

length of the lever to the distance between its fulcrum and point of connection with the catch bar.

The brush and doffer mechanism for clearing the short fibres or tow from the hackles consists in a circular brush, a pinned doffer, upon which the brush deposits its tow, and a reciprocating knife for clearing the tow off the doffer and dropping it into receptacles placed to receive it. The brush consists in an iron shaft the whole length of the machine or section, having bosses about 9 in. diameter keyed upon it at regular intervals. To these bosses are screwed staves of wood shaped so as to form segments of a circle. Rows of hair are set either directly in these staves or in slips of wood which are attached to them by screws. The hair may be set at an angle to the radius of the roller with a view to better penetration and cleaning of the hackles. The speed of the brush is so made to conform with the number of rows of hair, the speed of sheet, and the number of bars, that each row of hair strikes a hackle as it comes round and strips off the tow. The position of the brush is below the bottom sheet roller. It can be moved in and out to a position corresponding to the length of the hair, and such that the brush strikes the pin at its root, without touching the stock, and gives it a clean wipe. The brush can only act on one side of the pin unless the hackle is so open that the hair penetrates between the pins. To overcome this difficulty the brushes are sometimes worked through a clutch arrangement by means of which the speed of the brushes may be periodically reduced to a speed below that of the hackles, when the pins pass through the brush bristles, cleaning the side not acted on in the ordinary way. This difficulty in cleaning the pins when working fine and gummy flax has led to a change in the number of rows of pins in the hackle stock. At first only the finer hackles were made with a single row of pins, while at the present time many machines are made with single rows from end to end. It has been found in practice that a single row of pins, in comparison with double rows set at the usual distance apart, will cut in the proportion of 5 to 7. For instance, 50 pins per inch in a single row will cut as well as 35 per inch in a double row, although the latter has 70 pins per inch if the two rows be taken together. Long and fine machines now frequently finish with 60, or even 70, pins per inch in the single row.

Stripper-rod machines are of three makes. Perhaps the best known is Horner's Duplex. The stripping-rod mechanism, being less elaborate than the brush and doffer, occupies less room, and consequently in this make the machines composing the pair may be placed close together and supported between double gables. In this machine the two channels may be made to balance each other, thus dispensing with weights. The stripper rods are wooden laths, 3ft. to 4ft. long, about 2in. broad and a $\frac{1}{2}$ in. thick. The wood is shod with metal ends, or "stripper cocks," which work in radial slots in the rollers which drive the sheets. As the rollers revolve, the stripping rods shoot out by gravity to the lower extremity of their slots as they are carried round towards the under side of the roller, falling back again towards the centre as they approach the top. When falling from the centre, the rod passes close to the

pins of the hackle, loosening the tow from them, the tow being then received upon a "tow-catcher" which deposits it in the tow box every time the head rises. The stripping-rod arrangement employed by cotton necessitates the use of more rods—their number corresponding with that of the bars in the sheet. They are carried round with the sheet and act, as do Horner's, on the principle of gravity. Another form occasionally used for coarse work consists in a sheet of bars of the same pitch as the hackle bars, but exceeding them in number. The stripping sheet runs round the outside of the other, its bars occupying the spaces between the hackles, its extra length enabling it to be drawn outwards from them at a given point by means of a tension roller, thus clearing away the tow. The brush and doffer machine gives better results, and is now almost universal dealing with the finer qualities of flax. As before mentioned, the sheets are usually run at from 9 to 15 revolutions per minute, putting the pins through the flax at the rate of 120 to 13,000 per inch per minute, according to the number of bars in the sheet and the fineness of hackles. From 5 to 6 lifts of the head per minute, delivering the same number of holders, is the usual speed, working with four boys. At this speed a machine should put through 3 to 5 parcels per day, according to the size of the pieces.

The actual cost of machining may be taken at about 9d. per cwt. The yield in hackled flax from the machine usually runs from 60lbs. to 80lbs. per cwt., or from 53 to 71 per cent.; the remainder, with the exception of 1 or 2 per cent. waste, being tow, which is divided into four or more qualities (1, 2, 3, 4, etc.), according to the position on the machines where it is taken off. It ranges in market value from 2s. to 6s. per cwt., according to description and quality. The tow may be spoiled by having the parts of the doffing mechanism improperly set or in bad working order. If the flax be badly roughed, very long, or not sufficiently tightened in the holder, "ropey" tow is often the result. It is produced by the long fibres encircling the brush and keeping it from doing its work properly, they themselves failing to be stripped off by the doffer. Then again the doffer may be driven too fast or the knife too slow. The "card" or doffer should make about one revolution for every ten of the sheet, and the knife about 100 oscillations per minute. In order that the brush may strike every hackle, the number of teeth in the roller wheel must bear the same relation to the number of teeth in the brush wheel as the number of times the pitch of bars is contained in the circumference of the bottom roller does to the rows of hair in the brush. Thus, in a 27-barred machine, 2 $\frac{1}{2}$ in. pitch, circumference of bosses on bottom roller 25in., roller wheel 65 teeth, 8 rows of hair on brush, the number of teeth which the brush wheel must have in order that the hair may strike every hackle will be 52, or as—

$$\frac{25}{2\frac{1}{2}} = 10 : 8 :: 65 : 52$$

The speed of the doffing roller or card, taking the same particulars in conjunction with roller pinion 24 teeth, stud