COTTON CARDING

BY

J. J. O'GRADY

Woonsocket, R. I.

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Overseer of Carding

MANVILLE COMPANY

Social and Nourse Mills

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PREFACE.

In writing this book, which the author now submits for the benefit of his fellow overseers, and the assistance of those who have the ambition to become overseers, the author was actuated by the desire to have at hand a reference book containing as nearly as possible all the necessary information and data concerning the process of cotton carding, instead of having several books and papers which are almost always mislaid at the time they are needed. He feels confident that he has attained what he sought to accomplish, and as no one loses anything by extending a helping hand to others who may be less fortunate or who may need assistance, he places this book within reach of all who may desire a copy.

It ought to be a very handy reference book for overseers and superintendents.

CONTENTS

COTTON CARDING.

The first thing to be considered in the process of Carding is the mixing of the cotton, which is necessary on account of the density of the bale in which the cotton fibers are compressed and matted together; these bales are opened and in most mills are spread about in the mixing bins by hand. As the fibers in the different lots of cotton may vary from one-sixteenth to one-eighth of an inch in length, they should be opened alternately and mixed together thoroughly, because by this method you will obtain a fair average staple, resulting in less waste, as the longer staples will help to carry along and support those which are shorter and are yet considered long enough for the work for which they are intended.

The mixed cotton pile should remain unused a length of time sufficient for the air to circulate thoroughly through the cotton, thereby rendering it fluffy and dry enough for the first process to which it is to be subjected.

This first process is known as the hopper feeder or automatic opener. This machine consists of a large box, inside of which is a travelling latticed spiked apron. This spiked apron carries the cotton upward on its surface until at the top the large bunches of cotton, which have attached themselves to the spikes, are knocked back by the revolving spiked roll, which is turning near the uppermost end of the spiked apron and is set at a certain distance from this apron. This setting governs the weight of cotton that can continually pass this point.

The cotton now slides down an inclined board and falls upon a small apron which feeds the cotton through two steel rolls known as feed rolls, from which it is struck by the blades of the revolving beater, which renders the cotton fluffy, and this same action causes the heavier impurities to fall between the grid bars, which at intervals retard the passage of the cotton. It is during these slight intervals that the droppings leave the cotton.

The cotton is now drawn upward through a trunk by air suction furnished by a revolving fan in the breaker picker. This air current, passing through the perforated surfaces of two cylinders or cages, which extend the full width of the machine, one revolving above the other, causes the cotton to lay upon the surfaces of these two cages, and, passing between them, is formed into an endless sheet that then passes through the feed rolls, from which the cotton is struck off by the blades of the beater, which opens the cotton and, with the aid of the grid bars, causes the impurities to leave the stock. The cotton now passes between two more cages, and being compressed again into an endless sheet passes between four heavy calender rolls and is then wound upon the surface of a small iron roll. The mass of cotton wound upon this roll is known as a lap.

Four or five of these laps are placed upon a revolving apron at the back of the intermediate or finisher picker, according to the processes of picking desired, and undergoing a repetition of the former processes is again formed into a lap. There is an evening motion on these machines which makes it possible to obtain a lap which will weigh approximately the same number of ounces to the yard.

The doubling of the laps at the back helps to obtain this result. The laps from the breaker vary more or less, and, in doubling, the thick places in one lap are more apt to make up for the thin places in another, and the evening motion, which controls the speed of the feed rolls, speeding them or causing them to run slow, as is demanded by the variable thickness that may occur in the laps that are being fed into the machine, assures the delivering of a lap of an even number of ounces to the yard.

The obtaining of an even lap is verv important, as the card reproduces in the sliver the same conditions that are in the lap. Thick and thin places in the lap will result in thick and thin places in the carded sliver; also a lap, each yard of which is even in weight, will produce an even card sliver.

Having now obtained the cotton in the form of a lap, which facilitates the handling of the cotton, together with having it weigh, yard by yard, an equal number of ounces, we proceed to the Card.

The revolving flat card is, in regards to the making of good yarn, the *most* important machine in the mill.

The object of the cotton card is to disentangle and separate, as it were, the fibers of the cotton; to remove seed, leaf, neps, and a certain percentage of short stock, and to deliver the good or desired portion of stock over the surface of the doffer. At this point a comb strikes the cotton off in a web-like way, which is drawn through a trumpet by two calender rolls and thence into a can, which revolves underneath a coiler head, which contains two more smaller calender rolls.

The revolving flat card consists for the main part of lap roll, feed roll and feed plate, licker-in, cylinder, top-flats, doffer. The setting of the last five are very important and should be done by a skillful, experienced, and trustworthy man. Money should be no object in getting a man of this kind, as poor yarn and cloth is made by careless setting.

After carding comes the sliver lap machine. The cotton is delivered by the card into a can in a long, endless strand, and is called sliver.

Eighteen or twenty of these cans are placed back of the machine and the slivers from them are run side by side until the desired width of lap is obtained, and passes between three or four sets of rolls, which draw the stock, then passes between two pairs of heavy calender rolls, which compress the cotton, and is then wound upon a spool until the desired diameter is obtained.

When this diameter is reached a stop-motion, either mechanical or electrical, causes the frame to stop. In this way a uniform length of lap is obtained.

These laps are placed at the back of the ribbon lap machine, and after undergoing a similar process to the sliver lap machine, the lap produced is placed at the back of the comber, and having been acted upon by the different parts of the comber the cotton passes through the drawbox and coiler into a can and is ready to be placed at the back of draw frame.

The drawing frame is used to increase

the doublings, but especially to attenuate and parallelize the fibers and reduce the weight of the sliver to that which is desired for the slubber.

The slubber, or rather, any speed frame, is a machine which takes a strand of cotton, draws it, puts in twist, and winds it in layers upon the surface of a wooden bobbin.

After the slubber come the First Intermediate, Second Intermediate, and Fly Frame or Jack.

After passing through the Fly Frame or Jack Frame the process of Carding is completed, and the roving is passed along to the Spinning Department.

PICKER ROOM.

The picker room should have a mixing room large enough so that a pile of cotton sufficient for a week's run could be mixed at one time. There should also be a large bin constructed in this mixing room, in which all waste, that is supposed to be put back into the work, could be kept from one mixing day to another. This waste consists mostly of sliver from cards and drawing frame and slubber, the ends of laps that are broken out by strippers when they are putting in laps and roving waste. This roving waste should be spread on one of the picker aprons and allowed to pass through the picker, then throw it into the waste bin until the day you mix the cotton.

In making a mix it is advisable to use as many different lots of cotton as is possible. As the staple and grade of the different lots vary somewhat, it is better to have some of each kind in each mix than to have a great many bales of one kind in any individual mix, as in this way the pile will always contain a uniform mixture in regards to staple and grade, which insures uniformity in the numbers and even looking yarn.

First place bales around the space where the pile is to be erected, and have help understand that you wish them to take off thin layers of cotton at a time, and have the cotton spread about over the full surface of the mixing space, scattering each bale as much as possible. After obtaining a thickness of cotton that seems a fair proportion of the entire mixing, have the employees take a quantity of the waste that has been stored in the bin and spread this over the cotton, covering it in good shape, and continue in this manner, having a layer of cotton and a layer of waste, until the desired mixing is completed. Then have the man who fills the boxes take the cotton from top to bottom of the pile, and in this way the best results will be obtained, as both cotton and waste will be run in proportion.

CALCULATIONS ON MACHINES.

Production of Picker is found by taking the speed of fluted Calender roll and also the diameter of the same. Then the production equals the circumference of calender, times the revolutions per minute of calender roll, times total minutes run, times weight of one yard of lap, and divide this product by thirty-six inches in one yard and sixteen ounces in one pound, the result will be the production of the machine.

Example:—Calender=9″ in diameter.

R. P. M.=9.

Weight 1 yard=14 ozs.

Time run=50 hours.

What is production?

$$\frac{9\times 3.1416\times 9\times 60\times 50\times 14}{36\times 16}$$

=18,555 lbs.

To find what draft of picker is when you know the weight per yard and number of laps fed in and also the weight per yard delivered. Multiply the number of laps fed in by the weight of one lap and divide by the weight per yard delivered. Thus:—If we feed four laps each thirteen ounces to the yard and produce a lap that weighs twelve ounces to the yard, what is the draft?

$$\frac{4 \times 13}{12}$$

$=4\ 1/3=$the draft of picker.

To find the weight of lap that will be produced when you know the number of laps and weight per yard fed in and also the draft of picker, multiply the weight per yard fed in by the number of laps fed and divide by the draft, thus:—If we feed four laps each twelve ounces to the yard and draft of the picker is four and one-half, what weight per yard will be produced?

$$\frac{4 \times 12}{4\frac{1}{2}}$$

$=10\ 2/3$ ounces to the yard.

The weight per yard delivered multiplied by draft of picker and divided by number of laps fed will give the weight per yard you should feed in.

Weight per yard delivered=11 ozs. Draft=4. Number of laps fed in=5.

$$\frac{11 \times 4}{5}$$

$=8\ 4/5$ ozs. to the yard.

The production constant of a picker equals the circumference of the fluted calender roll times total minutes run divided by thirty-six inches in one yard and sixteen ounces in one pound.

Example:—If calender roll is 9″ in diameter and time run is 50 hours, what is the production constant?

$$\frac{9 \times 3.1416 \times 60 \times 50}{36 \times 16}$$

$=147.26=$Production constant.

The Production Constant times the revolutions per minute of calender roll, times ounces to the yard equals the pounds produced.

Example:—Production constant$=147.26$.

R. P. M. of calender roll$=9$.

Weight per yard$=14$ ounces.

How many pounds produced?

$9 \times 147.26 \times 14 = 18554.76$ lbs. produced.

The pounds required divided by the production constant times the weight per yard will give the required speed of calender roll per minute to produce this number of pounds.

Pounds required=12,000 lbs.

Production constant=147.26.

Weight per yard=8 ounces.

What is required speed of roll per minute?

$$\frac{12,000}{147.26 \times 8} = 10.18 \text{ R. P. M.}$$

CARDS.

The draft and production of cards vary according to conditions and the number of these machines that a person has in his room and from which he has to obtain sufficient sliver to meet the desired requirements.

If there are sufficient number of cards a good draft would run from 90 to 115 with the following settings:

Doffer to cylinder=Tight .007. Loose .005.

Cylinder and licker-in=.007.

Licker-in and feed plate=.007 (up to 1⅜″ staple).

Top flats=.009 (if great vibration), .007 if not.

Back plate=.012.

Front plate=.017.

Strip plate=.010.

Good results should be obtained if sliver is not over sixty grains per yard. The lighter the lap and sliver the better work will be produced by the card. Cards should be kept as clean and well oiled as possible.

Have a time set for stripping, oiling, and sweeping out, and have those duties attended to at that time.

For first-class results a card should not deliver more than 400 pounds per week. Run doffer 9 or 10 R. P. M.

To change production of card without changing the hank sliver, change the barrow gear.

Calculations for Cards.

If you wish to increase or decrease the production of a card without changing the hank sliver, change the barrow gear. This change does not change the hank sliver because this barrow gear controls the speed of the doffer, which delivers the stock, and also the speed of the feed rolls, which feed the stock into the card; so when you change the barrow gear you either speed or slow down these two parts of the cards in proportion.

If a card delivers 400 pounds per week and you desire 500 pounds per week, and you have a 16 tooth barrow gear giving 400 pounds, what gear will give 500 pounds? Multiply the present gear by the desired production and divide the product by the present production; therefore

$$\frac{16 \times 500}{400}$$

will give a 20 tooth barrow gear.

The draft of a card may be ascertained in two ways, namely:—By using the gears and diameters of feed and calender rolls or by weighing one yard fed into card and one yard of sliver that is delivered

Draft of Card.

If you are using a 12 ounce lap and the card sliver delivered weighs 48 grains per yard, what is the draft?

12 ounces $=12 \times 437\frac{1}{2}$ grs.$=5250$ grs.

Allow 5% of this for waste$=262.5$ grains.

$5250 - 262.5 = 4987.5$ grains fed in $4987.5 \div 48 = 103.9$, the draft of the card.

Draft of card using gears and rolls.

Draft between lap roll and feed roll.

Diameter of lap roll$=6''$.

Diameter of feed roll$=2\frac{1}{4}''$.

Gear on feed roll$=21$ teeth.

Gear on lap roll$=59$ teeth.

Then,

$$\frac{59 \times 9 \times 1}{21 \times 4 \times 6} = 1.05.$$

Draft of doffer and calender roll.

Diameter of doffer=24¾″.

Diameter of calender roll=4″.

Gear on doffer=.208.

Gear on calender roll=28.

Then,

$$\frac{208 \times 4}{28 \times 24.75} = 1.2.$$

Draft between feed roll and doffer.

Diameter of feed roll=2¼″.

Diameter of doffer=24¾″.

Gear on doffer=26 teeth.

Driving side shaft gear=32 teeth.

Change bevel gear on shaft=21 teeth.

Driven feed roll gear=154 teeth.

Then,

$$\frac{26 \times 4 \times 32 \times 154}{9 \times 24.75 \times 21} = 109.5.$$

Total draft of card=109.5×1.2×1.05=137.97.

To find the draft of a card.

Rule:—The diameter of calender roll and all drivers multiplied by each other and the result divided by diameter of feed rolls and all driven gears wil give the draft.

To find the weight on feed roll or any roll:

Measure the number of inches from fulcrum to the center of the weight, multiply this number of inches by the number of pounds in the weight and divide the product by the number of inches from fulcrum to point of contact.

To find the inches per minute that the top flats travel:

Cylinder makes 155 R. P. M.

End of cylinder shaft has 7″ pulley.

This drives 9″ pulley on stud.

Other end of stud holds single worm.

This single worm drives 26 tooth gear.

This 26 tooth gear is on stud, on the other end of which is another single worm.

This single worm drives a 40 tooth gear. On the same stud as this 40 tooth gear is what is known as the flat wheel.

This flat wheel is 8″ in diameter.

Thus:

$$\frac{155 \times 7 \times 1 \times 1 \times 8 \times 22}{9 \times 26 \times 40 \times 7}$$

$=2.91''$

that the top flats travel per minute.

To find production of a card:

The production of a card=the circumference of the doffer, times the revolutions per minute, times the total minutes run, times the weight of one yard of sliver divided by 36 inches in one yard and 7000 grains in one pound.

Example:—Diameter of doffer=27″.

Revolutions per minute=10.

Time run=50 hours.

Weight of one yard=40 grains.

$$\frac{27 \times 3.1416 \times 10 \times 60 \times 50 \times 40}{36 \times 7000}$$

=403.92 lbs.

DOFFER SPEED CONSTANT.

The doffer speed constant is found by multiplying the revolutions of the cylinder, times the diameter of pulley on cylinder shaft that drives pulley on the licker-in, times diameter of pulley on opposite end of licker-in that drives pulley on same stud as barrow gear, times 1 for barrow gear, and dividing by pulley on licker-in that pulley on cylinder drives, times diameter of pulley on stud with barrow gear, times number of teeth in doffer gear.

Example:—R. P. M. of cylinder=165.

Pulley on cylinder shaft=18″ diameter.

This drives licker-in pulley 8″.

Pulley on other end of licker-in=4¼″ diameter.

This drives pulley on stud with barrow gear 15½″.

Barrow gear=1 tooth.

Doffer gear=192 teeth.

What is the doffer speed constant?

$$\frac{165 \times 18 \times 4.25 \times 1}{8 \times 15.5 \times 192}$$

=.53.

The revolutions per minute that you desire the doffer to make divided by the doffer speed constant will give the required barrow gear.

If you wish the doffer to make 9 revolutions per minute and doffer speed constant = .53, what is the required barrow gear?

9÷.53=16.98 or 17 teeth=required gear.

The speed constant of doffer multiplied by number of teeth in barrow gear will give revolutions per minute of doffer.

If speed constant = .713 and there are 15 teeth in barrow gear, how many revolutions per minute will doffer make?

15×.713=10.695 R. P. M.

To find the number of inches of lap fed in per minute, multiply R. P. M. of doffer times bevel gear on end of doffer, times change gear, times circumference of feed roll, and divide by bevel gear that drives bevel gear on doffer times large plate bevel gear on end of feed roll.

R. P. M. of doffer=9.

Bevel gear on end of doffer=32.

Bevel gear on end of side shaft=32.

Bevel change gear=21.

Bevel plate gear on end of feed roll=120.

Diameter of feed roll=2¼″.

$$\frac{9\times32\times21\times9\times3.1416}{32\times120\times4}$$

=11.13 inches per minute.

Cards should be clothed with the best clothing obtainable, as the best is none too good. They should be ground by an experienced, skillful, and trustworthy man.

Cards should be ground light, as the lighter they are ground the shorter will be the nose of the wire and the longer will it keep its edge and produce better work.

Top setting is the most important part of setting a card, because the tops straighten out the fibers while they are passing between the tops and the cylinder and catch seed, leaf, and neps which they deposit on the outside as waste.

The doffer should be set as close as possible to the cylinder without rubbing. Licker-in should be set the same as tops. Feed rolls should be set according to the staple you are running; if they are set too close to the licker-in, the staple will be cut, and if set too far away the work will be cloudy.

The slower the doffer is run the better will be the work produced.

Care should be taken not to crowd the cards with a heavy lap. The lighter the lap the better the work. It is better to run light laps, as when the lap is heavy the wire will not handle the thickness in bulk, and the result is uneven, cloudy, knitty, rough, and unfinished work.

THE SLIVER LAP MACHINE.

After the sliver has been deposited in the card cans, these cans to the number of 18 or 20 are placed at the back of a machine known as the sliver lap machine. The sliver is drawn side by side over a table until the width desired for the lap is obtained, and passes through three sets of rolls, which draw the stock, and then passes between two pairs of heavy calender rolls, which compress the cotton, and delivers it in a continuous sheet that is wound upon the surface of a wooden spool until the desired diameter of lap is obtained. In some mills these laps are placed on the back of the comber. In others four of these laps are placed on the lap rolls at the back of a machine known as the ribbon lap machine, which acts upon these laps in the same manner as the sliver lap machine; that is, it draws the stock and places it on another spool which goes to the comber. The draft of these machines is about 2 and 4, respectively.

In making a combed yarn the processes before the comber should be run as light as conditions will permit, especially the carding process, as the lighter the lap the better the carding, and the imperfections that the card removes from the stock will not have to be taken out at the comber.

The ribbon laps to the number of 8 are placed upon the lap rolls of the comber and wind off over the surface of a curved steel plate and enters the machine through the feed rolls, and is then held by the nippers while the needles of the half lap pass through the cotton and take out whatever imperfections the card may have let pass. After the needles of the half lap pass through the stock, the segment with the aid of the leather covered detaching roll draws the stock through the needles of the top comb and delivers it into a pan, from which it is drawn by calender rolls, and passes through a draw-box consisting of four pairs of rolls, and then through a coiler head into a can that is then sent to draw frames.

The process of combing is used to remove imperfections, such as seed, leaf, neps, and also a certain percentage of short staple, thereby producing a sliver composed of fibers of almost uniform length, which means a stronger yarn.

Combing is a very uneven process, and it takes a good many doublings after combing to make an even yarn.

Combers should be set carefully to suit the length of staple, and the waste problem governs the setting somewhat according to the percentage desired.

The nippers should be set close to the half lap, as the closer the nippers are set the more deeply will the needles of the half lap enter into the cotton, and as a result the combing will be more thorough and more waste will be removed.

The waste is removed from the needles of the half lap by a revolving brush that in turn deposits the waste upon the doffer, from which a comb causes the waste to be deposited in a can for the purpose at the back of the comber.

COMBING.

Combing is a process by which fine yarns are made from long staple cotton. This is the highest type of finished carding. Imperfections which the card may let pass are only taken out by this process. It takes out all the short or uneven staple and only the required staple is allowed to pass into finished product. The process of combing is very costly. Carefulness and good judgment, together with a thorough knowledge of the machine, is necessary for good combing. Have machine clean, oiled, and free in all parts, nuts and bolts in good order, needles in cylinder and top combs in perfect condition and of uniform height. Cushions covered with fine quality of sheep skin of uniform thickness and not hard nor creased, the woolen cloth of standard weight, 10 ounces, and all wool, as these cushions are an important part of a comber. In setting a comber begin with the index gear, which has 80 teeth and is numbered up to 20 on its side, with 4 teeth between each number. Why? Because it is a guide for all the settings as given by rule. Next is the segment, which is the creased or flute part of cylinder, and should be set on a line to deliver roll with 1⅛ inch stock gauge at 5 index. Why? Because this segment is the important part on which most of the combing is done by top combs and detaching rolls; it also assists in delivering stock through the machine. Next are the cushions and nippers, connect rods, put on rocker springs, have caps and bolts screwed down in place, turn comber round by hand till nippers close and pushed back to farthest point. Set nippers and cushions to cylinder needles with a 21 gauge to the highest needles. This is done by turning cylinder round 2 needle bars at a time and going between nippers and needles each time. The nippers must run as close as a 21 gauge. Why? As cotton is held by nipper and cushions drawn back on the cylinder to loosen and take out seed, etc., it is necessary to set to a 21 gauge, as cylinder needles are passing through the cotton, and the closer the nippers are set to cylinder the deeper the cotton will pass into cylinder needles and more foreign matter will be removed. Set cushion plates to suit the stock being combed. The cushion plate gauge runs from 1⅛ inch to 1 7-16 inch. Set index wheel at 5. Have nippers on line with edge of segment, then set cushion to delivery roll so as to feel both easy with 1¼ inch gauge. Open nippers and swing cushion plate forward to full extent, where they are to be when machine is ready to deliver through top comb. The adjusting is done by screws on the back of rocker arm. When this is set, turn index wheel to close nippers. When these are down and back, which is at 12 index, then with the step gauge set bunter screws in rocker arms to bunter block with first step of the bunter gauge. Remember, the wider the step gauge used the more swing to the cushion plates and more waste removed from cotton. If nippers are swung back too far under back roll, there will not be space enough for lap to feed through. The nippers should just pass by the edge of the cushion plate, not close enough to rub the leather, but to nip paper. In setting cushion to nippers, take the rocker out, set cushion to nippers by a slip of paper, adjusting them from the back by the small screws. When the nippers will nip this paper between front edge of cushions and the outside lip of nippers all the way across they are right. Put rocker cushions and nippers back in machine. Take care not to disturb screws after setting them right once, then set lap feed roll 1 13-16 inches from delivery roll, this for 1½ to 1¾ inch stock. The detaching roll is a very important part of a comber. Why? Because it delivers the sliver with the assistance of delivery roll and segment. This roll must be very true and all of the same diameters. Seven-eighths inch is standard size; as they are moved forward and back by a comb all must strike the segment at the same time, not too hard, not too soon. If they get on too soon the stock will curl; if too hard it will spoil the rolls.

To set detaching roll, turn index to 6¾, then loosen cam and turn until detaching roll is clear down on segment, ready to move up or forward; then take a thin piece of paper and place it between the ends of detaching rolls and the holders, and by the back screws in holders turn up until the paper is slightly held between the ends of roll and holder; this will insure a good cushion of the detaching roll upon the segment, but not enough to destroy the rolls or varnish. The brass top roll is an important setting. Why? As this roll is what keeps detaching from licking and also a proper tension on the stock when the comber is lapping on or delivering. This roll is fluted and should set on a line with the roll under it so that the flutes on brass roll will mash with the flutes underneath. The distance between the brass roll and detaching should be about 19 gauge when rolls are down and on the work. The top comb is of great importance, as it regulates the amount of waste taken out, straightens the fibers, deposits the waste on last rows of cylinders, needles to be brushed off by the brush in doffer, from there to go into waste. The closer this top comb is set to detaching roll the more waste is taken out by it. Why? Because the more fiber passes through it, also the more length of staple is combed. The closer to segment the more waste, the farther away the less. The top combs should hang parallel to segment, also true to segment on both ends with a 21 gauge for 20 per cent. waste. Waste can be regulated by three parts of the machine, top comb, cushion, rocker and feed nippers. Good judgment should be used in taking out waste.

50s Egyptian 14½% waste.
60s Pealer 16½% waste.
100s Sea Island 20% waste.
Other Nos. in proportion.

The segment is set to steel roll 1⅛" stock gauge at 5 index. Why? Because it is the part of the comber, on which most of the combing is done by the top comb and the detaching roll.

The Cushions and Nippers should nip paper when ready to open off from the leather at from 4½ to 4¾. Why? Because this insures a proper grip on the stock, also proves that your cushions are ahead, ready to let go, and feed at the given time in harmony with the other settings.

Bunter and Rocker.

Bunters should strike the blocks at 4½ index and begin to leave the blocks at 9 index. Why? Because this regulates the distance the cushions are to travel back and forth in doing their work.

Nippers and Cylinder.

Nippers and cushions should be set to cylinder needles with a 21 gauge at 13¼ index and gauge your cylinder all the way round till index shows 19. Why? Because there are more or less high needles in cylinder, and these should come no closer than a 21 gauge to the leather; also at these given indices the needles on the cylinder are up and in the work, and cushions and nippers are at their lowest point.

Nippers and Segment.

Nippers should be just opening and on line with edge of segment and set to delivery roll with 1¼" stock gauge at 5 index. Why? Because your feed is about to begin through top comb, that which the cylinder needles have just passed through and also shows that all is free for feed to begin. Set top comb to segment with a 21 gauge. Always set from back, as that is where they are lifted. The set screws on the top of the comb are only for safety; in case anything on back of comb breaks or slips, the comb cannot get in on the cylinder. After the top comb is set to cylinder with a 21 gauge turn the safety screws on top of comb down on blocks till it nips paper. Take care not to lift top comb off from 21 gauge. Top comb should be set at 5¼ index. Why? Because every part that comes in contact with the work to be delivered is ready to do its work as soon as the comb is down, and also the segment is ready to deliver when comb is down at this time or index, as you then get the full length of segment; in other words, the wide surface of the segment part is used.

Detaching Roll and Segment.

The detaching roll should be down on segment at 6¾ index, as at that time the machine is ready to feed. It should be ready to come up and nip paper at 9 index, as the stock is feeding through at that time.

Brass Roll to Detaching.

This roll should set 1¼ as close as 20 gauge to the detaching roll at 12¼ index, as with this space the delivery will be smoother; also the proper tension will be on the stock between the brass and detaching rolls.

Nippers.

Should be opening or just leaving the leather at 4½ index. Why? Because the cushion is ahead to do its work. The nipper raises to be out of the way when machine feeds. Nippers should close or just touch at 9 index. Why? As the feed has come in on cushion and must be back in time for cylinder needle.

Lap Feed.

The lap should start to feed in at 6 index. Why? As the nippers are open and cushion ahead it is necessary for the feed to begin before nippers close.

The Delivery Roll moves back at from 1½ to 1¾ index. Why? To lap on the cotton, which has just passed through the top comb on to that which is to come through, making a compact web. This roll should move forward at 6 to 6¼ index. Why? The lapping on is done, the detaching roll is on the lap, the top comb is down in place, the amount of feed forward is then combed and delivered. Cylinder brushes should be set to cylinder deep enough to keep needles clean and to brush bottom of needles.

The DOFFER should be set just to touch the ends of cylinder brush, as should the doffer rub cylinder brush hard, the comber waste will be curly. Brushes should be set about twice a year on account of wear.

LAPPING ON AND PICK MOTION.

The pick catch should be down to feed back at 1¾ index to lap on stock. Should also be in motion to feed forward and deliver at 6¼. The pick gets its motion up and down from the circle eccentric. This circle eccentric can be moved to make machine shorten or lengthen its lapping on by loosening the set screws on the circle eccentric and moving it forward to shorten and backward to lengthen. This is very important for nice lapping and smooth work.

FEED AND WASTE.

The earlier the feed is started and nippers are opened the less waste is made.

The later you do these things the more waste.

Draft of comber equals the product of the diameter of feed roll, and all drivers gears divided by the product of diameter of calender roll and all driven gears.

POCKET SETTINGS.

Set segments on line at 5 index.

Set cushions to steel roll at 4½ index.

Set cushions and nippers to cylinder at 20 gauge.

Set bunter screws to strike block 4½ index.

Set bunter screws to leave block 9 index.

Set bunter with first step 5/16 gauge.

Set detaching to nip paper 6¾ index.

Should be same tension 9 index.

Steel roll start back 1⅝ index.

Steel roll start forward 6 index.

Feed from 4⅛ to 6. This depends on the amount of waste taken out.

Top comb down at 5 for Sea Island, Egyptian, Allen, Peeler, and 1¼ cotton 5½ to 6.

Nippers way up at 7¾ index.

Nippers down and back at 12 index.

Catch out of notch 12 index.

Catch down and back 2 index.

Set brass roll to 21 gauge 18 index.

Set brushes to bottom of needles.

Comber Needles.

No. of Bars.	Size Needles	No. per In.	No. in Bar
1, 2, 3, 4, 5, 6, 7,	22	28	266
7, 8, 9,	24	34	323
10, 11,	26	48	456
12, 13,	28	54	513
14, 15,	30	66	627
16, 17,	33	80	855

Comber Hand Work.

After starting in morning, oil detaching rolls, stop the comber with the nippers clear up, raise the top comb, roll out under ends with finger brush, oil rolls, put back in place, put on weight, pick top combs, put down in place and start up comber. Oil top and bottom rolls once a day; oil all combs and bearings and around gear head of machine twice a day. Oil rolls in draw box or head once a day. Oil brush three times a week. Oil all slow motions once a week, Monday morning; oil cylinder shaft once per day; clean and oil combers every Thursday; brush and sweep up four times a day at 8:00, 10:00, 2:00 and 4:00. Wire brush three times per week. Use broom corn to clean under brass guides and detaching roll at 7:20, 9:15, 11:00, 1:30, 3:15 and 5:00 o'clock. Change cans at 7:00, 8:30, 10:00, 11:30, 2:00, 3:30 and 5:00 o'clock, being about 1½ hours between.

FINISHER DRAWING.

The next operation after the comber is two or three processes of finisher drawing. Some mills have only two, most have three. Six ends are doubled into one at each process. Why? Because combing is a very uneven process and you have to double as often as possible to even the work before it gets to the other processes. Care should be taken to crowd these strands close side by side to cover up selvages. The draft should not exceed the doublings. Less is better. The more doubling the evener the yarn. Yarns from No. 50 up should undergo four processes of roving frames, as roving frames even up very fast. Why? Because any imperfections in roving, such as thick and thin places when doubled and redrawn, give these faults a different relation to each other. Thus a thin place on one is apt to come opposite a thick place, and when you run double roving in creel it will give a more even result. The four processes are slubber, first intermediate, second intermediate and jacks or fly frames; rolls, twist and draft must be right on these frames or previous work is ruined.

Rule:—The required hank divided by ½ of hank in creel will give draft required in frame to make required roving without any allowance for take-up in twist. The constant number divided by required draft will give draft gear wanted; then draft multiplied by ½ of hank in creel gives hank on spindle without twist, and that times .98 or 2 per cent. less for twist will give the exact hank that can be made from any hank in creel with any draft on machine.

The number of yards of cloth to the pound avoirdupois=its width in inches by the weight in Troy grains of one square inch and divide the product into 194.44 and quotient will be number of yards to the pound.

To find average number of yarn required to produce cloth of any weight, width and pick, add together number of picks per inch of warp and filling; multiply this sum by number of yards per pound desired and this product by desired width in inches. Divide by 840 and quotient will be the average yarn required; for any increase in weight by sizing or starching the yarn, allowance must be made in the yarn. This will form an approximate basis.

Care of Combers.

All persons employed as operatives or about combers should be instructed as to the importance of having a time to do their oiling, cleaning, brushing, picking top combs and attending to it at that time, and not when they feel like it, as delays are serious. Comber hands should not be allowed to leave their combers to go to sink or talk with any person away from their combers without having someone looking after their work while they are away, as a roller lap may cause a broken cylinder or other serious damage; also other parts may work loose, which means damage to the machine, also bad results to product. The rule should be a place for everything and everything in *its place;* a time for everything and everything *done* at that time.

DRAWING FRAMES.

The process of drawing is very simple and yet it is very important. The rolls should be perfectly true and all parts of machine should be well oiled.

The draft of the machine and the setting of the rolls should be looked after carefully. The draft of machine should never under any circumstances exceed the number of ends put up in the back, and also the draft should not be too short, as the intermediate draft between the rolls will not take care of the sliver in the proper manner, but the cotton will kink up between the rolls and sliver will be bunchy.

Oftentimes the stirrups, which are screwed to the weights, work loose and rest upon a rod which passes through these stirrups for the purpose of lifting the pressure off of the rolls. When this happens the result is uneven drawing sliver, from which will also result uneven slubber roving.

This portion of the frame should be inspected at least once a week.

The speed of front roll on drawing

frame is same as revolutions per minute of pulley on end of this roll; 400 R. P. M. is a good speed to run.

To find the draft of drawing frames, take the back roll gear as the first driver and then the diameter of the front roll and all drivers divided by the diameter of back roll and all driven gears will give draft of the machine.

Back roll gear=45 teeth.
Change gear=50 teeth.
Crown gear=100 teeth.
Front roll gear=22 teeth.
Diameter of back roll=1⅛″.
Diameter of front roll=1⅜″.

Thus:—

$$\frac{45 \times 100 \times 11}{50 \times 22 \times 9} = 5 \text{ the draft of machine.}$$

SETTINGS FOR DRAWING ROLLS.

For 1⅛″ Stock.

First and second rolls=1 5/16″ center to center.

Second and third rolls=1⅜″ center to center.

Third and fourth rolls=1 7/16″ center to center.

For 1¼″ Stock.

First and second rolls=1⅜″ center to center.

Second and third rolls=1 7/16″ center to center.

Third and fourth rolls=1 9/16″ center to center.

For 1⅜″ Stock.

First and second rolls=17/16″ center to center.

Second and third rolls=1½″ center to center.

Third and fourth rolls=1⅝″ center to center.

To find what pinion gear to put on a drawing frame when you wish to change the weight of the sliver:

Rule:—Multiply the number of grains desired by the gear in use and divide by the number of grains in sliver being made at present time.

Example:—A 40 tooth pinion gives 60 grains to the yard, what gear will give 63 grains to the yard of sliver?

$$\frac{63 \times 40}{60}$$

=42 teeth=the required pinion.

To find what draft, in the drawing frame, will produce a required hank drawing from a given hank carding, multiply the number of ends put up into back of frame by the hank drawing required and divide by the hank carding. This will give the required draft.

To find what hank carding is required to produce a required hank drawing with the draft of frame being given, multiply the number of ends put up by the hank drawing required and divide by the draft of the frame. This will give the required hank carding.

To find the coils of drawing in the drawing can for each revolution that the can makes, take the bottom plate as a driver and its speed as 1, and then ascertain by speed rule the number of revolutions that the top coiler plate makes to 1 of the bottom.

The rolls should be set ⅛", 3/16", and ¼" for the first and second, second and third, third and fourth, respectively. This designates the distance between the centers of the rolls over and above the length of staple.

The back rolls are set farther apart because they have to take care of the stock in a more bulky form than the others.

The production of a drawing frame is found by multiplying the circumference of calender roll by revolutions per minute by total minutes run by weight of one yard of sliver by number of deliveries and dividing by 36 inches in one yard and 7000 grains in one pound.

Diameter of calender roll=3".

Revolutions per minutes=250.

Number of deliveries=6.

Weight of one yard=80 grains.

Time frame runs=50 hours.

What is production?

$$\frac{3\times3.1416\times250\times6\times60\times50\times80}{36\times7000}$$

=1346 lbs.

A good roll varnish for leather covered drawing rolls:—

8 ozs. glue.

4 ozs. gum arabic.

1 qt. Ascetic acid.

Boil till glue and gum arabic are thoroughly dissolved, and then, after the mixture cools off, add one tablespoonful of oil of origanum. Keep in tightly corked bottle and pour out each time only what is needed to varnish the rolls on hand.

Total and intermediate or break drafts of drawing: back roll=1⅛" diameter=43 tooth gear.

Gear on end of back roll=24 teeth.

This 24 drives a gear of 36 teeth.

On same stud as 36 is a 40 tooth gear.

This 40 drives third roll gear 24 teeth.

Draft gear=45 teeth.

Crown gear=98 teeth.

Front roll gear=22 teeth.

Gear on end of front roll=24 teeth.

This 24 drives gear of 40 teeth.

On same stud as 40 is a gear of 24 teeth.

This 24 drives second roll gear of 38 teeth.

Diameter of second, third and fourth rolls=1⅛".

Diameter of front roll=1⅜".

$$\frac{24\times40\times9}{36\times24\times9}$$

=1.111=draft between third and fourth rolls.

$$\frac{38\times40\times11}{24\times24\times9}$$

=3.225=draft between first and second rolls.

$$\frac{24\times36\times43\times98\times24\times24\times9}{40\times24\times45\times22\times40\times38\times9}$$

=1.452 draft second and third rolls.

1.111×1.452×3.225=5.20=total draft rolls.

$$\frac{43\times98\times11}{45\times22\times9}$$

=5.20=total draft of rolls.

SPEED FRAMES.

The slubber is the first speed frame upon which the roving is placed upon a wooden bobbin.

The draft of slubber should run between 4 and 5.

The hank slubber roving depends a good deal upon the requirements of the room, as the slubbers have to turn off a sufficient production to keep the next process supplied.

To find the draft constant on slubber, take the back roll gear, crown gear, front roll gear and diameters of both the back and front rolls. Then the diameter of front roll times back roll gear, times crown gear, divided by front roll gear, times diameter of back roll will give the draft constant.

Back roll gear=56.
Crown gear=90.
Front roll gear=40.
Diameter back roll=1″.
Diameter front roll=1¼″.

$$\frac{56 \times 90 \times 10}{40 \times 8}$$

=157.50=constant draft.

Constant divided by draft desired will give the gear needed.

Rule to find twist gear to put on frame: Square the number of teeth in gear that is on frame at the present time, multiply by the hank roving being made, divide by the hank desired and find the square root of this result. Thus:—If you are making a .40 hank roving and you have a 45 tooth twist gear on the frame, what twist gear will be required for a .50 hank roving?

$45 \times 45 = 2025.$
$2025 \times .40 = 810.$
$810 \div .50 = 1620.$

The square root of 1620=a 40 tooth twist gear.

To find the lay gear proceed in same manner as in finding the twist gear.

Roving being made=.40 hank.
Lay gear on frame=35 teeth.
Roving desired=.50 hank.
What lay gear is required?

$35 \times 35 = 1225.$
$1225 \times .40 = 490.$
$490 \div .50 = 980.$

The square root of 980=a 31 lay gear.

To find the draft gear or pinion required when you are changing both the hank roving and also the creel roving.

Rule:—The hank being made, times creel roving desired, times the gear in use, divided by the hank roving desired, times the creel roving in use will give the pinion required.

Example:—If a frame is making a 5 hank roving with a 1.50 hank in the creel and a 35 tooth pinion gear, what pinion will you have to put on to make an 8.00 hank roving with 2.25 hank in creel?

$$\frac{5.00 \times 2.25 \times 35}{8.00 \times 1.50}$$

=32.8 or a 33 tooth gear.

The hank desired on the spindle multiplied by 2 and divided by the draft desired in the frame will give the hank creel roving required.

Example:—If you desire an 8.00 hank roving on the spindle and a draft of 6 in the frame, what hank roving is required in the creel?

$$\frac{2 \times 8.00}{6}$$

$=2.66$ the creel roving required.

To find the production of a speed frame, multiply the circumference of the front roll by the R. P. M. of front roll, times total minute run, times weight of 1 yard, times number of spindles, and divide by 36 inches in 1 yard and 7000 grains in 1 pound.

Example:—R. P. M. front roll=98.

Diameter front roll=$1\frac{1}{8}''$.

Weight of 1 yard=1.04 grains.

Time run=50 hours.

Number of spindles=192.

What is production?

$$\frac{1\frac{1}{8} \times 3.1416 \times 98 \times 60 \times 50 \times 1.04 \times 192}{36 \times 7000}$$

$=823.35$ pounds.

The circumference of front roll times R. P. M., times total minutes run, divided by 36 inches in one yard and 840 yards in one hank will give the hanks per spindle.

Diameter of roll=$1\frac{1}{8}''$.

R. P. M.=100.

Time run=50 hours.

What is hank per spindle?

$$\frac{1\frac{1}{8} \times 3.1416 \times 100 \times 60 \times 50}{36 \times 840}$$

=35.08 hank per spindle.

R. P. M. of spindle divided by the desired turns per inch in roving, times circumference of front roll will give the R. P. M. that front roll will have to make in order to give the required twist.

Example:—If you desire 4 turns to the inch in roving and diameter of front roll is 1⅛″ and spindle turns 1400 times per minute, how many R. P. M. must front roll make to give the desired number of turns per inch?

1⅛″ × 3.1416 = 3.53″ = circumference front roll.

4×3.53=14.12.

1400÷14.12=99 R. P. M. of front roll.

To find average hank, take the number of hanks of each kind and multiply by the average size and find the sum of the several results obtained in this manner; then add together the total number of hanks and divide, and the result will be the average hank.

Example:—

Hank roving	Average size	Hanks per spindle
8.00	8.25	32
5.40	5.15	40
6.00	6.02	38

What is average hank roving?

$$32 \times 8.25 = 264.00$$
$$40 \times 5.15 = 206.00$$
$$38 \times 6.02 = 228.76$$

110	698.76

$698.76 \div 110 = 6.35 =$ average hank.

TWIST IN ROVING.

The amount of twist necessary in roving depends upon the quality and length of staple that is being run through the frame. The standard twist is reckoned at 1.20 times the square root of the hank roving being made.

In some mills the carder is compelled by the superintendent to stick to this standard twist in making roving, and the result is disastrous as far as good spinning is concerned.

There should be twist enough put into the roving so that, as the back roller draws the stock into the frame, the roving will not be stretched, thereby lessening the number of fibers in its cross-section and resulting in bad spinning and light work.

On the other hand, if too much twist is inserted, it will also result in bad spinning, as the twist will resist the effort of the rollers to draw the stock, and will also cut or groove the leather on the top rolls and destroy the usefulness of these top rolls until they are recovered. After the roving reaches the back roll of the frame, the twist has accomplished the purpose for which it is inserted, as the other rolls draw the stock and remove all traces of the twist.

No fixed rule can be given that will answer in all cases concerning the amount of twist that should be inserted, as conditions that exist in one mill may be altogether different to those existing in another. The best way is for each overseer to test the twist in his roving from time to time, and in this way the loss or gain in amount of twist will be noted before the roving gets into the spinning department and causes trouble.

If a full bobbin is stood upon a smooth surface and it is possible to take hold of roving and draw about eighteen or twenty inches from the bobbin without stretching the strand, there is enough twist.

ROLL SETTINGS ON SPEED FRAMES.

Slubbers.

Stock	Steel Rolls	Cap Bars
1⅛ in.	1 3/16 in.	5/16 in.
1¼ in.	1⅜ in.	7/16 in.
1⅜ in.	1½ in.	9/16 in.

First Intermediates.

Stock	Steel Rolls	Cap Bars
1⅛ in.	1 3/16 in.	1/16 in.
1¼ in.	1¼ in.	1/8 in.
1⅜ in.	1 7/16 in.	3/16 in.

Second Intermediates.

Stock	Steel Rolls	Cap Bars
1⅛ in.	1 3/16 in.	1/8 in.
1¼ in.	1¼ in.	3/16 in.
1⅜ in.	1 7/16 in.	3/16 in.

Fly Frame or Jack.

Stock	Steel Rolls	Cap Bars
1⅛ in.	1⅛ in.	1/16 in.
1¼ in.	1¼ in.	1/16 in.
1⅜ in.	1⅜ in.	1/4 in.

The twist per inch is determined by finding how many turns the spindle makes for one revolution of the front roll and then dividing by the circumference of the front roll.

To find the number of revolutions that the spindle makes for one revolution of the front roll, take the gear on end of front roll and its speed as one, and then find speed of spindle by speed rule, thus:—

Gear on end of front roll=115 teeth.
Outside top cone gear=40 teeth.
Inside top cone gear=24 teeth.
Twist gear=41 teeth.
Gear on main shaft=54 teeth.
Outside spindle shaft gear=58 teeth.
Skew gear on spindle shaft=50 teeth.
Gear on spindle=26 teeth.

$$\frac{115\times24\times54\times50}{40\times41\times58\times26}$$

=3.013 turns per revolution.

Circumference of $1\frac{1}{8}''$ roll$=1\frac{1}{8}\times3.1416$ $=3.53''$.

$3.013\div3.53=.853$ turns per inch.

The change places on a speed frame are five in number:—

1. The draft or pinion gear.
2. The lifting or lay gear.
3. The twist gear.

4. The tension or rack gear.

5. The cone gear.

In changing over a frame from one hank roving to another usually the first four only are changed.

To find the hank of any roving reel off any number of yards and multiply this number by 8 1/3 and divide by the weight of this number of yards in grains, and the result will be the hank roving.

Example:—If 60 yards weigh 50 grains, what is the hank roving?

$60 \times 8\ 1/3 = 500.$

$500 \div 50 = 10.$ hank roving.

If 12 yards weigh 20 grains, what is the hank roving?

$12 \times 8\ 1/3 = 100.$

$100 \div 20 = 5.$ hank roving.

If the front roll of a second intermediate frame makes 133 revolutions per minute and has 128 spindles, and the front roller of a jack frame of 192 spindles on 8.00 hank roving makes 98 revolutions per minute, how many jack frames will this second intermediate frame support?

Front roll on second intermediate $= 1\frac{1}{8}''$

diameter.

Front roll on jack frame=1⅛″ diameter.

Back roll on jack frame=1″ diameter.

Front roll gear jack frame=30 teeth.

Crown gear jack frame=100 teeth.

Draft gear jack frame=30 teeth.

Back roll gear jack frame=56 teeth.

First find yards produced per minute by front roll on second intermediate.

$$\frac{133 \times 1\tfrac{1}{8} \times 3.1416 \times 128}{36} = 1671.33 \text{ yards per minute.}$$

Next find speed of jack frame back roll.

$$\frac{98 \times 30 \times 30}{100 \times 46} = 15.75 \text{ R. P. M.}$$

$$\frac{15.75 \times 8 \times 3.1416 \times 384}{8 \times 36} = 527.78 \text{ yards per minute.}$$

$1671.33 \div 527.72 = 3.16$ frames.

What would be the rovings and weights necessary to make a 40's yarn with the following drafts in the different machines through which a carded yarn would pass? Roving run double in spinning frame.

Draft of spinning frame=10.

Draft of jack=6.

Draft of second intermediate=5.32.

Draft of first intermediate=5.

Draft of slubber=4.

Draft of finished drawing=5. (6 ends up).

Draft of breaker drawing=4.5 (6 ends up).

Draft of card=100.

Draft of finisher picker=5. (5 laps fed).

Draft of intermediate picker=4.5 (4 laps fed).

$2 \times 40 \div 10 = 8.00$ hank roving in spinning creel.

$2 \times 8.00 \div 6 = 2.66$ hank roving in jack creel.

$2 \times 2.66 \div 5.32 = 1.00$ hank roving in second intermediate creel.

$2 \times 1.00 \div 5 = .40$ hank roving in first intermediate creel.

$40 \div 4 = .10$ hank drawing=83 grains to yard.

$83 \times 5 \div 6 = 69$ grains per yard off breaker.

$69 \times 4.5 \div 6 = 51.7$ or 52 grains per yard carding.

$52 \times 100 = 5200$ plus .05 for waste $= 5460$ grains or 12.22 ozs.

$12.22 \times 5 \div 5 = 12.22$ ounces to yard intermediate lap.

$12.22 \times 4.5 \div 4 = 13.75$ ounces to yard on breaker picker.

The Lifting Roll on Back of Slubber.

The surface speed of this lifting roll, which raises and supports the strand of drawing sliver in its passage, from the can to the back roll of slubbing machine, should at least equal and in fact slightly exceed the surface speed of the back roll. This causes the drawing sliver to be delivered to the back roll without having been stretched, as is the case when the back roll drags the drawing sliver faster than the lifting roll delivers it.

Most carders take it for granted the surface speed of this roll is correct and, in fact, never think of it.

Example:—Front roll=250 R. P. M.

Small front roll gear=40 teeth.

Crown gear=90 teeth.

Draft gear=35 teeth.

Back roll gear=56 teeth.

Chain gear on back roll=12 teeth.

Diameter of back roll =1″.

Diameter of lifting roll=2⅜″.

What chain gear should be on lifting roll?

$$\frac{250 \times 40 \times 35}{90 \times 56}$$

=69.44 R. P. M. of back roll.

1″×3.1416=3.1416 inches = circumference of back roll.

69.44×3.1416 = 217.15 inches drawing required per minute.

2⅜″×3.1416=7.46 inches = circumference of lifting roll.

217.15÷7.46=27.70 R. P. M., lifting roll should make.

$$\frac{69.44 \times 12}{27.70}$$

=30 teeth on end of lifting roll.

Total and intermediate drafts of speeder.

Back roll=56 tooth gear=1″ diameter.

Crown gear=100 teeth.

Draft gear=35 teeth.

Front roll=40 tooth gear=1¼" diameter=100 R. P. M.

25 tooth gear back roll drives 23 teeth middle roll.

Find total and intermediate drafts.

$$\frac{56 \times 100 \times 5}{35 \times 40 \times 4} = 5 = \text{total draft.}$$

$$\frac{25 \times 1''}{23 \times 1''} = 1.087 = \text{draft between second and third rolls.}$$

$5. \div 1.087 = 4.599 =$ draft between first and second rolls, or

$$\frac{100 \times 40 \times 35 \times 25}{100 \times 56 \times 23} = 27.15 \text{ R. P. M. of second roll.}$$

$27.15 \times 3.1416 = 85.29$ inches delivered per minute second roll.

$100 \times 1\frac{1}{4} \times 3.1416 = 392.70$ inches per minute first roll.

$392.70 \div 85.29 = 4.60 =$ draft between first and second rolls, or

$$\frac{23 \times 56 \times 100 \times 10}{25 \times 35 \times 40 \times 8}$$

=4.60=draft between
first and second rolls.

4.60×1.087=5.0002=total draft.

Costs of Carding.

If picker room turns out a production of 60,000 pounds and the total amount paid in that portion of the room is $42.00, the cost per pound equals $42.00÷60,000=.0007 per pound.

If the cards produce 51,000 pounds of sliver and the total amount paid is $70.00, the cost per pound for obtaining this sliver equals 70.÷51,000, or .00137 per pound.

If combers produce 45,000 pounds with total pay amounting to $65,00. the cost per pound equals 65.÷45,000, or .00144 per pound.

If total production on draw frames is 40,000 pounds and the total pay amounts to $32.00, the cost per pound equals 32.÷40,000, or .0008 per pound.

If slubber frame has 64 spindles and size of roving is .40 hank and price per hank is .09, what is cost per pound?

64÷.40=160 pounds produced for .09.

.09÷160=.00056 per pound.

If first intermediate frame has 108 spindles and size of roving=1.00 hank and price per hank=.11, what is the cost per pound?

108÷1.00=108 pounds for .11.

.11÷108=.00101 per pound.

If the second intermediate frame has 128 spindles and roving sizes 2.66 hank and price per hank equals .11, what is the cost per pound?

128÷2.66=48 pounds for .11.

.11÷48=.00275 per pound.

If jack frame has 192 spindles and roving sizes 8.00 hank and price per hank is .13, what is cost per pound?

192÷8.00=24 pounds for .13.

.13÷24=.00543 per pound.

If total amount paid to overseer, second-hand and other necessary help equals $180.00 and pounds produced equal 40,000, the cost per pound equals:

180.÷40,000=.0045 per pound.

Thus, summing up total cost per pound, we have the following:—

	Per lb.
Cost of picking	.0007
Cost of carding	.00137
Cost of combing	.00144
Cost of drawing	.0008
Cost of slubbing	.00056
Cost of first intermediate.........	.00101
Cost of second intermediate.......	.00275
Cost of jack	.00543
Cost of overseer, second-hand, miscellaneous	.0045
Total cost in card department.	.01856

CONSTANT NUMBERS.

On almost all machines used in the carding department it is possible to change the speed of certain parts by putting on gears or pulleys of different sizes, according to the required change.

The particular gear provided for this purpose is known as a change-gear; whenever a calculation is to be made, where a change-gear is used, it is possible to obtain what is known as a "constant," whereby it is easy to obtain any desired result without having to go through the entire calculation every time. This constant represents a part of the calculation already worked out, and, in practice, the knowledge of the constants of the different machines results in the saving of considerable time to the overseer.

To find constant, whether the calculation is for speed, draft or other result, proceed with the calculation under the regular rule for obtaining the result; but suppose the change-gear to have only one tooth. Suppose a shaft making 300 R. P. M. carries a 90 tooth change-gear, which drives a 50 tooth gear on another shaft, which also carries a 30 tooth gear that drives a 45 tooth gear, what is speed of 45 tooth gear?

$$\frac{300\times 90\times 30}{50\times 45}$$

$=360$ R. P. M.

Now, supposing the change-gear has only one tooth, what is the constant?

$$\frac{300\times 1\times 30}{50\times 45}$$

$=4$ constant speed.

Now, having found the constant, it is an easy matter to find what change-gear will give the speed required.

Divide the required speed by the constant and the result will be the required gear.

If you desire to run this shaft at a speed of 300 R. P. M., what is the change-gear required?

$300\div$the constant $4=75$ teeth required in the change gear.

SQUARE ROOT.

To find the square of a number, multiply the number by itself.

What is the square of 25?

25×25=625, the square of 25.

What is the square of 13?

13×13=169, the square of 13.

In finding the square of any number of which the last figure is 5, the last two figures will always be 25, and a short method of finding the square of any number ending with the figure 5 is to place the figures 25 down and then multiply the number before the figure 5 by one number higher than itself, and place result before the 25, thus:—

What is the square of 25?

First put down the number 25.

Second multiply the figure before the 5 by 3, which is one number higher than 2; then 3×2=6; affix 25 to 6 and you have 625 Ans.

What is the square of 45?

5×4=20; affix 25 and you have 2025 Ans.

What is the square of 115?

12×11=132; affix 25 and 13,225 Ans.

What is the square of 95?

10×9=90; affix 25 and you have 9025 Ans.

What is the square root of any number?

The square root of a number denotes the number which multiplied by itself will equal the number of which you desire to find the square root.

To find the square root of any number, put down the number and then, starting at the right, separate the number into periods of two figures each; thus, if you desire to find the square root of 13,225, after separating into periods you will have the first period of 1; the second will be 32 and the last will be 25, and in putting the number down on paper it will look like this, √1 32 25. As there are only five figures in the number, the first period will consist of only one figure, the figure 1.

Then proceed as follows:—

√1 32 25(115

1

21×1)32

```
          21
        ----
225×5)1125
      1125
      ----
```

Rule for Square Root.

First find the largest number which multiplied by itself will be contained in the first period. Place this figure in the quotient, then place its square under the first period. After subtracting, bring down the next period of two figures. Now double the figure in the quotient and place it at the left for a trial divisor as in example.

In example, 1 is the first figure in the quotient, as it is the largest number which, multiplied by itself or squared, will be contained in the first period, which is 1. After subtracting, the next period, which is 32, is brought down; double the first figure of the quotient for a trial divisor and you have 2; 2 is contained in 3 once; so place 1 in quotient as second figure, also affix the figure 1 to the trial divisor and you have 21. 21×1 or 21 is placed under the 32 and subtracted and leaves 11 for a remainder. Bring down the next period, which is 25, and affix it to 11, and you have 1125 for a dividend. Now multiply the two figures of the quotient by 2 and you have 22, which you place at the left for a trial divisor. 22 will go into 112 five times; place the figure 5 in the quotient and also affix the figure 5 to the number 22 and you have 225 for a divisor; then 5×225=1125, which, being placed under the dividend, leaves no remainder; therefore the square root of 13,225=115.

Multiply the quotient by itself, and its product is same as number of which you wish to extract the square root, the example is correct.

What is square root of 85,264?

```
         √8  52  64(292=square root
          4
          ---------
   49×9)452
         441
         -----
  582×2) 1164
         1164
         ----
```

No.	Sq.Rt.	No.	Sq.Rt.	No.	Sq.Rt.
1.00..	1.00	5.50..	2 345	10.00..	3.162
1.26..	1.122	5.80..	2.408	11.00..	3.217
1.50..	1.225	6.00..	2 449	12.00..	3.464
1.76..	1.327	6.20..	2.490	13 00..	3.606
2.00..	1.414	6.50..	2 550	14.00..	3.742
2.24..	1.497	6.80..	2.608	15.00..	3.873
2.50..	1.581	7.00..	2 646	16.00..	4.00
2.76..	1.661	7.20..	2.683	17.00..	4.123
3.00..	1.732	7.50..	2 739	18.00..	4.243
3.20..	1.789	7.80..	2.793	19 00..	4.359
3.50..	1.871	8.00..	2 828	20.00..	4.472
3.80..	1.949	8.20..	2.864	21.00..	4.582
4.00..	2.00	8.50..	2 915	22.00..	4.690
4.20..	2.049	8.80..	2.966	23.00..	4.795
4.50..	2.121	9.00..	3.00	24.00..	4.898
4.80..	2.191	9.20..	3.033	25.00..	5.00
5.00..	2.236	9.50..	3.082		
5 20..	2.280	9.80..	3.130		

WEIGHT OF LAP AND DRAFTS.

Card Drafts.

Ordinary print cloth stock=90 to 115.

Good American cotton=115 to 125.

Staple cotton=125 to 140.

(If conditions permit.)

For print cloth use 16 oz. lap.

For 8. to 12. hank American cotton use 13 to 14 oz. lap.

For 12. to 16. hank Egyptian or peeler use 12 to 13 oz. lap.

Finer hank staple cotton use 10 to 12 oz. lap.

(According to running conditions.)

Have draft on draw frames as long as conditions will allow, keeping under the number of doublings and finishing as light as possible to meet conditions.

Have draft on slubber from 4 to 5.

Have draft on intermediate from 5 to 6.

Have draft on fly frame from 6 to 6.75, not over 7 if possible.

POINTS TO LOOK AFTER IN THE CARDING DEPARTMENT.

In picker room cotton should be mixed carefully. Time spent on this work is never wasted if work is properly attended to.

Picker should be well oiled and kept as clean as possible.

Droppings taken out twice daily.

Eveners inspected daily to see that they are in proper working condition.

One bad working evener motion will throw out the numbers if not promptly attended to.

Have beaters revolve about 1000 R. P. M., not over 1100 R. P. M.

Have fan draft sufficient to lay cotton evenly on cages, but not to drive cotton against cages forcibly. This can best be governed by observation.

Have surface of cages and beater boxes as clean as possible at all times.

Weigh every finished lap made and put back any that vary more than a half pound on either side.

The draft of picking machinery is seldom if ever changed.

Set feed rolls from blade of beater about the thickness of a two-foot rule. Set first grid bar the same, and last grid bar the width of a two-foot rule, and have first grid bar two inches lower than feed roll.

The back grid bars are set farther away from the blade of the beater because after the cotton has been struck from the feed rolls by the beater blade, the fibers are loosened and the cotton has been reduced to a fleecy and fluffy state, and being thoroughly opened requires a larger space. If they are set as close to the beater blade as the front or first grid bars, the beater is liable to roll the fibers into neps, thereby increasing the amount of work that the card has to accomplish.

The air current should enter the trunk of the opener at exactly the same point as the cotton, so that the passage of the cotton through the trunk may be facilitated.

On intermediate and finisher pickers, the air should enter through the grates in the doors of the chamber that is below the grid bars and into which the droppings or impurities of the cotton fall, then under the feed rolls, then across the lower part of the circle described by the beater, then through the surface of the cages, then out through the ends of the cages and finally through the dust flue or pipe that is connected near the fan and conducts the air and dust to the dust room.

This dust room obtains relief from the pressure of air that enters it from the various fans by means of a stack or chimney that permits this air to escape from the dust room.

The area of this air shaft is governed by the number of flues or pipes that lead into the dust room. Care should be taken that the square feet in area of this air shaft exceeds the total area in square feet of all the flues that force air into the room.

If these flues or pipes become clogged up with dust so as to interfere with the proper passage of the air current, the result will be split and ragged edged laps, which are a great detriment to the proper running of the after processes. If fan speed is too great or powerful, some of this dust and droppings will be sucked along with the cotton and result in dirty laps.

On the cards see that setting of the different parts are set properly.

Be careful in putting oil into cylinder boxes, because if too much oil is put into them it runs down the end of the cylinder, works in on the card clothing, saturates the clothing and in a short while the clothing will soften and become useless.

Have defects which some time appear on the cards remedied at once, and do not neglect small defects, as it does not take much to deteriorate the quality of the sliver.

If a card strikes or raises after being set in the proper or desired manner, the clothing should be taken off and redrawn immediately, as a card might as well not be set at all if you have to draw off any of the parts after setting them.

See that cards are perfectly level and air currents securely blocked.

Insist on strippers having the surface of cylinder and doffer perfectly clean when they remove the stripping brush, and not leave a streak of cotton across the face of the clothing.

See that all parts of sliver lap, ribbon lap machines and combers run free and true. That all stop motions, electrical or mechanical, act and stop the machines promptly. Have fluted rolls kept clean and flutes free from dirt and of the proper sharpness so that they will bite the stock in the proper manner. Leather covered rolls must be perfectly true, or cut and bunchy work will result.

On draw frames have roll setting right; have frame well oiled, rolls true and kept varnished, stop-motions acting promptly, stirrups swinging clear of sides of rolls to avoid friction, and clearers kept as clean as possible at all times.

On speed frames see that gearing is oiled properly, rolls set to suit staple; that surface speed of lifting roll on back of slubber equals the surface speed of back roll; that the builder works freely; that traverse motion works properly; that clearers are kept clean, and that the holes in traverse rod are not clogged up with bunches of waste.

Terms and Their Meanings.

Power is transmitted by the following means:

1. Pulleys and belting.
2. Pulleys and ropes, cords or "bands."
3. Gearing.
4. Frictional contact.

A shaft is a round bar of either steel or iron that rests in bearings and can be rotated. A very small shaft, if running vertically, is called a "spindle;" if lengthwise an "arbor." The bearing in or upon which the bottom of a spindle runs is known as a "step." The upper bearing which steadies the spindle is known as a "bolster."

A countershaft is one by the aid of which the power is transmitted to the machine and is situated between the main shaft and the machine.

A pulley is a wheel, the face of which is prepared to receive a belt, cord or rope. Pulleys are made of wood, iron or compressed paper. They are fastened to the shaft by set screws or keys and in many instances by both. They are solid, split, flat-faced, crown faced, guide, tight and loose, and tension pulleys.

A flat-faced pulley is one having the whole width of its face parallel to the shaft.

A crown-faced pulley has its face slightly raised in the center. The amount of crowning is about 1/16″ to ⅛″ for high speed pulleys, and about ¼″ per foot of face width for low speed pulleys.

When pulleys are used, tight and loose, in pairs, they are usually made flat-faced; otherwise they are usually crowned.

A split pulley is one that has been made in sections and may be placed on shaft without taking shaft from bearings.

A solid pulley is cast in one piece and has to be slipped over end of shaft.

A guide pulley is one that is used to change the direction of a belt.

A tension pulley is one that is used to increase the arc of contact of the belt on other pulleys, thereby keeping the belt at a proper tension.

A cone may be assumed to be an extra long faced pulley or number of pulleys touching one another on one shaft. The diameter gradually reduces from one end to the other. By moving the belt you obtain a variable speed.

A drum or cylinder is similar to a pulley and has an exceptionally long surface and has the same diameter its entire length.

A rope driven pulley is one that has "V" shaped grooves cut in its face, thereby permitting the rope to obtain a stronger grip on the pulley.

There are several kinds of gears: spur gears, bevel gears, worm gears, sprocket gears, ratchet gears and mangle gears.

Spur gears transmit power between parallel shafts.

Bevel gears transmit power between non-parallel shafts.

Worm gears are driven by a screw or thread known as a worm. This method is used when a very low speed is desired.

Sprocket gears drive by means of chains.

Ratchet gears are used to obtain intermittent motion and are driven by a pin.

Mangle gears obtain reciprocating motion from rotary motion.

Oiling.

As pickers are heavy running machines, they should be oiled twice daily.

Cards should be well oiled daily; comb-boxes at least twice a week, and also have grinders examine comb-boxes daily so that they will detect any that are liable to heat up and posslbly cause fire.

Oil drawing frames each day.

Have fast motions on speed frames oiled twice a day and all slow motions once a week.

Insist on speeder tenders oiling their spindles the first doff each morning.

Oil spindle steps once a month.

Rolls on speeders should be oiled daily.

Examine hook bolster bearings on which bobbin gear shafts run at least once a month to be sure they contain a sufficient quantity of tallow.

Examine spindle shaft bearing in the same manner twice a year.

Oil spindle and bobbin shaft bearings

once a week.

Strict adherence to these rules will save many dollars for the company in a year's run in the line of repairs.

Scouring.

The work of scouring the different machines should be systematized in such a way that by doing a little each week the work will be accomplished with as little hindrance as possible to the smooth running of the different sections of the department, and also so that the regular production will not be seriously diminished.

The pickers should be thoroughly scoured every two months.

Drawing frames every four or five weeks.

Steel rolls on slubbers and first intermediate frames twice a year.

Steel rolls on second intermediates, fly frames and jacks should be done annually.

Bolsters on speed frames should be cleaned at least once a year.

Bobbin gears and bobbin gear rails should be cleaned monthly.

Spindle gears ought to be cleaned at least once a year, twice if possible.

If these rules are followed, cleanliness should be the result.

Recovering of Top Rolls.

The cost that is entailed in the carding department by the repairing or covering of top rolls is an expensive item, and the changing of leather covered top rolls should be carefully and intelligently looked after, as in many mills several top rolls are taken out and sent to be recovered when, if they were examined, they would be found to be in condition to run for another month. When changing top rolls the best way is to examine all the rolls carefully, pick out those that you desire to send away; change the rolls that remain by placing the second row in the back and filling in the first row with what new rolls you put in the frame. In this way you will be sure to always have a good front roll, which is absolutely necessary for the making of good roving. Top rolls on draw frames should always have a good coat of varnish upon them, especially the front roll.

Waste.

The waste problem is a serious one for the manufacturer, and every possible method that is conceived of is tried for the purpose of reclaiming the loss that is incurred by making of waste. Thousands of pounds of waste are made annually, and several thousands of pounds are made either through carelessness or thoughtlessness on the part of the employees.

What is meant by unnecessary waste and where is it most apt to be made?

Unnecessary waste is made at almost every process through which the cotton passes until it is finally transformed into cloth.

In the carding department unnecessary waste is made principally at the card, the drawing frame, and on the speed frame.

At the card a stripper will oftentimes have laps running out, and the other laps on this section will probably have sufficient yards of cotton lap to run the card for perhaps one-half to three-quarters of an hour, but instead of allowing these laps to run until the most tightly compressed part of the lap appears, which is about one yard from the end, he pulls out these laps for no other purpose than to have the laps all in together, so that he will not have to go back to change them later.

At other times he will see an end of sliver broken and running on to the floor, but he takes his own time about piecing it up again. This is unnecessary waste and should not be tolerated.

At drawing frames and slubbers, if the sliver does not happen to have been spliced together at the previous process, the employee thinks nothing of taking a handful of perfectly coiled and good sliver and casting it into a waste can.

At the speed frames a speeder tender will take out pieces or bobbins containing an hour's run on them and make waste of the roving on those bobbins either by cutting them off or pulling the roving from the bobbin. This is unnecessary waste.

ADVANTAGES OF TEXTILE SCHOOL.

Every young man who enters into any business should be imbued with the ambition to gain a place at the top of the business from which he hopes to obtain his livelihood.

To the young man in the cotton industry the evening textile school is an invaluable assistance, as it teaches young men, who unfortunately lack the advantages of a higher education, the rudimentary and theoretical knowledge that is necessary, in conjunction with the practical experience which they obtain while they are working at their positions during the day, for them to rise above the common laborer.

The textile school nurtures and in fact furnishes food to the brain, enkindles a latent ambition, stirs a man up so that, instead of being a sluggish machine, he desires to be a strong, capable, and efficient manager.

The testing, during the day, of the studies that he follows up during the evening, makes of him a person who is interested in his work instead of one who does only enough and no more each day than will satisfy the boss.

Many intelligent, practical men are kept back by lack of the theoretical knowledge that is necessary to enable them to become efficient managers, and as they have not the means to obtain this knowledge except after working hours, the textile school is a valuable friend and should be supported by any community that is fortunate enough to have one.

QUALIFICATIONS FOR A GOOD OVERSEER.

The overseer should have courage, caution, patience, perseverance, and determination. A combination of these attributes in a more or less degree goes to make what is known as man, and as the overseer is the one person upon whom the owners or managers of a factory, or in fact of any concern or establishment, place their dependence or confidence, he should do his best to show himself worthy of the confidence manifested by his superiors; and in what better way can he prove himself worthy of this confidence than by being a man in the true sense of the word at all times and in running his department in a straightforward, honest and conscientious manner?

The position of an overseer is not as comfortable a position for a man as it appears on the surface, as he has to take what is handed out from both ends of the line; in other words, from capital and labor. And the manner in which the overseer handles and straightens out the differences and frictions that arise in his department denotes his fitness or lack of fitness for the position that he is intrusted with.

To gain the confidence of the operatives it is necessary for the man in charge to be absolutely fair and square both to employer and employee.

To be unfair to either one is soon certain to make the overseer's position untenable.

The overseer should study the temperaments and dispositions of the operatives under his charge. Many hands are lost to a company through lack of patience on the part of the overseer.

Favoritism is one thing that an overseer should carefully guard against, and he should at all times insist that his second-hand and section hands treat his employees as human beings, as the employee is the most necessary adjunct to the business.

INSTRUCTIONS FOR GRINDERS.

1. The grinder and the assistant grinder are responsible for the work of the strippers and for the condition of cards.

2. Any difficulty with cards or neglect of work by strippers is to be reported to the overseer at once.

3. All settings and gearing must be made as the overseer directs, and no changes of the same made without his knowledge.

4. The grinder or his assistant will attend to oiling of comb-boxes, cylinders, doffers and lickers-in, and will see that other oiling is done properly by strippers.

5. Grind lightly and often is the rule.

6. One card is to be ground daily by each set of wheels.

7. Strip cards for grinding at 4:45 so as to have them clear by 6:00.

8. Take wheels off grinding cards at 5:00, and see that new ground cards are all right and that the grinding wheels are in proper condition for the next day.

9. Have cards set up and wheels going by 7:30.

10. During the day the grinder and assistant will see that the strippers attend to their work as directed.

11. While grinding, the boxes of the licker-in and feed rolls must be cleaned and the licker-in screens scoured; also see that mote knives are in place.

12. Settings of doffer, feed roll, licker-in and mote knives will be tried at each grinding.

13. Settings of "tops" will be tried at direction of the overseer.

INSTRUCTIONS FOR STRIPPERS.

All cards must be running at 6:50 and 1:00 P. M.

Strip cards twice daily, beginning as soon as cards are straightened out, and have stripping all done by 8:00 A. M. and 2:30 P. M.

All cards *must* be rolled out daily.

Wipe fronts with waste at 8:00, 9:30 and 11:30 A. M.; 2:30, 4:00 and 5:30 P. M. This is important and must be followed closely.

Keep waste off the floor at all times and the floor swept as the grinder directs.

Cards will be doffed promptly at direction of grinder, and cans pushed out of card alleys to drawing frames.

Cards will be cleaned thoroughly twice daily with short handled brooms provided by grinder

Oiling will be done before 9:30 A. M.

Stripping and putting in of laps must be done exactly as the grinder directs.

INSTRUCTIONS FOR SPEEDER TENDERS.

1. Oil spindles during first doff each morning. Section men will allow *no* exception to this rule.

2. See that steel rolls are clean at all times.

3. Clean top rolls thoroughly once each week. Wipe top rolls and cap bars daily.

4. Oil top rolls weekly after cleaning.

5. Pick clearers at 7:45, 10:15, 1:30 and 4:15 daily.

6. Wipe roller beam at 11:00 and 5:00 P. M. daily. Pick spindle bottoms between 5:00 and 6:00 P. M. daily.

7. Clean entire frame thoroughly each Saturday morning.

8. Clean bobbin gears during first week of each month. One hank per frame is allowed for this work.

9. Wipe creels before putting in roving. Keep bobbins and skewers in creels free from fly at all times.

10. Sweep alleys immediately after picking clearers or after doffing.