CHAPTER ONE

Good's Machines

FIBRE arrives in the mill in neat compressed bales which can be easily stored and transported. The Fibre or Hemp Store is a sizable building, usually standing by itself for fire-safety, and built sufficiently high-roofed for bales to be piled six or seven rows high by means of a light electric crane. A concrete or brick building with steel truss roof has been found very satisfactory, and a fire-extinguishing installation of the sprinkler type, automatically operated, is usually fitted. Hard fibre spinners should build their stores sufficiently large to allow, in normal times, of advantage to be taken of a favourable fibre market.

In the store each class and grade of fibre should be segregated so that for the purpose of making a suitable fibre-mix for a given yarn, sufficient bales of each grade can be easily and handily picked out and transported to the room where the first manufacturing process takes place.

The first operation in the production of rope yarn or binder twine is the opening of the bale. An axe is often used to cut the bands, after which the "stricks' of fibre are opened and "pieced out." In modern mills, after piecing out, the fibre is weighed into trucks to be taken to the back of the Breaker or 1st Good's machine.

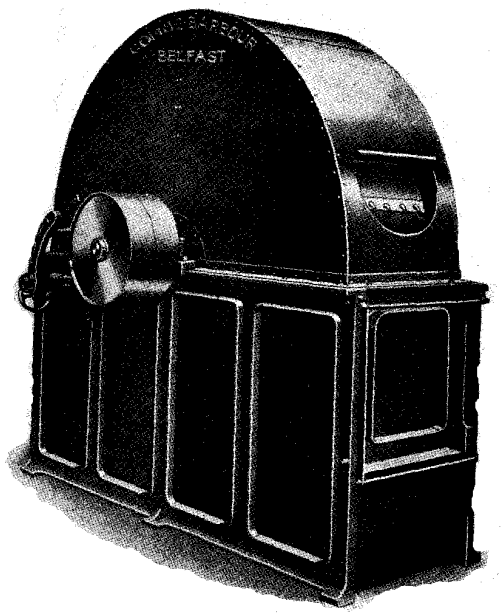
Generally, the next process is the spreading of these stricks on the travelling feed sheet of a Breaker or No. 1 Good's Hackling and Spreading Machine, but in some mills, before weighing, the ends of the stricks are hackled on a Bull Hackling Machine, the use of which depends on the quality of material being used and type of rope required.

Bull Hackling Machine

This machine consists of a cylinder 5 ft. 9 in. dia. x 2 ft. 1 in. wide which is covered with eight staves in the round. These staves have heavy pins of large diameter and up to 5 in. long. The diameter over pins of the standard machine is 6 ft. 8 in.

This cylinder is mounted on an axle which in turn is mounted on heavy cast iron gables not unlike those of a carding machine. The whole is carefully covered by sheet iron panels with an opening somewhat above the centre line of the cylinder through which the fibre is fed. The fibre is drawn into the pins and pulled out, after sufficient hackling, while being held by the operative.

The action of the pins straightens out the matted ends of the stricks of fibre and is suitable for manila, sisal, and New Zealand hemp, as well as many of the other fibres now being used in the rope trade. Its use for long fibres destined for trawl twines, etc., is well-known, but it now tends to be used successfully for lower quality material also. Production is



BULL HACKLER.
(Courtesy Fairbairn Lawson Combe Barbour, Ltd).

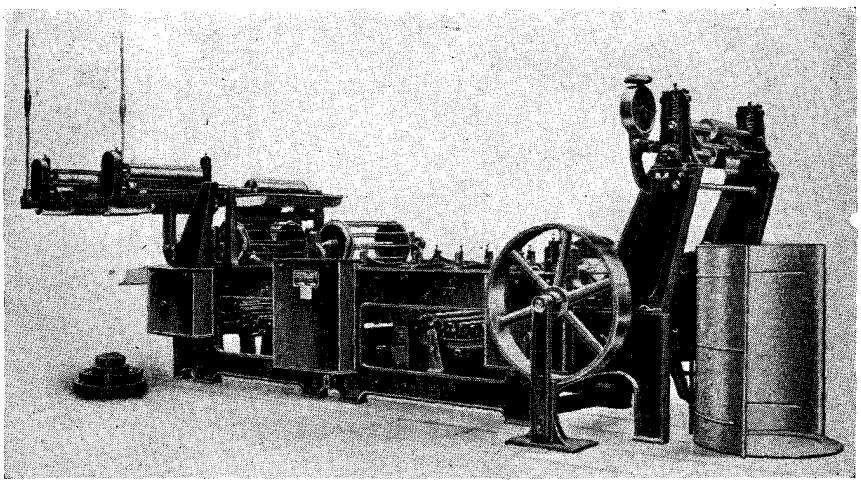
between 600 and 700 lbs. of fibre per hour. A man is required to feed the machine and three girls or boys are needed to open the bales and piece out the fibre.

Particulars of the machine are:—cylinder, 5ft. 9 in. over wood, 6 ft. 8 in. over pins, 2 ft. 1 in. wide; pulleys 16 in. x 4 in. fast and loose, 180 r.p.m.; horse power 2½ to 3; floorspace 8 ft. 3 in. long x 4 ft. 6 in. wide; total net weight 36 cwts.

Good's Machines

The formation of a sliver is accomplished on a Good's Hackling and Spreader, sometimes referred to as a "Breaker" or a No. 1 Good's machine. It consists of a pair of feeding rollers which draw the fibre from a chain lattice spreading sheet into a slow chain. This chain consists of bars connected together by strong links and running on slides. On these bars strong gill pins are carried. A second, or fast chain, then treats the fibres and delivers them to a pair of delivery rollers.

The machine is continuous in action, which is, briefly, as follows:—The fibre is fed on to a table at the feed end of the machine and is carried forward by the feed sheet to the feed rollers, which deliver the fibre to the slow chain. The rotation of the slow chain carries the fibre forward until the pins of the fast chain start to hackle or comb out the ends of the fibres as they are presented to its pins. The fast chain also carries the fibres forward until the leading ends are caught by the front or drawing rollers and pulled forward through the pins of the chain and thus drafted. The result of the combing action of the chains of pins is to split up the bunches of fibres into finer groups and to straighten and parallelise them. This treatment is repeated on machines of a similar construction up to five times in some instances until a regular sliver of uniform weight per unit length, and with all its fibres parallel, is formed.



Good's Hackling and Spreading Machine, with Sliver Piling Apparatus.
(Courtesy Fairbairn Lawson Combe Barbour, Ltd).

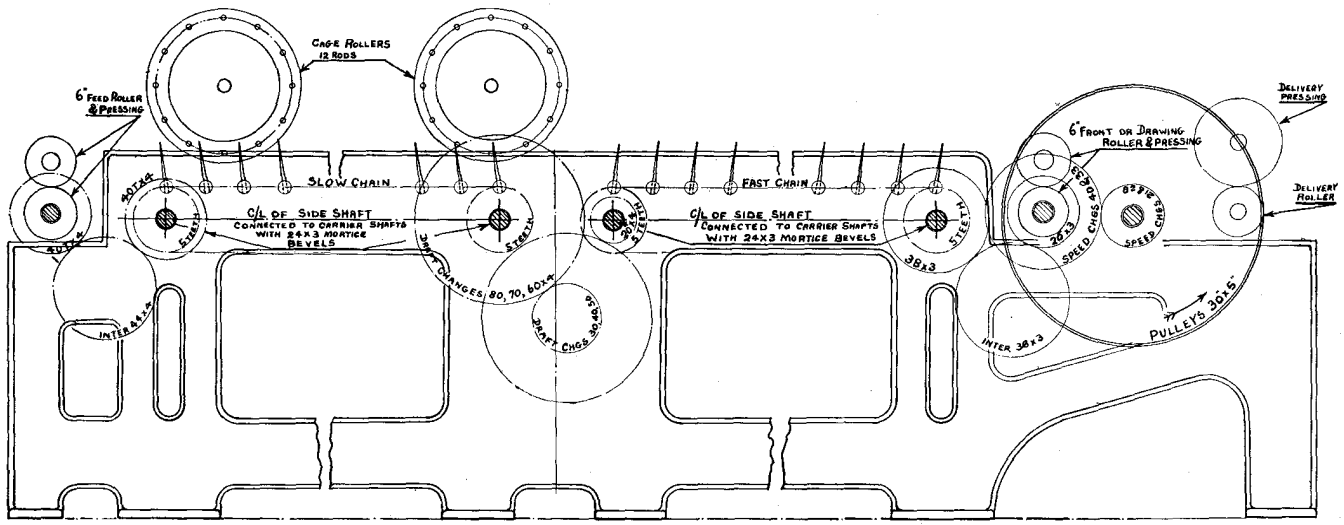
It should be noted that the spreading of the fibre is the last process which is manual. All the other processes are mechanical and free of the human element.

Mechanical Details

Good's machines require to be very solidly constructed as they have to deal with fibres of exceptional length and strength at high speed and in large bulk. Further, the chains and pins and all parts appertaining to the pinning of the fibre are subject to heavy wear and tear. To begin with, the principal of using chains running in slides is not mechanically an ideal one but, so far, no better method has been devised. The machines are built on massive cast iron gables which are tied together by heavy cross members, and the framework is exceptionally rigid and of great strength.

The feed rollers, drawing rollers, and delivery rollers consist of heavy cast iron bosses specially fluted and mounted on bearings suitable for heavy loads. Adjustable spring pressure is used for the pressing rollers.

The chains consist of round steel bars pinned with hardened steel hackle pins suitably pitched and raked. The bars are linked together with heavy malleable iron links, and are driven by malleable iron carrier wheels mounted on strong shafts with heavy bearings. On the ends of the bars are malleable iron "dogs" for guiding the bars between the slides fixed to each inner side of the gables. The dogs are secured to the bars by taper pins. The ends of the bars are reduced to accommodate specially hard steel runners which act as roller bearings to reduce friction on the slides. There is a pitch or shear pin arrangement for each chain to prevent breakage in case of a lap or choke. In high-speed machines dealing with large quantities of



Sketch showing general lay-out of Good's machine.

material, machinists mill a square on the bar end and the dogs have a square hole broached to give an exact fit. This gives a very strong job.

The top and bottom slides are of robust construction. The rising and falling cams and toe cams and fenders, which guide the bars and dogs after they have passed over the carrier wheels and slides, prevent the bars turning unless under control.

The cage rollers consist of heavy cast iron ends with twelve cross rods all mounted on a robust shaft. These cage rollers press the fibre into the gill pins and are mounted on heavy cast iron brackets one over the back and one over the front end of the slow sheet.

A lap stop motion consisting of a lever close to the sheet, which is depressed by a lap and releases the starting gear and shifts the belt to the slack pulley, is sometimes used.

The gearing is very solid and is now machine-cut throughout. Three or four per inch diametrical pitch gearing is mostly used. The chain carrier shafts are driven by bevel gearing from side shafts running along the gable of the machine, generally mounted on ball bearings.

A clock motion is as a rule fitted to No. 1 Good's machines to control the weight and regularity of spread, and bell or bell stop motions are fitted to any of the machines where necessary to measure a predetermined length into the pile or can.

Very often a series of fluted rollers are interposed between the feed sheet and the feed roller of No. 1 Good's machines to soften the fibres. These rollers are usually cast iron fluted rollers, gear driven from the side shaft of the slow sheet. They are supplied with a shear pin arrangement to prevent breakage should laps or chokes occur and are worked under spring pressure. They are referred to as a softening attachment.

Batching

The pros and cons of batching will be considered at a later stage, but in the meantime the apparatus for supplying the batch to the fibre while in the slow chain will be described. This consists of a trough in which runs a large *oil* roller. A scraper knife presses against this roller and scrapes the oil or batch from it. The batch runs down a corrugated plate and drops on the fibre. The quantity of oil deposited can be regulated by changing the speed of the oil roller. A continuous and regular supply is obtained by this means.

Piling Motions

The most modern machines are all fitted with piling motions, which serve the dual purpose of allowing the sliver to be delivered in the form of self-contained piles of a capacity many times that of the largest possible sliver can, and at the same time making sliver cans unnecessary. This pile can be dragged along the floor to the back of the succeeding machine with ease by a girl. The great length of sliver contained in the pile increases the efficiency of the unit as a whole, and greatly reduces the number of sliver piecings at the back of the next machine.

The delivery rollers of the motion are of large diameter and specially fluted. They are pressed together by springs, and are carried in a strong framing comparatively high up, being placed above a revolving platform which is usually sunk flush with the floor. This platform is driven from the machine and revolves slowly while the machine works. The platform is partially surrounded by a semi-circular sheet metal container so placed that its open side is towards the front of the machine. A pile of sliver is formed in the container as follows:

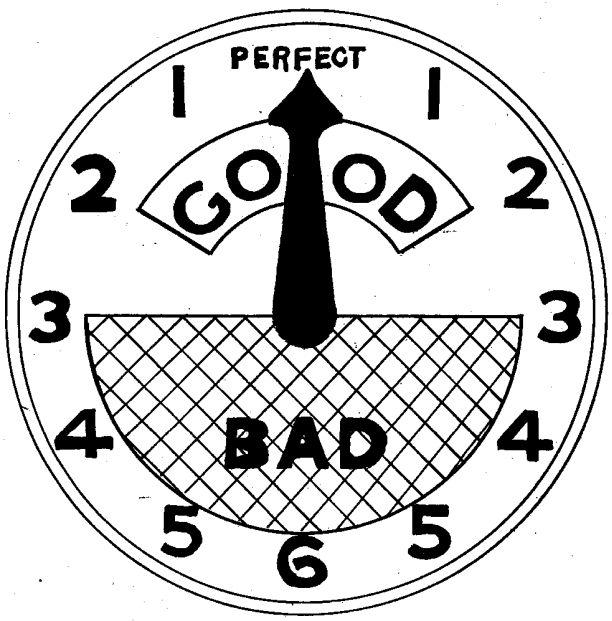
Since the speed of even the periphery of the platform—taken as a velocity—is much less than the speed of the sliver, the sliver as it is deposited on the platform forms a series of coils round the table. By continued repetition of the coiling motion a solid pile of sliver is formed. A pressing roller, usually of conical form, is used to solidify and compress the pile as it is built. The diameter of piles varies from 30 inch to 42 inch, the latter being more popular for 1st Good's machines where floorspace permits. The height varies up to 54 inch high. The semi-circular container supports the pile while it is being formed and avoids the chance of it being accidentally knocked over. The 2nd, 3rd, and further Good's machines are fitted with special long back uprights to facilitate the feeding of the machine by these large piles. These uprights are supported from the machine at one end and are usually supported from the roof at the other end. Roof support has the advantage of rendering the back of the machine clear of columns, thus assisting the operative when the piles are being dragged into position. The sliver is lifted from the piles by means of rollers driven from the machine by chains, and it passes along channelled conductors to the back rollers.

This arrangement permits 8 or 12 or more piles to be placed behind a machine, and they are all comparatively accessible for replenishment.

Spreading the Fibre

The spreading of the fibre is a most important operation, regularity of spread being essential to ensure a level yarn.

In some modern ropeworks, in order to get a lot of fibre over the Breaker or 1st Good's machine, the table supporting the feed sheet is about 30 ft. long. Three operatives spread on each side. The fibre trucks from the *piecing-out* and weighing are placed one behind each worker. A dial is fixed at the feed end of the machine and is operated by a man at the delivery end, who weighs the sliver and telegraphs by means of the dial when spreading is



too light or too heavy. The dial is graduated from 0 (where 12 is on a clock) to 6 (where 6 is on a clock) and has 1, 2, 3, 4, and 5 on both right and left side. A line through both 3's separates the white part of the clock-face, *i.e.*, the top half, from the coloured bottom half. When the indicator is between the 2's, spreading is good, when to the left spreading is light, when to the right, heavy. The numbers represent kilos, and the pile weight is 73 kilos.

A Good's Machine Specification

Particulars of a fairly standard modern 1st Good's machine are approximately as follow:—

Feed roller and pressing, 6″ dia. x 28″ face, with 25 flutes. Front roller and pressing, 6″ x 25″ face, with 25 flutes. Delivery roller, 6″ dia. x 12″ face, with 36 flutes, and its pressing 10″ dia. x 12″ face, with 60 flutes.

The centres of the slow chain carrier shaft are 4′ $10\frac{3}{4}$″ and those of the fast chain 5′ 8″.

Carrier wheels have 5 teeth on $7\frac{1}{2}$″ pitch circle diameter.

Pitch of bar $4\frac{1}{2}$″ on both chains; diameter of bar $1\frac{1}{2}$″ on slow and $1\frac{9}{16}$″ on fast chain.

Rake of pins 8°, away from direction of motion on the slow chain and with the direction of motion on the fast chain.

The pricking in, lantern or cage rollers have twelve rods on a 15″ P.C.D.

Pulleys are 30″ dia. x 5″ face and run at 130 r.p.m.

Speed wheels on the pulley shaft are 21 or 28 into 40 or 33 on front roller, giving two speeds. (Total, 61 teeth to maintain fixed centres.)

Fast chain drive is 26 on front roller into 38 intermediate into 38 on fast chain carrier shaft.

The mitre bevels between carrier shafts and side shafts have 24 teeth.

The draft gearing is as follows: 20 on back fast chain carrier shaft into 80 on stud with 30, 40 and 50 on its socket into 80, 70 or 60 on front carrier shaft of slow chain. (Total, 110 teeth on changes to maintain fixed centres.)

The feed roller gear is as follows: 40-tooth wheel on back carrier shaft of slow chain into 44 intermediate into 40-tooth wheel on bottom feed roller. This arrangement can be seen by reference to the sketch on page 2.

Calculations on the No. 1 Good's Machine

Draft Calculations

Considering the draft to be the surface speed of the drawing roller divided by the surface speed of the feed roller we have

$$\frac{6}{1}\times\frac{40}{40}\times\frac{24}{24}\times\frac{24}{24}\times\frac{\text{Change}}{\text{Change}}\times\frac{80}{20}\times\frac{24}{24}\times\frac{24}{24}\times\frac{38}{26}\times\frac{1}{6}=\text{Draft}$$

This being simplified by eliminating all fixed quantities which cancel we get:

$$\frac{\text{Change } 80}{\text{Change } 30}\times\frac{80}{20}\times\frac{38}{26} = 15.60 \text{ Draft}$$

$$\frac{\text{Change } 70}{\text{Change } 40}\times\frac{80}{20}\times\frac{38}{26} = 10.23 \text{ Draft}$$

$$\frac{\text{Change } 60}{\text{Change } 50}\times\frac{80}{20}\times\frac{38}{26} = 7.0 \text{ Draft}$$

The foregoing three drafts are theoretical, and, as the thicknesses of sliver vary between the nips of the feed and drawing rollers, so differences occur in practice. The calculations assume 6″ rollers, equally fluted, both feed and drawing, and π for these is taken at 3.4. In many cases, on the 1st Good's machine the feed rollers have coarser flutes and a larger pressing, and the size and shape of the flutes, together with the roller, must be taken into account for accurate calculations.

Calculation for lead of slow chain over feed rollers.

$$\frac{40}{40} \times \frac{7.5 \times 3.14 \times 100}{6 \times 3.4} - 100 = 15\% \text{ (approx).}$$

Calculation for lead of drawing roller over fast chain.

$$\frac{38}{26} \times \frac{6 \times 3.4 \times 100}{7.5 \times 3.14} - 100 = 26\% \text{ (approx.)}$$

Calculation for sliver delivered.

With 21 on pulley socket into 40

$$\frac{\text{R.P.M. Pulley} \times 21 \times 6 \times 3.4}{40 \times 12} = \text{Feet per min.}$$

With 28 on pulley socket into 33

$$\frac{\text{R.P.M. Pulley} \times 28 \times 6 \times 3.4}{33 \times 12} = \text{Feet per min.}$$

Other Good's Machines

Subsequent Good's machines are built on the same general lines as the 1st Good's or Breaker, but they vary in detail as follows :—

(*a*) 2nd, 3rd and subsequent machines are fitted with revolving lifting rollers which take the sliver from the piles and transfer it to the feed rollers of the machines.

(*b*) They have finer pins set closer together.

(*c*) The delivery speed is usually higher.

Their purpose is to parallelise the fibres and make the resulting sliver regular and as near to unit weight for unit length as possible. This uniformity is attained by doublings and draftings on the succeeding machines.

(*Continued top next column*)

The particulars of various Good's machines are approximately as follows :—

Long reach (13 ft. 9 in. between feed and drawing rollers), for abaca and similar hard or semi-hard fibres.

Machine No.	No. 1	No. 2	No. 3	No. 4
Pitch of Bar	4½″	4″	4″	4″
Diameter of Bars	1½–19/16″	1½–19/16″	1½–19/16″	1½–19/16″
Width of Gill (set over)	23½″	23½″	20″	20″
Pin Dia. Slow Chain	⅜″	9/32″	9/32″	9/32″
Projection „ „	4¾″	5⅛″	415/16″	415/16″
Pitch of Pin „ „	1–⅞″*	¾″	⅝″	17/32″
Pin Dia. Fast Chain	7/16″	5/16″	9/32″	9/32″
Projection „ „	411/16″	3⅞″	315/16″	315/16″
Pitch of Pin „ „	⅞–¾″*	⅝″	½″	15/32″
Pins p. Sq. Ft. „	42.66″	52½″	72″	77″

* The wider pitch is for rope yarn.

Short Reach for Sisal

Pitch of Bar	4½″	4″	4″	4″
Width of Gill (set over)	23½″	23½″	20″	20″
Pin Dia. Slow Chain	9/32″	9/32″	9/32″	9/32″
Projection „ „	5¾″	5″	4¾″	4¾″
Pitch of Pin „ „	1½″	¾″	⅝″	9/16″
Pin Dia. Fast Chain	7/16″	5/16″	9/32″	9/32″
Projection „ „	415/16″	311/16″	311/16″	311/16″
Pitch of Pin „ „	1¼″	⅝″	½″	15/32″
Pins Grouped in	4	2	2	2

The normal width of sliver at feed is 21-inches, and at delivery 6-inches. Some mills, especially American, use a gill width of 27½-inches on the No. 1 Good's.

Working Tables

While the actual working tables will be considered in a later chapter, the following partial tables for Good's machines are given as a fair average.

FT/LB Product	Machine	FT/LB in Slow Chain	FT/LB at Delivery	Slivers into Machine	Total Doublings	Draft
270/360	1st Good's	.361	3.68	Spread	1	10.2
Rope Yarn	2nd Good's	.46	4.69	8	8	10.2
Manila	3rd Good's	.586	6.0	8	64	10.2
550 Ft.	1st Good's	.3	3.06	Spread	1	10.2
Binder	2nd Good's	.382	3.89	8	8	10.2
Twine	3rd Good's	.487	4.96	8	64	10.2
Sisal	4th Good's	.62	6.32	8	512	10.2
400/1,100	1st Good's	.800	5.60	Spread	1	7
Sisal	2nd Good's	.933	6.53	6	6	7
Twines	3rd Good's	1.09	7.63	6	36	7
Careful light spreading, short drafts, fewer doublings.						
600	1st Good's	.24	2.44	Spread	1	10.2
Binder	2nd Good's	.244	2.48	10	10	10.2
Twine	3rd Good's	.248	2.53	10	100	10.2
	4th Good's	.421	4.30	6	600	10.2

The above was calculated from weights taken from actual machines in production.

The delivery speeds of Good's machines vary greatly in order to balance the system. A speed of 280 feet per minute has been recorded from a No. 4 Good's machine. Production varies with the weight delivered and the speed. Efficiencies vary between 65 per cent. and 80 per cent., according to the speeds used and the quality of product being made. The lower the product quality, as a rule, the higher the mechanical efficiency—though there are exceptions.

A highspeed system working on binder twine gave the following results :—

Number of Machine	1st Good's	2nd Good's	3rd Good's	4th Good's	Two 5th Good's Single Chain
Feet per lb. delivery	1.5	1.7	2	2.3	5.5
Draft	17	9.3	9	9	14
Doublings	—	8	8	8	6
Delivery speed, ft./m.	200	225	250	250	350
Calculated production	8,000 lbs.	7,800	7,600	7,600	7,600
Efficiency, per cent.	65	64	.66	65	65
Actual production	5,200	4,992	5,016	4,940	4,940

That is, an approximate hourly production of 5,000 lbs.

General Particulars

General particulars of Fairbairn Lawson Combe Barbour machines are:

	Machine	Floorspace Length	Floorspace Breadth	Size of Pulley	R.P.M.	H.P.	Weight approx. (Erected)
Long Reach Machines	No. 1 Good's	24′–6″	7′–0″	30 × 5	120/130	6	7 Tons
	No. 2 ,,	33′–0″	10′–0″	,,	140/160	6	,,
	No. 3 ,,	,,	,,	,,	150/165	6	,,
	No. 4 ,,	,,	,,	,,	160/180	6	,,
Short Reach Machines	No. 1 (with softening)	28′–7″	7′–0″	30 × 5	120/130	7	7¼ Tons
	No. 1 (without softening)	20′–3″	7′–0″	,,	120/130	5	4¾ Tons
	No. 2	28′–0″	10′–6″	,,	140/160	5	,,
	No. 3	,,	,,	,,	150/165	5	,,
	No. 4	,,	,,	,,	160/180	5	,,

Driving Arrangements

The majority of existing Good's machines are driven from lineshafts by flat belt to fast and loose pulleys, but a growing practice is to drive by individual electric motor and V-rope. Opinions differ as to what is the best drive and individual circumstances figure largely in the final decision.

When a V-rope drive and individual motor is used, many manufacturers interpose a variable speed clutch, thus permitting simplification of motor and switchgear. It should be noted that the use of an individual motor also allows a simple electric stopmotion to be applied, and a preset counter can be used so that the machine stops when a required length is delivered.

Standard "Fenner" drives for Good's machines are as follows:

Horse Power to Drive	R.P.M. Machine Pulley	720 R.P.M. Motors							960 R.P.M. Motors						
			Pulleys		V-Belts			Best Centre Distance		Pulleys		V-Belts			Best Centre Distance
		Drive Ratio	On Motor	On Machine	Belt No.	Size	No. of Belts		Drive Ratio	On Motor	On Machine	Belt No.	Size	No. of Belts	
5	120	6.00	8¾	48¾	C195	⅞	3	51.3	—	—	—	—	—	—	—
	140	5.18	10	,,	,,	×	3	50.3	6.86	5¾	36½	B173	2½ × ⅞	6	52.8
	160	4.50	8¾	36¾	C173	17/32	3	51.4	6.00	8¾	48¾	C195		2	51.3
	180	4.00	9¾	,,	,,		2	50.8	5.33	9¾	48¾	C195	⅞ × 17/32	2	50.5
6	120	6.00	8¾	48¾	C195	,,	4	51.3	—	—	—	—	—	—	—
	140	5.18	10	,,	,,	,,	3	50.3	6.86	5¾	36½	B173	2½ × ⅞	8	52.8
	160	4.50	8¾	36¾	C173	,,	4	51.4	6.00	8¾	48¾	C195		2	51.3
	180	4.00	9¾	,,	,,	,,	3	50.8	5.33	9¾	48¾	C195	⅞ × 17/32	2	50.5
7	120	6.00	8¾	48¾	C195	,,	4	51.3	—	—	—	—	—	—	—
	135	5.33	9¾	,,	,,	,,	3	50.5	7.2	5½	36½	B173	2½ × ⅞	8	52.9

NOTE.—These drives are designed to sustain high (150—200 per cent.) starting torques and work 8–10 hours per day.