

distant. The hackled end of the flax is tightened into this holder, and the other being removed, the new holder, with the top end now projecting downward, is placed in the channel of the other machine, where it undergoes the same process and is delivered finished at the fine end. The loys remove the finished flax from the holders, and crossing each piece in a "tipple box," form a compact bundle or tipple, the ends of which are tied or "tipped up," and the bundles removed to the sorter or direct to the spread-boards, as the case may be.

One of the first machines for hackling flax was that of Robinson, which only hackled one side of the piece at a time. Machine hackling has been greatly improved since that date, but is still by no means perfect. The precursor of the modern vertical sheet machine was Ardell's Intersector, which consisted of two rollers covered with pins, working close together, the tow being removed by brushes. It is obvious that by such an arrangement only that portion of the piece for the time being in the point of intersection of the rollers was receiving any work, so that each portion of the piece had to remain there a certain length of time. The pins also came in contact with the piece with their sides and not their points, and consequently lacked penetrating power, the point of contact also being a long way from the "nip" of the holder, resulting in a consequent loss in yield. An obvious improvement was the substitution of vertical sheets for these hackling rollers.

Modern hackling machines are of two kinds, brush and doffer and stripping-rod, the former being more suitable for fine flax than the latter, but occupies more room since the two machines composing a pair must be separate, it being found impossible to place them as close together as in Horner's duplex stripping rod machine. The terms "brush and doffer" and "stripping-rod," refer to the means whereby the hackles are kept clean and free from tow. The vertical sheet hackling machine consists of two or more "gables," supporting in the single machine one pair and in the "duplex" machine two pairs of vertical sheets of hackles, the mechanism for clearing the hackles of tow, the "head" or "channel" which carries the "holders" or clamps for the flax, and the necessary gearing for giving motion to the various parts. The sheets consist of three or more endless bands of leather five or six feet in circumference, and carrying 20 to 30 bars, to which the hackles are directly or indirectly attached. The length of the "leathers," or their outside diameter, equals the number of bars multiplied by their pitch or distance apart—say for 30 bars $2\frac{1}{2}$ in. pitch $30 \times 2\frac{1}{2} = 75$ in. These sheets are carried at the top by bearing rollers usually about $2\frac{1}{2}$ in. diameter, and driven by bottom rollers from 9 to 10 in. diameter by means of projections on the roller and recesses in the sheet, or vice versa. Thus the working side of the sheets can be set more or less parallel, both the top and bottom rollers being adjustable hori-

zontally, so that the action of the hackles may have effect upon any length of fiber presented to them. The penetration or "striking in" is fairly direct, and the point of intersection within a short distance of the nip of the holder, since the hackles or bars can be attached to wings which rise tangentially as they round the top roller.

In Horner's brush and doffer machines the bars consist of flat iron rods about 3-16 in. thick, and $1\frac{1}{8}$ in. broad, with a flange on one edge. The bars are screwed to the "wings" of a piece of iron, the body of which is attached to the back of the leather by means of screws and washers on front side. Horner's newest machines have top rollers about $2\frac{1}{2}$ in. diameter, with bosses shrunk on in position corresponding with the leathers of the sheet. These bosses are recessed to receive the plates attached to the back of the leathers, and thus the hackles fixed upon the bars are thrown forward so as to directly penetrate the flax close to the holder. The bottom rollers are also furnished with bosses about 10 in. diameter with projections upon their periphery, between which the pieces attached to the leathers fit and furnish the means by which the sheet is carried round.

The hackles consist of wooden stocks, usually 10 in. to 11 in. long, 1 in. broad, $\frac{3}{8}$ -in. or $\frac{7}{16}$ -in. thick. To obtain a sufficiently firm foundation for pins set very close together in the row, it is found necessary to cover the wood with thin sheet brass. The pins are of steel, 1 in. to $1\frac{1}{4}$ in. long over all, and from 14's to 30's B.W.G. Set in double rows in the stock they are about $\frac{1}{4}$ -in. apart. The distance apart of the pins in the same row varies, in the coarser hackle being frequently 4 in., or $\frac{1}{4}$ -pin per inch. In the finer hackles the pins are sometimes so close as 70 per inch. "Grouping" the pins is of great importance. An illustration will explain the meaning of this term. Suppose that in a 30-barred machine the fineness of one of the rounds of hackles is $\frac{1}{2}$ -pin per inch or pins 2 in. pitch. If all the pins in each of the 30 hackles comprising this round were set in exactly the same position, bands of fiber 2 in. broad would be left untouched by the pins. In order that no portion of the flax may be left unoperated upon, the first pin in each succeeding hackle must be placed 2-30 in. further from the end of the stock than in the preceding hackle.

A good way to arrive at the correct position of the first pin in each of the hackles in the group is to place close together a number of hackle stocks exceeding those in the group by one. See that the ends are quite square. Determine the position of the first pin in No. 1 hackle at a distance from the end compatible with strength. Suppose that there are to be 12 hackles in the group, and the pitch of the pins 1 per inch. Mark a point in the last or 13th stock 1 in. further from the end than the first. Join these points with a diagonal line. The correct position of the first pin in each of the