CHAPTER FIVE

Jute Batching

THE sequence of operations at the start of the jute spinning process depends upon which class of yarns is being made. For the better grades, such as those destined for hessian fabrics, where the raw material is long jute from which the root end has been cut, the principal machine is the spreader, but for the poorer grades of yarn the jute is passed over the softener as the short nature of the raw material precludes the use of the spreader. Because of this division the two systems will be treated separately, but before doing so it may be advantageous to discuss certain terms which are common to both. It has already been indicated that the term 'batching' strictly refers to the addition of oil and water to the jute, but the use of the term has spread to associated features at this stage in the process. The department where the jute is taken from the bale and prepared for carding is called the 'batching-house'. As will be explained shortly a blend of different types of jute is made up to suit the particular class of yarns being spun, this blend being known as the 'batch'. 'Conditioning' or 'maturing' refer to the resting stage which jute is given after the water and oil have been applied, it lasts longer with low-grade batches to allow the hard, barky, root material to become softened before passing on to the cards.

Since jute is a product of nature, and as such is subject to the vagaries of soil and climate, its properties are by no means constant at all times. If only one strain of jute were used until that was exhausted, then another type fed into the process, then a few months later yet another type fed in, it is obvious that there would be a continual change in the strength, colour, and regularity of the yarn from month to month. If, on the other hand, the different kinds of jute which are available are thoroughly mixed together into one homogeneous lot then this will provide a supply of raw material which is reasonably constant and which will spin a yarn of a suitable quality at all times. Certain factors must be borne in mind when the grades of jute are being selected to form a batch. It is better to avoid large differences in the physical properties of the grades being blended. For instance, it is not good practice to blend a high quality jute with a low quality one, since the good qualities of the former will be completely swamped by the poor qualities of the latter. For this reason blending is confined to similar grades of jute.

Commonly two to six grades of long jute are put into a batch for hessian-type yarns; for sacking yarns, cuttings, low-grade long jute, and mill wastes are used. It is desirable to express the components in terms of their relative percentages in the batch, for example.

Quality	*Quantity*	*Percentage*
Mill Hearts	2 bales	18
Export Lightnings	4	36
Grade Tossa 4	4	36
Export Hearts	1	9
Northern Tossa X-Bottoms	1,800 lb	30
Northern White C-Bottoms	1,800	30
Cuttings	1,200	20
Habi-jabi	900	15
Bale ropes	300	5

Examples are given below of the types of jute which may be used for the various classes of yarns.

Fine yarns ($3\frac{1}{2}$–6 lb/sp)	Top quality Dacca Tossa 4s and 5s, Crack Hearts, or similar grades.
Medium yarns (6–20 lb/sp)	Medium quality, Mill class of white jute or Export white, Grade Tossa, Out-port Tossa 2/3s, 4s. Warp batches always higher than weft. Kenaf may be included in weft batches.
Sacking yarns (12–40 lb/sp)	Warp from low marks of long jute, weft from cuttings, tangles, bale ropes, thread waste, and some low-mark long jute.

HESSIAN BATCHING

The various marks of jute are assembled at the start of the processing line. The ropes round the bales are cut through with an axe and laid aside to be processed separately. Under the extremely high pressure of the pucca baling press the jute becomes hard and as stiff as wood. Before the fibre can be handled satisfactorily it must be made more flexible. This is done by a machine called a bale-opener. The bale-opener is a massively built machine with heavy fluted rollers, intermeshing with each other. Figure 5.1 shows two types which are in

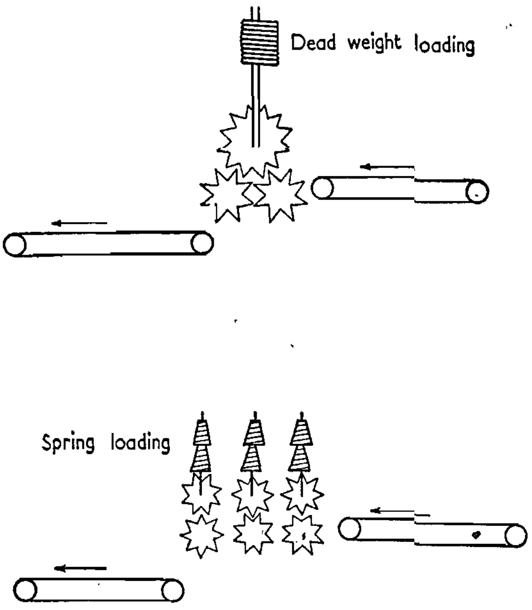

Figure 5.1. Two types of bale-opener

common use. When the ropes have been cut off, the bale still retains its rectangular shape and the jute is pulled off by hand in slabs or heads, each head comprising a bundle of reeds which have been loosely twisted together weighing 8–9 lb. Complete heads are fed into the bale-opener where the action of passing between the fluted rollers under pressure flexes the jute and it emerges from the machine soft and pliable. Most bale-openers operate at 28–30 ft/min and can handle 1 bale in about 2 min.

Recently an automatic bale-opening range has been developed by Douglas Fraser Ltd with a view to saving labour at this stage. The bale is placed on a feed lattice and is carried up into the bale-opener beneath rotating knives which cut the ropes. The bale is then squeezed by three pairs of heavy fluted rollers which soften and open out the heads into the form they were in before baling. The bale is then discharged on to a special trolley. Using this machine one man can handle 30 bales per hour.

The next step is to split the heads up into smaller bundles, called 'stricks', for feeding to the spreader. The heads are untwisted by hand, split lengthways into stricks weighing 3–5 lb. The stricks are then given a half twist at their middle, folded, and placed neatly on a barrow. The stricks should be as nearly the same size as possible and striking-up, as the operation is called, is a matter of experience. The first stages of blending begin at the bale-opener, for a head is taken from each mark of jute in turn and fed through the machine so that the pile of jute at the delivery end, from which the strikers-up work, is a mixture of the different marks. As the barrow is built up with stricks from the various marks in the batch further mixing and blending goes on. Once the barrow is full it is pushed to a holding-area to supply the spreader feeds.

THE SPREADER

The jute spreader was developed from the earlier Good's machine of the hard fibre trade and has now supplanted the softener for hessian-type yarn manufacture. Figure 5.2 shows the essential points of the machine.

The stricks are taken off the striking-up barrow one by one and laid by hand on the feed sheet of the spreader, the root end of one strick overlapping the crop end of the previous one. This is the point where the separate and individual reeds of jute are assembled into a continuous sliver. The stricks pass between a pair of fluted feed rollers and on to the pins of the slow-moving pinned lattice known as the slow chain; above the slow chain there are two or three lantern rollers to press the jute firmly down on to the pins. As may be imagined, the construction of the pins (and indeed the whole machine) is rugged. Halfway along the machine the material is transferred from the pins of the slow chain to those of a similar chain having a higher surface speed. Because of the greater linear speed of the fast chain the jute

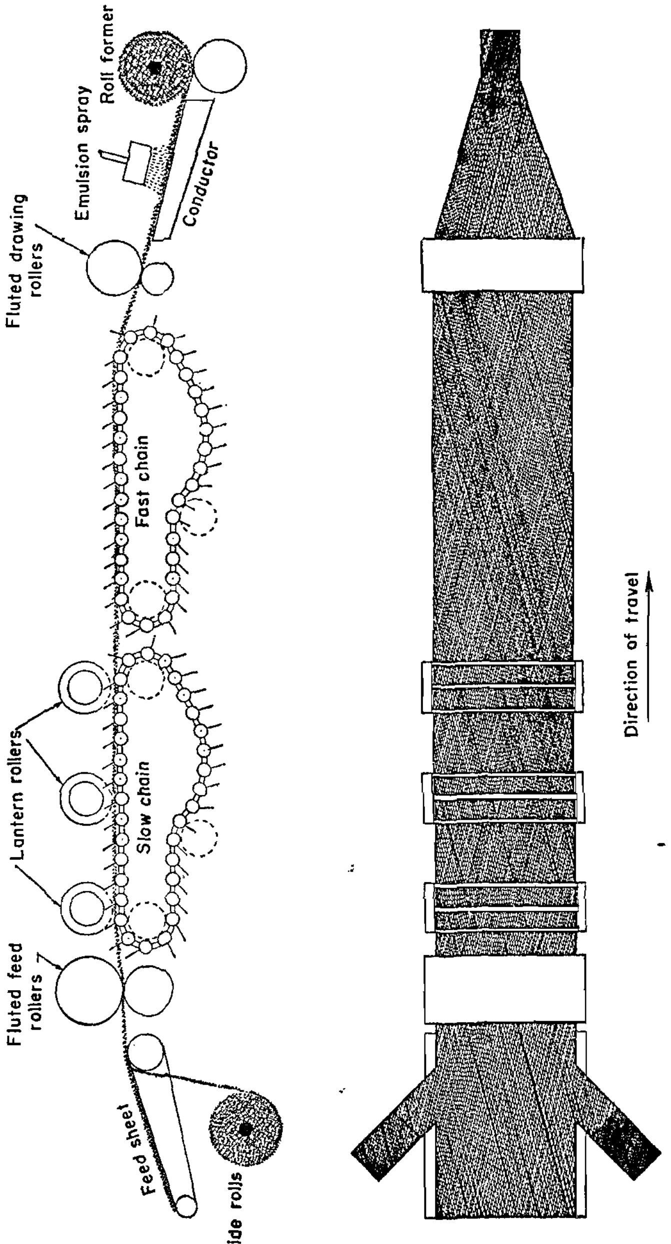

Figure 5.2. Jute spreader

is combed and drawn out, i.e. drafted, at this transfer point. When a fresh strick passes between the feed rollers and on to the slow chain it can be clearly seen that the root end is much heavier and bulkier than the remainder and as it comes under the action of the fast chain the faster moving pins tear and comb out this root end while the rest of the strick is securely held by the slow chain pins. This action continues until so much material has been transferred from the slow chain to the fast one that there is no longer sufficient jute imbedded in the slow chain to hold the strick back and it suddenly whips through the slow chain pins. This phenomenon of sudden release of restraint and its associated rapid fibre movement is met with at other stages in the process and is known as 'gulping'. Wherever it occurs it is undesirable since it means that the tail-end part of the material has not had the full treatment it needed.

The main spreader draft operates between the slow and fast chains and the linear speed of the latter divided by that of the former gives the draft at this point. If there is a draft of, say, 6 then 1 ft of material on the slow chain will become 6 ft on the fast chain. Concurrent with this attenuation or drawing-out in length there is a reduction in the sliver count.

The basic equations concerning draft are

$$(1)\ \text{Machine draft} = \frac{\text{Greater linear speed}}{\text{Lesser linear speed}}$$

$$(2)\ \text{Length fed} \times \text{draft} = \text{Length delivered}$$

$$(3)\ \frac{\text{Count fed}}{\text{Draft}} = \text{Count delivered}$$

The jute comes off the fast chain, passes between a pair of fluted delivery rollers and is guided down an open-topped channel where the emulsion is added, either by a pressure spray or by a gravity-fed drip weir. The final action is to collect the sliver in a form suitable for the next stage of carding.

There are four factors on the spreader which determine its efficiency from the points of view of quality and production.

(1) The fibre must be fed into the machine as evenly as possible.
(2) The stricks must be combined into a continuous sliver which is then drafted to the correct count—this action to be combined with a certain amount of preliminary splitting and opening of the stricks.

(3) The emulsion must be applied uniformly and at the proper rate.
(4) The delivered sliver must be in a state suitable for feeding to the breaker card.

FIBRE FEED

The spreader feeder is presented with a barrow containing perhaps 200 stricks and weighing 1,000 lb, enough material to last about half an hour and his problem is to feed all that jute to the spreader at the same rate from start to finish of the barrow and do the same for the next barrow and the next, hour after hour during the day. Without some assistance it would be extremely difficult for him to do this consistently and this assistance is given at the spreader by a weighing machine with an additional pointer on it. The barrow is pushed on to the platform of the weighing machine which is situated conveniently to the spreader feed and the dial of the balance registers the weight of jute on the barrow (after allowing for the tare of the barrow). If now the jute is taken off, one strick at a time then the reading on the weighing machine scale will gradually fall until it registers zero when the barrow is empty. In this way there is a ready means of knowing how much jute has been fed to the spreader but as yet no account has been taken of how quickly it has been fed. Unless the jute is fed at the correct rate in terms of pounds per minute it will be impossible to achieve the correct count of sliver. If the spreader feeder was given a clock and told that he must empty the barrow in, say, 32 min then he could judge fairly accurately that he would have to feed between 150 and 160 lb of jute every 5 min to achieve a regular feeding rate. Apart from the obvious disadvantages of providing clocks for each spreader this method would be liable to error for whenever the spreader stopped for any reason the feeder would almost certainly fail to note the exact time and so find it difficult to pick up the proper feed rate immediately. This difficulty can be overcome if a 'clock' driven by the machine itself is provided. The feeder can then be told that he must feed a specific weight of jute to the machine in one complete revolution of the machine-driven clock pointer or some fraction of it. This, in fact, has been commonplace on jute machinery for many years and the term 'clock length' is used. The clock length is simply the distance moved by the feed sheet in one revolution of the clock pointer. The weight of jute which is fed on to this length of feed sheet is called the 'dollop'.

Thus if the dollop is 700 lb and the clock length is 15 yd then the weight per unit length being fed is

$$\frac{700}{15}\times\frac{100}{1}=46{\cdot}7\ \text{lb/100 yd}$$

On the spreader the machine-driven clock pointer is placed on the front of the weighing machine dial and as the spreader runs it moves slowly round the face of the dial, giving the operative a pace to work to. By means of suitable gearing the clock pointer is made to move around the dial at a speed which will be matched with the dollop weight and the clock length. All the feeder must now do is to remove jute from his barrow at such a rate that the weighing machine pointer and the driven pointer are coincident at all times and he will be certain that he is feeding the jute at the correct rate. On the spreader this driven pointer is often called the 'slave' pointer but this is a misnomer; the driven pointer demands that the machine will be fed at a certain rate and therefore *it* is the master and the weighing machine pointer, which must follow it, is the slave.

Figure 5.3 illustrates the gear drive to the driven pointer on a spreader, the motion being taken off the feed rollers. In the previous paragraph it was said that the clock length was equal to the total

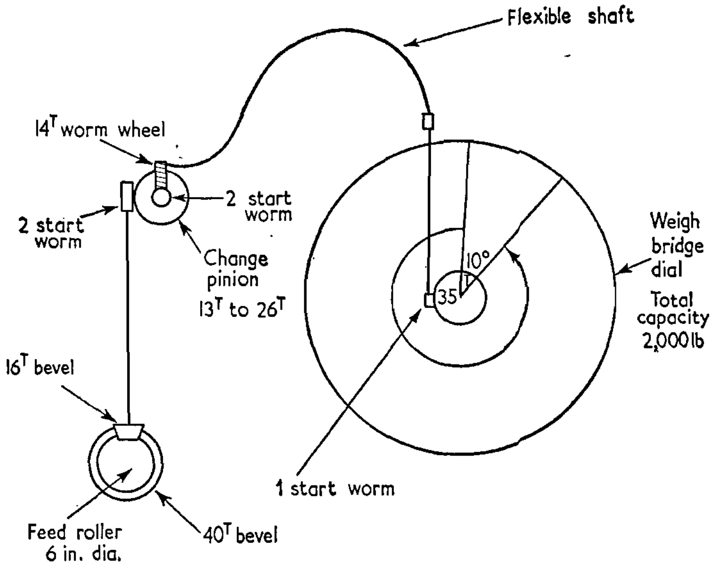

Figure 5.3. Gearing of spreader feed

distance moved by the feed sheet while the driven pointer moves through one revolution. For the spreader this is not quite true since, because of machine design, the pointer only travels through 350 degrees and not 360 degrees. The clock length is calculated by assuming that the feed to the machine is driven by the pointer (in fact, of course, it is the other way round) and finding the total distance the feed sheet moves. To enable quick changes to be made to the clock length there is a clock length change pinion in each gear train. In the example shown in Figure 5.3 the clock length is

$$\frac{350}{360} \times \frac{35}{1} \times \frac{14}{2} \times \frac{\text{change pinion}}{2} \times \frac{16}{40} \times \frac{6 \times 3{\cdot}142}{36} \text{ yd}$$

$$= 25 \times \text{change pinion yd}$$

i.e. the gearing constant is 25 and Clock length $= 25 \times$ change pinion yd

Since the change pinions in the gear drive to the pointer are in the range 13–26 teeth, alterations in the clock length of the order of 5–10 per cent can be made. This is of advantage if changes in the feeding rate are wanted or if the main draft changes on the machine are too coarse to effect the necessary alteration in sliver count. By using the spreader feed change pinion in conjunction with the main draft change pinion a wide range of operating conditions may be achieved, as will be seen later.

While this system of a master driven pointer and a slave weighing machine pointer offers a convenient and simple means of regulating the spreader feed it may not achieve its object under certain conditions. Ideally, the weighing machine dial should be directly in front of the feeder and he should look straight at it. However, in many installations this is impossible due to the layout of the work-place and the space available and the weighing machine dial is a few feet away from the feeder and situated at an angle to his line of vision. If this is so then there are certain positions on the dial where, to the feeder, the two pointers appear to be exactly in line, but when viewed from directly in front of the dial, as they should be, they are seen to be separated and the weighing machine pointer will either be lagging behind or leading the driven pointer. Under these conditions the feed will not be constant from start to finish of the barrow and one often finds that as the barrow is emptied the feeding rates gradually become greater, simply because of this positioning error resulting from parallax when the feeder views the two pointers. An attachment to the

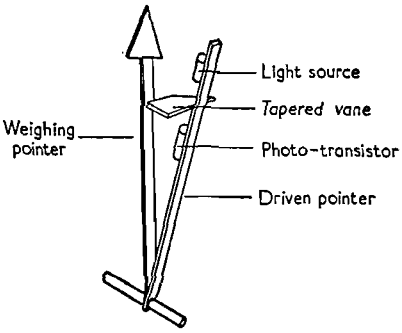

Figure 5.4. Essential features of the B.J.T.R.A. feed regularity meter

spreader feed called the 'Feed Regularity Indicator' has been developed by the B.J.T.R.A. to overcome this difficulty, Figure 5.4 showing the essentials of the method. A light source and a photo-transistor are fixed to the driven pointer a few inches apart and a triangular-shaped metal vane is attached to the weighing pointer. The vane can interrupt the beam of light shining from the light source on to the photo-cell by passing between them and, since it is tapered, the amount of light cut off becomes proportionately greater as the vane passes further between the two. In this manner the amount of light cut off can be used to measure how far the vane has penetrated between the light and the photo-transistor. The light falling on the cell generates a small

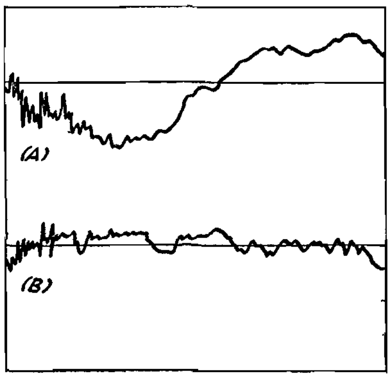

Figure 5.5. Records of pointer separation: A, without Feed Regularity Indicator; B, with Feed Regularity Indicator

current of electricity which is used to operate an indicator at the front of the machine directly above the feed sheet and in clear view of the operative. When the two pointers are exactly in line, as they should always be for perfect feeding, a certain amount of current is generated and the indicator registers 'correct rate of feed' but if the weighing pointer lags behind the driven pointer then more light is let past, more current is generated, and the indicator shows 'feed too light'. On the other hand, if the weighing pointer gets ahead of the driven one then the indicator registers 'feed too heavy'. Figure 5.5 shows two records of the amount by which the weighing pointer has been separated from the driven pointer, one being taken with the Feed Regularity Indicator in use and the other when it was not; the improved uniformity in the rate of feeding can be seen. The advantages of the Indicator are

(1) It assists the spreader feeder to keep a uniform rate of feed.
(2) Being situated directly above the feed sheet it is facing the feeder and there is no parallax.
(3) The Indicator shows clearly if the feed is heavy or light.

The Indicator can, if necessary, be coupled to a pair of counters which record the total length of sliver produced by the spreader and the amount of sliver produced within certain prescribed limits. This is done by arranging that one counter will operate as long as the spreader runs and the other will operate as long as the output current of the photo-cell lies within a certain range but to stop as soon as the current exceeds it. In other words, as long as the weighing pointer follows the driven pointer within a certain tolerance then both counters record, but whenever the feed is excessively heavy or light then one of the counters will stop. This can form the basis of a quality assessment for spreader feeding, e.g. if the limits of separation which will be tolerated are ± 10 lb then both counters will operate as long as the weighing pointer is within 10 lb of the driven one. But as soon as the pointer exceeds the tolerance one of the counters will cease recording until the weighing pointer returns within the 10 lb limit. The total length of sliver put out by the machine may be 16,000 yd in a day and there may be 14,500 yd of 'good', i.e. within-limit, sliver recorded; then one may say that for this period the spreader was being fed for 91 per cent of the time in a satisfactory manner.

Before leaving the feeding arrangements on the spreader it is necessary to discuss 'leader' rolls. These are two rolls of spreader sliver which are brought back to the feed end of the machine where they are entered through two special channels at the top of the feed sheet and pass into the feed rollers along with the hand-fed stricks. The purpose of using leader rolls is to give a more uniform sliver with a cleaner, neater edge to the roll of delivered sliver but off-setting these advantages is the occasional trouble experienced when the sliver coming from them breaks or becomes tangled, and the small amount of extra labour required to bring them from the delivery end of the machine to the feed. The leader rolls may be drawn from the normal supply of sliver rolls, in which case some of the jute gets an additional treatment with emulsion, or alternatively a supply of 'dry' rolls can be made specially for leaders—the latter method is to be preferred. The use of leaders is optional, some manufacturers being of the opinion that the rolls of spreader sliver are satisfactory without them.

DRAFTING

Most of the drafting on the spreader occurs at the transfer from the slow chain to the fast chain. Although small drafts—usually referred to as leads—are present at every transfer point, i.e. feed sheets to feed rollers, feed rollers to slow chain, fast chain to delivery rollers, delivery rollers to roll former. The object of a lead is to keep the material taut as control is passed from one stage to the next.

Typical values for speeds, draft, and leads are

Feed sheet	6 yd/min	
Feed rollers	7·3	Lead 21·5 per cent $\left(\frac{7\cdot3-6\cdot0}{6\cdot0}\times 100\right)$
Slow chain	8·0	Lead 8·8 per cent $\left(\frac{8\cdot0-7\cdot3}{7\cdot3}\times 100\right)$
Fast chain	44·8	Draft 5·6
Delivery rollers	58·2	Lead 29·8 per cent
Roll former	64·0	Lead 10·0 per cent

Overall draft 10·67 $\left(\frac{64\cdot0}{6\cdot0}\right)$

For each spreader there is a draft constant derived from the gearing; this is a numerical constant calculated from the number of teeth in the pinions of the gear train and the surface speeds of the feed and delivery rollers. The draft on the spreader can be altered to suit the production requirements by changing one pinion in the gear train. This pinion is called the draft change pinion; the pinion needed for a certain draft is found by dividing the draft constant by the draft, e.g.

Draft constant: 400

Draft required: 11

Draft pinion: $\frac{400}{11} = 36{\cdot}4$ teeth

Since pinions cannot have fractions of a tooth,

Draft pinion used: 36 teeth

Actual draft: $\frac{400}{36} = 11{\cdot}1$

Figure 5.6 illustrates a typical gear train for a spreader.

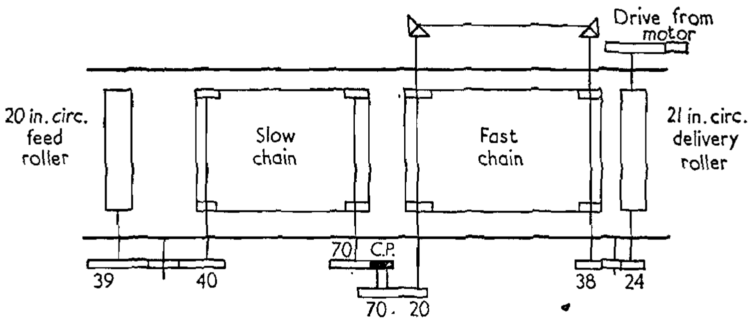

Figure 5.6. Spreader draft gearing

For illustration, the method of calculating the draft constant on the spreader will be shown. Assume that the delivery is driven from the feed and find the number of yards delivered as a result of 1 yd being fed in at the feed end. In the gearing of Figure 5.6 1 yd of feed requires $\frac{36}{20}$ revolutions of the feed roller and therefore the length of sliver delivered when the feed roller rotates through $\frac{36}{20}$ revolutions is,

$$\frac{36}{20}\times\frac{39}{30}\times\frac{70}{\text{change pinion}}\times\frac{70}{20}\times\frac{38}{24}\times\frac{21}{36}=\frac{397}{\text{change pinion}}$$

i.e. Draft constant = 397

By means of a range of draft pinions, different drafts can be selected to produce the count of sliver required. For the gearing illustrated in Figure 5.6 these are

Change pinion	*Draft*
33	12·0
36	11·0
40	9·9
44	9·0

It may be, however, that the changes in the draft shown are too large to suit a particular set of circumstances and in this case it is possible to obtain much finer steps of draft by using the clock length changes in conjunction with the spreader drafts. To show the details of the calculation of the delivered sliver count when certain pinions are used in the clock length gearing and the draft gearing, an example will be given.

Dollop weight	1,000 lb
Clock gearing constant	10
Spreader draft constant	350
Clock length change pinion	20
Draft change pinion	35
Emulsion application	25 per cent

Clock length $= 10 \times 20$

$= 200$ yd

Feed sliver count $= \dfrac{1000 \times 100}{200}$ lb/100 yd

$= 500$ lb/100 yd (2,500 ktex)

Emulsion applied $= \dfrac{25}{100} \times 500$ lb on each 100 yd of jute

$= 125$ lb

Total weight fed in $= 500 + 125$

$= 625$ lb/100 yd

Spreader draft $= \dfrac{350}{35}$

$= 10$

Delivered sliver count $= \dfrac{625}{10}$ lb/100 yd

$= 62{\cdot}5$ lb/100 yd (312·5 ktex)

TABLE 5.1. EXTENDED LIST OF SPREADER SLIVER COUNTS USING DRAFT AND CLOCK LENGTH CHANGE PINIONS

Clock change pinions	*Draft change pinions*			
	33	36	39	42
13	61·4	67·0	72·6	78·3
14	57·0	62·3	67·5	72·6
15	53·2	58·1	62·5	67·7
16	49·9	54·4	59·0	63·5
17	—	51·3	55·6	59·8
18	—	—	52·5	56·5

Table 5.1 shows the range of spreader sliver counts which could be prepared from a combination of feed gearing change pinions and draft change pinions, the figures being illustrative only and referring to a 20 per cent application, a 2,000 lb dollop, a feed constant of 25 and a draft constant of 397.

Thus, by a judicious choice of the two pinions it is possible to produce spreader slivers which differ in count by only 1 or 2 per cent. However, there is another matter to be taken into account and this is the rate at which the spreader feeder can actually work and still maintain an even pace for laying the stricks neatly on the feed sheet. Jute spreaders are constant delivery speed machines, i.e. the revolution rate of the delivery rollers is governed by the motor speed and the drive pulley dimensions, and when the draft is changed it is the feed sheet's linear speed that alters. If the draft is increased the feed sheet travels slower and if it is decreased then the feed runs faster.

Besides the general effect of altering the sliver count, drafting plays an important part in determining sliver quality. Spreader sliver is always very variable in count over short lengths, an unavoidable feature of the material and the manner of forming the sliver. If one weighs short lengths of sliver (18 in., for example) and plots the weighings in the order of cutting on a graph, then one can pick out definite wave-like variations in the weights. Figure 5.7 shows the results of such a test.

This is typical of spreader sliver, with short pieces as light as 25 lb/100 yd and others as heavy as 130 lb/100 yd. The peaks of the waves occur at regular intervals which measurement shows are equal to the distance between successive root ends of the stricks on the feed

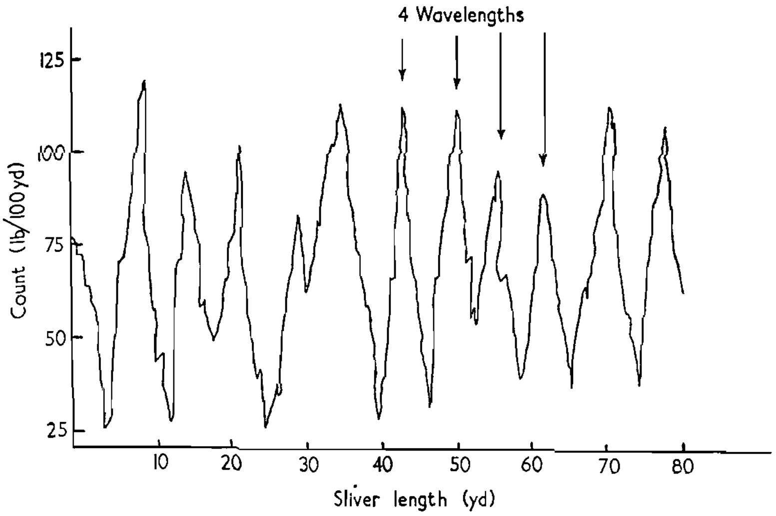

Figure 5.7. Spreader sliver, count of 18 in. lengths

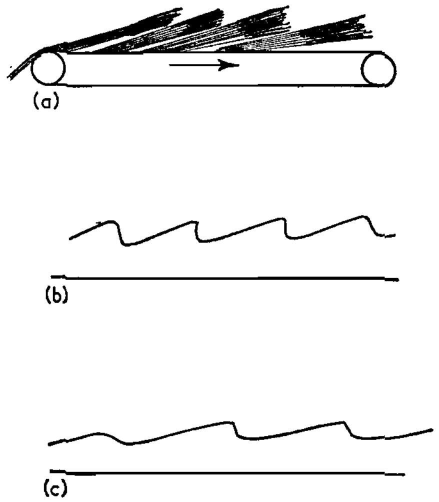

Figure 5.8. Diagram of weight variation in spreader sliver due to strick overlap.

(a) *Overlapping stricks on feed sheet;*
(b) *Weight variation fed in;*
(c) *Weight variation delivered*

sheet multiplied by the spreader draft. The height of the waves depends upon the size of the stricks, being greater for large stricks and smaller for lighter stricks. Figure 5.8 has been drawn to show how this comes about.

As the root ends of one strick overlap the body of the preceding one on the feed sheet it follows that there is a section of material on the feed sheet that is approximately twice the weight of that section immediately before it and immediately after it. When this extra heavy piece is carried forward to the pins of the fast chain then it produces a length of drafted sliver which is still heavier than that before it and after it—all that the draft does is to stretch out the double-weight section. When the delivered sliver is cut into short lengths the count is high at the point where the double-weight portion begins, i.e. at the leading end of each new strick, and falls as the bottom and the upper stricks taper away to their crop ends. Before the count falls to zero, however, a new strick has been thrown on the feed sheet and entered the pins of the two chains, and the weight pattern is repeated. It will readily be seen from Figure 5.8 that the wave-length (the distance from peak to peak) will be greater if the distance between succeeding stricks is great and if the draft is high. Similarly, if heavy stricks are overlapped then there will be a corresponding large amplitude (the height of the wave). These conditions are found when large stricks are used to feed the spreader; because they are heavy they need not be laid on the feed sheet so frequently and therefore the distance between root ends is great. Unless a heavy sliver is taken off the machine, a high draft will be needed to handle the heavy feed and, finally, the large bulky root end will give a wave with a high amplitude. Small stricks, on the other hand, produce a more regular sliver but they do require more labour and effort both at striking-up and the spreader feed. Under normal circumstances the spreader feeder cannot feed much faster than about 10–12 stricks per minute which, for normal rates of feed, requires stricks of about 2½ lb. This represents the minimum strick size, but in practice stricks of 5 lb are common since less labour is required at striking-up.

EMULSION APPLICATION

The emulsion is kept in its storage tank until required and then drawn off by a pump and fed into a ring-main. Figure 5.9 illustrates a typical system of pipelines in the batching department. The ring-main travels

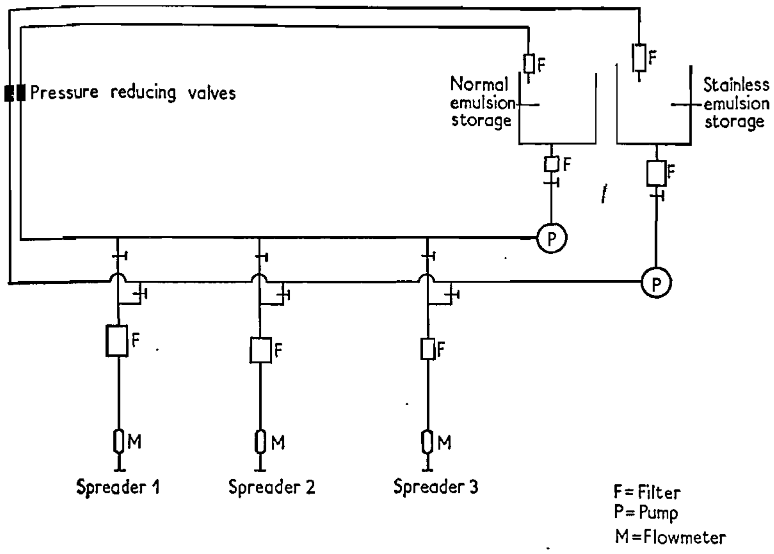

Figure 5.9. Emulsion distribution system

to the spreaders and back to the storage tank, appropriate filters being placed at the exit and the return of the storage tank to keep the liquid as free as possible from dust and dirt. At each spreader a supply line is tapped off, carrying a pressure-reducing valve if necessary, in addition to a throttling valve which cuts off automatically when the spreader is stopped. An alternative supply system may consist of a gravity-feed storage tank which delivers the emulsion to a second smaller storage tank by the spreader from whence it is drawn off by means of a low pressure gear-pump operated by the spreader itself. Whichever method is adopted it must have an adequate series of filters, including one as near the sprays as possible, and an automatic cut-out which will shut off the flow of emulsion whenever the machine stops.

In Chapter 4 the necessity for accuracy in compounding an emulsion and supplying it at the correct rate was emphasized. While it is true that doubling after the spreader helps to even out some of the irregularities of moisture and oil contents, by no means all will be eliminated and, more important, a wrong level of moisture or oil cannot be corrected. For these reasons it is vital that the application be correct.

Figure 5.10 shows the amounts of moisture and oil which will be added to the jute for different application rates and emulsion recipes;

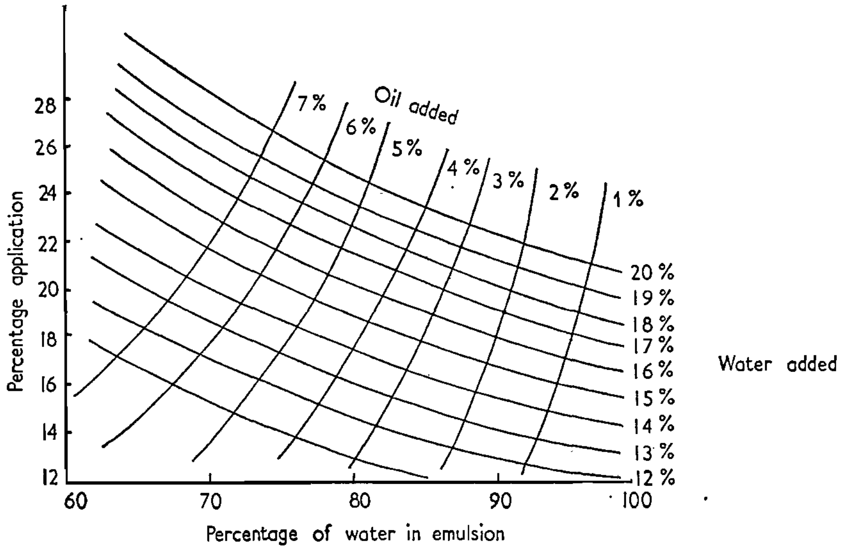

Figure 5.10. Percentages of oil and water added to the jute from various emulsion recipes and applications

notice again that there is one, and only one, combination of application and recipe that will give a specific moisture and oil addition.

The rate at which the emulsion is being fed to the jute may be indicated by one of three methods. The commonest of these is the Bourdon pressure gauge but flowmeters offer a better alternative. Finally, the Fraser ultrasonic plant meters the emulsion by valves and pumps and no external indicator is needed. The Bourdon pressure gauge is of the common type met with in steam-raising plant, water mains, etc., and although it has the advantages of cheapness and robustness, as a means of indicating the rate of flow it has serious drawbacks. Strictly speaking, it is impossible to give an accurate indication of the flow-rate with such a method—it is analogous to measuring the current flowing in an electrical circuit with a voltmeter. The main fault with using a pressure gauge is that when a blockage occurs downstream from the gauge, perhaps at the sprays themselves, then the fluid pressure in that part of the pipe will *rise* and through back-pressure the reading on the gauge will increase, giving the impression that more liquid is passing whereas in fact the flow has been restricted. Before any idea of the amount of emulsion being sprayed on to the jute can be obtained, it is necessary to run calibration tests to find the relationship between gauge pressure and rate of flow; this must be done individually for each spreader, for if there are two or more spreaders operated off the same ring-main then there will be a fluid pressure drop between them and consequently the same gauge pressure at each spreader will not give the same rate of emulsion flow. Another disadvantage in their use is that they are liable to error if the viscosity of the emulsion is changed, as may happen when changing from a stainless emulsion to a 5 per cent oil one. For example, one test showed that when the gauge pressure was kept constant at 16 lb/in² and a 20 : 80 oil–water emulsion passed through, then the rate of flow was 6·20 lb/min, but when the emulsion recipe was altered to give 30 : 70 ratio the flow rose to 6·5 lb/min, an increase of 5 per cent. Nevertheless, successful control of the application rate can be achieved with this simple apparatus provided the emulsion is clean, the filters are well maintained, and the flow/pressure calibration is checked frequently.

The most common type of flowmeter met with in the jute industry is the variable orifice type (Figure 5.11). The emulsion flows upwards

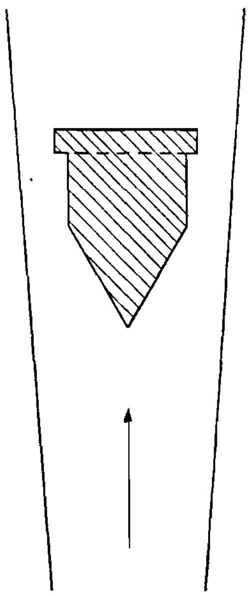

Figure 5.11. Variable orifice flowmeter

through a tapering tube containing a specially shaped metal float. The force of the emulsion passing the float causes it to rise and the height it rises within the tapering tube gives a measure of the amount of emulsion that is passing. The float is held at this height by a balance of forces; the emulsion flow is tending to make it rise but its weight is holding it back. The tube is calibrated in gallons per hour, pounds per minute, litres per minute (or some such convenient unit) for certain operating conditions of pressure, temperature, etc. The simplest form of flowmeter comprises a glass tube with the scale etched on it but more refined types are available which have external indicators capable of operating warning bells or flashing lights if the emulsion flow-rate falls outside certain prescribed limits. These meters are sturdy but quite sensitive to even small changes in the rate of flow and their advantages over pressure gauges are

(1) They register directly the amount of emulsion passing on to the jute; this makes it easy to calculate the percentage application.
(2) Floats can be obtained which are immune to changes in the viscosity of the emulsion and so changes from stainless to 5 per cent material can be made without any adjustment being required to the meter.

The Fraser ultrasonic system has already been dealt with, suffice it to say that the rate of flow is decided by the position of the various valves within the unit.

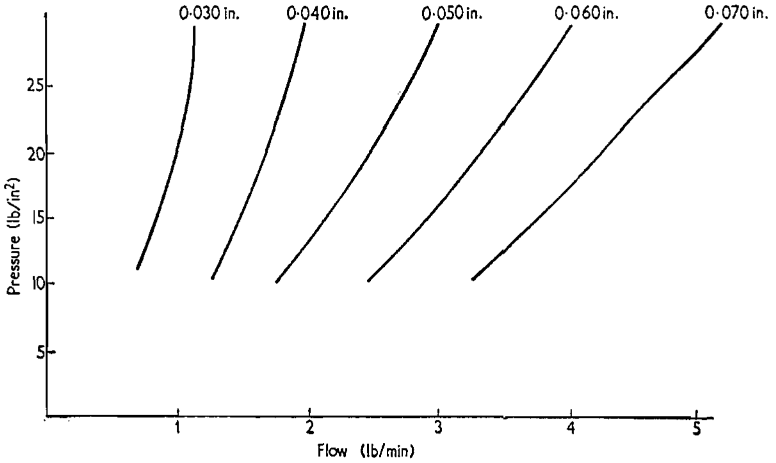

Figure 5.12. Typical rates of flow for various orifice sizes

After the emulsion has passed the metering point it is applied to the jute. Two methods of application are available, sprays or weirs, the former being used with pressure-fed systems drawn from a storage tank and the latter with the ultrasonic unit. Sprays are of the orifice-plate type with either a single central hole or a ring of smaller holes drilled vertically or at an angle at the semi-radius. The quantity of emulsion which will flow through a spray of this type depends upon the pressure at which the emulsion is delivered to it. The higher the pressure the greater is the flow, particularly with sprays with large holes. Figure 5.12 shows the rate of flow for a single-orifice spray operated at different pressures and various orifice diameters and it will be apparent that care must be taken when renewing sprays that the correct size of orifice be fitted.

In the weir method the emulsion trickles down grooves cut in the face of a small metal trough and on to the jute. Whichever method is used it is essential to see that the sliver is covered completely from side to side so that no fibre passes without getting its share of emulsion.

ROLL FORMING

The final demand imposed on the spreader is to provide a sliver in a form suitable for the next stage, carding. The sliver emerges from the nip of the delivery rollers, passes down the conductor, where it is sprayed with the emulsion, then enters the roll-former. The roll-former builds up a close-packed spiral of sliver, hydraulic or air pressure being used to make a dense, compact roll about 4 ft in diameter and 6 in. across the face.

When the roll is of the required size it is ready for doffing. (This is the term used in all textile processes for the action of removing full packages from a machine.) The exact moment of doffing can be decided by the diameter of the roll or by its length. The first method gives rolls of constant weight (or nearly so) whose lengths vary inversely as the count of the sliver; the constant length method gives rolls whose gross weight varies directly as the sliver count. This latter method is useful for routine process checking because if the length is fixed and known then, by weighing the roll, one has a ready means of checking the sliver count.

Depending on the type of roll former in use the rolls may be doffed automatically without the spreader stopping, or it may be necessary to doff the rolls manually, in which case the spreader is stopped.

After the rolls have been doffed they are laid aside for 24–48 hr to mature or condition. The moisture and oil added at the spreader are always, in spite of all the precautions taken, very irregularly distributed, but when the rolls are allowed to stand the moisture and oil become more evenly spread on the fibres. If too much water has been added or if the water is uneven and patchy on the sliver, lapping often occurs at the cards, i.e. the damp fibres stick to the rollers at the feed or delivery of the cards and travel round with them, a wad of fibres builds up, and the machine has to be stopped so that the jute can be cut off.

Spreader rolls may exhibit spontaneous self-heating just as root cuttings do. The benefits accruing (if there are any) have been the subject of debate. It is claimed that heating leads to better carding and cleaner yarn and other desiderata, but in spite of carefully controlled tests and many hours of observation at all stages under practical mill conditions no improvements in the process or the product have been seen when heated and cold jute have been processed. Nevertheless, many manufacturers hold that over long periods there is a definite improvement in processing when the spreader sliver is allowed to heat. The optimum conditions for heating vary from mill to mill but it is known that heating is stimulated by applying hot emulsion, applying sufficient moisture, building a large stack of rolls in a draught-free site, and using a protein-activated emulsifying agent which provides a readily assimilated food supply for the micro-organisms.

The technical details of the spreader vary according to the machinery maker and production requirements, but the figures shown below are typical of spreader operation in the United Kingdom.

Gill width	$23\frac{1}{2}$ in.
Pitch of pins:	
Fast chain	1 in.
Slow chain	$1\frac{3}{8}$ in.
Pin projection	5 in.
Pin diameter	$\frac{3}{8}$ in.
Feed speed	10–12 ft/min
Delivery speed	200–225 ft/min
Production	1,800–2,400 lb/hr
Range of drafts	6–12
H.P. to drive	12
Sliver roll weight	200–300 lb

Sliver roll length	300–400 yd
Sliver roll formation time	6–8 min
Sliver count	45–60 lb/100 yd (225–300 ktex)

BATCHING FOR SACKING YARNS

These classes of yarn are normally prepared for carding by passing through a softener. The raw material for such yarns is invariably of a lower grade than that required for hessian and similar yarns, that for sacking weft in particular being poor. For sacking warp the low grades of jute in kutcha bales are brought to the spreader feed where selectors make up stricks which are laid on the softener feed. The softener is a long machine comprising 64 or 72 pairs of cast iron fluted rollers, the lower of the pair being driven from a side-shaft and the upper, spring-loaded one by contact with the lower of the pair. Figure 5.13

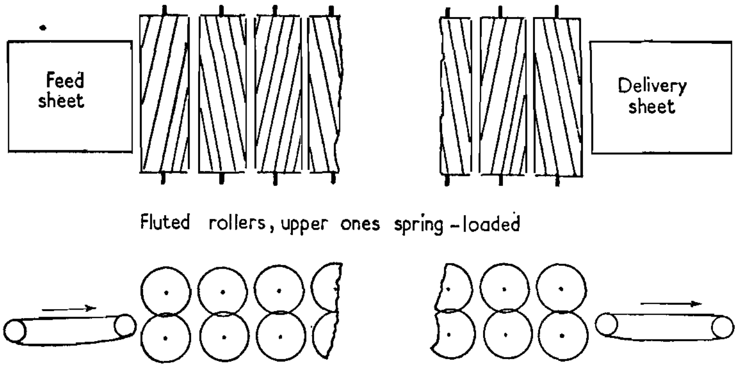

Figure 5.13. Jute softener

shows a diagrammatic view of a softener. The jute is flexed between each pair of rollers and is made softer, some of the loose dust and dirt falls off, and pieces of bark and stick become broken, making their removal at later stages easier. About two-thirds of the way along the rollers the emulsion is dripped on to the jute over a simple gravity-fed weir. As the jute is not fed to this machine in a continuous manner as it is on the spreader, there are gaps in the material and some of the emulsion falls straight through between the rollers; in addition it can drip from the jute itself as it proceeds towards the end of the machine. In order to collect this excess emulsion there is a sump beneath the machine. From here the excess is pumped back to storage through various filters to extract all the dirt and waste which inevitably finds its way into the sump.

Operatives standing at the end of the softener collect the jute as it comes off the machine, give the stricks a half-twist, and place them on a table. On the other side of this table another set of workers cut the root ends of the jute off (it will be remembered that in kutcha assortments the heavy, barky root end is not cut off). The root ends, or cuttings as they are called, are laid aside in special stalls to mature; these will be used later for sacking weft. The long jute is conditioned for 24–48 hr and is then ready for feeding to the breaker cards.

The quantities of cuttings from the warp batches are not sufficient for all the sacking weft yarns, so further supplies of cuttings must be obtained and, these, together with old bale-ropes and any tangled ravelled jute which is unsuitable for higher qualities are put through a softener. This material joins the cuttings from the warp batches in the maturing stalls. If the piles in the stalls are large enough ($1\frac{1}{2}$ tons or more) self-induced heating will occur and temperatures of 60° C may be reached in 9–10 days. This longer period of maturing is required for sacking weft batches because of the large amount of hard, rooty, barky material contained in them. During the maturing period the bacterial activity softens this harsh material, rendering its removal easier at carding.

The bins are usually built with specially slatted floors to allow a gentle circulation of air, a factor which is known to encourage heating. The heat which is generated arises from the growth of micro-organisms left on the fibre after retting and though the exact nature of this activity is not completely understood it is thought that the micro-organisms oxidize some of the natural fats and waxes in the jute, generating heat in the process. Tests have shown that up to 14 days in the pile cause no loss of fibre strength. After their sojourn in the stalls the cuttings are ready for feeding to the weft teaser cards.

Lattice feeders are now available which give an improved method feeding cuttings to a softener, Figure 5.14 showing one such system used by a Douglas Fraser Ltd machine. The cuttings are thrown on to a short conveyor which carries them forward to an inclined spiked lattice. The lattice carries the jute upwards past an evener roller which knocks any excess material back down the lattice. The cuttings continue until they are stripped from the lattice by a rotating bladed doffer and fall in an even stream on to the softener feed sheet. Adjustments to the speeds of the various components can be made and the clearances between the different parts can be altered to provide a range of operating conditions.

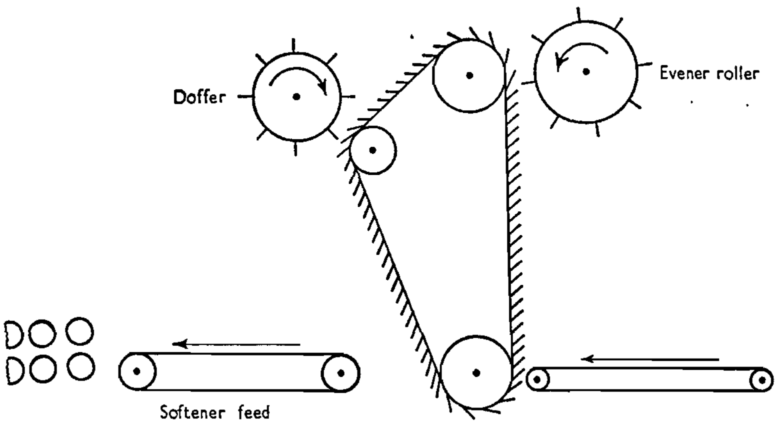

Figure 5.14. Root cuttings feeder

James Mackie and Sons Ltd produce a type of softener for use in conjunction with a lattice feeder similar to the one just described. It differs from the traditional machine in that it has two sets of 24 rollers and, between each set, a cuttings opener, consisting of a drum with coarse pins on its surface. The cuttings come along between the nips of the first set of rollers to meet the opener whose pins effect some degree of opening and begin the work of breaking down the hard, barky material. The opener then passes the cuttings to the next set of rollers where further flexing and softening occurs. The emulsion is added in two stages—the first application being just as the material enters the second set of rollers immediately after the cuttings opener. This dual application is said to lead to a more even distribution of moisture and oil on the jute. After the jute leaves the nip of the last pair of rollers it falls on to another conveyor which carries it to the maturing bins where it lies for a period so that the bacterial activity can soften the rooty material in the usual manner. It should be noted that this system requires the minimum amount of manpower, conveyors being used wherever possible. The remainder of the machines in this special range will be dealt with later.

SPREADER CALCULATIONS

The following worked examples are typical of those met with in working with a spreader or softener.

What is the delivered count of the sliver under the following conditions?

Raw jute feeding rate (lb/min) = 27
Emulsion flow (gal/hr) = 32
S.G. of emulsion $\doteq$ 0·97
Length of sliver in a roll (yd) = 450
Time to form a roll (min) = 7·2

$$\text{Emulsion flow} = \frac{32 \times 9{\cdot}7}{60} = 5{\cdot}2 \text{ lb/min}$$

$$\text{Total delivery} = 27{\cdot}0 + 5{\cdot}2 = 32{\cdot}2 \text{ lb/min}$$

$$\text{Delivery speed} = \frac{450}{7{\cdot}2} = 62{\cdot}5 \text{ yd/min}$$

$$\text{Sliver count} = \frac{32{\cdot}2 \times 100}{62{\cdot}5} = 51{\cdot}5 \text{ lb/100 yd}$$

If leaders were used how many leader rolls per hour would be needed if the draft is 12?

$$\text{Feed speed} = \frac{62{\cdot}5}{12} = 5{\cdot}21 \text{ yd/min}$$

$$\text{Length on a roll} = 450 \text{ yd}$$

Therefore

$$1 \text{ roll will last } \frac{450}{5{\cdot}21} = 86{\cdot}5 \text{ min}$$

But two leaders are always required, so

$$\text{Rolls per running hour} = \frac{2 \times 60}{86{\cdot}5} = 1{\cdot}39$$

What is the moisture regain of the sliver produced when the raw jute regain is 16 per cent and the application rate is 22 per cent, the emulsion being a 32/68 mix? At this regain the sliver count is

320 ktex, what will it be if the raw jute regain drops to 13 per cent? Raw jute fed consists of

Fibre	100 parts
Moisture	16 parts
Total	116 parts

Amount of emulsion added, 22 per cent of 116 = 25·5 parts

Of this quantity, 68 per cent is water and therefore the amount of water added to the jute is 17·3 parts (68 per cent of 25·5) and so the delivered sliver consists of

Fibre	100 parts	Raw jute
Moisture	16 parts	
Water	17·3 parts	Emulsion
Oil	8·2 parts	
Total	141·5 parts	

Hence

$$\text{Sliver regain} = \frac{16+17{\cdot}3}{100} \times 100 = 33{\cdot}3 \text{ per cent}$$

If the raw jute regain falls to 13 per cent then the sliver regain will become 30·3 per cent (13 + 17·3) and the sliver count will drop to

$$\frac{320 \times 138{\cdot}5}{141{\cdot}5} = 318 \text{ ktex}$$

The following information has been collected during a test:

Weight of jute on barrow at start of test = 1,415 lb
Weight of jute on barrow at end of test = 632 lb
Roll former speed = 63 yd/min

Roll weights	*Roll formation time*	
260 lb	6 min	50 sec
255	6	22
268	7	2
261	6	30

Average tare of metal roll-centres = 24 lb
Draft constant = 360
Draft pinion = 32 teeth

Find (1) the sliver count,
(2) the emulsion flow rate,
(3) the emulsion application rate,
(4) the weight per unit length on the feed sheet.

$$\text{Average roll weight} = \frac{260+255+268+261-4\times 24}{4}$$
$$= 237 \text{ lb}$$

$$\text{Average roll formation time} = \frac{6{\cdot}8+6{\cdot}4+7{\cdot}0+6{\cdot}5}{4}$$
$$= 6{\cdot}68 \text{ min}$$

$$\text{Length on roll} = 6{\cdot}68\times 63$$
$$= 420{\cdot}8 \text{ yd}$$

$$\text{Therefore, Sliver count} = \frac{237\times 100}{420{\cdot}8}$$
$$= 56{\cdot}5 \text{ lb/100 yd (283 ktex)}$$

$$\text{Weight of raw jute fed} = 1{,}415-632$$
$$= 783 \text{ lb}$$

$$\text{Total feeding time} = 26{\cdot}73 \text{ min } (4\times 6{\cdot}68)$$

$$\text{Feeding rate} = \frac{783}{26{\cdot}73}$$
$$= 29{\cdot}3 \text{ lb/min}$$

$$\text{Delivery rate} = \frac{237}{6{\cdot}68}$$
$$= 35{\cdot}4 \text{ lb/min}$$

$$\text{Therefore, Emulsion flow rate} = 35{\cdot}4-29{\cdot}3$$
$$= 6{\cdot}1 \text{ lb/min}$$

$$\text{Application} = \frac{6{\cdot}1\times 100}{29{\cdot}3}$$
$$= 20{\cdot}8 \text{ per cent}$$

$$\text{Machine draft} = \frac{360}{32}$$
$$= 11{\cdot}3$$

$$\text{Feed speed} = \frac{63}{11{\cdot}3}$$
$$= 5{\cdot}58 \text{ yd/min}$$

$$\text{Weight per unit length on the feed sheet} = \frac{29{\cdot}3}{5{\cdot}58}$$
$$= 5{\cdot}25 \text{ lb/yd (2,625 ktex)}$$