

tion with the pedal lever *D* and acting as feed roller in connection with the heavily weighted roller *G*, the cotton as emerging between this pair of feed rollers being struck by the blades *H* of the beater. In addition to this arrangement of feeding the scutcher there is generally provided a mechanism for adjusting the distance of the feed rollers *F* and *G* to the action of the beater blades *H*, i. e. the distance between the "bite" and the "blow", and which must be varied to suit the length of staple of the cotton worked to produce good results. By "bite" is meant the point at which the feed rollers hold the cotton and by "blow" the point at which the blades of the beater strike the cotton thus held by the feed rollers. It is not practicable to vary the relation of the parts as regulating the distance between the bite and blow, according to either long or short staple cotton under operation, by adjusting the beater, for which reason the feed rollers of the scutcher (i. e. the pedal roller and its heavily weighted pressure roller) are made adjustable to and from the beater. The mechanism for effecting this adjustment is shown by Fig. 62 showing one of a pair of adjustable stands *a*, to be attached to two sides of the frame of the scutcher. These two stands are exact

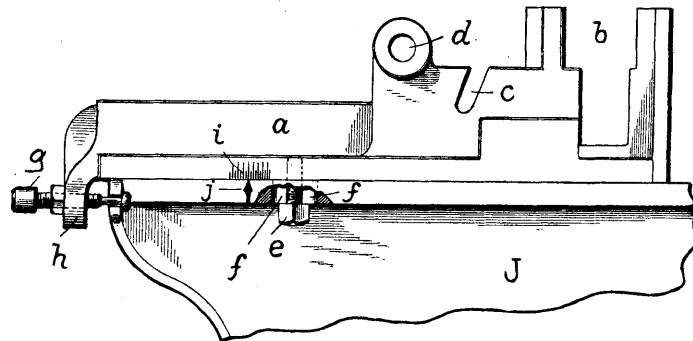


FIG. 62.

duplicates, thus an explanation of the one shown will suffice for both. Capital letters of reference in this illustration also refer to like letters in the preceding illustration in order to better explain the device. When speaking of adjusting the feed rollers we must remember that the same have to work in certain arbitrary and fixed relations to other parts of the scutcher, which feature must be maintained when changing position of the feed rollers and for which reason the proper position of said other parts must also be taken care of in said stand *a*. For this purpose we find in said stand *a* besides pockets *b* for the reception of the boxes of the feed rollers *F G*, a slot *c* for receiving the rail bar *E*, which carries the evener plates *C*, a bearing *d* for receiving the apron driving shaft *B*, and a plane surfaced part to which the apron side *I* is bolted. The stand *a* rests and can slide lengthwise on the top of the

frame *J* of the machine, there being a tongue and groove joint between them to insure the straight movement of the stand, which is held down in place by a bolt *e* passing up into its base through a slot *f* in the frame *J*. The back and forth adjustment of the stand is effected by a set screw *g* which is tapped into and through an ear *h* on the stand, and at its inner end is swiveled to the frame of the machine. By turning this screw in one direction or the other, the stand can be moved back or forward as required. On the side of the stand is a graduated scale *i* and on the adjoining part of the frame is an index *j*. The two stands (one on each side of the frame as previously described, both stands being exact duplicates) between them carry and support the feed rollers, eveners plates, and rail bar, the apron, apron sides, and apron driving roll shaft. When any change in adjustment with reference to distance of bite and blow of the machine is to be made, each stand is adjusted independently of the other, best done by two persons, one on each side of the machine, each guided by the index *j* registering upon scale *i* on his respective side of the machine.

Beaters.—In considering the question of the beater used in connection with scutchers we find that there is a great difference of opinion prevailing with regard to the advantages or otherwise, resulting in the use of a two or three winged beater or a carding beater. The latter, if used, refers more to the finisher scutcher; the two or three winged beater referring to any scutcher, as well as to pickers where they also are used.

In connection with Figs. 59 and 60 as explaining feeding mechanisms respectively, a two winged and a three winged beater are shown. The former is more easily made and can be more accurately balanced, being about 14 inches diameter and can be run without vibration at a much higher speed than the three winged beater which is generally from 16 to 18 inches diameter, and is revolved at a slower rate than the two winged. The respective velocities are from 1200 to 1500 revolutions for the two winged, and from 900 to 1000 revolutions for the three winged beater; what will readily explain that the two winged beater gives to the cotton a sharper blow and leaves it more quickly, whereas with the three winged beater a more dragging blow is imparted. The blades of the beater run across the width of the machine and are made of steel, securely riveted to three or four sets of arms keyed on the shaft. In some instances the blades of these beaters have been made of a form that is rectangular in cross section, but these, while operative to a certain extent, have not generally proved efficient, principally because of the fact that the edges of the blades which acted upon the cotton or other material being formed by the intersection of two planes at right angles to each other were too blunt to take the proper hold thereon, and as a result thereof the material operated upon was not properly opened up or the seeds and other refuse removed therefrom. In its proper form these blades are provided with operative edges that are made sharper and more acute by beveling the former back from

their faces to their rears, the amount of the bevel however not being sufficient to give a cutting action to the cotton. When one edge becomes dulled through continual usage, the beater can be reversed and thus the other edges of the blades brought into use, both ends of the shaft being made alike for this purpose. The force of the blow given to the cotton certainly is an important factor for good work, however we must remember that the force of a blow depends upon the weight of the object dealing the blow, as well as its velocity, what would explain that if the heavier three winged beater was run at the same number of revolutions as a two winged one, it would not only give $1\frac{1}{2}$ times more blows but at the same time each blow would be more forcible than the blow given by the two winged beater and this for two reasons. One is the increased weight previously mentioned, the other, that the centre of gyration (which in the heavier three winged beater is farther from the shaft), increases the force of the blow to such an extent that the three winged can be run slower than the two winged beater without decreasing the force of the blow in proportion to the reduction in speed and which item is the point of advantage in favor of the three winged beater, it thus being an easy matter to make the action of either form of beater practically alike. Some beaters have the edges of their blades made of hardened steel, but these do not wear any better than the ordinary blades, becoming dulled about as soon and cannot be sharpened without grinding which is considerable trouble, while the ordinary blades may be sharpened by planing off the dulled edges.

Beaters are also in the market in which grooved blades are provided; two styles of such beaters being in this instance made, one for

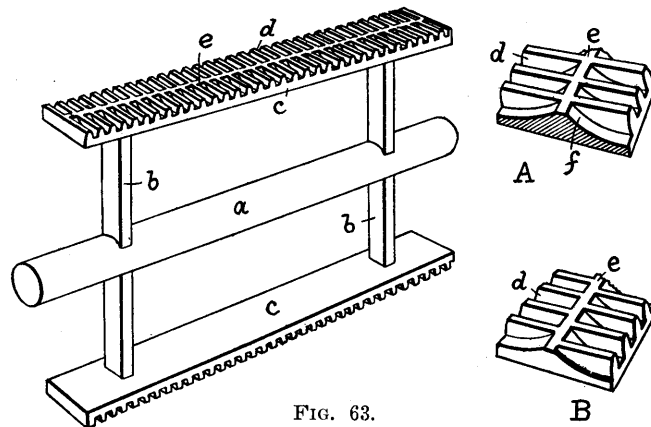


FIG. 63.

dealing with short and medium stapled cotton, the other for long stapled i. e. Sea Island or Egyptian cotton. With reference to the first mentioned construction Fig. 63 is given, being a perspective view of this

beater. The same comprises shaft *a*, radial arms *b* and bars *c*, provided upon their faces with teeth *d* which extend lengthwise at right angles to the length of the bars *c* and in the direction of rotation of the beater. The teeth have blunt forward ends and are arranged in two series, separated by a bridge *e*, one set of teeth being arranged either in alignment with the teeth of the other set as shown in detail in *A* or in alignment with the spaces between the teeth of the other set as shown in detail in *B*. The bridge *e* which separates the teeth into two sets has its sides beveled as at *f*, thus more effectually separating the fibres, preventing stringing of the cotton, and also checking the impurities released from the cotton, taking it through the grid and thus preventing it from again mingling with the cotton. If dealing with long stapled cotton, the construction of beater blade shown in Fig. 64 is to be used. In the same the teeth extend the full width of the beater blade so as to form continuous unobstructed spaces between them, across the full width of the blades for the reception of the long fibres of cotton. The blades as well as the teeth in this construction are curved, as shown, in order to conform to the curvature of the grid and consequently keep the teeth at all times in engagement with the cotton to more effectually open it. These two constructions of beaters are designed to work with common grids or with the special grid with "comb attachment" later on explained in connection with Fig. 67.

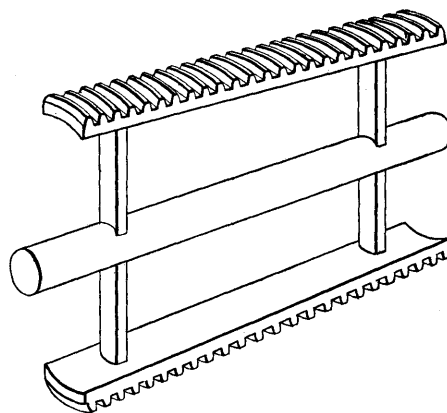


FIG. 64.

With reference to carding beaters, as previously referred to, there are different styles in use. Fig. 65 shows one style of construction. In the same the regular beater blades are provided with a series of pins projecting outwardly slightly from their faces, whereby to comb out and partially open up the cotton as fed to the beater before it is brought into contact with the edge of the blade. These pins are arranged in two rows, the individual pins of the one row being opposite the spaces between the individual pins of the other row in order to closely cover the feed. Three different methods of securing the pins to the blades of the beater are shown in the illustration. In *A* the body portion of the pins are shown threaded and inserted into correspondingly threaded orifices formed in the blades of the beater. In *B* the pins are provided with shanks of a reduced diameter, said shanks being inserted in properly shaped orifices in the beater blades, the shoulders of the pins resting in counterbored seats with which the blades are provided, their

inner ends being upset or riveted down against the inner side of the beater blade. In *C* the pins are shown as made in the form of an enlarged cone, with no threaded portion

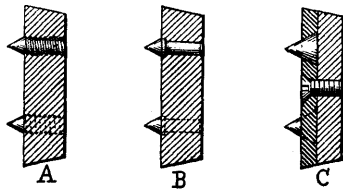


FIG. 65.

or stem, being clamped upon the face of the beater blades by a plate provided with suitably shaped orifices through which the pins pass and in which they are held, the plate being secured throughout its centre to the beater blade by means of common screws, countersunk into the plate. By thus employing pins with the beater

blades, the cotton is not only subjected to the usual beating and cleaning action, but also to a combing action prior thereto, the result of which is to so open up the cotton delivered to the beater as to render it impossible for the sharp edge of the beater blades to secure such a hold thereon as to enable it to draw in between the feed rolls any portion thereof even when imperfectly held thereby. Another carding beater, used extensively, is shown in its section in Fig. 66. The same can be readily applied to any make of machine and consists essentially of three wooden lags *A* fastened to the arms *B* of the beater. In these lags are inserted tempered steel pins *C*, arranged spirally, each row being farther from the centre than the preceding one, as will be readily seen by the dotted circle, the length and fineness of the pins *C* used, varying according to the class of work under operation. The action of this beater in taking the cotton from the feed rollers is a combined combing and beating one, in consequence of which the fibres are straightened in addition to being beaten.

Grids.—The opening and cleansing actions of the beaters are derived from the rapidly repeated blows of the blades striking the cotton away from the feed rolls in small tufts and dashing them against the bars of a grid, consisting of a series of stationary bars which extend from side to side of the machine, situated below the feed rolls and extending about a quarter of the distance of the revolution of the beater; driving in this manner the impurities the cotton contains out between the bars of the grid into a chamber and from which they are removed as found necessary. The setting of the grid bars is a matter of importance, they should be placed so as not to receive the fibres straight on the sharp upper edge, but more on the side, thus giving a face blow and at the same time shaking out more dust. Again the grid should be so set that the space left between the path of the beater and the bars,

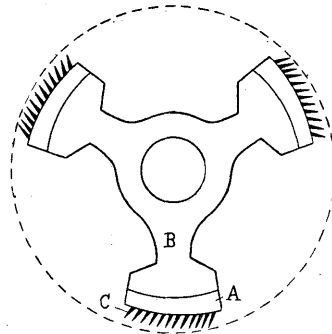


FIG. 66.

beginning nearest the feed rolls, gradually increases, in order to accommodate the cotton which obviously increases in bulk through being opened. The bars are supported by adjustable brackets bolted to the frame, the space between these bars being graduated, those nearest the feed roll having the widest space between them, as the greater part of the dirt is removed before the cotton passes the last bar. This feature will also explain why the grid bars in a picker are set more open compared to those in a scutcher. With reference to the adjustment of the bars it must be remembered that at first the cotton requires to be arrested quickly, so that it receives a shock which frees the impurities, after which the bars should subject the cotton more to a scraping action, for which reason the angle presented to the cotton by the face of the bar should become less acute, so that the cotton can roll over the bars, thus removing many of the motes and a good deal of leaf otherwise carried along with the cotton. The exact setting of the bars however is a matter of practice, depending on the condition of the cotton as well as the machine, remembering that the edges of the bars should always be kept sharp and clean. In the following illustrations Figs. 67 to 70 are shown different, special, constructions of grids and their setting.

In the construction of the grid shown in vertical section by Fig. 67 the same consists of curved side bars *A* and transverse bars *B* placed a slight distance apart, to permit the impurities in the cotton as liberated

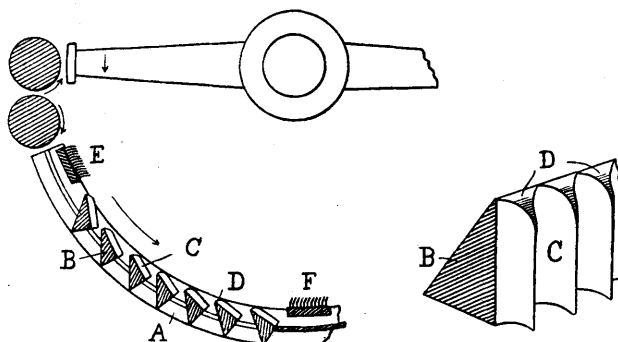


FIG. 67.

by the action of the beater to fall through. These bars *B* are provided on their upper sides with beveled teeth *C* having blunt curved ends *D* (see detail illustration), whereby when the cotton is thrown against them by the beater, said teeth act to separate and straighten out the fibres and at the same time prevent any material amount of cotton from passing between the grid bars along with the impurities. In conjunction with the toothed bars *B*, two combs *E* and *F* are employed in this grid, the same being made of card clothing and placed on opposite ends of the grid bars and have for their object to somewhat comb and straighten

the fibres during the process of scutching. For use in connection with this grid a beater provided with toothed blades as previously described and shown by Figs. 63 and 64 can be used to advantage.

Fig. 68 shows a method for setting the spaces between the grid bars. In this construction the ends *A* of the grid bars are provided

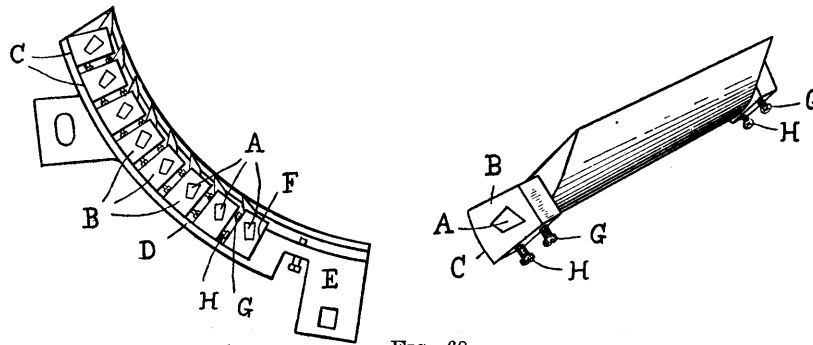


FIG. 68.

with blocks *B*, the outer curved surfaces *C* of which bear on the flange *D* of the frame *E*. The lowest of the series of bars rests against the shoulder *F* of the frame while each of the other grid bars is spaced from the one below it by adjusting screws *G* and *H*. By separately adjusting these screws *G* and *H* (see detail illustration) each grid bar can be set

correspondingly on both sides at any required angle with respect to the path of the beater.

In place of using screws for adjusting each grid bar independently, as thus described, the grid bars can be connected with an arrangement of levers for simultaneous adjustment, as shown by Fig. 69.

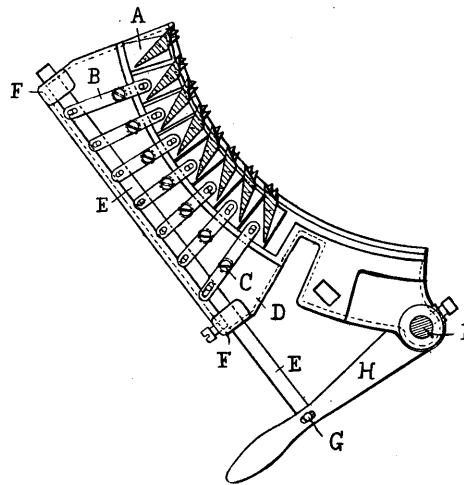


FIG. 69.

adapted to be moved by hand in either direction and thus through bar *E* and levers *B* setting the grid bars in the position required. Fig. 70

shows two other methods for varying the spaces between the grid bars, at the same time showing an arrangement for adjusting the grid, as a whole, nearer to or farther from the path of the beater. For setting the grid bars *A*, the same are provided on their journals either with spur gears *B* or triangular plates *C*, which mesh with teeth on a curved rack bar *D*. The back edge of said rack bar is formed along part of its length with a series of teeth which engage with a toothed gear *E*, mounted on

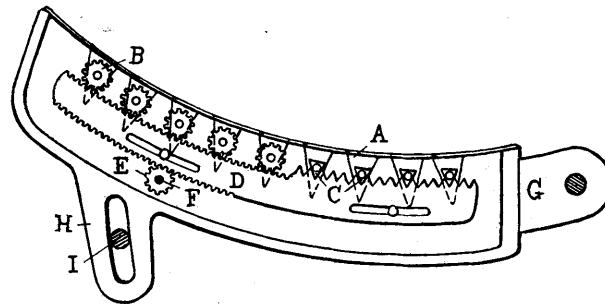


FIG. 70.

a shaft *F*, which has on it at one end a hand wheel (not shown) adapted to be turned and thus move the grid bars into the position desired. For setting the grid, as a whole, to or from the path of the beater, the rear portion of the frame *G* in which the grid is mounted is provided with a vertically slotted leg *H*, through which passes bolt *I*, for thus holding the grid in the position required.

Lapping.—The opened cotton is formed into a lap at as early a stage as possible, instead of ejecting it loosely from the scutcher, since no matter how uneven in weight a lap may be, it is not likely to be so variable as a mass of loose cotton placed on a lattice for feeding to the next machine. Again the earlier an evenly weighted feed is obtained the better the chances of obtaining final laps which are equal in substance, for which reason breaker as well as intermediate scutchers have lapping devices attached in order to give the finisher scutcher a chance to produce a lap as perfect as possible all around. In addition to this the cotton is easier handled in the shape of a lap than in its loose state, a feature which reduces the cost of labor considerably.

With reference to Fig. 71 which is a side elevation of the lapping device or section of a scutcher, the fleece of cotton *A* after leaving the calender rollers is wound into a lap *B* by passing it around a smooth roller *C* resting between two large fluted rollers *D E*, both moving in the same direction, and consequently turning the increasing lap by frictional contact at a corresponding surface speed. In order to produce a hard lap, there is hung onto each end of the lap roller a bar *F*, the upper end of which extends into a hooked shaped frame *G*, provided with antifriction rollers *H* as working against the protruding ends

of the lap roller *C*. The lower end of bar *F* terminates into a rack section *I* and which engages with the pinion *J* as fast to shaft *K*. The lap *B* in its formation causes an upward movement of the bar *F*, and to which a brake or pressure is applied (in order to get a hard wound lap) by means of a retarding surface *L* on a lever *M*, acting against a tension wheel *N* as mounted loosely on shaft *K*; said tension wheel *N* through a train of gears (not shown) working in connection with pinion *J* as fast

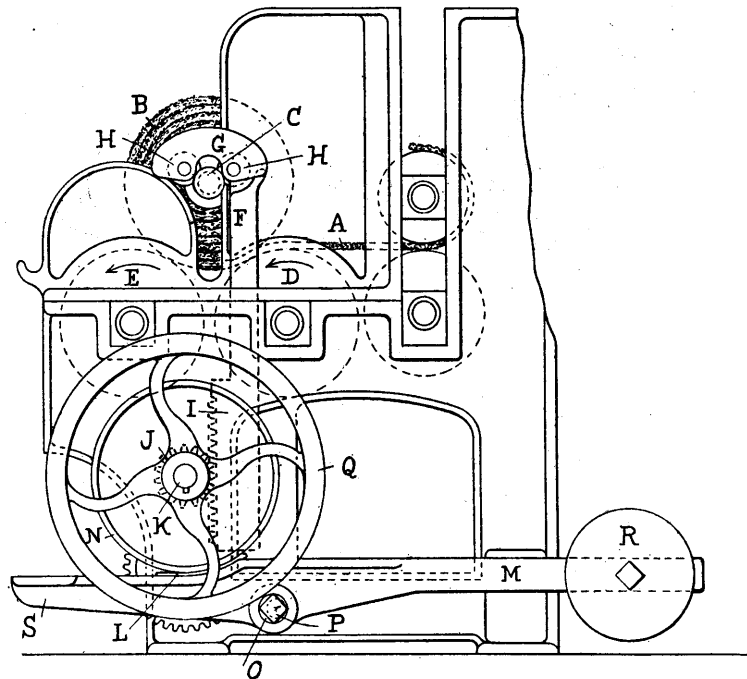


FIG. 71.

on shaft *K*. To vary the degree of tension upon the lap roll and lap, it is necessary that the tension or retarding surface *L* as on lever *M* shall bear for a greater or less part of its area upon the surface of the tension wheel *N*, and what is accomplished by an adjustable lever fulcrum *O* having eccentric bearing for the lever *M*; a fastening extension protruding through a hole in the frame side of the machine and having a threaded end which receives a locking nut and a collar which prevents the lever *M* from endwise movement upon its eccentric bearing. The lever fulcrum *O* has its outer end *P* so shaped as to permit turning by a wrench. To adjust the tension, the locking nut is loosened and the fulcrum *O* turned by a wrench to such extent as will cause the tension surface *L* of the lever *M* upon the tension wheel *N* to be increased or decreased, as desired; and when this has been done the nut is tightened

and thus the lever fulcrum *O* locked in its adjusted position. *Q* is a hand wheel fastened to the shaft *K*. The lever *M* has at one end an overbalancing weight *R*, and at its other end a foot treadle *S* by means of which the pressure of the tension or retarding surface *L* on the tension wheel *N* can be released, permitting through hand wheel *Q* turning of shaft *K* and pinion *J* as fast to it, thus providing means for the ready raising or lowering of the bar *F* through its rack section *I* for the purpose of doffing a finished lap and starting a new one. This arrangement of relieving the pressure to the lap under operation, can also be connected with the "knocking off" motion of the lapper, which works when a lap is of the desired size and when the delivery of material (feed rollers as well as calender rollers) is automatically stopped, thus preventing the lap from continuing to revolve under pressure, what would result in a tendency for the lap to lick when unrolled on the next machine.

NOTES ON PICKING AND SCUTCHING.—Taking for granted that the cotton has been well mixed, then the proper setting and care of the pickers and scutchers must be considered, since upon their proper adjustment largely depends the character of the work produced. Any of the leading makes of pickers and scutchers now on the market will make good work when properly set and looked after, but almost every different make of machine has some points of excellence peculiar to itself, perhaps making it more suitable for certain classes of work. To have a good running picker or scutcher, the machine must be well constructed, so that in running it will be free from vibration and jar. The chances are, to say the least, very much against a beater running well when it is not perfectly balanced, and the boxes not in good form. The extra amount of oil used on a badly running beater would in a short time pay for its being made right, and yet one can often see them running when it seems to be necessary to keep them almost flooded in oil. With a beater that is jumping and vibrating while running you are not getting the best possible work from that machine, because the beater is not delivering its blows evenly upon the stock as presented to it by the feed rollers. No doubt we destroy some staple every time the beater strikes it, but the amount is small in comparison with the quantity dealt with. The object in passing cotton through a preparing machine is to free it from dirt or seeds, and to thoroughly clean it—good yarn is impossible otherwise. If the dirt and seeds are not removed before carding, the former will take the point off the card wire, whilst the latter will be ground up into fine particles and distributed all through the yarn. The card wire will be choked and laid flat, thus reducing the number of carding points, and the particles distributed through the roving will cause it to break down every time one of them is passed through the front rollers, whether on the jack, the roving, or the spinning frames. Every time an end breaks down on any of these machines, there is considerable waste as well as loss of time, and which is much greater than that from the destruction of fibre by the beaters. Picking

as well as scutching requires a certain length of time for good work. If a greater weight of material must be opened to suit the whim or wish of a superintendent, this extra quantity is only obtainable at the expense of the quality, and, such a policy is eventually disastrous. If really necessary, two machines would be true economy, doing lighter work, thus have more time to open out the matted cotton and consequently give the best quality of work. Starting fair is of the utmost importance and that is by having the first work done thoroughly. The scutching machines (breaker, intermediate, and finisher) are almost exactly alike in construction. The differences between them are speeds and setting of the various parts. The scutchers in use are either of the single or double beater type. If we compare two single scutchers to one double scutcher, then in the former case the cotton will receive two doublings and two beatings, whereas in the latter it will have only one course of doubling, with two beatings. As doubling tends to produce uniformity, the lap, as produced from the two single scutchers, will be more uniform than that produced by the double scutcher, for which reason the single scutcher is to be preferred, and is more and more superseding the double scutcher. So long as the fibres are separated in picking and scutching with as little injury to the staple as can be done and the impurities eradicated as much as possible, it is a matter not only of discretion but of the utmost economy as to whether the intermediate scutcher is necessary. The mere fact that it is in use does not always prove its necessity, and some firms, although equipped with the three process system, have occasionally dispensed with it for a time when it has been thought that the cotton was of a sufficiently clean character to begin with, or that its use would not add materially to the strength of the yarn that is spun. If cotton fibres remain too long under the action of the picker or the scutcher, they show a certain amount of stringiness, and are then spoken of as stringy cotton, which means that the fibres are either damaged temporarily or permanently. Modern picking and scutching machinery has been carefully designed to prevent these irregularities in the preparatory treatment, but if the air current in a picker or breaker scutcher is very sluggish it will cause stringy portions of fibre to be formed, and these may get into the lap sheet of the intermediate or the finisher scutcher and thus make trouble in spinning. Unfortunately, impurities are adherent to the cotton, which when they are dislodged in the picker or the scutcher, will carry with them, even with the most careful work, a quantity of fibres that if thus not removed would give strength to the yarn spun. Every possible precaution must be taken during picking and scutching to not only dislodge the impurities, but also to guard against the possibility of their re-entering the cotton, rendering their extraction more difficult at each advancing stage. Some manufacturers adhere strictly to blade beaters for pickers and scutchers, but it will be found that the porcupine cylinder beater is the beater for a picker, the same also refers to the carding beater with reference to finisher scutchers.

The amount of feeding to pickers and scutchers, i. e. the weight of cotton presented to the opening influence of the machine, varies naturally with the strength of the feed rollers and the condition of the cotton at the respective stage. Long feed rollers of a small diameter and having the least rough surface, will be less capable of presenting a heavy feed to the beater than if dealing with shorter, larger and rougher rollers. If, when the machine is running, the cotton is seen to be detached in moderately large pieces, at about the middle of the feed rollers, it indicates that the feed is slightly in excess, but when this occurs over the whole of the width of the feed rollers, it shows that the feed is entirely too heavy; consequently perfect feeding is the case when such detaching of large pieces (known as "plucking") does not occur. Considering feeding in an average, the same varies in amount from about 36 to 64 ounces per yard length irrespective of its width, and as to surface of feed from $1\frac{3}{4}$ to $2\frac{3}{4}$ inches diameter \times 38 to 50 inches length of feed rollers. Variations of feed rollers are not responsible for variations in the weight of the feed, as frequently the lightest feeds are associated with feed rollers of large diameter. Generally small feed rollers are considered best adapted for short stapled and large feed rollers for longer stapled cotton. Pickers are frequently equipped with larger feed rollers than those used in connection with scutchers, since the cotton is presented to the picker in a more disconnected and irregular state thus requiring more power, while the scutchers, in their turn, always have easier work, the cotton being fed to them always more and more in an opened condition. The distance of the feed rollers from the beater blades and the angle at which said rollers are adjusted are very important points to be considered in order to avoid cutting or breaking the staple. It is important that the feed should neither be too great nor too little. If the feed is too great, then the result will be that the material will not get sufficiently cleaned; if too little, there will be a loss in production. If the feed is too wide or too thin, then the result will be that the laps will become defective—i. e. thick in the middle and thin at the ends, or vice versa. Irregular feeding will also produce the same result. It is absolutely necessary that the feed regulating motion should be kept clean and in good working order. The essentials of a good feed regulating motion are that it should be simple and sensitive, i. e. its mechanism must work practically instantaneously to accomplish what is expected of it. Irregularity in the weight and hank of the laps may be due to the unsatisfactory working of this feed regulating motion. When the feeding of the loose cotton is done by means of open feeding, the cotton must be spread evenly upon the lattice apron in order to present an even bulk of cotton to the action of the beaters so that they clean it uniformly without breaking the fibres. This trouble of uneven feeding, however, is now in most all mills done away with by means of the introduction of the hopper feed for the picker and trunk feeding to the breaker scutcher. The doubling of laps in the scutching machines is intended to avoid irreg-

ularities, and when a lap is conspicuous for its uniform margins, opacity in texture, with the least amount of impurities, it is a good start for a marketable yarn.

The speed of the beaters should be regulated according to the class of the cotton most used. With finer cotton, longer staple and lesser impurities, the beater can be driven at a slower speed, so as not to damage the fibres, compared to coarser cotton, having a shorter staple and containing more impurities, and when the beater must be driven at a comparatively greater speed since otherwise the cotton will not get sufficiently beaten-up and cleaned, and the lap will come out dirty. It is most important that the beater blades should be kept in good working order, as a rupturing of the fibres often results from worn rough, rounded, or too sharp edges of the blades of the beater. Beaters must be well oiled and cleaned underneath. Hot boxes must be looked out for, since they are frequently the cause of fires. In case of fire, if the same is inside the scutcher, do not stop the machine, but remove the laps and let the machine run, since if you should stop the latter and the fire was around the screen cages, the blast would probably be sufficient to melt the soldering, thus ruining the cages. Never throw water all over the scutcher unless the fire grows too fast, since water will do more damage to the machinery than the fire would if allowed to burn itself out. However pails filled with water should be kept handy at all times, but used with judgment if required. Permit as little waste as possible to be made, and such as made should not be allowed to lie on the floor to be trampled upon. Cleanliness should be strictly enforced in the preparatory department and will be a great preventative against fires.

It is essential that the grids should be kept smooth and clean, since if they get worn the fibres will be damaged. The spaces between the bars in the breaker scutcher vary from $\frac{5}{16}$ in. in the beginning to $\frac{3}{16}$ in. in the end, whereas those in the finisher scutcher vary from $\frac{3}{16}$ in. in the beginning to $\frac{2}{16}$ in. in the end. The reason for this variation is that the heavier impurities fall through the bars before the cotton reaches the end of the grid. It must be noted that the cleaning action more particularly takes place from the bite of the feed rollers to the centre of the grid. The cotton enters the finisher scutcher with a great many of its impurities removed by the breaker and intermediate scutcher, provided the latter is used, so that the distance between the bars in the finisher scutcher is less than that in the breaker scutcher. In some machines serrated bars (bars having saw shaped teeth) are placed at intervals, to assist the other bars of the grid in removing the impurities.

The proper speed of the fan to produce a draft in the scutcher is of the greatest of importance for perfect work and depends upon the amount of cotton passing through the machine, its size, and construction and area of the air passages. The objects aimed at in having this draft is two fold, viz:—the distribution of the cotton uniformly over the surface of the cages, and the extraction of impurities. The evils of a

fan running at too great a speed are that the cotton is not drawn uniformly over the surface of the cages, that the cotton does not remain for a sufficient time under the action of beaters, that the impurities, instead of falling through, pass on along with the good fibres, that the openings between the wires in the cages get filled up, and that therefore the impurities, instead of being got rid of, travel along with the fibres in the lap. If the fan runs at too slow a speed, the cotton will be carried in irregular quantities, with the result that the laps will be thick and thin. The air admitted into the beater chamber from underneath the grids is regulated by a plate called the dead plate and the wider the plate, the less the draft, and vice versa.

The cages in a scutcher perform a two fold function, viz:—extracting the impurities and affording a surface for the cotton to collect on so as to form a continuous sheet or lap. They are made either of wires or of perforated zinc. The former, although costlier than the latter, afford a greater space for the passage of impurities and air. The cage wires should be always kept clean and polished. To prevent stringing, or piling the cotton upon the cages at random, the fan draft must be steady and equal on all parts of the cages.

It is necessary that the calender rollers are kept smooth and polished, for which reason they must be frequently rubbed with whiting. If they are not kept in good condition, there will be a chance for the laps to lick at the succeeding machines. They are heavily weighted at both ends; but if the weight is too great, the laps will become hard, whereas if too little, said laps will become soft. If the weight is greater on one side than on the other, then said lap will assume a conical shape.

The licking of laps may arise from the dust flues, which possibly are too small, or the dust chimney may be so-placed that at times when the wind is blowing from a certain quarter it causes a down draft in the chimney. If the fault lies in the dust flues or chimney it will of course be necessary to correct those faults before satisfactory results can be obtained. Again the same may be caused by too much waste in the mixing, too great fan speed, short staple cotton, short and long fibres mixed together, laps as made at the preceding machines being soft, too thin or irregular, etc. The remedies generally adopted are: Compressing the lap as it is being formed by the application of a board, using rove bobbins, the rove winding round each layer as the lap is being formed, putting most of the draft in the top cage, and the application of moisture. Uneven laps are due to irregular feeding, uneven draft, feed regulating motion not acting properly, flues not clean, etc. To secure good work, the laps must be made level on their entire surface, of equal width and length, and of uniform weight. The numbers of yarn in a mill cannot be kept uniformly even with constant variation in the weight of the laps. All laps should be weighed as they are taken from the finisher, and none allowed to go to the card room weighing one-quarter of a pound from the standard. The impression is too prevalent in the pre-

paratory department that little deviations in the weight and thickness of laps will do no harm to the work, but there is not a process in the entire operations of cotton spinning that can be slighted without adverse results. Frayed and torn edges of the lap may be prevented by contracting the width of the lap by means of the contracting plates provided, or increasing or decreasing the draft as required. Bad selvages may be caused by the dampers not being correctly set. It is to procure a good selvage that the width of the machines is gradually reduced.

Scutcher neps (seen as little white specks) result from damage to the fibres, due either to a too high speed of the beater or the beater blades being sharp or torn or set too close to the feed rollers or grid. If laps are not evenly made on the scutchers, the liability of nepped cotton is increased when the same are on the cards, since the latter will not card out all of the neps, but in the operation of opening them, thousands of the fibres will be broken, which will either weaken the yarn, or increase the quantity of waste.

By draft in scutchers is meant the difference in movement between the feed to and the delivery of cotton from the machine, any change in either movement altering said draft. The draft in any of the scutchers should be that which will provide the lightest lap, per unit of length, that it is possible to make without affecting its uniformity; however it must be remembered that when the weight of the lap is reduced too much, such laps will become uneven. With reference to the lap produced on the finisher scutcher, the counts of yarn to be spun must be taken into consideration, since a certain weight of lap, per unit of length, is required for the card and which weight will range from about 9 ozs. to 14 ozs. per yard for a lap 40 inches wide, and 11 ozs. to 16 ozs. for 48-inch wide laps. The draft in the scutcher varies considerably and the operator must know what draft the scutcher has, so that in case the weight of the lap has to be altered, he may know exactly how much to alter the weight of the feed to give the required weight of lap delivered. Now if it is desired to make a lap weighing nine ounces to the yard, which at present weighs but eight ounces, you will have to know to begin with, the draft in the scutcher. If said draft is three, it will require three ounces more cotton to each yard fed to produce one ounce more weight on each yard of lap delivered by the scutcher; however if the draft should have been six it would have required six ounces more cotton per yard fed on to produce the same result. The easiest and most simple way to get the draft of a scutcher is to measure off one yard of cotton on the feed and weigh it. Suppose it weighs thirty-two ounces. Then take one yard from the lap as delivered and weigh it also. Suppose it weighs eight ounces. Next divide the weight delivered into the weight fed; which in our example will be eight divided into thirty-two which gives a quotient of four and which in the present example will be the draft of the scutcher. With this draft of four it will take four ounces additional weight of feed per yard to make the lap delivered one ounce to the yard heavier. Another method to figure

the draft of a scutcher is to find the surface speed of the front lap winding roller and divide this by the surface speed of the feed roller.

To find the length of a lap, take off a certain number of yards from the lap and weigh it, say for example 4 yards; then multiply the weight of full lap with four yards and divide product by the weight of the 4 yards, the answer being the length of the lap in question.

It is essential, in order to get sufficient production, that the waste made in the preparatory department is not too great. Many causes account for too much waste, such as the grid bars being too far apart, the spaces too many, the beater revolving at too great a speed, too much waste in the mixing, cotton very dirty, grid bars set too close to the beater, etc. To find the percentage of waste made in a scutcher proceed thus:—Weight of cotton fed to the machine minus weight of lap delivered, multiplied by 100 and product divided by weight fed = percentage of waste made by the machine. In the same manner you can ascertain percentage of waste made by a combined picker and scutcher, including cleaning trunk connections if such are used. If dealing with a bale breaker or picker only, you will have to weigh the clean cotton in place of laps and after this proceed as before.

MILL PLANS FOR THE PREPARATORY DEPARTMENT.—Besides selecting only the best and most modern machinery for this department, great care must be taken when planning its arrangement for a new mill. To avoid unnecessary handling of the finished laps, it is advisable to locate the scutchers on the same floor with the carding department; but in some cases, especially in connection with old mills, this may be for one reason or the other not practical and when a lap elevator has to be used to carry the laps to the card room floor. The bale breakers, hopper feeds or pickers, as the case may be, are ordinarily placed on the ground floor, however convenience of delivery of bale cotton to the opening room determines its location, a considerable distance between picker and breaker scutcher being no hindrance to the production of good work by these machines, giving in this manner a chance to use either inclined or horizontal or both kinds of cleaning trunks, which greatly assist in cleaning the cotton of impurities, hence less work for the scutchers. Poorly designed and equipped mills, although possibly favored by local conditions as regards raw cotton raised near its door, cheap labor, power, taxes, etc., can never think of competition with mills less favorably situated but equipped first class all around. A few plans for the proper laying out of the preparatory department for modern cotton mills will next be given, which however can be changed or modified to meet existing conditions. The machines thus shown are duplicated—side by side—according to size of mill.

Fig. 72 shows an arrangement with all the machinery on one floor, used in connection with smaller mills, when space is limited, and when picking, scutching and carding is done on the same floor. With this arrangement no cleaning trunk is required, the cotton as taken from

the mixing, or the bales direct, as the case may be, is fed to the hopper feed *A* as shown working in connection with a two beater (*B C*) two cage section (*D E*) breaker scutcher. The first beater *B* may be a porcupine cylinder and the second *C* a two or three winged blade beater, or both may be either two or three winged blade beaters according to the class of cotton handled, spun, by the mill. Four of the laps *F* as are in turn made by this breaker scutcher are next fed, as shown at *G*, to the intermediate scutcher, being a single beater (*H*) single cage section (*I*) machine, the beater being either of the two or three winged blade kind and provided with an evener device. Four of the laps *J* as are in turn made by this intermediate scutcher are next fed as shown at *K*, to

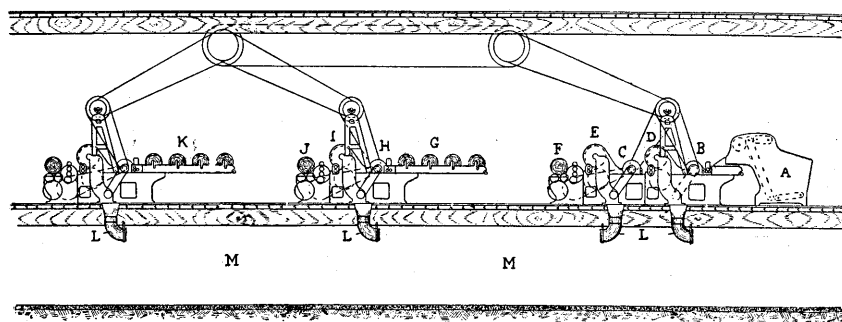


FIG. 72.

the finisher scutcher, being a duplicate of the former machine with the possible exception that a carding beater is used in place of a blade beater. It will be seen that the fans of all the machines through their dust flues (galvanized iron pipes) *L* discharge into the dust room *M* as situated beneath. Each flue pipe is provided with an automatic closing damper, kept open by the air pressure in the flue pipe, but which closes by its own weight as soon as the fan stops, being assisted in this by the air pressure in the dust room produced by the running fans, the closing of the damper preventing the dust from blowing back into the flue and thus the respective machine, when the latter is stopped. A dust chimney is provided to the dust room, leading to the open air, in order to prevent back pressure to the dampers and has an area of at least three square feet for each fan. The dust room, being situated below ground has its floor cemented and any overhead wood work covered with tin, for protection from fire. The heavy dirt will settle to the floor, from where it has from time to time to be removed, whereas light dirt will pass along with the air through the chimney. When dealing with mills spinning low counts of yarn, using a low price, dirty, cotton and when cleaning is of more importance than evenness of lap for the card, the intermediate scutcher can be dispensed with, adding a second beater

and cage section to the finisher scutcher, or building one or the other (breaker or finisher) or both scutchers with three beaters and cages. When dealing with a mill spinning only fine counts of yarn, using only a clean, long staple cotton, such cotton must be treated carefully and as the picking and scutching process is an unavoidable evil, it is necessary to reduce the number of beaters used to the least number possible, in this instance (with reference to Fig. 72) doing away with the intermediate scutcher without increasing the working capacity of the breaker scutcher, in fact in some cases cutting the latter down by omitting the second beater (C) and its cage section (E).

Fig. 73 shows a plan for a mill running on coarse work, in which the scutchers are on the second floor and the pickers on the first. *A* indicates the opening or mixing room, as the case may be, and from

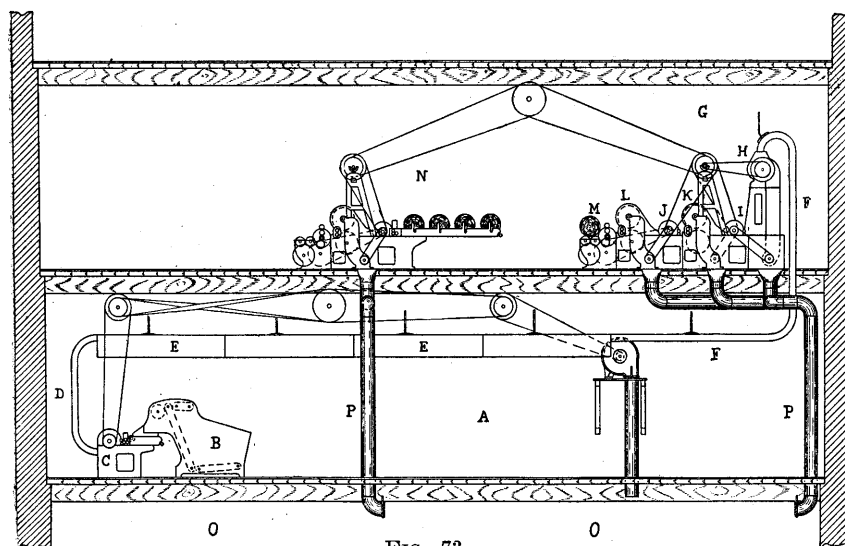


FIG. 73.

where the cotton is fed to the hopper feed *B* as connected to the porcupine picker *C*, which through trunk connection *D* delivers to the horizontal cleaning trunk *E* (provided with automatic sprinklers) and from where the cotton is drawn through trunk connection *F* into the breaker scutcher *G* as situated on the floor above. This breaker scutcher comprises a condenser and gauge box *H*, two beaters *I J* and cage sections *K L* and lapping section *M*. Four of the laps as formed in turn on this machine are next put up at the finisher scutcher *N*, which corresponds to the one explained in the previous plan. *O* indicates the dust room into which the flue pipes *P* discharge. The opening and picking as shown done on the first floor and the scutching as

on the second, may any time be reversed when the cards are on the first floor.

The plan shown by Fig. 74 refers to another two floor arrangement, with picking on the first floor and scutching on the second. In this plan the connection between the picker *A*, as fed by the hopper feed *B*, and the breaker scutcher *C* is formed by means of an inclined cleaning trunk *D*, thus doing away with condenser and gauge box for the breaker scutcher, as is used in connection with the preceding plan, on account of the shorter distance between it and the picker. The scutching room is shown equipped with what is known as the three process

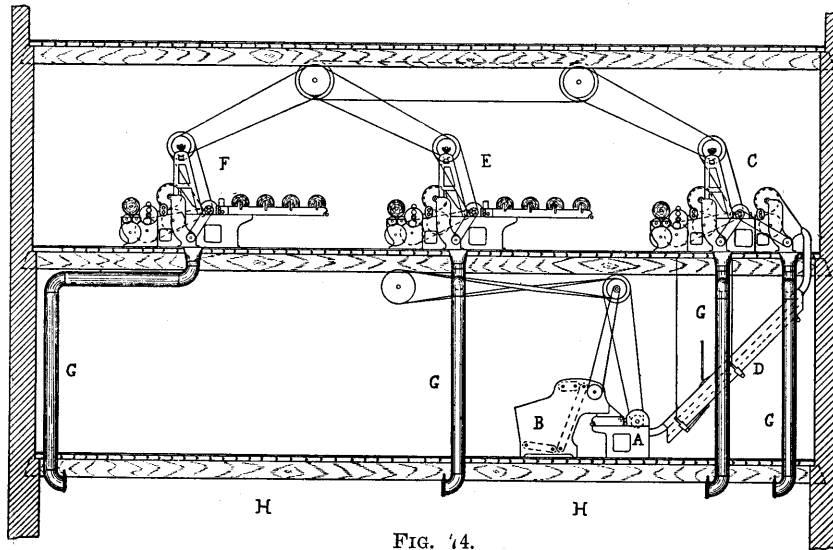


FIG. 74.

system, viz:—breaker scutcher *C*, intermediate scutcher *E* and finisher scutcher *F*, all three being in this case single beater machines. The scutchers, through flue pipes *G*, discharge as before in dust room *H*. This arrangement of placing pickers and scutchers can be reversed provided the card room is on the lower floor. In some instances in connection with this three process system, the scutchers are located on the third floor and the hopper feed, picker and cleaning trunk on the first, the connection between the latter and the breaker scutcher in this case passing up through the second floor, which in this instance can be or is used for mixings as are thus conveniently fed to the hopper feed below by means of a chute, or for other purposes, the opening of bales and mixing being in this case carried on on the first floor. In arranging flue pipes through rooms below, it is best to bring them down near the side walls or some of the pillars of the mill structure so that they are out of the way.

Fig. 75 shows how to arrange two sections of machinery in a three story mill. The opening of the bales (*A*), their mixing if so required, the feeding of the cotton to the hopper feeds (*B B'*) as situated on either side, the pickers (*C C'*) and the inclined cleaning trunks (*D D'*) are all located on the ground floor. Next we see that the picking and cleaning machinery as shown situated at the right hand side in the illustration (*B C D*) deliver the cotton by trunk connection *E* to the three process scutchers on the third floor (*F* breaker, *G* intermediate and *H* finisher scutcher); whereas the corresponding set of picking and cleaning machinery as shown situated at the left hand side in the illustration (*B'*

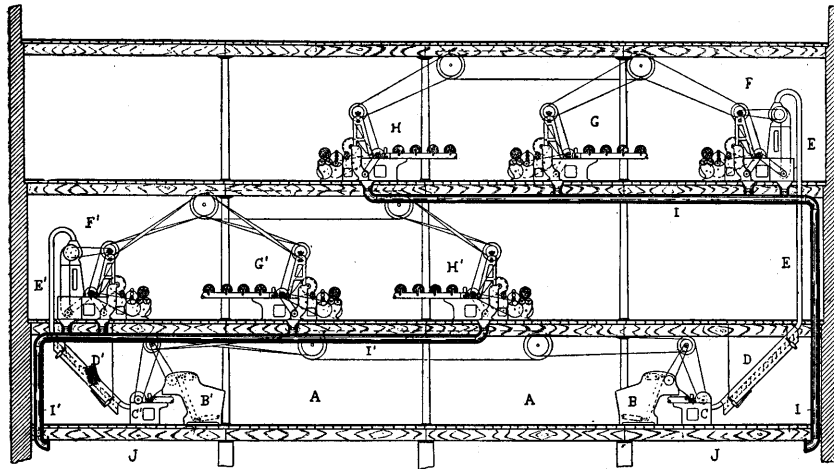


FIG. 75.

C' D') delivers by trunk connection *E'* to a similar three process system of scutching (*F' G' H'*) as placed on the second floor of the mill. Each section of scutchers is shown in this instance to discharge collectively through one flue (*I* and *I'* respectively) to the dust room *J*.

Sometimes it is necessary that the two sets of scutchers, as have been shown on the second and third floors, have to be transferred to the first and second floors, the picking machinery thus having to be placed on the third floor. When this is the case and it is not convenient to unload the bales in the picker room as on the third floor, they are then unloaded in the storage house and the picker room put in direct connection with the same through a cotton conveying pipe. Fig. 76 shows in section the plan for a mill having its preparatory department arranged in this manner. The cotton in the storage house, after having its bagging removed and mixings made, or not, as the case may be, is in turn fed to a bale breaker or a hopper feed and which is connected to one end of a conveying pipe through which the cotton is drawn by a strong current of air, produced by an exhaust fan placed about half way

between the ends of the conveying pipe. The other end of the conveying pipe *A*, as is blowing the cotton into the picker room, is provided with a condenser *B* which consists of a revolving screen upon which the cotton is deposited and which screen is connected to an exhaust fan *C*. Both ends of the screen are open, thus any light lint and dust is taken out by the exhaust fan *C* and discharged through flue pipe *D* into the dust room *E*, while the cotton is removed as the screen revolves and falls in a pile on the floor *F*, from where it is fed to the hopper feeds *G G'* a series of which are placed opposite on either side. The pickers *H* are shown to deliver the cotton to the three process system of scutchers on the second floor, whereas the pickers *H'* de-

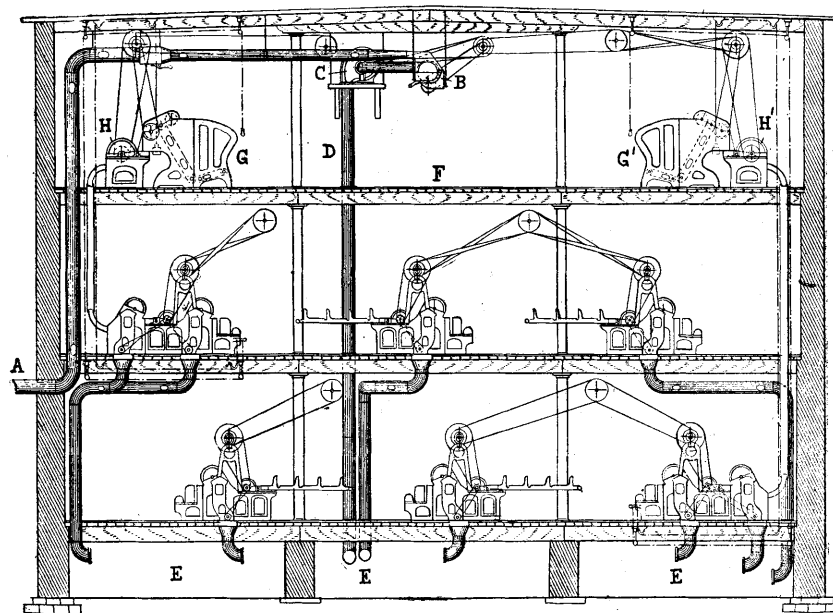


FIG. 76.

liver to the three process system of scutchers situated on the first floor; all the machines being connected by flue pipes with the dust room *E*.

CALCULATIONS.—By a thorough understanding of the principles underlying speed and gearing calculations the student will readily solve any practical calculation with reference to driving pickers and scutchers. If two circular disks, or rollers, of equal diameter are pressed into contact with each other and one is revolved or driven at certain speed, the same speed will be imparted to the other, i. e. one single revolution of one will result in one single revolution of the other and at the same time a movement of any portion of the circumference of one will equal

a similar portion of the other, resulting in what we term "equal revolution" or "equal speed" for the disks or rollers as the case may be. The same also refers to pulleys driven between each other by means of belt or rope. The next point to be known is how to get the circumference of a disk, roller or pulley and which is obtained by multiplying its diameter with 3.1416 (or $\frac{22}{7}$ expressed in a common fraction). If in place of dealing with circular disks we consider them to have notches cut in their circumferences, equally apart from each other and the resulting projections in one made to fit into the recesses of the other, we get gear wheels, which in turn will drive each other by leverage. The calculations as to their diameter remains the same as with circular disks since when gear wheels are in mesh with each other, the same number of teeth on each wheel occupy equal length on their surfaces. Considering a change in size of two rollers driven one from the other by friction or two pulleys driven one from the other by belt or rope, the matter is best explained by an example. Suppose the driving roller or pulley is 8 inches in diameter, driving in turn a roller or pulley respectively 6 inches in diameter. Required to ascertain the speed of the driven roller or pulley as the case may be.

$$8 \text{ inches} \times 3.1416 = 25.1328$$

$$6 \text{ inches} \times 3.1416 = 18.8496$$

$$\text{and } 25.1328 \div 18.8496 = 1\frac{1}{3}; \text{ or by cancelation}$$

$$8 \times 3.1416 \quad 8$$

$$\frac{\quad}{6 \times 3.1416 \quad 6} = \frac{\quad}{\quad} = 1\frac{1}{3}; \text{ which means that the driven roller or}$$

pulley will revolve $1\frac{1}{3}$ times during one revolution of the driver, showing an increase in speed.

Another example:—Driver 8 inches diameter, driven 12 inches diameter. $8 \div 12 = \frac{2}{3}$ which means that one revolution of the driver only revolves the driven $\frac{2}{3}$ of one revolution, showing in this case a decrease in speed.

With reference to wheels the same calculations apply, thus when two wheels of the same diameter and having the same number of teeth, gear with each other, their speed is equal. However their speed varies, provided their diameter and consequently number of teeth vary. Thus for example, if driver has 30 teeth and driven 20 teeth only, then $30 \div 20 = 1\frac{1}{2}$ which means that the driven wheel revolves three times during the time the driving wheel revolves only twice, consequently an increase in speed; vice versa a decrease in speed for the driven any time the same has more teeth than the driver. The driven can in turn be made to work as a driver in connection with a third wheel and this affair continued as required, being in this manner nothing else but a combination of examples as given.

Again we will meet frequently with two wheels keyed on one shaft, they being of any diameter and size of teeth as the case may require, each wheel again working in connection with a separate wheel (or train

of wheels). For example:—A wheel *A* with 24 teeth, gears with a wheel *B* with 12 teeth; fast to the same shaft as wheel *B* is another wheel *C* having 24 teeth and gearing with a fourth wheel *D* having 12 teeth. Considering *A* as the driver, *B* is the driven; *C* again a driver and *D* another driven wheel; required to ascertain the speed of *D* compared to that of *A*. This example could be solved as explained before by making two calculations, however it will be found more convenient to combine them into one calculation thus:—

$$\frac{A}{B} = \text{speed for } B, \text{ and } \frac{\text{speed of } B \times \text{teeth in } C}{\text{teeth in } D} = \text{speed of } D; \text{ or}$$

shorter yet by rule: Multiply drivers and divide by product of driven thus:—

$$\frac{A \times C}{B \times D} = \text{speed of } D \text{ and which will solve itself into}$$

$$\frac{24 \times 24}{12 \times 12} = 4, \text{ i. e. the wheel } D \text{ will revolve 4 times to each revolution of wheel } A.$$

Besides the above calculations we frequently will be called upon to ascertain the surface speed of any roller that is on the same shaft as a wheel. To solve such an example we must know besides the number of teeth in the wheel, the diameter of the roller; and when we simply have to multiply the circumference of the roller with its revolutions to get the surface speed of the roller. For example, with the previous gearing calculation, consider that the shaft of wheel *A* is connected to a roller 2 inches in diameter and the shaft of wheel *D* is connected to a roller $1\frac{1}{2}$ inches in diameter. Question: ascertain difference in surface speed between rollers connected to wheels *A* and *D*. The difference in revolutions between the wheels *A* and *D* as shown in the previous example is 4 in favor of the latter. Next find surface speed of rollers connected to shafts of wheels *A* and *D*. The speed for the first is found thus:— $2 \times 3.1416 = 6.2832$; and that for the latter thus:— $4 \times 1\frac{1}{2} \times 3.1416 = 17.8496$ inches, and $\frac{17.8496}{6.2832} = 3$, indicating that the surface speed of the roller connected to the (driven) shaft of wheel *D* is three times as quick as that of the roller connected to the (driving) shaft of wheel *A* or that there is that much draft between the two rollers. The above calculation can be simplified in this instance as follows:—

$$\frac{A \times C \times \text{diameter of roller on } D}{B \times D \times \text{diameter of roller on } A} \text{ or } \frac{24 \times 24 \times 1\frac{1}{2}}{12 \times 12 \times 2} = 3 \text{ and}$$

which proves the previous method of calculation. If a single worm is found in a train of gearing, consider it as a one toothed wheel, if it is a

double worm consider it as a wheel having two teeth. If dealing with pulleys, the diameters of the same are used in place of the number of teeth on a wheel.

DRIVING OF SCUTCHERS.—In the driving of scutchers the feed and lap parts are driven independent of the movement of the beater although their movement is derived from the beater shaft. In order to more clearly explain the drive for a breaker scutcher the accompanying illustration Fig. 77 is given, being a plan view of it, showing the arrangement of gearing. By reference to this illustration it will be seen that on one end of the beater shaft, as revolving in this case at 1450 revolutions per minute, are mounted two pulleys *B* and *B'* and on the other end two more pulleys *B²* *B⁴*, the latter two pulleys driving respectively only the fans of the calender and cage sections of the machine. The pulley *B'* is connected by a belt to pulley *C* which has on its end a spur gear *C'* meshing with a clutch gear *D*. When the scutcher is in operation, this clutch gear *D* is in engagement with its clutch member *D'* and through the arrangement of gears shown, the feed and lap parts of the machine are in turn driven thus:—

The gear on the clutch member *D'* meshes with a large gear *E* on one end of a cross shaft, movement of said gear driving the fluted lap winding rollers *P* and *R'* through train of gears *E' P' P² Q* and *R*, the gear *E'* being fast on the cross shaft carrying gear *E*. On the other end of said cross shaft as carrying the gear *E* is mounted a gear *E²* which through the train of gears *F F' S T U V W X X' Y* and *Z* drives the calender rolls *F² S' T'* and *U'*, stripper rollers *W'* and *X²* and the calender cage section.

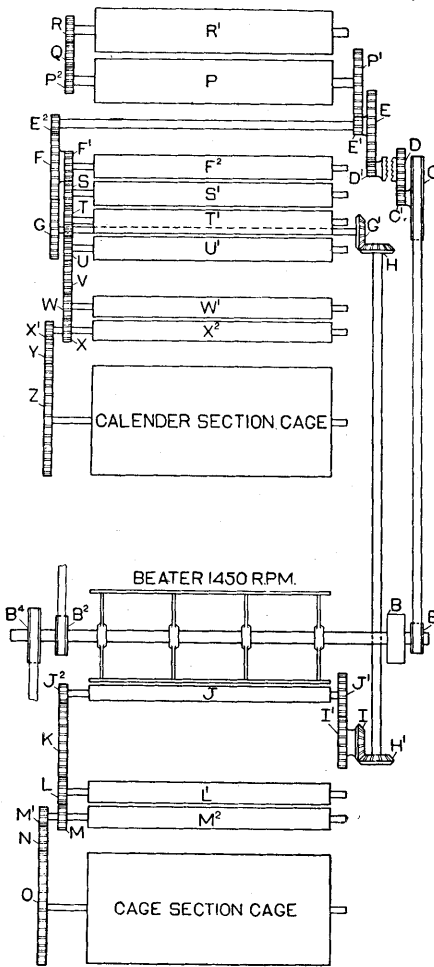


FIG. 77.

The connections for driving the feed and lap parts of the machine are in turn driven thus:—

section of the scutcher consists of a gear *G* receiving movement from the gear *F* as belongs to the train of gears previously referred to, the other end of the shaft on which gear *G* is mounted, carrying a bevel gear *G'*. A bevel gear *H* on one end of a long shaft extending from front to rear of the scutcher meshes with said gear *G'*, the movement of this shaft being transmitted through bevel gears *H'* and *I* and gear wheel *I'* to gear *J'* fast on one end of the shaft of the feed roller *J*, the other end of said shaft carrying a gear *J²*. The latter gear *J²* meshes with a gear wheel *K* which through gears *L M* transmits motion to the stripper rollers *L' M²* and in turn through gears *M' N* and *O* to the cage of the feed section. It will be readily understood that the machine can be run faster or slower by changing the speed of the beater shaft but this is hardly ever done since any portion of the machine itself can have the speed altered by a change of gearing at the point desired.

The following are the items referring to dimensions of gearing and pulleys used, with reference to Fig. 77. The scutcher is driven from a main driving pulley (not shown) 16" diam. \times 4 $\frac{1}{4}$ " face if dealing with a single beater scutcher, whereas in connection with a two beater machine a 5 $\frac{1}{4}$ " face is used; the usual speed in either case being 435 revolutions per minute. Fast on the same shaft as said main driving pulley is the beater driving pulley 30" diam. \times 4 $\frac{1}{4}$ " face, which in turn drives:—

- B* beater pulley, 9" diam. \times 4 $\frac{1}{4}$ " face; usual speed 1450 r. p. m.
- B'* feed pulley, 3" to 10" diam. \times 2 $\frac{1}{4}$ " face, advancing by $\frac{1}{2}$ " increments.
- B²* driving pulley, 6" diam. \times 2 $\frac{1}{4}$ " face, for driving the fan pulley, 8" diam. \times 2 $\frac{1}{4}$ " face, for the calender section.
- B⁴* driving pulley, 6" diam. \times 2 $\frac{1}{4}$ " face for driving the fan pulley 8" diam. \times 2 $\frac{1}{4}$ " face of the cage section, in case if dealing with a direct connected scutcher; but with a trunk connection *B⁴* is 8" diam. and the cage fan pulley 6" diam., in order to give a higher speed to the fan.
- C* driving pulley for bottom cross shaft, etc., 18" diam. \times 2 $\frac{1}{4}$ " face.
- C'* clutch driving gear, 15 teeth.
- D* large clutch gear, 35 teeth.
- D'* small clutch gear or bottom shaft driving gear, 17 teeth.
- E* bottom cross shaft driven gear, 96 teeth.
- E'* front lap calender roller driving gear, 12 teeth.
- E²* bottom cross shaft gear, driving calender rollers and top cross shaft, 14 teeth.
- F* large double intermediate gear, driving top cross shaft, 50 teeth.
- F'* small double intermediate gear, driving bottom calender roller, 27 teeth.
- F²* bottom calender roller, 7" diam.
- G* top cross shaft gear, 30 teeth.
- G'* side shaft driving bevel gear, 24 teeth.
- H* side shaft bevel gear at calender end, 24 teeth.

- H'* side shaft bevel gear at feed end, 28 teeth.
I compound intermediate bevel gear, 28 teeth.
I' compound intermediate gear, driving bottom feed roller, 37 teeth.
J bottom feed roller, 2" diam.
J' bottom feed roller gear, 33 teeth.
J² cage section top stripping roll driving gear, 9 teeth. To vary speed an 8 tooth gear can be used in its place.
K cage section top stripping roll intermediate gear, 52 teeth.
L cage section top stripping roll gear, 14 teeth.
M cage section bottom stripping roll gear, 14 teeth.
M' cage section bottom cage driving gear, 23 teeth.
N cage section bottom cage intermediate gear, 20 teeth.
O cage section bottom cage gear, 181 teeth.
P front lap winding roller, 9" diam.
P' front lap winding roller gear, 53 teeth.
P² back lap winding roller driving gear, 24 teeth.
Q back lap winding roller intermediate gear, 22 teeth.
R back lap winding roller gear, 24 teeth.
R back lap winding roller, 9" diam.
S 3rd. calender roller gear, 21 teeth.
S' 3rd. calender roller 5½" diam.
T 2nd. calender roller gear, 22 teeth.
T' 2nd. calender roller 5½" diam.
U top calender roller gear, 23 teeth.
U' top calender roller 5½" diam.
V calender section top stripping roll intermediate gear, 32 teeth.
W calender section top stripping roll gear, 14 teeth.
X calender section bottom stripping roll gear, 14 teeth.
X' calender section bottom cage driving gear, 23 teeth.
Y calender section bottom cage intermediate gear, 20 teeth.
Z calender section bottom cage gear, 181 teeth.

Fig. 78 is a plan view of the drive and gearing of a finisher scutcher, which more or less corresponds to that of the breaker scutcher. As in the latter drive, the beater pulley *B* is the main drive for the machine, driving the beater direct and from pulley *B'*, as on one end of said beater shaft, the scutcher gearing. On the other end of the beater shaft is a pulley *B²* which drives the fan of the calender section. The pulley *B'* transmits motion to a driving pulley *C* on which is fast a bevel gear *C'* meshing with a bevel gear *D* on one end of a long shaft extending on one side of the scutcher, the other end of this long shaft having on it (at the calender end of the machine) a bevel gear *D'* meshing with a bevel clutch gear *E*. This gear, when the machine is running, engages a clutch gear *E'* and through the train of gears *F F² G* and *G'* drives the calender rollers *G² H' I'* and *J'*, the gears *H I J* of which intermesh with each other and in turn with the gear *G'* previously

referred to. An intermediate gear *K* meshes with the gear *J* which was the last driven gear thus far referred to, and through the train of

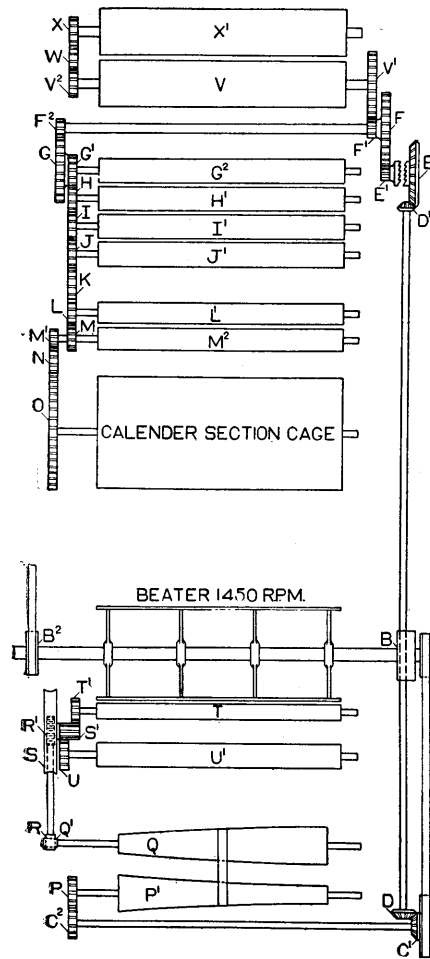


FIG. 78.

gears *L M* drives the stripper rollers *L'* and *M²*, the latter carrying a second gear *M'* which through gears *N* and *O* drives the cages. The lap winding rollers *V* and *X'* are driven from gear *F'* through the train of gears *V' V² W* and *X*. The drive for the feed of the machine is done by means of gear *C²* (as fast to the other end of the shaft carrying bevel gear *C'* previously referred to) meshing with a gear *P* fast on the shaft of the bottom cone drum *P'* of the evening mechanism, said cone drum in turn driving the top cone drum *Q* through the cone strap. The movement imparted to this cone drum *Q* in turn drives the feed roller *T* and apron roller *U* through the train of gears *Q' R R' S S' T'* and *U*.

The following items give the dimensions of gearing and pulleys used with this scutcher:—The size and speed of the main driving pulley as well as the beater driving pulley of this machine corresponds with that for the breaker scutcher as previously explained; driving in turn:—

B beater pulley, 9" diam. × 4½" face; usual speed 1450 r. p. m.

B' feed pulley, 3½", 4", 4½",

5", 6", 7", 8", 9" or 10" diam. × 2¼" face.

B² driving pulley, 6" diam. × 2¼" face for driving the fan pulley 8" diam. × 2¼" face, of the calender section.

C driving pulley for side shaft, etc., 12" diam. × 2¼" face.

C' evener cross shaft bevel gear, 27 teeth.

C² evener cross shaft change gear, 55 to 35 teeth, diminishing by

1 tooth.

D side shaft bevel gear at feed end, 27 teeth.

- D'* side shaft bevel gear at calender end, 18 teeth.
E large clutch bevel gear, 60 teeth.
E' small clutch gear, 17 teeth.
F bottom cross shaft driven gear, 96 teeth.
F' front lap winding roller driving gear, 12 teeth.
F² bottom cross shaft gear, 14 teeth, driving calender rollers.
G large double intermediate gear, 50 teeth, driving bottom calender roller.
G' small double intermediate gear, 27 teeth, driving third calender roller.
G² bottom calender roller 7" diam.
H 3rd calender roller gear, 21 teeth.
H' 3rd calender roller, 5½" diam.
I 2nd calender roller gear, 22 teeth.
I' 2nd calender roller, 5½" diam.
J top calender roller gear, 23 teeth.
J' top calender roller, 5½" diam.
K top stripping roller intermediate gear, 32 teeth.
L top stripping roller gear, 14 teeth.
M bottom stripping roller gear, 14 teeth.
M' bottom cage driving gear, 23 teeth.
N bottom cage intermediate gear, 20 teeth.
O bottom cage gear, 181 teeth.
P bottom cone change gear, 35 to 55 teeth, advancing by 1 tooth.
P' bottom cone drum.
Q top cone drum.
Q' worm shaft driving spiral gear, 9 teeth.
R worm shaft spiral gear, 9 teeth.
R' worm shaft worm, double threaded, right hand, equivalent to a gear having two teeth.
S large worm gear, 78 teeth.
S' feed roller and apron roller driving gear, 12 teeth.
T feed roller, 3" diam.
T' feed roller gear, 24 teeth.
U apron roller gear, 28 teeth.
V front lap winding roller, 9" diam.
V' front lap winding roller gear, 53 teeth.
V² back lap winding roller driving gear, 24 teeth.
W back lap winding roller intermediate gear, 22 teeth.
X back lap winding roller gear, 24 teeth.
X' back lap winding roller, 9" diam.

From the foregoing explanations it will be readily seen where to make any change in gearing as the case may require. The speed of any individual shaft is readily obtained by using an indicator, but by means of an indicator called the Tachometer the exact revolutions are at once obtained without the use of a watch as is necessary when using the common indicator.

CARDING.

Carding follows picking and scutching and is considered the most important operation in the whole process of cotton spinning, since upon the proper manipulation of the carding engine depends, in a great measure, whether the yarn will be dirty, rough and neppy, or perfect. Briefly stated the objects aimed at in carding are first, the removal of impurities that have been left in the lap by the preparatory machinery; second, the parallelization of the fibres to a certain extent; and third, the formation of a sliver for the next process.

After the cotton has passed through the hopper feed, picker, cleaning trunk and scutchers, and although a large percentage of leaf, seed, shell, sand, and small clusters of unripe fibres have been removed, there still remains a quantity of each in the lap as obtained from the finisher scutcher. Besides this the fibres are somewhat matted together, and lie in different directions; again neps need removal. Before the material can be spun into clean, level, strong yarn all such impurities must be removed and at the same time the individual fibres straightened out and placed in as parallel an order as possible, so that in the later on following processes they will draw better and this with less liability to damage, receiving and retaining the mechanical twist which finally converts the fibres into yarn. Owing to the fact that the fibres composing the lap fed to the card lie in different directions, and also that the natural twist which ripe cotton possesses causes them to curl somewhat, frequent brushing or combing is necessary, not only to place the fibres straight but to remove the shell, leaf, dead and therefore short fibres of cotton, neps, and any other impurities. Carding is of so much more importance because it is the last process in which cleaning of the cotton is effected; unless combing is carried out, the latter machine rejecting all fibres below a certain standard length, no card yet made having the necessary discriminating power to do this. Over-carding is detrimental to good work, whereas light carding is advantageous. Passing the fibres too slowly through the card will reduce the strength of the yarn. The length of time for carding depends upon the quality and cleanliness of the cotton under operation as well as the kind and counts of yarn to be spun from it.

Until about fifteen to twenty years ago there were four distinct kinds of carding engines in use, employed respectively according to the character of cotton used, as well as quality and counts of yarn required, viz:—the Roller, the Stationary Flat, the Combination or Union and the Revolving Flat card. The latter, however, on account of its superior points all around, has since years already driven its predecessors completely out of use in up to date cotton mills. The roller card was

chiefly used for low grade stock and coarse counts of yarn, and closely resembled the woolen card of to-day. Considering its principle of working, the roller card was well adapted for work where, as in woolen yarn, a great amount of the fibre extends outside the body of the thread, producing in turn a rough or oozy yarn. In connection with spinning low grades of cotton yarns, where quality is very seldom taken into account, it certainly was a very good machine for production. The stationary flat card was considered years ago to be the best card for long and fine cottons. In this specimen of a carding engine there were fitted over the cylinder, in adjustable brackets, a series of flats bent concentrically on their working surface so as to suit the cylinder. A long arm, extending upwards to the flats, moved around the cylinder shaft in both directions over all the flats, and carried at its extreme end a flat lifting and stripping apparatus, by means of which one flat after the other was lifted from its respective bracket, turned upward and thus its face exposed to the action of a stripper roller, which cleaned the flat, after which in turn the apparatus restored said flat to its proper bracket, and when the procedure was repeated with another flat. The order in which the flats were stripped varied, those nearest the lap requiring this attention more frequently than the others. The objection to the stationary flat card was that practically a space, the width of a flat, was continually bare on the cylinder, for no sooner is one flat stripped and let down in its place than another is lifted up. This space was a cause for sucking into the machine (on account of the great speed of the cylinder) any amount of dust and dirt flying about in the card room. Again the method of stripping the flats, in itself, was always more or less objectionable. The combination or union card was simply a combining of the roller and the stationary flat card into one machine, and had its origin in the idea that to pass cotton direct from the lickerin through the cylinder to the flats would result in filling the sliver with neps, and when consequently a roller and its clearer, and sometimes two or three rollers and clearers were placed next to the lickerin, the remaining working portion of the cylinder being covered with flats. The cause of the adoption of the revolving flat card over its predecessors consists mainly in the accuracy of the work done, in the smaller percentage of waste made, in the greater ease with which grinding, setting, and stripping are done, and in the decrease in cost of labor. In short, the adoption of the revolving flat card has been due to the fact that by its use there is brought about a decrease in cost and an increase in quantity produced.

THE REVOLVING FLAT CARD.—This name is given to this carding engine since its carding surface is composed of a series of narrow bars, technically known as flats, which are mounted in endless chains (one on each side) which revolve and thus move said flats over circular guide plates, known as the “bend”, as attached to the frame of the carding engine. The illustration Fig. 79 is a section of an approved form of a revolving flat card, showing its operation. One of the laps *A* as

was formed on the finisher scutcher, is placed, with its lap rod resting in grooves formed in brackets at the feed end of the machine, on a very slow revolving roller *B* which unwinds the lap through friction. The sheet of cotton thus unwound passes over a dish feed plate *C*, between its curved end (nose) and a slowly revolving feed roller *D*, when in turn it is engaged by the saw teeth of a quick revolving roller *E* known as the "lickerin" or "takerin". The cotton is no sooner thus taken from the feed roller by the lickerin than it is carried past a series of mote knives *F* which catch any motes, leaf, etc., still in the cotton and permit them to drop between said knives and a series of grid bars *G* out of the machine. After the cotton passes this grid it is carried around by the saw teeth of the lickerin and in turn engaged by the teeth of the

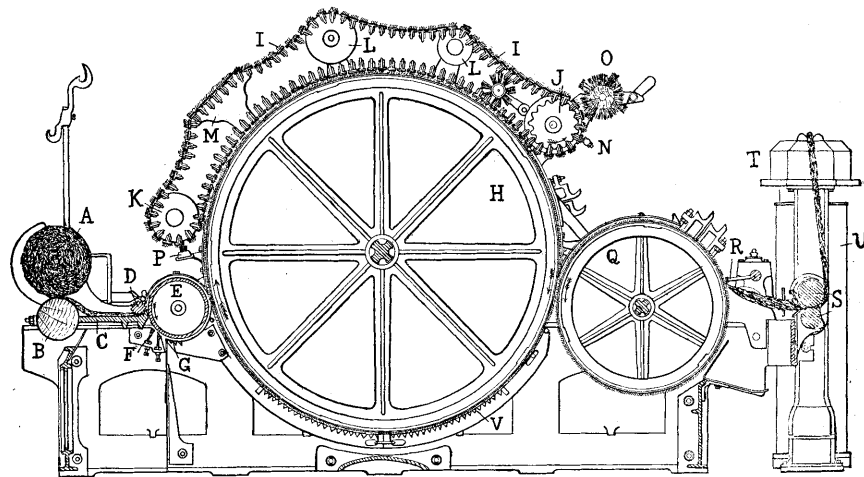


FIG. 79.

cylinder *H*, which revolves at a greater surface speed than the lickerin and has the teeth of its card clothing pointing in the same direction at point of contact, consequently stripping the latter of the cotton, carrying the same along to be in turn engaged by the teeth of the series of revolving flats *I*, which travel at an extremely slow speed (from 1 to 4 in. per minute) in the same direction as the cylinder *H* revolves, having their teeth set very close to and opposing those of the cylinder, consequently affording an almost stationary carding surface to the cotton, which, as it is thus dragged through the teeth of the flats is finally freed from much short fibre, seeds, etc., still adhering to it and which are embedded in the teeth of the cylinder and flats, the good fibres at the same time being laid more and more parallel. *J* is a driving roller which moves the flats and at the same time guides them at one end, a

roller *K* guiding them at the other end of the machine. *L* are two guide rollers for holding the series of flats apart, being also assisted in this procedure by a plate *M* which at the same time serves as a support for the flats to permit their being ground. Inside the two series of flats, near to the driving roller *J* is placed, as is clearly shown in the illustration, a brush for cleaning the tops of the flats as they pass it. The flats as they travel around guide roller *J* are turned face up and each flat in turn is stripped of accumulations of short fibres by a comb *N* and afterwards cleaned of any remaining fibres by a stripper brush *O*. In order to keep the bearing ends of the flats clear of lint, a brush *P* is provided, which engages the flats near the point where they enter into contact with the cylinder. The cotton after being carded by the action of the flats and cylinder, is in turn brought by the latter into contact with the doffer cylinder *Q*, which revolves at a slower surface speed than the cylinder, and in the same direction at its point of contact with the latter, the teeth of the respective clothing pointing in opposite directions, thus causing the cotton on the cylinder to be deposited in a condensed form on the doffer cylinder, from where in turn it is stripped in a continuous sheet by a quick (1200 to 1600 strokes per minute) vibrating doffer comb *R*. This sheet of cotton as it comes from the doffer has a certain amount of feltiness, or the fibres cohere and form a gauze just sufficient to be gathered together in the form of a sliver and in this shape conveyed to the calender rollers *S*, which increase the cohesion of the fibres and enable the sliver to be drawn up to the coiler head *T* and deposited into the sliver can *U*. Grid *V* forms the undercasing of the carding engine and through its apertures loose impurities drop out.

Between the last flat and the doffer, as seen from the illustration, there is a considerable space, which is covered by a metal plate correspondingly curved, this plate completely covering the breast of the cylinder and being jointed to a cover plate which partly surrounds the doffer. Both plates at their joint descend into the space between the doffer and cylinder and quite fill it up, thus preventing any accumulation of fly between the cylinder and doffer. The upper edge of the plate as covering the cylinder is provided with a knife edge which furnishes an additional cleaning action to the cotton. It will be seen that if it were not for this plate the fibres as held by the teeth of the cylinder would stand out radially and in turn be displaced by currents of air and give rise to a cloudy web. Both covers are readily removed when grinding, burnishing or stripping has to be done.

The mechanism for driving the doffer comb *R* might be said to consist of three parts, viz., the comb itself, the comb-box and the driving pulleys and cords. The comb itself, which may make about 1600 strokes per minute, is a steel bar connected by arms to a shaft which is made to vibrate by an eccentric in the comb-box. The motion is obtained by a large cord pulley on the cylinder shaft driving a small pulley on a stud not far from the floor. On the same shaft is another pulley

from which a cord extends upwards to a small pulley extending outward from the comb-box. This double system of pulleys gives the requisite increase of revolutions, starting at about 165 per minute with the cylinder. The motion (eccentric) as inside the comb-box revolves in a bath of oil and the comb-box itself is held down to the frame of the carding engine by bolts, being adjustable to and from the doffer by a setting screw in order to bring the comb to or farther from the doffer as the case may require. It sometimes happens that the band which drives the doffer comb breaks, or jumps off its score pulley and thus stops the vibration of the comb, and when the continued rotation of the doffer will fill the card clothing with fibres, clog the doffer comb, and cause the card teeth all around to get bent on account of the strain put on them. For this reason a stop motion is applied to the calender rollers which instantly stops the revolution of the feed roll and doffer at the moment the sliver breaks between the calender rollers.

In connection with some carding engines a slow motion is applied to the doffer in order to regulate the speed of the latter and consequently the delivery of sliver. The main advantage of the device is found when piecing up an end and when by simply moving a shipper handle the usual barrow wheel is thrown out of gear with the doffer gear and an extra set of gears simultaneously brought into engagement with the doffer gear and barrow wheel respectively, causing the doffer to be reduced in speed to about five revolutions per minute. It is then easy to gather up the broken ends and pass the sliver on to the coiler with a minimum amount of waste. A return of the shipper handle to its normal position immediately brings the barrow wheel back into engagement with the doffer gear, in turn starting the doffer at full speed.

A change from the quick to the slow speed and vice versa may be made quickly in this manner at any desired time without interfering with the continuous operation of the carding engine.

The shape of the dish feed plate with reference to the lickerin is always more or less subjected to the class of cotton worked and for this reason the accompanying illustration Fig. 80 is given, showing the shape of the dish feed plate as used in connection with different cottons in order to get best results. In this illustration detail *A* shows the shape for dirty short stapled cotton like the Indian cottons as are

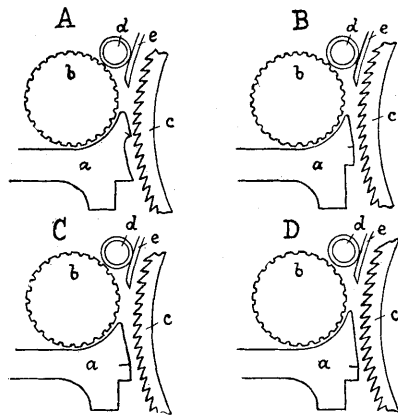


FIG. 80.

extensively used in that country and in Europe, *B* that for our American, *C* that for Egyptian or Florida Sea Island and *D* that for regular,

long stapled, Sea Island cotton. In the illustrations *a* indicates the dish feed plate, *b* the feed roller, *c* the lickerin and *d* the cleaning roller for the feed roller *b*, being an iron rod covered with flannel and placed between the cover *e* of the lickerin and the feed roller *b*; the dash on the dish feed plate indicating the point where the cotton becomes free of any combing action of the lickerin.

Cleaning action of the card.—The whole width of the sheet of cotton as unwound from the lap is presented to the lickerin at a continuous rate and the fibres are struck downwards from the feed roller and the nose of the dish feed plate by the serrated teeth of the lickerin, which acts as a breaker to the lap sheet, causing the fibres to become separated. This action of the lickerin provides means for the heavier impurities dropping through the knife grids or of being taken out later on by the flats. Fig. 81 is an illustration of metallic saw toothed wire before being put on the lickerin, its smooth portion being wound either spirally or in rings closely fitting together on a cast iron cylinder, so that each portion has a combing action on the fibres and separates them without injury. This lickerin clothing known as "Garnett" teeth is made in two shapes, one being finer pitched and a little more hooked than the other. The finer tooth is used when no undercasings are fitted to the lickerin, it carrying the fibres to the cylinder without dropping them. However as it is the general practice to use undercasings the coarser pitched toothed wire is generally used. As each saw tooth is equidistant one from another, any tendency of loading impurities in the teeth of the lickerin is prevented, and thus one of the best features of cleaning in the carding of cotton accomplished by keeping the lickerin cylinder constantly clean, which causes the fibres of the lap to be separated as uniformly as possible, since clean serrated teeth are always presented for work to the cotton as fed to it. A lap sheet may contain portions of seed kernels which are heavy and of an oily nature, also heavy notes or shell and other impurities passed on with the seed cotton during picking. The removal of the heavier impurities and separation of the fibres in the lap sheet has to be done by the lickerin, the released fibres being passed on to the cylinder for the removal of the finer impurities more persistently adhering to the cotton, for which reason the slowly revolving train of flats have to be so adjusted as to take them out. Impurities known as neps when viewed by the naked eye are simply seen amongst other fibres as white opaque specks, but are not only a bad sign in the material, but also a source of considerable damage to the yarn; a feature readily explained by the fact that when they are examined by means of the microscope it will be found that a nep is an entanglement of fibres centered in a small knot. If neps are not taken out by the card and thus pass on in the sliver to the drawing frame, etc., there is a chance of the fibres being drawn tighter in the entanglement, some being broken off in the draft rollers but leaving the whiter portion, which often sustains



FIG. 81.

itself until the yarn is spun. If in turn it passes into the fabric the same becomes troublesome to the manufacturer, especially if the fabric in question has to be dyed, when it probably will show up in a different color compared to the fabric. Neps should be taken out by the flats entirely and if they fail there is no other convenient method of getting rid of them. If the flats are set accurately and well ground there is every chance of neps being arrested, while shorter fibres that pass on and escape the flats ought to find a reception in the card grids.

It is of the greatest of importance that the lickerin is kept clear of short fibres and other impurities in order to produce better as well as the proper amount of work. The mote knives frequently do not accomplish this positively, for which reason such impurities as not removed are continually worked over, and as they become finer will impair the quality of the carding. In order to assist in the proper removal of such impurities, a cleaning device as shown in Fig. 82 is applied in some instances

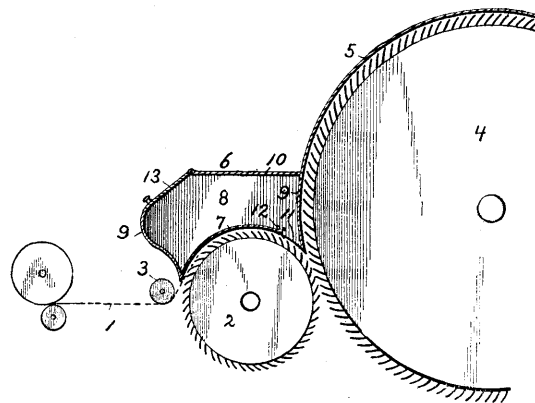


FIG. 82.

to the lickerin. Said illustration is a side elevation of the feed roll, lickerin, and the cylinder of a carding engine, the top plate of the cylinder and the cleaning device for the lickerin being shown in section. With reference to this illustration 1 designates the sheet of cotton as fed to the lickerin 2 by feed roll 3, and is then carried around to the cylinder 4, after passing the mote knives (not shown). Secured to the top plate 5 of the cylinder and shaped up integral therewith is a sheet metal collector box 6, which consists of a curved bottom plate 7, extending from the bottom edge of the plate 5 and on a greater area, but parallel with the teeth of the lickerin 2 and having side walls 8 and end 9 and top 10, whereby a substantially rectangular hollow receptacle is formed. Transversely of the bottom plate 7 and adjacent to its juncture with the top plate 5 an opening or slot 11 is provided, on the outer edge of which are arranged one or more adjustable cleaning knives 12, adapted to remove all foreign matter from the teeth of the lickerin during the course of its revolution. A door 13 is provided at the top of the collector box 6 to permit ready removal of impurities collected. The centrifugal action produced by the rapid revolution of the lickerin causes most of the foreign matter which has not been removed by the mote knives to be deposited into the collector through the slot 11, while

the vertical adjustable knife or knives *L* just clear the teeth of the lickerin as it revolves and thus effectually remove any short fibres or other impurities adhering to the lickerin.

Laps.—The condition of the lap greatly affects the cleansing and parallelizing of the fibres at the card, for which reason the sheet of cotton which is passed to the feed roller should be even in weight yard for yard if the sliver taken from the doffer is to be regular in weight. This factor cannot have too much attention paid to it, because irregularities in the feed will be reproduced in the sliver delivered by the card. The laps should neither be dirty nor too thick, as these characteristics tend to increase the percentage of waste made at the carding engine. Licking laps should be carefully guarded against, as they have a very deteriorating effect upon the working of the wires and the quality of the carded sliver produced. If the lap has a soft and thin end a bad selvage is reproduced in front, and the sliver coming from the doffer frequently curls at the end, especially where the speed of the doffer is high. Curling under the comb causes uneven sliver, waste and loss in production, due to the end or sliver breaking down, necessitating frequent piecing up. The same will also occur when the lap is not as wide as the working surface of the card clothing, for which reason laps should be made from two to three inches wider than the width of the wire on the card. The lap sheet is passed between the wedge-shaped guides in front of the feed roller, the terminal space being rather less, say two inches narrower, than the width of the wire on the cylinder, this being a plan adopted on account of the tendency of the fibres to spread out on the cylinder, the difference in width of feed thus preventing, to a large extent, uneven edges of the sliver and side waste. However, if the width of the cylinder wire is too great for the width of the laps, then the flats strip badly at the ends, owing to the thinness of the film at that point; the stripping brush not being able to take the fibres from the flats, resulting in their filling up at the ends. The weight per yard of the laps used in the card varies from 9 to 16 ounces, according to the width of the card and kind of cotton used.

The object of perfect feeding.—is to comb out the fibres, clean them and feed them, as far as possible, individually to the cylinder, the weight of the lap under operation determining the setting of the dish feed plate to the lickerin. The action of the lickerin upon the cotton presented by the dish feed plate is identical to placing it lightly in the path of a body of coarse moving combs. To get perfect feeding, it is important that the dish feed plate be so constructed as to enable the lickerin to take up the individual fibres and not lumps, which would result in imperfect carding. The shape of the nose of the dish feed plate is constructed so as to suit the quality of cotton being used. When short stapled cotton is used, it is obvious that the lickerin teeth must be nearer to the dish feed plate than when using a long stapled cotton. A rupturing of the fibres often results from having the dish feed plate too

near the surface of the lickerin. For a middling quality of cotton, and a lap 12 ozs. to the yard, a good setting for dish feed plate to lickerin is .007 or number 7 gauge. When setting the dish feed plate by any gauge, the same must be passed down between the plate and lickerin, care being taken to see that the gauge does not get between a mote knife and the lickerin, or the setting may be incorrect. The gauge should pass along so that a slight pressure is felt on it, but not sufficient to prevent it being drawn along easily, again the pressure should be equal across the whole width of the feed, a feature which however is not always obtainable, as some lickerins are not of equal diameter throughout, caused by the teeth rubbing on to the dish feed plate at some point, or by hard substances getting into the laps, causing the tops of the teeth of the lickerin to be taken off or knocked down sideways or otherwise badly injured. When such is the case, the teeth should be restored as good as possible to their original condition without any filing, except it is absolutely necessary to do so and when it should be done with a very smooth file, and afterwards the teeth blacklead in order to make them smooth, so that they will freely deliver the cotton to the cylinder. If the teeth were left rough, the fibres would be cut and made into neps, the cotton caking round the lickerin, making a large amount of neps and waste, besides being the cause of an uneven sliver. If the lickerin is set too far off from the cylinder at one side, cotton will cake round it and be made into neps. The diameter of the feed roller varies from 2 to 3 in., depending upon the thickness of the lap passing through, and is provided with grooves in order to hold the cotton with sufficient grip as it is being pulled by the teeth of the lickerin. If the feed is too heavy, the material will not be properly cleaned, and there will be great wear and tear, again if the feed is too light, there will be a tendency for the web to break. It is important that a sufficient pressure (about 120 lbs. at each end) be kept on the lap, otherwise the cotton will be taken up in lumps.

Setting of the mote knives, undercasing and lickerin.—The mote knives as used in connection with the lickerin are for the purpose of scraping off leaf and dirt from the fibres, as well as for regulating the quantity of fly made. The nearer they are set to the lickerin without touching the teeth, the greater will be their scraping action and the smaller the amount of fly. The knives can be adjusted along with the dish feed plate. The depth of a mote knife is about $2\frac{1}{2}$ in., whereas the thickness is about $\frac{1}{2}$ in. It is not uniform throughout, but tapers to a knife edge from about half the depth. The angle at which the knives are disposed is important, since upon it depends the taking out of the maximum amount of impurities accompanied by as few good fibres as possible.

The undercasing is generally set as close as possible, without touching the lickerin teeth, to avoid the emission of much fly. Where no undercasing is used, a large quantity of fly is made, some of which contains a large percentage of good cotton, but the yarn is cleaner and bet-

ter in this case. By examining the fly made under the lickerin the character of the setting of the feed plate to lickerin is indicated and when quantities of good fibres are found in the fly, better results with less waste would be obtained by a closer setting. If the setting is correct, the lap, when turned back from under the feed roller, will show the fibres composing the extreme end of it to be combed out and comparatively speaking, clean.

The setting of the lickerin to the cylinder may be made with the five or seven gauge (.005 to .007 inch), preferably the latter size, which should be drawn along without much pressure being required to move it. In setting, the bolts in the lickerin pedestals should be first loosened, and the latter then set with the screws and nuts provided for the purpose and fixed on the frame of the machine. By loosening the pedestal bolts stretching or springing of the setting screw is avoided and a truer setting obtained. The nuts should all be tightly screwed up to prevent a tight lickerin or doffer driving strap from pulling the lickerin teeth into those of the cylinder which would have a very bad effect upon the latter.

Setting of the flats.—The cylinder takes the cotton from the lickerin on account of its higher speed and carries it under the action of the flats, whose work is to comb, parallelize, and remove short fibres. This is accomplished by the points of the clothing of the flats being inclined in the opposite direction to those of the cylinder. The wire clothing of the flats is ground so as to produce very fine striations, or small channels, which catch and retain the fibres which are to be drawn through the wires of the flats. On examination of a flat, it will be found that the back edge is ground a little deeper (shorter) than the front edge. This is called the “heel” to the flat. The amount of heel for a flat about $1\frac{1}{2}$ in., is about 0.03. The object in having the heel is to ensure the fibres coming gradually in contact with the flats and not collecting at the back of the flats. This heel shape is first formed on the flat by grinding when said flat is new and its shape is maintained during the life of the clothing by providing the two ends of the flat with special beveled guideways corresponding in their amount of bevel exactly to the heel of the flat. During grinding (only) this beveled path guides the flat over a suitable bed and thus in its required position in order to maintain the bevel or heel to the clothing and which is brought in action at carding proper by the flat then being supported on its level portion of the ends. The flats during carding are in most instances supported by what is termed the bend, or flexible bend, which can be compressed to an arc of a circle having a slightly less radius than the normal, this construction being required on account of the teeth becoming shorter after grinding. The successful working of the card depends on the correct setting of the distance between the wires of the flats and cylinder and which is maintained by means of the flexible bend. If the flats are set too far away from the cylinder it will result in neps being formed in the sliver, while if set too close, the sliver will show raw, un-

carded, places as it is taken from the doffer and at the same time the wires of the clothing will become faced from constant rubbing. Several ways of setting flats are in use, all intended to produce the same result. One method is that provided by flexible bends, which have slots cut in them midway between the wire points on the cylinder and those on the flats. A setting gauge is simply passed through the slots in the flexible bend, and between the wire surfaces of the cylinder and flats, and the setting screws raised or lowered until the desired distance apart is obtained at each setting point. Some flats, owing to various causes may have their wire points higher in the middle than at their ends, and as the setting gauge does not go so far between the wire surfaces as to ascertain the closeness of this middle part, the wire surfaces may be in contact at this point although the gauge passes in easily at the ends. If the flexible bend is then raised so that one side is slightly higher than the other, the setting is liable to suffer from want of parallelism, a thing as important as the closeness of setting. The wire on the flats may also be higher in the middle than at the ends, caused by defective grinding or in consequence of some flats deflecting more than others owing to their weight or to the pressure put upon them during the operation of grinding. When flexible bends are fitted with end raising or lowering screws and nuts, take the pulley driving the flats off its stud and place a key with a handle on the end of the worm shaft which drives the flats. Next select a flat whose wire points are the highest in the set, and take out of the chain one or two flats on either side of it; turn the chain forward with the handle key until the flat which is intended to be set comes over the first setting point, and then lower the two side supports on either side of the card and pass the gauge between the flat and cylinder and adjust the screws until you are able to draw the gauge all across the width of the wire with the same amount of pressure. Wind the flats forward until the setting flat comes above the next setting point, and proceed to set the front points in the same manner. Then work back to the lickerin, because the points first set may have been pulled in a little by the compression of the flexible bend. Raise the side supports on either side of the card so as just to touch the flexibles, and screw all up tight. Turn your flats out, and replace the two flats taken out for setting purposes, rotate the cylinder, and listen if any part is in contact and if such is the case raise the point gradually to clear. In adopting a size of setting gauge the length of the flat must be taken into account, and the quality of the cotton or growth be considered. For Sea Island cotton, with the wire surface in perfect condition, a number 5 gauge may be used for flats up to 40 in. wide on the wire. For average cotton, in connection with the same size flats, about number 11 gauge is used. The longer a flat the weaker it will be and the greater its deflection, hence the coarser the setting employed. Another method of setting flats which are supported on flexibles with slots cut in them, is thus:—When both the flat and cylinder wire surfaces are known to be one height, or if a high flat can be found, then set to it.

Take the filling up pieces out of the slots and loosen the two flexible supports on each side, put the gauge in the slot provided in the middle of the flexible bend, and by means of the screws and nuts provided on the frame sides, raise or lower the flat until the gauge will pass between the wire surfaces with only light pressure. Then set the point on the opposite side in the same manner, and work the flats back to the setting points nearest to the lickierin. Set these, and then proceed to the front. After this point has been set, the side supports must be brought to bear against the flexible bends and when the proper distance of flats from cylinder can be ascertained by moving the gauge in the slot nearest to it. Some carders prefer to set the back points so that the flats will be a little further from the cylinder than they are at the front, on account of the body of cotton treated at that point being somewhat greater and dirtier than at the front. There is, however, no need for this if the flat is the ordinary width and the proper amount of heel on it. The flats should be set to comb and straighten out the fibres as early as possible. Some cards are made with setting screws and nuts in place of the side supports, making five setting points on both sides of the card, and when a card is so provided very accurate setting should be obtained.

A flexible bend is now in the market, which is attached to the centre support in such a manner that it swivels upon it and enables the bend to be set absolutely concentric with the cylinder. Fig. 83 is a diagram of it. The segment plate *B* is turned to a true circle on the lower edge, while the upper edge is in the form of a spiral curve. Said segment plate rests upon a projecting flange, turned concentric with the cylinder bearing, of the fixed bend *A* in such a manner that it can be moved in either direction. Resting upon the upper or spiral edge of this plate are nine blocks *C*, the same being of such varying lengths that their upper ends form again a concentric circle, the curve formed by the upper and lower points thus being practically a corresponding segment to the plate *B*, but inverted, viz., with the spiral curve to the bottom and the concentric circle to the top. Upon the upper ends of these blocks rests an accurately turned flexible bend *D*, which consists of a section of a ring, of equal depth throughout, over which the flats travel. The weight of the flats compel this bend to rest closely on its supports, and thus the flats travel absolutely concentric with the cylinder. The blocks *C* are held in position by an outer covering plate with cut-out grooves on the inside, corresponding with the blocks *C*, so that they can slide radially but not sideways. On the outer face of the spiral plate *B* a worm rack *F* is cut into which gears a worm *E*, fixed on a short spindle revolving in brackets on the fixed bend. By turning the spindle, the spiral plate *B* is moved so that the blocks are either raised or lowered as desired, and thereby the bend *D* assumes a circle of larger or smaller radius, but remains always absolutely concentric with the cylinder; thus the distance of the flats from the cylinder can be adjusted exactly at will, and, as a considerable movement of the spiral plate makes a very minute alteration in the radius, a fine adjustment can be obtained. In

order to show to the carder exactly what he is doing, also to enable him to make the adjustment perfectly equal on both sides of the card, an indicator is fixed on each side, which, by its revolving dial plate and a pointer fixed to the casing, shows the adjustment to $\frac{1}{2000}$ part of an inch. The indicator is worked by a fine pitched pinion in a rack *G* fixed on the spiral plate *B*. The head of the spindle for turning the worm

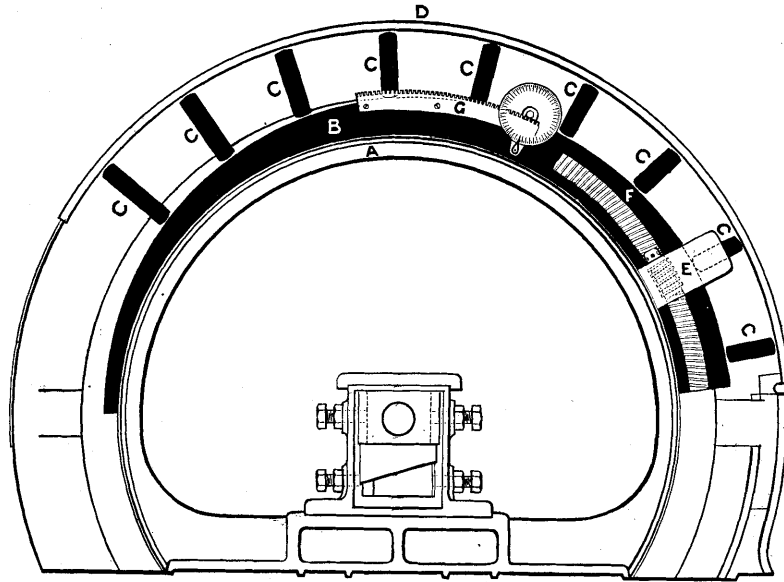


FIG. 83.

rack *F* is under lock and key, so that all interference by anybody but the carder is obviated. Adjustable cylinder pedestals are also provided, being constructed with two wedges below the cylinder bearings, which can be moved by adjusting screws, thereby enabling the cylinder to be moved vertically, whilst other side screws can move it horizontally, thus enabling it to be set absolutely concentric with the bend.

Setting of doffer, comb and cylinder undercasings.—Set the doffer to the cylinder by a number 5 gauge, and the doffer comb at its closest contact with a number 7 or 8 gauge, although to a great extent the speed of the doffer and the counts of the sliver as taken from the doffer determine the setting of the comb, which however must be set at the same time sufficiently low, in addition to being close, to strip clear, a position best found by trial. The cylinder undercasings are generally made in two parts and set by passing three long gauges between the cylinder wire and the top side of the casing, one gauge being in the centre of

cylinder and one at each side. The brackets holding the casing are secured to the card frame by a stud, a screw being provided for adjusting the height of the undercasing.

The waste made on a card,—may be roughly divided into two kinds, viz., strippings and fly. Strippings is the waste taken from the flats, cylinder and doffer, whereas fly is the waste thrown or falling off the lickerin, cylinder, doffer, etc., during work. The number of times that fly is gathered varies with different management and different classes of cotton or machinery. Lickerin fly as a rule is gathered more frequently than the other, some people gather it once a day, some twice a day, others oftener, whereas in some cases this fly is gathered at every stripping time. The fly underneath the doffer and cylinder in some cases is gathered twice a week, and in other cases only once a week. If the fly is not gathered with sufficient frequency it is possible for it to be caught up again by the working parts of the card and passed forward with good cotton, giving in turn rise to a cloudy web. The amount of waste made at the card varies from 5 to 10 per cent. according to class of cotton used as well as condition of laps.

The coiler.—In order to give an explanation of the method of coiling the sliver in its can, the illustration Fig. 84 is given, being a vertical section of the coiler mechanism, showing also three different details connected with it. The sliver after leaving the calender rollers *S* (as was shown in Fig. 79) of the carding engine enters the coiler head *T* through the trumpet *a* and is drawn down by two delivery rollers *b* as placed side by side, being kept pressed together by a spring *c*, as is shown in detail illustration *A*, showing the plan of the coiler head *T* with its top raised. By turning a lever *d*, as secured to one end of this spring *c*, the tension on said spring is released, permitting the sliver to be easily unwound from the delivery rollers *b* in case a wind up occurs on the same. Detail illustration *B* is a section taken through the two delivery rollers *b*, showing the sliver as coming from the card entering the trumpet *a* and passing between the delivery rollers *b* on to and through a slanting passage way in the coiler gear *e* (see again main illustration of the coiler) into the sliver can *U*. The delivery rollers *b* as well as the coiler gear *e* are driven from the upright shaft *f* by the gears *g h* and *i* respectively, said shaft *f* receiving motion from the bottom calender roller *S*, through the series of gears *j k l* and *m*. If the laying of the sliver in the can depended only upon the rotation of the coiler gear *e*, the result would be that the sliver would be laid in a series of ascending coils which would become entangled with each other when being drawn out at the next process and cause breakage. In order to overcome this, the can *U* is rotated slowly in the opposite direction to the coiler gear, accomplished by placing the can on a plate *n*, having a gear at its bottom by which it is rotated through the gear *o* on the shaft *f* driving the gears *p q r s* and *t*. Thus as the can *U* slowly rotates in the opposite direction to the rotation of the coiler gear *e*, the sliver is coiled in

various positions, the centre of each successive coil being a little removed from that of the one preceding it, a procedure readily explained by detail illustration *C* which shows that each successive coil touches the inside of the can at only one point, thus making the coils quite free from one another and permitting them to be withdrawn later on without becoming entangled. At the same time a much greater length of sliver can be deposited in the can than if the coiling depended only on the

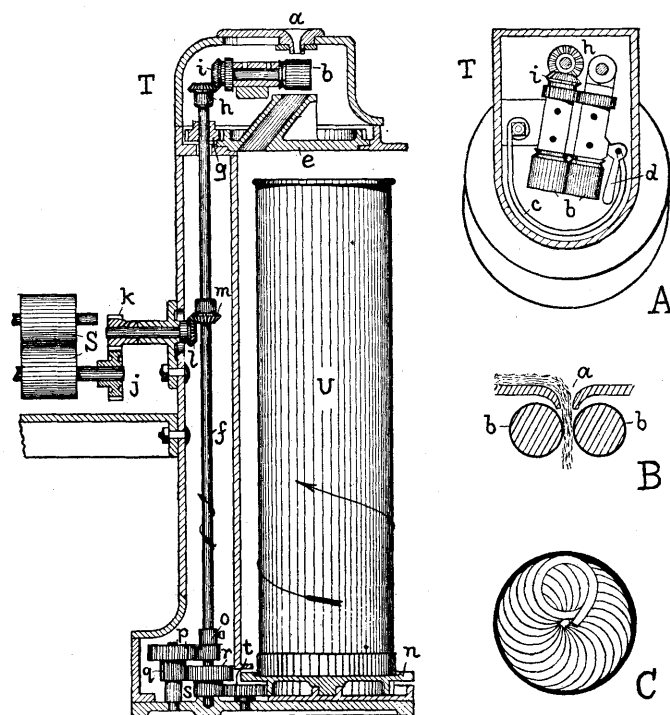


FIG. 84.

rotation of the coiler gear. When it becomes necessary to oil the bearings for the coiler delivery rollers *b* in the coiler, the trumpet *a* as made in the form of a large flat plate which covers almost the whole of the top of the coiler head, is simply pushed to one side, permitting ready oiling without breaking the sliver.

RAILWAY HEAD.—The adoption of the revolving flat card as the carding engine has indirectly been the cause of introducing the English system of cotton spinning in this country i. e. using a set of three drawing frames instead of two drawing frames and a railway head, this affair giving to the railway head its death knell; new mills not installing the same any longer and old mills which have it gradually discarding it.

The object of the railway head is to equalize the slivers as are fed to it either from a series (a line) of cards direct, or from sliver cans placed near it. With reference to feeding from the cards, the sliver formed at each card is fed, not to a can, but to the so called railway belt, running along at the delivery end of each card, and terminating at the railway head. As all the cards in the line feed to the same belt, there are always a number of slivers feeding to the railway head from the belt and in which instance the evening motion of the railway head is an advantage, because if one card of the line should cease running, the evening trumpet of the railway head would immediately adapt the draft to the decreased number of slivers, and the work could go on without interruption. The use of the railway belt meant a decrease in cost of handling, for this automatic feeding of the breaker (first process) drawing (that is, the railway head) made handling unnecessary from the time the lap was fed to the card to the time the cans were removed from the railway head. In some instances the railway belt is not used, and the drawing is fed from cans, the advantage of the evening motion of the railway head in cases of idle cards being thus obviated, its sole claim of value in this instance resting in its action upon balancing light weight or overweight slivers, and upon lumps or light spots in slivers. This is where the head should have been particularly useful, but as a matter of fact quite a little of the lump or light part will have passed before the evening motion of the head will have an effect upon the sliver, for the work is done at the rolls; the first end of any underweight or overweight having passed through the rolls and hence is beyond the reach of any evening device before it reaches the trumpet of the head and sets it properly; consequently a part of the sliver is always beyond redemption by any evening device before its action of evening work begins. In the same manner the evening will be reducing or increasing the draft upon a sliver for a little distance after the sliver is of normal size; hence, upon lumps and underweight parts of a sliver the railway head is only partly effective. Upon slivers thick or thin for some length the railway head will be of advantage in so adapting the drafts as to make the delivered slivers of proper weight. But even under these circumstances evenness is best obtained by having the weight of the laps fed to the card uniform and using three drawing frames in place of two and a railway head. Single as well as double railway heads are built, the latter being nothing more than two machines combined in one. The weakness of the railway head is further shown by comparing it to the extra drawing frame as used in the English system of carding in place of the railway head. The drawing frame has six heads, hence to do the work of a drawing frame six single railway heads or three double heads would be necessary. The question of the cost of these as compared with the cost of one drawing frame, and again the question of the space occupied by one drawing frame as compared with that occupied by three or six railway heads, are of vital importance and the cause of the discarding of the railway head.

Where the railway head is used, in order to get the best results from it, the following items will be of value:—The weights must hang straight, the levers stand parallel with the beam, and the conducting pins at the back be as close as possible to the rollers. The slivers ought not to be contracted any more than just enough to prevent feather edges on the front roller. The up-take must be computed to such a nicety as to prevent the slightest drag between the card front and the railway back. There should be no back play in the shipper screw to prevent the evener from acting quickly. The cone belt ought to be level and of the best material. The rollers, on account of the heaviness of the weights require strict attention, and must be varnished frequently. If even the slightest curl up of the sliver occurs, the rollers must be set a little wider, whereas if thick and thin places appear they must be moved a little closer. These and the driving belt of the back portion of the head, the pitch of the gears, and the manner in which the slivers from the doffers enter on the belt, all have an important part in making the railway head keep up to the standard of work. A convenient rule for ascertaining the production of a railway head is as follows:—Multiply the revolutions of the front roller by the weight of one yard of sliver in grains, and this product by .00926. The result is the pounds per day of 10 hours, allowing 10 per cent. for stoppage, etc. Example:—Revolution of front roller 300, weight of sliver 100 grains, then $300 \times 100 \times .00926 = 277$ lbs. Ans.

DOUBLE CARDING.—The carding of cotton by a first and second process obviates, in connection with certain classes of yarns, the use of the comber, it being a procedure by which a considerable amount of doubling is obtained, the second carding removing not only impurities still remaining in the cotton, but also some of the many shorter fibres with which, for example, brown Egyptian is often intermixed. Double carding is necessary where the counts of yarn spun do not warrant the expenses of putting in combers. Double carded yarn is frequently doubled in the “wet twiner” process and made into ball warps, such yarns being remarkable for their strength and serve as a backbone for some special fabrics, such as the warps of velvets and some fancy Jacquard fabrics. However it must be remembered that with ordinary counts of yarns, double carding does not bring about good results, since the yarn is found to be weaker on account of the extra carding reducing the spirality of the fibres.

CARDING BLEACHED AND COLORED COTTON.—Changes in temperature, the time that elapses between drying and carding as well as the manner in which it has been handled at bleaching or dyeing, drying, etc., frequently are the cause for bad carding, compared to similar quality of cotton carded in its natural state and which is more easily carded and spun on account of the oil the cotton possesses in its natural condition. Since bleached and colored cottons absorb moisture more readily than in its natural state, a continuous moderate temperature is

required for carding, as well as spinning them. Location and construction of the mill will be factors to be considered, since it is very troublesome business to card cotton out of which the natural oil has been extracted by bleaching or dyeing, especially if the card room is exposed to northern winds or situated above a sub-cellar (dust room) or has floors through which air currents have free passage, creating a strong upward current which draws the fibre when in a fleecy state, in all directions, divides the slivers on the coiler head, causing them to spread out and separate, remaining no longer compact, sticking to the edges and sides of the can, for which reason the air in the room must be well impregnated with moisture. For this reason when the weather outside is cold, as a remedy for sticky work in connection with bleached or colored cotton, the heat in the room is frequently raised to 90° and above, and this knowing that the same quality of cotton in its natural state works best at between 70 and 75°. Extreme heat however will not help, it will only aggravate the trouble since the greater the heat in the room, the stronger the upward current of air, for which reason the proper way is to maintain the temperature in the room, both night and day at a minimum, say about 65 to 68°, so that the variations of temperature in the room between floor and ceiling are as near alike as possible. To counteract the upward current of air in the room in some instances carders have had recourse to a system of heating the cans in order to create a downward draft in the can which will take the cotton with it. If the air is found to be too dry, "moisteners" applied as near the ceiling as possible will be found of advantage, since in this manner a downward current of moistened air is created which checks or retards the upward current and thus counteracts a most important cause for bad work. Besides temperature, etc., of room, the method employed in bleaching or dyeing, drying and storing of the cotton before carding will influence the work. Although good light is essential for carding, yet intense light is injurious to colored work. Solid colors will stand light better, whereas mixtures will cause trouble since the lighter color has a tendency to fly from the darker, intense rays of light as well as heat increasing the attractive power which draws them apart. Colored window curtains, or frosted glass will subdue the force of intense light, assisting in better carding besides preserving the color (gloss) of the cotton. All conditions which make poor work in connection with carding cotton in its natural state will act with so much more force in a mill running on colored work. In dyeing cotton to be carded, care must be exercised to have the fibres free and devoid of stickiness, so that they will not get broken besides losing portions of coloring matter during carding. Bleached or dyed cotton after drying should be stored loosely and at a temperature of 65° for about 10 days before using, in order to absorb the proper amount of moisture and thus be brought as near as possible to its natural state. If colored cotton is carded when too dry, much of the coloring matter will be thrown off, giving in turn a dull and faded appearance to the yarn, besides giving rise to the generation

of electricity hence poor carding. The doffer comb will fail to strip the doffer properly, and the parallelization of the fibres is affected by the electricity which causes some of them to stand out straight from the sliver instead of lying parallel. When railway heads are used the sliver may adhere to the sides of the railway and the edges are made ragged besides causing a further disturbance of the parallelization of the fibres. This disarrangement of fibres increases the difficulties of successful manipulation in the succeeding processes, as the dry, electrically charged cotton has a great tendency to lick on the rollers, a tendency that is facilitated by the positions of the fibres. On the other hand, if the cotton to be carded is in a too wet condition it will not only lose color but will also destroy the wire of the card clothing besides producing poor work. A desire to save may move the dyer to re-use the dye bath a number of times, a feature which properly called is wasting, because in the cotton there is a small percentage of natural oil which operates against the action of the dye and remains in the bath, which by re-use becomes overcharged and causes the cotton to feel greasy and the dye to easily rub off. Such cotton will not card well, will not separate at the feed rolls, will clog on the card clothing, and the short fibres will roll up into neps making in turn a cloudy sliver besides a large percentage of waste. During extracting, the cotton should be kept as open as possible, using for this purpose a hydro-extractor and not squeeze rollers, the latter leaving the cotton more or less in hard compressed pieces and thus unfit for carding. Drying will not open these matted pieces to any appreciable extent, nor will the beater in the picker or scutcher entirely do so, and consequently when presented to the card in this state, the card wire although it may be of the best, sharpened and set in the most approved fashion, will not produce good even work. When cotton of this description is carded the increase in waste is considerable. Rollers also press out portions of coloring matter and thus may be the cause of a variety of shades in the same lot of material. With reference to drying, itself, the cold air method is the safest for this kind of material since there is no chance of damage (over-drying) to the fibres. Bleached or colored cotton when thus properly handled both before and at carding will be found to work nearly as well and with little more trouble than cotton carded in its natural state.

CARD CLOTHING.—The working surfaces of the cylinder, flats and doffer of the carding engine, for the purpose of carding the cotton, are covered with card clothing, being wire staples known as card teeth, imbedded in some sort of material, technically termed their “foundation.” Said foundation may be either constructed of a special woven cotton cloth of great evenness and strength, or a combination of a layer of woollen cloth interposed between two layers of cotton, or in some cases a thin layer of India rubber (Para) used in connection with cotton and wool layers; the whole of these layers, in either case, being specially prepared, i. e. cemented together, forming in this manner a very firm but at the same time flexible foundation, in which the wire staples or card

teeth are inserted and securely held, while at the same time having liberty of movement to a certain degree. It is obvious that if a tooth of the nature of a carding point is so held that it has no power of yielding, the danger of damage to it and the fibre of the cotton is very materially increased, while it is equally obvious, on the other hand, that if it is not firmly gripped it will speedily become loose and will not present to the cotton as it passes sufficient resistance to be of any use. Of the three card clothing foundations quoted, that of cotton-wool-cotton is the most satisfactory combination, for although not quite as flexible as that containing rubber, it is not so liable to be affected by heat and oil. With reference to the all cotton structure the effect will be to so hold the tooth that when it is deflected there will be very little yielding of the foundation itself. This under certain circumstances is very desirable and for which reason the same is invariably used for the clothing of flats where a firm foundation is required to keep the teeth in their exact position and enable a close setting. For cylinders, cotton-wool-cotton as well as cotton-rubber foundations are used, whereas for doffers only cotton-wool-cotton foundations can be used since the doffer is not protected from the heat of the sun. It will thus be seen that there is a wide divergence in the effect of the foundation upon the tooth itself and this must not be forgotten. It will, however, be noticed that in all of the three varieties of foundations there is a material employed which is comparatively unyielding, and which plays an important part in the work of the clothing. Card clothing for covering cylinder or doffer is usually made in long strips known as "fillets", about three inches wide, and of sufficient length to cover the whole surface of the cylinder or doffer. The card teeth are mostly made from specially drawn and tempered steel wire, and are bent into a sort of staple, the two points of which are again bent to the requisite angle, the entire process of inserting the card teeth in the foundation, from the wire to the card clothing, being done by one machine. With reference to the amount of bend of the points of the card teeth after their leaving the foundation there is no uniformity as to the degree of angle prevailing amongst manufacturers of card clothing since even in card clothing made by the same manufacturer differences of several degrees of angle exist; the object of the bend being to enable the wires to more readily take hold of and card the fibres. If said bend should be too acute, the wire will hook itself into the fibres which will be difficult to detach, while if the bend should be too obtuse the wire can not properly take hold of and card the fibres, the proper amount of bend thus being a matter of practical opinion.

Three different modes of setting the teeth are in use. The first is called the plain setting, that is, when their points are looked at they are in straight lines both longitudinally and transversely. This is a setting which is not largely used for the revolving flat, since if any fibrous material is drawn through teeth arranged in this fashion it will tend to assume a stringy appearance, and much good fibre will be taken

out along with the bad. The second method of setting is the twill. This, as its name implies, follows the mode of forming twilled cloth and the points run in diagonal lines transversely of the clothing. The third setting adopted is the ribbed, the teeth being set in groups of three, each group overlapping its predecessor. The twilled fillet always shows a spiral groove when wrapped around a cylinder or doffer, while the ribbed fillet joins up close, and looks neater, but both patterns remain in use. Some carders on coarse work prefer the twilled setting, on account of the stronger edges of the fillets giving a better foundation for the wire there. Fig. 85 is given to show the previously referred to three modes of setting the teeth in card clothing and of which *A* shows the plain or open setting, *B* twill setting and *C* rib setting. The diagrams show the back of the clothing, the dots representing where the

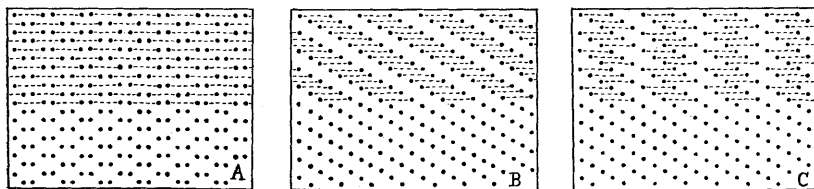


FIG. 85.

teeth penetrate the foundation, the back of the teeth i. e. the crown or the cross bar which couples two teeth together being shown by dotted lines. Cylinder and doffer are usually covered with rib set fillets, the flats however in some instances are covered with twilled set clothing, especially when the teeth are made of mild steel wire. The strips for the flats are usually made in broad sheets of the requisite width in which the teeth are set, in the manufacture of the clothing, in straight lines right across.

The term "cut" as used in connection with card clothing means the length of wire which forms the two teeth, generally about one inch, and may go to $\frac{1}{8}$, $\frac{1}{4}$, or less. The "crown" is the head of the staple between the points; it may be $\frac{3}{16}$, or $\frac{1}{4}$ inch, more or less, the object being to make all the points of a uniform distance on the face of the card according to the counts.

Card clothing is graded by "counts", this phrase indicating the number of tooth points in a given space, the unit for which in our country is the square foot; whereas in England the method of computation is based upon the number of teeth which are found in a width of four inches, which was the size of sheet formerly made. They assume in their calculations that there are always ten crowns to the inch, longitudinally, consequently if in the width named there were 120 crowns, the English count would be 120's, and the number of crowns per square inch would be $\frac{1.20 \times 1.0}{4} = 300$ crowns; $\times 2$ (points in each crown) = 600

$\times 144$ (square inches in one square foot) = 86400 tooth points per square foot, which equals our count, using number 35 wire. However the number of rows sometimes varies, especially in ribs and twills of finer counts, for which reason care with reference to calculation must be exercised. The counts of wire used for the cylinders and doffers vary with the quality of cotton employed, the clothing generally adopted by our manufacturers being:—for coarse yarns (below 30's yarn) for cylinder number 32's wire with 64800 to number 33's wire with 72000 points per square foot, for doffers number 33's wire with 72000 to number 34's wire with 79200 points per square foot. For medium qualities of yarn (from 30's to 50's yarn) for cylinder number 33's to 34's wire with 72000 to 79200 points respectively and for doffer number 34's to 35's wire with 79200 to 86400 points, respectively, per square foot. The general rule is that the better the quality and the longer the staple of the cotton the finer should be the count of the card clothing.

The rule for determining the count of a clothing is:—Ascertain crowns per square inch and multiply them by 144 (being the number of square inches in one square foot) and the product multiply by 2 (on account of two points to each crown) the result being the number of points per square foot i. e. our count. The counts of card clothing most frequently met with are

80's Eng. count	=	57600	points per sq. foot,	our count	=	No. 31's wire.
90's " "	=	64800	" " " "	" " "	=	" 32's "
100's " "	=	72000	" " " "	" " "	=	" 33's "
110's " "	=	79200	" " " "	" " "	=	" 34's "
120's " "	=	86400	" " " "	" " "	=	" 35's "

The width of filleting for covering cylinder is 2 inches, whereas that for the doffer is $1\frac{1}{2}$ inch.

The rule for ascertaining length of filleting required to cover cylinder or doffer is :—Multiply diameter by 3.1416 and product by the width of clothing on cylinder; divide result by width of filleting, add to this the circumference of cylinder or doffer for tail end and waste and divide in turn by 12 (inches in one foot).

Example:—50 inches diameter of cylinder, 40 inches width of clothing on cylinder, 2 inch filleting to be used.

$50 \times 3.1416 = 157.08 \times 40 = 6283.2 \div 2 = 3141.6 + 157.08 = 3298.68 \div 12 = 274.89$ or practically 275 feet of filleting, the length required.

Fillets before being put on the cylinder or doffer should be kept for some time subjected to an equal temperature to that of the card room, since otherwise the clothing will blister on the cylinder or doffer as the case may be. Previous to mounting the filleting on the cylinder or doffer, as the case may be, its end portion must be shaped so as to permit a diagonal winding thereafter, a similar special shaping or trimming of the filleting being resorted to with reference to (about) the last two rounds to be wound on. This method of shaping the ends or tails

of the filleting is readily explained by means of Fig. 86 showing diagrammatically the proper methods of putting the filleting on cylinder and doffer, giving also the exact shape and angles, or the necessary taper to cut the ends of the filleting. This if properly carried out, will secure

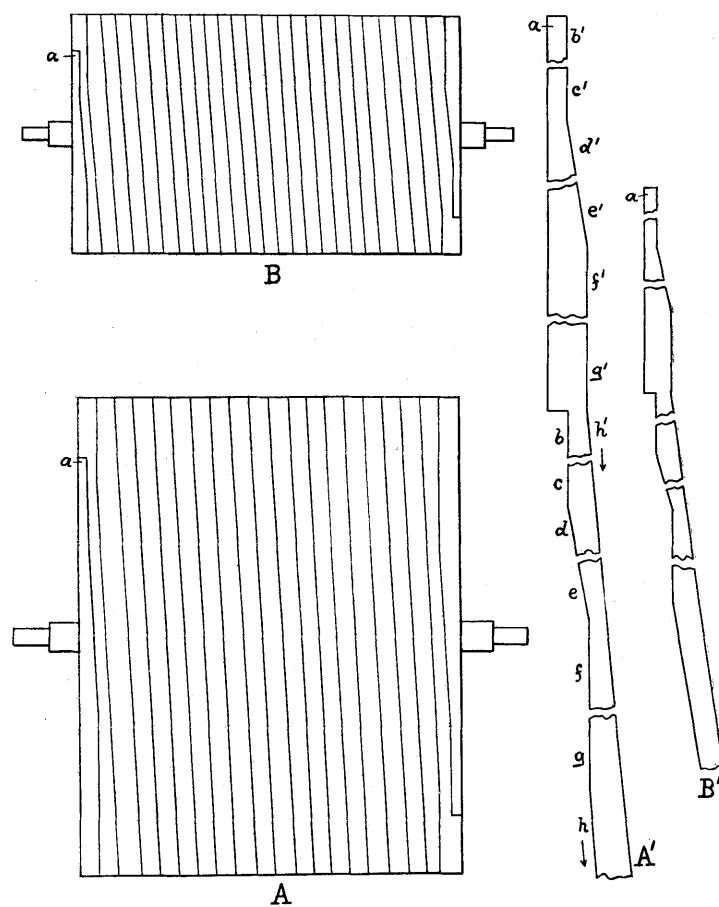


FIG. 86.

perfectly parallel edges of wire and no break in the continuity of the carding surface and will also be lapped on tightly without any puckering or blistering. With reference to the illustration, diagram A shows the method of covering a cylinder and diagram A' shows (enlarged compared to the preceding diagram) the proper method of shaping or trimming the starting end of the filleting in order to produce this result, the

filleting being shown in sections (portions broken out) on account of space. Letter of reference *a* in both diagrams indicates the corresponding end of the filleting, and examining diagram *A'* more in particular it will be readily seen that places marked *b b'*, *c c'*, *d d'*, *e e'*, *f f'*, *g g'* and *h h'* respectively correspond in shape in order to conform, side by side, in position when on the cylinder. In a similar manner the filleting has to be trimmed or shaped when arriving in winding towards the other side of the cylinder. Diagram *B* shows the proper way of covering the doffer and diagram *B'* how to shape or trim the end of the filleting to get this result. Since these two diagrams in their principle are identical with diagrams *A* and *A'* no further explanation is required. In covering the cylinder or doffer, the thus shaped end of the filleting is fastened to either one, as the case may be, by means of a tack driven into one of the wooden pegs which fill the holes drilled in its periphery for this purpose, and the filleting is then wound on, the cylinder or doffer being slowly rotated for this purpose and the filleting stretched or held taut either manually or by machine, the latter plan being superior since in that way a very regular drag is exerted on to the filleting. As soon as nearly the whole of the surface of the cylinder or doffer is thus covered, the other end of the filleting is then properly shaped, as previously explained, tacked and the cylinder or doffer, as the case may be, then allowed to stand for a few hours to permit the elasticity of the foundation to adjust itself over the entire surface. The card clothing is then tacked down to the various wooden pegs previously referred to. Before beginning to put on the clothing, be sure to mark the sides of the cylinder or doffer with a piece of chalk just opposite each row of pegs, across the cylinder, as this will enable you to tell where to drive the tacks after the clothing is on.

The strips of card clothing for covering the flats are attached in different ways, the object being in any case to hold the wire to the various parts in such a way that they cannot rise or blister, so that an unvarying carding surface is presented. One plan is to drill a number of small holes near the edges of the flats, and through these, and similar holes made in the strip of card clothing, lead rivets are passed. One side of the strip is first fastened by these rivets, the strip then stretched and the other side riveted. A better arrangement is to secure the strips by clasps which pierce the edges of the strips and are then clenched on the under side, in this way protecting the strip from the action of the revolving brush which otherwise frays the foundation of the clothing. Another method is to use clips, the same being passed round the sides of the clothing as well as the flat, and are closed at the top and bottom by a special machine. Fig. 87 shows this method of applying the clips. Detail illustration *A* shows the clip *a* ready to be inserted in the strip *b*. The point *c* of the clip which is passed through the strip *b*, as shown by detail illustration *B*, is then bent over as shown by detail illustration *C* and when the strip with clips thus attached to both edges is applied to the flat, the two projecting ends *d* and *e* of the clip being then bent

over the edges of the strip and flat respectively as shown by detail illustration *D*, thus firmly securing the clothing to the flat. Another

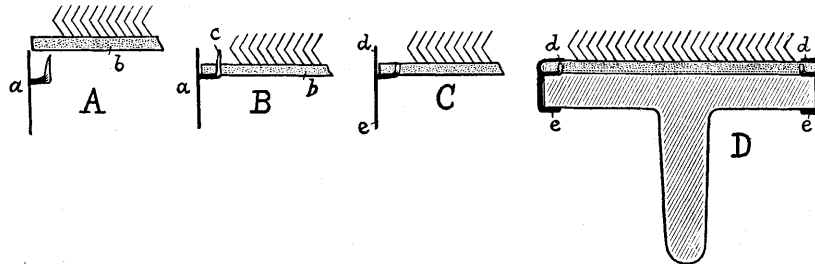


FIG. 87.

method of attaching card clothing by means of clips to the flats is shown by means of Fig. 88. In this instance the card clothing is stretched on

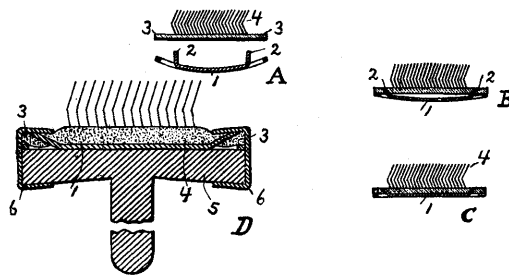
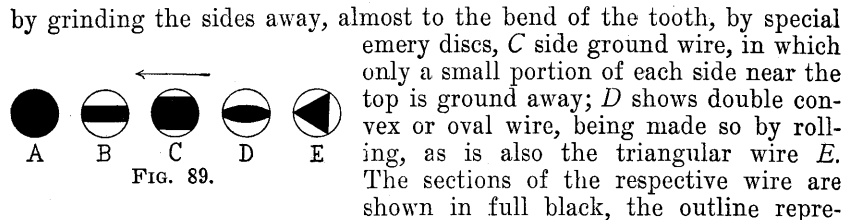


FIG. 88.

a special plate before applying the same, in connection with this plate, to the flat, the fastening of the clothing and its plate afterward requiring only the application of fastening clips. Detail *A* is a cross section, showing the card clothing about to be applied to its plate, *B* a like view showing the clothing applied to the plate and *C* a similar view showing the clothing in its stretched condition. Detail *D* is a sectional view (enlarged compared to the former figures) of the flat stretching plate, stretched card clothing and clips, shown attached to a flat. *1* indicates a stretching plate which is curved (see *A*) and provided with prongs *2* adapted to enter the edges *3* of the card clothing *4*. After the clothing is thus applied (see *B*) the prongs *2* are then bent backward, a feature which simultaneously straightens out the plate *1*, and in turn stretches the clothing, as shown by detail *C*. After this operation, the clothing and its plate are placed on the flat *5* and binding clips *6* applied, thus fastening the clothing and plate securely to the flat.

Card wire.—The kind of wire used in the manufacture of the card clothing considerably effects the carrying forward of the fibres in the process of carding. Different sections of wire are represented in Fig. 89, of which detail *A* shows round wire, *B* plough ground wire as formed



GRINDING.—With reference to round wire there are two periods when card teeth are ground, the one during manufacture, and the other after the clothing is applied to the machine in the mill. Card teeth are ground during the manufacture for two reasons—viz., to enlarge the space between contiguous teeth, and to leave the surface true and level. The first of these operations comprises what is known as plough and side grinding, both by no means being synonymous, although they have the same object i. e. to produce what is very erroneously called a “needle point”. It is quite obvious that the production of anything of the nature of a needle point is impossible after the wire is fixed in the foundation. What is technically called a needle point is practically a knife edge, the metal on the sides of the teeth being ground away, so that each tooth as it approaches the cotton presents to it a more or less sharp edge, for the purpose that when the surface grinding of the cloth-

ing takes place in the mill in order to resharpen the teeth, there is always an approximately sharp surface dealing with the cotton.

Plough grinding has for its object the reduction of the tooth for a great part of its depth, and is effected during the process of manufacture thus:—After the fillet has been made it is traversed over a perfectly true cylinder at a slow speed; thin emery discs are thrust between the teeth, and being revolved at a very high velocity, grind off from the sides of the teeth a certain portion of the wire. The discs are preceded by small “furrow” guides or “ploughs,” by which the various rows of teeth are kept apart, so that each tooth is equally ground on both sides. The tooth, when looked at from the front after grinding, presents from a little below the knee a taper profile. With reference to side grinding the intention is to deal with the extreme points of the teeth only. Hardened and tempered steel wire, plough ground, seems to be most in demand, since it is adapted for nearly all classes and growths of cotton. The chief reasons advanced for its being preferred are that owing to its hardness, the points, when once got up by grinding, are retained much longer than mild steel wire points, thereby increasing the life of the wire to a great extent. Better carding and a greater production are obtained, due to the wire being better able to treat a thicker body than mild steel wire, and to the card being stopped less for grinding. To be successful with hardened and tempered wire, assuming that it is put in a sufficiently strong foundation, is wound at the correct tension and has the proper amount of angle given to it in order to enable it to strip clear, it is an absolute and imperative necessity that the wire should be ground in an efficient manner, that is, sufficiently hard to cut it.

It is generally conceded that to wait until the points of the teeth are dull and then grind them on the top is a mistake, and it is infinitely better to grind lightly for a few minutes often than to grind heavily for a longer time and at greater intervals. The length of time a card should be ground depends, of course, on the condition of the wire at the commencement of grinding. Where the cylinders and doffers have been in contact for some time, causing the points to be very smooth, the dead or solid roller should be used until the points are got up all across and feel alike, the disc roller being applied to finish. The rollers should be set to a fine gauge at both ends of the cylinder or doffer, and then lowered, whilst rotating, to the operator’s judgment, and should in every case be kept working until the wire is parallel across the width of the card, so that even setting will be obtained. All should be got up or ground and set once per month. The weight of cotton passed through cards, and the quality of the carding desired, affects the time that should be allowed to elapse before again grinding. This is a matter which, however, rests with the discretion of the person in charge. It should be noted that, when setting, care must be taken to avoid stabbing cylinders and doffers with the gauge, as this is misleading through the spring or resilience of the wire, and also risky to the wire itself. When new grinding rollers are obtained, it is very good practice to

gauge them to see that they are perfectly true in diameter, straight, and also see that they are properly balanced. The grinding brackets should be tried when the grinding rollers are for the first time put in, to see that the roller is parallel with the cylinder and doffer shafts. The grinding rollers are also best ordered, so that they can be re-covered at the mill with emery filleting when the other is worn.

Before the card is ready for grinding, the wire must be all drawn up with the card knife in good shape, and all the bent wire picked up and tubed in line. If the picking up of the fallen teeth is neglected for any length of time, the standing wire will get ground so much shorter, that when they are picked up they will be found to be what we call "long teeth". They will become very troublesome to grind down to the same plane. On account of their being bent backward and forward, the perforations in the foundation, through which they pass, give them no support, so that they wobble from side to side with the slightest pressure. They will thus not stand up against the emery wheel to take an edge on. If they are not too numerous, the easiest way is to pull them out by means of side catching pliers; but the time and pains expended on the operation prevent it being generally adopted. Again, in looking over a card that has been running for some years, a great number of teeth may be found to be bent down, being caused either by unskillful stripping, or heavy hand brushing of the cylinder to remove the "hook" or "barb" after grinding. It is necessary in grinding wire to see that the pressure put upon the points is not too great, because there is a tendency in all metal substances to "flow", as it is called, which speedily develops a faulty place. The effect upon a card tooth is to form at its point a hook or barb, which is very detrimental. It is clear that if a barb is formed at all the chance of effective carding is lessened, and it is also clear that if the wire is allowed to become so far worn as to necessitate heavy grinding, the chance of forming a barb is greatly increased. It is, therefore, a preferable plan to grind the cylinder lightly once a month than to grind heavily at longer intervals. If the wire be hardened and tempered there is an additional reason for the avoidance of pressure i. e. hard grinding, since the heat produced will cause it to soften. If it is requisite to take a good deal off the point of the tooth, it should be done slowly and positively not all at once by too hard a grinding.

When a card has been running for some time the teeth of the clothing become dulled at their points, and require sharpening. This is effected when the cylinder is dealt with by removing the cover above the doffer and bringing a grinding roller carried in bearings fast on the frame of the machine into contact with the wire on the cylinder. The cylinder during grinding is rotated by proper gearing at a very slow surface speed ($1\frac{1}{2}$ to 4 revolutions per minute) compared to that of the grinding roller in order to obtain a true cylindrical surface. The grinding rollers used are of two kinds, viz:—a roller made of equal width to the cylinder, and covered over its whole surface either with emery or

emery filleting; or a narrow roller similarly covered and slidingly mounted upon a steel tube having a slot cut longitudinally throughout its length. Within this tube is a combined right and left handed screw, the roller being connected to this screw by means of a fork which passes through the slot in the tube. By fixing a pulley on the end of this tube the same can be driven at any speed desired, whereas the traverse motion given to the roller by driving the screw as is in the tube, by

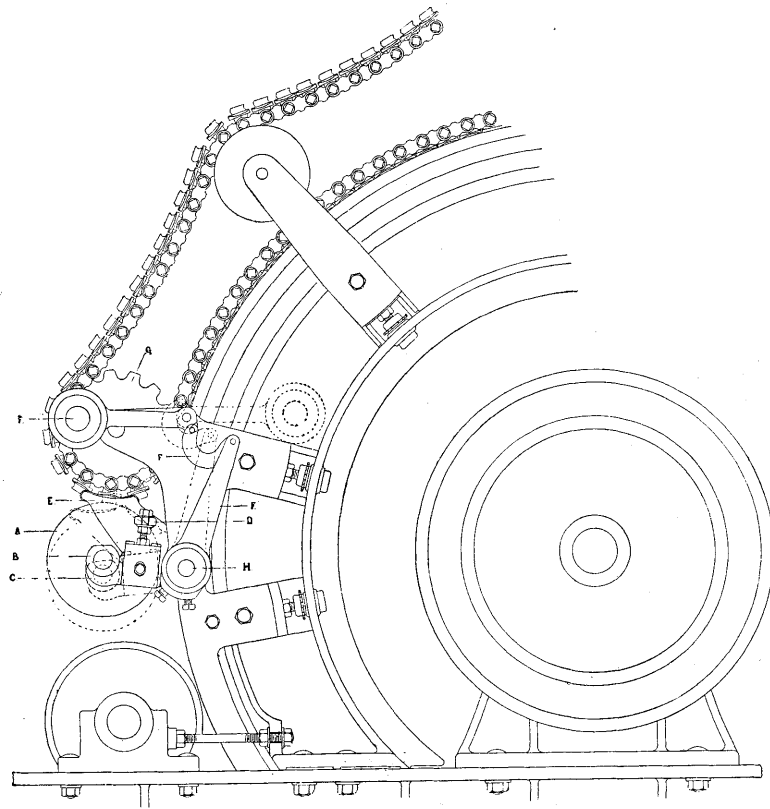


FIG. 90.

means of a pulley fixed on its shaft, can thus be regulated. The two threads on the screw as mentioned before combine at each end, so that a constant to and fro motion is given to the roller, in order to continually vary its point of contact with the cylinder to get even grinding. A similar to and fro motion is also given for the same purpose to the large roller, provided such is used, by a suitable cam and lever arrangement. A similar procedure is pursued with grinding the doffer,

the grinding roller in this instance being applied almost vertically over its centre. The amount of the grinding required depends greatly on the efficiency of the grinder. Some mills grind frequently and thus need to grind only light, while other mills delay the affair for a longer time, i. e. until absolutely required to do it on account of bad work and when consequently heavier grinding has to be done. The first plan will be found to be the better, since thus a good point to the teeth is preserved, and the rough action of a severe grinding avoided.

In grinding the flats, a large roller covered with emery or emery filleting is used, said roller extends the full width of the machine and is placed either under the flats, near to the point where they are about to enter upon their work, or on the top of the returning flats. In the first instance the flats have their teeth in practically the same position as when working, their surface consequently being partly convexed and which is ground off by the roller, in turn giving to the clothing of the flats an even surface for co-operation with the cylinder. In the second instance the flats as they return over the top have their wire surface pointing upwards, and when the natural deflection of the flats would in this instance of course also exist, but in the opposite direction, so that a concave surface would be the result. A grinding roller would straighten this surface, and the consequent effect would be to increase the convexity of the flats when they come round for work in connection with the cylinder. To obviate this disadvantage the grinding roller is mounted in a frame and the flats pass over a special plate as they come under the action of the grinding roller, which feature in this instance grinds the flats so that their clothing presents an even surface to the cylinder when at work.

The first mentioned procedure of grinding flats is shown by means of Fig. 90, showing not only the apparatus but also its position and relation to the rest of the card. The grinding roll *A* runs in self adjusting bearings *B* and is supported upon V shaped brackets *C* which are adjustable by means of set screws and check nuts *D* upon the grinding shoe or yoke *E* which is held against the working surface of the flat, during the operation of grinding, by the weight lever *F*. The pressure of the weight lever is applied immediately opposite the shoe, so that the flat cannot be sprung during the grinding operation. The sprocket wheel *G* parallels the flats on the bend, takes up any unequal stretching that may occur in the flat chain, and allows the flats to approach and pass the grinder perfectly parallel. The shoe *E* has its surface which engages with the working surface of the flats milled exactly to templet and is of such a shape as to ensure the grinding of the wire perfectly straight from heel to toe. All of these parts are pivoted upon the stud *H*, and, as each card is supplied with the apparatus, no removal of any part is necessary from card to card as the grinding is carried on. The dotted lines in the illustration show the position assumed by the grinding apparatus when the operation of grinding has been accomplished and the roll removed to another card.

With reference to the second mentioned procedure of grinding flats the latter are supported on the same face and in the same plane when grinding as when carding, consequently the original pitch of their teeth is maintained. The procedure of grinding will be easily understood by reference to Fig. 91. At the top will be seen the bridge

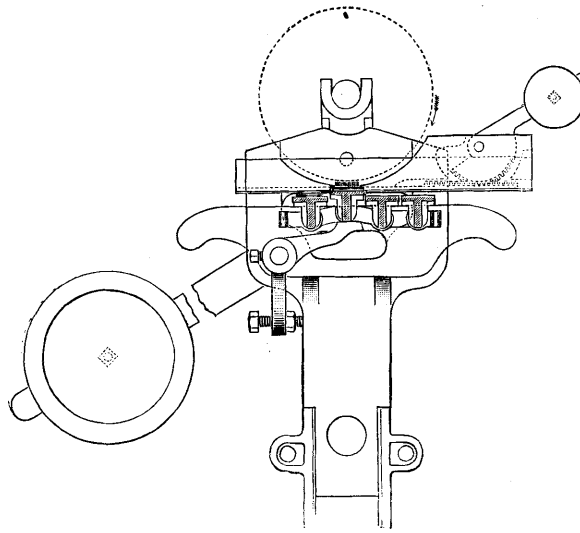


FIG. 91.

bracket in which a rack and bar slide. To this bar is attached a shoe or pin (shown across the end of the raised flat) the lower surface of which is milled to the particular bevel or heel at which it is desired to grind the flat. The position of the carding surfaces of the flats when grinding is regulated by the shoe or pin previously mentioned, and the action of the lifter (shown in the illustration as supporting the raised flat) with its levers, one of which is loaded by the large weight shown at the left in the illustration. Each flat as it travels along seizes the lip of the shoe, and is carried forward until its clothed surface has passed under the grinding roller. The flat then drops off the lifter, and releases the shoe, which is immediately returned to its original position by the positive movement of the rack quadrant and small weight shown at the right in the illustration.

Another style of the latter system of grinding is shown by Fig. 92. In this arrangement the grinding bracket *A* is fixed to the rigid bend. The curved arm shown to the left carries a stud *C* upon which is pivoted a lever *D*, the free end of which rests upon the projecting part of the bracket *A* when no grinding is being done. The pivoted lever *D* has adjustably attached to it the bracket for supporting the grinding roller, and it also supports a slide *F* by means of the projecting lugs *f*. In order to give the required heel to the flats, while grinding, a wedge shaped piece *f'* is attached to the slide *F*, the thick end of the wedge *f'* being provided with a projecting lip, against which the forward edge of each flat bears. In operation, the flats travel in the direction of the arrow up the horn bracket, which is provided with a raised projection

I, upon which the curved portions of the chain link stud bosses enter, and on which they can tilt themselves. The working surface of each flat is by this means brought into contact with the wedge *f'*. In the

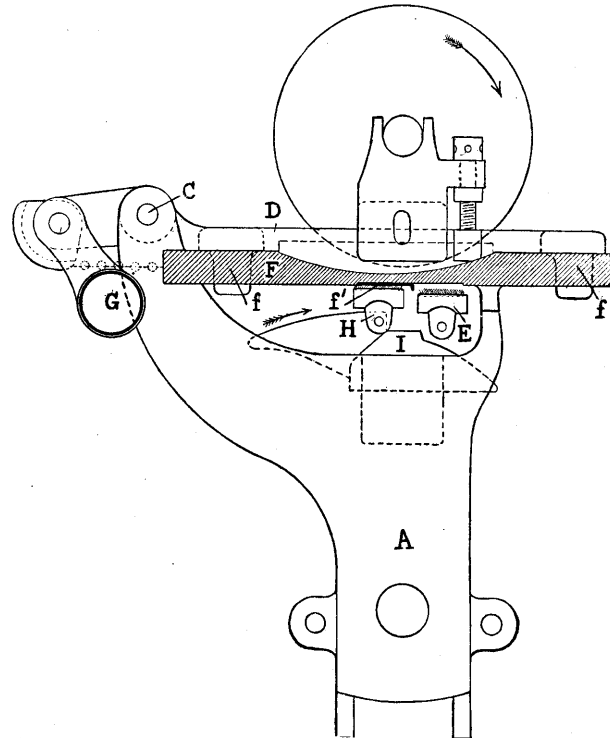


FIG. 92.

illustration the flat *H* is shown just about to engage with the projecting edge of the wedge, while the flat *E* has just left it. When flat *H* does so engage with the edge of the wedge, the slide *F* is slowly pushed forward by the flat until the whole of the wire surface upon it is ground, when it leaves the wedge by dropping downwards off the rear end of the projection *I*, as in the case of the flat *E*. Each time this occurs the slide *F* is returned to its normal position by means of the weighted lever *G*, sector and chain, the latter being attached to the end of the slide, which is also provided with a pin to control the extent of its backward movement. The distance between the centre of the grinding roller and the surface of the wedge *f'* is adjustable by the screw shown, but when once set, the distance remains the same, and consequently the height of the card wire surface on each flat is always constant when measured from the working surface.

The emery of the grinding roller, in passing over the points of the wire, causes them to bend backwards and forwards at a very rapid rate as long as the grinding continues, for which reason if the wire is not of a good quality, or its foundation not well made, the card clothing will soon break up and become useless for good work.

Re-covering Grinding Rollers.—In re-covering a roller first paste well all over its surface with cement (boiled oil and white lead), then put on the cloth or thick coarse calico, let this dry thoroughly and get perfectly hard, and then glue well all over its surface, and drop on the first coat of emery, after which keep the roller slowly turning for an hour or so. The next day glue again well all over this coat, and drop on the second coat of emery in the same manner as the first, and keep the roller again turning slowly for an hour. After a reasonable time put the “cutter” to and varnish, when, having put the roller by for a time, it will be ready for use. It is of the utmost importance that the emery rollers should be covered perfectly true, and with a good, sharp and even grinding surface.

BURNISHING.—Emery, and even the finest grades which are commercially obtainable will to a considerable extent affect the surface of the card wire at the grinding, thus all plough ground wires when received at the mill and put on the cards will have the sides of their teeth more or less abraded and scratched, and, if left untouched, would injure the coating of wax of the cotton fibre, the preservation of which is absolutely necessary for good spinning, etc. A rough tooth will present a saw like surface to the fibre which will scrape off some of its wax coating, and whenever this happens a fine white powder will be found about various parts of the machine, particularly about the trumpet guide and the mouth of the coiler head. Such an occurrence is a sure sign that the fibre is being damaged, and consequently the condition of the card clothing should be examined, and when it will usually be found necessary to burnish the wire teeth of the card clothing after grinding, in order to remove any burs and rough edges, sometimes formed upon the teeth, especially when too heavy grinding has been done. Burnishing must also be resorted to when card teeth become rusty, since otherwise streaks of cloudy and uncarded fibres will show in the sliver. Burnishing of the card teeth is done by a revolving wire toothed brush, mounted in bearings on the frame of the carding engine, the teeth of the brush penetrating the card clothing from $\frac{1}{8}$ to $\frac{1}{16}$ of an inch below the points of the teeth. The brush consists of a wooden roll, wound with straight wire fillet, about $\frac{1}{8}$ of an inch deep. Cylinder and doffer are generally burnished at the same time, the procedure being readily explained by means of Fig. 93, which is a diagram of a carding engine with the burnishing brushes in position. The burnishing brushes *A* are supported at either end by stands adjusted to the arches of the cylinder and doffer, and upon the end of the shaft of each brush a pulley *B* is adjusted. A grooved pulley *C*, for the recep-

tion of bands *D*, *E* and *F* takes the place of the usual barrow wheel. *G* indicates the loose pulley of the cylinder, and which has in its face a groove for carrying the band *D* for driving the pulley *C*, while the burnishing brushes are driven from *C* by the bands *E* and *F*. The doffer is also driven from the pulley *C* by the gears *H*, *I*, *J*, and *K*, the latter being upon the doffer shaft. On the opposite end of the doffer, and shown by dotted lines, is a pulley *L*, by which the cylinder is driven through belt *M* and pulley *N*. It will thus be seen, that as motion is

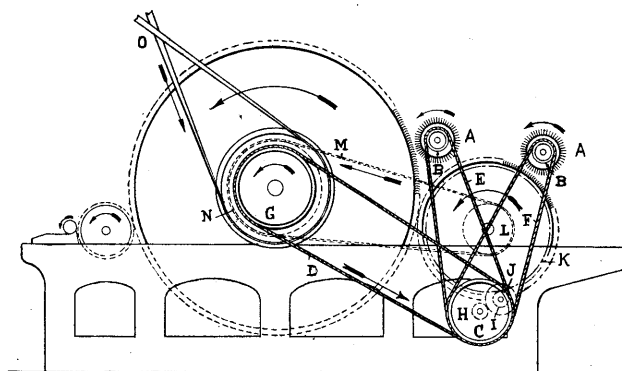


FIG. 93.

transmitted to all parts of the machine through the band *D*, it must be kept reasonably tight. *O* indicates the main belt as run on the loose pulley *G*.

STRIPPING.—It is necessary for good carding that the teeth of the card clothing should be kept not only sharp and smooth, but at the same time they must be periodically thoroughly freed from the accumulation of short fibres, neps and motes with which the clothing has become charged, since good carding depends upon the maintenance of the elasticity of the teeth which if embedded in a mass of waste material cannot act as effective upon the cotton to be carded as when quite free. The flats in the carding engine are stripped automatically after every passage they make over the cylinder, by the stripping apparatus every card is provided with, and consequently are always in a perfectly clean condition. However such is not the case with the cylinder and doffer, which although doing not as much work as the flats (since they only act more or less as a carrier for the cotton and thus would keep clean i. e. working condition for a much longer time than the flats and because a little accumulation of waste in its clothing is not of so much importance as it is with the teeth of the flats which have to do the actual carding) have thus to be stripped only periodically. Stripping the cylinder and doffer should be looked after closely. If the stock is fairly clean, twice a day will be sufficient, but should the stock be short

and trashy, the stripping should be done oftener. It is very good practice to strip the cards in the room in regular rotation, so that there is always a fair proportion of them running with cleaned clothing, and when as a result the carding throughout the room will in an average be even in quality. The stripping of the cylinder and doffer is performed by a wire brush, which has the additional effect of burnishing or polishing their teeth and thus partially freeing them from any roughness they may have on their surfaces. The same closely resembles the burnishing brush previously explained, with the exception that the wires instead of being straight are bent similarly to card clothing teeth. Fig. 94 is a diagram of a carding engine with the stripping brush

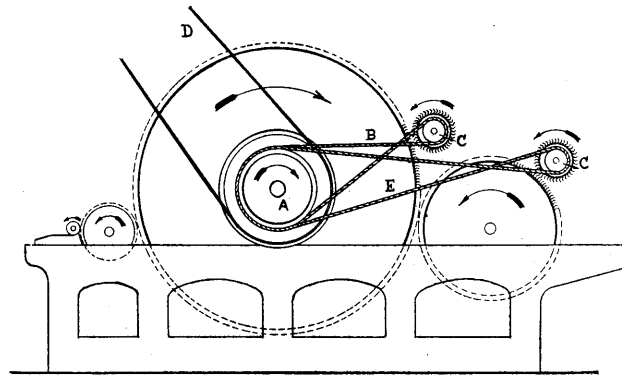


FIG. 94.

mounted (in stands—not shown) in position for cleaning either cylinder or doffer. The stripping brush is set so that its wires penetrate about $\frac{1}{8}$ of an inch into the teeth of the clothing of the cylinder or doffer and, with reference to grinding the cylinder, the same is driven from a groove in the loose pulley *A* by a band *B* and pulley *C*. The main belt *D* is run on to the tight pulley just far enough to turn the cylinder around very slowly. By the drive shown it will be seen that the surfaces of the cylinder and brush at their point of contact turn in the same direction, but, as the brush runs at a much greater speed, the dirt is very easily removed from the clothing of the cylinder. After the cylinder is thus cleaned, the same operation is repeated in connection with the doffer, the band *B* being taken off and the brush placed in the proper position for stripping the doffer, being driven by a similar (longer) band *E* in the same manner as with the cylinder. Before stripping, the main belt *D* is moved on to the tight pulley and allowed to drive the cylinder during the time the stripping brush is placed in position and when the belt is moved onto the loose pulley for driving the brush. The barrow bar, which until now has remained down, is then thrown into gear and the doffer allowed to make one revolution, being

driven through its usual gearing from the momentum the cylinder had gained while belt *D* was on its tight pulley. Although the surface of the doffer runs in the opposite direction from that of the stripping brush at their point of contact, yet it must be remembered that the teeth on both are bent at such an angle that the stripping of the doffer is readily accomplished. After cylinder and doffer are stripped, the brush is removed and cleaned by hand and thus ready for use again.

It may occur now and then that cotton fibres stick to or fill up the clothing, more particularly the flats, a feature sometimes caused by carding damp cotton which rusts the otherwise highly polished card wire, causing some of the fibres to stick to these rusty points, said fibres in turn collecting others and thus quickly fill the clothing. Other causes are roughness of the wire due to side grinding and the after polishing process, and also in some makes of card clothing imperfect hardening and tempering of the wire. Deficiency of angle from point to bend and bend to foundation may also be the cause of the fibres sticking as well as the breaking out of the wires. The wires of the clothing should not be set too straight if clear stripping is expected. In some cases the fibres will stick if the carding engines stand on a damp floor, or are subjected to cold drafts from doors or windows. To remedy this trouble, arrange special steam pipes above the cards in order to keep the temperature evenly at from 70° to 75° F. To clean cards having their clothing thus filled, get all the caked cotton from the spaces between the wires by means of strips of card filleting, a little wider than the wire on the flat, and about 6 in. long. Press the two wire surfaces together with the angle of the wire in the right direction, so that when the strip is pulled up by one hand and held slightly down with the thumb of the other it will remove all the caked fibres. If this process is too slow or too expensive, cover a wooden roller, about 6½ in. diameter, with stripping fillet in rings, so that the wire points will enter the wire clothing of the flat straight. Set the wire points of the roller to work about ¼ in. into the wire points of the flat and run the roller slowly, from 20 to 30 revolutions per minute, clearing in turn the fibres out of the wire very effectively when the bristle brush in front is revolved slowly in the opposite direction to the normal, stripping the roller at the same time periodically by a hand card. After the caked cotton is all removed, burnish the clothing of the flats, using chalk on the roller in order to polish and smooth the wire and afterwards grind the flats. One or more repetitions of this process may be necessary before the trouble is remedied.

The bristle brush as used in connection with cleaning the flats of fibres left on by the stripping comb, must be set to clear the foundation of the clothing, otherwise it will drive the fibres into the wire. If they are set to penetrate ¼ in. into the wire it will be sufficient with good brushes. When using clothing having side ground wire points, the brush gets worn in an irregular manner, causing the longer bristles to more or less felt the fibres in the clothing of the flats. If the bristles

are split by the wire, or thin ends are worn to a fine point, the brush requires trimming either by a machine constructed for the purpose, by scissors, or by singeing while rotating, with a hot iron, placing the brush in a turning lathe. Trimming or singeing causes the bristles to be less soft and yielding, and to have, therefore, a better cleaning effect. Some carders claim that the hot iron produces small burnt balls on the ends

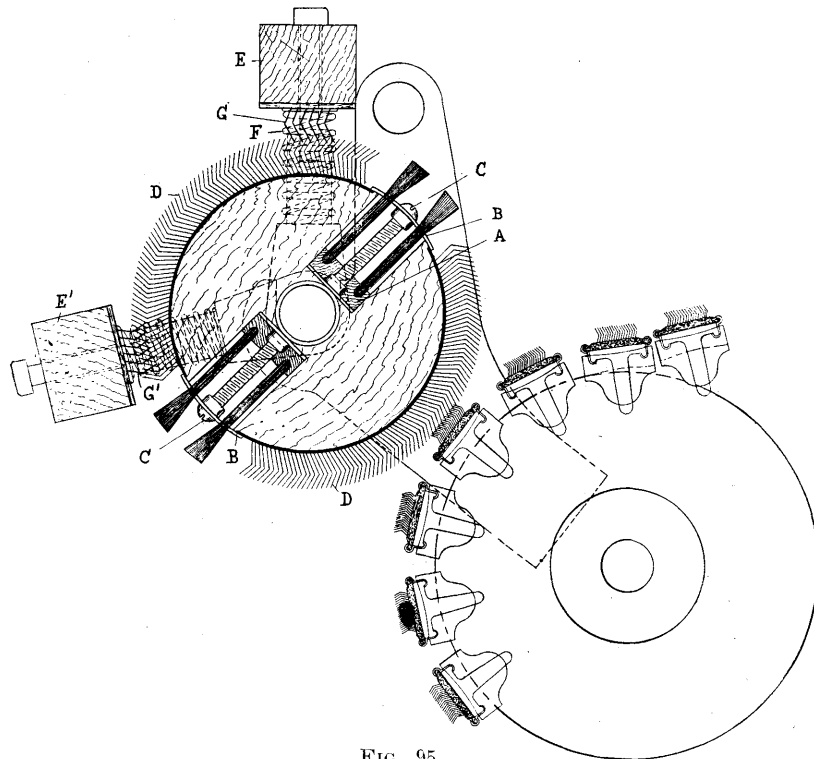


FIG. 95.

of the bristles which stop in the wire clothing and cause the cotton to adhere to them. The best results are obtained by a machine specially made for clipping the bristles, as clipping with scissors is as a rule unsatisfactory. The stripping comb for the flats should be set as parallel as possible to the flats, and at the same time just clear the wire in any position the comb assumes.

Lately several new stripping brushes have come into the market, of which the one illustrated by Fig. 95 will be of interest. This brush contains only a few bristles, the rest of the periphery of the roller being covered with wire teeth. Examining the illustration which shows this brush, as well as its support in section, showing also its engagement

with the flats, we find that the bristles are mounted in two double series (extending diagonally across the width of the roller) in lags *A* and extend through brass plates *B*. The length which these bristles extend outside of plate *B* is regulated by a screw *C*, thus permitting ready adjustment of the bristles when worn, in order that they penetrate the teeth of the flats to the proper extent. It will be readily understood that the bristles of the brush penetrate the clothing of the flats deeper than do the wire teeth *D* which do the actual stripping, whereas the bristles will effect a thorough cleaning of the foundation of the clothing of the flats. Above the brush is mounted a tooth clearer *E* which in its normal position has its wire teeth *G* held only slightly in contact with the wire teeth *D* of the brush by means of a spring *F*, the action of its wire teeth on the wire points of the stripping brush being only to press the strippings into the latter and thus prevent their falling into the flats again. When it is necessary to clean the brush, the clearer *E* is moved from its position above the brush down to the lower position *E'* shown in the illustration and then pressed inward so that its wire teeth *G'* will penetrate into the wire portion of the brush, and when in turn the clearer is bodily moved up to its former position *E* while the brush is rotated in the opposite direction, this procedure effectually cleaning the wire clothing of the brush. The brush when in operation is driven at a slow speed, from 5 to 10 revolutions per minute, and on account of this as well as the few bristles used in its construction and their manner of adjustment, does not require to be singed, permitting also at the same time ready replacing of the bristles when worn.

Another stripping and cleaning apparatus for cleaning the flats of revolving flat cards is shown in its section by Fig. 96. The apparatus

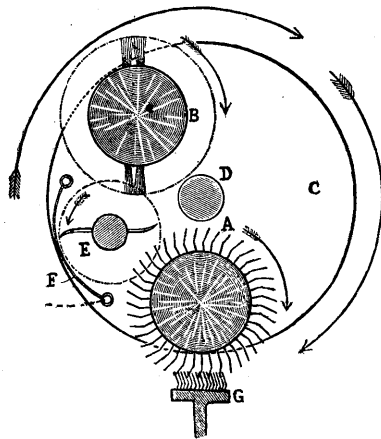


FIG. 96.

consists of the combination of a separate wire stripping brush *A* and a separate spiral bristle brush *B*, both of small diameter, carried by two end discs *C*, and revolving or traveling round the axis of a central driving shaft *D*. Both brushes (*A* and *B*) are driven by special gear wheel arrangement in such a manner that they are caused to revolve on their own axes at the same time, and in the same direction as they are traveling round said central driving shaft *D*. A circular comb *E*, also driven by special gear wheel mechanism, is attached, which strips or clears both brushes (*A* and *B*) automatically while the apparatus is at work, and in this manner the two brushes are always kept clean and efficient to perform their work. A hinged guard

or cover *F* is placed over the circular comb *E*. When the apparatus is at work the wire stripping brush *A* and the bristle brush *B* alternately strip and brush the flats *G* by exerting a double action or movement on the wire, that is, an upward or lifting and at the same time a forward movement by which means any adhering cotton fibres and other impurities in the flat clothing, which have not been effectively removed by the flat stripping comb, are literally picked out of the wire and immediately and automatically collected by the circular comb. When the comb gets full of fibres, etc., the hinged cover *F* encasing it is turned down and the strippings collected removed by the attendant; under ordinary conditions the apparatus will work several days without requiring strippings to be removed from the comb. The bristle brush *B* is slightly larger in diameter than the wire brush *A*, a feature which enables the bristles to penetrate deeper into the wire and brush out the dirt from the foundation of the clothing. The apparatus is worked from the usual flat stripping brush brackets and is set and adjusted in the same manner as any ordinary flat stripping brush; it is driven by a single grooved band pulley and can be applied to any make of revolving flat carding engine without any alteration or addition to the card. Its speed is slow, say 40 to 50 revolutions per minute.

In order to keep the tops of the revolving flats clear from lint, etc., some cards have a cleaning device applied as shown by the illustration Fig. 97. The same consists of a wooden roller, a section of which is in the shape of a five pointed star, about the length of a flat, being covered with felt and placed loosely in position i. e. resting on the tops of the flats as indicated by the illustration. The motion of the flats revolves this roller slowly, collecting the lint on the felt. Any time it is required to take accumulation of lint from the roller, the same can be readily removed from the flats. Below this roller as shown in the illustration, there is placed a small brush for keeping the bearing ends of the flats clean, this brush corresponding to the brush *P* as shown in connection with illustration of the complete carding engine Fig. 79.

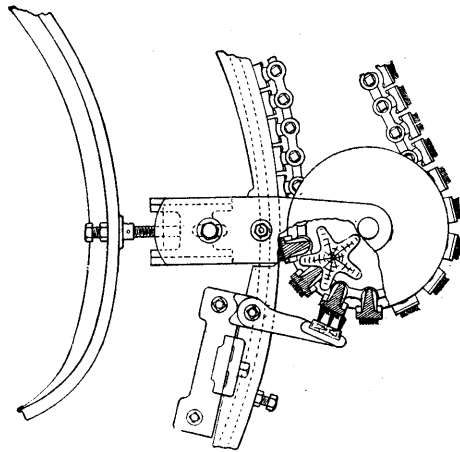


FIG. 97.

To prevent the waste as continually stripped from the flats during the running of the card from dropping on the casing of the doffer, some cards have a trough arrangement applied, into which the waste drops

and from where it is guided between two rollers and passes in the form of a sliver into a receptacle placed at the side of the card. Fig. 98 is a perspective view showing this device applied to the card. A trough like receptacle *F* is placed below the vibrating stripper comb *D'* and in front of the traveling flats *B*, being extended transversely across the same to receive the strippings *S* as removed from the flats by the comb. In one of the grinder roll stands *K*, is detachably mounted a second

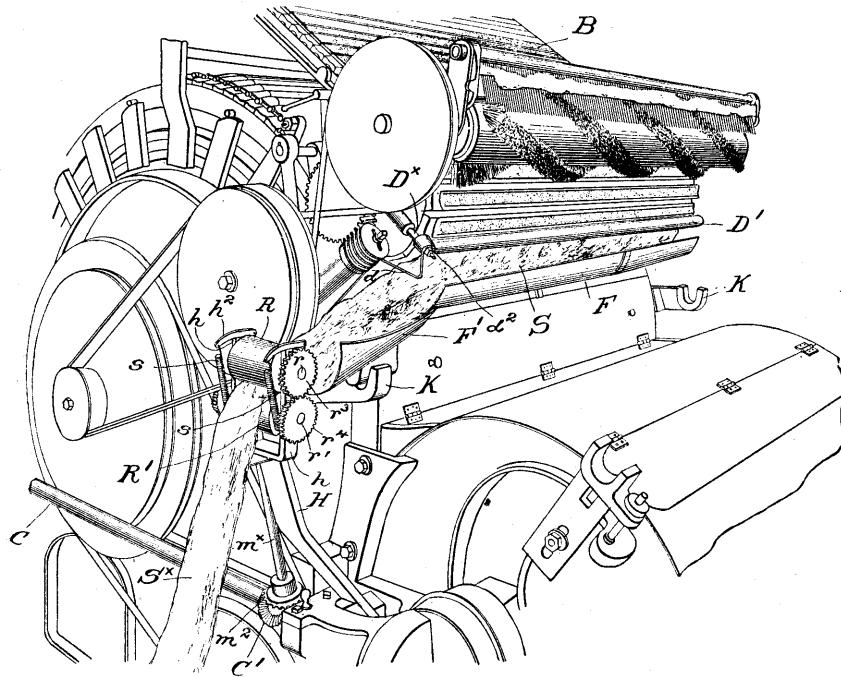


FIG. 98.

trough *F'* which meets the end of the trough *F* and forms a continuation thereof, extending beyond the side of the card. A strut *H* is rigidly secured to the main frame of the machine and its upper end is forked at *h* to form bearings for the journals *r* and *r'* of two rolls *R* and *R'* respectively, the journals of the upper roll *R* being vertically movable in slots of the branches *h*. The rolls *R R'* are held pressed together by springs *s* attached to arms *h*² extending over the journals *r*, and thus the pinions *r*³ *r*⁴ are always in contact with each other. Motion is imparted to the lower roll *R'* by the shaft *C* through the auxiliary shaft *m*^x, one end of which carries a bevel gear *m*² which meshes with the bevel gear *C'* of the shaft *C* while the other end of the

shaft m^x carries a worm (not shown) which drives the lower roll R' . A rearwardly bent piece of wire d is mounted on one of the comb arms D^x by a nut d^2 which wire assists in freeing the waste from the comb, the waste after passing the wire being guided through a trumpet and in turn between the rolls $R R'$, emerging from the attachment in the form of a sliver S^x .

An ingenious method for operating the stripper comb for the flats has lately been brought into the market, the object being to provide means whereby the bars which hold the stripper comb are pivoted on a point other than the centre on which they turn, thus moving the comb towards the flats in its downward movement and away from the flats on

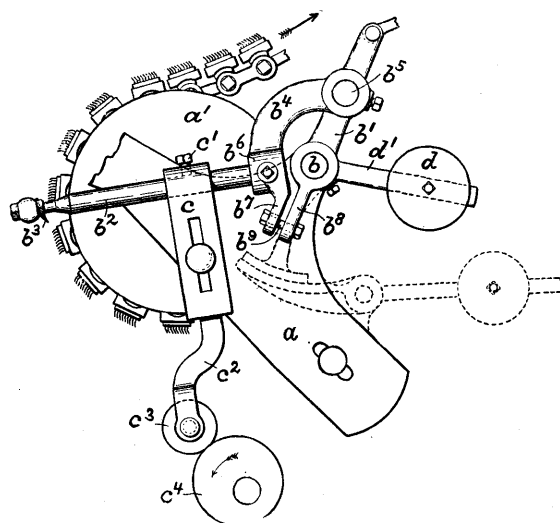


FIG. 99.

its return movement in order to more effectually strip the flats. Fig. 99 is a side view of the stripper comb and its actuating mechanism. Fig. 100 is an enlarged side view of the stripper, showing in dotted lines the movement of the comb. On a bracket a as bolted to the frame of the card is carried the disc a' around which the flats revolve, and also a shaft b . To the ends of this shaft (on each side of the carding engine) is secured an arm b' carrying a shaft b^5 on which a curved arm b^4 is mounted. The lower end of this arm is provided with a socket b^6 for the reception of the arm b^2 as carries the comb b^3 , said socket having formed on it a bracket b^7 which is connected by a link b^9 with a corresponding bracket b^8 on the lower end of arm b' , the two brackets $b^7 b^8$ being adapted to move toward or away from each other. The arm b^2 has the weighted rider c adjustably secured to it by the set screw c^1 . The bifurcated arm c^2 is adjustably secured to the rider and provided with the roller c^3 , which bears on the cam c^4 , by the rotation of which the rider c and the frame supporting the comb are operated to swing during the first part of the stroke on the center b^5 and then through the rest of each stroke on the bearing b . In the upward stroke the bracket b^7 moves away from the bracket b^8 the length of the link b^9 , (during this movement the comb frame swings on the center b^5) when the link draws the bracket

b^s and swings the arm b' on the shaft or bearing b , said bearing now forming the center on which the comb frame swings. In the downward stroke the first part of the stroke acts to bring the brackets b^7 and b^s together, the comb frame swinging on the center b^s , the comb frame and the arms b' during the rest of the stroke swinging on the bearing b , the path of the comb during the upward and downward stroke being shown by dotted lines in Fig. 100. The rapidity of the movement of the comb and the comb frame requires, to insure the prompt diagonal movement of the comb at the beginning of each stroke, some frictional resistance to the free swinging of the arm b' on its bearing.

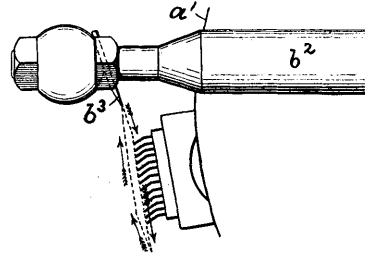


FIG. 100.

For this purpose a convex shoe (shown in dotted lines) may extend from the arm b' in contact with a segmental plate pivotally supported and counterweighted; or by counterweighting the arm b' with the weight d , adjustably secured to the lever d' , the resistance required may be readily secured and the prompt action of the comb insured by the adjustment of the weight d .

THE DRIVE FOR A CARD,—is explained by means of illustrations Figs. 101, 102 and 103, of which Fig. 101 is a plan view showing the relative position of the various gears, pulleys, rolls, etc., side by side; Figs. 102 and 103 being right and left hand side elevations respectively. The card is driven through pulley N as is fast to one end of the cylinder driving shaft, the other end of said shaft carrying pulleys N' N^2 . From the pulley N' a cross belt drives the pulley O as fast on the lickering shaft, a pulley O' on the other end of said shaft driving by means of an open belt an auxiliary pulley P . This pulley P carries a spur gear P' which meshes with the gear Q of the compound gear Q Q' , the smaller one Q' in turn driving the gear C^2 as fast to the doffer shaft and which in turn through the intermediate gears D and E drives gear F as fast on one end of the shaft carrying the calender roller F' . A gear F^2 (= j Fig. 84) on the other end of said calender roller shaft meshes with a gear G (= k Fig. 84) and through a short shaft and two bevel gears (l m Fig. 84) drives the bevel gears H' and I (= h i respectively in Fig. 84) which in turn rotate gears I' J' , driving through them the coiler delivery rollers I^2 and J . Motion is imparted to the feed end of the carding engine by means of bevel gear C on the doffer shaft meshing with bevel gear B' as carried on one end of a long side shaft, extending the length of the card, the other end of said shaft carrying a bevel gear B , meshing with a bevel gear A^2 fast on the shaft carrying the feed roll A . The latter shaft on its other end carries a gear A' which drives through intermediate gears R S the gear T as fast to the shaft carrying lap roll T' . Fast to pulley N' is a grooved pulley N^3

- C'* Grinding pulley, 11" diam. \times $2\frac{3}{4}$ " face.
*C*² Doffer gear, 180 teeth.
D and *E* Intermediate gears, each 51 teeth.
F Calender change gear, 19 teeth.
F' Bottom calender roller, $2\frac{1}{8}$ " diam.

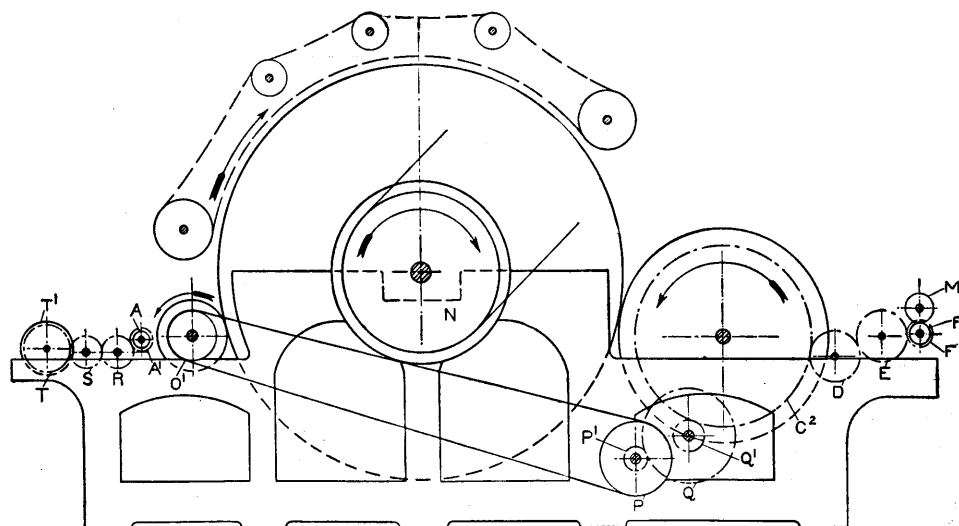


FIG. 102.

- F*² Coiler driving gear, 24 teeth.
G Coiler change gear, 16 teeth.
 Coiler driving bevel gear, 20 teeth (see *l* Fig. 84).
 Coiler middle upright bevel gear, 20 teeth (see *m* Fig. 84).
H' Coiler top upright bevel gear, 20 teeth.
I Coiler calender bevel gear, 20 teeth.
I' 1st coiler calender spur gear, 20 teeth.
*I*² 1st coiler calender roller, 2" diam.
J 2nd coiler calender roller, 2" diam.
J' 2nd coiler calender spur gear, 20 teeth.
M' Top calender roller, $4\frac{1}{4}$ " diam.
N Cylinder driving pulley, 20" diam. \times $3\frac{1}{8}$ " face; usual speed 165 to 170 r. p. m.
N' Lickerin driving pulley, 19" diam. \times $2\frac{1}{4}$ " face.
*N*² Flat driving pulley, $6\frac{1}{2}$ " diam. \times $3\frac{1}{4}$ " face.
*N*³ Comb driving pulley, 26" diam., for $\frac{5}{16}$ " diam. band.
O Lickerin driven pulley, 7" diam. \times $2\frac{1}{4}$ " face.
O' Barrow gear driving pulley, 6" diam. \times $2\frac{1}{2}$ " face.
P Barrow gear driven pulley, 9" diam. \times $1\frac{1}{2}$ " face.

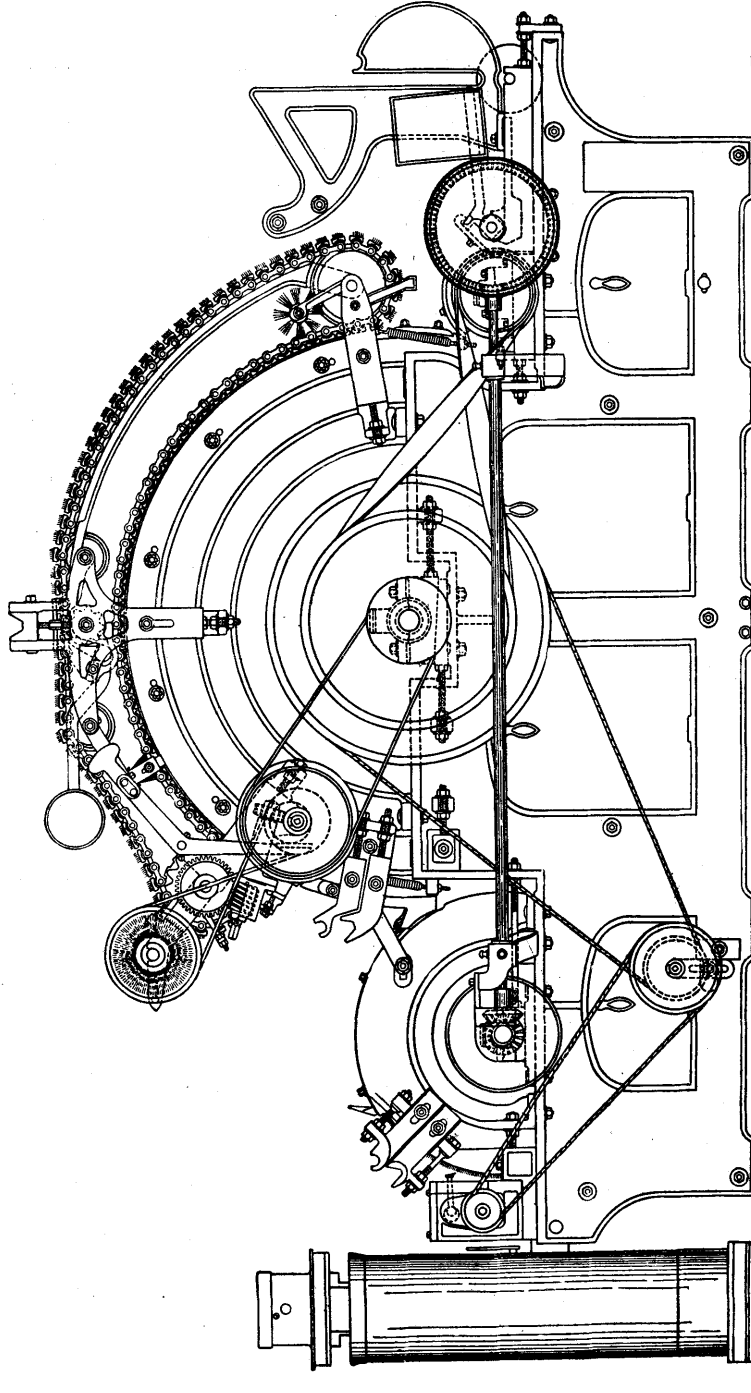


FIG. 104.

DRAFT,—in a card refers to the difference of the surface movement between its two extreme parts i. e. its feed (lap unwinding roller) and delivery (calender) rollers; the different points where draft occurs being between the lap unwinding roller and the feed roller, between the feed roller and the lickerin, between the lickerin and the cylinder, between the cylinder and the doffer, between the doffer and the calender rollers, and between the calender and the coiler delivery rollers. Of these, the draft between the lap unwinding and the feed roller has for its purpose to stretch the lap; the draft between the feed roller and lickerin regulating the amount of cotton fed to the carding engine. The draft between the lickerin and the cylinder after once properly set is hardly, if ever, altered since an increase in speed to the lickerin would lessen the tendency of the cylinder to parallelize the fibres and a reduction would not tend to as effectively operate the cotton presented at the feed, while the objections to altering the speed of the cylinder are that increasing the speed would make the combing action of the flats more severe on the fibre, whereas a reduction of its speed would lessen production. The draft between the cylinder and the doffer regulates the weight of the sliver. The drafts between the doffer and the coiler delivery rollers are necessary to absorb the tendency of the sliver to stretch at these two points. The combination of all these various drafts must be taken into consideration in the production of a certain count of sliver. Alterations in the count of the sliver are usually effected by changing the wheel on the side shaft which drives the one on the feed roller and which changes the draft between the feed roller and the lickerin and also the relation of the speed of the feed and lap unwinding rollers, with all the other parts, in turn altering the quantity of cotton treated by the lickerin, cylinder and doffer in direct proportion to the change. The draft between the doffer and cylinder exercises a greater influence on the quality of the work than the draft in any other portion of the card, besides the amount of production is also governed to a great extent by the draft between these two parts. Always see to it that the doffer cleans the cylinder of all fibres possible, so that the latter can exert its full value on the fresh supply of cotton as fed to it by the lickerin. It is, therefore, of the greatest importance to make the doffer as effective as possible, one of the most important points being to know its most advantageous speed and weight of the fibres delivered by it. A good plan is to run the doffer at its highest speed and to feed to the card as light as possible consistent with production required for the subsequent processes, keeping in mind to run the carding engine only at such a speed as will produce good work.

Most mills have their machinery arranged to suit the range of counts of yarns required by their trade and under ordinary conditions will not have to change to any great extent the class of work done by individual cards as well as other machinery. If it becomes necessary to make radical changes in the spinning of counts of yarns, care will have to be exercised. With reference to carding, to change from high to low

counts will not be difficult, whereas if required to change from low to high counts, provided the card is in a shape to do this, it is first necessary to ascertain the weight of production required of each card to keep the subsequent machinery running. Then guided by production wanted, set the card so as to give, as near as possible, the proper weight of sliver, running the card at the most satisfactory speed. Afterwards make the sliver lighter but without decreasing production by increasing the total draft and the speed of the doffer in proportion until the sliver will stand no further reduction in size without its being liable to break. If it is afterwards found that excessive breaks occur make a slight reduction in the total draft as well as the speed of the doffer. The following example will better explain the subject:—Assuming that the production of each card must be 700 pounds per week of 54 hours and that the diameter of the doffer is $26\frac{3}{4}$ inches and that 12 revolutions per minute would be a fair speed in the estimation of the carder to begin with, then in order to produce the above weight in the time given, the draft would have to be such that one yard of sliver from the doffer will weigh:—

$$\frac{700 \text{ pounds} \times 7000 \text{ grains}}{54 \times 60 \times 12 \times \frac{26\frac{3}{4}}{36} \times \frac{22}{7}} \quad \text{or} \quad \frac{36 \times 7 \times 700 \times 7000}{54 \times 60 \times 12 \times 26\frac{3}{4} \times 22} = 53.96 \text{ grains.}$$

Having thus obtained the weight in grains per yard of the sliver, the quickest and most simple rule for ascertaining the draft for the card is thus:—Divide the weight of one yard of lap as is fed to the lickerin by the weight of one yard of sliver as delivered by the doffer. Supposing the lap weighs 10 ounces per yard then with reference to our example we find:—

10 ounces = 4375 grains and

$4375 \div 53.96 = 81.07$ which is the exact draft of the card. If after starting the card with the draft thus obtained it is found possible to further reduce the sliver, then increase the draft and speed of the doffer; but if it is found that the sliver is too thin to stand the strain put on it, reduce the draft and speed of doffer until the proper result is obtained. The rule given for ascertaining the draft of a card can be used any time and under any conditions by weighing one yard of sliver delivered as well as of lap fed, this procedure being a great deal quicker and simpler than by gearing calculations, besides there is also an assurance of its being absolutely correct because it is based on weight, for it is weight and length that in all cases determine the counts of lap, sliver or yarn. However if a change in draft is required, gearing calculations will have to be resorted to. The chief difficulty in connection with alterations bearing on the production of the card is that of deciding at which of the points the change can be made with the most satisfactory results. Such involves a complete knowledge not only of the working of the parts, but also of the extent of the capacity of each.

CALCULATIONS.—To find total draft of card between lap roll and calender rollers at one operation by means of gearing calculations (Multiply all the drivers for a dividend and all the driven for a divisor; the quotient being the draft.) the following example with reference to Fig. 101 is given:—The doffer to be $26\frac{3}{4}$ " diameter and the calender roller F' $2\frac{1}{3}$ " diameter. On one end of the doffer shaft is a bevel wheel C having 24 teeth, driving a side shaft bevel B' having 34 teeth. On the other end of this side shaft is a change gear B of 18 teeth, driving a bevel gear A^2 of 120 teeth on the feed roll shaft. A gear A' of 17 teeth on the other end of said feed roll shaft drives through two intermediates a gear T of 48 teeth on the lap roll shaft, the lap roll T' itself being 6" in diameter. A gear C^2 of 180 teeth on the doffer shaft drives, by means of two intermediates, a gear F on the bottom calender roller shaft, having 19 teeth.

$$\frac{180 \times 2\frac{1}{3} \times 34 \times 120 \times 48}{19 \times 24 \times 18 \times 17 \times 6} = 121.05 \text{ total draft.}$$

The draft of a card if knowing speed of calender roller (or doffer) and feed roll is found by rule.—Multiply r. p. m. of calender roller (or doffer) by its diameter and divide product by r. p. m. of feed roll multiplied by its diameter. Example:—Calender roller = 90 r. p. m., $2\frac{1}{3}$ " diam.; feed roll = 2 r. p. m., $2\frac{1}{4}$ " diam.

$$\frac{90 \times 2\frac{1}{3}}{2 \times 2\frac{1}{4}} = 57.5 \text{ Ans.}$$

Another example using doffer in place of calender roller:—Doffer = 15 r. p. m., $26\frac{3}{4}$ " diam.; feed roll = 3 r. p. m., $2\frac{1}{4}$ " diam.

$$\frac{15 \times 26\frac{3}{4}}{3 \times 2\frac{1}{4}} = 59.44 \text{ Ans.}$$

Another rule is.—Count the number of revolutions of the doffer or the calender roller for one of the feed roll, this multiplied by the diameter of the doffer or the calender roller and divided by the diameter of the feed roll will give draft as before. Example:—(Doffer r. p. m. = 15, feed roll r. p. m. = 3 and $15 : 3 :: 5 : 1$) 5 turns of doffer to one of the feed roll, diam. of doffer = $26\frac{3}{4}$ ", diam. of feed roll = $2\frac{1}{4}$ ".

$$\frac{5 \times 26\frac{3}{4}}{2\frac{1}{4}} = 59.44 \text{ Ans.}$$

Another example using calender roller in place of doffer:—(Calender roller r. p. m. = 90, feed roll r. p. m. = 2 and $90 : 2 :: 45 : 1$)

45 turns of calender roller to one of the feed roll, diam. of calender roller = $2\frac{7}{8}$ ", diam. of feed roll = $2\frac{1}{4}$ ".

$$\frac{45 \times 2\frac{7}{8}}{2\frac{1}{4}} = 57.5 \text{ Ans.}$$

The purpose of draft between the feed roll and the doffer is to change the weight of the sliver without altering the weight of the lap. Changing the feed gear *B* in illustration Fig. 101 alters the speed of the feed roll *A*, one way or the other, giving in turn a different weight of sliver. For this reason if changing to a feed gear having a greater number of teeth the result will be to speed up the feed roll and consequently send a greater amount of cotton through the card; and if at the same time no alteration is made in the change gear (*Q'*) a heavier sliver will be delivered. Substituting a feed gear having less teeth will reverse this result. For example to change from a draft of 85 to 100 the speed of the feed roll *A* must certainly be decreased, because a lighter sliver is required and consequently the feed gear *B* must be altered substituting one having fewer teeth.

To change the weight of sliver use rule.—Change the feed gear in proportion to the weight of sliver required. Example:—A sliver of 35 grains as now produced has to be changed to one of 30 grains. Ascertain the feed gear required for the latter weight, the gear in use being a 28. From previous explanations a feed gear with fewer teeth will be required.

$$\frac{30}{35} \text{ of } 28 \text{ or } \frac{30 \times 28}{35} = 24 \text{ the feed gear required.}$$

To vary the weight of material carded in a given time (by carding the material more or less) without altering the hank sliver, is a problem which will frequently come up and which has to be solved by using a different change gear (*Q'* with reference to Fig. 101) by rule.—Multiply change gear on by the weight required, and divide by present weight. Example:—Suppose we are producing 600 lbs. per week with a 20 teeth change gear. Question.—Find change gear required to produce 750 lbs. per week.

$$\frac{750 \times 20}{600} = 25 \text{ toothed change gear is required.}$$

To find draft between lap and feed rollers.—Example:—Diameter of lap roll 6", diameter of feed roll $2\frac{1}{4}$ ", lap roll gear 48 teeth, feed roll gear 17 teeth.

$$\frac{2\frac{1}{4} \times 48}{17 \times 6} = 1.0588 \text{ Ans.}$$

To find draft between doffer and calender roller.—Example:—Diameter of doffer $26\frac{3}{4}$ ", diameter of calender roller $2\frac{1}{8}$ ", doffer gear 180 teeth, calender change gear 19 teeth.

$$\frac{2\frac{1}{8} \times 180}{19 \times 26\frac{3}{4}} = 1.0181 \text{ Ans.}$$

The draft between the feed roll and the doffer can also be found in a similar manner to the last two examples, thus:—Diameter of feed roll $2\frac{1}{4}$ ", diameter of doffer $26\frac{3}{4}$ ", doffer bevel gear 24 teeth, side shaft bevel gear 34 teeth, draft change gear 21 teeth, feed roll driving gear 120 teeth.

$$\frac{26\frac{3}{4} \times 34 \times 120}{24 \times 21 \times 2\frac{1}{4}} = 96.2433 \text{ Ans.}$$

Multiplying the last three answers (drafts) will give the total draft for the card, thus $96.2433 \times 1.0588 \times 1.0181 = 103.7$ total draft for card, which answer is proven (considering all three examples in one) by "Multiplying all the drivers for a dividend and all the driven for a divisor, the quotient being the draft" thus:—

$$\frac{2\frac{1}{8} \times 180 \times 34 \times 120 \times 48}{19 \times 24 \times 21 \times 17 \times 6} = 103.7 \text{ Ans.}$$

To ascertain draft of card required, weight of lap and sliver required being given. Example:—Weight of lap 12 ozs., per yard, weight of sliver required 48 grs. per yard, allow 5% for waste and drying in. 12 ozs. = 5250 grs. 5% loss = $5250 \div 20 = 262\frac{1}{2}$ grs., leaving $4987\frac{1}{2}$ grs. to be considered as weight of lap used. There are to be 48 grs. to the yard in sliver, thus $4987\frac{1}{2} \div 48 = 103.9$ draft required.

To ascertain revolutions of doffer.—The speed of the doffer should not be taken by a speed indicator because the doffer turns very slowly and if particular care is not taken to have the point of the indicator firmly pressed against the doffer shaft, the counts as indicated by the index finger on the face of the dial will not be correct. A more accurate method of counting the turns of the doffer without resorting to gearing calculations is to count the number of spokes of the doffer gear that pass a certain point in a minute and divide this by the number of spokes contained in the gear, thus obtaining the complete number of revolutions. Suppose 54 spokes pass a given point on the card in one minute and that there are 6 spokes in the doffer gear, then $54 \div 6 = 9$ r. p. m. for doffer.

To ascertain revolutions of doffer by means of gearing calculations use rule.—Multiply the drivers for a dividend, multiply the driven for a divisor, and multiply the quotient by speed of cylinder. Example:—(In connection with Fig. 101.) Cylinder 165 r. p. m., liekerin driving

pulley on cylinder shaft (N') 19" diam., lickerin driven pulley (O) 7" diam., barrow gear driving pulley on lickerin (O') 6" diam., barrow gear driven pulley (P) 9" diam., barrow spur gear (P') 28 teeth, doffer lever intermediate gear (Q) 104 teeth, doffer change gear (Q') 20 teeth, doffer gear (C^2) 180 teeth.

$$\frac{19 \times 6 \times 28 \times 20}{7 \times 9 \times 104 \times 180} \times 165 = 8.93 \text{ r. p. m. for doffer.}$$

The doffer change gear is supplied in different sizes, (17 to 40 teeth, advancing by one tooth in the present drive) however by simply substituting the particular gear on hand in place of the 20 teeth gear given in example the proper revolutions of the doffer will be ascertained. To explain the subject consider in connection with the example the change gear to have 25 teeth in place of 20.

$$\frac{19 \times 6 \times 28 \times 25}{7 \times 9 \times 104 \times 180} \times 165 = 11.16 \text{ r. p. m. for doffer.}$$

In the same manner if any other gear or pulley in the example given is to be of a different size, simply substitute said size for the one given in example. To explain the subject consider the barrow spur gear (P') in the previous example to have only 24 teeth.

$$\frac{19 \times 6 \times 24 \times 20}{7 \times 9 \times 104 \times 180} \times 165 = 7.65 \text{ r. p. m. for doffer.}$$

To find the speed of cylinder use rule.—Multiply the speed of the line shaft by the diameter of pulley fixed on it and divide product by diameter of driving pulley on cylinder shaft. Example:—Line shaft = 207 r. p. m., pulley on line shaft = 16" diam., pulley on cylinder shaft = 20" diam.

$$\frac{207 \times 16}{20} = 165.6 \text{ r. p. m. which in practical work will equal}$$

about 165 r. p. m. on account of slippage of belt.

To find speed of the revolving flats per minute.—The best practical method is to mark their position on the bend and time distance moved per minute with a watch.

To find the hank carding use rule.—Measure off 6 yards of the sliver and divide its weight in grains into the constant number for a dividend for said 6 yards and quotient will be the hank required. Example:—6 yards sliver weigh 14 dwt. 4 grs. (= 340 grs.) Question.—Ascertain hank carding. To ascertain a constant number for a dividend for a number of yards, multiply said number of yards by 100 and divide

product by 12. Thus in our example $\frac{6 \times 100}{12} = 50$ constant number for 6 yards, and thus $50 \div 340$ (gr. weight of the 6 yds. sliver) = 0.147 hank carding.

To find what part of a hank the lap is, the draft of the carding engine and hank carding being given use rule.—Divide hank carding by draft and from quotient deduct 5% for waste and drying in. Example:—Hank carding = 0.160, draft = 120.

$0.160 \div 120 = 0.00133$ ($\times 5 = 0.00665 \div 100 = 0.00006$) and $0.00133 - 0.00006 = 0.00127$ hank lap.

To find the production of a card,—the following items being given. Diameter of doffer = 26.75 inches (including 0.75" wire) = 84.03 inches circumference. Revolutions of doffer = 9 per minute. Weight of sliver = 40 grains per yard. Actual working = 60 hours = 3600 minutes.

$$84.03 \times 9 \times 40 \times 3600$$

————— = 432 pounds per

36 inches in one yard \times 7000 grains in one pound

week delivered, from which must be deducted the proper amount for stripping, cleaning, etc., (from 5 to 10%). In the same manner as thus taking the doffer into consideration, some carders use the coiler calender rollers in its place, for which reason another example is given. Diameter of coiler calender roller = 2 inches = 6.28 inches circumference. Revolutions of coiler calender roller = 162 per minute. Weight of sliver = 60 grains per yard. Actual working = 60 hours = 3600 minutes.

$$6.28 \times 162 \times 60 \times 3600$$

————— = 872 pounds per

36 inches in one yard \times 7000 grains in one pound

week delivered, from which the same as before the proper amount of loss on account of stripping, cleaning, etc., (from 5 to 10%) must be deducted.

To find the number of carding engines required to keep up with a given number of deliveries of drawings.—Multiply the revolutions per minute of drawing frame back roller by its diameter, the number of the deliveries and the ends up at each delivery and divide this product by the revolutions per minute of doffer multiplied by its diameter, the quotient being the number of cards required. Example:—Drawing frame back roller 40 r. p. m., 1 $\frac{3}{8}$ " diam., 3 deliveries @ 6 ends each; doffer 6 r. p. m., 24" diam. Question:—Find number of carding engines required to supply these three (3) deliveries.

$$40 \times 1\frac{3}{8} \times 3 \times 6$$

————— = 6.87 Ans. which practically calls for 7 cards,

$$6 \times 24$$

light.

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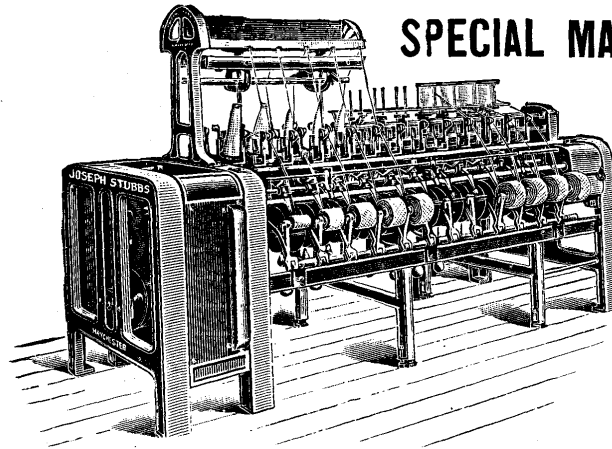
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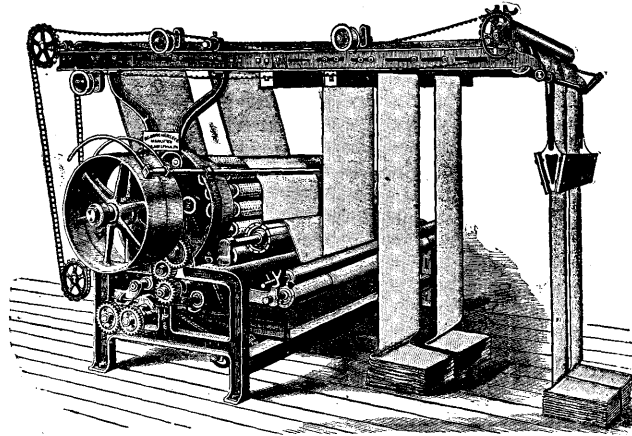
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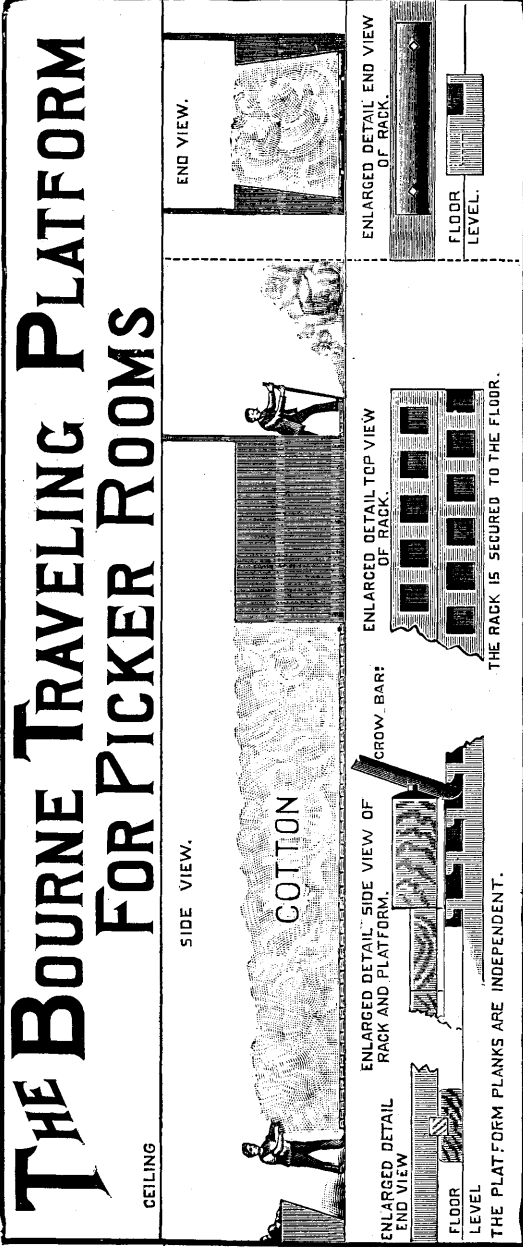
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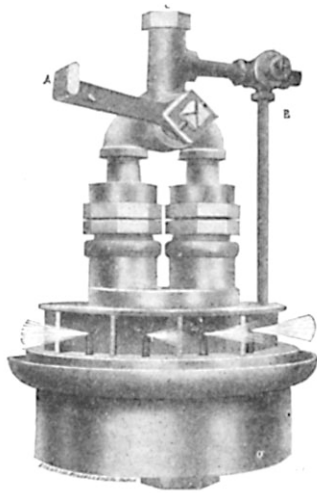
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Special attention given to Clothing for Revolving Top Cards. Experts furnished to Clothe
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EXCLUSIVE AMERICAN LICENSEE FOR THE

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CLARKSON'S 1901 HUMIDIFIER



This cut is one-fifth actual size of Humidifier.

When lever is at A one-third of Humidifier is in operation; when at B two-thirds are in operation; when at C the Humidifier is in full operation, and when at the opposite of C is entirely shut off.

The Clarkson System of Air Moistening

with the 1903 Patented Humidifiers IS THE NEATEST AND BEST ON THE MARKET for Cotton, Woolen and Silk Mills, and all places requiring a Constant Humidity. It increases production, makes stronger and smoother yarn or cloth, and purifies the air, making it more healthful for the operatives. It cools the air in summer and warms it in winter. No sweating of pipes or wetting of floors. It is the neatest looking, requires the least attention, and will outlast any system on the market. Patented throughout the world. For further particulars, address

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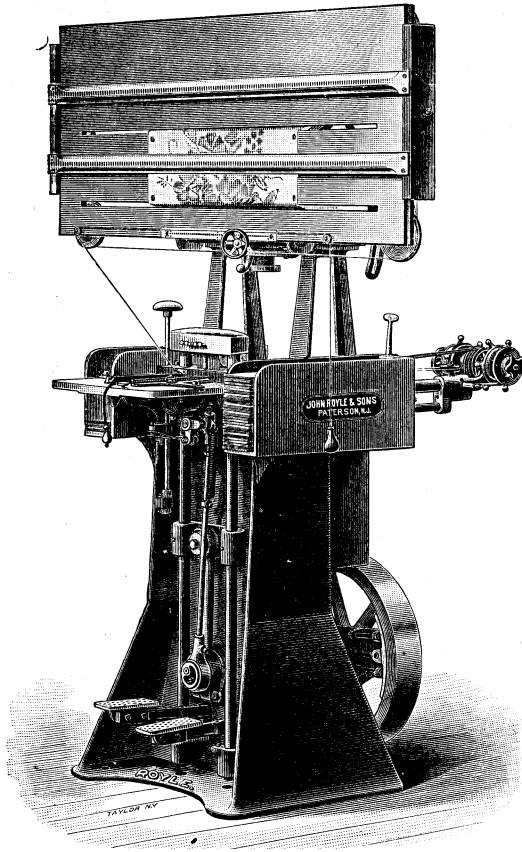
In the Gray, Dyed or Printed.

**ON SPOOLS, CONES OR SHUTTLE BOBBINS;
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FAST COLORS WARRANTED.

*Special Yarns made to order for all sorts of Silk
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The merits of the **ROYLE POWER PIANO MACHINE** are worthy of your attention. Controlled by regular driving it is positive and regular in its action, and the operator, relieved from supplying the power falls into its rythmic action unconsciously, while devoting his mind to reading the pattern and controlling the keys. The consequence is, he turns out twenty-five per cent. more work, and without increasing fatigue, as the day wears on, than he would if he had to pedal his strength away on a foot

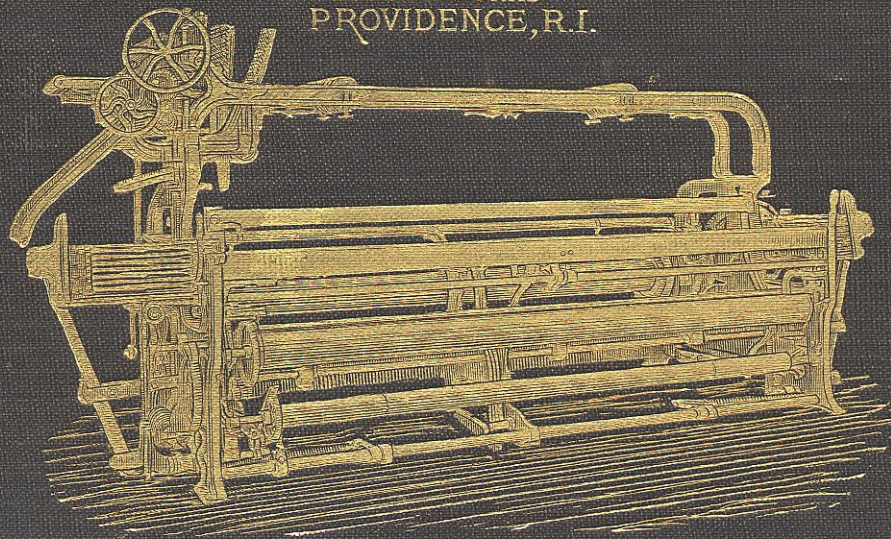
machine. The original expense of such a machine may be more, but it more than pays the difference by the increased volume of work.

THE **ROYLE AUTOMATIC REPEATER** is in close relationship to the **POWER PIANO MACHINE**. The one originates and the other duplicates, and does it perfectly, and the perfection of its work is the outcome of its simplicity.

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BUILDERS OF EVERY VARIETY
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