

CARD CLOTHING

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What This Text Covers . . .

1. FLEXIBLE WIRE CARD CLOTHING Pages 1 to 19
Most cards, in the United States at least, are covered with flexible wire card clothing. You'll learn here about the different types of flexible clothing, and about how they are constructed for different purposes. You'll also study how to perform the necessary calculations.
2. CLOTHING THE CARD Pages 19 to 37
The installation of card clothing is a highly skilled job. The clothing is expensive and is expected to stay in place for many years. The quality of the carding is affected by the clothing. Here you'll learn exactly how to clothe a card.
3. GRINDING THE CARD Pages 37 to 46
Many overseers of carding started their careers as card grinders. Card grinding is probably the most important of the technical occupations in the card room. It is described in this section.
4. METALLIC AND SEMIFLEXIBLE CLOTHING Pages 46 to 64
Many textile technologists believe that the cards of the future will all be clothed with metallic wire. True or not, you'll be interested in comparing the new developments with the conventional clothing. You can study here the main points in which the various types of clothing differ from each other, and lay a foundation for forming your own opinions in the matter.

Card Clothing

Flexible Wire Card Clothing

Major Types of Clothing

1. When you studied carding principles, you observed that the most important working parts of all cards are covered with card clothing. The selection of the proper sizes of clothing, the correct installation of the clothing, and the careful maintenance of the clothing are among the most important fundamentals in carding. If you were to attend a meeting of carding overseers, you would find that the topic of card clothing is an endless source of technical discussion among the experts.

If you could read all that has been written about card clothing, you would probably come away from your reading confused by the variety of opinions you encountered. To introduce you to the study of clothing, we will therefore begin with a clear description of the major types of card clothing: 1) flexible wire clothing, and 2) metallic clothing. At first glance it seems impossible that two entirely different materials can be used for the same purpose. But, as you study carding theory and practice, you'll find that this is so. You will also find one point on which all experts agree: you cannot have good carding if your card clothing is not properly taken care of. For successful carding you must, therefore, study the care and maintenance of card clothing.

To start with, we will look at the type of flexible wire clothing that is commonly used for the card cylinder or, to be more specific, for the foundation into which the card wires are set.

Foundation for Clothing

2. As you have learned, leather was used originally for card clothing. Today leather is still used in some places, but not often. It is hard to get leather that is entirely uniform, and even if such leather is available, it is rather expensive. Various fabric foundations have been developed instead, and several of these have proved to be more satisfactory than leather.

Let's look now at the specifications a satisfactory clothing foundation must meet: 1) The foundation must be strong. It must fit the cylinder tightly, and it is therefore put on under controlled tension. It must also absorb the strain of carding year after year—ten years is considered the life span of well-kept clothing. 2) The foundation must not stretch. Otherwise the clothing will become loose, develop blisters, or raise. This condition will not only turn out poor work, but with the fine settings maintained in carding, the wires on adjacent carding surfaces may touch each other. This would cause dulling of the wire and add to the cost of maintenance. 3) The foundation must have "give," or flexibility, within itself. It must allow the wire to move slightly under the strains of carding, and help the wire to regain its original position when the strain ceases. It must also hold the wires in place during grinding and during normal carding operations. 4) The initial cost of card clothing is a minor item compared to other expenses in carding. You will find that proper maintenance will keep this cost controlled. The price of the clothing should be in proportion to its quality.

3. No single textile fiber, or a fabric made from it, would meet all the specifications for a good foundation. A characteristic foundation for cotton-card cylinder clothing may consist of four layers. The top layer may consist of a strong cotton twill fabric. The second layer consists of a heavy fabric with a strong linen warp and woolen filling. The third layer consists of a somewhat lighter fabric, either all cotton or a strong cotton warp with worsted filling called "cordette." The back, or

fourth, layer is again cotton twill. The cotton twill lends strength to the foundation, and it is comparatively inexpensive. The linen, which runs lengthwise of the clothing, provides strength and prevents stretching. The wool, which runs crosswise of the clothing, provides flexibility for the wires. The different layers of the card clothing are cemented together with a suitable adhesive, so that the whole foundation forms one thick fabric. After the glue or other adhesive is dry, it is oil resistant and reasonably moisture resistant. It is pliable, yet holds the fabric in firm bond.

There are endless variations in the construction of clothing foundation. Linen warp is sometimes used without any filling as one layer in the foundation. This is called "flexifort," and clothing containing such linen warp is called flexifort clothing. Use may also be made of two layers of cotton cloth at the bottom, then a layer of wool, and then a layer of cotton on the top. This type of foundation is often called CWCC clothing. For doffers, and also for flat tops, a clothing called CWC is used. This has cotton twill on the face and back, with heavy woolen cloth between the two layers of cotton twill.

A popular clothing for cylinders in woolen or worsted carding consists of a top layer of cotton, a second layer of cotton warp with wool filling, a third layer of flexifort warp, and a bottom layer of cotton. For special purposes the top layer of the foundation may be covered with felt, or with rubber or plastic. However, we'll go into these variations later. The foundation for the clothing is made in broad width. After the adhesive has thoroughly dried, the clothing is cut into long narrow strips, and the wires are inserted.

Wire for Teeth

4. The wire teeth of the card clothing are made from different metals and come in various sizes and shapes. Tempered steel, ranging in diameter from 0.009 to 0.017 in. (inches), is most commonly used. The cross section of the wire is usually

round, but it may be oval, triangular, or diamond-shaped for special purposes.

There are certain terms you'll hear in connection with card wire. A *cut* is the short piece of wire from which each card wire is bent. The *staple*, as the name implies, is the staple-formed piece of wire that is inserted into the foundation. The bottom part of the staple, which lies flat on the back of the clothing, is called the *crown*. The two ends of the staple protrude through the foundation and their tips are called the *points* of the wire. The staple is bent between the surface of the clothing and the point of the wire; this bend is called the *knee* of the wire.

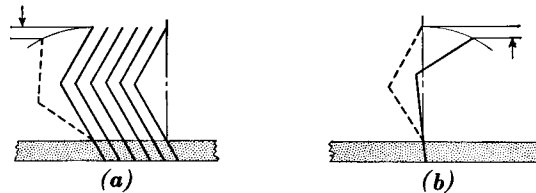


FIG. 1. ANGLE OF WIRE

The wire is not placed perpendicularly through the foundation, but at an angle, as shown in Fig. 1 (a). The angle at the knee offsets the angle at which the wire passes through the foundation. This is an important point. If the fibers resist the action of the wire, the point is pulled backward and moves down in a curve as indicated. When the wire is in this position, the setting between the carding surfaces becomes more open. Now look at Fig. 1 (b) and observe what happens if the knee of the wire is bent past the angle at which the point of the wire is above its base. When the wire encounters resistance it will be raised as indicated. In a close setting it may well strike the opposite carding surface, causing damage to the wire.

5. From all that has been said so far, you will already understand how important it is that card clothing must be made just right. The wire teeth are put into the foundation by a machine

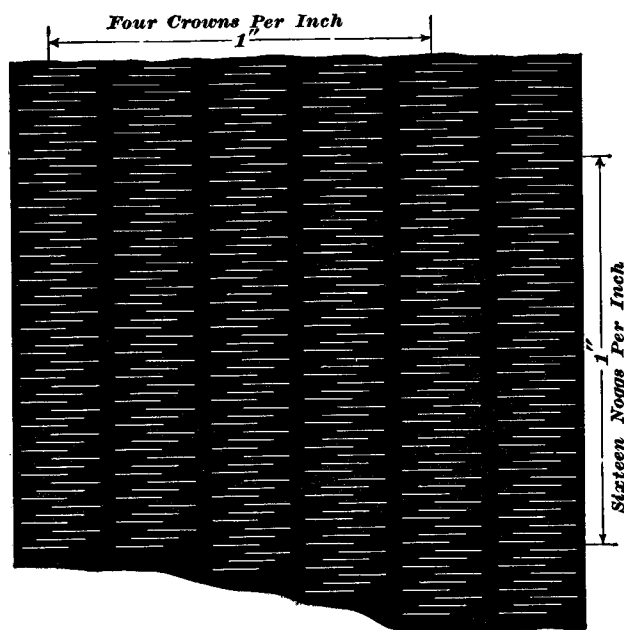


FIG. 2. RIB-SET CLOTHING

that is completely automatic. It first cuts the wire and bends it in the form of a staple. It then pierces holes in the foundation and pushes the wire ends through. Finally, it bends the knee of the wire at the correct angle.

There are two major forms in which flexible wire card clothing is produced: 1) fillet clothing, or filleting; and 2) sheet clothing, including tops. The fillet clothing comes in narrow strips, usually $1\frac{1}{2}$ or 2 in. wide. It is wound around the card cylinders or the various card rolls in a spiral. The length of the filleting is several hundred feet, the exact length depending upon the size of the cylinder to be covered.

Sheet clothing is sometimes used to cover the cylinders of woolen and worsted cards. Such sheet clothing is usually 5 in. wide, and as long as the width of the cylinder. It is full of wire staples, except for a narrow border on all sides that is

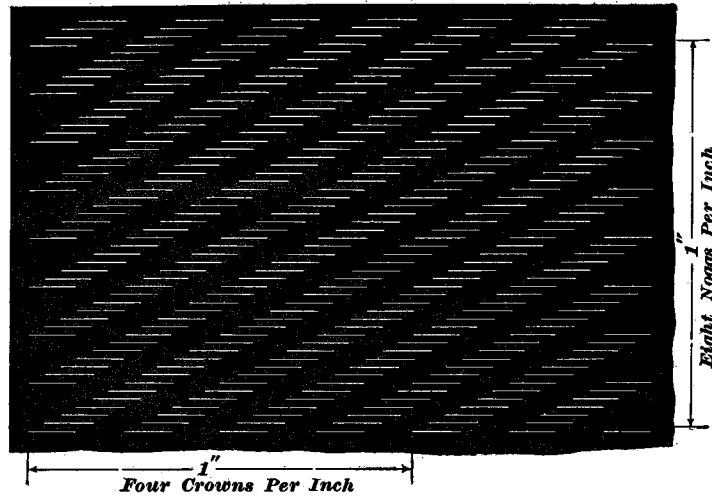


FIG. 3. TWILL-SET CLOTHING

used to attach it to the card cylinder. For cotton cards, sheet clothing is used on the flats. These sheets, or tops, fit the flats. They are $1\frac{3}{8}$ in. wide and $42\frac{1}{2}$ in. long. A $\frac{7}{8}$ -in. strip down the center is full of wire staples, while $\frac{1}{4}$ -in. strips on each side are left blank for attaching the sheet to the flats.

Rib Set and Twill Set

6. If you look at the surface of card clothing, the teeth seem to be tightly set without any particular pattern. But if you look at the back of fillet clothing, you'll note that the crowns form a riblike pattern as shown in Fig. 2. Note how one crown is off to the left, one is in the center, and the third is to the right of the rib. On the surface of the clothing there will be, of course, two points for each crown. The three crowns you have just observed form a short diagonal line within the rib. Each group of three crowns is called a nogg.

In the clothing shown in the illustration there are four crowns per inch and sixteen noggs per inch. This information is used in determining the number of points in card clothing. Most

clothing is standardized to four crowns per inch, and only the number of noggs needs to be specified.

If you look at the back of sheet clothing, you'll find the wire set in twill lines, as shown in Fig. 3. Each seventh crown will be exactly over the first crown of the next twill line, so the repeat of the twill is six. Since this repeat is called the nogg in twilled clothing, there are six crowns per nogg, not three as in rib-set clothing. In any type of clothing, however, the number of crowns per inch is generally standardized at four. Now let's take a look at various ways of measuring card clothing.

Points per Square Foot

7. When it comes to ordering card clothing, you must know how to specify the clothing you want. There are two ways of doing that, the American and the English system. Both are used in the United States; so, while two systems are a nuisance, you'll have to become familiar with both of them. Either way, you must first take a ruler and measure the crowns per inch and the noggs per inch. In Figs. 2 and 3 you'll see how to go about this.

In the American system it is customary to specify the points per square foot. You can use a rule or a formula, whichever you prefer. Remember, in order to understand the figures used, that there are two points for each crown; and that a square foot has 144 square inches.

Rule: *Multiply the number of crowns per inch by 2. Multiply the number of noggs per inch by the number of crowns per nogg. Multiply the results by each other and by 144.*

FORMULA.

$$P = C \times 2 \times N \times F \times 144$$

in which P = points per square foot;
 C = crowns per inch (in width);
 N = noggs per inch (in length);
 F = crowns per nogg.

EXAMPLE. Look at the rib-set clothing in Fig. 2. Note that there are 4 crowns per inch in the width, and 16 noggs per inch in the length. Recall that there are 3 crowns per nogg in rib-set clothing. How many points per square foot does this clothing have?

SOLUTION.

$$P = 4 \times 2 \times 16 \times 3 \times 144 \\ = 55,296 \text{ points per square foot. Ans.}$$

8. As long as you are dealing with regular clothing, the formula in the preceding article can be greatly shortened. For rib-set filleting you can use the formula that follows.

FORMULA.
$$P = N \times 3,456 \quad (1)$$

in which P = points per square foot;
 N = noggs per inch.

This formula presupposes that the clothing has 4 crowns per inch. If this is not the case, you must use the long formula given in the preceding article. Sometimes you may want to determine the points per square inch, rather than per square foot—some manufacturers list their clothing in this manner. You can use the same formula as above, but use 24 to multiply the noggs instead of 3,456.

For twilled sheet clothing, where each nogg has twice as many points as in the rib-set clothing, use the formula that follows.

FORMULA.
$$P = N \times 6,912 \quad (2)$$

in which P = points per square foot;
 N = noggs per inch.

If you want the points per square inch, use 48 instead of 6,912. Again, the short formula works only for standard clothing with 4 crowns per inch.

English Counts

9. Although the system is fairly simple, many mill men don't really understand the English method of counts in card cloth-

ing. You'll have to take a brief look at the history of card clothing to do so.

A century ago card clothing in England was made in 4 in. wide strips. The crowns were set like bricks in a wall, or like plain weave. That is, there were two crowns per nogg. This plain, or open, set is seldom used today. The clothing always had 5 crowns per inch and each count indicated the number of noggs in 4 in. Each count was equivalent to 720 points per square foot.

Even though the clothing on which it is based has become almost extinct, the English counts are used today for all types of card clothing. The noggs and crowns in modern clothing are differently arranged, but one English count still represents 720 points per square foot. To compare the points per square foot to the English counts, use these simple formulas.

FORMULA.

$$C = \frac{P}{720} \quad (1)$$

in which C = English counts;

P = points per square foot.

EXAMPLE. You need card clothing with 64,800 points per square foot. The card clothing in the supply room is marked with English counts. Which counts do you need?

SOLUTION. $C = 64,800 \div 720 = 90$ s counts. Ans.

This formula may also be used in another form to find the points per square foot when the English counts are known.

FORMULA.

$$P = C \times 720 \quad (2)$$

in which P = points per square foot;

C = English counts.

EXAMPLE. A doffer is to be covered with 120s clothing. How many points per square foot do you specify?

SOLUTION.

$P = 120 \times 720 = 86,400$ points per square foot. Ans.

TABLE 1
FILLET CLOTHING FOR COTTON CARDS

English Counts	Points (Square Foot)	Noggs (Approximately)	Wire Gauge Number
90s	64,800	19	31
100s	72,000	21	32
110s	79,200	23	33
120s	86,400	25	34

Wire Gauge

10. Up to now we have counted only the wire points, but there is another item to consider—the diameter of the wire. This diameter is thicker for coarse clothing than for fine clothing. The wire diameter is numbered by the American standard wire gauge. The higher the gauge number, the finer is the wire. For example, No. 30 wire has a diameter of 0.014 in.; No. 32 wire is 0.0128 in. in diameter; No. 34 wire is 0.0104 in. in diameter, and so forth. You can measure the wire with a simple V-shaped measuring gauge. Slip the wire into the V-shaped slot of the gauge, and read the number on the side when the wire is as far as it will go.

There are no definite standards to guide you in selecting a wire of certain diameter for a card clothing having a certain number of points per square foot. However, there are certain diameters generally used with clothing of a particular number of points per square foot. In Table 1 some card fillet clothing commonly used for cotton cards is listed.

While the English counts are commonly used in the designation of clothing for cotton cards, this is not the case with respect to woolen-card clothing. For woolen-card clothing the wire gauge number and the noggs are usually given in the specifications. Consequently, we'll list these first in Table 2. Also, it is better to specify "8-rib, 3-twill" for the 2-in. fillets, so as to avoid all possibility of misunderstanding.

TABLE 2
FILLET CLOTHING FOR WOOLEN CARDS

Wire Gauge Number	Noggs	Points (Square Foot)	English Counts (Approximately)
28	10	34,560	48s
30	12	41,472	58s
32	14	48,384	67s
33	16	55,296	77s
34	18	62,208	86s
35	20	69,120	96s

You will notice that the range of the woolen-card clothing runs to much lower points per square foot than that of the cotton-card clothing, and that the wire in equivalent clothing is somewhat finer.

Flexible Clothing for Cotton Cards

11. Most cotton cards, in America at least, are covered with flexible clothing. The types of clothing used are fairly standardized. For the cylinder, CWCC clothing is used. Carded cotton to be spun into coarse counts, say 4s to 15s, is carded with 90s counts cylinder clothing. For medium-carded yarns and coarse-combed yarns of 15s to 30s, 100s counts cylinder clothing is used. For fine yarns of 30s to 70s, 110s counts cylinder clothing is used. For extremely fine-combed yarns, those above 70s, 120s counts clothing is used.

Characteristic cotton-card cylinder clothing is shown in Fig. 4. Note the thickness of the CWCC foundation. The clothing, like most cylinder filleting, comes in strips 2 in. wide. If you could inspect the backs of the strips, you would find 8 ribs in the width, that is, 4 crowns per inch. You would count 21 noggs per inch in the length. In accordance with the formula you have learned, this would give you:

$$P = 21 \times 3,456 = 72,576 \text{ points per square foot}$$

Since clothing of 100s English counts would have $100 \times 720 = 72,000$ points per square foot, this is the type of clothing that would be used. The difference of 576 points per square foot is insignificant and would be neglected.

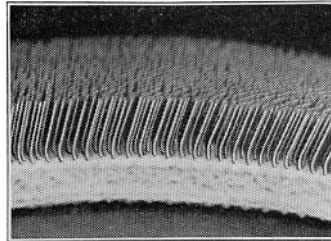


FIG. 4. CYLINDER CLOTHING,
100s, CWCC

12. The clothing used for the doffer is somewhat finer than that used for the cylinder. Usually there is a difference of 10 counts. For instance, you would use 110s counts on the doffer with 100s counts on the cylinder. The foundation of the doffer clothing is thinner; CWC foundation is normally used. The tops for the flats are usually selected to match the doffer clothing, that is, the clothing on the flats is also 10 counts finer than that on the cylinder.

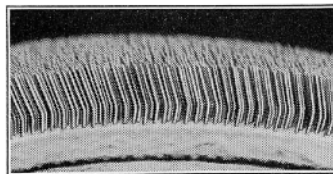


FIG. 5. DOFFER CLOTHING,
120s, CWC

Characteristic cotton-card doffer clothing is shown in Fig. 5. You will notice that the wire is finer and the foundation thinner than that of the cylinder clothing. The height of the wire is the same— $\frac{3}{8}$ in. from the crown to the point. The doffer filleting is only $1\frac{1}{2}$ in. wide. The clothing shown has 6 ribs in the width, that is, 4 crowns per inch. There are 25 noggs per inch.

In accordance with our formula, that would be 86,400 points per square foot, or 120s counts clothing.

Flexible Clothing for Woolen and Worsted Cards

13. While there is a certain amount of standardization in cotton carding, this is not the case in woolen and worsted carding. In wool fibers there is a much wider range between coarse and fine and long and short than there is in cotton fibers. Of course the cards are different too, as you have learned. Many mills have even dispensed with flexible clothing altogether and have changed to metallic clothing, which we will consider in some detail later.

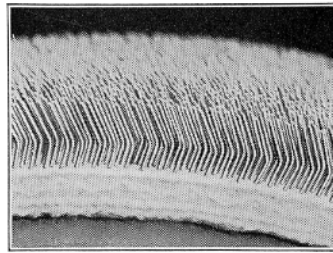


FIG. 6. CYLINDER CLOTHING,
No. 33, CWCC

Even if your major interest is in cotton, you will do well to study clothing for woolen and worsted cards as well as that for cotton cards. Rayon and synthetic staple, and blends of all kinds of fibers, are being processed more and more frequently. The more types of card clothing you know and understand, the better you will be equipped to experiment when the conventional type of clothing proves unsatisfactory for a new fiber.

A characteristic cylinder clothing for a woolen card is shown in Fig. 6. With a CCWC foundation, 2-in. width, 4 crowns per inch, and 16 noggs per inch, the clothing is quite similar to a coarse cotton-card cylinder clothing. The wire is gauge No. 33. This clothing might be used on the first breaker for very fine, lofty wool; on the second breaker for medium work; and on the

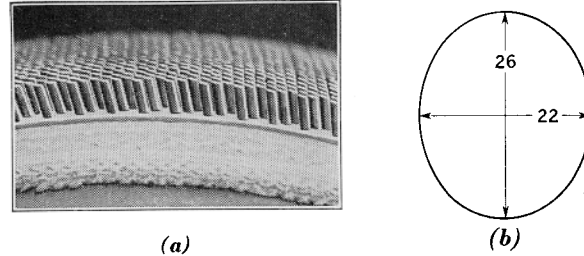


FIG. 7. CYLINDER CLOTHING, No. 22-26, 8-PLY

finisher when fairly coarse work is run. The clothing for the workers is like the cylinder clothing, but it is only $1\frac{1}{2}$ in. wide.

The staple or the over-all height of the clothing is $\frac{1}{3}\frac{2}{3}$ in. from the crown to the point of the wire. This is $\frac{1}{3}\frac{1}{2}$ in. higher than the $\frac{2}{3}$ -in. height of the clothing for cotton cards.

14. The clothing you studied in the preceding article was more or less the same as that on a cotton card. But the clothing shown in Fig. 7 (a) is different. This is a very heavy fillet, used for carpet wool and other coarse, matted fibers on the first breaker card. The foundation is 8-ply, with a wool face. The wool face makes stripping easier and helps to absorb the shocks while the wires work on the tangled fibers.

The wire on all the clothing we have studied so far was round in cross section, but the cross section of the wire in Fig. 7 (a) is double-convex, as indicated in the section, sketch (b). The gauge is given as No. 22-26, because the shorter diameter is equivalent to No. 22, the longer diameter to No. 26. This form of the wire has at least two advantages: 1) the long diameter adds strength to the wire; 2) the short diameter gives room for the fancy to lift the stock to the surface. Also, as you'll realize when you study card grinding, double-convex wire takes and holds a sharper point.

If you were to look at the lock of the 2-in. strip of clothing, you would notice only 6 ribs, that is, 3 crowns per inch. With 10 noggs per inch, this is a very open spacing. Its purpose is to leave room for the stock between the heavy wires.

15. Now let's look at another variety of cylinder wire—that used in the worsted-type clothing shown in Fig. 8. At first glance this clothing resembles the clothing shown in Fig. 4 and Fig. 6. With No. 33 wire, 8 crowns per inch, and 20 noggs per inch, it is suitable for fine work. It differs from the clothing

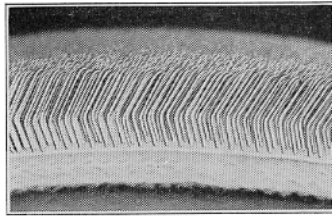


FIG. 8. CYLINDER CLOTHING,
NO. 33 PLATED, 5-PLY
RUBBER FACE

we have considered so far by being constructed specifically for working with moist stock. The wire is plated to resist rust. The foundation is 5-ply, with a top layer of rubber. This rubber face keeps the moisture in the stock from penetrating into the foundation.

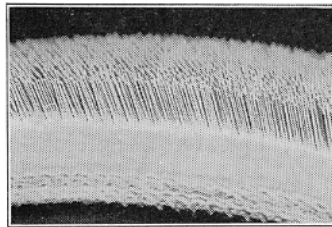


FIG. 9. CYLINDER CLOTHING,
NO. 34 PLATED, 6-PLY
FELT FACE

You'll see still another type of card clothing in Fig. 9. The outstanding characteristic of this clothing is the felt face of the foundation. This felt layer encloses the wire clear up to the knee. While the soft felt doesn't restrict the normal movement of the wire, it does help to return it to normal pitch.

However, the main purposes of the felt are to save stock, to keep the card from loading up, and to keep the sliver uniform.

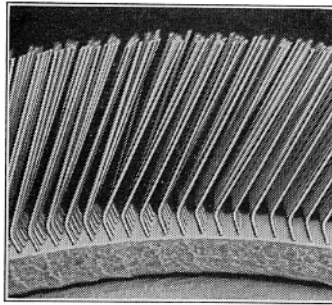


FIG. 10. FANCY CLOTHING
WITH KNEE

Normally, when a card is started after stripping, the sliver will be light for some time. This condition doesn't cease until a bed of firmly entangled fibers is formed from the surface of the clothing to the knee of the wire. The light sliver produced, and the fiber base, represent losses of stock. When fine wool or other expensive fibers are carded, the felt-base clothing may save money. You might also try felt-base clothing when carding synthetics that form static electricity and tend to load up the card. With plated wire and high humidity this type of clothing has been found helpful in preventing loading. Remember, however, that felt-base clothing requires great care in setting the fancy and in stripping; otherwise you may injure the felt base.

Fancy Clothing

16. There is little difference between the clothing used for the cylinder and that used for the flats, or the workers and strippers. But you'll find the fancy clothing, Fig. 10, quite different. You'll remember that the fancy has only a raising action and that the wire points reach into the points of the cylinder clothing.

The fancy clothing shown is set in a leather foundation, and the wires are $1\frac{1}{4}$ in. from the crown to the tip. The wire is No. 28, plain set with 12 rows across the $1\frac{1}{2}$ -in. width of the fillet. It has 2 noggs per inch. This type of fancy clothing may be used on short stock because it has a very soft action.

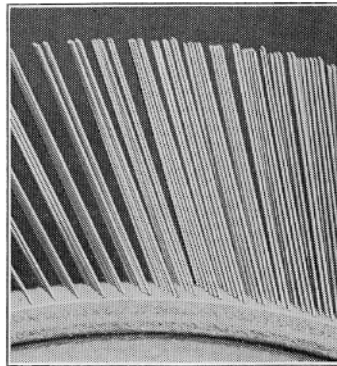


FIG. 11. FANCY CLOTHING,
STRAIGHT WIRE

Fancy clothing with a straight wire, as shown in Fig. 11, is more commonly used today. It can be used on almost any card and for any type of fiber. The straight wire is set into the leather foundation at a 65-degree pitch, and it has a somewhat stronger action than equivalent wire with a knee. In some types of cards where the fancy roll is not enclosed, the straight-wire fancy may cause more fly than a knee-wire fancy. Even so, most woolen carders prefer straight-wire fancies, because they can set these fancies more easily, and run them more slowly without danger that the stock may wind on them.

The particular clothing shown in the illustration has No. 28 wire, $1\frac{1}{2}$ in. long, from crown to point. There are 3 crowns in the $1\frac{1}{2}$ -in. width of the rib-set clothing, with 3 noggs per inch lengthwise. You'll be able to figure out for yourself how much more loosely the fancy wire is spaced, as compared to cylinder wire. Generally, a common fancy has about half as many points per square foot as the cylinder wire it is used

with. Open-spaced fancy clothing has about half as many points as common fancy clothing.

Which Clothing to Use

17. When clothing a new card or reclothing old cards, the overseer of carding has to decide upon the best clothing to use. You have already seen how many different types of flexible wire clothing there are. Later on we will also discuss other types of clothing: metallic clothing and semiflexible clothing. The decision is a difficult one to make. With proper care, good clothing will last a good many years. A wrong decision may cause years of headaches and cost the mill a lot of money. You'll want to give the matter some thought.

First of all, get all the facts you can. You know for sure what types of cards you are using. Get in touch with the machine company that built the cards and find out which type of clothing is recommended by the engineers who built the card. Consider the stock you are using at present. Try to determine what stock you will use in the future. Of course, you can't tell for sure, but if your mill is one that goes in for novelties and experimentation, you might choose a versatile clothing rather than one that is too specialized.

Consider the experiences of others. Call in the technical consultants or the representatives of reliable card clothing manufacturers. These men go from one mill to the other and have a wealth of experience. Read all you can find in current textile magazines about reports from mills and overseers' meetings, so you'll learn from the experience of other card room experts.

When you have compiled all the information you can, you'll find that there is much disagreement among the experts. Clothing A worked just fine in one mill. Another mill, with the same cards and the same stock, found clothing B much better. Seems confusing? You'll usually find that the experts and engineers forget to allow for the human factor—the men

who set, maintain, and run the cards. These men have worked with a certain type of clothing for years. They know exactly how it will work. They don't want to change and learn all over again. This is an important point to consider. Retraining your help costs time and money, and you'll need some substantial gain to make it worth while.

By now you'll realize that there is no simple, all-purpose answer to your problem. But by the time that you finish your study of carding, you'll know enough to understand the expressions used by carding experts. You'll have a thorough knowledge of good carding practice. You'll know where to go for further advice. Then you'll be prepared to make sound decisions regarding your own problems.

Clothing the Card

Fillet Clothing on the Card Cylinder

18. New cards are shipped to the mill without clothing, because it might be damaged in transit. We'll assume that you have some new cards set up, or some old cards that require new clothing. You have carefully studied the various types of clothing and have selected the type you want. The next step is to put it on. Let's see then, to start with, how a cylinder is covered with fillet clothing.

Looking at a bare cylinder, you'll notice parallel holes of rows; they are drilled across the width of the cylinder. These holes are plugged with hardwood. You can drive tacks through the card clothing into these wooden plugs to fasten the clothing to the cylinder. The clothing is wound spirally on the cylinder. One spiral is tightly placed next to the other. The ends of the clothing must be tapered, of course. Otherwise, they would stick out. About $\frac{1}{16}$ in. on each side of the cylinder is left bare, to make sure that the clothing never goes over the edge.

The main point you'll have to keep in mind is that the clothing must go on tightly and evenly. If there is any unevenness in the clothing, or if even a single spiral becomes a little slack, you'll get high spots, or blisters. Such blisters can ruin the clothing, cause shoddy work, and even start a disastrous card fire. No wonder that mills will train men specially to clothe cards, or else leave the job to an experienced card erector or to the boss grinder.

Preparing the Cylinder

19. Before you start clothing a cylinder, make sure that the cylinder is in good shape. In the case of an old cylinder, check the wooden plugs. Drive small wooden pegs into the old tack holes. Replace all plugs that are loose. Sandpaper the tops of the plugs, to make sure they don't stick out. Most important—clean the cylinder well. Remove all rust, grease, old paint, and oil spots. In the case of old or badly made cylinders, it may also be necessary to turn the cylinder. However, this is a job few mills have the facilities to do properly, and so it is best to leave it to a well-equipped machine shop. In any case, the cylinder must be perfectly dry and smooth. Stove polish has been found to be a good means to smooth the cylinder.

A point of argument is whether or not to paint the cylinder before you put on the clothing. Most cotton carders have dispensed with this practice, but it is recommended by some woolen carders. The main arguments against painting are these: 1) The cylinders are made with extreme accuracy, which even a coat of paint may destroy. 2) The paint causes the clothing to stick to the cylinder, making a messy job when it becomes necessary to redraw the clothing. Arguments in favor of painting are as follows: 1) The paint prevents the crowns from rusting through when the humidity in the card room is high. This seems to be a pretty good argument. 2) The paint prevents the clothing from slipping. Opinions

vary about this point, because the paint also takes the give out of the clothing in case of obstruction. 3) The paint reduces static by insulating the wire from the cylinder. This argument is open to doubt, however, because the movement of the wire during carding soon wears the paint off between the crowns and the cylinder surface.

Burnt linseed oil makes a good covering for the cylinder. Some carders, however, prefer lead paint, shellac, or special paint mixtures. If you are particularly interested in the question of whether or not to paint cylinders and in what to use, you might write to the Davis & Furber Machine Company for a booklet entitled *Clothing Woolen and Worsted Cards*. This booklet contains the opinions of a score of experienced carders who work with cotton, blends, and wool.

If you have wooden cylinders on an old card, you must turn them to a true cylindrical surface before clothing. Wooden cylinders must be painted or shellacked to prevent the wire from chafing the wood, and to keep moisture out. Aluminum rolls, which are used on some modern cards to save weight, are prepared just like the iron cylinders.

Getting the Clothing Ready

20. The clothing comes from the card clothing manufacturer in large rolls. It is packed in boxes and wrapped in moisture-resistant paper. This doesn't mean, however, that you can keep the clothing in some damp hole for years on end. Store it in a dry place, and use the oldest shipments first, so that it doesn't get a chance to deteriorate.

Before you go to the storeroom to get the clothing, you must know how much you'll need. For this purpose you can use a rule or a formula. You measure the diameter and the width of the cylinder. You know the width of the fillet, in inches. With these measurements you can find the length of the clothing in feet by applying the rule that follows.

Rule: Add the width of the fillet to the width of the cylinder. Multiply the sum by the diameter of the cylinder and by 3.14. Divide the product by 12 times the width of the fillet.

The rule has been further simplified by expressing the two constants as one; that is, $3.14 \div 12 = 0.26$ (nearly).

FORMULA.

$$L = \frac{(F + W) \times D \times 0.26}{F}$$

in which L = length of fillet required, in feet;

F = width of fillet, in inches;

W = width of cylinder, in inches;

D = diameter of cylinder, in inches.

EXAMPLE. You want to clothe a cylinder that is 50 in. in diameter and 40 in. wide. The fillet clothing is 2 in. wide. How many feet of clothing will you need?

SOLUTION.

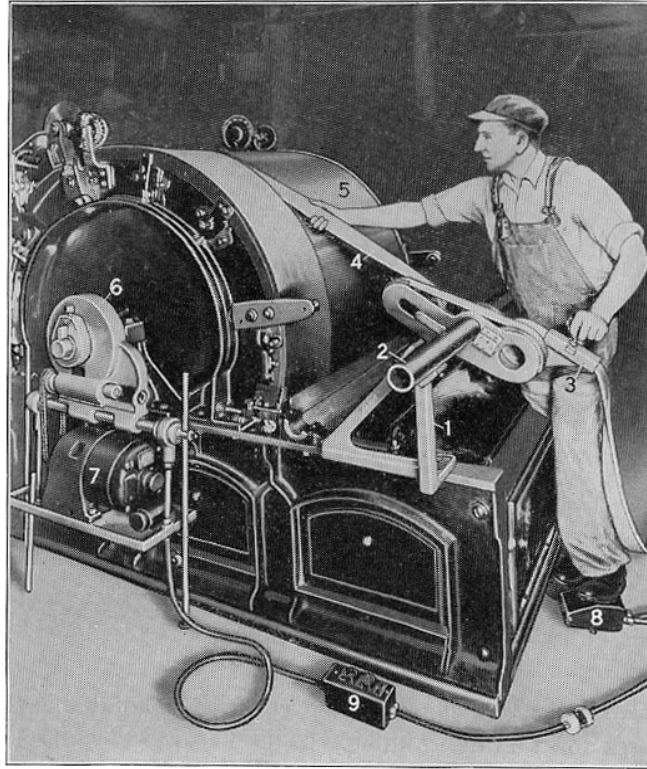
$$L = \frac{(2 + 40) \times 50 \times 0.26}{2} = 273 \text{ ft. Ans.}$$

The preceding calculation allows for tapering the clothing, but it doesn't allow for stretch. Stretch varies greatly, say between 2% and 5%, but it can't be predicted accurately. However, it is better to have 5 or 10 ft left over than to run short.

Now get the card clothing from the storeroom, unwrap it, and put it down in the card room. Leave it there for a day so that it will become conditioned to the proper temperature and humidity.

Tension Regulators

21. The fillet must be put on the card cylinder under considerable tension. It is put on from the back, that is, from the feed end. Various devices are in use to put the proper tension on the clothing during winding. One of these, the Tuffer Tension Regulator, made by the Howard Brothers Manufac-

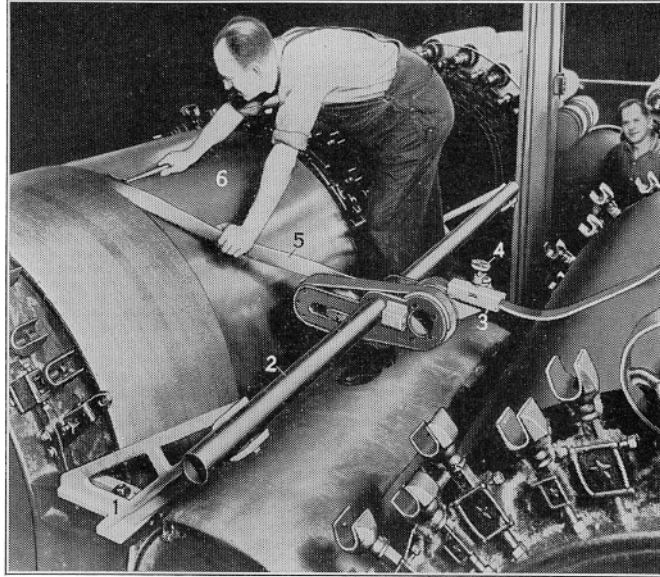


- | | | |
|---------------|-------------------|---------------------|
| 1. stand | 4. fillet | 7. electric motor |
| 2. slide tube | 5. cylinder | 8. foot switch |
| 3. trough | 6. cylinder drive | 9. reversing switch |

FIG. 12. CLOTHING A COTTON CARD CYLINDER

turing Company, is shown in operation on a cotton card in Fig. 12. The card has been prepared by taking off the drive belts and by removing the feed plate and lickerin. The flats in the back have been loosened and folded over to the front. The old clothing has been taken off and the cylinder prepared for the new clothing. A stand is bolted to the card frame and holds a slide tube on which the regulator moves.

As you can figure out from the position of the card, the fillet goes on with the teeth pointing forward. The fillet enters the



- | | | |
|---------------|--------------------|-------------|
| 1. stand | 3. trough | 5. fillet |
| 2. slide tube | 4. adjusting screw | 6. cylinder |

FIG. 13. CLOTHING A WOOLEN CARD

tension device through a trough over which an adjustable plate presses down on the clothing. In the illustration you see the man clothing the card with his left hand on the adjusting screw, which regulates the tension. The fillet is then guided over several friction pulleys that add more tension. A dial shows you the total tension that is put on the clothing.

22. Another problem in winding the clothing on that is of turning the cylinder. This can be done by means of a hand crank or winch. It is hard work, even for a couple of husky men, to turn the cylinder slowly for hours at a time against several hundred pounds of tension. In Fig. 12 you see a motor drive that does away with this labor. It has a foot switch which allows the man who clothes the card to regulate the speed. A reversing switch is handy when you want to cut the end-tapers, or redraw some of the fillet.

There is no fundamental difference between clothing a cotton-card cylinder and clothing a woolen- or worsted-card cylinder. In Fig. 13 you see the tension regulator installed on a woolen card. The workers and strippers have been taken off. The man clothing the card stands on the lickerin, which is covered to prevent damage to its clothing.

How Much Tension to Use

23. There is some difference of opinion as to the best tension for the cylinder fillet. If you know the best tension from experience, or if you have specific recommendations from the card clothing manufacturer, you can disregard the figures given in this article. If not, they will serve you as a guide. No matter which tension you decide upon, be sure to hold it accurately throughout the job. Each spiral of clothing that is put on with too much or too little tension will give you trouble later on.

The exact tension depends on the type of fillet you use and the kind of stock you intend to run. Too little tension, especially on heavy work, will cause the clothing to get loose during carding. Too much tension will take the life out of the foundation and give a harsh carding action.

For CWCC or equivalent 4-ply clothing of good quality, 350 lb (pounds) is considered satisfactory. For the heavy clothing sometimes used on woolen cards, you may go even higher, up to 400 lb. These figures apply to the regular 2 in. wide cylinder fillet.

Some men who clothe cards put the clothing on the card only once, with the full tension. Others prefer to wind the clothing on temporarily with a lower tension, say 250 lb. Then they let the cylinder stand overnight, so that the clothing adjusts itself. The next day they take the clothing off and repeat the job with the full tension. If you follow this second method, you can draw a straight chalk line across the cylinder clothing after it has been put on with the temporary tension.

Then, when you rewind the cylinder, each spiral should gain a little, and the chalk marks will show you whether or not the gain is even.

Whether redrawing is necessary or not is debatable. Some experts claim that it is the only way to clothe a cylinder properly. Others say that it is a waste of time and takes the life of the foundation. It all depends on the kind of clothing you use, and the type of work you expect your card to do.

Tapering the Ends

24. The clothing is wound on in a spiral, and so its ends must be tapered to conform to the edge of the cylinder. There are two ways of doing this: the inside taper and the outside taper.

The *inside taper* has the following advantages: 1) It makes a neater job, because the cut edges of the clothing are not exposed. 2) The edges of the card web will be even, because of the neatly hidden taper. The disadvantages are: 1) The inside taper is difficult to cut accurately. 2) If the clothing should get loose and you have to redraw the card, you'll have trouble with the taper on the end.

The *outside taper* has the following advantages: 1) It is comparatively easy to cut. 2) You can cut off any surplus if you have to redraw the card. 3) You can draw the clothing on full width, with regular tension, and cut the taper afterwards. The disadvantages are: 1) You have to paint, bandage, or otherwise protect the cut edge. 2) The sides of the card web will be ragged.

In general, the inside taper is better for cotton cards. The edges of the card web should be neat. Also, redrawing the clothing is seldom necessary, especially when the clothing has been drawn twice to start with. The outside taper is preferred by most woolen carders. The edges of the woolen card web go into the side draws, or waste ends, anyway and do not have to be even. The cylinders are usually much wider and do heavier

work, and so there is more chance of the clothing having to be redrawn.

Drawing with Inside Taper

25. Before marking the tail end of the fillet for the taper, you must measure or calculate half the circumference of the cylinder. This would be, in the case of a 50-in. cylinder,

$$\frac{50 \times 3.14}{2} = 50 \times 1.57 = 78.5 \text{ in.}$$

From this you must deduct a little for stretch; about 3% is average. Let's make it 76 in. Now look at Fig. 14 (a). Mark the tail end of the fillet in accordance with the sketch. For the first 76 in., marked x , make a line right in the middle of the fillet. For the next 76 in., marked x_1 , draw a straight diagonal line from the end of your first line to the inside edge of the fillet. For the third 76 in., marked x_2 , draw a straight diagonal line from the center of the fillet to the outside edge of the fillet.

The dotted lines in the illustration show the outlines of the original width and shape of the fillet. The solid lines show the appearance of the fillet after cutting. But don't cut the fillet until after you have put it on. The line under x runs between rows, so there will be no trouble. But the diagonal lines run across the rows of teeth. You must pull the teeth where you are going to cut, so that you will not have any loose pieces of wire floating around in your card. You can pull the teeth now for the line under x_1 , but wait before pulling the teeth for the last line. You may have to move this line a little if the fillet stretch during drawing hasn't been correctly estimated. Now thread your clothing through the tension device, and you are ready to start clothing the card.

26. Put the tail end of the fillet on the left edge of the card, $\frac{1}{16}$ in. from the edge. Put in a few tacks, and set the tension device at about half the full tension. Turn the cylinder slowly, putting in tacks as you go along. After the cylinder makes half a turn, cut the line you marked under x , Fig. 14 (a). The left

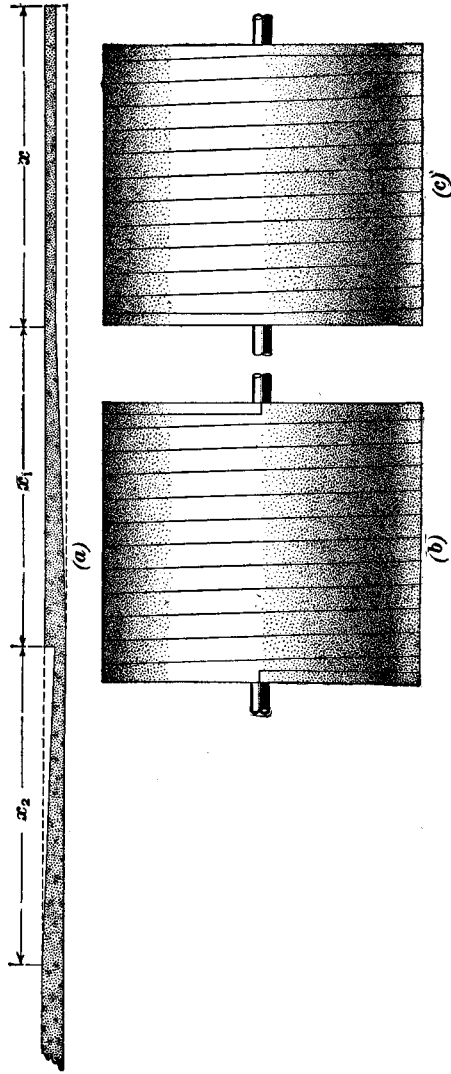


FIG. 14. FILLET WITH INSIDE TAPER

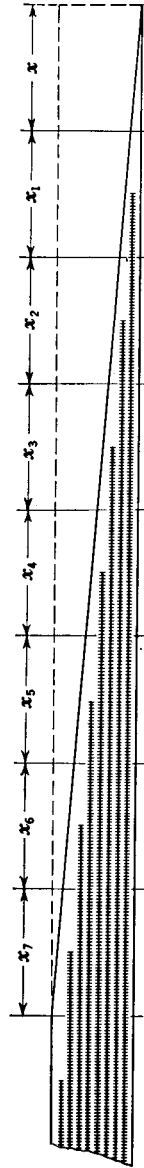


FIG. 15. FILLET WITH OUTSIDE TAPER

side of the cylinder should look as shown on the left of sketch (*b*). Now continue turning and tacking. Cut the line you marked under x_1 as you go along. The fillet should fit on as shown in sketch (*c*). After the cylinder makes one full turn, the fillet should be exactly over the starting point. If the stretch has thrown off the line you marked under x_2 , adjust it. The half cut should fit exactly to the tail end, as shown in sketch (*b*). Pull the wire and cut as you continue winding. The fillet should now fit in spirals, as shown in the illustration. As the taper widens you can slowly increase the tension. After $1\frac{1}{2}$ turns, all of the taper is wound and you can set the tension regulator at full tension.

After the tail end is tacked down, you just keep winding. Some carders like to tack down the clothing at intervals all across the card. Others hold that there is no danger of slippage if the clothing is put on without tacking across the card, but with sufficient tension, and if the fillets are placed tightly against each other. Even when the tacking is done with a special tacking tool, the tacks bend a few teeth. If a tack should fall out during carding, it will do a lot of damage. Some carders also like to put a twist in the fillet between the tension device and the cylinder. This may be of some help in placing the spirals tightly next to each other. However, this practice may strain the edges of the fillet and it is better to guide the fillet carefully than to use twist.

As you came to the end of the card you must reverse the tapering operations. That is, you start with x_2 and wind up with x . Of course, if you use the double-drawing method, you don't cut the end taper until after the final drawing. Even if you believe in tacking all across the card, you should let the card stand for a day to let the tension equalize in the clothing before the final tacking.

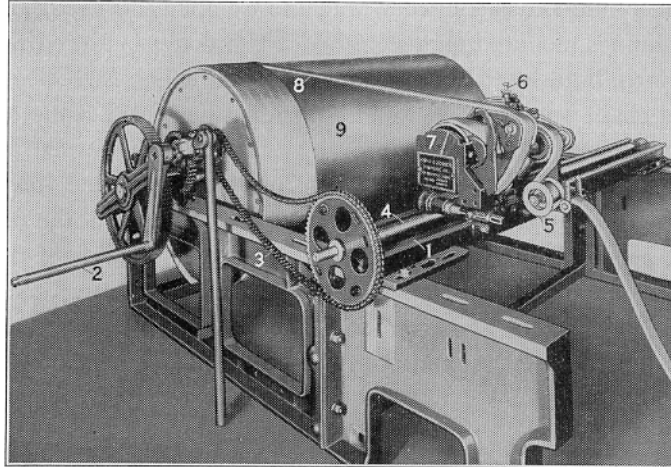
Sometimes you may have to redraw the clothing on a card that has run for some time. You must then use judgment about the tension—it depends on the strength of the fillet. Some-

times the fillet breaks, or it may be necessary for some other reason to piece fillets together. In that case you must remove the wire on the ends of the fillets. After that you can sew the foundation together, or better, splice it together with wire clips similar to the ones used for splicing belts. Finally, you must drill holes into the card cylinder, fill them with plugs, and tack down the clothing on both sides of the break. Redrawing and splicing are both practiced, but if you consider the cost of the material to be carded and the damage that may result if the splice breaks, you may find it more economical not to splice a broken fillet.

Clothing the Doffer

27. In principle, there is no difference between clothing the cylinder and clothing the doffer. You use the same calculation to determine the length of the clothing you need, but you must remember to substitute the dimensions of the doffer for those of the cylinder. The fillet used on cotton-card doffers is usually only $1\frac{1}{2}$ in. wide. The larger woolen and worsted cards are covered with 2-in. fillet. The doffer clothing is usually lighter than the cylinder clothing, and you use about 100 lb less tension. If you have found 375 lb all right on the cylinder, 275 lb should do the job for the doffer. However, remember that this tension, just like the tension for cylinder clothing, is an average figure. It is not customary to draw the doffer clothing twice, even where it is preferred for clothing the cylinder.

If you want to clothe the doffer with an inside taper, just follow the steps for clothing the cylinder with an inside taper. We will now see how to clothe a doffer, but this time with an outside taper. These directions will, of course, apply equally well to clothing a cylinder with an outside taper. We will also use a tension regulator different from the one discussed in Art. 21. Although the same tension regulators work equally well on cylinders and doffers, you will want to learn about different machines and practices. Then you'll know what to do if you have to work with them.



- | | | |
|----------------|--------------------|------------|
| 1. slide bed | 4. screw | 7. pointer |
| 2. winch | 5. rubbing roll | 8. fillet |
| 3. chain drive | 6. adjusting screw | 9. doffer |

FIG. 16. CLOTHING A DOFFER

Drawing with Outside Taper

28. To prepare fillet for outside taper, you must count the ribs on the back of the fillet. Let's say you want to clothe a doffer with 2 in. wide fillet, which has 8 ribs. Now calculate the circumference of the doffer, and divide the result by the number of ribs in the fillet. For instance, for a 36-in. doffer,

you would get $x = \frac{36 \times 3.14}{8} = 14$ in. Allowing for a little

stretch, you would use about $13\frac{1}{2}$ in. Divide the tail into $13\frac{1}{2}$ -in. sections, as shown in Fig. 15. Pull the crowns in section x , so that you can cut the point of the taper. Pull the crowns of 7 ribs in section x_1 ; the crowns of 6 ribs in section x_2 ; and so on. Cut off the fillet as shown, but leave about $\frac{1}{4}$ in. of bare foundation for tacking alongside the diagonal cut. You are now ready to start clothing the doffer.

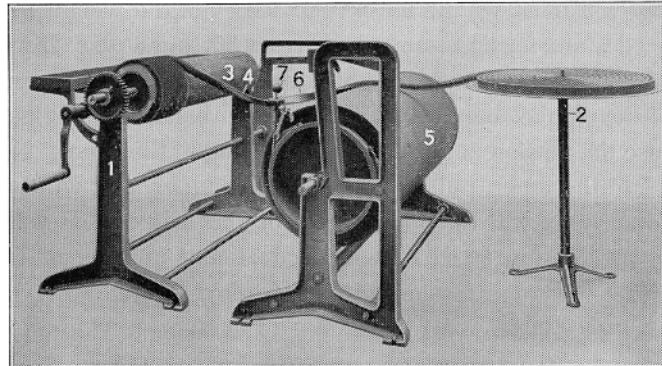
In Fig. 16 you see a doffer as it looks during winding. To control tension, a Perfection card-clothing tension machine,

built by the Davis & Furber Machine Company, is used. The machine is mounted on a slide bed. The doffer is turned with a winch, built by the same company. The winch is connected by a chain drive to a screw in the sliding bed, so that the tension machine head traverses slowly as the doffer is turned. As you see, the fillet is guided over a rubbing roll on the way to the tension device. This roll rubs against the back of the fillet and pushes in any wire staples that stick out. The fillet then passes under a guide plate with a tension adjusting screw. Finally, the fillet passes around a friction pulley and over a weighing device. A pointer in front of the machine shows the tension.

29. Before you start tacking, you can mark the rim of the doffer with chalk, to show the location of the plugs. Now fasten the end of the taper with two tacks, about $\frac{1}{8}$ in. from the edge of the doffer. Turn the winch until the end of the taper is beyond the top center of the doffer. Set the tension regulator at 25 lb and continue until section x is tacked down. Put the tacks in the narrow edge you left on the taper. When you come to section x_2 , you can increase the tension to 35 lb. As the taper gets wider, you can increase the tension more rapidly, until you reach full tension at the end of section x_7 .

The main points you must watch out for when putting on the fillet are these: 1) To maintain the correct tension throughout. 2) To have each spiral tight against the previous spiral. 3) To be sure that the taper is accurate, so that there are no uneven angles in the spiral, especially where the taper begins. 4) To put enough tacks in the taper so that it will not move over in spots when you push the next spiral up against it.

When you come to within $\frac{1}{8}$ in. of the opposite rim of the doffer, measure off sections as you did at the start. Pull the wire, one rib more for each section. Cut the taper and tack it down, with two tacks in the last plug. When you use the outside taper, the cut edge of the fillet is exposed all around the card. A good way to protect this edge is to cover it with two



- | | | |
|--------------------|---------------------|-----------------|
| 1. roll stand | 3. top roll (fancy) | 5. fillet drum |
| 2. revolving table | 4. fillet | 6. weight lever |
| | 7. thumb nut | |

FIG. 17. CLOTHING A TOP ROLL

coats of shellac. Another method is to nail a narrow steel band tightly over the edge of the taper all the way around.

In calculating the length of the sections for the taper, don't forget to allow for stretch. It amounts to about $\frac{3}{4}$ in. per section for a 60-in. cylinder, a little more or less, depending on the type of clothing you use.

Clothing the Top Work

30. All cards, except revolving flat cards, have rolls. These workers, strippers, fancies, and other top work must also be covered with card clothing. In general, you can follow the same procedures you have just learned for the cylinder and the doffer. However, because these smaller rolls are easier to handle, you can take them out of the card for clothing.

After you have cleaned and polished the roll to be covered, you can put it in a roll stand, as shown in Fig. 17. Put the fillet on the revolving table. Tack the end of the fillet to the roll, and wind the fillet spirally around it, without tension, as shown. When the roll is covered, cut the fillet. Clamp the end to the fillet drum and wind the fillet back to the drum.

Now you must set the tension device. Set the weight lever at the desired tension—anywhere from 50 to 200 lb. During a preliminary test winding, tighten the thumb nut, which regulates the brake band, until the lever balances, or kicks. Release the tension and rewind the clothing to the drum. Now calculate the taper, pull the wire, cut the taper, and wind the roll exactly as you did in the case of the cylinder or doffer. Once the tension is set, you can cover any number of rolls requiring the same tension without further setting.

The fillet for top work is usually $1\frac{1}{2}$ in. wide. The tension to be used varies for different types of clothing, but the following figures may serve as a guide: workers, 200 lb; strippers, 125 lb; tumblers, 150 lb; lickerins (diamond-point fillet), 150 lb; and fancies (leather foundation), 75 lb. While clothing the top work is easier than clothing the cylinder, you must be just as careful. Uneven tension, or clothing that slips and comes loose, will give poor carding—no matter how carefully you set the card.

Clothing the Flats

31. While cylinders and rollers are usually clothed in the card room, or the card-room shop, clothing the flats for revolving-flat cards is a specialized job. Fastening the tops to the flats with rivets, or sewing them on, was tried and discarded as unsatisfactory. The common practice today is to send the flats, a whole set at a time, to the shops of the card-clothing manufacturers for reclothing.

At the shop a set of tops is made up to fit the flats. Thin U-shaped sheet metal clamps are placed around the long sides of each flat. The top edge of each clamp has projecting teeth to grip the foundation of the tops. For some types of cards, the tops are placed face down in the bed of a special flat-clothing machine. The flat is then placed over the tops, and a rolling press moves along the machine. For other models of cards, the clamps are bent around the stretched sheet in one

move. Either operation puts the clothing under tension and, at the same time, squeezes the clamps together. The teeth on the edge of the clamp grip the foundation and hold the tops in place. Smaller clamps are put over the ends of the flats to hold the tops all around.

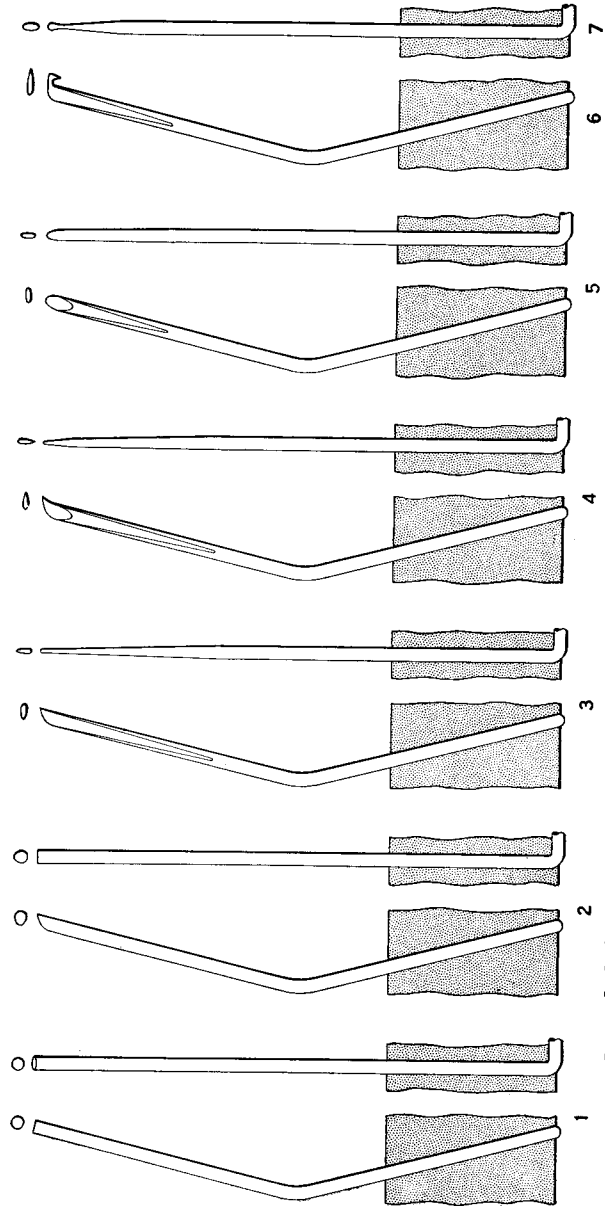
Sheet Clothing for Cylinders

32. In former days sheet clothing was universally used on the first and second breaker cylinders of woolen cards; it was also often used on the main cylinders of worsted cards. Today the foundations for fillet clothing can be made much stronger, and this has led to an increased use of filleting. Also, as you'll see, metallic-clothed worsted cards are gaining in popularity. We'll discuss sheet clothing briefly, so you'll know how to apply it where it is still used.

The sheet clothing is usually about 5 in. wide, and as long as the card is wide. The foundation of the sheets is a little wider, and you need room for tacking. In general, 24 sheets are used for a 48-in. cylinder, 30 sheets for a 60-in. cylinder. After the cylinder has been cleaned and prepared for clothing, draw a straight line across it. With a pair of dividers, divide the circumference of the cylinder into 24 (or 30) equal parts. Then draw lines parallel to your first line, to mark where each sheet of clothing fits.

For sheet clothing you need two special tools, a clamp and a hammer. Put the upper edge of a sheet of clothing on one of the lines you have drawn, stretch it across, and tack it down. For tacking you use a hammer with a narrow curved head. Then block the cylinder, so that it can't turn. Fasten a clamp to the lower edge of the sheet. With a strap that passes through the link of the clamp and is attached to a ratchet, stretch the sheet and tack it down. Start on the sides of the sheet and work toward the center. When you come to the last sheet on the card, put a piece of wood between the first two sheets, to protect the wire from the clamp.

CARD CLOTHING



- 1. card clothing before grinding
- 2. chisel point, top grinding
- 3. tapered point, plow grinding with disks
- 4. wire point, worn or fine emery (front view)
- 5. needle point, perfect condition
- 6. dull wire, needs grinding
- 7. hooked wire, overground (side view)

FIG. 18. RESULTS OF GRINDING

You have now seen how all types of flexible clothing are attached to the carding surfaces. The next step is grinding, which gets the wire into uniform shape for setting and carding.

Grinding the Card

The Card Grinder

33. Every employee in the mill performs an essential job—otherwise he wouldn't be hired. Some jobs, however, can be learned by the average person in just a few weeks. Card grinding is not one of these routine jobs. A card grinder requires certain personal qualifications to start with. He needs mechanical aptitude, a keen sense of hearing, a delicate touch, great patience, an understanding of his responsibility, and most important, a profound will to learn the theory and practice of carding. It is just as impossible to make a good card grinder out of a negligent and disinterested learner as it is to put a sharp edge on a soft wire.

In every mill where cards with flexible wire card clothing are used, the quality of the card room production depends to a large extent on the shape the clothing is in. The card clothing is kept in good operating condition by straightening bruised wire and by grinding. Consequently, the selection and training of card grinders is a prerequisite to quality production.

Top Grinding

34. The wire in a card is so small that you would need a microscope to see how it is altered by grinding. In the sketches, Fig. 18, the wires have been enlarged; actually each wire measures only $\frac{3}{8}$ in. from the crown to the point. Grinding affects only the part of the wire above the knee, that is, the top $\frac{3}{16}$ in. of the wire. In each sketch you'll find a side view of the wire on the left and a front view of the same wire on the right. The top view is shown above each side view and front view.

The original grinding of the wire is usually done by the card-clothing manufacturer. Because the wire staple was cut

straight and then inserted at an angle into the foundation, the point will look as you see in sketch 1. The staple is not entirely even either. Some points tend to stick out a little. The card clothing is now passed under a rapidly revolving emery roll. This roll, while it spins rapidly, has no traversing, or side-wise, motion; and it is therefore called a dead roll. The clothing is moved so that the back of the wire strikes the dead roll. As a result, the tops of the wires are ground away. Since the wires are flexible, they'll give a little. The back of each wire tooth will be rounded off, while the front forms a chisel point, as shown in sketch 2. This top grinding leaves a perfectly even carding surface.

Plow Grinding

35. The next step in preparing the clothing is to grind off the sides of the wires. By doing this the wires are made narrower, and there will be more room between them for the fibers. You'll also be able to put a better point on the wire, and it will stay sharp for a longer time. Because this works on the same principle as a hollow-ground knife, or a plow, it is called plow grinding. The grinder used has thin emery disks. During grinding, the disks pass between the rows of wire, following the rib, so that every wire gets the same point—theoretically at least.

During plow grinding the emery disks are set right into the card clothing, about halfway down to the knee of the wire. The effect is about the same as if you were to take a very fine file and file off first one side of the wire and then the other side. In theory, each wire should look like sketch 3, Fig. 18, tapering off from the knee toward the point. In practice you'll find much variation. Remember that the wire is quite flexible, and likely to give when the emery disk presses against it. While most wires approach the ideal taper, more or less, others are ground off straight as far as the disk goes down. Still others are ground off more on top than farther down, or vice versa.

As long as the wire diameter is narrowed in the plow grinding, these slight irregularities don't seem to do any harm.

Burnishing

36. After plow grinding, the wire should be smoothed again. This is done with a burnishing brush. The burnishing brush is a roll set with straight wire about $\frac{3}{4}$ in. long. The brush is set into the clothing, just as the emery disks were. As the burnishing brush revolves, its wires rub against the card wire. The action is similar to the one your dentist uses when he polishes your teeth with a sharp brush to smooth the fillings. After plow grinding and burnishing, a light top grinding usually follows, to smooth off any wires that may have been distorted. Then the clothing is ready to be packed and shipped to the mill.

Disk grinders and burnishing rolls are set right into the clothing during the grinding and burnishing, and if this isn't done with great accuracy, the emery disks or the burnishing-brush wires will rip up the foundation of the card clothing. The grinding operations mentioned thus far are therefore seldom performed in the mill. However, when the clothing on a card has become extremely dull or rusty, it may be worth while to burnish it in the mill.

The grinding operations to be described next are usually performed in the mill. Some mills, however, prefer to let the card-clothing manufacturer do a preliminary job of needle-point grinding. If the person who clothes the card does a very careful and even job, this may save time in performing the first grinding.

Needle-Point Grinding

37. The objective of grinding the card in the mill is to arrive at a sharp point, as shown in sketch 4, Fig. 18. This is called a needle point, although, as you can see, it certainly doesn't resemble the point on an ordinary needle. The top

taper of the wire is simply sharpened to a point that has its sharp edge in the direction of the carding action. The point can be ground by rolls of different types, as we will see. No matter which type is used, the grinding surface presses against the wire and has a traversing motion. The carding surface during grinding moves in the opposite direction from carding. Thus, if you do it properly, the sharp point is bent over just a little as shown.

If you place your hand or your thumbnail lightly on correctly ground card clothing, and try to move it against the points, you'll feel how the points take hold. With some experience you'll be able to tell when a card needs grinding. You can then feel accurately whether the wire is dull, as shown in sketch 5. The wire becomes dull at regular intervals after the card has been run for some time. The exact times depend on the type of clothing you use and on the type of stock you are running. When the wire becomes dull, it must be ground again. Most mills have a regular schedule for grinding, to make sure that the wire on all cards has sharp points.

Faulty Grinding

38. While correct grinding improves a card tremendously, incorrect grinding is worse than useless. One of the worst results of bad grinding is shown in sketch 6, Fig. 18. The side view gives you a gruesome enough picture; you don't need a front view. The wire has been ground with too much pressure, or for too long a time, and possibly with worn emery that has lost its bite. The result is that the point of the wire has now bent over and forms a hook. Such hooked wire holds the stock. It is practically impossible for the doffer or the fancy, to dislodge the stock. The carding surfaces become loaded and all desirable carding action stops. Once the wire has been ground into hook form it is almost impossible to restore it to usefulness. So watch the wire!

Another type of faulty grinding is illustrated in the front view, sketch 7, Fig. 18. This is called a wire point, because the

cross section is rounded like that of the wire itself. It is usually caused by using, on the grinding roll, emery that is too fine for the wire it is used on. The points of the wire bend over, and the emery acts on the side of the wire, below the point. Thus, while you get a narrow neck in the wire, the point itself remains dull. Such grinding doesn't improve the carding action, and you'll have to do the whole job over again.

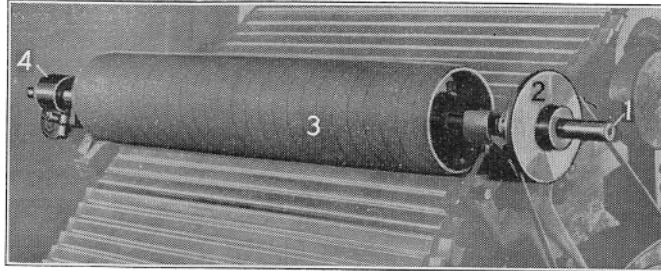
By now you'll have a good picture of the type of grinding you want. Let's take a look at the grinding rolls then, and learn how you can use them to best advantage.

Grinding Surface

39. The surface of the grinding rolls is covered with coarse emery fillet. The foundation of the emery consists of strong cotton tape, usually $1\frac{1}{2}$ in. wide. The tape runs through a machine which covers one side of it with glue, after which the machine feeds emery in an even layer on the surface and presses it down into the glue. The rolls which press the emery down may be smooth or grooved. When the rolls are smooth, the fillet will have a rough, but even, surface. When the rolls are grooved, the emery will be arranged in lengthwise waves, or ridges. Since the ridges expose part of the sides, as well as the surface of the emery granules, the ridged form is very effective.

Emery is made in grades designated by numbers which refer to the average size of the emery granules. For very coarse wire you can use 5s or 6s emery, which usually has eight or ten ridges per inch. For fine wire, you can use 7s or 40s emery, which usually has about sixteen ridges per inch. Remember that even the best emery will wear off after some use. Grinding with dull emery is about as effective as trying to shave with a dull razor. You can only ruin your card clothing that way.

Some attempts have been made to replace emery fillet with other materials because the covering of the grinding rolls is a bother. Carborundum has been used with some success. But,



1. shaft 3. drum
2. grooved pulley 4. oscillating motion

FIG. 19. LONG GRINDER

while these granules are harder than those of emery, they still wear loose eventually and drop off. A thick, solid shell of emery may be used instead of the fillet-covered grinding surface. However, any ridges on this shell will soon be worn off and it will, at best, be equivalent to even fillet. At worst, the shell may wear unevenly and give spotty results. When everything is said and done, most card grinders prefer the emery-fillet-covered grinders for the normal grinding routine.

Long Roll Grinder

40. Two entirely different types of grinders can be used for grinding the card clothing: the long grinder and the traverse grinder. We'll first look at the long grinder, also called the long roll grinder, the drum grinder, or the dead roll grinder. The last of these names is somewhat misleading, because the long grinder has, as you'll see, a slight traverse, or oscillating, motion. Long grinders are made by several manufacturers, and the exact dimensions differ for different purposes.

A characteristic long grinder is shown in Fig. 19. The illustration shows the grinder installed and grinding the flats. The drum, or shell, of the grinder should be about 2 in. wider than the card to be ground. As shown in the illustration, the whole surface of the drum is covered with emery fillet. The drum is fastened on a shaft which projects about 12 in. on each side.

On one side of the shaft is a worm enclosed in a worm box. The worm meshes with a worm gear which has a yoke pinned off-center to it. The other end of the yoke is connected with an oscillating motion arm that slides on the shaft. A stud connects the arm with an oscillating motion support.

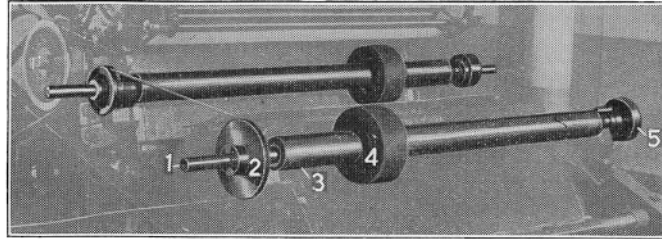
When the grinder is mounted, it rests in special stands on the card. The bushing in the stand fits between the bearings of the oscillating motion arm and the oscillating motion support. On the other end of the grinder shaft is a grooved pulley, driven by a band from the cylinder pulley. As the pulley turns the shaft, the worm turns the worm gear. The yoke, being off-center, is given a sidewise motion. Since the oscillating motion arm and its support are held stationary by the support bracket, the whole shaft with the grinding drum is given an oscillating motion.

41. The oscillating motion of the long grinder is very slight, usually less than 1 in. The motion prevents little uneven spots on the grinder from hitting always on the same point of the card clothing. As the grinder turns, it grinds mostly the back of the teeth. The oscillating motion also causes a slight grinding of the sides of the teeth, but it does not do a very good job of this.

The long grinder fills a definite need in carding. It is used wherever evening of the wire surface is the major objective. The long grinder is used on newly clothed cards and on cards where the clothing has been repaired. It is also used for grinding top work, and for flats on revolving-flat cards. However, for grinding that is meant to put a good, sharp point on card wire, the traverse grinder is preferred.

Traverse Grinder

42. The traverse grinder, sometimes called the horsfall grinder, is shown in Fig. 20. In the installation shown, two traverse grinders are grinding the cylinder and the doffer of a card simultaneously. This grinder has a narrow roll, about 4



1. shaft 2. pulley 3. shell
4. grinding roll 5. differential

FIG. 20. TRAVERSE GRINDER

in. wide. The roll is covered with emery fillet. In operation, the roll traverses, that is, it travels from one side of the grinder to the other. In fact, the roll completely clears the card cylinder on each side; otherwise the edges of the cylinder would be ground too much while the grinding roll was changing its direction of travel.

The grinding roll is mounted on a narrow steel shell. Inside the shell is a shaft, or traverse screw, containing right-hand and left-hand threads which are connected to the end of the roll. A follower projects from the grinding roll, passes through a slot in the shell, and rests in the groove of the thread. If the shell and the screw were turned at exactly the same speed, the grinding roll would rotate, but it would not traverse. However, since the shell turns more rapidly than the screw, the follower slides through the threads of the screw, and the grinding roll traverses from one side to the other and back again.

The shell is driven by a grooved pulley on one side, which is connected by a band to the cylinder pulley. In some early grinders there was a slightly larger pulley on the other side, which drove the screw. On modern grinders the screw is driven by differential gearing from the shell.

43. Now imagine the various motions of the traverse grinder:
1) The cylinder turns, so that the wire points strike with their backs against the grinding roll. 2) The grinding roll turns

and thereby tends to grind the backs and tops of the wires. 3) The traverse motion presses the protruding emery particles against the sides of the wire and tends to grind the sides of the wire. You see how this combination of motions is necessary to give you a good needle point.

If you were to calculate the speed of the different motions, you would find that every single wire point touches the grinding surface several thousands times during a 6-hour grinding period. This is an important matter when you stop to consider what actually happens in grinding. You'll understand that proper grinding requires many light abrasions of the wire, from several different angles. Heavy grinding over a short period of time cannot be substituted for lighter grinding over a longer period of time.

Grinding Pressure

44. One of the most important points in grinding is the amount of pressure to put on the grinding roll. If you don't put enough pressure on the roll, you'll accomplish little good by grinding. If you put too much pressure on the roll, you'll get hooked points, as you have seen. Setting the roll for best results in grinding is a job that requires experience. In this text we'll not discuss the exact way in which grinding rolls are installed. That varies with different types of cards, and you'll learn it in connection with carding practice. All we can do is to tell you, in the next few paragraphs, how an experienced carder determines whether the grinding roll exerts enough pressure on the wire.

First of all, the grinder makes sure that the grinding roll is even; that is, that it just touches the wire on each side of the card. Then he starts the card and slowly applies pressure, evenly on both sides, by means of adjusting screws on the grinding roll stands. He holds his ear near the grinding roll and listens to the sound it makes on the wire. There should be a light buzzing sound, similar to that made by a hive full of

honeybees. Here and there, where the grinding roll strikes a protruding wire, a light sparking takes place. After you have worked with an experienced grinder for a while, you'll learn to recognize the buzz and the amount of sparking that is best.

Remember: if the grinding roll makes a sharp hiss, and is trailed by a continuous shower of sparks like a Fourth-of-July sparkler—you are ruining your card clothing!

More or less complicated gauges have been developed to do away with setting the grinding roll by sound and sight. Some card grinders have had good results with such gauges. But most grinders check the setting by ear, even when it should be correct according to the gauge. Later, in connection with carding practice, you'll read more about grinding. Right now we'll look at metallic clothing, which represents an entirely different approach to carding.

Metallic and Semiflexible Clothing

Development of Metallic Wire

45. The question of whether flexible wire card clothing or metallic wire card clothing is preferable is one of the most controversial in the field of carding. Some claim that metallic wire represents one of the greatest contributions ever made to card room efficiency. Others point out that, after all, the great majority of all cards are being built for, and clothed with, flexible clothing. Let's look, then, at all sides of this problem, so that you can come to a sound conclusion if you are faced with the decision.

First of all, let's briefly review what we know of carding—and what we thought we knew. We know that the fibers come to the card in a more or less entangled state, and that they leave the card in a reasonably opened state. Of course, there are always a few neps, that is, little bunches of entangled fibers, but these can be kept to a minimum by careful carding. This is all we really know—everything else is based on trial-and-

error experimentation, on experience handed down through generations of carders, and on assumptions. If you want to understand and properly evaluate the issues involved, you must separate the facts from the assumptions, because many of the latter have proved to be incorrect. Let's look then at some of the assumptions that were generally believed, not so many years ago.

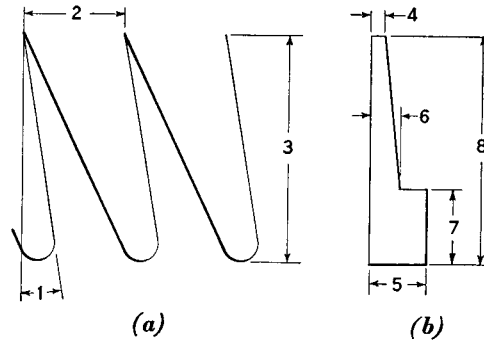
46. Going back to, let's say, the beginning of the twentieth century, you'll find that all cards were covered with flexible card clothing. Metallic wire clothing was then used only for garnetts. The carding action in those days was thought of as pulling the fibers apart between the points of the wires. It was assumed that the garnett tore the fibers apart, but that the flexible wire had a more gentle pulling action.

This seemingly logical assumption received a jolt when it became more and more common to enclose the cards in order to keep fly out of the air. It was found that the covers often changed the carding action, and after that it was discovered that actually the air currents in the card played a major role in carding. Later studies showed beyond doubt that, indeed, the air currents and the centrifugal action of the card are at least as important in the disentangling of fibers as the pulling or tearing action of the wires.

As long as it was assumed that the metallic clothing was likely to tear the fibers, metallic clothing was used only for low-grade stock. But today it is clear that you can use metallic clothing for any type of fiber without shortening the average fiber length or causing other injury to the fibers. This brings us up to the present. We'll now see where metallic clothing is being used.

Distribution and Types of Wire

47. In the United States metallic clothing has gained its greatest popularity in worsted carding. This fact is due to a



- | | |
|--|---|
| 1. 10-degree angle from vertical | 5. $\frac{3}{32}$ in., width of wire base |
| 2. $\frac{1}{16}$ in., from point to point | 6. $\frac{3}{16}$ in., base of tooth |
| 3. $\frac{3}{4}$ in., height of tooth | 7. $\frac{3}{4}$ in., height of wire base |
| 4. $\frac{1}{12}$ in., width of point | 8. $\frac{1}{4}$ in., height of wire |

FIG. 21. METALLIC WIRE FOR COTTON AND RAYON

large extent to the efforts of Proctor & Schwartz, who build cards especially designed for the use of metallic wire. The metallic worsted card became available just when the depression of the 1930's forced textile manufacturers to cut costs, and it has been very successful.

Over the years, metallic clothing has also made quite a bit of progress in the woolen industry. Most cotton mills, however, still prefer the flexible clothing. Before you jump to the conclusion that metallic wire is not practicable for cotton carding, take a look at France and Germany. In these countries much of the textile industry was damaged during World War II, and it had to be rebuilt. The result was that most mills installed metallic clothing on the cotton cards.

In Germany the industry went so far as to set up standards for the metallic cylinder wire on cards for cotton and synthetic staple. Fig. 21 (a) shows the side view of the wire, and sketch (b) shows a section through the wire. Note the dimensions give in the legend. They will give you a good idea of the type of metallic wire that is suitable for carding cotton and synthetics.

48. In explaining the way in which metallic clothing originated, it is often compared to the lickerin wire on cotton cards. However, there are some differences between lickerin wire and metallic clothing. As you'll remember, lickerin wire is triangular in section, and fits into grooves in the lickerin. Metallic wire has a broad base, as you can see in Fig. 21 (*b*). Above this base the wire narrows down, somewhat like the wire in flexible clothing after careful plow grinding. The wire is wound spirally around the cylinder, with the base of one wire touching the base of the next. The space between wire points sidewise is therefore determined by the width of the base. The lengthwise distance between points in the wire shown in Fig. 21 is $\frac{1}{16}$ in.; that is, there are 16 points per inch.

Metallic wire for cotton and synthetic carding in the United States has not been definitely standardized. However, 13 points per inch lengthwise, and 33 to 36 wires per inch across the card, are given by the *American Cotton Handbook* as common for cotton cards covered with metallic clothing. Until a standard has been decided upon, your best bet is to take the recommendations of the card clothing manufacturer for specific purposes.

As you have seen in connection with flexible clothing, the clothing for cotton cards is fairly well standardized. But clothing of widely different sizes and construction is used for woolen and worsted cards. The same is true of metallic clothing. Fig. 22 shows the wires used on a Proctor & Schwartz worsted card for fine wool. Note the flat surfaces of the bur wire. The wire on the first cylinder is coarser than that on the second cylinder. The angle of the wires on the strippers, and especially on the doffer, is very sharp—so that the wire will pick up the fibers for transfer. The illustration shows the wires in actual size, so as to give you a clear picture of their respective dimensions. Sooner or later, if you work in a card room or have any connection with men who do, you'll get into a discussion of metallic clothing.

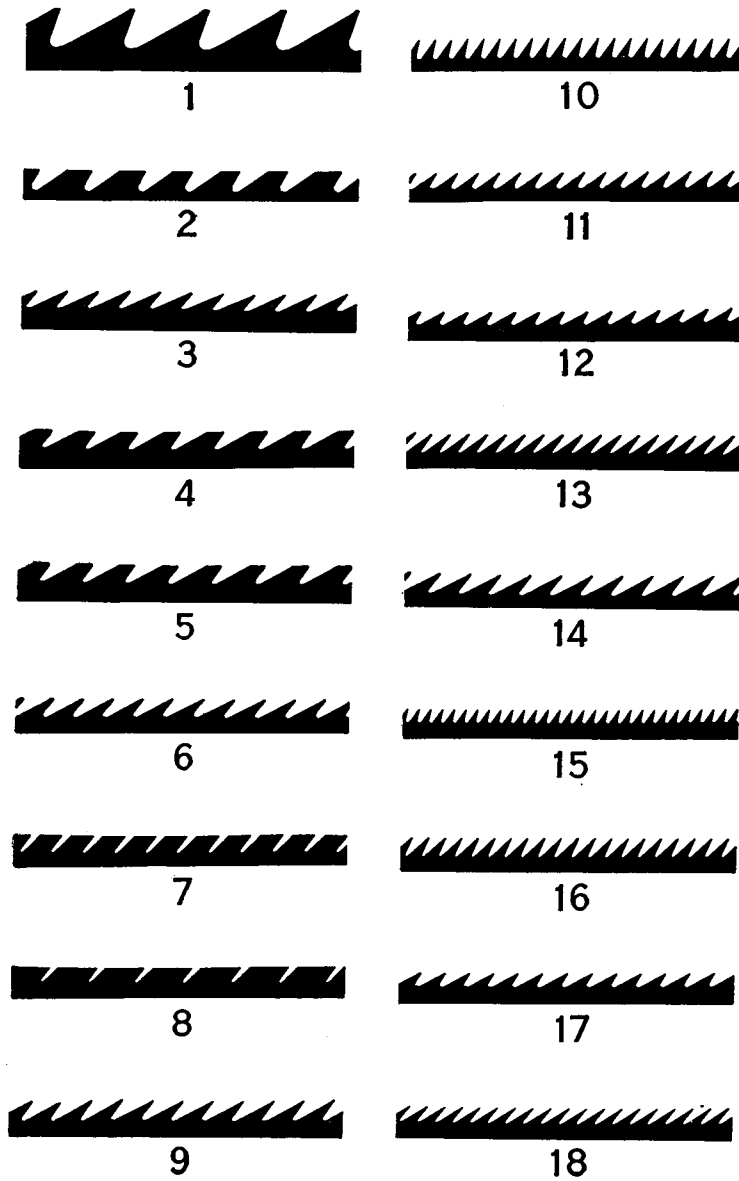


FIG. 22. METALLIC WIRE FOR WORSTED CARD

LEGEND FOR FIG. 22

- | | |
|------------------------------------|------------------------------------|
| 1. feed rolls | 10. first main cylinder |
| 2. first bur cylinder | 11. first main cylinder workers |
| 3. first transfer stripper | 12. first main cylinder strippers |
| 4. breast cylinder | 13. first doffer |
| 5. breast workers | 14. third transfer stripper |
| 6. breast strippers | 15. second main cylinder |
| 7. second bur cylinder | 16. second main cylinder workers |
| 8. second bur cylinder (alternate) | 17. second main cylinder strippers |
| 9. second transfer stripper | 18. second doffer |

Advantages of Metallic Wire

49. Because flexible wire has proved itself over many years, metallic wire would not even be considered if it didn't have certain advantages. In this and the following articles, we'll look at some points in which a card clothed with metallic wire is superior to one clothed with flexible wire.

As you have seen, flexible wire clothing must be ground at regular intervals. Later, when you study carding practices, you'll learn just how often grinding must be done for specific purposes. The grinding not only ties up the card being ground, but also requires highly skilled card grinders. Metallic clothing requires little, if any, grinding. The shape of the wire points, for instance, makes plow grinding unnecessary. Under conditions of very heavy strain, the points may become a little dull and may have to be touched up by a very light grinding with fine emery, but this occurs so seldom that it is negligible. For all practical purposes, you gain all the time spent on grinding, and save the labor cost of the grinders, when you use metallic clothing.

Another point in favor of metallic wire is that there is very little need for stripping. The flexible card clothing, on the other hand, loads up with fibers between the base and the knee of the wire, and it must be stripped at regular intervals. A continuous stripper has been developed which works with good results on cotton, but all cards that work on wool or synthetics have to be stopped frequently for stripping. With metallic wire, stripping is largely eliminated. Stripping is only

necessary as a cleaning action once in a long while when dirty fibers are handled—with synthetics no stripping is done at all. In short, metallic wire increases efficiency and reduces costs during operation.

50. Another important factor to consider in connection with clothing is the quality of the product. Some interesting figures were compiled over a period of time by a mill that used cards with metallic clothing alongside cards with flexible wire clothing for the carding of fine cotton. The tests showed that the sliver from the cards with metallic clothing was much more even. This is only what could be expected, because the sliver is always a little light after stripping owing to the fact that a lot of stock is being retained by the card—and there was very little stripping on the cards with metallic clothing.

Still another advantage of metallic wire, especially when carding synthetics, is the reduction of neps. Tests in mills all over the world have shown that when metallic clothing is properly installed, set, and maintained, it reduces the nep count in the card web.

Finally, metallic clothing on revolving-flat cards need not be changed when alternating between cotton and synthetics. That is, the same type of metallic wire that works satisfactorily on cotton also works well on synthetics.

To summarize: metallic clothing 1) reduces labor costs, 2) reduces waste, 3) increases production, and 4) improves quality. However, before you rush in and tell management to change all cards immediately, let's look at the other side of the story.

Disadvantages of Metallic Wire

51. Suppose you are superintendent in a mill that has used nothing but flexible card clothing. You have decided to give metallic clothing a try. Of course, the first man you'll discuss the idea with will be your overseer of carding. Chances are that your trouble will start at this point.

As we have seen, the card grinder is one of the most highly skilled men in the card room. Many overseers in the industry have worked their way up by way of a job as grinder. The metallic clothing, if it is installed throughout the mill, will do away with the necessity for grinding. Consequently, the average overseer of carding regards metallic clothing with the same distaste that a battleship admiral regards a jet fighter or bomber. Furthermore, cards have to be set and fixed differently if you use metallic clothing, and so the fixers will also be far from enthusiastic.

Good men are hard to get in any line, including carding. So you will have to spend a lot of time, and rely on patience, persuasion, and training, to get your men to give the idea a fair try. This need for having to re-educate and enlist the cooperation of your carders is perhaps the greatest single drawback to changing to metallic clothing.

Next, if you are considering the installation of new cards, you will have to consult with the sales engineer of the machine company you do business with. Most cards built in the United States are designed for operation with flexible wire. The engineer knows how they will operate with that clothing, and he can give you definite facts on settings, production, and so on. Again you will find little enthusiasm, unless you happen to deal with an engineer of a company that has had plenty of experience with metallic clothing.

Assuming that you have overcome the difficulties caused by the human element, you'll have to take a look at the technical difficulties—and the cost.

52. The lifetime of flexible wire and of metallic wire is about the same under average conditions. In the United States the cost of metallic clothing is somewhat higher than that of standard flexible clothing, which is mass produced in tremendous quantities. It is interesting to note that in Europe, where metallic clothing is now more popular, no such difference in price exists.

Next comes the installation, which, as we will see, is quite different from that used for flexible clothing. Very few mills have the special equipment and the trained men needed to clothe a card with metallic wire. The normal procedure is for you to take the cylinder out of the card and ship it in a special crate to the nearest shop of your card clothing manufacturer. This costs much more than to have your own employee install the clothing. While a card runs for a good many years, once it is properly clothed, the expense of the change-over is considerable.

If you have card cylinders designed for flexible clothing, they must be built up for metallic clothing. In the average cotton card, for example, this adds about 500 lb to the weight of the card. You must therefore check on the strength of the mill building, especially if the card room is not on the ground floor, and make sure that it will support the added weight. Also, the added weight requires more power to start the card, and your card drive has to be able to do the job.

Pieces of metal or bunched-up masses of stock may get into the card once in a while and damage the clothing. This damage is easier to repair in flexible wire than in metallic wire. Such damage, however, is evidence of poor work in preparing the stock for carding, and it should not happen in a well-managed mill. Finally—but this is a minor item—cards with metallic clothing usually cause more fly than other cards.

To summarize: metallic clothing 1) costs more to install; 2) requires extensive training for the card room employees; and 3) adds considerably to the weight of the cards.

It is hard to make a general statement about metallic clothing, because conditions vary from mill to mill. Generally, your chances for good results are much better when you install metallic clothing in a new mill than they are when you change over an old mill which has been designed for cards with conventional clothing and where the card room employees have been trained to work with that clothing.

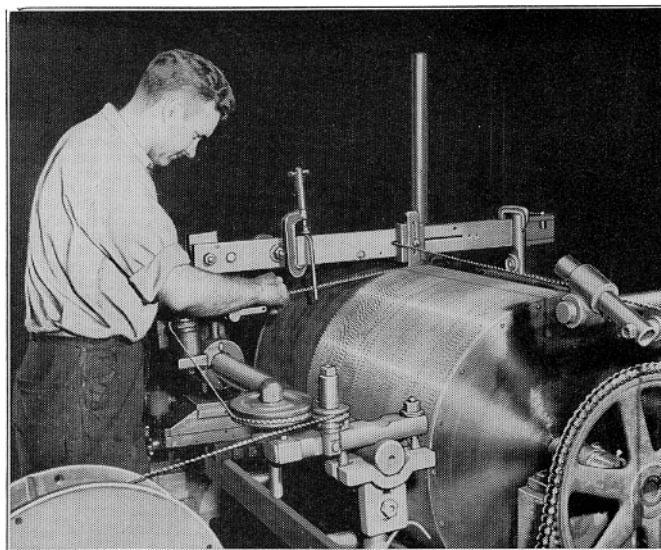


FIG. 23. WINDING THE FOUNDATION

Application of Metallic Clothing

53. When you compare the dimensions of metallic wire with those of flexible card clothing, you'll notice that the flexible clothing is about twice as high as equivalent metallic wire. Unless the card has been built especially for metallic clothing, the cylinder must be built up. In either case, the cylinder must be carefully cleaned and prepared before clothing operations begin.

The cylinder to be clothed is placed in a frame. Holes are drilled all along the edge of the cylinder and metal rings are applied to prevent the wire from sliding sidewise. The foundation wire is then applied as shown in Fig. 23. Note the surface of this wire, which somewhat resembles the treads of an automobile tire. This will help to keep the card wire securely in place. Since metallic wire can't be fastened with tacks, it is soldered at the beginning and the end. The devices used for guiding the wire and applying tension to it are different from those used for flexible wire.

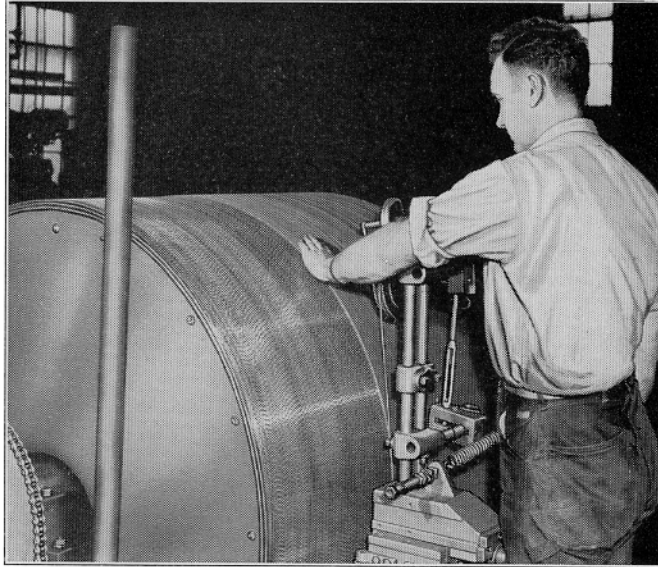


FIG. 24. WINDING THE WIRE

After the foundation wire is applied, the cylinder is ground until the surface is absolutely true. Keep in mind that there is no give in metallic clothing. In preparing the cylinder, and later in setting the card, you must work with much finer tolerances than when you use flexible wire.

54. After the foundation has been prepared, the metallic wire is wound on. This is the most important part of the procedure, because the winding must be done quite evenly. As shown in Fig. 24, special equipment is used to maintain precise tension throughout the winding. Even if the mill management decides to rewind cards in the mill rather than to send them for rewinding to the shop of the card clothing manufacturer, such equipment must be obtained, and a man must be trained to use it.

After the wire is wound, it is carefully ground to extreme accuracy. It is the only grinding that metallic clothing ever gets in normal service, and it takes only a short time. Follow-

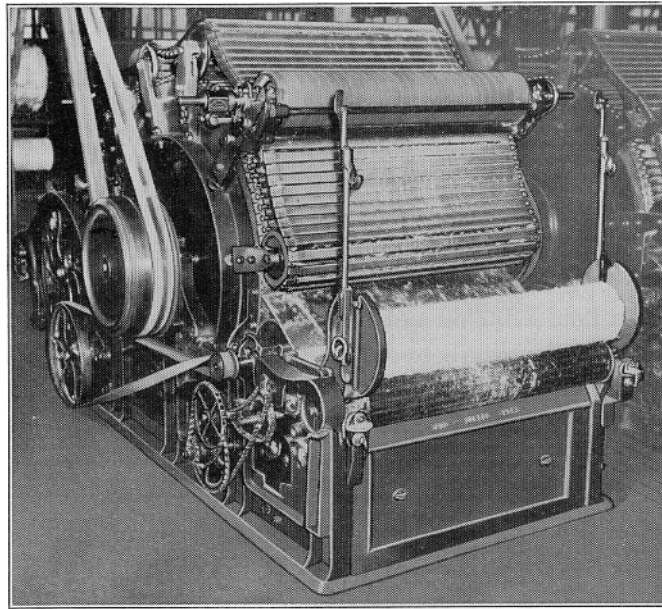


FIG. 25. GRINDING THE FLATS

ing the grinding, the wire is carefully brushed to remove all traces of oil, dirt, and grit. The cylinder is then returned and installed in the card. Of course, care must be taken not to damage the clothing during moving and installation in the card.

In cards that use workers, strippers, and similar rolls, these are handled exactly like the cylinder. The only exception is the fancy, which has a brushing action, and for which metallic wire is never used. Another place where metallic wire is not practicable is on the flats of a revolving-flat card.

Some of the advantages of metallic wire on cotton cards would be lost if the card had to be stopped while the flats are ground. As shown in Fig. 25, this may be avoided by giving the flats a light grinding while the card is in operation. You'll note the grinding roll on top of the flats. If you try this, be sure to keep the grinding very light, because sparks may cause

a card fire. Don't try it when a card is working with rayon staple or a similar material that catches fire easily.

Maintenance of Metallic Clothing

55. When metallic clothing is used for carding loose clean fibers, it needs no maintenance for years on end. However, when dirty, matted fibers are processed, especially on garnetts, a few maintenance tools are needed.

A cleaning tool consists of a small steel bit clamped into the end of a holder. This tool is used to remove tightly packed dirt and stock from between the wires. Place a bar across the cylinder at a convenient place. Rest the tool on the bar, and push the bit lightly between the wire. Rotate the cylinder slowly, with the backs of the wire teeth against the tool (never the points, which might be bent). For safety it may be better to use a winch to turn the cylinder instead of using a power drive. When the dirt is not too hard, two properly spaced bits may be used at the same time. The cylinder and doffer are cleaned this way, right at the card, while smaller rolls are taken to a cleaning stand.

Even when there is not too much dirt in the card, stripping may become necessary—for instance, if you switch from rayon staple to acetate and you don't want the two types of fibers intermingled. Such light stripping can be accomplished simply by using hand cards. Use the cards so that you strip the fibers from the teeth of the metallic clothing. That is, pull the hand card in the direction in which the teeth point, not against them.

56. Teeth that have become bent can be straightened with an awl. This tool is run between the strands of wire on which the bent teeth are located, against the back of the teeth. A turn of your wrist will push the awl against the side of the bent teeth and straighten them out. Move the cylinder by hand when you have straightened the teeth in one place, never by power. If you use power, the awl may slip into the card

and cause damage—and the card may chew your arm off while you try to rescue the awl.

On garnetts, or on cards working on very tangled stock, the teeth may need sharpening once in a great while. Special files are used for this purpose. Rest the file holder on a bar placed across the cylinder. Turn the cylinder so that the points run against the file. This will sharpen the points. However, if you run the backs of the points against the file, you'll get hooked points. So watch out.

Once in a great while it may happen that something gets caught in the card and the wire breaks. In that case you must rewind the wire up to the damaged spot, and then solder it down. After repairs, the card should be given a light grinding with very fine emery, just to even up the wire.

Semiflexible Clothing

57. As you have learned, flexible and metallic clothing each have certain advantages and certain disadvantages. The increasing popularity of metallic clothing has accelerated research by the card clothing manufacturers. The objective is, of course, to discover a card clothing that combines some of the desirable features of flexible clothing with some of the desirable features of metallic clothing. One result of such research is the semiflexible clothing now produced in different forms under different trade names. Since semiflexible clothing is a comparatively recent development, there are no large-scale, world-wide tests and statistics we can compare. The best we can do is to have a look at the clothing, and to compare the experiences of mills that have used it.

One type of semiflexible clothing is the Tufferbrute, manufactured by the Howard Brothers Manufacturing Company and shown in Fig. 26. Note the thick, multi-ply foundation, the straight teeth, and the oval section of the teeth. This clothing was designed for use on the first breaker of a woolen-card set. The clothing can handle stock containing hard burs, shives, and

other impurities that are likely to damage conventional card clothing. Rugged fancy clothing was developed to work in conjunction with the cylinder clothing.

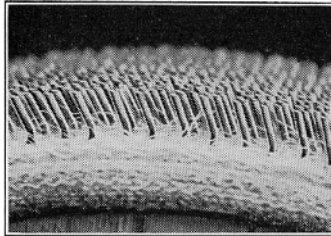


FIG. 26. SEMIFLEXIBLE CLOTHING

Reports from mills indicate that this semiflexible clothing does away with the troubles formerly encountered when conventional clothing was used on coarse work. The semiflexible clothing did not blister, lasted several times as long, needed very little stripping, and reduced to a minimum the necessity for grinding. A further advantage was that less preparation was required, because the clothing could handle stock with a minimum of previous opening and picking. Another interesting result was that the amount of fly was reduced. In short, the reports were very encouraging, and so it will be worth while to study semiflexible clothing in more detail.

58. A useful set of data has been compiled by the Benjamin Booth Company about the Strip-O-Matic clothing manufactured by that organization. In Fig. 27 (*a*) an enlarged cross section of the wire is shown. Note the elongated and streamlined shape. This shape gives strength to the wire, while leaving room between the wires for the stock to be carded. If you call to mind what you have learned about the influence of air currents in carding, you'll understand why the streamlining of the wires may well help to reduce fly.

In sketch (*b*), Fig. 27, the teeth of the Strip-O-Matic clothing are superimposed on the teeth in regular flexible clothing. The

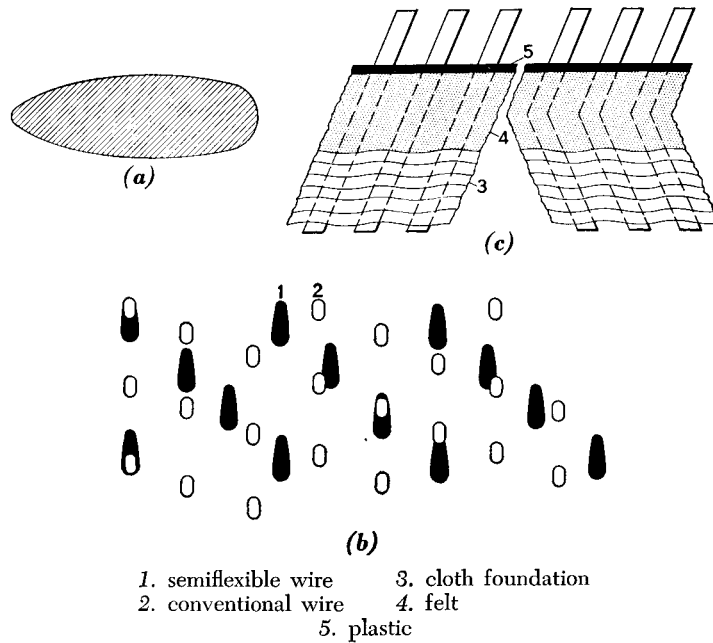


FIG. 27. SECTIONS OF SEMIFLEXIBLE CLOTHING

black, elongated points are those of the Strip-O-Matic, while the hollow points are those of the conventional clothing. Note that the twill lines of the elongated points are much steeper. There are about the same number of points sidewise, but fewer points lengthwise. This arrangement allows the stock to move freely around the wires. Thus, while the wire is not very flexible, there is little fiber breakage.

A section through the clothing is shown in sketch (c), Fig. 27. The wires may be straight, as shown on the left of this sketch, or they may have a knee, as shown on the right. In either case the wire has a certain amount of flexibility, but that of the knee wire is greater. The foundation has, at the bottom, several woven plies similar to those found in conventional clothing. Over this base is a thick layer of felt. This embeds the wire, yet allows a limited amount of flexibility.

The felt layer is topped off by a layer of tough plastic. This protects the foundation against any hard impurities that may be in the stock.

The wire height above this thick foundation is very short. The stock cannot penetrate deeply, and so in this respect the clothing resembles the metallic wire clothing. Of course, it is this feature that largely reduces the need for stripping.

59. Semiflexible clothing is attached to the card in the same manner as conventional clothing. For fillets 2 in. wide, a tension of 400 lb or more is used; for 1½-in. fillets, 175 to 200 lb is used. In clothing the cylinder, don't put the fillets quite as tightly together as with conventional clothing.

The only grinding required is to even up the points. In other words, use only top grinding, just as is used with metallic clothing. The amount of stripping required, while a great deal less than with conventional clothing, depends largely on the type of stock run.

Sources of Information and Supply

60. You have now studied in great detail what types of card clothing and maintenance equipment are available to the carder today. Perhaps you have wondered why there is so much controversy, that is, why you can't get simple, definite answers as to the type of clothing best suited for each particular purpose. You must remember, however, that properly installed, well-made card clothing lasts for many years. As a result, cards are often run on all types of stock, 24 hours a day. No research laboratory could expose the clothing to such punishment for such a long time. Consequently, you are forced to rely on the experience of men who have observed the various types of clothing in action under different conditions over a period of years.

It is always wise to consult with the representatives of card clothing manufacturers. These men go from one mill to the other and have the facts with which to make comparisons. If

you can't reach these representatives you can write to the companies that make card clothing and equipment. In the following list you'll find the names of some of these companies. This list does not attempt to be complete—there are too many companies who make card clothing to list them all. But it gives you some reliable sources of supply and information.

Ashworth Brothers, Inc., Fall River, Mass. Card clothing supplies and service.

Benjamin Booth Co., Philadelphia 34, Pa. Card clothing. (The original sketches for Fig. 27 were made available by this company.)

Davis & Furber Machine Co., North Andover, Mass. Card clothing of all types; woolen and worsted cards. (The photographs for Figs. 16 and 17 were made available by this company.)

Howard Bros. Co., Worcester 8, Mass. Card clothing of all types; emery fillet. (The photographs in Figs. 4 to 13, and that in Fig. 17, were taken from samples of clothing made by this company.)

Proctor & Schwartz, Inc., Philadelphia 20, Pa. Woolen, worsted, and staple fiber cards; garnetts; metallic wire of all types. (Fig. 22 shows wire made by this company, which also made available photographs for Figs. 23 to 25.)

B. S. Roy and Son Co., Worcester 3, Mass. Grinding equipment.

Whitin Machine Works, Whitinsville, Mass. Woolen, cotton, and staple fiber cards; grinding rolls. (The photographs for Figs. 20 and 21 were made available by this company.)

When you write to one of these suppliers, try to get permission to write on your company's letterhead. The more clearly you explain your problem, the more definite will be the information you can expect to get.

Another important source of information about new equipment and types of clothing are the trade magazines of the tex-

tile industry. Most of these magazines provide handy mailing cards which you can use to obtain more information.

Summary

61. Good yarn cannot be spun without proper carding of the stock. Good carding, in turn, cannot be done without suitable, properly maintained card clothing. Consequently, in deciding upon the frequency of grinding and the type of clothing to be used, the quality of the carding must not be sacrificed. On the other hand, the cost of the carding must not be prohibitive.

The job of the carder is a very responsible one. A good carder must learn as much as possible from the experience of others, yet he should be open to new ideas. The problems posed by new types of card clothing, and by the new fibers being constantly placed on the market, make the job of the carder ever more important and interesting.

Card Clothing

Serial 6201

Edition 1

Examination Questions

Notice to Students.—Study this instruction text thoroughly before you answer the following questions. Read each question carefully and be sure you understand it; then write the best answer you can. If the answer involves a mathematical solution, show enough of your work to indicate how you obtained your answer. We will not accept answers alone. When you complete your work, examine it closely, correct all the errors you can find, and see that every question is answered; then mail your work to us. **DO NOT HOLD IT** until another examination is ready.

1. A mill has installed a set of revolving-flat cards, to be used mainly for the preparation of cotton for 20s yarn. It is desired to cover the cylinders and doffers with flexible wire card clothing. What counts of clothing would you use (*a*) on the cylinder and (*b*) on the doffer?
2. Suppose that you are examining a piece of regular flexible wire card clothing. What should be the location of the points, as compared to the crowns of the wire?
3. The emery cover of a grinding roll is worn down. Rather than hold up the job, the card grinder puts a little more pressure on the grinding roll and continues with the grinding. What is likely to result?
4. Revolving-top flat cards can be used for both cotton and short-staple synthetics. In which of the two following cases would you find the installation of metallic clothing more advantageous: (*a*) if you continue to use the cards only for cotton; (*b*) if you intend to use some of the cards for synthetic staple?

5. In carding synthetics, loading up of the cylinder is one of the main problems. Which type of flexible wire card clothing is most likely to help in preventing this trouble?
6. You are to cover a doffer having a diameter of 27 in. and a width of 45 in. The fillet clothing to be used is $1\frac{1}{2}$ in. wide. How many feet of fillet will you need, approximately?
7. Suppose that the cards in a card room are due for re-clothing within a year. The cards are located on the second floor of the mill—neither the mill construction nor the card drives could handle the extra weight of metallic clothing. Yet you would like to try something to reduce maintenance cost. Is there anything you can do?
8. You are to cut an outside taper for a 60-in. cylinder on 8-rib, 2-in. fillet. Each of the 8 sections should be how many inches long?
9. Double-convex wire takes and holds a sharper point than ordinary round wire. Explain why this is so.
10. If you have had practical experience with card clothing, discuss two advantages and two disadvantages of metallic wire, as compared to flexible wire card clothing. If you have not had practical experience, base your answer on your study of this text. State whether your answer is based on this instruction text or on your own experience.
11. You are to cut an inside taper for a 27-in. doffer. How many inches of fillet will you need for the taper on the tail end of the fillet?
12. Suppose that you are looking over several samples of card clothing that a salesman left with you. Sample A is marked “CWC”; sample B is marked “Made with Cordette”; sample C is labeled “Flexifort”; sample D is marked “Felt Face.” Briefly describe, in your own words, what these labels tell you about the foundation of the card clothing.

13. Suppose that you have been using a certain type of card clothing in your mill for a good many years. A card clothing salesman calls on the superintendent and shows him test results which seem to indicate that the carding output may be raised by about 2% with a novel type of card clothing. This card clothing would require new setting and maintenance procedures. The superintendent asks your opinion. What would you tell him?
14. In the storeroom are two rolls of regular rib-set card fillet from which the labels have been lost. The fillets are 2 in. wide, with 8 ribs across the width of each fillet. Counting the noggs per inch, you find that the fillet in roll A has 19 noggs per inch, while the fillet in roll B has 23 noggs per inch. Calculate the number of points per inch for each of the two fillets.