

WOOLEN CARDING

(PART 3)

CARD CLOTHING

1. Card clothing, the material with which the various rolls of the card are covered and by means of which the wool or other stock is opened out and prepared for the spinning, consists of wire teeth set in leather or some other suitable foundation and having a bend, or forward inclination, from a point called the **knee** of the tooth. The foundation employed for woollen cards is generally leather, but on cotton and worsted cards various woven combinations are used.

Flexifort, a foundation largely used for worsted card clothing and frequently for woollen cards, consists of a woven fabric, generally cotton or cotton and wool but sometimes composed of cotton and linen, the face of which is covered with a veneering of india rubber. The india rubber gives a firm yet elastic foundation and is especially adapted for worsted carding, as this fiber is carded while moist; any dampness would rot either a cotton or a leather foundation for the clothing. On cotton cards combinations of wool and cotton are generally used for the clothing. Leather is generally used as the foundation of clothing for woollen cards. Rubber clothing cannot be used for woollen cards, as the oil that is applied to the wool will quickly weaken the rubber.

2. Wire.—Besides the foundation, several points in regard to the wire should be carefully noted: (1) Its character as to shape and preparation; (2) the angle at which it

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passes through the leather; (3) the angle at the bend, or knee; (4) its size; (5) its setting in the foundation.

Card clothing is set with many kinds of wire—iron, steel, tempered steel, brass, tinned, etc.—but the best wire to use for woollen carding is the tempered steel, which makes a springy, elastic tooth that is not easily bent out of place. The wire is better if tinned, as then there is no liability of the clothing rusting during damp weather or if water is applied to the stock. *Round wire* is generally used, although another kind, known as the *elliptical wire*, which is made by

TABLE I

Birmingham		American	
No. of Wire	Diameter Inch	No. of Wire	Diameter Inch
28	.014	28	.012641
29	.013	29	.011257
30	.012	30	.010025
31	.010	31	.008928
32	.009	32	.007950
33	.008	33	.007080
34	.007	34	.006305
35	.005	35	.005615
36	.004	36	.005000

passing round wire through heavy rolls and slightly flattening it out, is sometimes used. *Triangular wire* has also been used, as well as the *diamond-point wire*, which is used for licker-in and feed-rolls.

Fine wire is more elastic than coarse wire and has a gentler action on the stock and also allows of a more open set of the clothing with the same number of points per square foot. If nothing but the wool to be carded comes in contact with the wire, fine wire will be found to be as durable as coarse, but the fine clothing will necessitate more careful handling and grinding. When a uniform quality of

stock is carded the clothing can be adapted to it; but where several kinds and qualities of wool are used, it is best to have the wire fine enough to handle the best quality of wool and the coarser kinds will not be injured, neither will the clothing with proper care.

Two gauges are commonly used for determining the number, or size, of wire; namely, the English, or Birmingham, and the American, or Brown & Sharpe. Table I shows the comparative sizes of the two systems. The card gauges used for determining the proximity of one roll of a card to another, such as the setting of the workers to the main cylinder, are also based on the same system as wire gauges.

The standard sizes of wire used on woolen cards are usually No. 33 wire, American gauge, for first breaker, No. 34 wire, American gauge, for second breaker, and No. 35 wire, American gauge, for finisher card. The fancy on each card is usually made one number coarser and the wire set more open. Doffers are sometimes covered with wire one number finer, while tumblers are usually clothed with coarser wire. This depends on the carder and is usually designated when ordering the cards.

3. The wire teeth are placed through the foundation by a machine that automatically cuts the wire and bends it in the form of a staple, pierces the holes in the foundation, thrusts the wire through, and then makes the knee, or forward bend. The wire is not passed straight through the foundation but at an angle opposite to that of the forward inclination of the tooth; this angle is very slight and serves to offset the bend at the knee of the tooth. This is shown in Fig. 1, which also shows the forward bend of the wire. The wire passes through the leather foundation *a* at an angle and is bent forwards again at the knee *b* until the point *c* touches the perpendicular *de*, which is drawn from the point where the wire issues from the foundation,

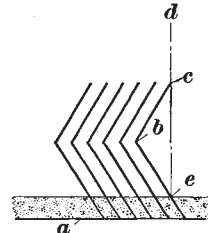


FIG. 1

The tooth should not be bent forwards past the perpendicular to any great extent; for if it is, the point will rise when the strain comes on the tooth, owing to the arc in which the tooth moves, as the wire is not held perfectly rigid, but a certain amount of play is allowed, owing to the flexible nature of the foundation and of the wire. Thus, if the tooth is inclined forwards past the perpendicular line, the strain on it when carding will raise its point and make the setting of the card closer; that is, the slight raising of the point will have the same effect as setting the rolls nearer to each other. On the other hand, if the point of the tooth just reaches the perpendicular, any strain on the tooth will have the effect of depressing the point; this will increase the distance between

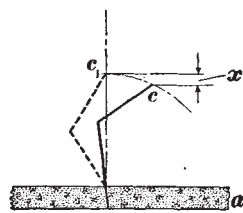


FIG. 2

the rolls or make the setting more open, thus easing the strain. In order to make this clear, reference is made to Fig. 2; if the tooth were pushed from c to c_1 , its point would be raised the distance x , which in some cases might be sufficient to put it in contact with another roll. Besides, there is a tendency of the tooth to straighten at the knee, which will also have the effect of raising the point.

4. Clothing for Workers and Strippers.—Fig. 1 shows the general proportions of clothing suitable for the workers and strippers of a woolen card. It will be noticed that the distance between the knee and the foundation of the clothing is just a trifle shorter than that between the point of the tooth and the knee. This is about the right place for the forward bend of an ordinary working tooth to commence. The nearer the knee is to the point of the tooth, the stronger will be the clothing and the more tenaciously will it hold the fibers of the stock; on the other hand, the nearer the knee is to the base of the tooth or the foundation of the clothing, the more flexible will be the clothing and the more will its action resemble that of a brush.

5. Clothing for the Fancy.—Fig. 3 shows a section of a piece of card clothing such as is used for covering the fancy. The wire is longer than the ordinary tooth and more flexible, and the knee is lower, because the fancy is set into the teeth of the main cylinder and acts as a brush. The knee is often made even lower than is shown. It will be noticed that the point of the tooth of the fancy clothing in the illustration projects beyond the perpendicular. This is not a disadvantage unless the bend is extreme, for as the teeth on this roll do not engage with the wool, there is no danger of the point of the tooth being lifted, owing to the direction of rotation and surface speed of the fancy; however, if the bend at the knee is extreme, the fancy will pack the main cylinder with wool.

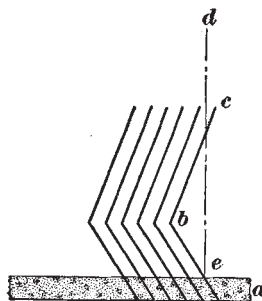


FIG. 3

Straight wire is sometimes used for the fancy, but it often has a tendency to make a large amount of flyings by throwing the wool from the cylinder, especially if the clothing is applied with considerable tension and the fancy is not speeded just right.

SHEET AND FILLET CLOTHING

6. There are, generally speaking, two varieties of card clothing—*sheet* and *fillet*, or *filleting*. The sheet clothing is manufactured in sheets 5 inches wide and as long as the width of the card on which they are to be used. Fillet clothing is made in long, continuous strips, 1, $1\frac{1}{4}$, $1\frac{1}{2}$, or 2 inches wide; it is wound continuously around the roll to be covered.

Sheet clothing is commonly used on the main cylinders, while filleting is used for all other rolls of the card, except those covered with metallic clothing and the finisher doffers, which are covered with rings of clothing that are slipped on and spaced evenly apart. The finisher cylinder is sometimes covered with filleting, which is to be preferred. The teeth are set into sheet clothing so that their crowns—the parts of

the teeth on the back side of the clothing—are *twilled*; that is, they are set in diagonal lines like a piece of twilled cloth. Sometimes sheet clothing is made *plain set*, that is, with the crown of the teeth overlapping in the same manner as bricks are laid; although this form has been extensively adopted in England, it is not generally used in America. Here most of the cards are clothed with 8-crown twilled clothing. Fillet clothing is always *rib-set*; that is, the teeth are so inserted through the foundation that the crowns form ribs on the back running lengthwise of the fillet; the teeth in

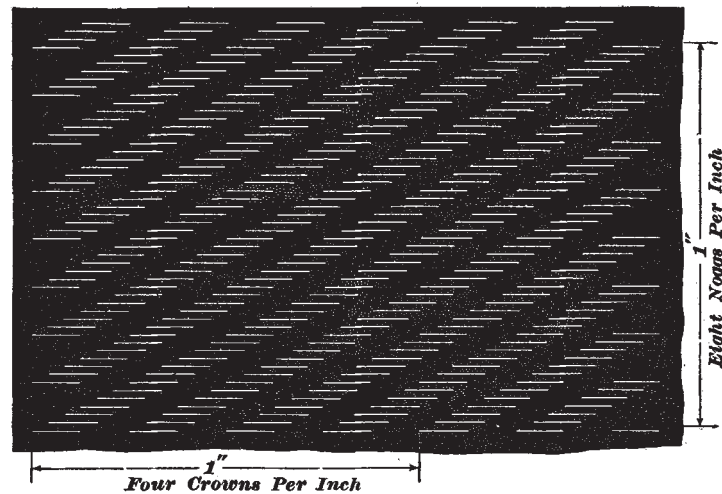


FIG. 4

rib-set clothing may be either twill set or plain set. To find the **crown** of a piece of clothing, the number of crowns, or backs, of teeth in 1 inch of two rows should be counted. Therefore, 8-crown clothing would contain 4 crowns per inch across the clothing, but there would be eight points per inch in one row on the face of the clothing, as there are two points to every crown. The piece of sheet clothing shown in Fig. 4 is 8-crown clothing, having 4 crowns per inch. Fancy clothing is more open, being usually set with 4 crowns for fillet $1\frac{1}{2}$ inches wide.

7. The **nogg** is the distance between the first tooth of one line of twill and the first tooth of the next line; thus, if as in Fig. 4 the clothing has a 6-twill, there are 6 teeth per nogg. If more points per square foot are wanted, the number of noggs per inch is increased; if less points are desired, the number of noggs is reduced. The noggs run crosswise of the sheets of sheet clothing and lengthwise of the strip of fillet clothing. After either sheet or fillet clothing is applied to the card, the noggs always run around the rolls, while the crowns extend from side to side of the card.

CALCULATIONS

8. To find the number of points per square foot in card clothing:

Rule.—*Multiply the number of crowns per inch by the number of noggs per inch, by the number of teeth per nogg, by the number of points per tooth (2), and by the number of square inches in a square foot (144).*

EXAMPLE.—Find the number of points per square foot in the sample of card clothing shown in Fig. 4, the number of crowns per inch being 4, the number of teeth per nogg 6, and the number of noggs per inch 8.

SOLUTION.—

Number of crowns per inch . . .	4	
Number of noggs per inch . . .	8	
	32	
Number of teeth per nogg . . .	6	
	192	
Number of points per tooth . . .	2	
	384	
Number of inches per square foot	144	
	1536	
	1536	
	384	
	55296	points per sq. ft. Ans.

When the number of points per square foot is divided by the number of noggs per inch, it will be noticed that, with

8-crown clothing (4 crowns per inch), each nogg increases the number of points per square foot by 6,912, thus: $\frac{55296}{8} = 6,912$. From this it will be seen that in order to find the number of points per square foot in 8-crown (4 crowns per inch) sheet clothing, it is only necessary to multiply the number of noggs per inch by 6,912.

Fig. 5 shows a piece of $1\frac{1}{2}$ -inch rib-set fillet that is made 8-crown, the same as sheet clothing; however, fillet clothing

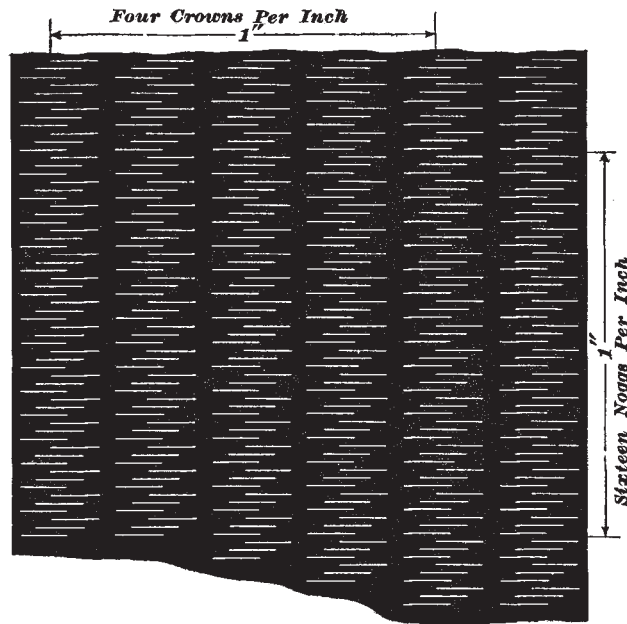


FIG. 5

is set for the same size of wire with twice the number of noggs per inch and one-half the number of teeth per nogg.

9. The rule for finding the number of points per square foot in fillet clothing is the same as for sheet clothing.

EXAMPLE.—If the fillet shown in Fig. 5 has 4 crowns per inch, 16 noggs per inch, and 3 teeth per nogg, what is the number of points per square foot on the face of clothing?

SOLUTION.—

Number of crowns per inch . . .	4	
Number of noggs per inch . . .	16	
	64	
Number of teeth per nogg . . .	3	
	192	
Number of points per tooth . . .	2	
	384	
Number of inches per square foot	144	
	1536	
	1536	
	384	
	55296	points per sq. ft. Ans.

When the number of points per square foot is divided by the number of noggs per inch, it will be noticed that each nogg in 8-crown fillet clothing increases the number of points per square foot by 3,456. From this it will be seen that in order to find the number of points per square foot in 8-crown fillet clothing it is only necessary to multiply the number of noggs per inch by 3,456.

The following tables show the number of points per square foot for different-sized wire that are regarded as the standard number for 8-crown clothing (4 crowns per inch) and orders for any number of wire are usually filled by manufacturers in accordance with them:

TABLE II
SHEETS

No. of Wire	Noggs per Inch	No. of Points per Square Foot
28	5	34,560
30	6	41,472
32	7	48,384
33	8	55,296
34	9	62,208
35	10	69,120
36	11	76,032

TABLE III
FILLETING

No. of Wire	Noggs per Inch	No. of Points per Square Foot
28	10	34,560
30	12	41,472
32	14	48,384
33	16	55,296
34	18	62,208
35	20	69,120
36	22	76,032

TABLE IV
FANCY FILLETING

No. of Wire	Noggs per Inch	No. of Points per Square Foot
28	10	23,040
30	11	25,344
32	12	27,648
33	13	29,952
34	15	34,560
35	16	36,864
36	17	39,168

CARE OF CARDS

SETTING CARDS

10. The **setting** of cards is the adjustment of one roll to another in order that each roll may have its proper action on the stock as it passes through the card. The various parts of the card are set according to the work that is being run and the condition of the stock when it comes under their action. If a card is set too open, the wool will not be properly carded or opened out; if it is set too close, especially on the first breaker card, where the wool is not so well opened as on the other cards, there is a liability of the fibers being broken or cut and the value of the spinning properties of the wool materially reduced. The setting of the first breaker should be more open than that of the second, owing to its receiving the stock in almost its natural condition and having to perform the first opening of the wool fibers; as the wool is being constantly opened the finisher may be set closer than the second breaker.

11. Gauges.—Formerly it was customary to set cards by the eye and ear alone, but owing to the fact that the light struck at varying angles on the card clothing, the settings

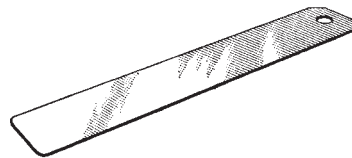


FIG. 6

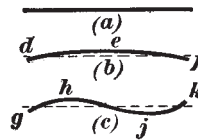


FIG. 7

were never really accurate. The setting is now accomplished by means of **gauges**, shown in Fig. 6; these are flat strips of tempered steel about $1\frac{1}{4}$ inches wide, 7 or 8 inches long, and varying in thickness according to a given standard. They

should be accurate and when made by a reliable maker will be found to be of uniform thickness. The standard adopted for their thickness is the same as that used for the standard sizes of wire, so that the thickness of a No. 30 gauge is the same as the diameter of a No. 30 wire.

Although the most exact settings are obtained by means of card gauges, after being used for some time almost all gauges are found to have been bent crosswise and, instead of being perfectly flat, as shown in Fig. 7 (*a*), they become shaped as shown in Fig. 7 (*b*) and (*c*) and, consequently, touch at points *d*, *e*, and *f* in Fig. 7 (*b*) and *g*, *h*, *j*, and *k* in Fig. 7 (*c*).

While the thinner gauges, if bent in the shapes shown in Fig. 7 (*b*) and (*c*), will straighten somewhat when introduced between the rolls of the card if a tight fit is obtained, it has been found from numerous observations and tests that the thickness of the gauge is always exceeded. The thicker gauges, such as Nos. 24 or 26, when bent as shown in Fig. 7 (*b*) and (*c*), scarcely yield at all when used in setting and a large percentage of error is consequently introduced. This will cause the parts of the card to be set farther from each other than the indicated thickness of the gauge. Home-made or damaged gauges are never accurate, and should not be used except for feed-rolls or burr cylinders.

12. The points at which the distance between the rolls of the woolen card need to be adjusted, or set, are the following: Between the top and bottom feed-roll; between the burr cylinder, or licker-in, and feed-rolls; between the burr cylinder, or licker-in, and the burr guard, or licker-in fancy; between the burr cylinder, or licker-in, and the tumbler; between the tumbler and the main cylinder; between the main cylinder and the strippers; between the main cylinder and workers; between the workers and strippers; between the main cylinder and fancy; between the main cylinder and the doffer or ring doffers; between the doffer and the doffer comb. On the condenser the setting of the wipe roll to the doffers and the proximity of the rub aprons must also be regulated.

The setting of the various parts, as designated above, must necessarily vary according to conditions. The length of the fiber is one important element; the longer the fiber, the more open must be the settings. Then, again, the condition of the wool as it comes to the first breaker must be considered; if it is matted, the setting must be more open on the first two or three workers of the first breaker in order not to bend the clothing by trying to open out the stock at once. With such stock it is sometimes a good plan to set the workers progressively on the first breaker, but if the stock is well opened and lofty the card may be set close.

Although the first breaker must be set more open than the other cards, it must not be set too open, because when the wool leaves the first breaker it must be well carded, as it is on the condition of the wool, when it leaves this card, that the ultimate result of the carding largely depends. The carder, therefore, is always careful of the first breaker and sees that it turns out the stock in a lofty sliver, free from specks or neps as far as possible; otherwise, a great amount of additional care on the second breaker and finisher cards will be required.

The second breaker card is always set finer, or closer, than the first and the finisher closer than the second breaker, in order to card the stock thoroughly fiber from fiber. After each carding, the wool is more open and separated, and thus allows closer adjustments of the working parts without breaking the fibers of wool.

Before setting the card care should be taken to have all belts in place, for if the card is set with the belts off, the settings will be disturbed when they are placed in position. When setting workers and strippers, care should be taken to remove any dirt or flyings from between the bearing and the shaft, if an open bearing is used.

Only one end of a gauge is ground accurately to the indicated thickness, so that in setting the different parts of the card to each other the opposite end, which is the one with the hole in it, should be grasped and the gauge inserted between the rolls for a distance equal to barely one-half of

its length. It should then be moved slowly back and forth across the card and the proximity of the rolls varied until a correct setting is obtained.

One side of the card should be set first, regulating the distance between the rolls so that the gauge will slip between them readily, neither binding nor being too loose, but simply requiring an easy but firm pressure to move it along between the rolls. Then the other side of the card should be set in the same manner.

After both sides of the card are set, the side that was adjusted first should be gone over again, as the setting of the other side of the card always disturbs the original setting more or less. On very particular work some carders go over a card several times.

AVERAGE SETTINGS

13. Setting the First Breaker.—Although the setting of the card depends largely on the stock being carded and the judgment of the carder, the following will be found to be average settings of ordinary woolen cards on from 4- to 6-run work. The adjustable bearings of the rolls of a card, except the workers and strippers, are carried on slides and are adjusted by means of screws that have circular heads with holes drilled in them. In order to turn the screw a small *set* is inserted into the hole and the screw turned, after the bolts that hold the bearings have been loosened. The adjustment screws are usually provided with check-nuts. For setting the feed-rolls of the first breaker to each other and for setting the burr cylinder to the feed-rolls and also between the burr cylinder and tumbler and between the burr cylinder and burr guard a coarse gauge, about No. 22 or 24, is generally used. This gauge is kept for this purpose and is usually an old or damaged one, as setting burr cylinders and feed-rolls injures the gauges. The setting of these parts is not so important as that of the working parts, such as the tumbler, workers, strippers, doffer, etc., to the main cylinder, which may be set with a No. 26 gauge. The doffer

should be set slightly closer to the main cylinder. This may be done by pressing it tighter on the gauge when setting or by using a finer gauge. Although the fancy is usually set by ear alone, it is better to use a gauge and judge the depth of the setting by the pressure required to force it between the fancy and the main cylinder. The teeth on the fancy should dip slightly into the teeth on the main cylinder, probably about $\frac{1}{32}$ inch, although this is never measured; the fancy is set and then turned by hand, its depth being judged by the whiz it makes in rubbing through the clothing of the cylinder. The fancy usually needs adjustment after the card is running, in order to make it handle different stock successfully, being set either off or on as the occasion demands. The doffer comb should be set as close to the doffer as possible without striking.

14. Setting the Second Breaker.—The second breaker is set similar to the first except that the setting is closer, being set to about a No. 28 gauge throughout. The feed-roll stripper in the second breaker should be set quite close so as to keep the top feed-roll clear. The licker-in fancy should be set so as to dip slightly into the licker-in wire in order to keep it clean and clear from short fibers of wool.

15. Setting the Finisher Card.—The finest settings are made on the finisher card when a No. 30 gauge is used. The ring doffers of the finisher should be set very close to the main cylinder in order to strip the stock thoroughly from the cylinder. A No. 32 gauge is often employed for setting the ring doffers.

16. Setting the Condenser.—The wipe roll of the condenser is usually set to the ring doffers with about a No. 22 gauge. The teeth in the gear on the end of the wipe roll should intersect about half their depth when the wipe roll is set to the aprons. The distance between the under side of the wipe roll and the top of the bottom rub apron should be sufficient to allow the roving to clear properly, since if this distance is not great enough the vibration of the rub apron will rub the roving against the surface of the wipe roll,

which does not vibrate, and thus cause the roving to be split. The wipe roll should be as close as possible to the top apron and still not touch it. These points should be carefully noted, for if either of the vibrating rub aprons come in contact with the wipe roll, twitty roving will be made.

The distance between the rub aprons on the Davis & Furber double-apron condenser is regulated by small slotted pieces of sheet iron that are slipped between the bearings of the apron rolls and the frame of the condenser. These packings are usually one of two thicknesses, $\frac{1}{16}$ inch or $\frac{1}{8}$ inch, but the $\frac{1}{8}$ inch packing is ordinarily used. For coarse wool, both packings are placed in position so that the space between the rub aprons is about $\frac{1}{3\frac{1}{2}}$ inch. For medium work, the packing on the lower rub apron is removed so that the space at the front of the top and bottom rub aprons is about $\frac{5}{3\frac{1}{2}}$ of an inch; this allows a slightly less rubbing action. For fine work where a less amount of rubbing action is required, both packings are removed so that a space of about $\frac{9}{3\frac{1}{2}}$ inch is left between the top and bottom rub aprons at the front, while at the back part of the aprons a slight rubbing action is given. The pair of rub aprons of each deck nearest the ring doffers are generally adjusted so that there is a uniform distance or about $\frac{1}{3\frac{1}{2}}$ inch between them. The throw of the eccentrics that cause the vibrations of the rub aprons should be so adjusted as to be slightly in excess of the width of the rings on the doffers. For instance, if the rings on the doffers are 1 inch in width, then the throw of the eccentrics should be adjusted so as to be about $1\frac{1}{16}$ inches.

The amount of rubbing that is imparted to the stock can be varied by altering the speeds of the eccentrics. The faster the aprons are made to traverse, the greater will be the rubbing action. Defective work is often made by the speed of the eccentrics being so slow that the ribbons of wool cannot be rubbed into roving by the rub aprons as fast as they are delivered by the wipe roll. When using a condenser with screw adjustments, both sides of the aprons should be carefully set, in order that no variation in the distance between the aprons at each end shall exist.

17. Setting Workers and Strippers.—The method of setting the workers and strippers will be readily understood by referring to the illustration of the first breaker in *Woolen Carding*, Part 1. In this illustration, the poppet heads that carry the shafts of the strippers and workers extend through sleeves attached to the arch of the card and also pass through a flange on the arch, being held in position by two check-nuts, one on each side of the flange. In order to set the worker or stripper closer to the main cylinder, the top checknut should be loosened and the bottom nut tightened. To set the worker or stripper farther from the main cylinder, the bottom nut should be loosened and the top nut tightened.

When setting workers and strippers or other rolls to a cylinder covered with sheet clothing, the cylinder should be moved so that the adjustment will take place at the center of a sheet and not on the edge, because nearly all sheets are slightly higher in the center and if the worker is set on the edge of the sheet there is some liability of contact with the highest part of the sheet. Sheets are apt to grow higher in the center as the clothing wears and is stretched by the strain during carding. This tendency is aggravated by the centrifugal force of the rapidly rotating cylinder, which tends to throw the clothing away from its center, especially if it is loose.

The sleeves through which the supports for the worker bearings pass are larger than the sleeves through which the supports for the stripper poppet heads pass and allow a lateral movement for adjusting the worker to the stripper. This movement is governed by two screws that are threaded into the sleeve and press against the support of the worker bearings. After the proper adjustment is obtained, both screws should be carefully tightened.

18. Setting the Doffer.—In setting the doffer, the fancy may be taken out in order that a clear view may be had and the distance accurately gauged all the way across. The main cylinder, as well as the doffer, should be turned

into various positions and at each movement carefully tried with the gauge, so as to be perfectly sure that when the card is in operation there will be no contact between the two. It is important when setting the doffer to have the worker belt in position, for if this is neglected it may raise the doffer slightly in its bearings, and so bring the doffer too close to the main cylinder and destroy the points of both.

19. Setting the Fancy.—More trouble is usually experienced with the fancy than with any other part of a woolen card. The fancy is the only roll of the card that is set with the belt off. This is necessary, because, in setting, the fancy is made to revolve by hand and the depth of the setting judged by the sound produced by the fancy wire passing through the cylinder clothing. After it has been set and the stock is on the card, it is often necessary to change its setting, for if not properly set for a given stock, the fancy will either throw the stock out of the card or else choke up, or lap; or it may pack the main cylinder. When the fancy is throwing the stock, it is usually set too hard into the cylinder or else is speeded too fast, or the teeth may be too straight and stiff. It often laps with wool because its clothing is rough, or because its speed is too slow. When a fancy is working right, the wool is lifted to the points of the cylinder clothing uniformly and thus can be readily taken by the doffer.

The surface velocity of the fancy should only be slightly in excess of the surface velocity of the cylinder. To find the relative surface velocities of the main cylinder and fancy, turn the cylinder over once and count the rotations of the fancy; then multiply the circumference of the fancy by the number of times that it rotates to one turn of the cylinder. The circumference of the cylinder should be to this product as about 4 to 5 if the fancy is speeded right.

20. The settings previously given should not be regarded as absolute, as in woolen carding there is a wide range of variation in card setting, and as no two conditions are the same, no hard and fast rule can be laid down. Some carders

set as fine as a No. 32 gauge on the first breaker, No. 33 on the second breaker, and No. 34 on the finisher card, with the ring doffers set to perhaps a No. 35 gauge. This, however, is an extreme case and is only possible when the cards are in excellent condition and the stock very fine. Other carders working on a similar grade of wool may use Nos. 28, 30, and 32 gauges. Again, cards are frequently set much more open, as, for instance, a No. 22 gauge on the first breaker, No. 26 gauge on the second breaker, and No. 28 gauge on the finisher. Much depends on the carder, the previous preparation of the stock, and the condition of the cards; a variation of a point or two in setting is of no material difference, provided that the wool is well carded. The main point to be observed is the condition of the stock as it leaves the card. Take the sliver from the first breaker and pull it apart, holding it toward the light; it can readily be seen whether the card is operating on the wool satisfactorily or whether the sliver is full of specks or neps that are not opened out. The sliver from the second breaker should be examined in the same way and if the wool is not free from specks the cards may be gone over and set closer.

The carder must use judgment in setting his cards and take into consideration the wool being worked and also the number of yarn to be spun. If the setting is too close, the wool is cut or the fiber broken; if too open, the stock is not opened and is liable to be rolled into bunches. The settings should avoid these extremes and yet be as open as possible to card the stock properly; if set finer than necessary, the treatment of the wool is more severe than is needful.

Some carders set progressively; that is, they begin with the first worker in the first breaker card, which is set open; the setting then grows finer until the ring doffers are reached. Such an adjustment might begin with a No. 22 gauge with the first worker and end with a No. 34 between the finisher cylinder and the ring doffers.

In some mills it is customary to set strippers one point finer both to the main cylinder and to the workers. Strippers

are never set progressively as above explained, the progression being between the workers and the main cylinders and the main cylinders and doffers, which are the working points of the cards.

STRIPPING CARDS

21. From time to time the clothing of the cards becomes so choked and filled with short fibers, dirt, dust, shives, grease, and other matter that has been removed from the carded wool that the operation of carding is seriously affected; from this arises the necessity of cleaning, or as it is called, **stripping** the cards. Some stock contains much refuse matter and other dirt and quickly fills up the card; other stock, being comparatively clean, will allow the card to run for a much longer time without cleaning. Less cleaning is required, therefore, if the stock is prepared for the cards in the best manner and as thoroughly cleaned of foreign matter as possible.

22. Time of Stripping.—The first breaker needs more cleaning than the second breaker card and the second breaker needs more than the finisher, for as the wool proceeds much of the dirt is being constantly removed. Generally speaking, the first breaker should be cleaned every day; in some mills, to economize time, it is customary to clean the main cylinder and doffer one day and the whole card the next. The second breaker may be cleaned every other day, cleaning the cylinder and doffer and the whole card alternately. The finisher card may be stripped twice a week on low stock, cylinder and doffers and all through alternately, and once a week on fine stock. It may be necessary to clean the ring doffers oftener than this. It must be remembered that when the second breaker or finisher card is stopped, the production of the set is also at a standstill. With the first breaker the case is changed as, if there is a sufficient number of balls ahead to supply the second breaker creel, the production will not be checked.

If the plan of cleaning the cylinder and doffer and the whole card alternately is adopted, care should be taken not

to clean two cards of a single set all through at the same time in order to avoid making a large number of thin rovings. These when made should be pulled from the jack-spool and placed in the hopper of the first breaker self-feed. Many mills clean the card all through each time, which is the best way, although the alternate plan saves much time and is fairly satisfactory.

It is necessary that the doffer should always be kept clean in order to remove the stock from the main cylinder. In England, it is customary to run a small conditioning roll, called a *dickey*, over the doffer, which keeps the doffer wire clean and in good condition.

The above statements will give some idea of the average time a card will run before cleaning, but no hard-and-fast rule for the cleaning can be laid down. It is customary in some mills to clean the cards periodically whether they require it or not, thereby making unnecessary waste or else allowing the card to run longer than it should without cleaning; a better plan is to look over the cards twice a day and have such cards or such parts as require it cleaned, thus making allowance for different kinds of stock.

23. Method of Stripping.—When the card is to be stripped the belts are thrown off and the stripping performed by means of hand cards. Two men are employed to strip a card, one working on each side of the card, in this manner the work being more advantageously accomplished. The usual method of stripping is as follows:

The belt is first thrown off from the self-feed, if the first breaker is to be cleaned, and the feed-rolls of the card disconnected by means of the small lever that throws the side shaft out of gear. The card is then allowed to run 4 or 5 minutes in order to allow it to clean itself as much as possible. The belts are then removed and the fancy taken from its bearings and placed in a rack, where the dirt is removed from it by means of a hand card or a comb. Two pieces of pipe are used in removing the fancy and the workers and strippers. These are slipped over the ends of the shaft and

the roll lifted out of the card by two men without any danger of dropping it, as is otherwise liable to occur owing to the grease on its shaft. Care must always be taken when removing any roll of the card not to damage the clothing, which if bent and bruised will not properly perform its functions.

The last worker is then taken out and placed in the empty fancy box and stripped, after which it is laid either on the floor or, preferably, in a rack. The same process is then carried out with the strippers and the rest of the workers, except that, in some cases, after two workers and two strippers have been removed the rest are stripped in their positions. Sometimes after the last pair of workers and strippers—the pair nearest the fancy, which are the first cleaned—have been placed in the rack, the others are brought back to the fancy boxes and stripped and are then immediately returned to their positions. Care should be taken to replace the rolls in their original positions and not interchange the workers and strippers; their numbers are generally stamped on the shafts by the makers.

The main cylinder and doffer are necessarily stripped in their bearings, as are also the licker-in and tumbler. The licker-in fancy, feed-rolls, and feed-roll stripper should be carefully cleaned, as well as the doffer comb, each time the card is stripped. After the card has been thoroughly cleaned, the rolls should be placed back in position and the belts replaced.

The card may now be allowed to run empty for 4 or 5 minutes, in order to remove loose particles of refuse that may be resting on the surface of the clothing, after which it is a good plan to run over the settings and change such as may be found inaccurate, being careful, however, that there are no particles of waste wool or other substances under the bearings.

The card may now be put in operation and the wool allowed to enter by putting the feed-rolls in gear again, but it must be allowed to run for 4 or 5 minutes after this in order that it may become filled with wool to its utmost

capacity and the sliver, or side drawing, attain its original weight before the product of the card is passed on to make roving. If this is not done the rovings made just after stripping will be thin and light and will not spin to the right number of yarn. The weight is apt to be a little light on the card for an hour or two after the stripping, but this of course is not returned to the self-feed but is spun, although perhaps the draft in the mule may have to be changed slightly to make the required number of yarn.

For stripping the ring doffers of the finisher card a special hand card of about No. 34 wire should be used; it should be used only for this purpose. Two men will keep from eight to twelve sets of cards clean, varying of course according to the stock, whether low or fine, and also according to its previous preparation.

GRINDING

24. Although **grinding**, or sharpening, the card clothing is frequently performed too often and at other times continued too long, there can be no doubt that at times the cards need grinding to replace the points of the teeth that have become worn or dull by abrasion or accident. Cards are usually ground too often where hardened and tempered wire is used; more frequent grinding is necessary on cards covered with mild wire, which is soft.

In some districts of Europe it is customary to grind the cards two or three times a month. This is wrong, for if the cards are properly set and cared for, there should be no necessity oftener than once in 3 months, and many times a card will run 6 or 8 months or even a year without grinding. More card clothing is spoiled by grinding too often and by overgrinding than work spoiled by dull cards.

Two kinds of points are obtained by grinding. The **chisel point** is the point put on the tooth by a roller emery grinder that has no traverse. This form of grinder grinds down the top of the tooth to a flat, or chisel, edge, while the traverse grinder, which grinds the tooth on each side as well as on the top, owing to the traverse of the roll, produces

what is known as a **needle point**. It must be understood that the term *needle point* does not mean that the wire is pointed the same as a needle or that it is nearly so sharp. The term is simply one of distinction between the flat, or chisel, point and the more rounded point due to grinding the wire on two sides and on the top.

While it is important that the clothing shall be sharp, it is also important that the teeth shall be smooth, since any roughness of the tooth is liable to cause it to catch and break the fibers.

One of the worst things that can happen to clothing is the formation of a **hook**, or **burr, point**. This sometimes happens when the grinding is continued too long or when the grinding roll is pressed too heavily on the clothing, thus turning over the point of the tooth and making a burr on the under side. When clothing is injured in this manner, the wool is with difficulty transferred from one roll of the card to another and the fancy also lifts the stock from the main cylinder with difficulty. When grinding, it is always better to grind lightly and rapidly than to grind slowly and with heavier pressure. Heavy grinding is liable to heat the wire and draw its temper.

IMPORTANT POINTS IN GRINDING

25. The different rolls of the card need varying degrees of attention in regard to grinding; some parts of the card need to be sharper and in better condition than others, which may require only smoothness to perform their functions. The main cylinder of the card after being once ground sharp will keep in good condition for some time, especially if the fancy works properly, since if set into the teeth of the main cylinder to a reasonable depth, it will keep the points of the same smoothness and in good working order by reason of the abrasion of the teeth against each other. The main cylinder needs to be smooth and true rather than extremely sharp, as this latter condition in a measure defeats the action of the workers and of the doffer by having

a tendency to hold the stock instead of allowing it to be transferred to those rolls.

The fancy is required to be perfectly true and should be smooth above all, for if the teeth are rough, it has a tendency to throw the stock from the main cylinder, thus making an increased percentage of waste in the form of flyings. Great care should be taken in grinding the fancy, and the grinding roll should only be allowed to touch it lightly, as the long, flexible teeth are liable to injury. After the fancy is ground it should be placed in the card and set well into the main cylinder, about $\frac{1}{8}$ inch. After being allowed to run into the cylinder in this manner for about $\frac{1}{2}$ hour it should be set off to its normal position and allowed to run a little longer. A hand card may be freely sprinkled with oil and held on the fancy while it is running on the main cylinder. By this means both the fancy and the main cylinder are made smooth and put in the best working order. Some fancy clothing, being made with a straight tooth with no bend at the knee, requires especial care in grinding in order that the teeth will not be bent or injured.

Workers must be kept sharp and true in order to card and open the wool, and also in order to take the stock from the main cylinder. The worker should always have a sharper point than the cylinder for this reason. In England, it is customary to set the strippers into the workers until a slight whizzing sound, caused by the contact of the teeth, is heard. The object of this is to keep the worker wire in good condition, the rubbing action of the stripper being to sharpen and smooth the worker. When grinding workers, care should be taken to avoid forming a burr on the wire, the tendency being to overgrind the roll while endeavoring to obtain as sharp a point as possible.

The strippers are simply conveyers of the wool from the workers to the main cylinder and should be kept smooth rather than sharp. Strippers are usually $2\frac{1}{2}$ or 3 inches in diameter and owing to this small diameter, the teeth are spread apart more by being projected from a surface bent around so small a circle. This makes it necessary to exercise

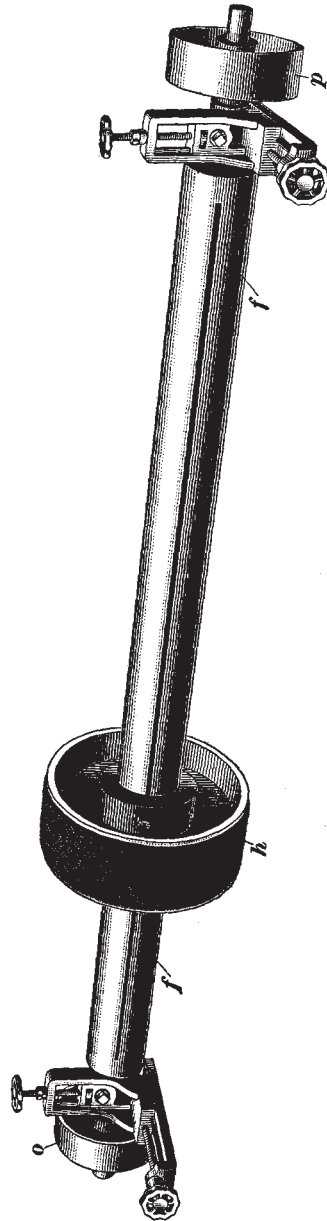


FIG. 8

some care in grinding or the teeth will be bent out of shape.

The doffer is one of the most important parts of the card and should always be kept sharp and in good condition. It should always be smooth as well as sharp and the nearer it is set to the cylinder, the better it will work, provided that there is no contact between the two. The doffer should be sharper than the main cylinder in order readily to take the wool from the latter.

Before grinding, the card should be thoroughly cleaned and all places where the clothing is damaged should be remedied. The bent teeth are raised into position by means of a small steel blade provided for the purpose, or with a jack-knife.

TRAVERSE GRINDER

26. The main cylinder and doffer should be ground at the same time and without being removed from the card, which may be accomplished by means of a **traverse grinder**; the one shown in Fig. 8 is known as the Roy traverse grinder.

Fig. 9, which is a section of this grinder, shows that it consists primarily of a steel shell *f*, on which a sliding, or traversing, grinding wheel *h* is mounted.

Attached to this wheel is a slotted **T** piece *a* that extends through a slot cut the entire length of the shell and, by means of a dog *b* attached to the chain *k*, imparts the traversing motion to the wheel. The dog *b* is really a stud link, since it forms one part, or link, of the chain. The chain is driven by means of the pulley *p*, known as the *traversing pulley*, which is attached to a journal *j* that passes through a sleeve formed in one piece with the head of the shell. Attached to this journal is a bevel gear *e* that drives a gear *d* driving another gear, to which is attached the driving sprocket *c*, around which the chain passes. At the other end of the shell is a flange binder pulley *r* around which the chain passes and which may be adjusted by means of an adjusting screw *n*, in order to take up the slack of the chain when it stretches. A rotary

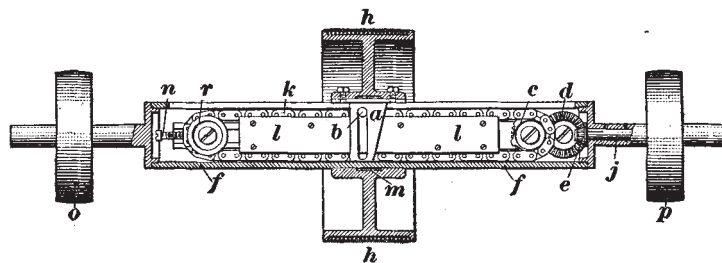


FIG. 9

motion is imparted to the grinding wheel by means of the pulley *o*, which is attached to a shaft forged in a solid piece with the other head of the shell. This pulley imparts motion to the shell; and as the **T** piece projects through the slot in the shell, the motion is also imparted to the grinding wheel. A steel plate *l* guides the chain.

The *grinding wheel* is an iron pulley covered with twine and afterwards having coarse emery glued on it. Special emery fillet is sometimes used for covering grinding wheels and rolls. Covering emery rolls should not be attempted in the mill unless emery fillet is employed, as the work must be perfect and the roll true; otherwise, the grinding will be imperfect. The emery should always be coarse, in order to allow the particles to project into the clothing and to grind the

sides of the teeth as well as the top. Grinding wheels are made up to 13 inches in diameter and the larger the wheel within reasonable limits, the better work it will do. In order that the grinding wheel may slide easily on the shell, a chamber m is cut around the inside of its hub and a felt washer inserted; this being saturated with oil lubricates the shell as the grinding wheel slides back and forth. The shells for traverse grinders are made 4 or 5 inches in diameter. The 5-inch shell is to be preferred, since the greater the diameter, the less is the tendency of the shell to spring and consequently to make the grinding uneven.

27. Speed.—The traversing pulley p , Figs. 8 and 9, should always be driven more slowly than the driving pulley o , both being driven in the same direction, there would be no traverse of the grinding wheel if the speeds of both pulleys were equal. The revolutions of the bevel gear e that drives the traverse chain is equal to the revolutions of the driving pulley o minus the revolutions of the traversing pulley p . In order to make the grinding wheel traverse faster, the speed of the traversing pulley is reduced.

The speed at which grinders are driven varies considerably with different carders, but the following table gives the average speed of the grinding wheel and the number of times that it traverses across the card per minute. The table is made for different widths of cards.

TABLE V

Width of Card or Traverse of Grinder Wheel Inches	Revolutions per Minute of Grinder Wheel	Number of Times Across the Card per Minute
36	375	15
40	365	14
48	340	12
60	300	10
72	275	8

28. Adjusting Device.—After a traverse grinder has been used for some time, the grinding wheel and shell become so worn that the grinding wheel is loose and perfect grinding is difficult to attain. In order to remedy this defect and to afford a method of easily adjusting the size of the hole in the hub of the grinding wheel to the diameter of the shell, the hole in the grinding wheel in the latest machines is bored tapered instead of straight. A tapered, split bushing with a chamber for the felt oiler is inserted into the tapered hole in the grinding wheel; a collar is then screwed on each side of the hub of the wheel up to the bushing. By loosening collar at the small end of the bushing and tightening the one at the large end, the bushing is pressed into the hub of the wheel and, being split and tapered, is contracted around the shell until a proper fit is obtained.

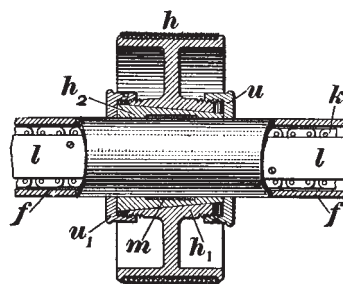


FIG. 10

This device is not shown in Fig. 9, being placed only on the latest models, but it is shown in Fig. 10; h_1 is the hub of the grinding wheel, which is bored tapered, while h_2 is the tapered bushing that fits into h_1 , and is held in position and adjusted by means of the threaded collars u, u_1 . To tighten the grinding wheel, thus giving less play on the shell, loosen collar u and tighten u_1 ; loosening u_1 and tightening u has the opposite effect.

29. Operation.—The method of grinding the main cylinder and doffer at the same time by means of the traverse grinder just described is as follows: Referring to Fig. 8, it will be seen that the journals of the shell are carried in adjustable bearings, which may be moved in two directions by means of screws provided with hand wheels, allowing the grinding roll to be set both to the main cylinder and also to the doffer. The doffer, however, is usually set

to the grinding wheel instead of the wheel being set to the doffer. The bearings of the traverse grinder are bolted to the fancy brackets when grinding the main cylinder and doffer, the fancy and last worker being removed and placed in a rack in order to allow room for the grinding wheel. Usually, however, the workers and smaller rolls of the card are being ground on the grinding frame (which will be dealt with later) while the main cylinder and doffer are being ground.

When grinding the main cylinder its direction of rotation is reversed, in order to grind against the backs of the teeth. When the card is driven with an open belt, the direction of rotation of the main cylinder may be reversed by crossing the belt, but if the card is driven by a cross-belt, the belt will have to be taken up by means of holes punched in it, and run open. Often an extra belt is provided for driving the cards while grinding cylinders. The doffer should run in its usual direction, but its speed should be increased by putting a pulley on its shaft and driving it from the main-cylinder shaft.

The grinder may be driven from pulleys fastened to the third stripper shaft of the card. A pulley may be placed on each end of the stripper shaft, one for driving the shell and another smaller one for the traversing motion of the grinder. The stripper may be driven from a belt directly from the flange on the main cylinder. Before placing the grinder on the fancy brackets, the doffer should be moved from the main cylinder about 2 inches. The grinder may then be set to the main cylinder until a whizzing sound, caused by the contact of the emery with the clothing, is heard. Each side should be carefully adjusted so that the wire will not be overground on one side. After the grinder has been adjusted to the main cylinder the doffer may be adjusted to the grinder, using the same precautions as before, in order to grind the doffer even.

The doffer should always have the preference over the cylinder and should always be sharper; however, the grinder should not press too hard on the wire or a hook will be formed on the under side. It is better to set the grinder light at first and after the grinding has been going on for an

hour set it down a little heavier. The grinding of the cylinder and doffer usually takes from 4 to 8 hours. The wire is tested at intervals to see if it is sharp enough, by means of the thumb, which is pressed against the point. It is also a good plan to examine the wire with a magnifying or pick glass to determine whether the point of the tooth is ground to the proper shape and also to be sure that the point is not turned over and the wire hooked.

It is always best when grinding to stop a little short of the sharpest point possible rather than to put a burr point on the wire. Smoothness should be sought more than sharpness. In case the wire becomes hooked, the defect may be remedied to a certain extent by *facing* the wire or by using a burnishing brush, which is a roll covered with straight clothing set loosely in the foundation. This roll is set to run into the clothing and removes the burr. Facing is a dangerous operation and often results in the ruin of the clothing. The operation consists of running the grinding roll against the points of the clothing and should be done very lightly, only allowing the grinder barely to touch; otherwise, the clothing will be damaged. It is best never to run a grinding roll in this manner.

The traverse of the grinding wheel should preferably be long enough to carry it clear of the clothing on each side. This prevents all possibility of the clothing being ground at the ends of the cylinders more than in the center, which sometimes happens when the motion of the grinding wheel is reversed before it has cleared the clothing, as it then remains in contact with the sides of the clothing for a longer time than with the other parts.

30. Some grinders instead of being driven by means of a chain have a traversing motion imparted to them by means of a reciprocating screw; that is, a screw provided with right-hand and left-hand threads that are joined at each end. In the groove, fits a fork, or traveler, having a stem through the slot in the outer shell in which the screw turns. By means of the stem the grinding wheel is not only rotated by

the shell, but a traversing motion is imparted to it by the screw. The fork changes from one thread to the other and reverses the motion of the grinding wheel at each side.

TRAVERSE GRINDING FRAMES

31. The workers, strippers, fancies, and tumblers are not ground in their positions, as are the main cylinder and doffer of the card, but are removed and taken to a machine called a **grinding frame**. This machine, shown in Fig. 11, consists of an iron frame on which is mounted, on suitable bearings, a traverse grinding wheel *h* identical with the one employed in grinding the cylinder and doffer. The grinding frame is arranged to grind two rolls at one time, one on each side of the traversing grinding wheel, the rolls being placed in **V**-shaped notches in the slides *c* that rest on the top of the frame. These slides are adjustable, by means of screws, to the grinding wheel, thus allowing the rolls being ground to be adjusted to the same. The screws are provided with hand wheels *d* for easily adjusting the rolls and also with check-nuts for locking them when once the rolls have been set. Pulleys, setscrewed to the shafts of the rolls to be ground, are driven by means of a belt from the bottom shaft of the grinding frame. The grinding wheel is also driven from the bottom shaft of the frame by two belts, one of which drives the traversing motion of the grinding wheel while the other imparts a rotating motion to it. When putting on the belts before grinding, care should be taken before the rolls are set up to the wheel to see that the directions of rotation are such that the grinding wheel will grind the backs of the teeth on each roll.

Referring to Fig. 11, it will be seen that an adjustable stand *f* also carries slides with **V**-shaped notches; this is for the purpose of grinding shorter rolls that do not have shafts long enough to rest in the bearings on each side of the machine. Inside of the frame of the grinder there is a small emery-covered roll *g* for grinding hand cards; this is driven from the main or bottom shaft.

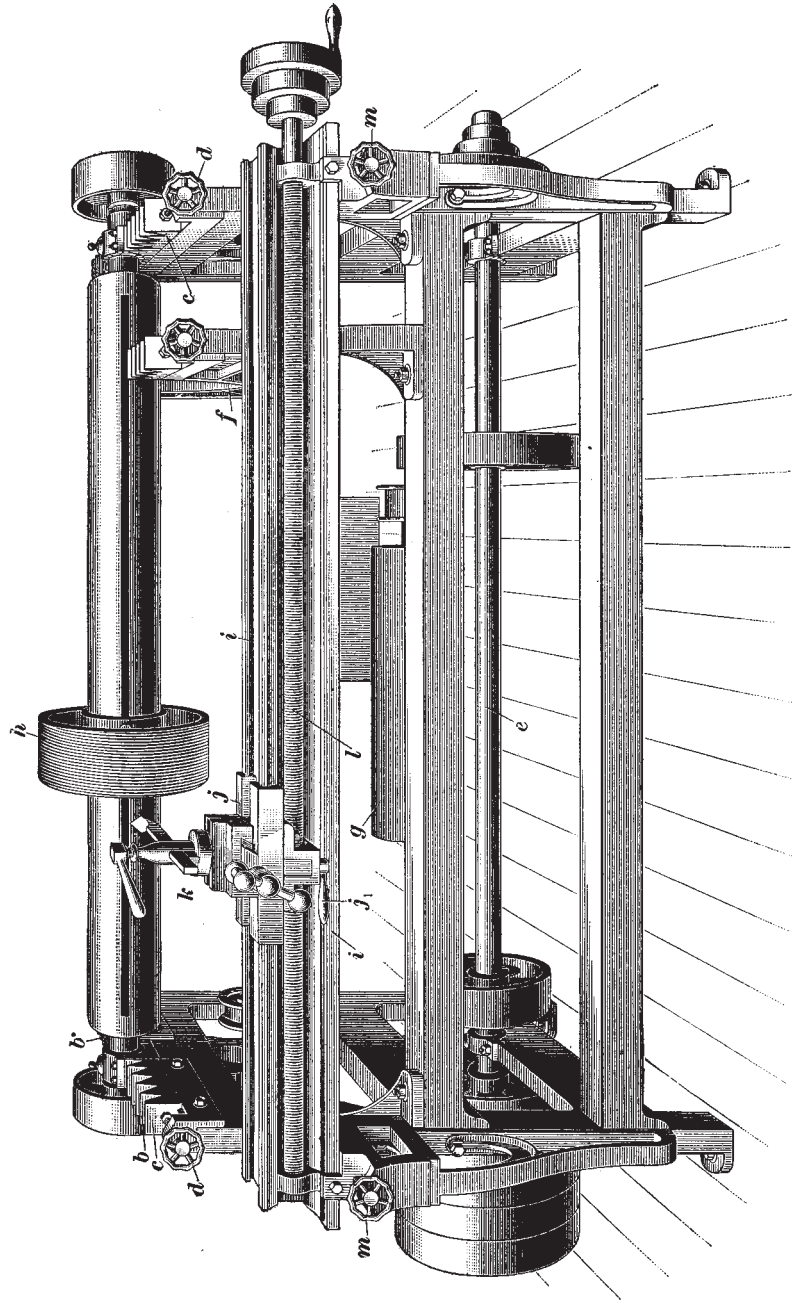


FIG. 11

The grinding of the smaller rolls of the card takes 3 to 4 hours. Great care should be taken when grinding strippers not to injure the wire because, owing to the small diameter of the stripper, the wire stands more open on it than on the larger rolls. The workers should have the most grinding of the smaller rolls of the card, as they need a sharp point for taking the wool from the main cylinder as well as for the actual carding.

The fancy should not require much grinding, as its friction with the main cylinder should keep it in good condition. Many carders do not grind the fancy at all, claiming that as the fancy does not engage with the wool perfect smoothness is better than sharpness. The point produced on any roll by wear is always smoother than that obtained by grinding. If the fancy is ground it should be ground very lightly and only for a short time, so as not to jam or disarrange the long teeth of the roll. After grinding, it is a good plan to allow the fancy to run into the cylinder of the card for about $\frac{1}{2}$ hour, being set up hard at first and afterwards being moved off to its normal position. This will take off any roughness left by the emery. When grinding the tumbler perfect smoothness is desired rather than extreme sharpness.

32. Grinding Metallic Rolls.—Occasionally the burr cylinder of the first breaker card or the metallic feed-rolls need grinding and sometimes the burr cylinders of the burr picker are brought to the card room for grinding. The grinding of these rolls is a difficult task and should never be attempted until the roll is considerably worn, as at best they can only be improved and not rendered as good as new. Metallic burr rolls may be ground on the traverse grinding frame, but the *solid emery* or *carborundum* wheel should be used instead of the iron grinding wheel covered with emery. The grinding frames are supplied with solid wheels if so desired. When grinding metallic rolls the grinding wheel should always revolve against the point of the teeth. This is the opposite way from which the rolls covered with card clothing revolve, but it is necessary in order to prevent the

metallic wire from becoming hooked. The burr cylinder should be made to revolve very slowly, say not more than 10 turns per minute, and the grinder pressed very lightly against it. The grinding being very light, it takes more time, and 2 days are sometimes spent in grinding a single roll. Sometimes a file is fixed in the turning post of the grinder and allowed to bear on the surface of the roll. The roll is then revolved toward the file at the rate of from 250 to 300 revolutions per minute. If burr cylinders are worn very badly, they are placed in a lathe and turned down.

When grinding any metallic roll great care should be taken not to heat it, which is very apt to be done and may affect the trueness of the cylinder. Small rolls, like feed-rolls, are very difficult to sharpen and more satisfactory results can be obtained by filing them by hand.

After the burr cylinder is ground sufficiently to feel sharp to the hand, although it cannot be made to feel as sharp as card clothing, means must be taken for smoothing it up. The grinding always leaves a metallic roll rough and the teeth more or less burred, or hooked. One way to smooth a metallic roll after grinding is to reverse its direction of rotation and hold the end of a soft pine board against it until notches are worn by the teeth. The end of the board may be moistened with oil and sprinkled with powdered emery, which will smooth the teeth and remove any rough edges, leaving the roll smooth and in good condition.

ROLLER GRINDING FRAME

33. The grinding frame shown in Fig. 11 contains a narrow traversing grinding wheel, but Fig. 12 shows a grinding frame known as the **roller grinder**, which is preferred by some carders. This grinder is identical with the traverse-wheel grinding frame with the exception of the wheel, or roll, *h* for grinding, which extends entirely across the frame, grinding the entire surface of the worker or other roll at once. Rolls can be ground in less time with a roller grinder, but are more liable to be ground in stripes or

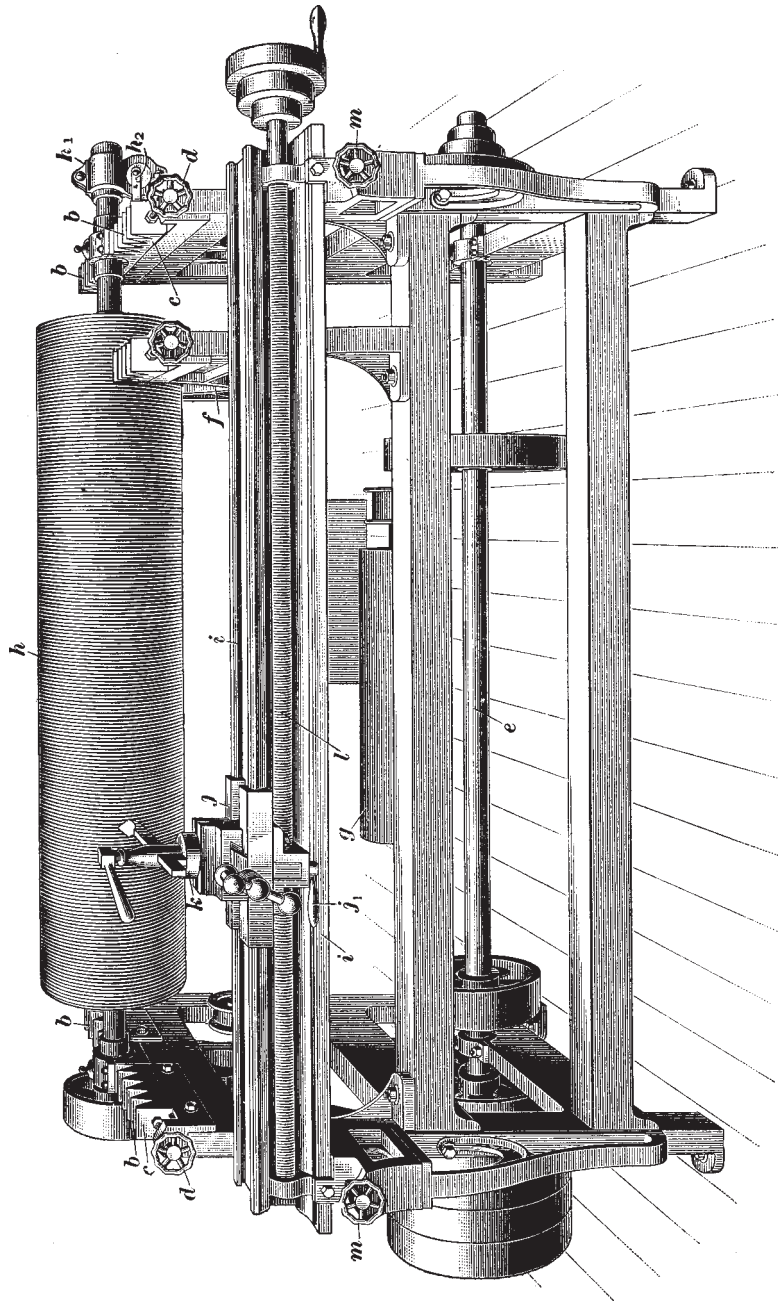


FIG. 12

unevenly. To prevent this the roller grinder has a slight traverse of about 2 inches. This is accomplished by giving the roller a reciprocating motion by means of the device shown on the right-hand side of the grinding-roll shaft. This consists of a worm on the shaft, which meshes with a worm-gear, both being contained in the casing h_1 , Fig. 12. On the side of the worm-gear is a crankpin that is connected to the stationary bearing of the grinding-roll shaft by means of rod h_2 . When the grinding-roll shaft revolves, the worm-gear is turned and the crankpin, working against the arm attached to the stationary bearing, moves the whole casing, and also the grinding roll, by means of collars on the shaft. A roller grinder is also made for grinding cylinders and doffers.

TRUING WOODEN CYLINDERS

34. Often when wooden rolls are used in a card it will be found that they are not true when the card is being set or when the roll is being ground. In this case the rolls should not be evened up by grinding, as this will make some of the teeth shorter than others and make good carding difficult. The only remedy is to take off the clothing and turn down the roll. This is done on a grinding frame, except in the case of the main cylinder, which is trued by fastening the turning lathe to the frame of the card, the doffer being removed. After the clothing has been taken off from the roll that is to be trued, the roll is placed in the grinding frame. In the case of large rolls, as for instance a doffer, it is sometimes necessary to remove the grinding wheel in order to make room.

It will be noticed, Figs. 11 and 12, that the turning lathe is fastened to the front of the grinding frame and consists of a rest i on which there is a movable slide j carrying a tool post k , in which the turning knife is fastened. The slide is controlled by a screw l running the width of the frame, which is either turned by hand by means of a handle or preferably driven by means of a belt and two three-step pulleys, one on the screw shaft and the other on the bottom shaft of the

grinding frame, as seen at the right of the frame. A small handle j , under the slide, allows it to be disengaged from the screw after the latter has been moved entirely across the width of the roll that is being trued. The slide is then moved back by hand and the handle underneath turned in, which allows the screw to act and the slide to make another traverse.

The whole turning lathe may be adjusted to the roll that is being trued by means of hand wheels m on each side of the machine, which operate screws provided with check-nuts for fastening the lathe in any desired position. Small adjustments of the turning knife may be made by means of a crank that operates the tool post. Care should be taken to have the rest perfectly parallel with the shaft of the roll to be trued. The turning knife passes through a slot in the turning post and is so arranged that it may be set and securely fastened at any angle. When turning, or truing, the point of contact of the turning knife with the cylinder should be on a level with or slightly above the axis of the latter.

When truing the main cylinder of the card it often becomes necessary to place blocks under the turning lathe in order to raise it high enough. The doffer being removed, the turning lathe is placed in its position resting on the end of the card frame. If it is not desired to place blocks under the lathe, the turning knife should be set so as to come in contact with the cylinder at the proper angle.

It is better to take off several small, or thin, shavings from the cylinder rather than to attempt too thick a shaving. Before putting the knife to the cylinder, the latter should be scraped by holding on it the edge of a piece of board or an old piece of sheet-iron or steel with a straight edge; this removes any grease or dirt that may be on it which would dull the knife.

In order to make a smooth surface, the turning knife must be sharp and the cylinder should revolve against its edge. When removing sheets from a cylinder before truing it, care should be taken, if the heads of the tacks are broken off, not to leave the latter protruding in the wood, where they will come

in contact with and ruin the turning knife. It is better to drive the slide that carries the knife with a belt rather than to attempt to turn it by hand, as more uniform results will then be obtained. If it is desired to operate the slide by hand, it is best to disengage it from the screw entirely and move it across the face of the cylinder with a firm, uniform pressure. The turning lathe should always be in line with the axis of the main cylinder. If the latter is level, as it should be, the turning lathe may be leveled also; but otherwise it is a good plan to sight the shaft of the cylinder over the lathe rest.

After the cylinder has been trued and its surface made to run perfectly, a sheet of sandpaper tacked on a block of wood may be lightly passed over the surface finally to smooth it before replacing the clothing. If there are small knot holes in the cylinder they must be filled with putty, slightly warmed beeswax, or a wooden plug, before the clothing is put on; otherwise, the teeth over them will be pushed through the foundation of the clothing and be lower than the rest.

In turning the smaller rolls of the card, the same rules apply as with the main cylinder, except that they are trued in the grinding frame. Iron cylinders and doffers never have to be trued if properly used, but if sprung through any accident, they should be turned down in the machine shop.

CLOTHING CARDS

COVERING WITH SHEET CLOTHING

35. Whenever old clothing is replaced with new, or after cylinders have been trued, there arises the necessity of recovering the cards, this may be done with one of three coverings—sheets, fillet, or rings. The **sheet clothing**, as has been previously stated, consists of sheets 5 inches wide and as long as the width of the card. They are used on the main cylinders of the first and second breakers, and in order to prevent their blistering, or raising, in the center, they

should be applied with considerable tension and be securely fastened in place with long tacks, 12-ounce tacks being suitable for this purpose. Tacks made without any web on the under side of the head, which would be liable to cut the foundation, are provided for attaching card clothing to the cards.

The cylinder should first be marked off with a pencil so that each sheet will be placed in the proper position and parallel to the axis of the main cylinder. This marking is usually done after the cylinder is turned down and with the turning lathe in position. With the cylinder turning, a mark is first made with a pencil $\frac{3}{4}$ inch from each edge. Then the circumference of the cylinder is divided on one of these lines, with a pair of dividers, into as many parts as there are sheets. If the main cylinder is 48 inches in diameter it is customary to apply twenty-four sheets, a certain amount of space being

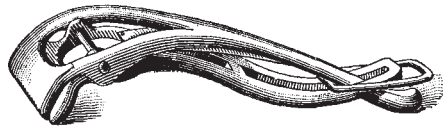


FIG. 13

necessary between the sheets for tacking; this means that twenty-four equal divisions will be made around the cylinder. Then using the turning rest, which is parallel to the axis of the main cylinder, as a rest, a line is marked across the card at each of the points spaced off with the dividers. The turning lathe is then removed from the card and the sheets of clothing applied. The tacks should first be stuck into each sheet about $\frac{7}{8}$ inch apart and $\frac{1}{4}$ inch from the wire. The upper edge of the sheet is then placed on one of the lines drawn across the main cylinder and the tacks driven in. A clamp, Fig. 13, is then attached to the lower edge of the sheet and a strap passed through the link of the clamp and attached to a ratchet, by which the sheet of clothing can be stretched. The ends of the sheets should always be stretched first and firmly tacked, after which the middle portion of the sheet may be stretched and tacked.

While the tension is being applied to the sheet, the main cylinder must be prevented from turning. This may be

accomplished by means of a bar of iron propped against the bolts on the inside of the cylinder and resting on the floor. After the first sheet is tacked on, the lower edge should be trimmed to the pencil line and the operation repeated.

When stretching the last sheet, it will be necessary to place a block of wood in the space between the sheets on the first and second sheets tacked on for the clamp to rest on so that it will not injure the clothing. After all the sheets are on, the ends of each sheet should be drawn out and a single tack put in each. If the card clothing is sufficiently stretched and well tacked it will not blister. Iron cylinders have parallel rows of holes drilled in their surfaces and tapered, hardwood plugs driven into the holes. The tacks are driven into these plugs when the clothing is applied.

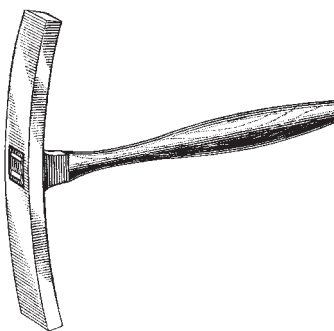


FIG. 14

The hammer used for driving the tacks when sheet clothing is being applied is of a peculiar shape, as shown in Fig. 14; the head is 8 or 10 inches long and the face of the hammer $\frac{1}{4}$ in. \times 1 in. This shape is adapted for driving the tacks without jamming the card clothing.

COVERING WITH FILLET

36. Fillet Winding Frame.—The rolls of the card that are not covered with sheet clothing, metallic wire, or rings are covered with fillet, which is applied by various means, the object being to wind the fillet with sufficient tension to prevent its becoming slack.

Fig. 15 shows a machine for doing this. The desired length of fillet for any given roll is found (as will be explained later) and one end tacked to the large drum *f*, around which it is wound; the other end of the fillet is then

tapered and tacked to the roll *e*, which is to be covered, and which is turned by means of the crank-handle *d* and gears *c*, *b*.

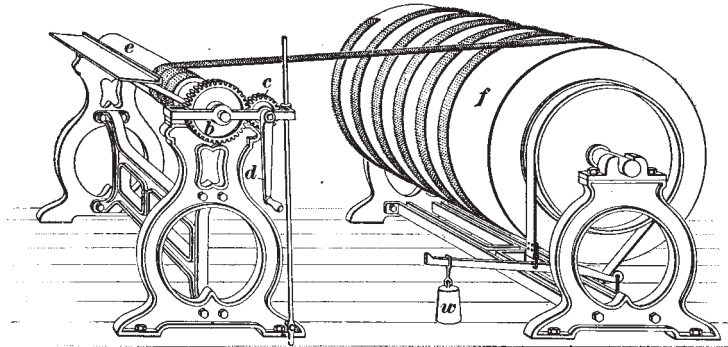


FIG. 15

The desired tension is obtained by means of an adjustable weight *w* placed on a lever, to which a strap passing around

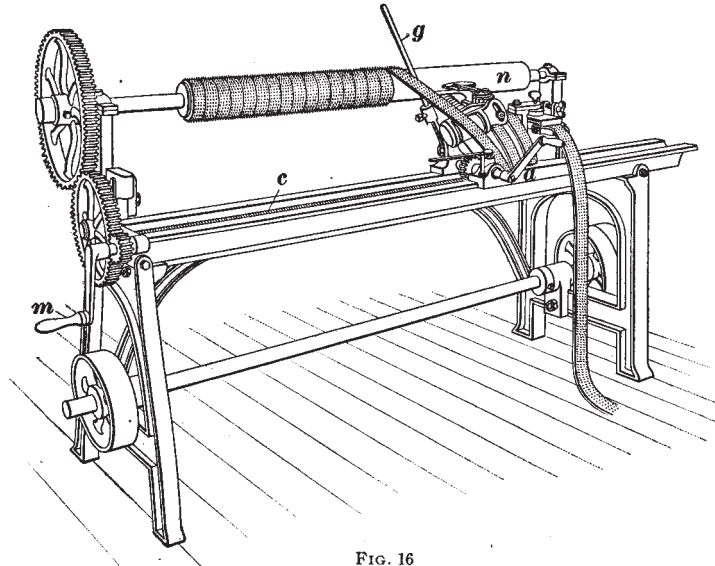


FIG. 16

a flange on the drum *f* is attached. By moving the weight, any amount of friction may be placed on the drum and,

consequently, any amount of tension on the fillet that is desired may be obtained. When the end of the roll is reached, the fillet should be carefully secured and then trimmed off flush with the end of the roll. The taper at each end is necessitated by the fact that the fillet is wound on spirally and the taper must therefore coincide with the pitch of the spiral.

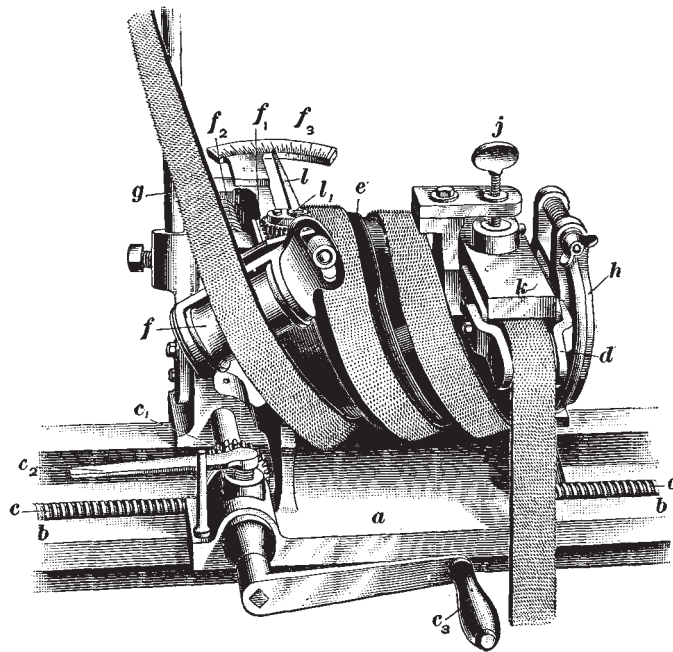


FIG. 17

37. Fig. 16 shows a fillet winding frame similar to the one described except that it is equipped with a patent drum for regulating the tension of the fillet as it is placed on the cylinder. An enlarged view of it is shown in Fig. 17, where it will be seen that it consists of a carriage *a* that slides on a bed *b*. Sufficient motion is imparted to the carriage by means of a screw *c* to guide the spirals of fillet close up to each other. The fillet when being wound is usually placed in a basket, from which the end is taken and passed through

the trough *d* to what is known as the *cone drum e*, around which it is wrapped three times. The fillet emerges over the roller *f* and is guided on the roll to be wound by the rod *g*.

The tension is obtained in the following manner: The drum *e*, which revolves as the fillet passes over it, is made in three sections—the first $6\frac{1}{2}$ inches, the second 7 inches, and the third $7\frac{1}{2}$ inches in diameter. The part with the largest diameter is covered with leather so that this portion of the drum and the fillet revolve together; and as it requires a greater length of fillet to cover this surface than it does to cover either of the smaller sections, the fillet is drawn over these at a greater speed than that at which their surfaces revolve. The friction between the fillet and the drum produces the tension on the former, the amount of which may be regulated by the brake *h* on the drum shaft and also by a thumbscrew *j* that presses the die *k* down on the fillet, which is drawn over a spring cushion.

About 200 pounds tension may be obtained by means of the brake *h* alone, the rest being obtained by means of the thumbscrew *j*. The fillet must always be passed through the trough so that the teeth will point in the opposite direction to its motion; otherwise, they will be injured. For main cylinders wound with 2-inch fillet a tension of 275 pounds is about right; smaller rolls require less tension as does also narrower fillet. Doffers may have fillet applied with about 175 pounds tension, while 125 pounds is sufficient for workers. The amount of tension with which the fillet is being wound in this machine is indicated by a finger *l* on the dial *f₃*. This is accomplished by arranging the roll *f* to press against a strong coil spring *f₂*, connection being made with a rack *f₁* and pinion *l*, so that the motion of the roll when acted on by the tension of the fillet is communicated to the finger and indicated on the dial.

The frame shown in Fig. 16 is also used for truing wooden rolls, in which case the fillet winding device is removed and a turning lathe substituted. In this case the frame is driven by a belt, but when winding fillet, motion is imparted to the

roll to be wound and to the winding device by means of the crank *m*.

In using this machine it is essential that for each revolution of the roll *n* the carriage shall move along the bed a distance corresponding to the width of the fillet. This is sometimes accomplished by gearing the screw that imparts the traverse motion to the carriage from the roll that is being covered, the train of gears being so arranged that 1 tooth of the change gear moves the carriage $\frac{1}{32}$ inch to each revolution of the roll. From this it will be seen that $1\frac{1}{2}$ -inch fillet will require a 48-tooth gear and 2-inch fillet a 64-tooth gear. In actual practice, however, a 49-tooth gear is used for $1\frac{1}{2}$ -inch and a 66-tooth gear for 2-inch fillet, since the fillet is wider than the nominal width and measures $1\frac{17}{32}$ inches and $2\frac{1}{16}$ inches, respectively.

After large rolls are covered with fillet they should be allowed to stand for 3 or 4 hours in order that the fillet may become adjusted and then it should be tacked crosswise of the cylinder. When covering with card clothing, if the roll is not reversible end for end, care must be taken to have the teeth of the clothing pointing in the right direction. As a rule, the workers, strippers, tumblers, and fancies are covered with $1\frac{1}{2}$ -inch fillet, while the doffer is clothed with 2-inch fillet, as is also the finisher cylinder when it is clothed with fillet.

Before winding on the fillet some carders paint the surface of the cylinder or roll, but this is not done so much at the present day. The usual custom is to brush the cylinder with linseed oil just before the fillet is wound on. This prevents the backs of the teeth from rusting and also prevents cracks from opening in the cylinders. Iron cylinders, of course, do not need this treatment.

38. The following rule is used to find the length of filleting required to cover a given roll:

Rule.—*Multiply the diameter of the roll by its length, in inches, and by 3.1416 and divide by the width of the filleting multiplied by 12 to reduce the answer to feet.*

A little allowance must be made for tapering the ends of the fillet at the start and finish and also to leave enough to keep the tension when finally tacking the clothing to the rolls.

EXAMPLE 1.—What length of 2-inch filleting is required on a 48-inch card to cover a 24-inch doffer?

$$\text{SOLUTION.}— \frac{24 \text{ in.} \times 48 \text{ in.} \times 3.1416}{2 \text{ in.} \times 12 \text{ in.}} = 150.796 \text{ ft. Ans.}$$

EXAMPLE 2.—What length of $1\frac{1}{2}$ -inch filleting is required to cover a 10-inch fancy on a 60-inch card?

$$\text{SOLUTION.}— \frac{10 \text{ in.} \times 60 \text{ in.} \times 3.1416}{1.5 \text{ in.} \times 12 \text{ in.}} = 104.72 \text{ ft. Ans.}$$

COVERING RING DOFFERS

39. Many carders have difficulty in clothing ring doffers, the rings being made endless and of a slightly smaller diameter than the doffer in order to fit it tightly. The following method of application, however, will be found to accomplish the purpose and not to injure the rings: The doffer should be taken out of the card and placed on end on a box, its shaft passing through a hole bored in the latter. To help in getting the rings on, a wooden cone may be made about 6 inches long, with its lower end of the same diameter as the doffer. Through its center a hole is made, which allows it to be placed on the doffer shaft. The rings may now be placed over the cone and pushed down about an inch over the doffer. A square board 3 or 4 inches wider than the diameter of the doffer should be obtained and a round hole slightly larger than the diameter of the doffer cut into it. This can be slipped over the doffer and the rings readily forced into place without bruising the leather by pounding. After all the rings are on the doffer it may be taken to the grinder and the rings, which are at varying distances apart, easily adjusted by means of a screwdriver or small stick. With the doffer revolving toward the operator but against the back of the teeth, the screwdriver should be pressed against the side of the leather part of the ring, which may thus be slid in any desired direction.

Before doing this, however, a gauge should be made for spacing the rings in order that the divisions between them may be made equal. This gauge consists of a stick as long as the width of the card and marked with as many divisions as there are rings, the latter to be spaced equally over a distance equal to the width of the clothing on the main cylinder. The waste-end ring, which is wider than the others, should be placed on the end of the top doffer farthest from the stripper belt and on the end of the bottom doffer nearest the stripper belt. Some carders place the top waste-end ring on the side of the card on which the longer side of the Apperly feed is.

The method of marking off a gauge stick for a 48-inch card with two waste ends and 48 rings on a double-doffer card is as follows: First the waste-end rings should be made $1\frac{1}{2}$ inches wide. This leaves 45 inches (48 inches — 3 inches) in which to place 48 rings. If the rings on the top and bottom doffers were all the same size, they would then be $\frac{45}{48}$ or $\frac{15}{16}$ inch wide, but the top rings must be narrower; therefore, the gauge stick must be marked so as to space twenty-four $\frac{1}{8}$ -inch rings 1 inch apart on the top doffer, while the bottom doffer will have twenty-four 1-inch rings $\frac{1}{8}$ inch apart.

When the gauge is made for the right number of rings equally spaced, the doffer should be fastened with collars in the grinder so that it will have no lateral motion, or play, and the gauge placed in front of it about $\frac{1}{4}$ inch from the wire. The rings may now be moved with the screwdriver until they coincide with the divisions marked on the gauge. The bottom doffer is treated in the same manner and when both doffers are spaced, the rings of the top doffer should just fit into the spaces of the bottom doffer and the ends of the doffers should be flush.

40. Strips of leather, as free from grease and dirt as possible, are prepared as wide as the space between the leather part of the rings and glued or tacked in with the ends butting together. Filleting with the wires removed is

frequently used for this purpose. These strips should not be cut too wide or the rings will be forced from their positions; but, on the other hand, they should fit snugly so that the rings will be held firmly in position when the card is in operation.

Another method of securing the rings that is sometimes used is as follows: Having adjusted the rings in their correct positions, a cop of cotton yarn should be procured and with the doffer in the grinding frame and the teeth of the rings revolving against the point, the thread should be touched to the outside ring, to which it will instantly cling. The thread is then guided neatly back and forth between the rings, one layer of cotton being wound over another until the same thickness as the leather foundation of the ring is obtained; then the thread is quickly crossed over to the next space, and so on continuously to the end. When finished, the doffer is stopped and with a small brush and a thin glue solution the cotton is saturated, the crossings from one space to another first being cut and the ends of the cotton thread tied together. The grinding may be commenced at once and the packing will dry as the grinding proceeds. This makes a solid, compact filling with no danger of the rings becoming displaced. If desired, strips of leather may be tacked over the cotton filling, just touching the wires of the rings.

CARDING SURFACE

41. The following rule is used to find the number of square feet of carding surface on a cylinder covered with sheet clothing:

Rule.—*Multiply the length of the sheets (width of card) by the width of the sheets (5 inches) and by the total number of sheets on the cylinder and divide the product by the number of square inches in 1 square foot (144).*

EXAMPLE.—On the main cylinder of a 48-inch first breaker card there are 24 sheets of card clothing; how many square feet of carding surface has the cylinder?

$$\text{SOLUTION.}— \frac{48 \text{ in.} \times 5 \text{ in.} \times 24}{144} = 40 \text{ sq. ft. Ans.}$$

42. To find the number of square feet of carding surface on a cylinder or roll covered with filleting:

Rule.—Multiply the diameter of the cylinder, in inches, by 3.1416 and by its length, in inches, and divide the product thus obtained by the number of square inches in 1 square foot (144).

NOTE.—To find the exact surface area of a given cylinder at the points of the clothing, add $\frac{3}{4}$ inch to its diameter.

EXAMPLE.—How many square feet of carding surface on a 7-inch worker, the card being 48 inches wide?

SOLUTION.—

$$\frac{7\frac{3}{4} \text{ in.} \times 3.1416 \times 48 \text{ in.}}{144} = 8.115 \text{ sq. ft. Ans.}$$

43. The following tables show the amount of clothing required for a set of 48-inch cards, the finisher main cylinder being covered with filleting. The reference to angular wire refers to the angular, or diamond-point, wire with which the lickers-in and feed-rolls of the second breaker and finisher cards are covered, this wire being stronger and coarser than the ordinary card clothing wire. Lickers-in may be garnetted with licker-in wire.

TABLE VI
FIRST BREAKER

No.	Cylinders	Dimensions Inches	Length Feet	Width Inches	Square Feet
24	Sheets (main cyl.)	5 × 48			4 0.0 0
6	Workers	7 × 48	61	1½	4 3.9 8
6	Strippers	3 × 48	27	1½	1 8.8 4
1	Doffer	24 × 48	156	2	2 5.1 3
1	Fancy	10 × 48	87	1½	1 0.4 7
1	Tumbler	9 × 48	78	1½	9.4 2
1	Burr cylinder	7 × 48	Metallic		7.3 3
2	Feed-rolls	2 × 48	Metallic		4.1 8

1 5 9.3 5

TABLE VII
SECOND BREAKER

No.	Cylinders	Dimensions Inches	Length Feet	Width Inches	Square Feet
24	Sheets (main cyl.)	5 × 48			4 0.0 0
6	Workers	7 × 48	61	1½	4 3.9 8
6	Strippers	3 × 48	27	1½	1 8.8 4
1	Doffer	24 × 48	156	2	2 5.1 3
1	Fancy	10 × 48	87	1½	1 0.4 7
1	Tumbler	9 × 48	78	1½	9.4 2
1	Licker-in	5½ × 48	48	1½ angular	5.7 5
1	Licker-in fancy	3 × 48	27	1½	3.1 4
1	Feed-roll stripper	1¾ × 48	24	1 angular	1.8 3
2	Feed-rolls	1¾ × 48	24	1 angular	3.6 6

1 6 2.2 2

TABLE VIII
FINISHER

No.	Cylinders	Dimensions Inches	Length Feet	Width Inches	Square Feet
1	Cylinder	48 × 48	312	2	5 0.2 6
5	Workers	7 × 48	61	1½	3 6.6 5
5	Strippers	3 × 48	27	1½	1 5.7 0
1	Fancy	10 × 48	87	1½	1 0.4 7
1	Tumbler	9 × 48	78	1½	9.4 2
1	Licker-in	5½ × 48	48	1½ angular	5.7 5
1	Licker-in fancy	3 × 48	27	1½	3.1 4
1	Feed-roll stripper	1¾ × 48	24	1 angular	1.8 3
2	Feed-rolls	1¾ × 48	24	1 angular	3.6 6
48	Rings (doffers)	12 × 48			1 2.5 6

1 4 9.4 4

The lengths given in these tables for fillet clothing are long enough to allow for tapering the fillet on each end of the cylinder. The total carding surface of the entire set of cards is approximately 471 square feet; this is the surface of the rolls before they are covered. The surface of the teeth of the card clothing itself would be slightly in excess of this.

POINTS IN MANAGEMENT

44. In the management of card rooms many points must be watched, but the following results should always be attained: (1) The production of good work; (2) as large a production as is consistent with the quality of work required; (3) economy in avoiding unnecessary waste and keeping down the expense of wages, power, supplies, etc.; (4) the maintenance of the machinery in good condition.

With reference to the first point, it may be said that this is judged by the appearance of the roving and by the resulting yarn. If the rovings are round and full, free from *twits* and imperfections, and of the right weight, the carder may feel satisfied that any imperfection of the resulting yarn is not due to the carding. A *twit* is a thin place in the roving, or yarn, that looks as though the roving were partly broken. Where twits occur in the roving, bunches and thick places are also apt to occur. If the roving is twitty, the yarn will also be full of thin places. Twitty roving causes much trouble in card rooms; it is produced in many ways. Sometimes the twits are caused as far back as the scouring, since if the wool is scoured with too hot liquor the grease seems to be driven into the fiber, rendering it stiff and wiry. Wool rendered harsh in the drying will also make twitty roving, unless carefully oiled and carded. Sometimes the clothing on the finisher-card cylinder grows slack and blisters through usage; this is a cause of twits that is only remedied by taking the clothing from the cylinder, recovering it, and afterwards grinding to a true surface. A poorly working licker-in on the finisher is also apt to cause twits; the licker-in should always take the wool evenly in small bunches and

not in large flakes or uneven bunches. Twitty roving is often caused by trying to spin fine yarn out of wool that is only fit for spinning coarse yarn. Sometimes a poorly working fancy will cause twits, especially if it is inclined to *choke* with wool, when it is often called a *lapping fancy*. Any defect in the doffer rings of the finisher doffers is sure to cause a defect in roving. These rings should be carefully attended to and kept in good condition; they should always be smooth and have a point that is sharper than the cylinder of the finisher. If the wipe roll, which strips the ribbons of carded wool from the rings, is driven too fast or if not set properly with regard to the rings, twitty roving is liable to result. Twits are also sometimes caused by too much draft between the aprons of the condenser and sometimes by poor or dirty aprons. Sometimes the rovings are not rubbed solid enough and so are liable to be weak in places. Twits are often caused by too high speed of the cards, especially of the ring doffers. If one fiber receives more oil than another, that fiber has a different action; and when one part of the batch of wool is over-oiled and another part is not sufficiently lubricated, twitty and uneven roving will often result.

Great care should be taken to bring the stock from the first breaker in good condition, as on the character of the carding done by the first breaker the resulting roving will largely depend. The side drawing from the first breaker card should be frequently examined for neps and vegetable matter. The sliver should be round and full from the first and second breakers and the rovings from the finisher card should be round and perfect, without having been rubbed too much. All little points that tend to deteriorate the quality of the work should be carefully attended to and the cards stripped when necessary; that is, when they become so filled with dirt as to clog the clothing and prevent the wire from acting freely on the stock as it passes through the card.

The economizing of production can be obtained by limiting as much as possible the time allowed for stripping, grinding, or setting the cards and also by not allowing the

rest of the set to be stopped any longer than is necessary while stripping or grinding one card. The production may be increased by speeding up the whole card or by increasing the speed of the doffer and the feed-rolls by changing the small gear that drives the large gear on the doffer shaft. Cards should never be speeded so fast as to make a large percentage of flyings, as these not only increase the amount of waste, but settle on the card and make it more difficult to clean, besides having a tendency to work into the bearings and around the shaft, collecting in lumps that are sometimes caught and carried into the card, rendering the roving uneven. Too much stock should not be forced through the card by speeding up the doffer, nor should the sliver be made too heavy. The quality of the work in woolen carding should rarely be sacrificed for production.

As a rule, two men or boys will care for from four to six sets of cards with a creel feed at the second breaker and an Apperly feed for the finisher card. Two men will strip from eight to twelve sets of cards. The labor cost of a card room varies according to the price of labor in the locality in which the mill is located, the class of work, and other conditions.

As little waste as possible should be made and all soft and clean waste should be run through the cards again. A good deal of the waste around the card may be dusted, run through the picker, and then worked over. Greasy waste should not be allowed to accumulate in piles or in bins, and water should never be put on greasy waste. Under these conditions there is great danger of spontaneous combustion and a serious fire.

The care of machinery requires that the cards shall be frequently cleaned and oiled. Cards should be wiped down with a piece of waste every night, the flyings removed and also the waste on the floor gathered up. Every week the cards should be thoroughly cleaned and the card room swept. The cards should be carefully cleaned after every stripping, and all dirt and waste removed from the bearings. After cards have been ground they should be cleaned and the wire brushed out with a strong bristle brush.

Machinery, in order to be kept in the best condition, requires frequent oiling. All fast-running parts of the card, such as the strippers, main-cylinder, fancy, tumbler, and lick-in bearings should be oiled twice a day. The workers do not need to be oiled oftener than once in 2 or 3 days and sometimes not more than once in a week. The main-cylinder and fancy bearings should be packed with tallow, having a small hole in the center so that it will allow the oil to run directly on the shafts and provide a reserve of lubrication that will melt in case of a hot bearing. If tallow cannot be obtained, small pieces of waste should be placed in the bearings and soaked with heavy oil. The doffer-comb driving mechanism is run in oil and should be examined once in 2 weeks to see if there is sufficient oil in the reservoir, or casing.

All belts on the card should be examined once a week, especially the stripper belt, and all broken or worn lacings should be replaced. The belts should be cleaned every time the cards are stripped and, when dry, they should be oiled with castor oil. When the parts of the card are disturbed in any way, they should be carefully gone over again in order to detect any variation in the setting.

ELECTRICITY IN THE CARD ROOM

45. Any animal fiber, especially wool or silk, is liable to become charged with electricity, owing to friction combined with a dry state of the fiber and of the atmosphere. The place where the most difficulty with electricity is experienced in woolen carding is at the condenser, where the rubbing action of the aprons, or rolls, tends to charge the rovings with static or frictional electricity, which causes them to cling to the aprons and to the iron parts of the card frame and spool stand, thus becoming broken and winding around the rubs. When a roving breaks and is not immediately replaced, a blank space is left in the spool, making it imperfect. Sometimes when very dry or harsh stock is being carded, it becomes almost impossible to run the cards, owing

to the electricity, which is more troublesome in dry weather than in damp and in winter than in summer.

The card room should always be fitted with a humidifying plant in order to keep the air moist and thus reduce the electric charges as much as possible, but even then there is often difficulty with the rovings. The longer the throw, or the traverse, of the condenser aprons and the closer together they are set, the more difficulty there is; the electrification may often be reduced by setting the aprons farther apart and decreasing the traverse, only allowing enough rubbing action to condense the rovings into a round thread.

A remedy that is sometimes used with good results for the prevention of electric charges is soap, which, when added to the emulsion when the wool is being oiled, seems to render the wool soft and less liable to become electrified. About 2 pounds of soap to 100 pounds of wool is generally sufficient to prevent electrification and also to render the stock moist and silky in feeling, enabling the yarn to be spun into a round, lofty thread. Alum has been found to reduce the liability to electrical effects and is usually dissolved in the water used for the emulsion for oiling in about the proportion of $\frac{1}{2}$ pound of alum to 100 pounds of stock.

The use of steam is sometimes resorted to in order to prevent electric charges from being produced, although steam is expensive to use for this purpose. The method is to run a steam pipe under the floor of the card room on a line with the condensers. Holes are bored at the end of each condenser and the pipe under the floor tapped with a $\frac{1}{2}$ -inch pipe, which should extend across the condenser $2\frac{1}{2}$ inches below the lower rovings and plumb with the rear of the rub aprons. This pipe should be perforated with small holes 2 or 3 inches apart and should have a valve attached so that the steam may be turned on or off as desired. There will be no trouble with electrification if the steam is turned on before starting the cards. No more steam should be turned on than is absolutely necessary, or the aprons will stretch or become otherwise injured; and it should be shut off the moment the finisher card is stopped. It should not be

used unless the presence of electric charges is very evident as, if too much is used, the wire of the finisher card may become rusted.

WEIGHT OF ROVING

46. In order that a woolen yarn may have a definite size, or **run**, that is, a certain number of yards per pound, it is necessary that the roving, or roping, from the cards shall be of a given, uniform weight. It is, therefore, one of the duties of the carder to make the rovings of such weight that they may be spun into the required run of yarn with a reasonable draft in the spinning.

The draft that can be given on the mule depends on the quality of wool used and the size of the yarn being spun. If the wool is of good quality and is not spun too fine, a half draft in the mule is reasonable; that is, if the draw of the carriage is 72 inches, then 36 inches of roving will be let out before the delivery rolls of the mule stop. If a low grade of stock is being spun, it may be necessary to let out 40 or more inches of roving before stopping the delivery rolls. If the mules are running on half draft, that is, letting out 36 inches of roving and drafting it into 72 inches of yarn, the roving must be brought from the card just twice the weight of the required yarn.

It is not customary actually to figure the weight of the roving by the amount of wool fed to the card, as the weight of stock fed is an unknown quantity; though the Bramwell feed supplies the wool to the card uniformly by weight, this weight is not usually known or taken into account. The point is to bring from the first breaker a sliver that will allow a suitable gear on the second breaker to give the required weight of the roving from the finisher. For instance, if the card is taking off 48 ends, the side drawing from the first breaker should weigh from 200 to 220 grains per yard if it is desired to make 4-run yarn. For a 40-inch card, carding for 4-run yarn and taking off 40 ends from the finisher, the side drawing from the first breaker may weigh from 180 to 190 grains per yard. These

weights give sufficient leeway for changing the gear on the doffer shaft of the second breaker until the rovings from the finisher are of the right size.

47. Finding Required Size of Roving.—The size of the roving, as has been previously explained, depends on the number of yarn to be spun and on the draft of the roving in spinning. The latter depends on the character of the stock and also on how near to the limit of its capabilities it is being spun; low stock will stand less draft than sound wool with good spinning properties. The size of the roving necessary to spin a given yarn is to the amount of roving let out by the delivery rolls of the mule as the number of yarn spun is to the draw of the carriage; therefore, the following rule is necessary to find the size of roving that should be made on the card for a given size, or run, of yarn, the draft in the mule in spinning being known:

Rule.—*Multiply the length of roving, expressed in inches, delivered by the rolls on the mule by the size, or run, of the yarn to be spun and divide by the draw of the carriage, in inches (72). The answer will be the size of roving required to spin the run desired with the draft given.*

EXAMPLE.—Suppose that it is desired to spin 5½-run yarn and that the stock will allow 36 inches delivery of roving to be drawn out to 72 inches of yarn of the desired size. Of what weight should the roving be brought from the card?

$$\text{SOLUTION.}— \frac{36 \text{ in.} \times 5.5 \text{ run}}{72 \text{ in.}} = 2\frac{3}{4}\text{-run. Ans.}$$

48. Changing Size of Roving.—The carder, having found the required run of the roving, must now take steps to procure the right size and to have all the rovings uniform. It must be remembered that changing the gear on the doffer shaft of the finisher does not change the weight of the roving when the finisher card is fed continuously from the second breaker; this gear simply changes the character of the feeding of the Apperly feed. If the slivers are crowded on the feed-apron and do not lie smoothly, a larger gear on the finisher doffer shaft will drive the feed-apron

faster and, consequently, spread out the slivers on the apron, rendering them less closely packed. The weight of the roving is generally changed by means of the gear on the doffer shaft of the second breaker; this is the best place, although it may be readily changed on the first breaker. The weight of the sliver from the first breaker and, consequently, the weight of the roving may be changed by the gear on the doffer shaft; a larger gear produces a heavier sliver, as it speeds up the feed-rolls of the card and also makes the dumping arrangement and feed-apron of the Bramwell feed, which is geared from the feed-rolls, work more rapidly. It may also be changed by changing the gear on the feed-rolls, which drives the dumping arrangement and feed-apron. The oftener the self-feed dumps, the heavier is the side drawing from the card.

Alterations in the weight of the first breaker sliver may also be made by changing the amount of wool deposited in the weighing pan of the self-feed. More wool is placed in the pan, or scales, if the weight that balances the pan is moved toward the extremity of the lever, or away from the pan. This is apparent, since more wool is required to overbalance the scale, and the elevating and stripping aprons are not stopped until the scale is overbalanced, the scale being the governing element.

49. Sizing Roving.—In order to find the size or run of the roving that a card is producing, it is necessary to measure a certain length and either find the size by means of a run scale or find the weight by means of a grain scale and then figure the run. If it is necessary to use a grain scale, it is convenient to have a table with the weight and size of a given length figured out. Sometimes 50 yards of yarn is measured and sometimes only 20 yards. Whatever the length, however, it is usually measured by means of a stick either 1 or $\frac{1}{2}$ yard in length and 3 or 4 inches in width, around which a number of rovings are carefully wound until the length desired is obtained. Sometimes instead of using a stick for measuring the yarn, marks are made on a

post or on the wall exactly 1 yard or $\frac{1}{2}$ yard apart. The required number of rovings is placed even with the top mark and allowed to hang loosely; they are then broken off squarely at the bottom mark. This insures an even and uniform length being weighed each time, as the tension is always the same. It is somewhat difficult in winding the rovings around a stick always to keep the same tension, and if this is not done a considerable error may be brought into the calculation, since the length weighed may vary in different cases.

50. The top and bottom spools of the condenser are always weighed separately and also spun separately, either on different mules or on separate sides of the same mule, it being possible to have different drafts on different sides of a woolen mule, thus allowing the same size of yarn to be spun even if there is some variation in the size of the roving.

The necessity for keeping the top and bottom spools, or all three spools in a three-deck condenser, separate, arises from the fact that it is impossible to set the doffers to the main cylinder absolutely the same. Then again the top ring doffer makes the first stripping from the main cylinder of the card, while the bottom doffer takes what is left on the cylinder. Although the rings of the top doffer are made narrower than those of the bottom doffer and its speed may be changed, there is a tendency for rovings on one spool to be heavier or lighter than those on the other. This necessitates making separate weighings from the top and bottom spools. If there is much difference in the weight of the rovings from the top and bottom doffers, the speed of the top doffer should be changed slightly; increasing its speed makes the rovings from the top doffer lighter, and decreasing it makes them heavier.

If the mules are running on half draft, it is customary instead of weighing 50 yards of roving to weigh 25 yards. This, of course, makes the reading of the run scale identical with the ultimate size of the yarn when it is spun, as the mule draws the roving out to twice its original length.