Area.	Diameter.	Circum.	Area.
$\frac{1}{16}$	·1963	·0030	2 in.	6·2832	3·1416
$\frac{1}{8}$	·3927	·0122	$\frac{1}{16}$	6·4795	3·3411
$\frac{3}{16}$	·5890	·0276	$\frac{1}{8}$	6·6759	3·5465
$\frac{1}{4}$	·7854	·0490	$\frac{3}{16}$	6·8722	3·7582
$\frac{5}{16}$	·9817	·0767	$\frac{1}{4}$	7·0686	3·9760
$\frac{3}{8}$	1·1781	·1104	$\frac{5}{16}$	7·2649	4·2001
$\frac{7}{16}$	1·3744	·1503	$\frac{3}{8}$	7·4613	4·4302
$\frac{1}{2}$	1·5708	·1963	$\frac{7}{16}$	7·6576	4·6664
$\frac{9}{16}$	1·7671	·2485	$\frac{1}{2}$	7·8540	4·9087
$\frac{5}{8}$	1·9635	·3068	$\frac{9}{16}$	8·0503	5·1573
$\frac{11}{16}$	2·1598	·3712	$\frac{5}{8}$	8·2467	5·4119
$\frac{3}{4}$	2·3562	·4417	$\frac{11}{16}$	8·4430	5·6727
$\frac{13}{16}$	2·5525	·5185	$\frac{3}{4}$	8 6394	5·9395
$\frac{7}{8}$	2·7489	·6013	$\frac{13}{16}$	8·8357	6·2126
$\frac{15}{16}$	2·9452	·6903	$\frac{7}{8}$	9·0321	6·4918
			$\frac{15}{16}$	9·2284	6·7772
1 in.	3·1416	·7854			
$\frac{1}{16}$	3·3379	·8861	3 in.	9·4248	7·0686
$\frac{1}{8}$	3·5343	·9940	$\frac{1}{16}$	9·6211	7·3662
$\frac{3}{16}$	3·7306	1·1075	$\frac{1}{8}$	9·8175	7·6699
$\frac{1}{4}$	3·9270	1·2271	$\frac{3}{16}$	10·0138	7·9798
$\frac{5}{16}$	4·1233	1·3529	$\frac{1}{4}$	10·2102	8·2957
$\frac{3}{8}$	4·3197	1·4848	$\frac{5}{16}$	10·4065	8·6179
$\frac{7}{16}$	4·5160	1·6229	$\frac{3}{8}$	10·6029	8·9462
$\frac{1}{2}$	4·7124	1·7671	$\frac{7}{16}$	10·7992	9·2806
$\frac{9}{16}$	4·9087	1·9175	$\frac{1}{2}$	10·9956	9 6211
$\frac{5}{8}$	5·1051	2·0739	$\frac{9}{16}$	11·1919	9·9678
$\frac{11}{16}$	5·3014	2·2365	$\frac{5}{8}$	11·3883	10·3206
$\frac{3}{4}$	5·4978	2 4052	$\frac{11}{16}$	11·5846	10·6796
$\frac{13}{16}$	5·6941	2·5801	$\frac{3}{4}$	11·7810	11·0446
$\frac{7}{8}$	5·8905	2·7611	$\frac{13}{16}$	11·9773	11·4159
$\frac{15}{16}$	6·0868	2·9483	$\frac{7}{8}$	12·1737	11·7932

Diameter.	Circum.	Area.	Diameter.	Circum.	Area.
$\frac{15}{16}$	12·3700	12·1768	$\frac{1}{2}$	20·4204	33·1831
			$\frac{9}{16}$	20·6167	33·8244
4 in.	12·5664	12·5664	$\frac{5}{8}$	20·8131	34·4717
$\frac{1}{16}$	12·7627	12·9622	$\frac{11}{16}$	21·0094	35·1252
$\frac{1}{8}$	12·9591	13·3640	$\frac{3}{4}$	21·2058	35·7847
$\frac{3}{16}$	13·1554	13·7721	$\frac{13}{16}$	21·4021	36·4505
$\frac{1}{4}$	13·3518	14·1862	$\frac{7}{8}$	21·5985	37·1224
$\frac{5}{16}$	13·5481	14·6066	$\frac{15}{16}$	21·7948	37·8605
$\frac{3}{8}$	13·7445	15·0331			
$\frac{7}{16}$	13·9408	15·4657	7 in.	21·9912	38·4846
$\frac{1}{2}$	14·1372	15·9043	$\frac{1}{16}$	22·1875	39·1749
$\frac{9}{16}$	14·3335	16·3492	$\frac{1}{8}$	22·3839	39·8713
$\frac{5}{8}$	14·5299	16·8001	$\frac{3}{16}$	22·5802	40·5469
$\frac{11}{16}$	14·7262	17·2573	$\frac{1}{4}$	22·7766	41·2825
$\frac{3}{4}$	14·9226	17·7205	$\frac{5}{16}$	22·9729	41·9974
$\frac{13}{16}$	15·1189	18·1900	$\frac{3}{8}$	23·1693	42·7184
$\frac{7}{8}$	15·3153	18·6655	$\frac{7}{16}$	23·3656	43·4455
$\frac{15}{16}$	15·5716	19·1472	$\frac{1}{2}$	23·5620	44·1787
			$\frac{9}{16}$	23·7583	44·9181
5 in.	15·7080	19·6350	$\frac{5}{8}$	23·9547	45·6636
$\frac{1}{16}$	15·9043	20·1290	$\frac{11}{16}$	24·1510	46·4153
$\frac{1}{8}$	16·1007	20·6290	$\frac{3}{4}$	24·3474	47·1730
$\frac{3}{16}$	16·2970	21·1252	$\frac{13}{16}$	24·5437	47·9370
$\frac{1}{4}$	16·4934	21·6475	$\frac{7}{8}$	24·7401	48·7070
$\frac{5}{16}$	16·6897	22·1661	$\frac{15}{16}$	24·9364	49·4833
$\frac{3}{8}$	16·8861	22·6907			
$\frac{7}{16}$	17·0824	23·2215	8 in.	25·1328	50·2656
$\frac{1}{2}$	17·2788	23·7583	$\frac{1}{16}$	25·3291	51·0541
$\frac{9}{16}$	17·4751	24·3014	$\frac{1}{8}$	25·5255	51·8486
$\frac{5}{8}$	17·6715	24·8505	$\frac{3}{16}$	25·7218	52·8994
$\frac{11}{16}$	17·8678	25·4058	$\frac{1}{4}$	25·9182	53·4562
$\frac{3}{4}$	18·0642	25·9672	$\frac{5}{16}$	26·1145	54·2748
$\frac{13}{16}$	18·2605	26·5348	$\frac{3}{8}$	26·3109	55·0885
$\frac{7}{8}$	18·4569	27·1085	$\frac{7}{16}$	26·5072	55·9138
$\frac{15}{16}$	18·6532	27·6884	$\frac{1}{2}$	26·7036	56·7451
			$\frac{9}{16}$	26·8999	57·5887
6 in.	18·8496	28·2744	$\frac{5}{8}$	27·0963	58·4264
$\frac{1}{16}$	19 0459	28·8665	$\frac{11}{16}$	27·2926	59·7762
$\frac{1}{8}$	19 2423	29·4647	$\frac{3}{4}$	27·4890	60·1321
$\frac{3}{16}$	19·4386	30·0798	$\frac{13}{16}$	27·6853	60·9943
$\frac{1}{4}$	19·6350	30·6796	$\frac{7}{8}$	27·8817	61·8625
$\frac{5}{16}$	19·8313	31·2964	$\frac{15}{16}$	27·0780	62·7369
$\frac{3}{8}$	20·0277	31·9192			
$\frac{7}{16}$	20·2240	32·5481	9 in.	28·2744	63·6174

Diameter.	Circum.	Area.
1/16	28·4707	64·5041
1/8	28·6671	65·3968
3/16	28·8634	66·2957
1/4	29·0598	67·2007
5/16	29·2561	68·1120
3/8	29·4525	69·0293
7/16	29·6488	69 9528
1/2	29·8452	70·8823
9/16	30·0415	71·8181
5/8	30·2379	72·7599
11/16	30·4342	73·7079
3/4	30·6306	74·6620
13/16	30·8269	75·6223
7/8	31·0233	76·5887
15/16	31·2196	77·5613
10 in.	31·4160	78·5400
1/8	31·8087	80·5157
1/4	32·2014	82·5160
3/8	32·5941	84·5409
1/2	32·9868	86·5903
5/8	33·3795	88·6643
3/4	33·7722	90 7627
7/8	34·1649	92·8858
11 in.	34·5576	95·0334
1/8	34·9503	97·2053
1/4	35·3430	99·4021
3/8	35·7357	101·6234
1/2	36·1284	103·3691
5/8	36·5211	106·1394
3/4	36·9138	108·4342
7/8	37·3065	110.7536
12 in.	37·6992	113·0976
1/8	38·0919	115·4660
1/4	38·4846	117·8590
3/8	38·8773	120·2766
1/2	39·2700	122·7187
5/8	39·6627	125·1854
3/4	40·0554	127·6765
7/8	40·4481	130·1923
13 in.	43·8408	132·7326
1/8	41·2338	135·2974
1/4	41·6262	137·8867
3/8	42·0189	140·5007
1/2	42·4116	143·1391
5/8	42·8043	145·8021
3/4	43·1970	148·4896
7/8	43·5897	151·2017
14 in.	43·9824	153·9384
1/8	44·3751	156 6995
1/4	44·7676	159·4852
3/8	45·1605	162·2956
1/2	45·5532	165·1303
5/8	45·9459	167·9896
3/4	46·3386	170·8735
7/8	46·7313	173·7820
15 in.	47·1240	176·7150
1/8	47·5167	179·6725
1/4	47·9094	182·6545
3/8	48·3021	185·6612
1/2	48·6948	188·6923
5/8	49·0875	191·7480
3/4	49·4802	194·8282
7/8	49·8729	197·9330
16 in.	50·2656	201·0624
1/8	50·6583	204·2162
1/4	51·0510	207 3946
3/8	51·4437	210·5976
1/2	51·8364	213·8251
5/8	52·2291	217·0772
3/4	52·6218	220·3537
7/8	53·0145	223·6549
17 in.	53·4072	226·9806
1/8	53·7999	230·3308
1/4	54·1926	233·7055
3/8	54·5853	237·1049
1/2	54·9780	240·5287
5/8	55·3707	243·9771
3/4	55·7634	247·4500
7/8	56·1561	250·9475

Diameter.	Circum.	Area.	Diameter.	Circum.	Area.
18 in.	56·5488	254·4696	23 in.	72·2568	415·4766
1/8	56·9415	258·0161	1/8	72·6495	420·0049
1/4	57·8342	261·5872	1/4	73·0422	424·5577
3/8	57·7269	265·1829	3/8	73·4349	429·1352
1/2	58·1196	268·8031	1/2	73·8276	433·7371
5/8	58·5123	272·4479	5/8	74 2203	438 3636
3/4	58·9056	276·1171	3/4	74·6130	443·0146
7/8	59·2977	279·8110	7/8	75·0057	447·6992
19 in.	59·6904	283 5294	24 in.	75·3984	452·3904
1/8	60·0831	287·2723	1/8	75·7911	457·1150
1/4	60·4758	291·0397	1/4	76·1838	461·8642
3/8	60.8685	294·8312	3/8	76 5765	466 6380
1/2	61·2612	298·6483	1/2	76 9692	471·4363
5/8	61·6539	302·4894	5/8	77·3619	476·2592
3/4	62·0466	306·3550	3/4	77·7546	481·1065
7/8	62·4393	310·2452	7/8	78·1473	485 9785
20 in.	62·8320	314·1600	25 in.	78·5400	490·8750
1/8	63·2247	318·0992	1/8	78·9327	495·7960
1/4	63 6174	322·0630	1/4	79·3254	500·7415
3/8	64·0101	326·0514	3/8	79·7181	505·7117
1/2	64·4028	330·0643	1/2	80 1108	510·7063
5/8	64·7955	334·1018	5/8	80·5035	515·7255
3/4	65·1882	338·1637	3/4	80 8962	520·7692
7/8	65·5809	342·2503	7/8	81·2889	525·8375
21 in.	65·7936	346·3614	26 in.	81·6816	530 9304
1/8	66·3663	350·4970	1/8	82·0743	536·0477
1/4	66·7590	354·6571	1/4	82·4670	541·1896
3/8	67·1517	358·8419	3/8	82·8597	546·3561
1/2	67·5444	363·0511	1/2	83·2524	551·5471
5/8	67·9371	367·2849	5/8	83·6451	556·7627
3/4	68·3298	371 5432	3/4	84·0378	562·0027
7/8	68·7225	375·8261	7/8	84·4305	567·2674
22 in.	69·1152	380·1336	27 in.	84·8232	572·5566
1/8	69·5079	384·4655	1/8	85·2159	577·8703
1/4	69 9006	388·8220	1/4	85·6086	583·2085
3/8	70·2933	393·2031	3/8	86·0013	588·5714
1/2	70·6860	397·6087	1/2	86·3940	593·9587
5/8	71·0787	402·0388	5/8	86 7867	599·3706
3/4	71·4714	406·4935	3/4	87·1794	604·8070
7/8	71·8641	410·9728	7/8	87·5721	610·2680

Diameter.	Circum.	Area.	Diameter.	Circum.	Area.
28 in.	87·9648	615·7536	33 in.	103·6728	855·3006
1/8	88·3575	621·2636	1/8	104·0655	861·7924
1/4	88·7502	626·7982	1/4	104·4582	868·3087
3/8	89·1429	632·3574	3/8	104·8509	874·8497
1/2	89·5356	637·9411	1/2	105·2436	881·4151
5/8	89·9283	643·5494	5/8	105·6363	888·0051
3/4	90·3210	649·1821	3/4	106·0290	894·6196
7/8	90·7137	654·8395	7/8	106·4217	901·2587
29 in.	91·1064	660 5214	34 in.	106·8144	907·9224
1/8	91·4991	666·2278	1/8	107·2071	914·6105
1/4	91·8918	671·9587	1/4	107·5998	921·3232
3/8	92.2845	677·7143	3/8	107·9925	928·0605
1/2	92·6772	683·4943	1/2	108·3852	934·8223
5/8	93·0699	689·2989	5/8	108·7779	941·6086
3/4	93·4626	695·1280	3/4	109·1706	948·4195
7/8	93·8553	700·9817	7/8	109·5633	955 2550
30 in.	94·2480	706·8600	35 in.	109·9560	962·1150
1/8	94·6407	712·7627	1/8	110·3487	968·9995
1/4	95 0334	718·6900	1/4	110·7414	975·9085
3/8	95·4261	724·6419	3/8	111·1341	982·8422
1/2	95·8188	730·6183	1/2	111 5268	989·8003
5/8	96·2115	736·6193	5/8	111·9195	996·7830
3/4	96·6042	742·6447	3/4	112 3122	1003·7902
7/8	96·9969	748·6948	7/8	112·7049	1010·8220
31 in.	97·3896	754·7694	36 in.	113·0976	1017 8784
1/8	97·7823	760·8685	1/8	113·4903	1024·9592
1/4	98·1750	766·9921	1/4	113·8830	1032·0646
3/8	98·5677	773·1404	3/8	114·2757	1039·1946
1/2	98·9684	779·3131	1/2	114·6684	1046·3941
5/8	99·3531	785·5104	5/8	115·0611	1053·5281
3/4	99·7458	791 7322	3/4	115·4538	1060·7317
7/8	100·1385	797·9786	7/8	115·8465	1067 9599
32 in.	100·5312	804·2496	37 in	116·2392	1075·2126
1/8	100·9240	810·5450	1/8	116·6319	1082·4898
1/4	101·3166	816·8650	1/4	117·0246	1089·7915
3/8	101·7093	823·2096	3/8	117·4173	1097·1179
1/2	102·1020	829·5787	1/2	117·8100	1104·4687
5/8	102·4947	835·9724	5/8	118 2027	1111·8441
3/4	102·8874	842·3905	3/4	118·5954	1119·2440
7/8	103·2801	848·8333	7/8	118 9881	1126·6685

Diameter.	Circum.	Area.	Diameter.	Circum.	Area.
38 in.	119·3808	1134·1176	43 in.	135·0888	1452·2046
⅛	119·7735	1141·5911	⅛	135·4815	1460·6599
¼	120·1662	1149·0892	¼	135·8742	1469·1397
⅜	120·5589	1156·6119	⅜	136·2669	1477·6342
½	120·9516	1164·1591	½	136·6596	1486·1731
⅝	121·3443	1171·7309	⅝	137·0523	1494·7266
¾	121·7370	1179 3271	¾	137·4450	1503·3046
⅞	122·1297	1186 9480	⅞	137·8377	1511·9072
39 in.	122·5224	1194·5934	44 in.	138·2304	1520·5344
⅛	122·9151	1202·2633	⅛	138·6231	1529 1860
¼	123·3078	1209 9577	¼	139·0158	1537·8622
⅜	123·7005	1217·6768	⅜	139·4085	1546 5530
½	124·0932	1225·4203	½	139·8012	1555·2883
⅝	124·4859	1233·1884	⅝	140·1939	1564·0382
¾	124·9787	1240·9810	¾	140·5866	1572·8125
⅞	125·2713	1248·7982	⅞	140·9793	1581·6115
40 in.	125·6640	1256·6400	45 in.	141·3720	1590·4350
⅛	126 0567	1264·5062	⅛	141·7647	1599·2830
¼	126·4494	1272·3970	¼	142·1574	1608·1555
⅜	126·8421	1280·3124	⅜	142·5501	1617·0427
½	127·2348	1288·2523	½	142·9428	1625·9743
⅝	127·6275	1296·2168	⅝	143·3355	1634·9205
¾	128·0202	1304 2057	¾	143·7382	1643·8912
⅞	128·4129	1312·2193	⅞	144·1209	1652·8865
41 in.	128·8056	1320·2574	46 in.	144·5136	1661·9064
⅛	129·1983	1328·3200	⅛	144·9063	1670·9507
¼	129 5910	1336·4071	¼	145·2990	1680 0196
⅜	129·9837	1344·5189	⅜	145·6917	1689·1031
½	130·3764	1352·6551	½	146·0844	1698·2311
⅝	130·7691	1360·8159	⅝	146·4771	1707·3737
¾	131·1618	1369·0012	¾	146·8698	1716·5407
⅞	131·5545	1377·2111	⅞	147·2625	1725·7324
42 in.	131·9472	1335·4456	47 in.	147·6552	1734·9486
⅛	132·3399	1393·7045	⅛	148·0479	1744·1893
¼	132·7326	1401·9880	¼	148·4406	1753·4545
⅜	133·1253	1470·2961	⅜	148·8333	1762·7344
½	133·5180	1418·6287	½	149·2260	1772·0587
⅝	133·9107	1426·9859	⅝	149·6187	1781·3976
¾	134·3034	1435·3675	¾	150·0114	1790·7610
⅞	134·6961	1443·7738	⅞	150·4041	1800·1490

Diameter.	Circum.	Area.	Diameter.	Circum.	Area.
48 in.	150·7968	1809·5615	53 in.	166·5048	2206·1886
$\frac{1}{8}$	151·1895	1818·9986	$\frac{1}{8}$	166·8975	2216·6074
$\frac{1}{4}$	151·5822	1828·4602	$\frac{1}{4}$	167·2902	2227·0507
$\frac{3}{8}$	151·9749	1837·9364	$\frac{3}{8}$	167·6829	2237·5187
$\frac{1}{2}$	152·3676	1847·4571	$\frac{1}{2}$	168·0756	2248·0111
$\frac{5}{8}$	152·7603	1856·9924	$\frac{5}{8}$	168·4683	2258·5281
$\frac{3}{4}$	153·1530	1868·5521	$\frac{3}{4}$	168·8610	2269·0696
$\frac{7}{8}$	153·5457	1876·1365	$\frac{7}{8}$	169·2537	2279·6357
49 in.	153·9384	1885·7454	54 in.	169·6464	2290·2264
$\frac{1}{8}$	154·3311	1895·3788	$\frac{1}{8}$	170·0391	2300·8415
$\frac{1}{4}$	154·7238	1905·0367	$\frac{1}{4}$	170·4318	2311·4812
$\frac{3}{8}$	155·1165	1914·7093	$\frac{3}{8}$	170·8245	2322·1455
$\frac{1}{2}$	155·5092	1924·4263	$\frac{1}{2}$	171·2172	2332·8343
$\frac{5}{8}$	155·9019	1934·1579	$\frac{5}{8}$	171·6099	2343·5477
$\frac{3}{4}$	156·2946	1943·9140	$\frac{3}{4}$	172·0026	2354·2855
$\frac{7}{8}$	156·6873	1953·6947	$\frac{7}{8}$	172·3593	2365·0480
50 in.	157·0800	1963·5000	55 in.	172·7880	2375·8350
$\frac{1}{8}$	157·4727	1973·3297	$\frac{1}{8}$	173·1807	2386·6465
$\frac{1}{4}$	157·8654	1983·1840	$\frac{1}{4}$	173·5734	2397·4825
$\frac{3}{8}$	158·2581	1993·0529	$\frac{3}{8}$	173·9661	2408·3432
$\frac{1}{2}$	158·6508	2002·9663	$\frac{1}{2}$	174·3588	2419·2283
$\frac{5}{8}$	159·0435	2012·8943	$\frac{5}{8}$	174·7515	2430·1833
$\frac{3}{4}$	159·4362	2022·8467	$\frac{3}{4}$	175·1442	2441·0772
$\frac{7}{8}$	159·8289	2032·8238	$\frac{7}{8}$	175·5369	2452·0301
51 in.	160·2216	2042·8254	56 in.	175·9296	2463·0144
$\frac{1}{8}$	160·6143	2052·8515	$\frac{1}{8}$	176·3323	2474·0222
$\frac{1}{4}$	161·0070	2062·9021	$\frac{1}{4}$	176·7150	2485·3546
$\frac{3}{8}$	161·3997	2072·9764	$\frac{3}{8}$	177·1077	2496·1116
$\frac{1}{2}$	161·7924	2083·0771	$\frac{1}{2}$	177·5004	2507·1931
$\frac{5}{8}$	162·1851	2093·2014	$\frac{5}{8}$	177·8931	2518·2992
$\frac{3}{4}$	162·5778	2103·3502	$\frac{3}{4}$	178·2858	2529·4297
$\frac{7}{8}$	162·9705	2113·5236	$\frac{7}{8}$	178·6785	2543·5849
52 in.	163·3632	2123·7216	57 in.	179·0712	2551·7646
$\frac{1}{8}$	163·7559	2133·9440	$\frac{1}{8}$	179·4639	2562·9688
$\frac{1}{4}$	164·1486	2144·1910	$\frac{1}{4}$	179·8566	2574·1975
$\frac{3}{8}$	164·5413	2154·4626	$\frac{3}{8}$	180·2493	2585·4509
$\frac{1}{2}$	164·9340	2164·7587	$\frac{1}{2}$	180·6423	2596·7287
$\frac{5}{8}$	165·3267	2175·0794	$\frac{5}{8}$	181·0347	2608·0311
$\frac{3}{4}$	165·7194	2185·4245	$\frac{3}{4}$	181·4274	2619·3580
$\frac{7}{8}$	166·1121	2195·7943	$\frac{7}{8}$	181·8201	2630·7095

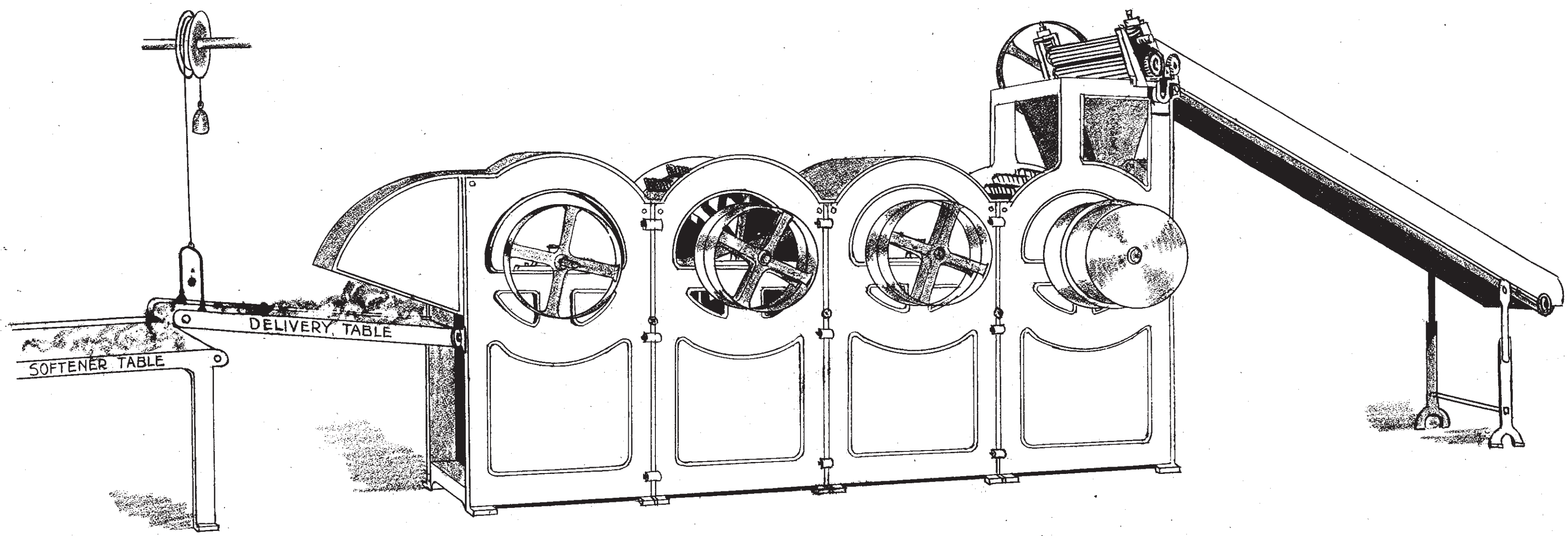
Diameter.	Circum.	Area.	Diameter.	Circum.	Area.
58 in.	182·2128	2642·0856	63 in.	197·9208	3117·2526
1/8	182·6055	2653·4861	1/8	198·3135	3129·6349
1/4	182·9982	2364·9112	1/4	198·7062	3142·0417
3/8	183·3909	2676·3609	3/8	199·0989	3154·4732
1/2	183 7836	2687·8351	1/2	199·4916	3166 9291
5/8	184·1763	2699·3338	5/8	199·8843	3179 4096
3/4	184·5690	2710·8571	3/4	200·2770	3191 9146
7/8	184·9617	2722·4050	7/8	200·6697	3204·4449
59 in.	185·3544	2733 9774	64 in.	201·0624	3216·9984
1/8	185·7471	2745·5743	1/8	201·4551	3229·5770
1/4	186·1398	2757·1957	1/4	201·8478	3242 1782
3/8	186·5325	2768·8418	3/8	202·2405	3254·8080
1/2	186·9252	2780·5123	1/2	202·6332	3267·4603
5/8	187·3179	2792·2074	5/8	203·0259	3280·1372
3/4	187·7106	2803·9270	3/4	203·4186	3292·8385
7/8	188·1033	2815 6712	7/8	203·8113	3306·5645
60 in.	188·4960	2827 4400	65 in.	204·2040	3318·3151
1/8	188·8887	2839·2332	1/8	204·5917	3331·0900
1/4	189 2814	2851·0510	1/4	204·9894	3343·8875
3/8	189·6741	2862·8934	3/8	205·3821	3356 7136
1/2	190·0668	2874·7603	1/2	205·7748	3369 5623
5/8	190·4595	2886·6517	5/8	206·1675	3382·4355
3/4	190·8522	2898·5677	3/4	206·5602	3395·3332
7/8	191·2419	2910·5083	7/8	206·9529	3408 2555
61 in.	191·6376	2922·4734	66 in.	207·3456	3421·2024
1/8	192·0303	2934·4630	1/8	207·7383	3434·1737
1/4	192·4230	2946·4771	1/4	208·1310	3447·1676
3/8	192·8157	2958·5159	3/8	208·5237	3468·1901
1/2	193·2084	2970·5791	1/2	208·9164	3473·2351
5/8	193·6011	2982·6669	5/8	209·3091	3486·3047
3/4	193·9931	2994·7792	3/4	209 7018	3499·3987
7/8	194·3865	3006·9161	7/8	210·0945	3512·5174
62 in.	194·7792	3019·0776	67 in.	210·4872	3525 6606
1/8	195·1719	3031·2835	1/8	210·8799	3538·8283
1/4	195·5646	3043·4740	1/4	211·2726	3552·0185
3/8	195·9573	3055·7091	3/8	211·6653	3565·2374
1/2	196·3500	3067·9687	1/2	212·0500	3578·4787
5/8	196·7427	3080·2529	5/8	212·4507	3591·7446
3/4	197·1354	3092·5615	3/4	212·8434	3605·0350
7/8	197·5281	3104·8948	7/8	213·2361	3618·3300

Diameter.	Circum.	Area.	Diameter.	Circum.	Area.
68 in.	213·6288	3631·6896	73 in.	229·3368	4185·3966
⅛	214·0215	3645·0536	⅛	229·7295	4199·7424
¼	214·4142	3658·4402	¼	230·1222	4214·1107
⅜	214·8069	3671·8554	⅜	230·5149	4228·5077
½	215·1996	3685·2931	½	230·9076	4242·9271
⅝	215·5923	3698·7554	⅝	231·3003	4257·3711
¾	215·9850	3712·2421	¾	231·6930	4271·8396
⅞	216·3777	3725·7535	⅞	232·0857	4286·3327
69 in.	216·7704	3739·2894	74 in.	232·4784	4300·8504
⅛	217·1631	3752·8498	⅛	232·8711	4315·3926
¼	217·5558	3766·4327	¼	233·2638	4329·9572
⅜	217·9485	3780·0443	⅜	233·6565	4344·5505
½	218·3412	3793·6783	½	234·0492	4359·1663
⅝	218·7339	3807·3369	⅝	234·4419	4373·8067
¾	219·1266	3821·0200	¾	234·8346	4388·4715
⅞	219·5193	3834·7277	⅞	235·2273	4403·1610
70 in.	219·9120	3848·4600	75 in.	235·6200	4417·8750
⅛	220·3047	3862·2167	⅛	236·0127	4432·6135
¼	220·6974	3875·9960	¼	236·4054	4447·3745
⅜	221·0901	3889·8039	⅜	236·7981	4462·1642
½	221·4828	3903·6343	½	237·1908	4476·9763
⅝	221·8755	3917·4893	⅝	237·5835	4491·8130
¾	222·2682	3931·3687	¾	237·9762	4506·6742
⅞	222·6609	3745·2728	⅞	238·3689	4521·5600
71 in.	223·0536	3959·2014	76 in.	238·7616	4536·4704
⅛	223·4463	3973·1545	⅛	239·1543	4551·4023
¼	223·8390	3987·1301	¼	239·5470	4566·3626
⅜	224·2317	4001·1344	⅜	239·9397	4581·3486
½	224·6244	4015·1611	½	240·3324	4596·3571
⅝	225·0171	4029·2124	⅝	240·7251	4611·3902
¾	225·4098	4043·2882	¾	241·1178	4626·4477
⅞	225·8025	4057·3886	⅞	241·5105	4641·5299
72 in.	226·1952	4071·5136	77 in.	241·9032	4656·6366
⅛	226·5879	4085·6631	⅛	242·2959	4671·7678
¼	226·9806	4099·8350	¼	242·6886	4686·9215
⅜	227·3733	4114·0356	⅜	243·0813	4702·1039
½	227·7660	4128·2587	½	243·4740	4717·3087
⅝	228·1587	4142·5064	⅝	243·8667	4732·5381
¾	228·5514	4156·7785	¾	244·2594	4747·7920
⅞	228·9441	4171·0753	⅞	244·6521	4763·0705

Diameter.	Circum.	Area.	Diameter.	Circum.	Area.
78 in.	245·0448	4778·3736	83 in.	260·7528	5410·6206
⅛	245·4375	4793·7012	⅛	261·1455	5426·9299
¼	245·8302	4809 0512	¼	261 5382	5443·2617
⅜	246·2229	4824·4299	⅜	261·9309	5459·6222
½	246 6156	4839·8311	½	262·3236	5476 0051
⅝	247·6083	4855·2568	⅝	262·7163	5492·4118
¾	247·4010	4870·7071	¾	263·1090	5508·8446
⅞	247·7937	4886·1820	⅞	263·5017	5525·3012
79 in.	248·1864	4901·6814	84 in	263 8944	5541·7824
⅛	248·5791	4917·2053	⅛	264·2871	5558 2881
¼	248·9718	4932·7517	¼	264·6798	5574·8162
⅜	249 3645	4948·3268	⅜	265·0725	5591·3730
½	249·7572	4963 9243	½	265·4652	5607·9523
⅝	250·1499	4979·5456	⅝	265 8579	5624·5554
¾	250·5426	4995·1930	¾	266·2506	5641·1845
⅞	250·9353	5010·8642	⅞	266 6433	5657 8357
80 in.	251·3280	5026·5600	85 in.	267·0360	5674·1500
⅛	251·7207	5042·2803	⅛	267·4287	5691·2517
¼	252·1134	5058 0230	¼	267·8214	5707·9415
⅜	252·5061	5073·7944	⅜	268·2141	5724·6947
½	252·8988	5089·5883	½	268·6068	5741·4703
⅝	253·2915	5106·4060	⅝	268·9997	5758·2697
¾	253 6842	5121 2497	¾	269·3922	5775 0952
⅞	254 0769	5137·1173	⅞	269·7849	5791·9445
81 in.	254·4696	5153·0094	86 in.	270·1776	5808·8184
⅛	254·8623	5168·9260	⅛	270·5703	5825 7168
¼	255·2550	5184·8651	¼	270·9630	5842·6376
⅜	255·6477	5200·8329	⅜	271·3557	5859·5871
½	256 0404	5216·8231	½	271·7484	5876·5591
⅝	256·4331	5232·8371	⅝	272·1411	5893·5549
¾	256 8258	5248·8772	¾	272 5338	5910·5767
⅞	257·2105	5264·9411	⅞	272·9265	5927·6224
82 in.	257·6112	5281·0296	87 in.	273·3192	5955 6926
⅛	258·0039	5297·1426	⅛	273·7119	5961·7873
¼	258·3966	5313·2780	¼	274·1046	5978·9045
⅜	258·7893	5329 4421	⅜	274·4973	5996 0504
½	259·1820	5345 6287	½	274·8900	6013·2187
⅝	259 5747	5361·8391	⅝	275·2827	6030·4108
¾	259·9674	5378·0755	¾	275·6754	6047·6290
⅞	260·3601	5394·3358	⅞	276 0681	6064·8710

Diameter.	Circum.	Area.	Diameter.	Circum.	Area.
88 in.	276·4608	6082·1376	93 in.	292 1688	6792 9248
1/8	276·8535	6099·4287	1/8	292·5615	6811·1974
1/4	277·2462	6116·7422	1/4	292·9542	6829·4927
3/8	277·6389	6134·0844	3/8	293·3469	6847·8167
1/2	278 0316	6151·4491	1/2	293·7396	6866·1631
5/8	278·4243	6169·8376	5/8	294·1323	6884·5338
3/4	278·8170	6186·2591	3/4	294·5350	6902·9296
7/8	279·2097	6203·6905	7/8	294·9177	6921·3497
89 in.	279·6024	6221·1534	94 in.	295·3104	6939·7946
1/8	279 9951	6238 6408	1/8	295·7031	6958 2636
1/4	280·3878	6256·1507	1/4	296·0958	6976·7552
3/8	280·7805	6273·6893	3/8	296·4885	6995·2755
1/2	281·1732	6291 2503	1/2	296·8812	7013·8183
5/8	281·5659	6308 8351	5/8	297·2739	7032·3853
3/4	281·9586	6326·4460	3/4	297·6666	7050·9775
7/8	282·3513	6344·0807	7/8	298·0593	7069 5940
90 in.	282·7440	6361·7400	95 in.	298 4520	7088·2352
1/8	283·1367	6379·4238	1/8	298·8447	7106·9005
1/4	283 5294	6397·1300	1/4	299 2374	7125·5885
3/8	283·9221	6424·8649	3/8	299 6301	7144·3052
1/2	284·3148	6432·6223	1/2	300 0228	7163·0443
5/8	284·7075	6450·4039	5/8	300·4155	7181 8077
3/4	285·1002	6468·2107	3/4	300·8082	7200·5962
7/8	285·4929	6486 0418	7/8	301·2009	7219·4090
91 in.	285·8856	6503·8974	96 in.	301·5936	7238·2466
1/8	286·2783	6521·7772	1/8	301·9863	7257·1083
1/4	286·6710	6539·6801	1/4	302·3790	7275·9926
3/8	287 0637	6557·6114	3/8	302·7717	7294·9056
1/2	287·4564	6573 5651	1/2	303·1644	7313·8411
5/8	287·8491	6593·5431	5/8	303·5571	7332·8008
3/4	288·2418	6611·5462	3/4	303·9490	7351·7857
7/8	288·6345	6629 5736	7/8	304·3425	7370·7949
92 in.	289·0272	6647·6258	97 in.	304·7352	7389·8288
1/8	289·4199	6665·7021	1/8	305·1279	7408·8868
1/4	289·8125	6683·8010	1/4	305·5206	7427·9675
3/8	290·2053	6701·9286	3/8	305·9133	7447·0769
1/2	290·5980	6720 0787	1/2	306·3060	7466·2087
5/8	290·9907	6738·2530	5/8	306·6987	7485·3648
3/4	291·3834	6756·4525	3/4	307·0914	7504·5460
7/8	291·7661	6774·6763	7/8	309·4841	7523·7515

Diameter.	Circum.	Area.	Diameter.	Circum.	Area.
98 in.	307·8768	7542·9818	$\frac{1}{8}$	311·4111	7717·1563
$\frac{1}{8}$	308·2695	7562·2362	$\frac{1}{4}$	311·8038	7736·6297
$\frac{1}{4}$	308·6622	7581·5132	$\frac{3}{8}$	312·1965	7756·1318
$\frac{3}{8}$	309·0549	7600·8189	$\frac{1}{2}$	312·5892	7775·6563
$\frac{1}{2}$	309·4476	7620·1471	$\frac{5}{8}$	312·9819	7795·2051
$\frac{5}{8}$	309·8403	7639·4995	$\frac{3}{4}$	313·3746	7814·7790
$\frac{3}{4}$	310·2330	7658·8771	$\frac{7}{8}$	313·7673	7834·3772
$\frac{7}{8}$	310·6257	7678·2790	100 in.	314·1600	7854·0000
99 in.	311·0184	7697·7056			



ORR'S PATENT ROOT OPENER.

A Machine specially designed to Open and Clean Jute and other fibrous roots, generally known in the Jute Trade as cuttings. The Machine consists of four strongly built cylinders all revolving in the same direction. These cylinders carry heavy steel pins, which intersect stationary pins fixed into breast plates. The rubbing action opens and cleans the roots, and the dirt and sand fall out through gratings underneath the cylinders. The cuttings or roots are fed evenly on to the feed table, and are carried up to a pair of fluted rollers, which pass them into the hopper, and then into the Machine.

The Root Opener should be placed in such a position to deliver direct on to the feed table of the Softening Machine, thus saving labour, and this arrangement insures an even feed for the Softener, which in turn is most important for uniform batching.

This Machine is capable of opening and cleaning sufficient material for a Softening Machine, making the working a continuous process. If, however, the Softener is required to work long Jute, the delivery table of the Root Opener can be instantly raised to allow the operators to feed long Jute.

Cuttings can be opened and cleaned rapidly, and at a minimum cost. They are prepared and delivered on to the Softener table in a condition most suitable to receive the batching mixture. The roots having been opened, and the fibre loosened, the oil and water are rapidly absorbed and remain in the fibre during the process of carding. This is not the case when cuttings have not been previously cleaned and prepared, and it will be found that much of the batching mixture is carded out along with the dirt and sand and is lost.

In treating cuttings with an opener and getting rid of the dirt and sand, there is a great saving in card covering, and much less tear and wear to the Cards and other Machines that follow.

A number of these Root Openers are at work in Indian Jute Mills, and they are giving every satisfaction.

Sole Makers:

JAMES F. LOW & CO., Ltd.,

MONIFIETH.

TELEGRAMS—KEAY, DUNDEE. NATIONAL TELEPHONE No. 344.

THOMAS C. KEAY,

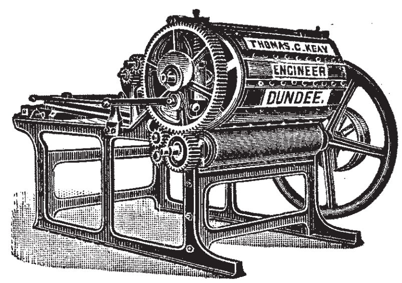
ENGINEER AND MACHINE MERCHANT,

MACHINERY AUCTIONEER AND VALUATOR,

Northern Machine Works, Ogilvie Street, Dundee.

NEW AND SECOND HAND

Jute, Flax, Hemp, & Tow Machinery

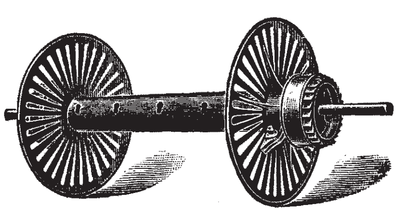


Sack Printing Machines.

Engines, Boilers, Lathes, Machine Tools,

MAKER OF

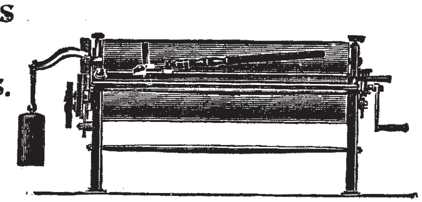
Evaporative Steam Condensers.
Sack Printing Machines.
Sack Cutting Machines.
Yarn Power Reels.
Drawing Rollers for Drawings, Rovings, Spinning Frames, &c.
Arbors for Spinning Frame Wood Pressing Rollers.
Loom and Sack Sewing Machines Spare Parts, etc.



Loom Beams and Flanges.

PLANS AND ESTIMATES GIVEN FOR MILLS AND FACTORIES.

CATALOGUES ON APPLICATION.



Sack Cutting Machines.

THOMAS C. KEAY,

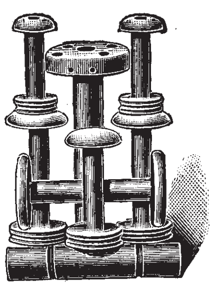
MILL FURNISHER, SHUTTLE, PICKER, and BOBBIN MAKER,

Engineer, Machine Merchant, Machinery Auctioneer & Valuator,

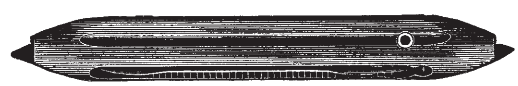
17 BALTIC STREET, DUNDEE.

SPECIALTIES—

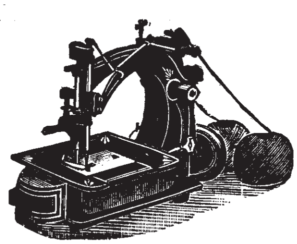
Bobbins, Shuttles, Baffalo and Leather Pickers, Planetree Rollers, Bobbin Ends, Picking Arms, Bank Pins, Reel Spokes, Buffalo Skips, Belting—all kinds, Bolts and Nuts, Oils, Picking Bands, Cotton Banding, Belt Laces, Martingale Strapping, and every requisite in Furnishings for Jute and Flax Mills.



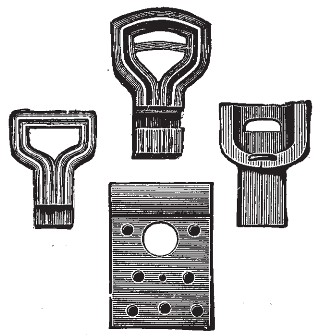
Bobbins all sizes.



Beech and Persimmon Wood Shuttles.

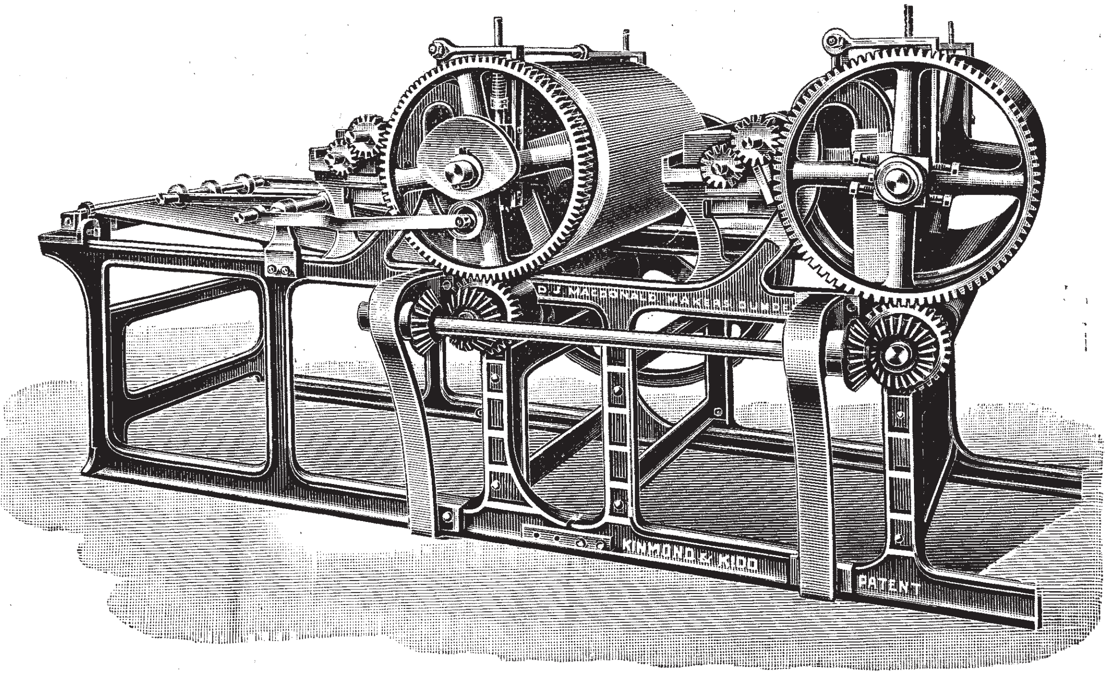


Union Bag Sewing Machine.



Buffalo Pickers.

Government Waterproof Belt Dressing.



2 Colour Printer.

D. J. MACDONALD,

C.E., M.I.Mech.E.

ENGINEER & MACHINE MAKER,

SOUTH ST. ROQUE'S WORKS, DUNDEE.

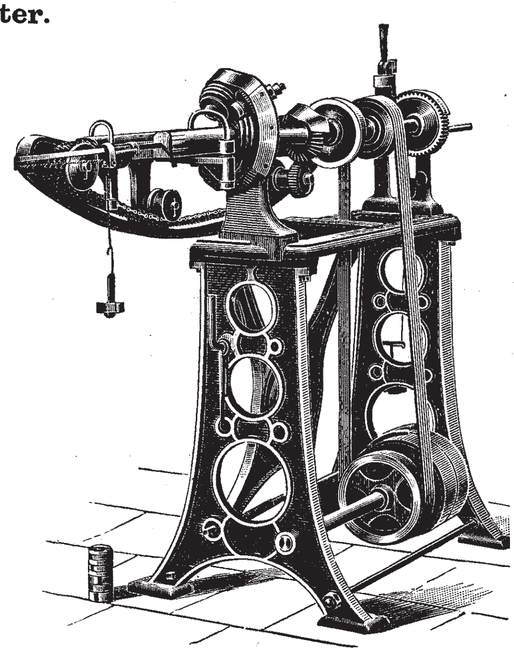
Telegrams—"Medalist, Dundee."

MAKER OF

Sack Cutting, Hemming, Sewing, and Printing Machines; Tarring, Dyeing, Bleaching, Pitching, and Proofing Machines; Rubber Mills: Vulcanising Presses; Spreading Machines; Engines: Air Pumps; Shafting, &c.,

SOLE MAKER OF

Kinmond & Kidd's Patent Double Colour Printer.
Macdonald's Patent Overhead Hemming Machine.
Hill's Patent Yarn Tester
Sturrock's Patent Furnace Bridge.



Overhead Sack Sewing Machine.

D. J. MACDONALD,

C.E., M.I.Mech.E.,

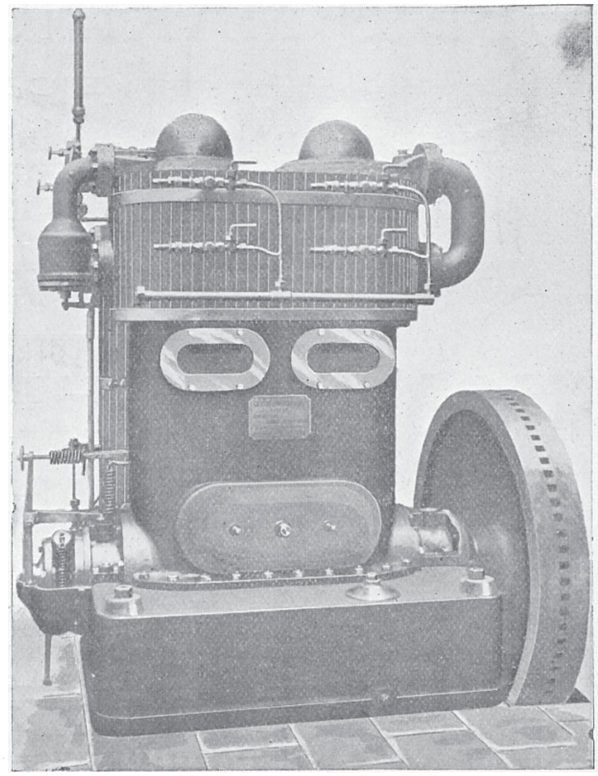
CONSULTING ENGINEER,

13 Constable Street, Dundee

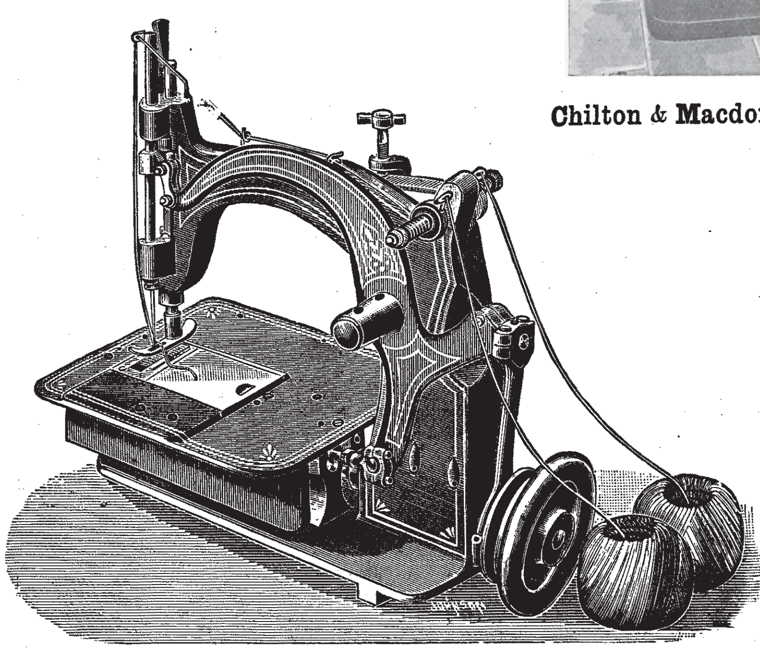
Plans Specifications and Estimates prepared.

Engines & Machines Inspected Tested and reported upon.

Special Machines designed for Inventors and others.



Chilton & Macdonald Patent High Speed Engine.



"Union" Special Sewing Machine.

D. J. MACDONALD,

MILL, FACTORY, & ENGINEERS' FURNISHER, & EXPORTER,

WARD ROAD & LINDSAY ST.

DUNDEE.

SOLE AGENT FOR

SCOTLAND AND BRITISH INDIA

FOR

Indestructable Fibre Sliver Cans, etc.

AGENT FOR

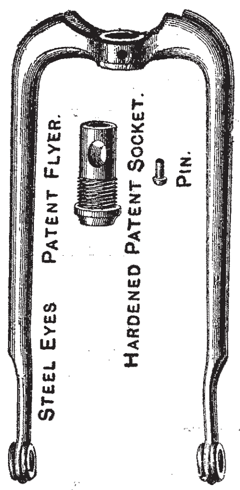
Union Special Sewing Machines, etc.

Engineers' Tools and all classes of Machinery supplied, and spare parts and accessories for same.

Machinery and goods Inspected by Experts before being despatched.

EDWARD LUCAS & SON,

DRONFIELD FOUNDRY, near SHEFFIELD.



MAKERS OF

Spinning Spindles and Flyers,

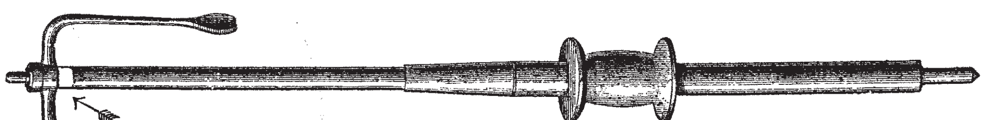
For Flax, Jute, Worsted, Cotton, &c.; also

Roving Spindles and Flyers.

ALSO MAKERS OF

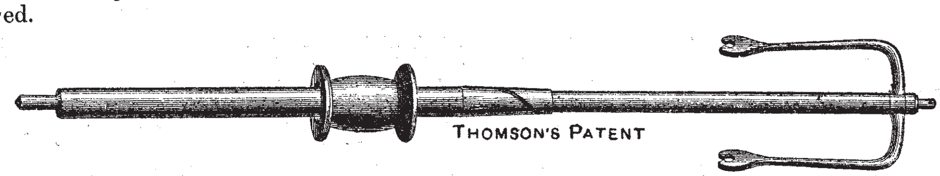
WARP, LOOM, & SILK SPINDLES.

INQUIRIES SOLICITED.



SAML. LUCAS'S PATENT SPINDLE

SAML. LUCAS'S PATENT SPINDLE has a collar hardened and fixed under the screw, which can be replaced; and Spindles worked down at the shoulder can have this Patent Collar put on at a small cost. The advantage of this Collar is that it prevents the shoulder at the bottom of screw becoming untrue by the flyer coming down on shoulder when working, the collar being equal in temper to the flyer. Many thousands of these Patent Spindles are now running, and are much approved.



THOMSON'S PATENT

Malleable Iron Castings of Superior Quality for all Purposes.

Telegraphic Address—"LUCAS, Dronfield."

AGENTS—

Messrs RICHARD L. BAXTER & CO., 81 Murraygate, Dundee.

TELEGRAMS—"FERGUSON." TELEPHONE No. 94.

Robert Ferguson & Sons,

OIL MERCHANTS, &c.,

MILL FACTORY, & ENGINEERS' FURNISHERS,

All kinds of Oils for Lubricating and Batching Purposes, Belting (all kinds), Laces, Picking Bands, (Green, Chrome, or Oak Tanned), Shuttles, Buffalo Pickers, Bobbins, Plane Tree Rollers, Roller Cloth Dressers Flannel, India Rubber Goods, Spindles and Springs of every kind, Bolts and Nuts, Set Screws, Brass Goods, &c.

SPECIALTIES { **WOOD SPLIT PULLEYS (Thousands in use) "BUFFALO" AUTOMATIC INJECTOR, "GLOBUS" BELTING, (Canvas, Gutta Percha, and Balata —Kirkcaldy's tests prove this to be the strongest Belt in existence).**

FOREIGN INDENTS SPECIALLY ATTENDED TO

11 to 15 Royal Exchange Lane, Dundee.

Fairmuir, Tinplate, Plumber, and Sheet Metal Works.

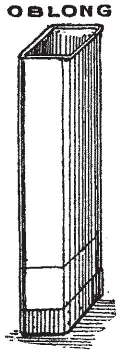
JOHN GALLOWAY,

IRONMONGER, TINSMITH, PLUMBER, & GASFITTER.

Every description of Mill and Factory work done

Gas, Water, and Steam Pipes Fitted.

OBLONG



Manufacturer of the Special Machine made Sliver Cans and Spinning Conductors, &c. Cop Pans, Pirn Trays, Shuttle Grooves.

These Cans are made (with Special Machines) of the best P.C. and Black Sheet Steel, Corrugated in Mouth, and specially Stamped Bottom, firmly riveted with 6 in. base piece, and extra strong Hoop to body of Can.

Delivery from 600 to 800 per week, as may be arranged for.

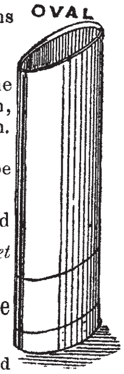
PICKER GROOVES or CHANNELS—to Lengths as ordered

Stamped Figures and Letters in Iron, Steel, or Sheet Brass—various sizes.

Maker of the New Improved Machine-made Spinning Conductor.

Sliver Cans, Cylinders, and Card Conductors Repaired or Altered

OVAL



Estimates given for any quantity.

Special Discount for large quantities.

Special Van sent for Broken Cylinders (on receipt of Telephone message), and immediately returned when repaired.

SHOP & STORE—309 & 311 HILLTOWN, DUNDEE.

Workshops—FAIRMUIR and FAIRFIELD STREETS.

TELEPHONE No. 434.

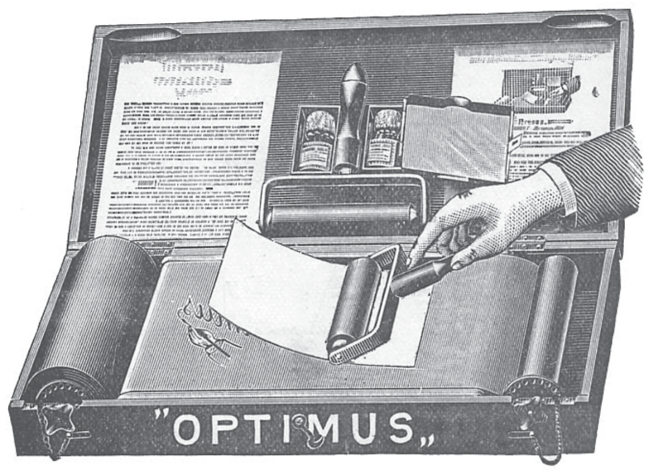
There is no time to be LOST nowadays !

YOU OFTEN WANT A FEW HUNDRED

copies (more or less) of a Circular, Price List, Post Card, Notices, Letters, Quotations, Agenda, Specifications, Maps, Drawings, etc., etc

What you want is the

Optimus Duplicator!



PRICES—

No. 1—4 × 6 in., complete with ink, **For Post Cards.**		**12/6**
No. 2—$8\frac{3}{4}$ × 13 in., **Quarto & F.-Cap.**	do.,	**27/6**
No. 3—14 × 19 in., **Double Folio.**	do.,	**50/-**
No. 4—$15\frac{3}{4}$ × $19\frac{3}{4}$ in., **Extra.**	do.,	**70/-**
No. 5—$20\frac{1}{2}$ × 24 in., **Extra.**	do.,	**90/-**

You merely write, draw, or type your original—place it on the 'Optimus' and you then have a negative from which you can take as many copies as you like.
It takes and reproduces inks of any colour at one and the same time.
It needs no blacking or inking and is the cleanest Duplicator on the market.
When one plate is finished with, you merely roll it away and thus expose another for use.
The plates being self absorbing can be used over and over again.

OPTIMUS REFILLS.

No. 1—About 3 yards, **3/6**. No. 2—About $5\frac{1}{2}$ yards, **6/6**. No. 3—About $5\frac{1}{2}$ yards, **9/-**
No. 4—About $5\frac{1}{2}$ yards, **15/-**. No. 5—About $5\frac{1}{2}$ yards, **17/-**.

OPTIMUS INKS.

Black, **1/2** per bottle; Blue Black, Blue, Yellow, Green, Red, Pink, and Violet, **1/-** per bottle.

WILLIAM KIDD, Manufacturing Stationer,
WHITEHALL STREET, DUNDEE.

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