LUMBERING AND WOOD-WORKING INDUSTRIES

IN

THE UNITED STATES AND CANADA

TOGETHER WITH

NOTES ON BRITISH PRACTICE AND SUGGESTIONS FOR INDIA. [by Frederick Alex. LEETE].

IN THREE VOLUMES.

Vol. I ..	..	Chapters I to VI—Logging.
Vol. II ..	..	Chapter VII—Sawmills.
Vol. III ..	..	Chapters VIII to XIV—Economic Forest Research, Wood-working industries, such as Barrel-making, Plywood, Matches, etc. and a chapter on the Water Hyacinth.

Volume II.

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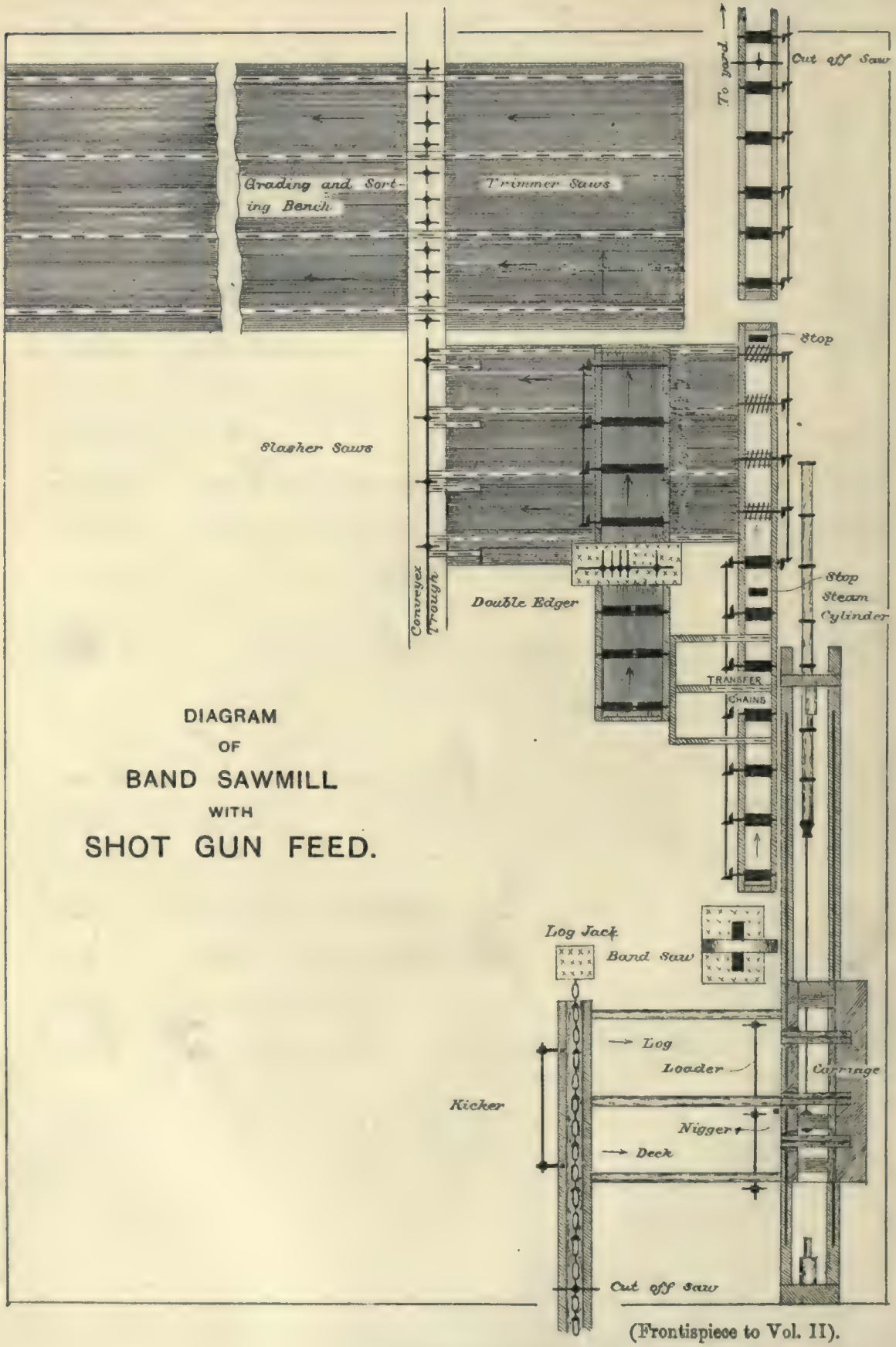


DIAGRAM
OF
BAND SAWMILL
WITH
SHOT GUN FEED.

(Frontispiece to Vol. II).

Volume II.

CHAPTER VII.

SAW MILLS.

Introduction.

89. The contrast between American and Indian mills is so very marked that the writer takes up the subject with some reluctance, because statements must be made that are bound to be controversial and unpalatable. There is no getting away from the fact that, measured either by British or by Western standards, Indian practice is very much behind the times.

The term "Indian" is here used in its broad sense as referring to the Indian Empire as a whole. It is only right to mention that there are differences between the various provinces. Owing to the fact that the last twelve years of the writer s service have been spent in Burma, he is better acquainted with conditions there than he is with those prevailing in other provinces. In respect of Burma itself there is no hesitation whatever in stating that sawmills machinery is very out-of-date and inefficient in comparison with the best modern practice in other parts of the world.

A striking example can readily be given. Bandsaws hold the field absolutely in North America for log sawing, and they are rapidly coming to the front in Great Britain. In Burma there are believed to be none at all. Other provinces are more advanced, for one British firm alone has supplied no less than twenty-five Horizontal Bandmills to Railway Companies and to others.

Most of the sawmill machinery in India has come from home, and it is only natural that this should have been the case originally. But it is rather curious to note that, by continuing to get their supplies from the same source—after the industry has assumed large dimenions—lumbermen in India have shown far too little desire to follow the lead of big lumber producing countries in other parts of the world.

The inference that may be drawn from the preceding remark, that British sawmill practice is totally different to Canadian and American practice, is fully justified by fact. As the title of this book implies, the greater part of it is taken up with a description of Western practice. At the end of this chapter on sawmills some notes on British practice are given. But it should be clearly understood that they are only fragmentary. The writer did not have time to study the matter in detail, and to describe it fully would require a good sized volume.

Quite recently, when the writer expressed surprise at finding Western mill machinery so little used in England, an explanation was given to him which seems quite reasonable. It was as follows: American mills work faster than English ones, and so they would be apt to dislocate business, for the supply of raw material (logs) would probably run out. By being compelled to stand idle for longer periods the mills would simply waste the time they saved.

Can such an argument be seriously advanced with regard to India ? Certainly not. With forests of such great extent that they are comparable in size to those in the Western Hemisphere India need not be handicapped by fear of exhaustion of supplies.

90. It is very probable that the marked differences in labour conditions account for a great deal of the slowness in introducing improved methods and machinery into India. In America labour has always been so expensive that there has been every inducement for the exercise of ingenuity in inventing labour-saving devices. On the other hand in India labour is so cheap and plentiful that mechanical devices for reducing the amount of it have stood no chance of finding favour unless they are themselves inexpensive to instal. After living in this kind of atmosphere for many years it becomes fatally easy to assume that the equipment to which one is accustomed is not only good enough for the purpose but that any great outlay on machinery of a different kind would be a waste of money.

A simple illustration may be given to show that it is not likely to be waste of time to study American milling methods. When the last census was taken the number of men employed in the timber industry in Rangoon was about 20,000. In reply to enquiries as to how many men would be required to do the same amount of work in America the writer was more than once told that 2,000 would suffice. The average daily wage in Rangoon was fully one rupee before the war, and in America not more than six or seven rupees. Moreover, it is hard to believe that American machinery would cost as much as Rangoon plant of the same total capacity, and it would certainly take up less than half the same amount of room.

Another point may be mentioned. The mechanical devices in Western mills are primarily intended to reduce the amount of labour, but the full benefit cannot be reaped from them unless the men employed in the mill work well. There is no room for dilatoriness or "taking things easy." The log carriage must travel fast; and, as soon as one log is finished, another must be ready for it. It is the same throughout the mill.

The writer is of opinion that the above consideration need not be an effective bar to the use of Western machinery in sawmills in India. As explained later on in this chapter one or two men requiring special qualifications are necessary, such as the Filer and Log Sawyer, but for the most part the work is mechanical and does not call for any violent exercise of the muscles. The greater part of the work in mills and lumber camps in the Southern States is done by coloured labour, and with good supervision, there is no reason why Indians and Burmans should not prove equally satisfactory. Shorter hours are probably indicated and if necessary, half-day shifts (*i.e.*, doubling the labour) could be resorted to. Even so, for the same output the total bill for labour would be far below its present figure.

In concluding these introductory remarks the writer desires it to be understood that they are chiefly based on the mills he is acquainted with in Burma. Only in so far as mills in India proper are radically different are any qualifications to the remarks made in this chapter called for.

91. It is proposed to discuss the subject of sawmills under the following headings:—

(1) Description of North American sawmills and comparison with Indian mills.—

(*i*) General Design.
(*ii*) Double storey plan.
(*iii*) Storage of logs.
(*iv*) Entrance of logs into mill.
(*v*) Log Carriage.
(*vi*) Filing Room.
(*vii*) Band and Circular Saws.
(*viii*) Single and Double Edgers.
(*ix*) Trimmers.
(*x*) Re-saws (including Frame Saws).
(*xi*) Live Rolls and Conveyers.
(*xii*) Engine Room and Belting.
(*xiii*) Electric Drive.
(*xiv*) Water Power.
(*xv*) Special Mills (Portable, etc.).

(2) Summary of suggestions for mills in India.

(3) Notes on the history of sawmill practice in America.

(4) Notes on British Sawmill practice.

(5) List of Manufacturers of Milling Machinery.

Section 2.—GENERAL DESIGN OF MILLS.

General Design of Mills.

92. Before going into details as to the design and equipment of Western Sawmills, it will be as well to make a few general remarks. It is a comparatively simple matter to give a general idea of the design of the mills because they are all so very much alike. To anyone whose knowledge of Sawmill practice is confined to Europe it may come as a surprise to be told that there is only one type of lumber sawmill throughout the length and breadth of the North American Continent. There is nothing comparable to the diversity of design of mills and of the machinery in them which is such a conspicuous feature in England. All mills of any size and at all permanent in character have such a strong family likeness that a careful study of one modern mill would enable anyone to form a good idea of practice in general. It is true that there are differences in detail between hardwood and softwood mills, but these differences are only in the outside arrangements for getting the logs into the mill. Inside the mill itself the sawing arrangements are just the same in both cases.

Once having satisfied himself of the correctness of the above statements, an observer must at once realize how strongly this simplicity of design speaks in favour of Western practice. Taking into account the fact that milling in North America is carried out under such a wide range of different conditions, both as to climate, scale of operations and nature of the timber dealt with, there must be something

superlatively good about modern mill design for it to be so remarkably uniform, and simple in character, in spite of the keenness of the competition of the large number of manufacturers of machinery supported by the industry. The keynote everywhere is large output per machine and the free use of mechanical devices for saving labour.

Mill Pond.

A conspicuous feature of a mill for softwoods is the " Mill pond " into which the logs are discharged from the logging railway or other source of supply. For a mill dealing with hardwoods which will not float the pond is replaced by skidways, on to which the logs are rolled from the railway cars, or placed by an overhead derrick.

The mill itself has at least two floors, and generally a third one. All the driving mechanism, shafting, etc., is on the ground floor, so that the first or main floor is left entirely free for the operation of the machines. As the majority of the mills in America are Bandmills it is usual to find a third floor above the main floor to accommodate the filing room. The latter only occupies part of the floor space of the mill and so it is customary to have in extension of it a raised platform running the whole length of the building, from which an excellent view can be obtained of all the operations in the mill. In Circular sawmills the filing room is generally placed on the main floor.

To bring logs into the mill they have to be pulled up an incline. In hardwood mills this incline often takes the form of a tramway up which loaded cars are hauled by means of a ropeway and winch. In softwood mills the universal practice is to haul the logs from the pond up an inclined trough by means of an endless chain provided with *Dogs* or *Spikes*. All that the attendant at the lower end of the trough has to do is to pole the logs forward until they are firmly gripped by the *Dogs*.

Inside the mill, alongside the trough or tramway as the case may be, is a sloping platform known as the " *Log Deck*," leading down towards the " *Log Saw Carriage*."

To bring the logs from the trough on to the *Deck* a contrivance known as the " *Log Kicker* " is used. The operator by pulling a lever causes two Steel Arms, worked by steam power to shoot forward and push the log bodily out of the trough. It then rolls down the *Deck* until held up by two quadrant shaped projections (" Loader "). When the sawyer is ready to cut up another log he pulls a lever which causes the quadrants to drop, thereby allowing the log to roll on to the carriage.

Every one in India knows how painfully slow a business it is to turn a heavy or crooked log round on the log table, to get it into the desired position for successive cuts. It is true that in Western sawmills very small logs are often turned round by hand, but the universal practice for logs of any size in permanent mills is to make use of a mechanical contrivance known as the *Nigger*, a steel arm rising from the floor and operated by steam.

A detailed description is given later on of the *Log Saw Carriage.* Here it may suffice to mention that it is a much more elaborate piece of mechanism than the plain travelling steel Table to be met with in British and Indian Sawmills. It is provided with automatic *Dogs* for holding the logs firmly in any desired position, and these *Dogs* can be instantaneously applied or released. The moving of the log forward for successive cuts is not done by hand levers but by means of mechanism known as the *Setworks.* For the proper placing of tapered logs special levers are provided.

Log Saw Carriage.

One of the most remarkable things about the Log Carriage is its extreme mobility. The mechansim provided for the purpose is wonderfully elastic in operation, and the writer believes that it is far superior to the general run of practice at home and in India. Full descriptive notes are therefore given and the writer is optimistic enough to think that careful perusal of these notes, and of the illustrated catalogues of standard makers of machinery, will in itself be sufficient to lead the generality of mill owners in India to feel desirous of overhauling their plant. The matter has a very important bearing on mill outturn. British mechanism for driving the carriage is positive, *i.e.*, the speed cannot, as a rule, be varied without stopping, or at least checking, the motion of the carriage. The result is, therefore, that the speed of the carriage is as a rule much slower than it need be, as it is turned down to the slow speed necessary for occasional big logs. In North America, on the other hand, the sawyer has absolute control, and by means of a single lever he can instantaneously change the speed from the slow rate required with a large or refractory log to the racing speed at which the carriage is driven backwards. Knowing how elastic steam is it should appeal very powerfully to an Engineer to be told that the favourite form of feed in better class mills is by direct steam, namely, either shot gun or twin engine and rope.

Although the *Log Carriage* undoubtedly deserves its place in popular estimation as the most important machine in the mill it is also true that in respect of the other machines and mechnical arrangements for handling timber the differences between British and Western practice are very striking. No two British mills are alike in the way baulks, planks and slabs are dealt with after leaving the log saw; the machines for the purpose are of various designs. In many cases one type of machine is called upon to complete the conversion.

On the other hand the standardizing of machine design as applied to Western sawmills is largely due to the universal recognition of two distinct stages after the rough lumber leaves the log saw, *viz* :—

1. Squaring the long sides (Edging).

2. Squaring the ends (Trimming).

Special machines have been evolved which are simple in design and yet so wonderfully efficient that their operation is extremely fascinating to watch, and their superiority to British machines *for the same purpose* cannot but be freely admitted.

The first of these two operations is performed on a machine known as the *Double Edger*, as it trims both long sides simultaneously. It consists of two or more circular saws mounted on a common shaft in such a way that the distance between the saws can be varied at will. The necessary adjustment is practically instantaneous. The rough planks to be edged are placed in position by hand and are carried forward by feed rolls.

Double Edger.

The method of performing the second operation, or trimming of the ends of planks, depends on the size of the mill. In large mills the *Trimming Saws* are mounted in gangs or rows at a fixed distance apart, generally about a foot. The individual saws can be raised or lowered independently of each other. A single operator controls the machine and by pulling levers, or by pressing keys as the case may be, he can bring any two desired saws into position to trim off the end of any piece of wood passed endwise below them.

Trimmers.

The Log Carriage, Double Edger and Trimmer would not in themselves be sufficient to account for the efficiency of Western sawmills. They are capable of doing so much work simply because of the excellence of the arrangements for moving the timber from machine to machine in its passage through the mill. There is no carrying of wood about by hand, or piling on tramway trucks, as in British and in Indian mills. Such a practice would inevitably lead to congestion and reduce the output. In Western Mills *as soon as each plank or slab is cut*, it automatically moves forward to the next machine, either on *rolls* or on *chain conveyers*. Each machine therefore has a steady supply of material to operate upon, and correct design for a mill is simply a matter of having the three types of machines of the right size to suit each other for the desired class of sawing.

Conveyers.

Lastly, in this general description it may be noted that Live Rolls and Chain Conveyers are not only freely used for passing the wood from machine to machine and finally out of the mill altogether, but conveyers are also used for slabs, refuse pieces and saw-dust. There is no removal of refuse and saw-dust by headloads in baskets. Whatever is required for the furnace goes direct to it in the conveyers and the balance passes out to and is burnt in, an *Incinerator*.

93. Although all mills resemble each other in having *log Deck*, *log Carriage*, *Edger*, *Trimmer* and *Conveyers*, there are endless variations in details. In very small and temporary mills the steam *Kicker*, *Loader*, *Nigger* and *Live Rolls* may be dispensed with and a single *pendulum Cross-cut saw* may have to do all the trimming. In very large mills there may be as many as four log saws and carriages. In many mills *bandsaws* are supreme, but some operators still cling to *big circular saws*. For the sawing of planks band or circular *Re-saws* are installed in some mills, in others, *Vertical Frame* or *Gang* saws are preferred. Some operators burn all the slabs and small stuff ; others cut it into laths, shingles, box shooks, etc. ; in fact there is no hard and fast line of division betweeen lumber sawing now under discussion and manufacturing processes dealt with in a separate chapter.

In the United States of America there are something like 50,000 lumber and manufacturing plants, ranging in size from the smallest of portable mills to the

(1), Unloading into Mill Pond,—Davis, W. Va.

(2). Mill Pond, Railway Track to the right (not shown);—New Bern, N. C.

(para. 95).

biggest of permanent ones. There are a large number of manufacturers of saw-mill machinery and they are always on the look out for something original, for some improvement to patent. It can therefore be readily understood that there are a bewildering number of different designs to choose from.

All that the writer proposes to do is to describe the general features of each type. The principal makers publish profusely illustrated catalogues which may well be carefully studied by anyone interested in the subject. The writer is indebted to manufacturers for most of the illustrations in this chapter, as very few good photographs of the interior of mills were taken on the tour.

The illustrations must not be taken to indicate any decided preference for particular designs or firms. Choice fell on them simply because they happened to be the best pictures available.

Double Storey.

94. It might at first sight be thought that the vibration from heavy machines raised off the ground would be excessive. This is not the case even where the main-floor is supported wholly on wood posts. Brick or masonry walls are indeed exceptional. In the majority of mills the only brickwork or concrete is in the foundations of the posts and for the boiler and engine.

The advantages of the two storey plan are obvious. Not at all unimportant are the facilities afforded for getting rid of sawdust and refuse by means of chain conveyers working in troughs.

The term "*Portable Mill*" is rather elastic. It is usually applied to any mill which is so small that it can easily be moved about, irrespective of the length of time it may be required at any one place. From lack of attention to the latter point it is commonly supposed that any kinds of temporary or make-shift arrangements are good enough for such mills. This is a mistake. A mill may be a small one, but if it is to stay in one place for a long time it may as well be set up to the best advantage, especially as it can supply the necessary timber itself and very little additional expense on iron work is required.

For the above reason, the writer suggests that the double storey plan be adopted in India for any mills which may be expected to remain in one place for six months or more.*

Section 3.—ENTRANCE OF LOGS INTO MILLS.

Storage of logs at the Mill.

95. The storage of softwood logs is always done in a *mill pond*, except when ice and snow make it impossible. Unloading of cars is simply a matter of

*The June 1919 number of American Forestry, the magazine of the American Forestry Association, contains several copiously illustrated articles on the operations in France of the American Lumber Corps, 20th Engineers (Forestry). Several of the illustrations clearly show the Double Storey character even of temporary mills, and also how general is the use of Skidways for the storage of logs. One picture shows the Skidway in a storage yard leading down to a canal or flume filled with water, along which logs are poled to the foot of the incline up into the mill. The idea is a very good one and is worth bearing in mind when the timber is suitable and water is available. By means of it the length of the endless chain conveyer can be considerably reduced and steam power economized (*F. A. L.*—25-8-19.)

super elevating the outer rail and making a skidway sloping from the track towards the pond. A couple of men armed with peavies can unload a train of several cars in a few minutes.

In hardwood mills the logs are sometimes unloaded from the cars on to *skidways* of poles or beams placed at right angles to the railway track. The skidways have a gentle slope towards a trough on the side opposite to the track. In the bottom of the trough is an endless chain with spikes at intervals for conveying the logs into the mill. An arrangement of this kind was seen at River Marnie Quebec for handling small Spruce logs in the winter with the thermometer at zero.

Travelling or stationary derricks are used for sorting and piling where logs are of large size or are not passed into the mill direct. At Helena, Ark, a large stationary derrick with a 70 feet jib or boom was seen. It stacked logs in piles from 20 to 30 feet high in a semicircle, and placed them in the conveyer leading into the mill as required. At Sardis, Miss, a crane mounted on a high platform running on a broad track from 12 to 15 feet wide was seen. There was room for loaded cars to pass underneath.

To help in sorting logs and in the raising of sunken ones a miniature overhead skidding outfit is somtimes installed across the mill pond, *e.g.*, at Townsend, Tenn. For the recovery of " sinkers " hand operated windlasses and grappling tongs mounted on a small raft are sometimes used, *e.g.*, at Bogalusa, La.

An alternative to the trough and endless chain method that is employed in some mills is to haul the cars direct into the mill without unloading on arrival from the forest. The hauling is done by cable and *Steam Jack*. The *Log Deck* is large enough to accommodate full loads.

The chief objections to this plan are that it requires a larger stock of cars and also that the mill is liable to run short of logs if any serious breakdown occurs on the railway or in the forest.

A variation of this method is to unload the logs on the slipways on arrival from the forest and to re-load them on to special cars for hauling by cable into the mill.

96. Storage of logs in a mill pond or open river has hitherto only been used in Burma for teak. It is believed that the same method could generally be used with advantage for other species because (1) it is undoubtedly cheaper than any other method of handling logs that will float, (2) immersion in water is known to be a good way of storing logs which decay rapidly in a damp atmosphere, and (3) immersion in water is also useful in preventing splitting (or " checking ") of logs exposed to the sun in the dry season. The possibility of obtaining a suitable supply of water for a mill pond of the requisite size should therefore be one of the first considerations in the selection of a mill site.

For dry storage of heavy species some form of timber slipways should always be used. Logs should not under any circumstances be allowed to rest on bare earth. If they do, the mill yard is bound to become a quagmire in the rains, to say nothing of the extra wear on the saws, and of the accumulation of mud inside the mill itself.

(1). Endless Chain Conveyer in a Hardwood Mill ;—Charleston, Mississippi

(2). Trolley and Cable method of hauling logs in to a mill.
(Photo by Professor Bryant)

(1). Spraying of logs before entering mill,—Elk River, Idaho.

(2). Mill Pond and spraying of logs;—
Fernwood, Idaho.

The endless chain conveyer and the cable car methods of passing logs into the mill each have their advantages. It would, however, hardly be safe to depend entirely on taking cars into the mill direct without unloading; although it might be done for extra heavy logs in order to avoid the additional handling involved in storage on the slipways.

Nothing more is required if logs are of medium size and can be passed into the mill more or less in the order of arrival from the forest. In any ordinary operation some of the logs can certainly be rolled by men armed with peavies or cant hooks. Even if special appliances are provided for moving the heavy logs they should not be used on the small ones.

97. With regard to *temporary* (*portable*) *mills*, a detail brought out later on in this chapter is the fact that the smallest type of mill equipped with Western appliances can convert timber from five to ten times as fast as any mill of the same size and with the equipment usually to be met with in India.

The task of feeding a small Indian mill with logs by animal haulage is not as a rule an easy one and so it is fairly obvious that some better plan should be devised if the number of logs is to be multiplied half a dozen times. A certain amount of storage at the mill must be allowed for, and so skidways are indicated. A small gauge tramway (2 feet) would also come in useful. If both are installed the skidways should be raised above ground level, or the tramway be sunk below it, in order to facilitate loading.

98. The operation of the *Steam Jack* for hauling the logs into the mill by endless chain, or by car, is in the hands of a man stationed on the *Log Deck*. It is his business to see that the sawyer is kept well supplied with logs at all times.

Entrance of Logs into the mill.

A detail worth special notice is that *friction* is made use of to a very considerable extent throughout the mill for driving machinery. Slot or Jaw couplings are rarely used. About the only example that the writer can call to mind is the coupling of the carriage *Trailer* (paragraph 105). In the hands of a good man friction wheels can be used to switch on and off without the violent jerking which is inevitable with slot couplings. The cone clutches on skidding machines are one example of the use of friction. In Plate LXIV an illustration is given of bevel wheel friction, and in Plate, LXX there is one of spur wheel form. Friction is also used for *Live Rolls*, but not for the multiple chain conveyers by which lumber is fed to trimming saws as it is essential for the chains to travel at the same rate as each other in order to keep the lumber square to the saws.

Special attention is invited to Plate LXI showing very clearly the *Spraying* device seen at Elk River, Idaho. The practice of spraying is an innovation of recent origin which is growing in favour, although not yet in general use. The writer saw it in operation in three mills, *viz.*, Charleston, Miss, Fernwood, Idaho and Elk River, Idaho. It is very rightly claimed for the spraying of logs that it saves the wear on the saws very considerably.

99. In many operations logs are brought from the forests in as long lengths as possible. Cross-cutting is either done in the pond or yard with a steam or

gasoline reciprocating saw—as for example the Drag Saw illustrated in paragraph 74, or it is done inside the mill before the logs leave the trough. In the latter case the log is gripped in a pair of jaws and the cross-cutting is done either by circular, reciprocating or chain saw. The cutting is generaly done to standard lengths. In two or three mills the writer saw a simple device for doing without tape or measuring stick. It consisted in a number of chains hanging over the trough at known distances from the saw. In some cases the logs butt against a stop.

100. The illustrations of the "*Kicker*," "*Loader*" and "*Nigger*" need very little explanation. They are all operated by steam.

To a stranger the *Nigger*, when first seen, is almost uncanny in its efficiency. The lever by which the sawyer controls it has an universal joint. According to the direction of motion of the lever the amount of steam admitted to the two cylinders can be varied at will. If the steam enters both equally, the arm moves straight upwards. If more steam passes into the rear cylinder the arm bends forward, but with more steam in the front cylinder the arm bends backwards. Combinations of these three motions enable the sawyer to do almost anything he likes with the Nigger. The ease with which logs of almost any size can be turned round on the carriage is remarkable. A log can be turned into half a dozen different positions in as many seconds and yet leave the sawyer enough time to make up his mind which he likes best.

There are two chief forms of the *Nigger*, *viz.*, (1) *Oscillating*, and (2) *Stationary*. The description just given applies to the first named. The stationary type can only move straight up and down. The Waterous Engine Works Company turn out a combination of both, known as the *Waterous-Kendall Nigger*, which is claimed to be safer to operate and yet quite as effective as the oscillating type.

101. In some mills the places of Steam Kicker and Nigger are taken by an *Overhead Canter or Log Turner*, also operated by steam. In Plate LXIV three bevelled or cone friction wheels may be seen. By means of the hand lever (also shown) the sawyer can move the drive shaft backwards or forwards, causing one or other of the pair of small friction wheels to engage with the large one on the shaft carrying the chain and drag hook.

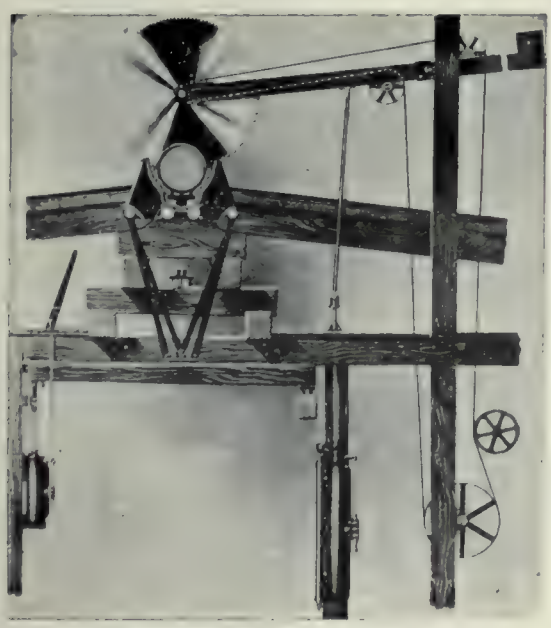
For heavy logs a double geared form of the same device is used.

On the Pacific Coast even the Nigger can find logs that are too big for it to move and the aid has to be invoked of machines such as the *Simondson Log Turner* (Clark Bros. Co.) or the *Pacific Coast Log Turner* (Allis-Chalmers Manufacturing Company), with regard to which reference may be made to catalogues.

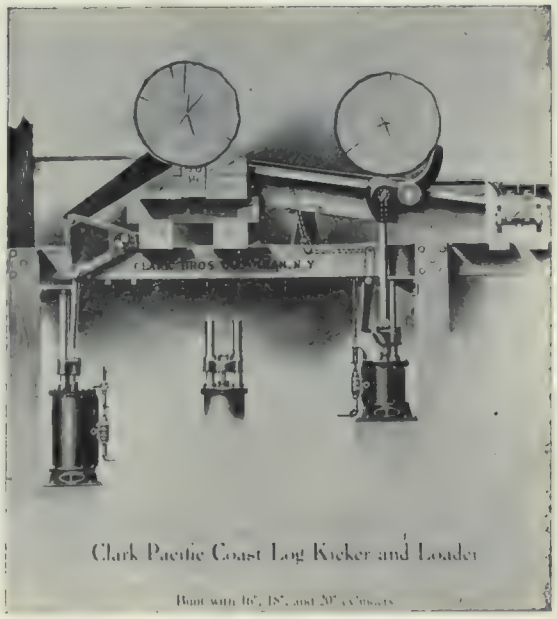
102. The argument with regard to *portable mills*, advanced in paragraphs 94 and 97, may also be applied to the equipment for handling the logs inside the mills. If any considerable number are of large size an *Overhead Log Turner* should be installed. A *Screw Pulley* suspended over the carriage would be useful for the purpose, but it is no cheaper to buy and is slower in operation.

The diagram shown in Plate LXIV illustrates a simple device to be met with in many small mills for facilitating the turning of logs by hand. To relieve the

(1). Chain saw for cross-cutting inside mill—Elk River, Idaho.

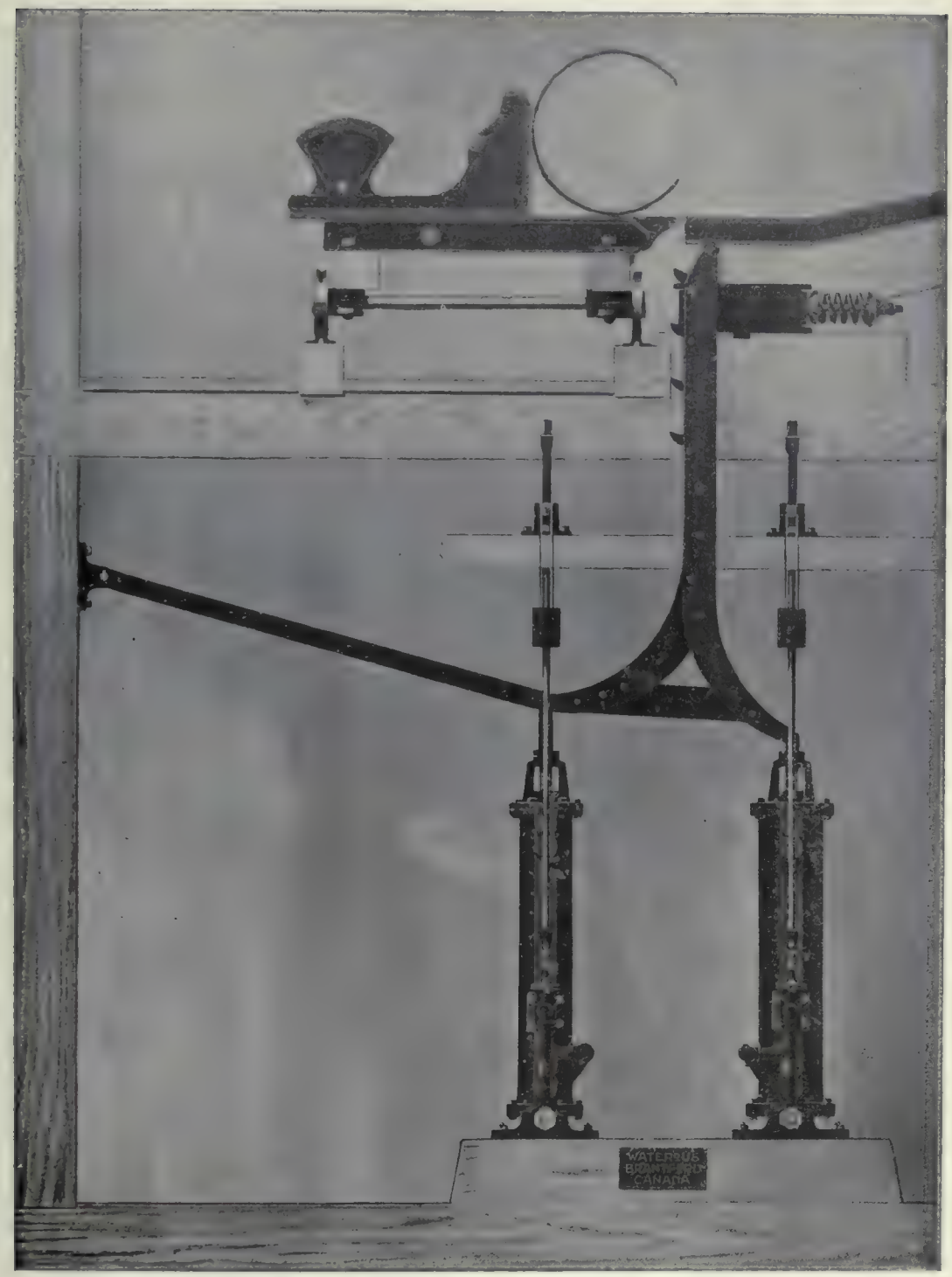


(2). Pendulum Saw for cross-cutting inside mill



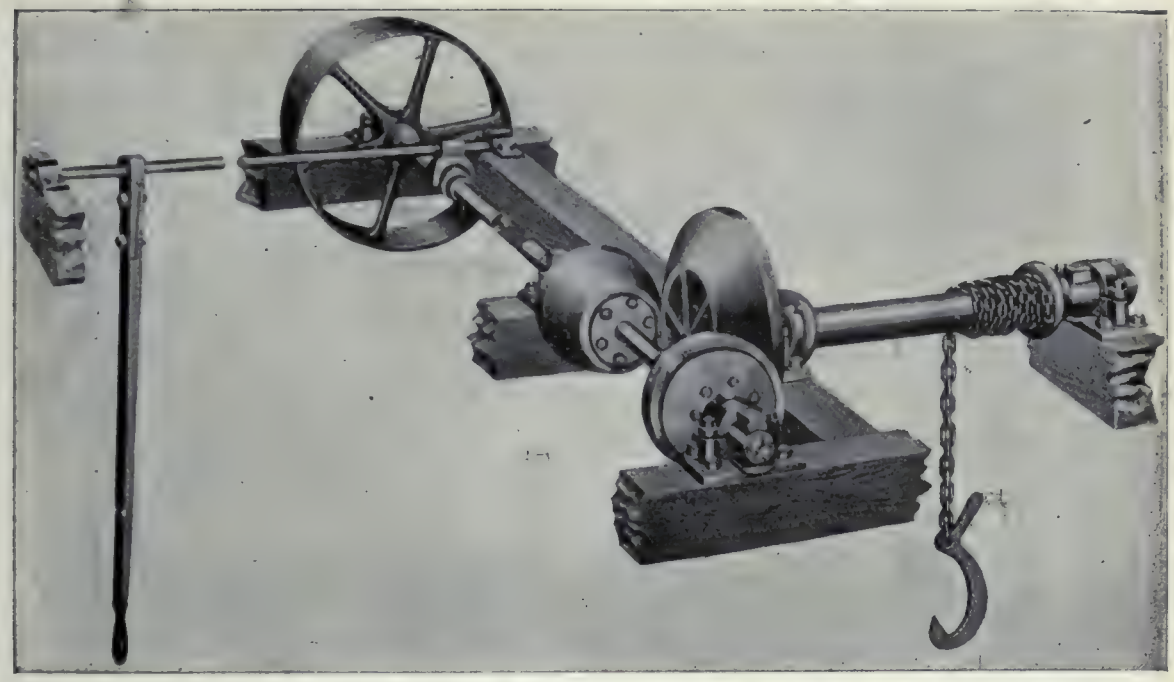
(3). Steam Log Kicker and Loader.

(2) and (3) (by permission of Messrs. Clark Bros. & Co.)

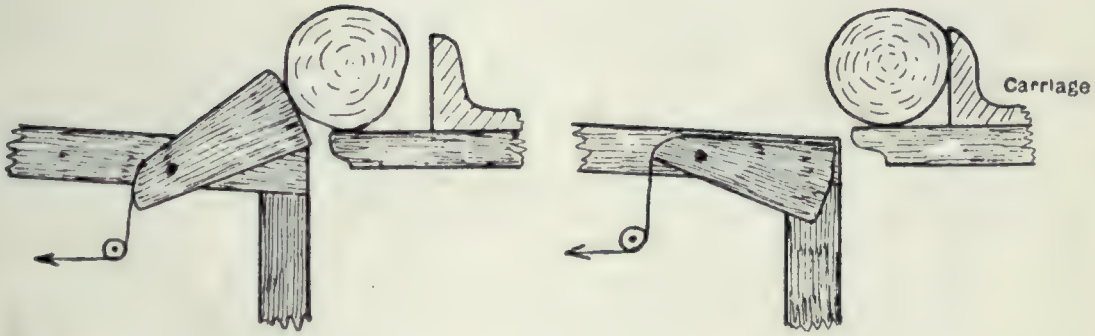


Oscillating Steam Nigger (by permission of Messrs. The Waterous Engine Works Co.)

(para 100).

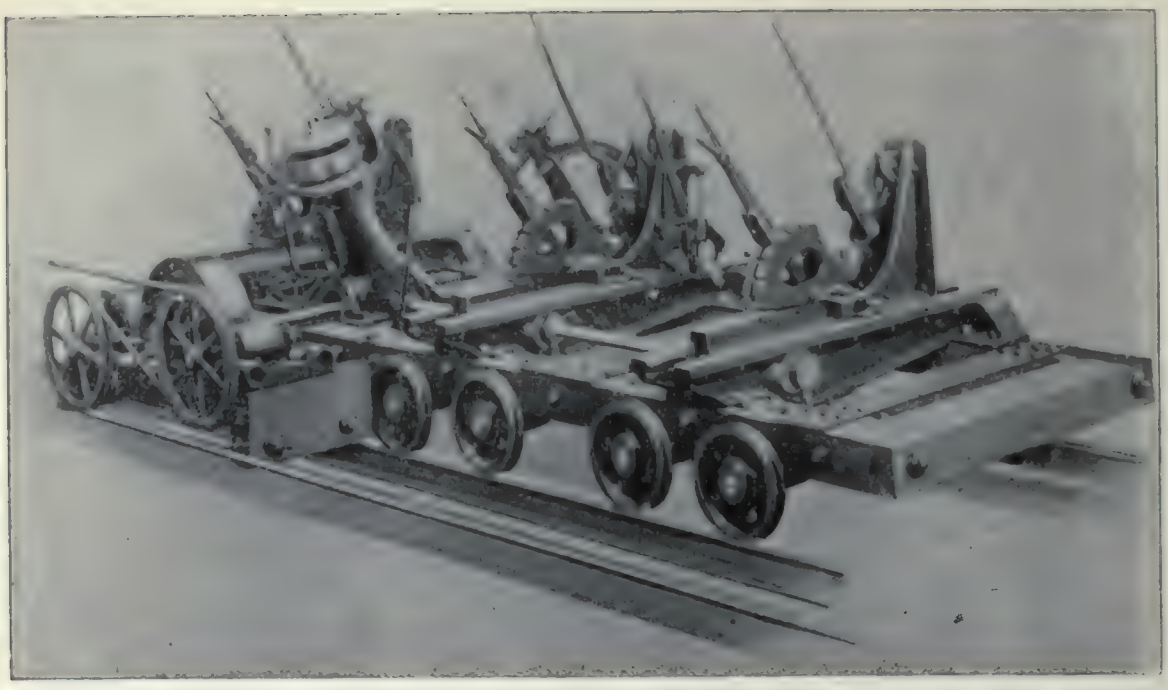


(1). Overhead Log Canter or Turner (single geared) (By permission of Messrs. The Allis-Chalmers Manufacturing Co.)

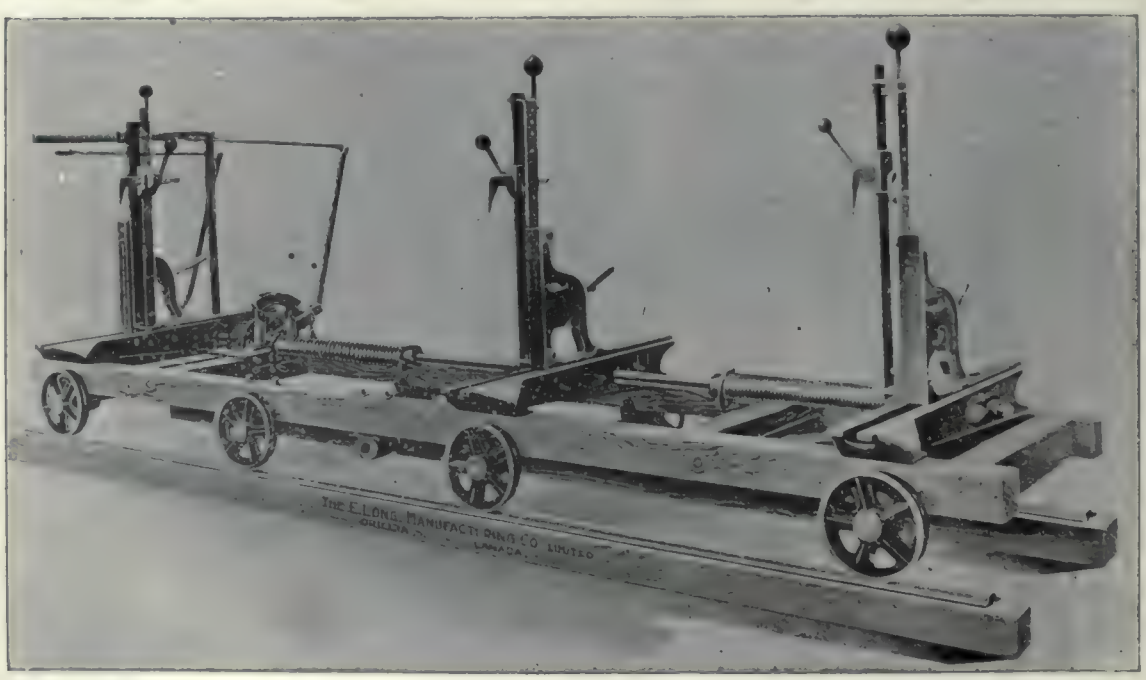


(2). Device for turning logs by hand in small mills.

(para 101).



(1). Heavy duty log carriage with Trout Power Setworks,—(view from the side opposite to the Saw ;—place for log to the right of the knees) (By permission of Messrs. The Allis-Chalmers Manufacturing Co.)



(2). Light Log Carriage for medium sized and small logs.—(view from the near side, place for log in front of the knees.)
(By permission of Messrs. E. Long Manufacturing Co.)

strain on the head blocks of the carriage the turning is done towards the log deck. To stop the log from simply rolling back on to the deck, quadrant shaped blocks of wood or iron are raised for the log to butt against. When not in use the blocks drop out of the way below the level of the deck timbers. The sawyer raises them by means of a lever or foot pedal.

Section 4.—LOG SAW CARRIAGE.

Log Carriage.

103. It is with some regret that the opening paragraph of this chapter is not devoted to the *Log Carriage*, for it is indeed a wonderful piece of mechanism. It deserves to be carefully studied, because in it, more than in anything else, lies the secret of the superiority of the Canadian and American sawmill. The remark below is worth repetition here although taken from a manufacturer's catalogue :—

> "Several machines used in the manufacture of lumber have been called "the heart of the sawmill", but we think any mill man of experience will agree with us that of all the machinery used in manufacturing lumber, the log carriage should enjoy this distinction".

The parts of the machine are many and varied. The following is a list of them :—

(1) The *Head Blocks* consisting of the *Seat* for the log to rest upon, and the *Knees* for it to butt against.

(2) The *Dogs* for gripping the log.

(3) The *Taper Setworks*, with independent sliding motion to the knees to accommodate crooked or tapered logs.

(4) The *Setworks* proper, for moving the log forward step by step for successive cuts.

(5) The *Offsetting* mechanism, for moving the carriage back a trifle on the way back, in order to avoid the risk of the log coming into contact with the saw.

(6) The *Receding* mechanism, for moving the Knees back for the next log.

(7) The *Feeding* mechanism, for moving the carriage backwards and forwards.

(8) The *Trailer*, or *Carriage Extension*, for extra long logs.

Supplementary are the *Nigger* and *Overhead Log Turner* already described, and the *Slab Turner* or *Cant Flipper*. The latter is a device for steadying the falling over of big slabs or planks on completion of a cut. If this were not provided for there would be risk of damage through splitting.

Sawyer and men on the carriage.

104. The operator in charge of the log sawing is known as the *Sawyer*. He stands in front of the saw and faces the carriage with two levers within easy reach, one for the *Nigger* and the other for the *Feed*. By a turn of the wrist he plays with

the log until it is in the right position for sawing, and by signs he gives his instructions to the men on the carriage, (1), to twist the log round if it tapers, and (2), to advance or recede it until it suits his ideas as to the thickness of the next cut (or the first slab) as the case may be. With the other lever he feeds the log to the saw *at any desired speed* and brings the carriage back again, usually at top speed.

Riding on the carriage are two and sometimes three men, one for the *Setworks* and the others for the *Head blocks*. With medium sized logs one man can manage two head blocks.

The sawyer gives his instructions to the Setworks operator by raising or lowering his fingers according to a regular code of signals. In *Portable mills* the sawyer usually does the setting himself, and nobody rides on the carriage.

On the wall opposite the sawyer, a *Notice Board* is usually to be met with. It is posted up from time to time with instructions from the Mill Superintendent as to the sizes to be cut.

At Davis, W. Va, the writer saw *a large mirror* on the wall on the right of the sawyer near the Log Deck. When turning a log over the sawyer was enabled to see both ends without moving a step.

105. The general appearance of a carriage may be gathered from the illustrations. As the name implies, the machine is a *Carriage on wheels* and not simply a *table* which travels on a series of rollers or small wheels placed at intervals from end to end of the track.

The framework is of timber. On it are mounted from 2 to 5 *Head Blocks* or supports for the log. The lower part of each head block is known as the *Seat*, and the upper bracket-like part is called the *Knee*. The sliding (*setting*) of the knee backwards and forwards across the seat is usually done by *Rack and Pinion*. The pinions of all the head blocks are keyed to a longitudinal shaft. The mechanism for turning this shaft is called the *Setworks*.

Rails.

The wheels and rails are not all alike. On the same principle as in the bedplate of a lathe, the rails on one side are inverted V shaped and on the other side they are flat.

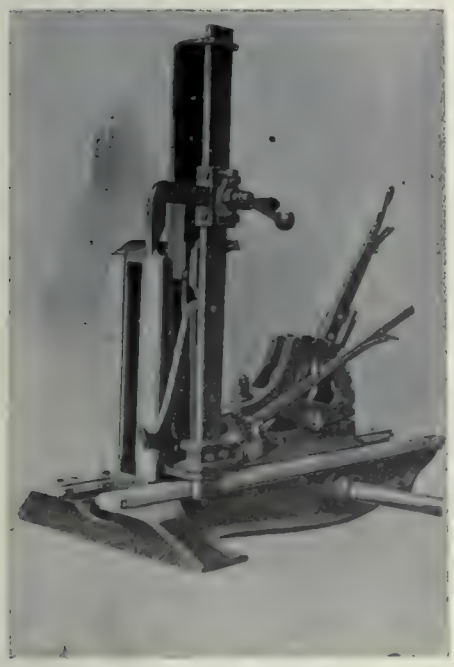
Trailer, (carriage extension).

Carriages are built of any length and with as many *Head Blocks* as desired by the purchaser. To avoid always having to use an extra long carriage where only a limited number of long logs have to be sawn, a *Trailer*, or extra length to be coupled on to the main carriage, can be provided. On it there are usually two head blocks. When not in use the Trailer remains at the end of the track. It is a mere matter of a few seconds to bring it into use. The sawyer runs the carriage right back until it pulls up against the Trailer. The couplings, both for the frame and for the Set Shafts, automatically lock together. The couplings for the latter are winged so that the Knees on the carriage and the trailer cannot be out of perfect line with each other.

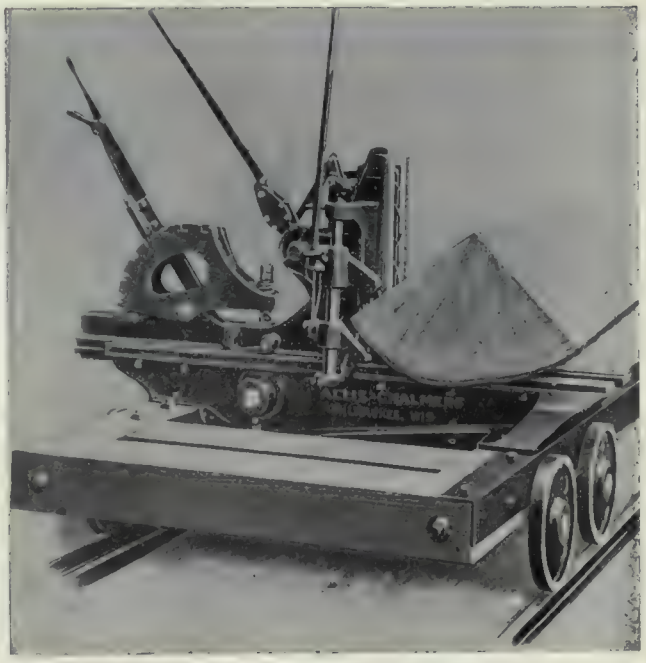
With the *Log Table* no such arrangement is possible. The table proper can only cut logs of a given length; and, if the feed is by rack and pinion, an extra length of table cannot be added.

(1). Usual type of board Dog,
one face of the knee removed.

(2). Hammer Dog.



(3). Knight Ideal Dog,



(4). Quarter Log Dog.

(By permission of Messrs. The Allis-Chalmers Manufacturing Co.)

Most of the logging of *pyingado* for conversion into metre gauge sleepers in Burma is done to double sleeper lengths, *i.e.* 12 to 13 feet. Logs of extra large diameter are cut to single sleeper lengths, *i.e.* 6 to 7 feet. A few of the small logs are cut to 3-sleeper lengths, *i.e.* 18 to 20 feet. A carriage with 3 head blocks about 5′ 8″ apart (or better still 4′ 6″ and 6′ 6″ respectively) would take all three of these classes of logs. With a 2-head block trailer any length up to 28 or 30 feet could be managed.

Dogs.

In the illustrations of carriages it may be noticed that each head block is provided with two levers ; one is for the *Dogs* which grip the log and the other is for *Taper Setting*. There is a great variety of *Dogs* on the market, some of which seem to be rather complicated. The writer came across several instances of logs or piles of boards being held perfectly well by nothing more than sliding spiked dogs similar to those shown in Plate LXV (2).

Attention is invited to the two lower illustrations in Plate LXVI. Both devices for gripping portions of logs are very good. Radial or "quarter" sawing is likely to become of increasing importance in India, in order to reduce warping and also to bring out the ornamental qualities of some of the more valuable tropical woods. For such sawing the Western carriage is far superior to the plain flat table (paragraph 118).

Taper setting.

106. The mechanism for adjusting the *Knees* to suit crooked or tapered logs usually takes one of two forms. On light carriages [*vide* Plate LXV (2)] the *Taper Set lever* acts on a plate enclosed in the *Knee*. Pulling the lever down causes this plate to stick out in front of the knee. An even simpler contrivance to be met with at times is to place pieces of wood of known thickness in front of the knees as required.

On heavy duty carriages the mechanism is on the lines of the diagram, Plate LXVII (1) copied from the catalogue of Messrs. The Waterous Engine Works Company. Details are as follows:—

The *Rack* by which motion is communicated to the *Knee* is not bolted to the latter. They can slide over each other, the motion being controlled by the short arm of the lever which fits into a recess in the rack. The pivot of the lever is on the knee. Pulling the lever down causes the knee to advance. With the taper set lever locked the knee can only be moved by operating the *Set Works*.

Setworks.

107. The *Setworks* for advancing the log for successive cuts are either operated by hand or by steam power. The former is the usual method for medium sized and small logs unless the Management is extra keen on high speed working.

With heavy logs the hand setworks lever is operated by a man riding on the carriage. In the illustration of a light carriage—Plate LXV (2)—it may be noticed that there is a horizontal arm to the lever. With such a carriage the sawyer does the setting himself. The wooden bar seen on the left of the same picture is

graduated, and shows at a glance what the actual distance is between the knees and the line of the saw.

A detail of the hand-operated setworks which is worth special notice is the method of reducing back-lash. If there were only one pawl for engagement with the teeth of the ratchet wheel the play of the lever would be considerable. A number of pawls (from 2 to 6) are therefore used, with the points staggered—Plate LXVII (2). Within very small limits, therefore, no matter where the lever comes to rest, one pawl is sure to be in close contact with a tooth on the ratchet wheel.

The adjustments are such that a log can be advanced by any desired fraction of an inch, from one thirty-second upwards, by a single throw of the lever. On the other hand, if thick cuts are required, any multiple of an inch up to 4" can be got in one stroke. In better class machines the feeding forward is done both by the forward and backward throws of the lever.

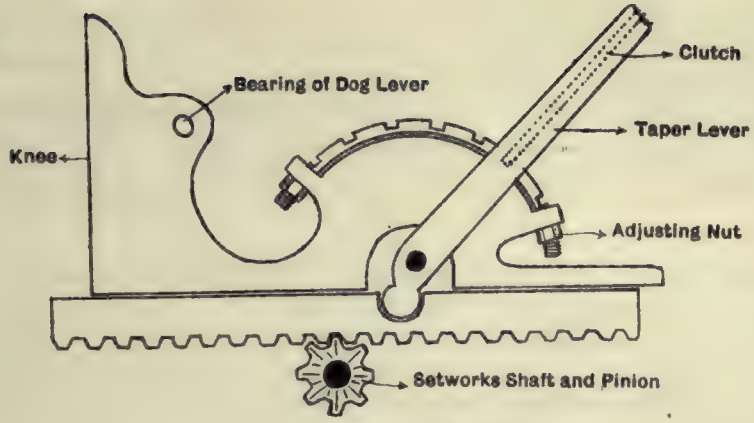
The mechanism is expressly designed for operation at high speed without any sacrifice of accuracy. The writer was often rather bewildered, when watching operations, at the rapidity with which the carriage raced backwards and forwards without any appreciable halt in between, and although the planks were of varying thicknesses there was no cause to complain of their exact measurements being too large or too small. The severest test to which the *Setting Mechanism* can be put is to measure the sides and angles of a *Squared* piece of timber. The standard of excellence in respect to both sides and angles is uniformly very high with the Western Log Carriage, even after severe service extending over several years.

Setting by rack and pinion is not the only method in use. Several manufacturers are prepared to supply *Screw Mechanism* if desired.

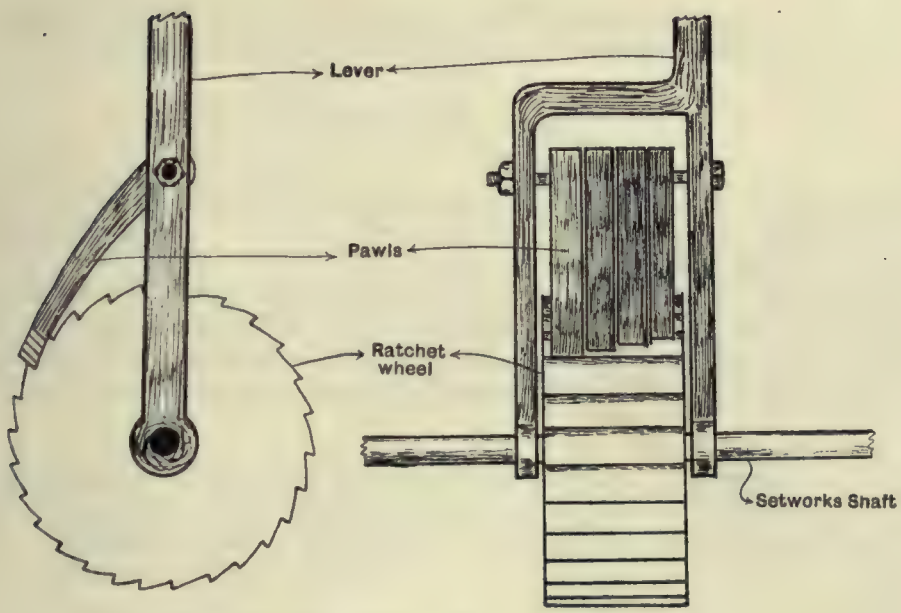
One firm (The McDonough Manufacturing Company) holds the patents for what are known as *Grip Setworks*. It is claimed for this device that it is absolutely free from lost motion, *i.e.*, back-play, and that it is so very sensitive that the operator can vary the thickness of lumber as close as one-hundredth part of an inch, as compared with one thirty-second with ratchet mechanism

In the ordinary type of *Steam Setworks* a small engine is mounted on the carriage. Steam is conveyed to it and the exhaust steam is taken away by means of two small tubes sliding in and out of two long narrow steam pipes laid between the rails of the track as shown in the diagram—Plate LXVII(3).

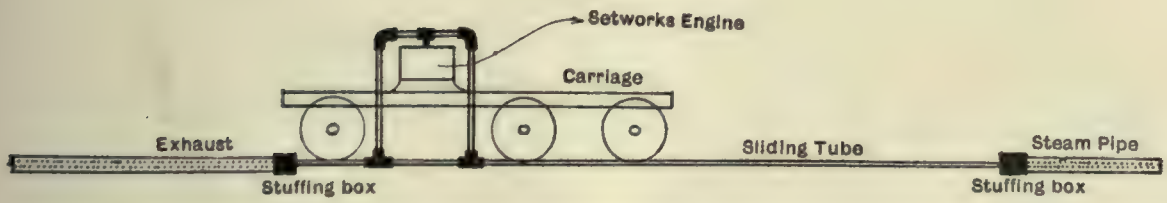
Another favourite form is the *Trout Power Setworks* shown in Plate LXV (1). The rope in the foreground, which passes round two large wheels on the carriage, has nothing to do with the carriage feed. The rope is an endless one and extends from end to end of the track. By means of a live drum under the floor it is always in motion. The wheels on the carriage are therefore always revolving, no matter where the carriage itself may happen to be. All that is required to operate the setworks is to put in the clutch, and this is done by movement of pointers on the graduated dial at the top of the setworks column. The manufacture of this type of setworks is not confined to one firm. The various makes differ in detail but they are alike in principle.



(1). Method of operation of lever for taper setting.



(2). Method of reducing back-lash in the set-works; enlarged view of ratchet wheel and pawls.



(3). Method of arrangement of steam set-works.

108. As soon as the carriage begins to move backwards a device is automatically brought into play which pulls the knees back a trifle, so that there may be no risk of the log catching against the back of the saw. This motion is known as *Offsetting* and does not require the operation of any hand lever. It is not necessary with circular saws, and of course it is not required with double band saws, *i.e.*, cutting both ways.

Offsetting.

To *recede* or move the knees back to make room for the next log (or after a half log has been turned round) either of two methods is employed, *viz.*, (1) *Friction* and (2) *Spring*. The latter is the more common, as it is cheaper to instal than the friction device, and it answers perfectly well for logs of moderate size. Forward movement of the *knees* coils a powerful helical spring on the setworks shaft,—*vide* Plate LXV (2)—and to cause the knees to spring back (recede) it is simply necessary to lift the pawls off the ratchet wheel. To prevent the knees from going back too violently a pedal band-brake is provided.

Receding.

In the *Friction method* the movement of a lever brings a friction wheel connected to the Setworks Shaft into contact with a power driven wheel.

CARRIAGE FEED MECHANISM.

109. The movement of the carriage plays such an important part in the successful operation of the machine as a whole, and there is such a great variety in the mechanical devices connected with it, that it is proposed to discuss the matter in some detail. A good appreciation of the possibilities offered by the wide range of choice that exists in this part of the appliances in Western mills should appeal very powerfully to men who are only acquainted with the devices usually met with in the East.

Feeding Mechanism.

Although when speaking of the motion of the carriage in a general way the term "*Feed*" is applied to the motion in both directions in its strictly technical sense the term is limited to the forward motion, and the return or backward movement is spoken of as the "*Gig*" *motion*.

Feeding is done in the following ways:—

(*i*) Direct Steam or Shot Gun.

(*ii*) Twin Engine and Rope, with or without gearing.

(*iii*) Friction and Rope.

(*iv*) Friction with Rack and Pinion.

(*v*) Belt and Rope.

(*vi*) Belt with Rack and Pinion.

Friction is so much better than *Belt* that the chief reason for mentioning the last two methods is to emphasize the desirability of avoiding the use of them. They find no place in big mills, and even in moderate sized mills they are not common. The field for them is limited to small mills and, even amongst the latter, the more modern and better class ones make use of *Friction*.

But good as *Friction* is it must still be classed as inferior to *Steam*. Unfortunately the latter is more costly to instal and requires greater skill in operation.

Rope V. Rack and Pinion.

In describing feed mechanism there are two parts to be dealt with, namely, (*a*) the Power and (*b*) the Carriage Connection. For the latter, there is a choice between (1) Direct Steam or Shotgun, (2) Rope and (3) Rack and Pinion.

Plate LXVIII illustrates one form of rope feed. It may be seen that both ends of the rope are tied to the carriage. The rope passes round wheels at both ends of the carriage track and is also given two or more turns round a grooved power-driven drum. Power is communicated to the latter by either of the methods described later on, namely, Direct Steam, Friction, or Belt.

In the case of Rack and Pinion the grooved drum is replaced by a Pinion wheel which engages in a toothed Rack fixed to the underside of the carriage and extending its whole length. Rope feed has the advantage over Rack and Pinion in that the length of the feed is independent of the length of the carriage. A long log cannot be cut on a short carriage with Rack feed, whereas it is a simple and inexpensive method to have an extra long track for rope feed. With Rack feed the carriage itself must be as long as the longest log ever to be cut upon it.

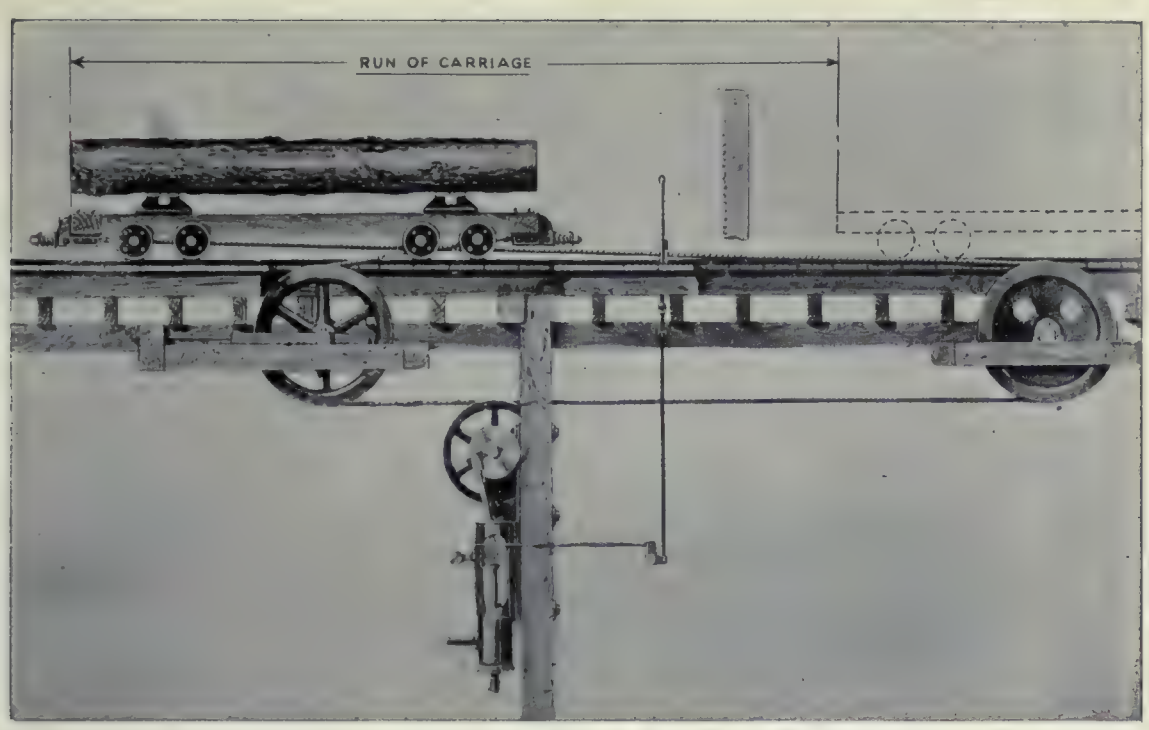
Rack and Pinion Feed has been almost entirely superseded by *Rope Feed* in North America, but it still holds first place in England. There are points in favour of both methods and individual choice is therefore not out of place. The writer's own preference is in favour of Rope Feed.

Shot Gun.

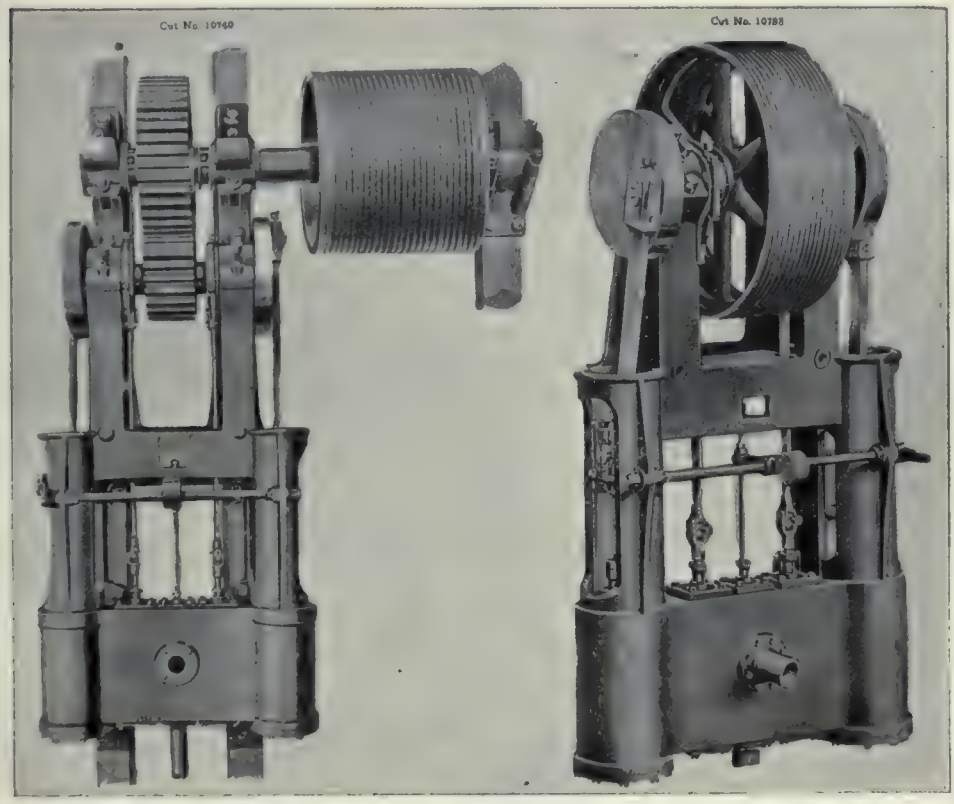
110. In the *Shot Gun* method the carriage is coupled to the piston of a long steam cylinder fixed between the rails of the carriage track (*vide* Plate LVII, frontispiece). It is in common use in big mills, but it calls for a very skilful and reliable sawyer. Slight forgetfulness, or mis-calculation, on his part may send the carriage full tilt into the buffers at the ends of the track. The practical limit is about 40 feet. In many large mills it is common to find one carriage with Shot Gun feed for logs of short or medium length and a Rope feed carriage for the long logs. Provision is sometimes made for turning the cylinders and piston round every month or two, so that all the parts may wear equally.

Twin Engine.

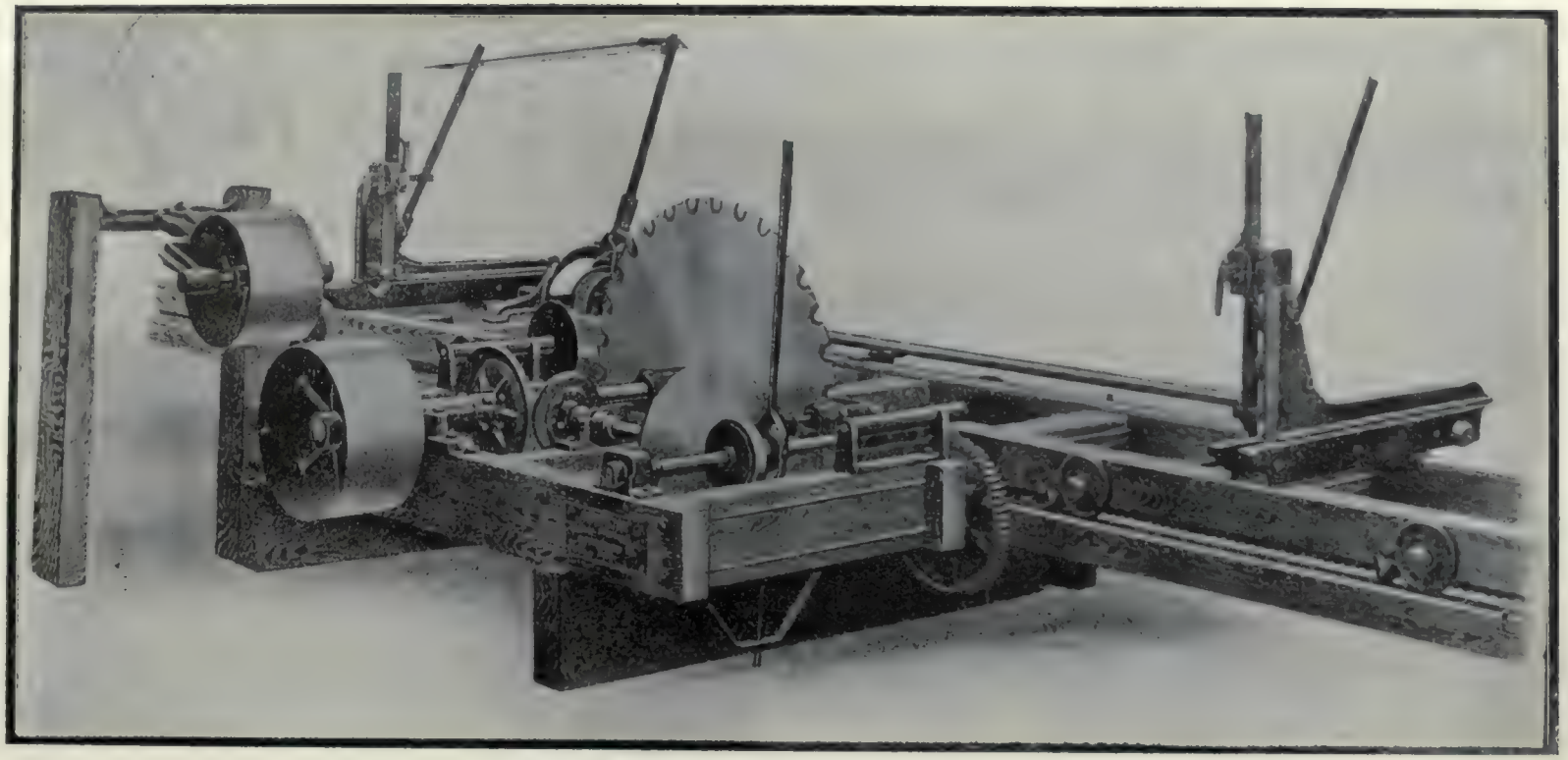
Twin Engine and Rope feed is probably the commonest method in permanent mills. A pair of small pistons working in steam cylinders communicate motion to the shaft which carries the rope drum—*vide* Plate LXVIII. This method gives as good results as the shot-gun plan and is easier to keep in order. Moreover it is cheaper to instal and it is not so dangerous to operate. If the carriage does travel too far or too fast the rope may be expected to break before much damage is done. Many operators prefer to have two thin ropes instead of one thick



(1). Diagrammatic view of Twin Engine and Rope Feed.



(3). Twin Engine and Rope Drum; geared drive. (2). Twin Engine and Rope Drum; direct drive.
(By permission of Messrs. The Allis-Chalmers Manufacturing Co.)



(1). Friction Disc feed with Rack and Pinion.
(By permission of Messrs. The American Saw mill Machinery. Co.)

(para 111).

Instead of driving the drum shaft direct *Gearing* may be introduced. This has the advantage of allowing the engines to run at a greater speed, thereby making the motion more steady and giving the sawyer better control.—Plate LXVIII (2).

For elasticity of working under varying load (*i.e.*, different widths of cut) *Steam Feed* of either kind is incomparably better than any other plan. With a turn of the wrist the sawyer can make the carriage travel at the pace best suited to the saw.

111. There are two kinds of *Friction Feed, viz.*, (1) *Disc*, (2) *Wheel.*

Friction Disc.

In theory, the *Disc* method is the better, because it gives a positive method of varying the feed. Referring to Plate LXIX a small friction wheel may be seen in front of, but not touching, the disc, which is connected by spur wheels with the saw shaft. By means of the lever the friction wheel can be made to slide along the shaft, and the latter can also be moved slightly until the wheel comes into contact with the disc. If the wheel and disc are in contact near the rim of the latter the friction wheel shaft will revolve faster than if the contact is made nearer the centre. If the wheel is moved past the centre the revolution will be in the opposite direction.

In another *Disc* pattern on the market there are two friction wheels, one for the *Feed* and the other for the *Gig*, working on opposite faces of the *Disc.*

112. The disc method used to be common in North America, but in lumber mills now-a-days it decidedly takes second place to the *Friction Wheel* plan. The latter is such a general favourite that details of the various forms in which it is used may be given.*

Friction Wheel.

*See paragraph 166 for the British combination of Friction Disc and Friction Wheel, which is undoubtedly superior to either of them singly for cutting hardwoods.

If a flat faced wheel on pivoted bearings be brought into contact with a power driven wheel the motion communicated to it will depend on the amount of friction set up between the wheels. If the pressure be reduced beyond a certain point slipping begins to take place, and the speed is reduced accordingly. This is the principle on which friction wheels are employed. In the hands of a skilful man the range of speed is so great *that cones wheels can usually be dispensed with.*

The feed mechanism is of two main types, according as mounted on :—(1) *An independent Frame* or (2) *The Frame* of the *Saw.*

The chief practical difference between them is that slower speed can be obtained with (1), and so the rope drum can be mounted on the same shaft as the iron friction wheel. This is not the case with (2) owing to the high speed of the saw, and gearing has to be interposed between the friction shaft and the rope drum.

113. (1) *Independent Feed Works.*—Plate LXX gives examples furnished by the catalogues of two well-known firms. The large flat faced friction wheels are made of iron, the small ones are made of wood fibre or leather. The wheel at the right hand bottom corner (*d*) of (1) is on the power shaft. By means of the belt it drives the small friction wheels (*a* and *b*) in *opposite* directions.

The eccentricity of the bearings of the Rope drum and big friction wheel shaft should be noticed (*e* and *h*). This enables the sawyer, by movement of the lever, to make contact either to the right or to the left. Contact to the left is for the *feed* and to the right for the *gig* or return. Owing to the smaller size of the belt wheel on the right the *gig* motion is faster than the *feed*. By allowing the wheels to slip the *feed* can be reduced to any desired amount.

All the wear is on the fibre covered wheels. Their life depends a great deal on the sawyer. In the hands of a good man they may last several months, whilst another man may wear them out in a week. They are comparatively inexpensive and easy to replace. Ply-belting is a good substitute for fibre, and a mixture of the two is indeed preferred by some operators.

The following are some of the chief variations from the double type shown in Plate LXX (1) :—

(*i*) Single type, *vide* Plate LXX (2) which is obviously not so powerful.

(*ii*) Sliding, instead of eccentric, motion of the shaft to bring the wheels into contact with each other : also shown in Plate LXX (2).

(*iii*) *Feed* and *Gig* wheels of different sizes in order to get slower speed and more power for the *Feed*. The drawback to this method is that the fibre wheels are not interchangeable.

(*iv*) The addition of a heavy *Fly Wheel* to the *Feed Shaft* to give the slow but steady feed often required in cutting hardwoods.

(*v*) *Cone Wheels* and belting in addition to the friction wheels, to increase the range of speed. In practice, as already remarked, this addition is rarely made use of.

114. (2) *Friction Feed on Saw Frame.*—Designs similar to those already described are made, with gearing between the friction shaft and the rope drum.

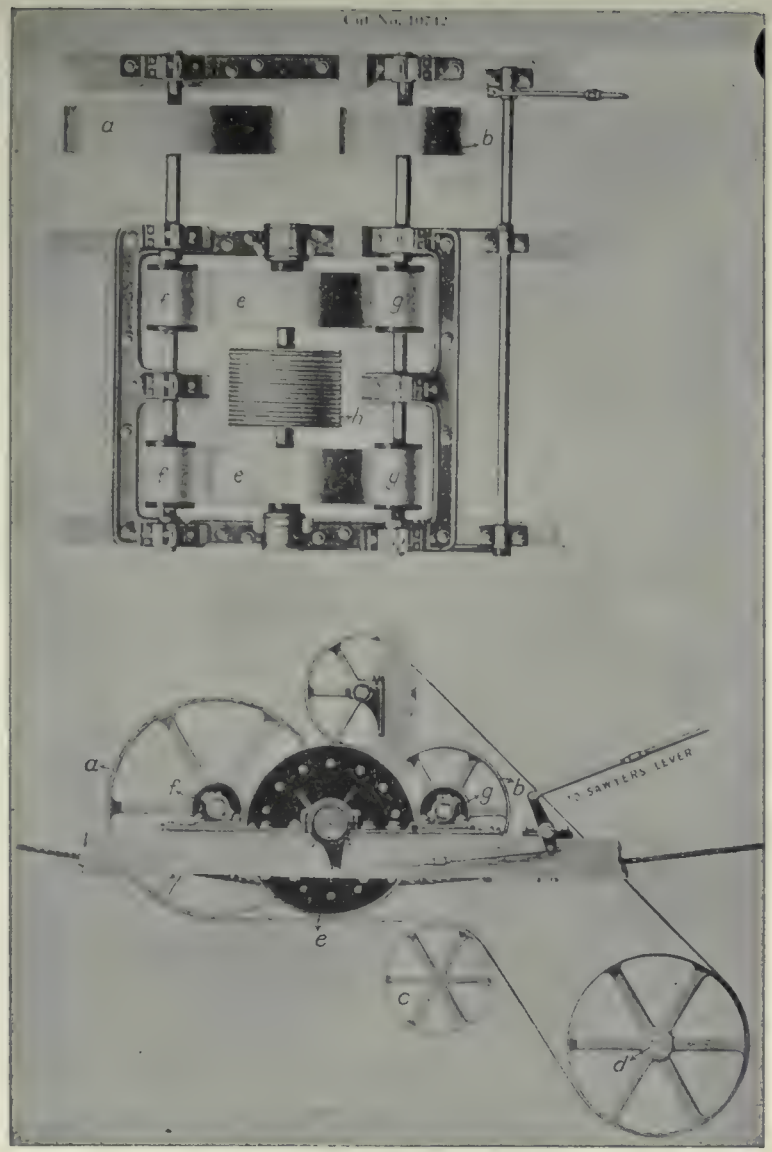
Using belts wheels of the same size, and interchangeable friction wheels, one firm only gears down the Feed, the Gig being driven direct.

In another design the fibre wheels are moved to and from the large iron friction wheel which is mounted on a stationary shaft bearing.

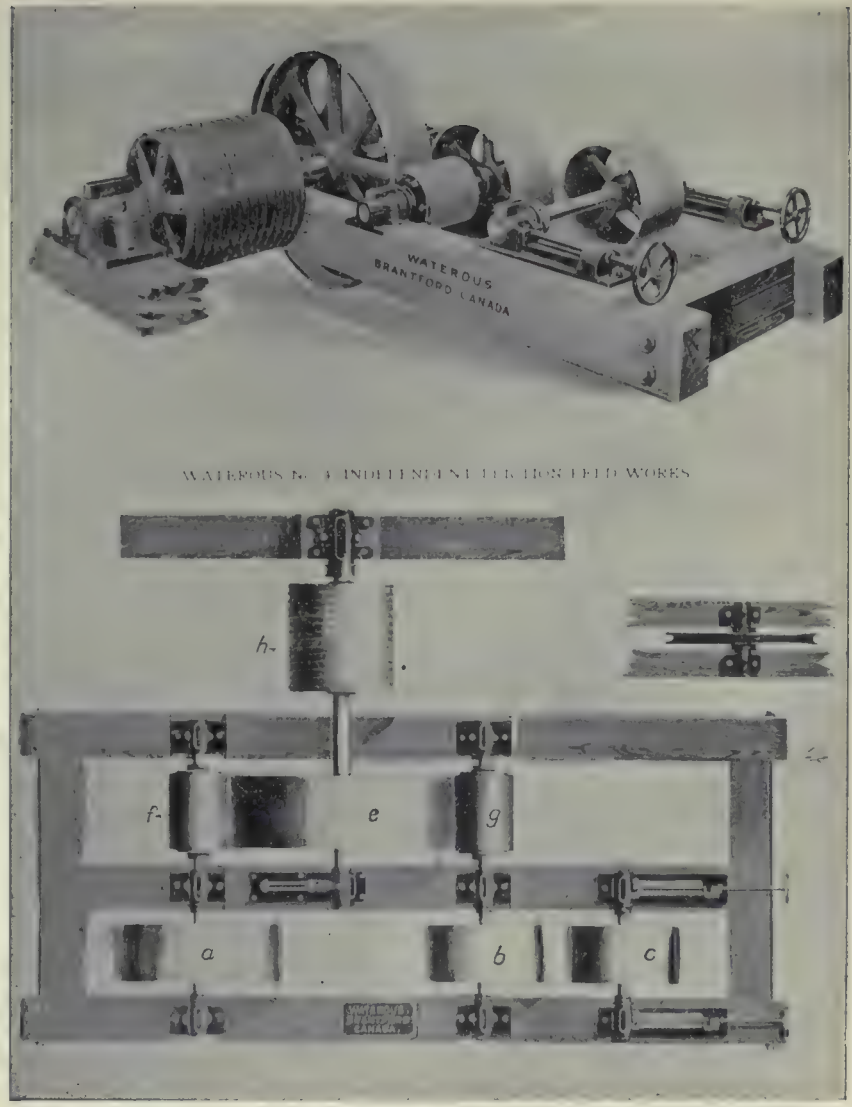
Plate LXXI (1) is an example of single friction wheel feed similar to Plate LXX(2), except that the feed works are built into the same frame as the saw.

In Plate LXXI (2) only one fibre friction wheel is used (for the *Feed*) and the *Gig* motion is obtained by means of a *Belt*. Movement of the lever causes two arms to rock. The short one carries a fibre wheel and the long one supports an idle wheel. On the Saw and Rope Drum Shafts is a pair of wheels with flanges. The flanges are provided so that the belts passing loosely round these wheels may not slip off. When the idle wheel is brought down it tightens the belt and sets the drum in motion.

Lastly, fibre wheels may be dispensed with altogether, and both *Feed* and *Gig* motions are obtained by means of belting. The Sawyer's lever has two arms as in the last example, but both of them carry Idle wheels. In the *Feed* slip can be made use of just the same as with friction wheels.

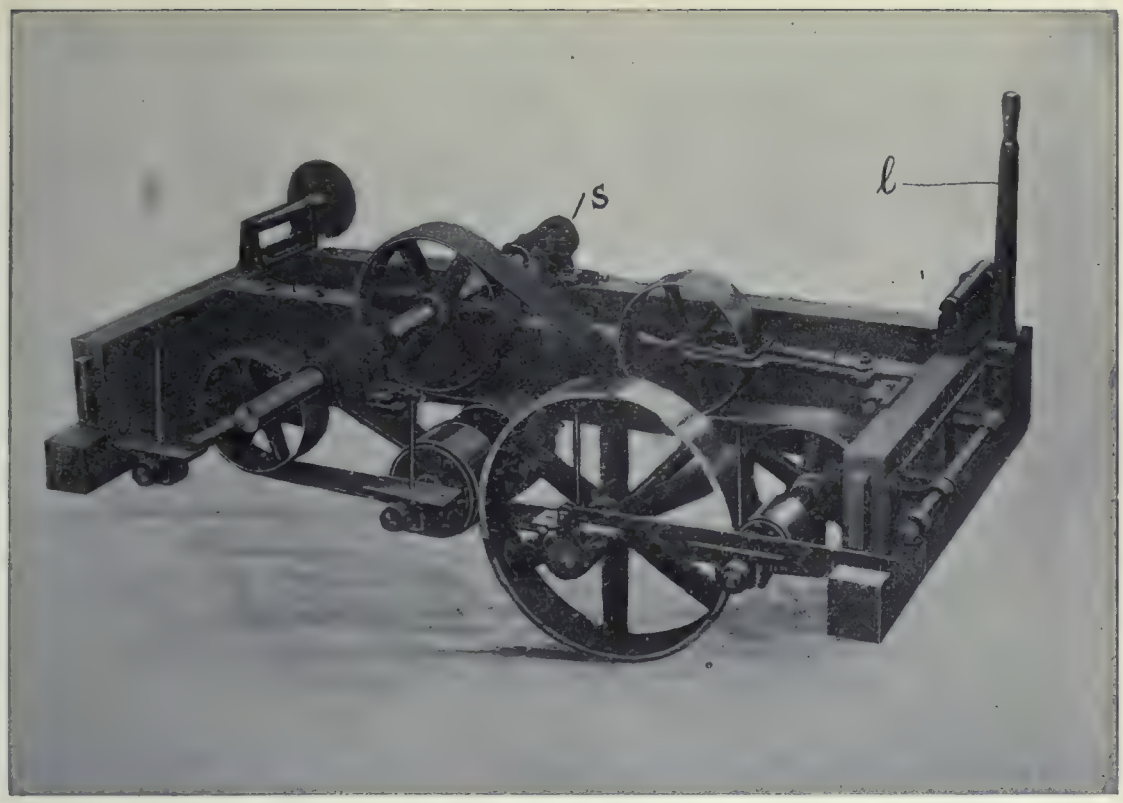


(1). Plan and end view of Double Friction wheel feed for carriage on separate frame.
(By permission of Messrs. The Allis-Chalmers Manufacturing Co.)

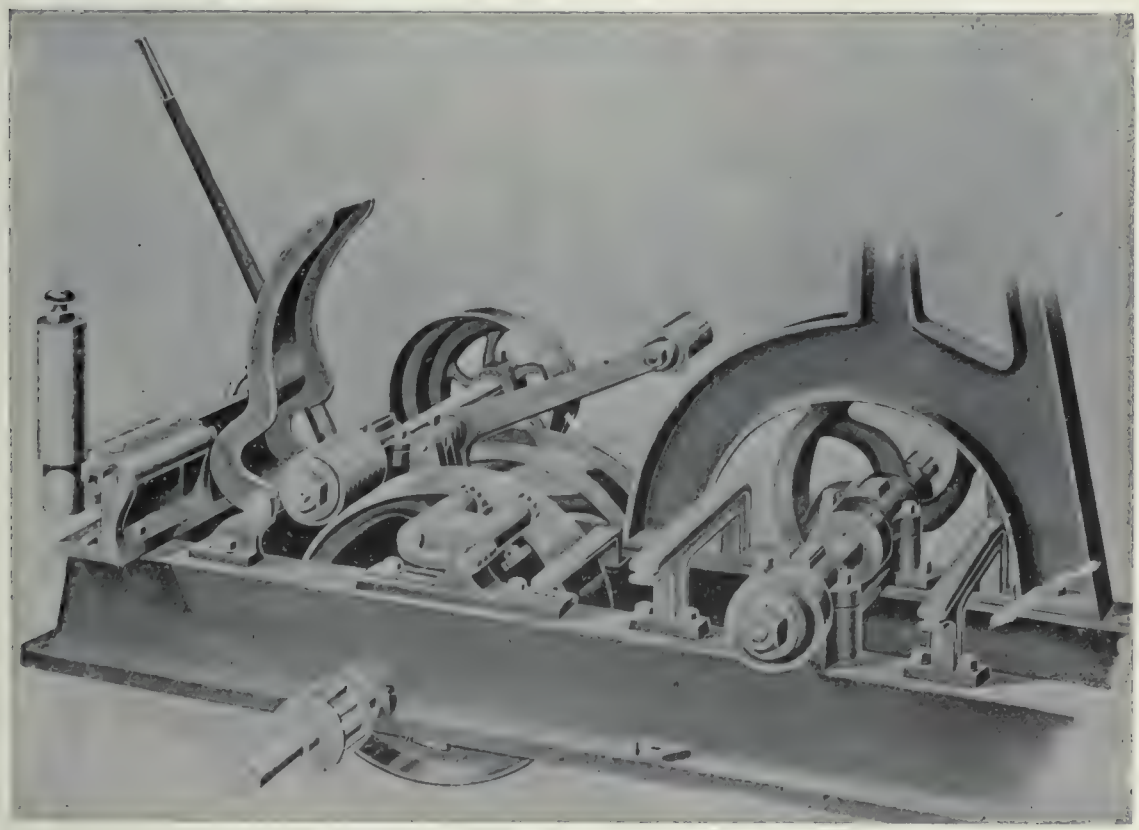


(2). Examples of two different designs of Single Friction wheel feed for carriage on separate frame.
(By permission of Messrs. The Waterous Engine Works Co.)

a, b—Belt wheels driven in opposite directions ; c—Idle wheel for tightening the Belt ; d—Power driven wheel.
e—Iron friction wheels. f, g—Fibre covered friction wheels. h—Grooved Rope Drum. (para 113).



(1). Example of Single Friction wheel feed on Saw Frame.
Shaft (S) carries the saw and also one of the belt wheels of the feed ; (L) is the Sawyer's lever.
(By permission of Messrs. The American Sawmill Machinery Co.)



(2). Combination of Friction and Belt feed on Saw Frame.
Note :—The illustration is of a *Double Circular Saw*, hence the part of the framework on the right.

115. *Summarizing* the preceding notes on *Feed Mechanism*, the writer recommends that *Friction Wheel and Rope* should be adopted as the standard for India. *Belting* is so often troublesome in the hands of semi-skilled men, and the cost of renewals is frequently so serious an item from the same cause, that it should be used as little as possible. Friction wheels are comparatively inexpensive to buy and replacement is easy. In the wide range of forms of friction feed roughly outlined in the foregoing notes (and in paragraph 166) it should be apparent to anyone that there would be no difficulty in finding designs and sizes suitable for every kind of hardwood or softwood to be met with in India.

Recommendations.

116. It was rather surprising at first to find that *All Steel Carriages* are not popular in the West. *Timber Frame work* to support the head blocks is much preferred. The reason is that such a carriage is more elastic than an all-steel one and stands up better under the rough treatment a log carriage has invariably to put up with. Moreover, if a steel frame does get bent it is a difficult matter to put it right again, whereas if any part of a timber frame gives way it can easily be replaced. Repairs are indeed only rarely required.

Timber framework of carriage.

The argument has been advanced to the writer that timber carriages do so well in America because of the dry atmosphere there and that they would not do so well in England because of the greater humidity. The same might be said with regard to India. No weight need be attached to such an objection because there is no reason to suppose that expansion of the timbers would throw the setting out of truth and shrinkage could be met by tightening nuts from time to time.

117. The experiences of the writer at Lutcher, La, may serve as an excellent illustration of the efficiency of the *Western Log Carriage and Nigger*. At the time of the visit a big hollow Cypress log measuring about three tons was being rolled on to the carriage. As Cypress is one of the most valuable woods in America there is no disposition on the part of mill-managers to leave hollow or defective logs in the forests, or to permit lack of care to be shown in conversion. This particular log called for the exercise of great skill and judgment, for it was a mere drain-pipe with a ragged interior, the good wood being only from 6 to 12 inches in thickness. The sawyer turned it over half a dozen times with the " Nigger ", in less time than it takes to tell this story, before he made up his mind what to do. He then went ahead and, after taking a slab off each of the four sides, took one inch planks off, one after the other, until there was literally nothing left but a hollow shell which fell to pieces with a few blows from an axe. The whole operation did not take more than ten minutes.

Quality of sawing and speed of working.

It was the same in every mill visited. Whilst never tired of watching the the long arm of the *Nigger* shoot up and turn logs over like rolling pins, yet the performances of the carriage were equally fascinating. Movements were so fast that they were difficult to follow, and yet there was never any occasion to criticize results.* Whatever waste is to be met with in Western mills must be looked for elsewhere than in the operations of the log carriage.

(*With regard to the quality of the sawing *see* paragraph 165).

118. Before going further, it will be as well to see how the equipment so far described compares with that in Burma mills. In the latter, as already remarked, breaking down of logs is done on *plain steel circular saw tables with rack and pinion feed*, *vide* Plate LXXII. After a log has been rolled, or deposited, on the table, it is levered into position by hand with crowbars. Wooden wedges are then put in at intervals along both sides to keep it from wobbling. Getting a log into the best position for sawing is often a troublesome business because, unless a log is of fairly good shape and free from swellings and buttresses, it is by no means an easy problem to hold it in any desired position, other than the one it would take up if left free to move.

Comparison with Plain Log Tables in India.

After the first cut has been made the log has to be turned over and levered into position for the second cut. Foot-rule and chalk are required before the third cut can be made. If, for example, a plank 2″ thick is to be taken off chalk marks at a corresponding distance from the edge of the table have to be made at both ends. Crowbars are then picked up and the log is levered forward until it toes an imaginary line through the chalk marks. The cut can then be made. The same performance has to be gone through for each subsequent cut.

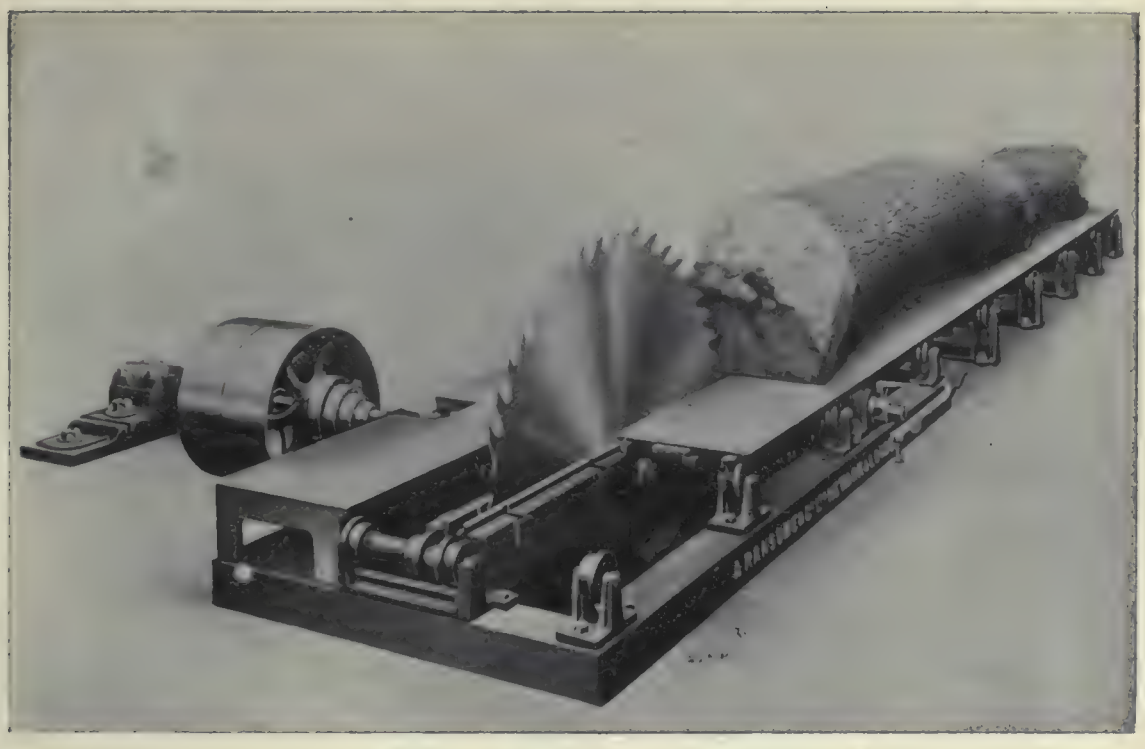
With such a method of procedure it can be readily understood that more time is consumed in getting ready for sawing than in the actual cuts themselves. The writer timed operations himself in more than one sawmill in Burma some years ago, and found that an average cut took about a minute and then there was an interval of from two to six minutes before the next one began.

Further, in respect of the *Rack and Pinion method* of *Feed* so generally used in India, there is room for improvement. The pinion is driven by belt wheels, but *not* in the same manner as mentioned in paragraph 114. *Tight belts on fast and loose pulleys are used*, the belts being shifted from one to the other by lever as required. The feed is *positive*, and there can be *no systematic use of slipping to obtain variations in speed*. The saw either stands up to an advancing log, or else it slows down, and may even stop dead. This is a lamentably common occurrence in small mills, as the engine is usually so small that there is no reserve of power. The sawyer can do nothing but back the table, to give the saw a chance to speed up; then he sends the table forward again, and he may or may not finish the cut without a repetition of the performance.

The argument need not be laboured. It may be stated, without fear of contradiction by men who know the capabilities of both, that the Western log carriage with rope feed can do half a dozen times as much sawing as any plain rack feed table in the world.

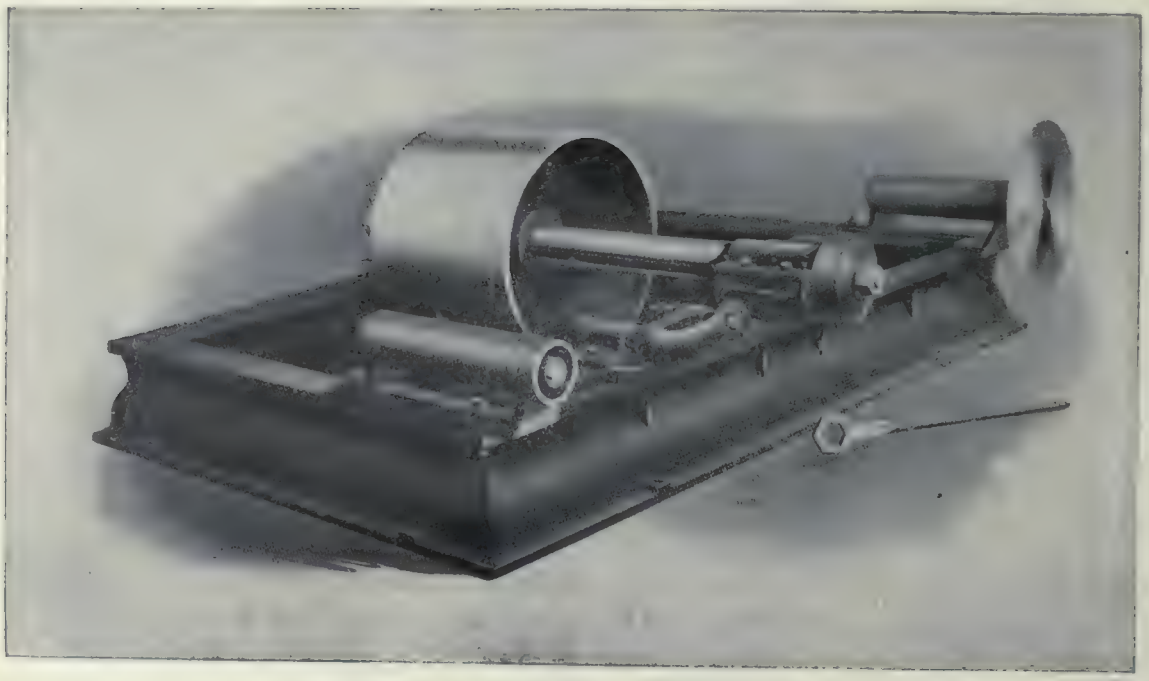
119. In respect of the quality of the sawing the advantage rests with the carriage, owing to the fact that the log or piece of timber being sawn is rigidly clamped, instead of simply resting on a plain table. Moreover the opportunities for sawdust and chips to throw the plain travelling table out of truth are much greater than with the Western carriage. Every time a half log has to be turned over the table has to be brushed clean.

Quality of sawing.



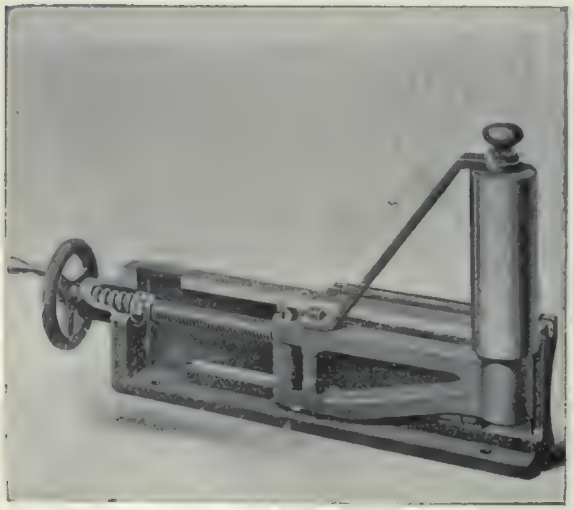
(1). Plain Rack Feed Log Table of British design
Note.—The fast and loose pulleys and cone wheels.

(2). Plain Rack Feed Log Table of British design with 3 speeds operated by separate levers.
(By permission of Messrs. Stenner and Gunn).
In both of the above designs the feed is *positive* ; the speed cannot be varied by allowing the belt to slip.

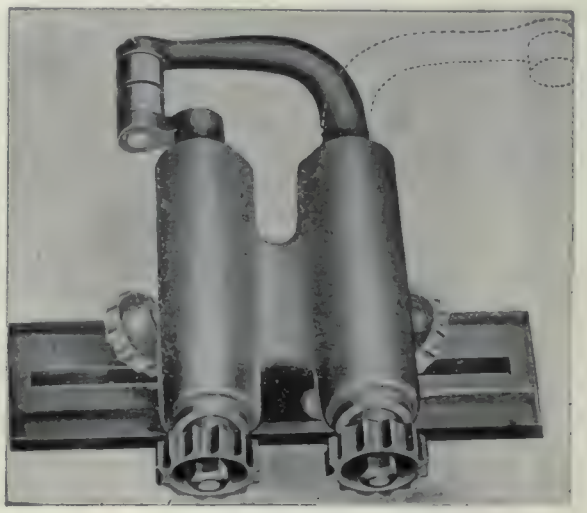


(1). Circular Saw Frame showing Lumber Spreader.
(By permission of Messrs. Clark Bros. Co.)

(para 120).



(2). Lumber Gauge Roll (Gurnsey's patent.)



(3). Circular Saw Guide.
(By permission of Messrs. The Lane Manufacturing Co.)

(para 121).

The *Plain Table* may be held to possess one advantage, as it is such a simple matter with it to cut on the curve by levering the log slightly to one side as the cut proceeds. This detail is of some practical importance in the sawing of teak squares. There is however not much in the argument, because the same thing can be done on the carriage. Suppose, for example there are three head blocks. If the end ones are unlocked from the set-works shaft, one can be advanced and the other receded by moving the levers a notch or two as the log travels forward.

Tapered cutting of squares is obviously as simple as could be desired with the carriage.

Cost of Operation.

The number of operators is practically the same in both cases (4 or 5 men). The only expensive man on the carriage is the *Sawyer*, and his pay in America is equivalent to from 18 to 30 rupees a day. The higher figure would probably have to be paid to induce a first class man to go to India, but he would be cheap at the price, and he would only be needed for a month or two in any particular mill, as there is nothing which good Indians or Burmans, such as are to be found in mills in Rangoon, could not master in a very short time.

Lumber Spreader.

120. Special attention is invited to the small steel disc mounted in a line with the saw in Plate LXXIII (1). This disc is known as the *Lumber Spreader* or *Splitter*. It is an integral part of the sawing outfit in all Western mills. There are various patterns, differing from each other chiefly in the devices for adjustment.

The function of the disc is to keep the jaws of the cut from binding on the saw, and the disc does its duty very effectively for, even though the writer is not prepared to go so far as to state that wooden wedges are never used for the purpose he cannot call to mind ever having seen them so used.

This is another detail—a small one perhaps— in respect of which practice is decidedly different in India. The driving in of wedges generally keeps one man fully occupied whilst sawing is in progress.

Lubrication and Saw Guides.

121. The general practice in India for lubricating the saw and for keeping it from wobbling or chattering is to put strips of wood covered with rag soaked in oil into slots on both sides of it. Every few minutes an attendant dips a stick with a rag on the end into an oil receptacle (of bamboo) and gives the saw a flick or two.

The greasy rag device has certainly no near relative either in Canada or the States. The *Guides* described below are to be met with everywhere, with or without water lubrication. Water is used to keep resin from sticking to the saw. A jet plays on to the saw near the guide. It is desirable to have facilities for turning on a good flow of water quickly, in case of excessive heating of the saw, due to meeting with spikes, knots, etc.

The *Guides* in use for *Circular Saws* consist simply of small round hardwood or hemp plugs held, end on, in iron brackets near the rim of the saw. There are several patterns. Accurate adjustment can be made whilst the saw is running.

One arm can be thrown back [as shown in Plate LXXIII (3)] when it is desired to remove the saw.

A similar device is used for bandsaws, except that the hardwood plugs are rectangular in section and cover a greater width of the saw blade. By means of a lever the sawyer can cause the guide to slide up or down. It is the usual practice to keep them down as close as possible to the wood being sawn, and so they are constantly being shifted.

At the right hand corner of the saw-frame on Plate LXXV a small upright roll may be noticed. An enlarged view of an improved form of the same device is shown in Plate LXXIII(2). It is known as a *Lumber Gauge Roll.* The roll can be screwed backwards or forwards to any desired distance from the line of the saw. When not required it can be hinged back out of the way. It comes in useful when there is much sawing to one dimension, and also when making last cuts, as it prevents the lumber from springing away from the uprights.

Section 5.—SAWS.

Filing.

122. The *Filing Room* is usually built above the main floor, where band-saws are used, so that they can be lifted directly into the room by pulley through a trap-door in the floor. The room is enclosed on all sides and has a good floor. No fear seems to be experienced of emery dust finding its way into the machinery down below.

The filing and tensioning of saws calls for skill that is only obtainable by long experience. The pay of the *Filer* is on a par with that of the *Sawyer.* Moreover the remark made about importing the latter into India applies also to the *Filer,* with this qualification that he would probably be required as a permanency.

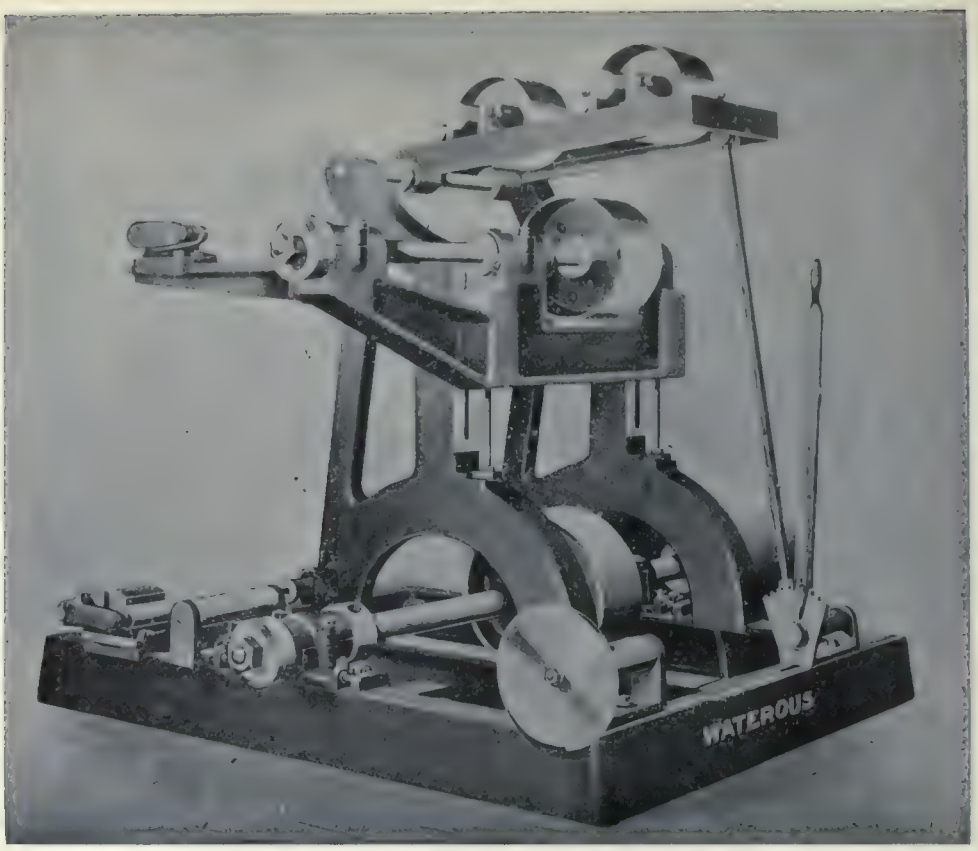
Although the writer does not pretend to be able to file and tension saws himself, yet it was a simple matter to learn what the desiderata are, and even in respect to bandsaws there seems to be nothing beyond the capacity of good Burmans or Indians with adequate tuition and adequate supervision.

It is hardly necessary to state that there is very little filing or "setting" of teeth by hand, except in portable mills of the smallest type. A wide range of machines is available. In choosing appliances for India one cannot do better than ask for and act on the advice of the firm indented upon for the saws themselves.

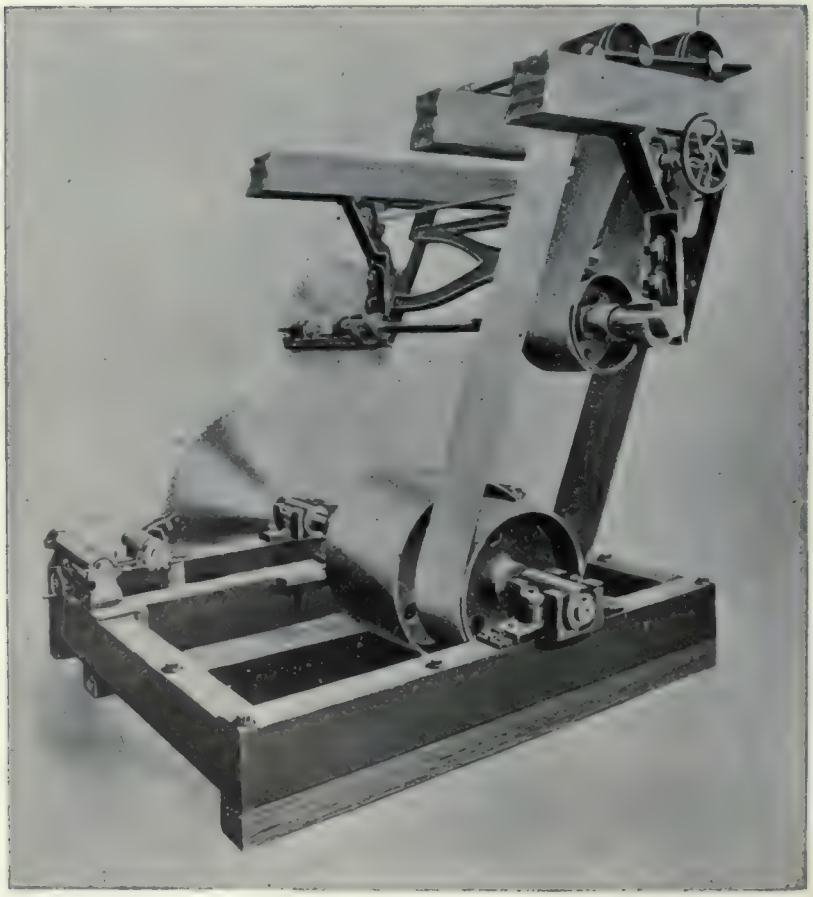
Inserted tooth saws.

123. Although Circular Saws with *Inserted Teeth* are a common sight in Western mills, a good many operators can be found who prefer to use *Solid Teeth.* The chief reason is because the inserted tooth has double the *Kerf* of the solid tooth. In the conversion of valuable woods, even in a small mill, it would be a matter of importance to lose a quarter of an inch of wood at every cut. Inserted teeth are also more expensive to purchase but, on the other hand, the saws remain constant in diameter, whereas the solid tooth saw steadily gets smaller and smaller.

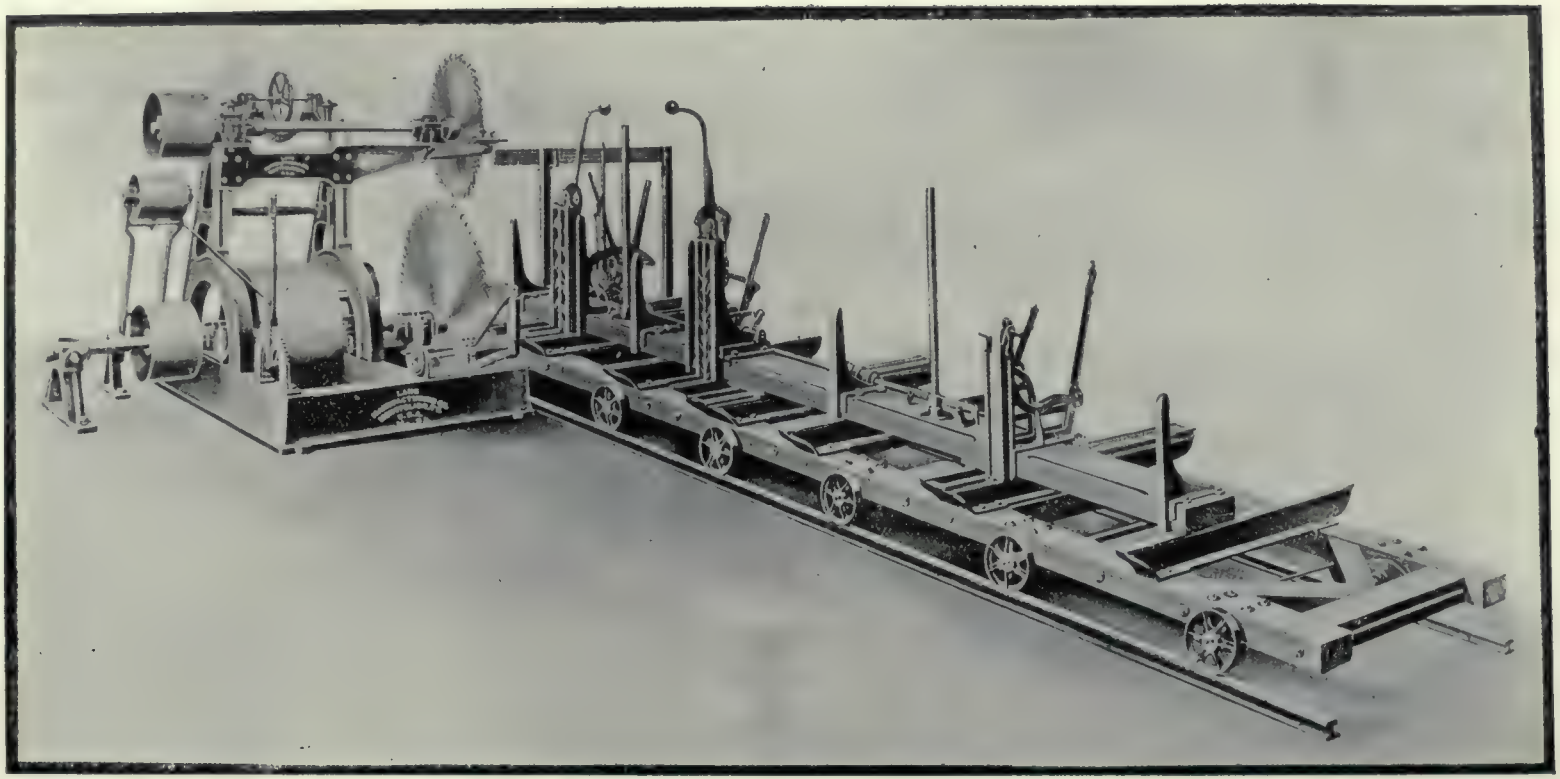
The writer recommends the use of Inserted Teeth for breaking down logs, *but only in cases where it is impracticable to instal Double Saws,* described in the next paragraph.



(1). Double Circular Sawmill with reversed motion for the upper saw.
The saws themselves not in position; spindles only shown.
(By permission of Messrs. The Waterous Engine Works Co.)



(2). Double Circular Sawmill with upper saw on independent frame.
(By permission of Messrs. The Allis-Chalmers Manufacturing Co.)



Double Circular Sawmill, with both saws revolving in the same direction.
(By permission of Messrs. The Lane Manufacturing Co.)

(para 124).

124. Big circular saws are very expensive to purchase, and it is decidedly wasteful to use them on small logs, for a smaller saw would not only cost less, but it would waste less wood in sawdust.

Double Circular Saws.

On the other hand it leads to a deplorable waste of time to use a circular saw on logs that are too large for it. The hacking off by axe of slabs only partially sawn through is a common practice in small mills in India and it may even be seen occasionally in mills owned by wealthy firms.

The writer remembers on one occasion seeing a big *Pyingado* log being turned upside down for a second cut, to complete the first one. Half an hour was wasted in doing so, and it is scarcely necessary to remark that good wood was also wasted, because the two cuts were not in the same plane.

An excellent device for increasing the usefulness of circular saws in the breaking down of logs is to mount them double, *i.e.*, two saws one above the other. Several firms specialize in such *Double Saws and they can safely be recommended for use in India.* The saving resulting from the use of smaller saws would very quickly make up for the greater initial outlay.

The best plan is undoubtedly to mount both of the saws on a single iron frame. Two illustrations are given (Plates LXXIV and LXXV). It should be noted that there is no necessity for the upper saw to be always running. A lever is provided for regulating the tension of the belt and it is a simple matter to let the belt hang loose when the upper saw is not required.

For operators who do not care to go to the expense of the compound iron frame, an alternative is available, as the upper saw can be mounted on a separate frame bolted to the roof timbers—Plate LXXIV (2).

An advantage possessed by this plan is that it gives the operator a better view, but more care is required to see that the saws run in unison. In one of the mills visited by the writer an outfit of this kind was seen that badly needed putting right. There was a difference of a quarter of an inch between the surfaces left by the two saws:—a sad waste of wood in sawing Douglas Fir squares of 36″ side.

It is to be noted that the upper saws in Plates LXXIV and LXXV revolve in opposite directions relative to the lower saw. The objection to both saws revolving in the same direction is that the sawdust from the upper saw tends to choke up the cut in the path of the lower one.

125. The way in which *Bandsaws* have taken first place in Canada and the United States is remarkable. Only a few years ago big bandsaws for breaking down logs were unknown. To-day they are to be found in nine out of ten of the better class mills. One firm the writer knows of, that specializes in the manufacture of machinery for circular saws, claims that they do cleaner sawing than bandsaws, but no operator in a bandmill could be found to corroborate this assertion.

Band-saws.

The chief reason why bandsaws have become so popular appears to be on account of the smaller kerf as compared with circular saws. The amount of wood converted into sawdust is not more than half.* Not only is this a matter of importance with the more valuable timbers, but it is not to be despised in any operations of large size.

Moreover, it does not make much difference to a bandsaw what the size of the logs may be, provided it is large enough for the biggest of them. Even if the saw is used on small logs it can continue to be used on big logs until the band is quite worn out. This is very far from being the case with circular saws. No matter what such a saw may have been called upon to cut its usefulness for cutting big logs is gone long before its life as a saw is at an end.

Log Bandsaws in Canada and the States are all of the *Vertical* type, Horizontal machines are only used for re-sawing. Log bandsaws vary in size from 6 to 10 feet. Plate LXXVI is an example of a single cutting saw mounted on wheels 9 feet in diameter. The upper saw wheel is raised by steam (as illustrated) or by hand wheel and screw.

Where extra output is desired without the additional expense of a second saw frame and carriage, *Double Bandsaws* are often installed, that is, the saw has teeth on both edges and cuts in the backward as well as in the forward motion of the log carriage. The output of a double mill is about 20 per cent. more than of a single one.

Objections to the use of bandsaws in India.

126. Two objections may be raised to the use of bandsaws in India, *viz.*, (1) that they easily go wrong and call for too much skill on the part of sawyer and filer, and (2) that they are not suitable for logs such as teak, etc.

The first objection has been partially disposed of in the remarks on the filing room staff (paragraph 122), and it should be sufficient to add that a number of big bandsaws already exist in India, and several of them are believed to be used for teak.

It is hardly necessary to remark that no one would dream of installing a bandsaw in an out-of-the-way place, or where operations are not on a big enough scale to justify the employment of really skilled operators under first rate supervision.

The second objection is harder to meet, but the writer is convinced that it can be done. Some ten years ago he was told a story of a well-known European maker of sawmill machinery, who came to Rangoon to find out why nobody there would look at bandsaws, and who went away prepared to admit that his saws were not suitable, although he did not despair of making them suitable some day.

It would be a risky thing to assert that the problem had not yet been solved, for the perfection of modern manufacture of bandsaws, large and small, is wonderful. If doubt exists in the mind of anyone, it would be a good plan to send samples of typical hardwoods to some of the leading manufacturers.

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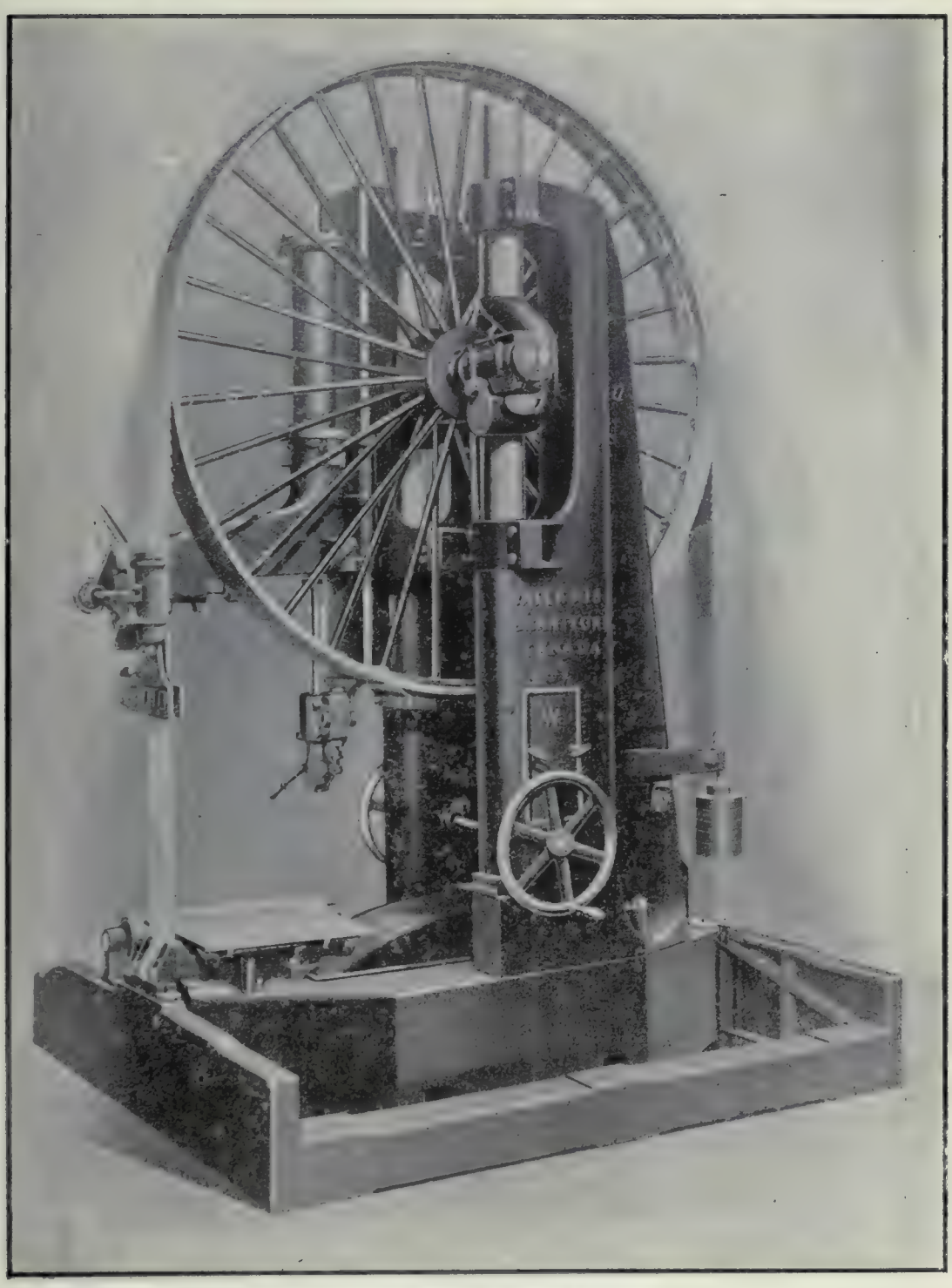
*See paragraph 165. The British practice of using thinner bandsaws than in America is better still, as the waste in sawdust is much smaller.



Vertical Bandmill—Single Cutting
(By permission of Messrs. The Waterous Engine Works Co.)

(para 125).

The difficulty with teak lies partly in the fact that there are considerable deposits of a siliceous nature in the cellular spaces throughout the wood, so that a saw soon loses its edge.

Most of the sawing of teak in bandmills in India is really re-sawing of squares shipped from Burma. The existence of these mills cannot therefore be said to go far towards meeting what is believed to be the main objection to the use of bandsaws for teak logs, *viz.*, the sandy grit so often met with in the surface of the logs.

Dragging over stony ground scores the surface of the logs and weathering develops cracks, in which a good deal of sand finds its way in the course of subsequent floating operations. All streams are highly charged with sandy silt in the monsoon period, and a large proportion of the logs are of such ancient origin that deep cracks have had time to develop in them.

On account of this surface grit, if the suggestion to send samples of wood to saw manufacturers is adopted, it would be as well to send *old* logs and to advise the consignees to well rub them all over with wet sand before trial.

127. The writer believes that the objection can be met by either, or by a combination, of two devices seen in the course of the tour; *viz.* :—(1) *Spraying* and (2) *Overhead Grooving.*

Spraying.

Spraying of logs has already been mentioned and illustrated in paragraph 98 (Plate LXI). The best results are naturally obtained by the use of clean water, but powerful jets of Rangoon River solution would certainly be very effective. In all mills (band or circular) where logs of any kind covered with mud are cut up, this spraying device should be thought about. The cost of installation would not be great and might be expected to be more than covered by the reduction in the bill for saws.

Overhead Grooving.

At *Fort Bragg, Calif.* the writer saw an excellent example of another method of keeping grit out of the way of bandsaws. The big *Redwood* logs are apt to pick up and retain so much grit that saws are rapidly dulled by coming into contact with it.

In the *Fort Bragg* mill a small pendulum saw known as a *Rosser Saw* hangs over the log carriage. It is very thick and ploughs a channel $\frac{3}{4}$" wide and from 2" to 6" deep just ahead of the bandsaw. As the kerf is so wide there is no necessity for being very particular about the mounting. The balance weight causes the little saw to rise out of the way when not required. By means of a rope near at hand the sawyer pulls it down to make any desired depth of cut. A thin "*Drunken*" *Saw* would serve the same purpose.

A similar device could easily be rigged up for teak logs. There should be no difficulty in adding an attachment by which the depth of cut could be regulated properly, even on a log that tapered very considerably. Cracks rarely go in more than three inches.

Section 6.—EDGERS AND TRIMMERS.

Single and Double Edgers.

128. After planks have been sawn on the *Log Carriage* the edges (or long sides) have to be trimmed, and the ends have to be squared. These two operations are invariably performed by separate machines. Details of the three illustrations of machines for *Edging* are as follows:—

Plate LXXVII (1)—Heavy type machines of this design will cut stock up to 6″ in thickness. The various sizes range in width of lumber space from 48″ to 96″. Either toothed or fluted feed rolls are provided. There are usually six saws, a stationary one at each end and four moveable ones in between them. The moveable ones are operated by the levers at the front end of the table. Graduated quadrants and locking devices are provided, so that no time is lost in adjusting the saws for each piece of lumber as it arrives. The smallest width possible between saws is 3″. The channel iron guides at the sides are moveable, and can be set to cover the stationary saws (thereby eliminating them) or they can be swung out to cut from 1″ to 6″ between themselves and the stationary saws.

Plate LXXVII (2)—A light type of machine suitable for portable mills. It will take lumber up to 5″ in thickness and 30½″ in width. Two sizes are built: *No. 1*, with two saws, one stationary and the other moveable, and *No. 2*, with three saws, one stationary and two moveable.

The board on the left hand side of the table is a moveable guide for the lumber to rest against. It is operated by the lever and graduated quadrant. The two hand wheels are for the moveable saws; levers can be substituted for them if desired.

In both sizes the first moveable saw can be brought within two inches of the stationary one, and in No. 2 size the moveable saws can be brought within 4″ of each other. With the saws moved to the extreme right, the clear space is 22¾″ for No. 1 and 18¾″ for No. 2.

Plate LXXVIII—A Single Edger designed for two purposes. It can be used in small mills the capacity of which does not warrant the installation of a double machine, or it can be used in mills cutting very fine or high priced timber. The feed is by hand. Saws up to 24″ in diameter can be used.

By reference to the mill plan in Plate LVII (frontispiece) it may be seen that the Double Edger is placed to one side of the mainline of live rolls. The machine has its own set of rolls,—dead ones in front and live ones to carry the lumber away after being edged. The diagram will help to show how the lumber is moved across from the main rolls. One of the men attached to the Log Saw has the duty of sending the lumber along the live rolls after sawing. When he receives a piece which has to be

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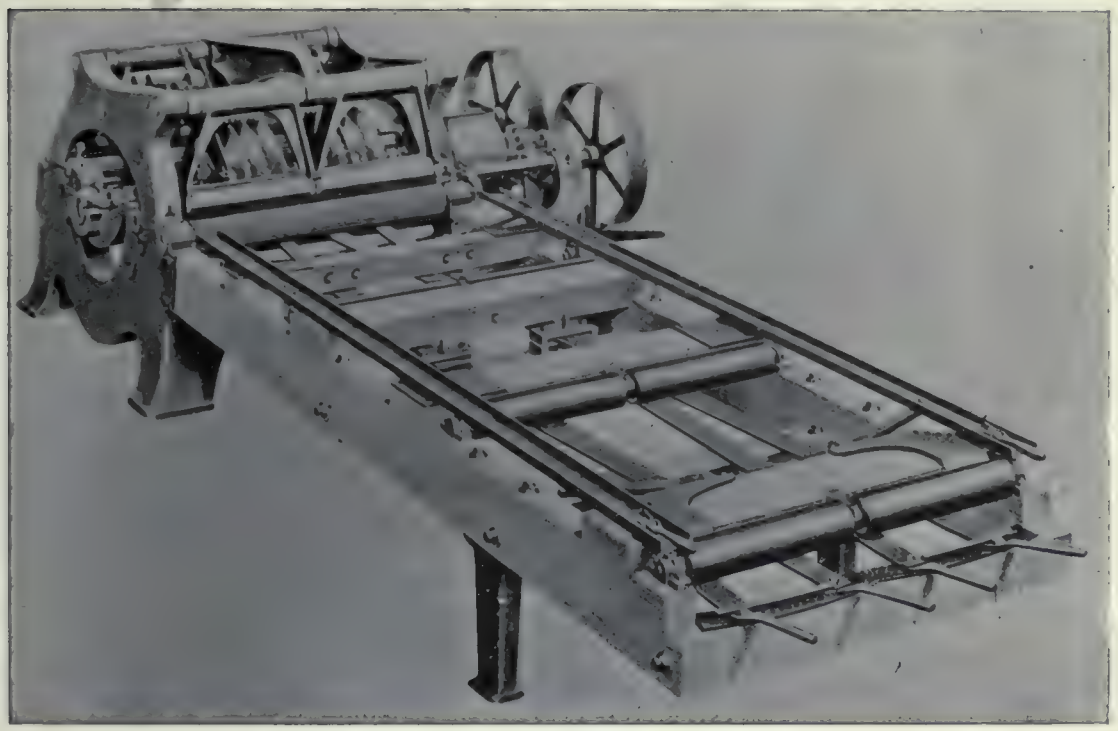
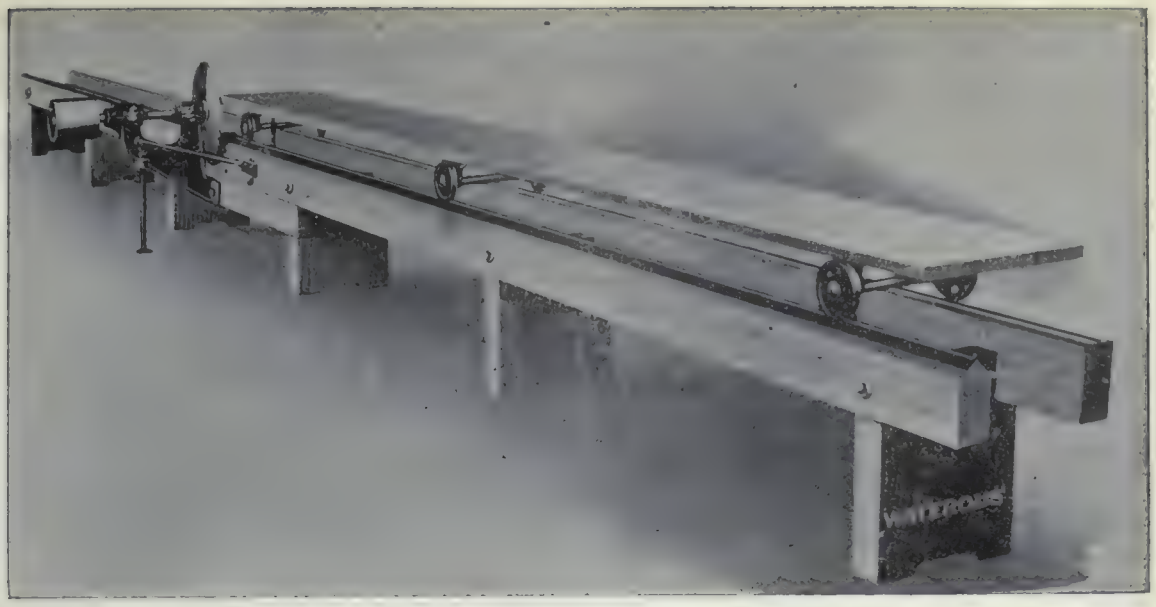
Note.—Another illustration of a light type of Edger is shown in Plate XCI (3) (Paragraph 153). It is similar to the above with the addition of a roll at the top of the frame. This is useful when pushing lumber back for re-edging.



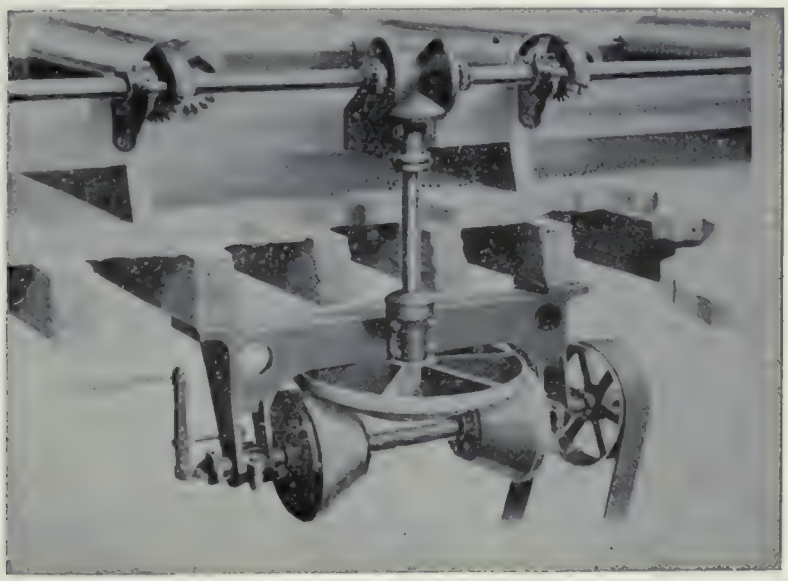
(1). A 60 inch Double Edger.
(By permission of Messrs. The Allis-Chalmers Manufacturing Co.)

(2). A 30 inch Double Edger.
(By permission of Messrs. The Waterous Engine Works Co.)

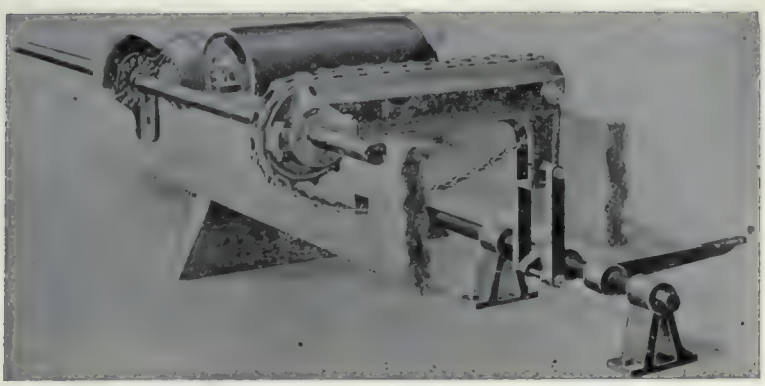
(para 128).



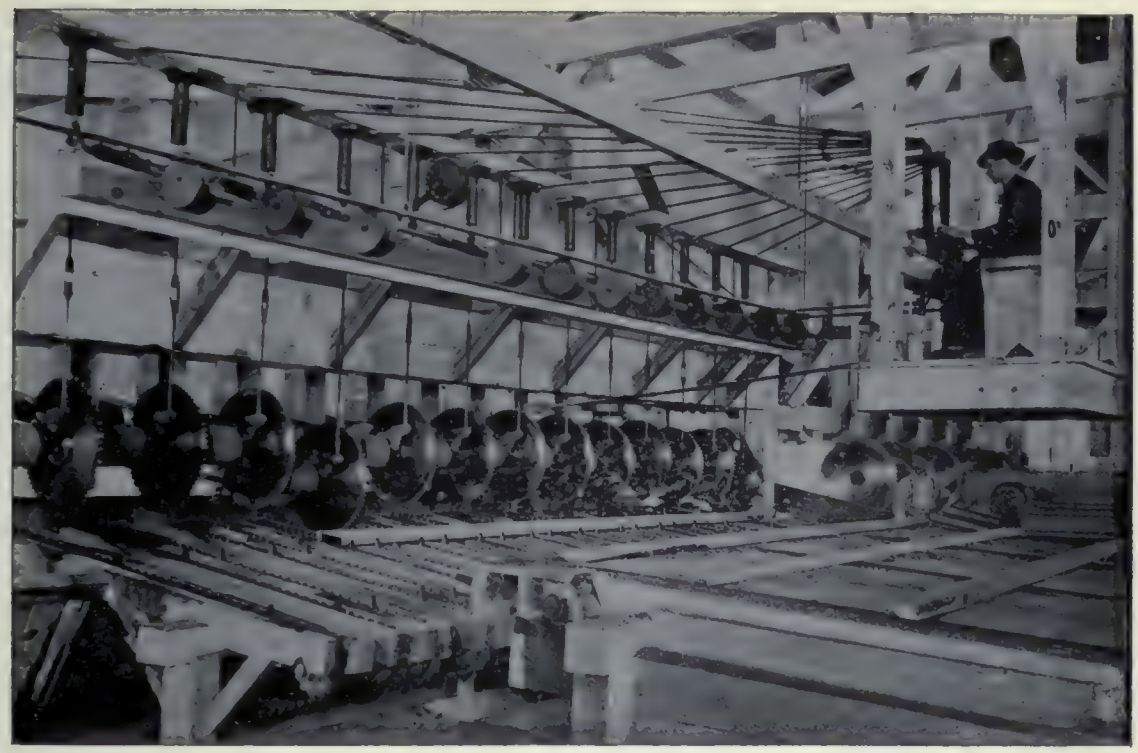
(1). Single Edger with Hand Feed.
(By permission of Messrs. The Waterous Engine Works Co.)



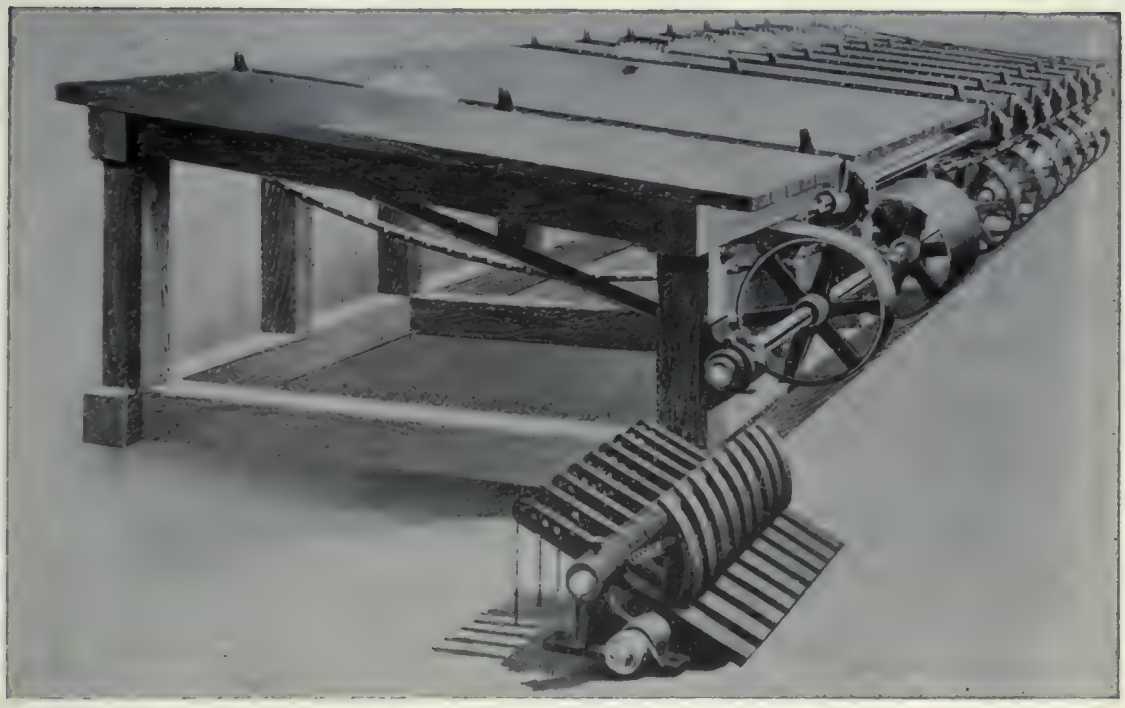
(2). Bevel Friction Live Roll Drive.



(3). Lift Transfer operated by foot pedal.
(2) and (3). (By permission of Messrs. the Allis-Chalmers Manufacturing Co.)



(1). Gang of Pneumatic Trimming Saws
(By permission of Messrs. The Allis-Chalmers Manufacturing Co.)



(2). Gang of Undercut Trimming Saws.
(By permission of Messrs. Clark Bros. Co.)

(para. 131).

edged, he raises the *Stop* by means of a lever. The raising of the *Transfer Chains* is done either by steam or by foot pedal as shown in Plate LXXVIII (3).

To operate the Edger there are usually three men. Two of them stand in front of the machine. Their duty is to place each piece of lumber in position and, after adjustment of the saws, to push it forward until gripped by the feed rolls. The third man stands on the far side of the machine to look after the refuse.

Re-edging.

129. As a rule, the lumber passes out of a mill at the opposite end to the log entrance. The writer remembers coming across one exception to this rule; *viz.*, at Davis, W. Va, where entrance and exit are at the same end of the mill. This plan was adopted to facilitate *Re-Edging*, or sending lumber (a second time) through the Edger *after grading* (paragraph 141).

This is a matter which may be expected to receive more and more attention as time goes on, bringing with it exhaustion of supplies, reduced profits and greater demands for small stuff. It is mentioned here as it is likely to have an important bearing on the designs of mills for use in India.

130. As a makeshift, or temporary measure, the long edges of a pile of planks can be squared on a log carriage because they can be held tight by the dogs. This is quite beyond the capacity of the Plain *Log Table* in India, where most of the edging is done on *Push Benches*.

The Managing Director of one of the leading firms of sawmill machinery manufacturers on the Pacific Coast told the writer a story that will bear repetition, for it is quite credible and the moral is a good one. The story was as follows. A mill owner came to the manufacturer for advice because his mill returns were steadily becoming more and more unsatisfactory. The answer he received was that this was only to be expected as his mill was so out-of-date. He was advised to send someone he could trust on a tour of inspection of other mills. He took the advice and sent out two men. They came back and told him that the criticism of his plant was justified as, amongst other things, it contained no up-to-date Edger. Although rather sceptical the owner decided to go to the expense of installing one. Within a month he came back to the manufacturer full of praise for the new machine, as he said it had increased the output 30 per cent, without adding a cent to running expenses.

Trimmers or Cut-off Saws.

131. The squaring of the ends of lumber and the cutting to lengths are done on *Trimmers* or *Cut-off Saws*. There are two type of saws, *viz.* :—

(1) Swing or Pendulum Saws.

(2) Bench Saws, either fixed or sliding.

In the first type the saws are either brought down from above to meet the lumber, or they are raised from below. In the second type, the bearings of the saws are stationary. Swing Saws are either worked singly or in gangs, each saw being independent. Plate LXXIX gives examples of large Gangs such as are used in big mills. On the Pacific Coast Gangs of as many as 60 saws may be seen.

It may be noticed that the lumber is fed to these gang saws sideways by means of conveyer chains, both ends of the lumber being trimmed simultaneously. For heavy timbers such as squares, beams, etc., this method is not suitable and the trimming is done, one end at a time, by means of a single *Swing Saw* operating from above or below the main line of live rolls. In big mills there are various ingenious devices for stopping the lumber and starting the saw. As an example of the simplest form, suitable for portable mills, reference may be made to Plate XCI(2) (paragraph 153).

132. In the case of saws of the 2nd type, or *Bench Trimmers*, the lumber is always fed to them sideways. The cutting of the ends may either be done simultaneously or separately. An illustration of each type is given; details are as follows:—

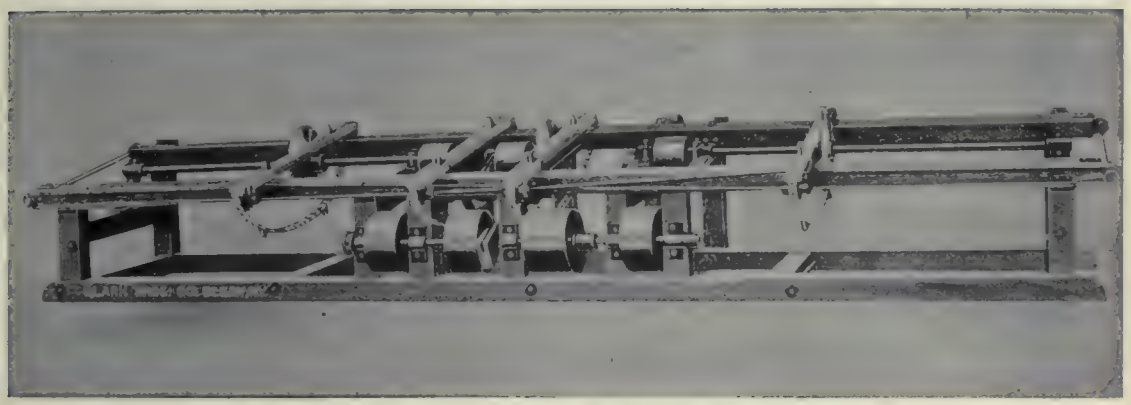
Plate LXXX (1). *2 or 3 Saw Bench Trimmers.*—The two outer saws can slide along their shafts, which are in line with, but separate from each other. The frames carrying the endless feed chains for the lumber are bolted to the bearings of these saws, and can be moved sideways with them. By means of rod and chain connections, the saws move to or from the centre at the same rate. Operation can be from either end of the bench, or at the middle, as desired by the purchaser. A graduated scale shows at a glance the distance between the saws. The maximum lengths for standard machines are 16 and 20 feet respectively, but other lengths can be supplied if required. With the middle saw in operation, the shortest length (*i.e.*, with the outer saws close in), is 4 feet. This saw swings, and can be lowered out of the way, when not required. Using 22″ saws, stock up to 6″ in thickness can be trimmed. The rate of travel of the chains (Feed) can be varied to suit different thicknesses of lumber.

Plate LXXX(2). *Two-Saw Right (or Left) Hand Trimmer.*—The two saws are on fixed bearings on either side of the bench, but they are not in line with each other, one of them is about 6 feet in front of the other. After one end of a piece of lumber has been trimmed by the front saw the operator, standing beside the machine, has plenty of time to shift the lumber into position for the other end before it reaches the saw. If necessary he can stop the feed by means of the hand lever shown in the picture. This style of machine is rated as being capable of dealing with the lumber in a mill with a daily output of 80 tons (40,000 B. F.)

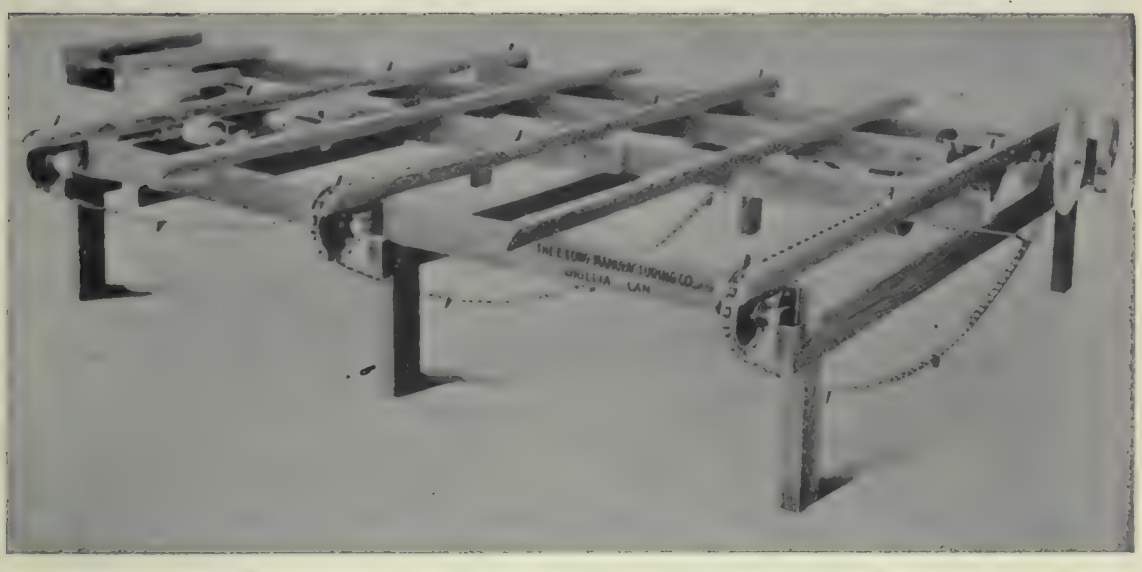
Slab Slashers.

133. Even in a mill where most of the slabs and refuse are got rid of by fire it is not the rule to send the pieces to the Incinerator in whatever lengths they happen to have been produced by the Log Saw or by the Edger. The same remark applies in cases where there is close utilization in the form of Lath, Shingles, Box-material, etc. In both types of mill provision is made for cutting the slabs and refuse into short lengths, or *Slashing* as it is termed.

For this purpose a number of saws are mounted in a row as illustrated in Plate LXXXI. The usual distance apart is the standard Lath length of 4 feet. The saws have *fixed* bearings which are of special design to stand the severe service required of the saws. Any desired number of saws and spacing can be installed if required.

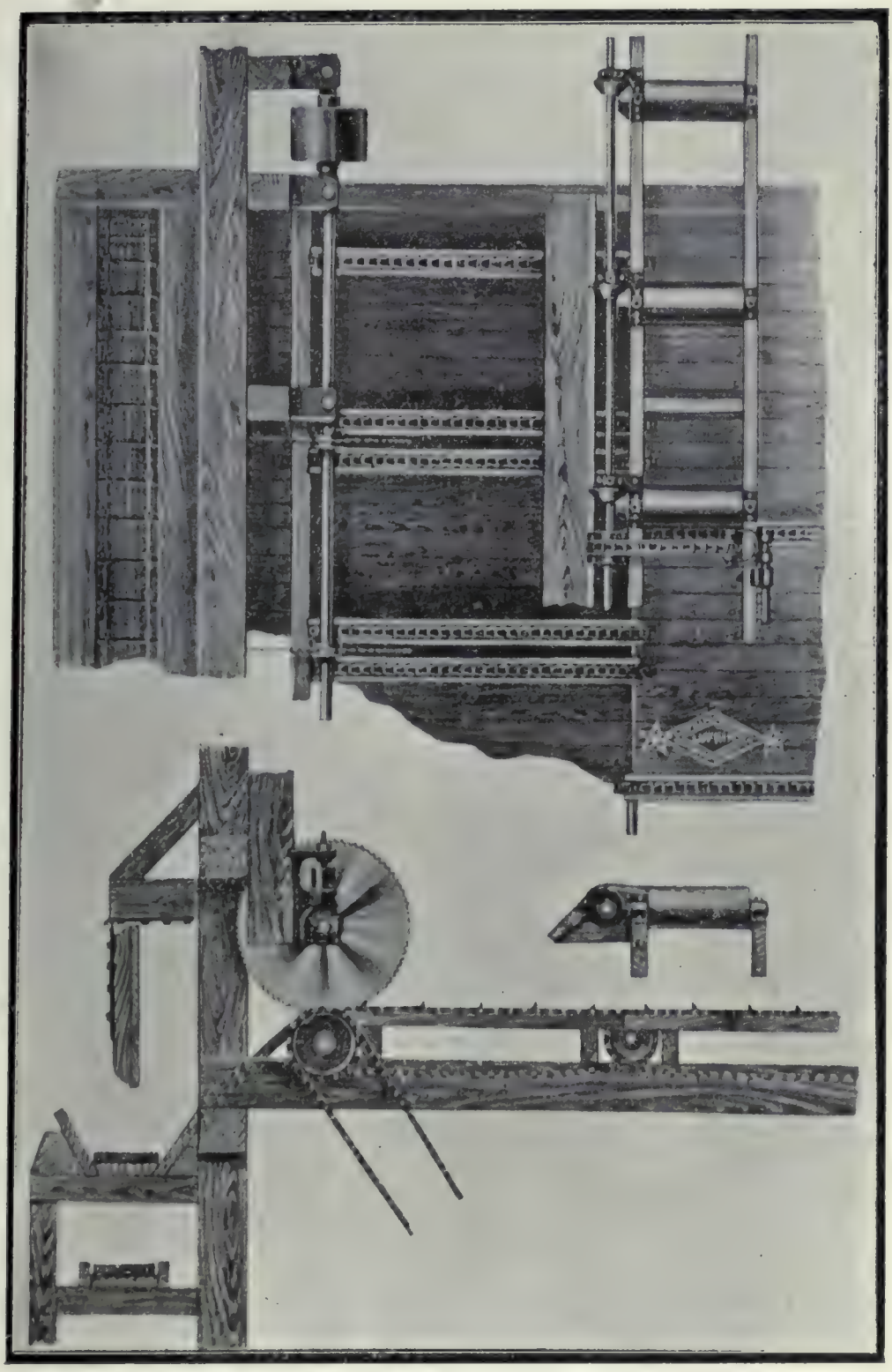


(1). Two or three Saw Bench Trimmer.
(By permission of Messrs. Clark Bros. Co.)



(2). Two Saw Left Hand Trimmer.
(By permission of Messrs. E. Long Manufacturing Co.)

(para 132).



Slab Slasher.
(By permission of Messrs. The Lufkin Foundry and Machine Co.)

(para 133).

Section 7.—Re-sawing Machines.

134. On a Log Carriage it is of course possible to break down a log in such a manner that there is nothing of value left in the slabs and the planking is of the thickness required for sale. The extent to which this is done depends on the object for which the mill is in operation. It is done, for example, in mills which only turn out large dimension stock and have no use for small stuff in slabs.

Re-Saws.

As is well known this used to be the position very generally in North America not so very long ago. On the Pacific Coast, as a whole, it still exists, but the day for it has gone on the Eastern side of the continent. Exhaustion of supplies and ever increasing demands for wood of all descriptions have led to a very high degree of economical utilization.

The War has indeed very considerably accelerated progress in this respect everywhere. The apparently insatiable demand for box material, for example, has led to a rapid development of factories for working up small stuff in many localities in the West, and the majority of these new concerns may be expected to remain after the war is over.

135. Except in small and temporary mills, there are limits to the amount of work a log saw can be expected to do economically, simply because other machines exist which can do part of the conversion with smaller expenditure in labour. Such machines are called *Re-Saws*. They only require the services of two men, whereas a Log Saw takes 4 men. In America this means a difference in wages of 7 to 10 dollars a day.

Re-Saws are of various kinds, but they all belong to one or other of two types, *viz.*—

(*a*) *Reciprocating*, or (*b*) *Revolving* Machines,

Both types are divisible into :—

(*i*) *Vertical*, and (*ii*) *Horizontal Machines.*

Reciprocating Machines, which are usually called *Frame Saws*, *Gang Saws* or *Mill Webs*, are more or less obsolete in Canada and the United States, although they are extensively used in the United Kingdom, and also by the larger firms in India.

It is believed that these machines only find a place in those Western mills which produce large quantities of small scantling of one dimension from logs of fairly uniform size, so that from 15 to 20 saws can be used at a time. In the course of his tour the writer only saw two such machines in operation, and they were engaged on turning half logs directly into 1″ stock. The machines are not even listed in their catalogues by makers of modern Re-Saws.

136. What is almost universally meant by the term *Re-Saw*, in Canada and the States, is a machine of the *Revolving type.*

It consists of one or two Band or Circular saws (vertical or horizontal) running between feed rolls, so mounted that lumber of any shape and size up to the capacity of the machine can be cut into stock of any desired thickness.

If it is desired to cut timber down the middle, both rollers are pivoted and their spindles are so mounted that they can be moved in or out at the same rate. If the machine is to be used for cutting to any given thickness (as for example in working up slabs), only one spindle moves; the other is adjusted to give the desired thickness and then clamped.

All that the operator has to do in either case, is to push the front end of the piece of wood between the front pair of rollers until it is gripped firmly by them. The machine does the rest. In a well designed machine there is no slipping in the feed, the sawing is true to gauge and the adjustments for varying dimensions can be made without loss of time.

The introduction of a *Re-Saw* into a mill naturally makes alterations in the ground plan. The Edger must be placed further away from the Log Saw, so that the Re-Saw may come in between them, although there must still be provision for the transfer from the main line of live rolls direct to the Edger, of stock which does not require to be re-sawn.

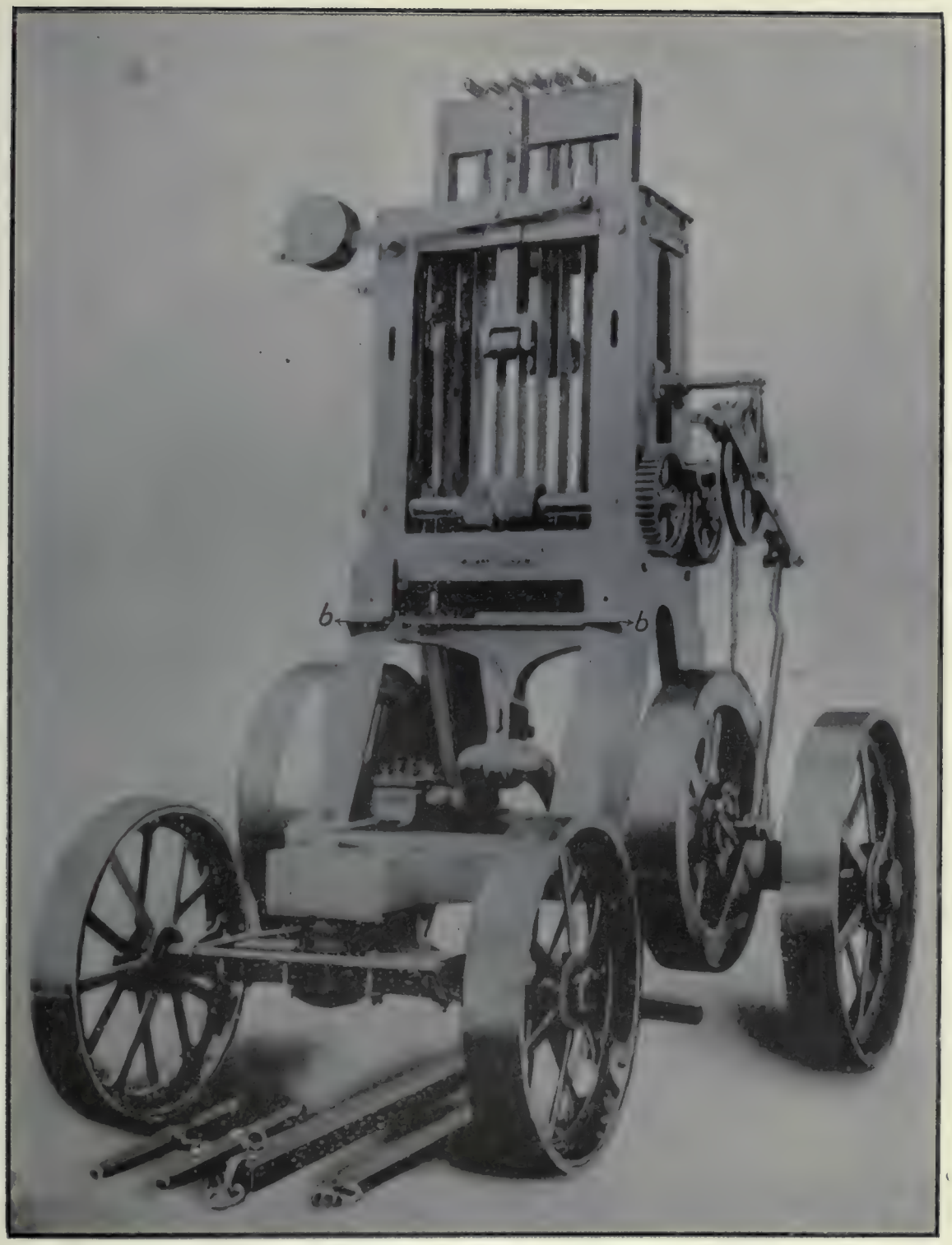
It is a matter for regret that no illustrations of modern Re-saws are included in this report owing to want of space. The range of choice of design is a very wide one and reference is invited to the catalogues of leading manufacturers both in North America and in Great Britain.

137. In Rangoon *Vertical Frames* are used a great deal for finishing off Teak Squares, but neither Frames nor any other kind of Re-Saws are used for a similar purpose in North America for the simple reason that such sawing can be done in a tenth of the time by a Log Saw. The difference in time is so great that the question of saving in labour does not enter into the calculation. Moreover, the sawing is quite as accurate, just as clean, and, in the case of Bandsaws, with no greater waste in sawdust.

138. Whilst in charge of the Pyinmana Forest Division, Burma, the writer had the management of a *Government Sawmill* in which the sawing outfit consisted of a 32″ Vertical Frame Machine, a 36″ Push Bench and a Pendulum Cut-off saw. The mill was of a portable type set up for the production of Metre Gauge sleepers from *Pyingado* logs. One object in view in the establishment of the mill was to demonstrate that sawing of sleepers could be done more cheaply by machinery than by hand.

The Frame Saw was of a portable type (*vide* Plate LXXXII) although the wheels shown in the picture were not used in transporting it to the mill site. On arrival there the machine was lowered into a pit so that the track on either side for the log carriage might rest on the ground.

Quoting from memory, the writer is under the impression that it took 14 men to run the mill and that the average daily output, with the mill at its best, did not exceed 30 sleepers and 25 cubic feet of scantling (approximately 3 tons of 50 cubic feet).



Portable Vertical Frame Saw for logs of British design.

The machine is intended to be sunk into a pit or the floor raised so that the longitudinal beams supporting the carriage rails rest in the brackets (b, b). The top of the log carriage then comes level with the top of the fluted feed rollers.

(para 138).

In addition to the slow rate of sawing there were two serious objections to the outfit, *viz.*—

(*a*) Logs more than 7′ 6″ in girth could not be passed through the Frame without previously being slabbed with hand saws.

(*b*) The placing of logs directly on the feed rollers of a Frame Saw would be objectionable in any case, unless the logs were perfectly symmetrical; but it was particularly unfortunate in this instance because the logs were rarely, if ever, free from pronounced irregularities (buttresses, swellings, etc). Wobbling was therefore inevitable, with bad effects on the saws and on the rate of sawing.

Proud as the writer was of the work done by this mill in his time, he now feels regret that the experiment was not made with a Canadian or American Portable outfit. The initial cost would not have been any greater, but the output would have been multiplied very considerably, even on the assumption that experience with the Log Carriage was bought in the same laborious way as with the Log Frame machine.

The Government of India is strongly advised not to buy any more Reciprocating Frame Saws of any kind (either for logs or for re-sawing) and also seriously to consider at once the question of scrapping such as exist to-day in Government Sawmills, e.g., in the Andamans and possibly elsewhere. Continued use of them can only be defended in cases where several blades can be used simultaneously on the production of large quantities of stock of one dimension.

Push Benches in India.

139. Having now mentioned all the principal types of machines in use in Canada and in the United States, it will be as well to complete the references to the equipment of mills in India. If there are no *Double Edgers* in India, and hardly any modern *Re-Saws* similar to those described in the preceding paragraphs, the question naturally arises as to what kinds of machines are used for working up the planks, baulks and slabs produced by the Log Saws.

The answer to such a question is a simple one because all the work is done on *Plain Circular Saw Benches*, either of the *Push* variety or of the *Rope* or *Roller Feed* types. In any of the large mills in Burma these machines can be counted by the dozen. As each of them calls for the services of at least two men the number of them is in itself sufficient to account for a large part of the crowd of men who find employment in the mills.

There is no desire to make light of the fact that it conduces to elasticity of working for each bench to cut to all sizes, and to more or less finish the conversion of each piece of wood handed over to it. But it is fairly obvious that this method of working must multiply labour enormously. It is impossible to believe that the capital cost of *Western Edgers* and *Re-Saws* and *Trimmers*, capable of doing the same amount of work, would not be smaller, and there can be no question that working expenses would be only a mere fraction of what they are at present.

It is not necessary to assume that considerably higher wages would have to be paid to operators on modern machines, for there is nothing in these machines

which is beyond the intelligence of the average employee in Indian mills. The men would be required to work faster, and this might mean having double shifts, but nothing more.

If the skilled supervision that is at present diffused over a host of machines were concentrated on a smaller number of them there would certainly be enough of it to keep employes up to the mark, even in respect of the economical conversion of valuable woods like Teak.

Section 8.—ROLLS AND CONVEYERS.

Live Rolls and Conveyers.

140. With a view to focussing attention on sawing appliances, the superiority of Western mills has, in the foregoing description, been ascribed to them. This is hardly correct for a very important part is played by the mechanical devices for moving lumber from machine to machine, and in the disposal of refuse.

The appliances for bringing logs into the mill and for placing them on the Log Carriage have already been described. For the movement of the lumber and refuse produced by the Log Saw three kinds of mechanism are used, *viz.* :—

(*i*) Live Rolls.

(*ii*) Dead Rolls.

(*iii*) Chain Conveyers—

(*a*) Multiple Dog Chains on tables or benches for lumber.

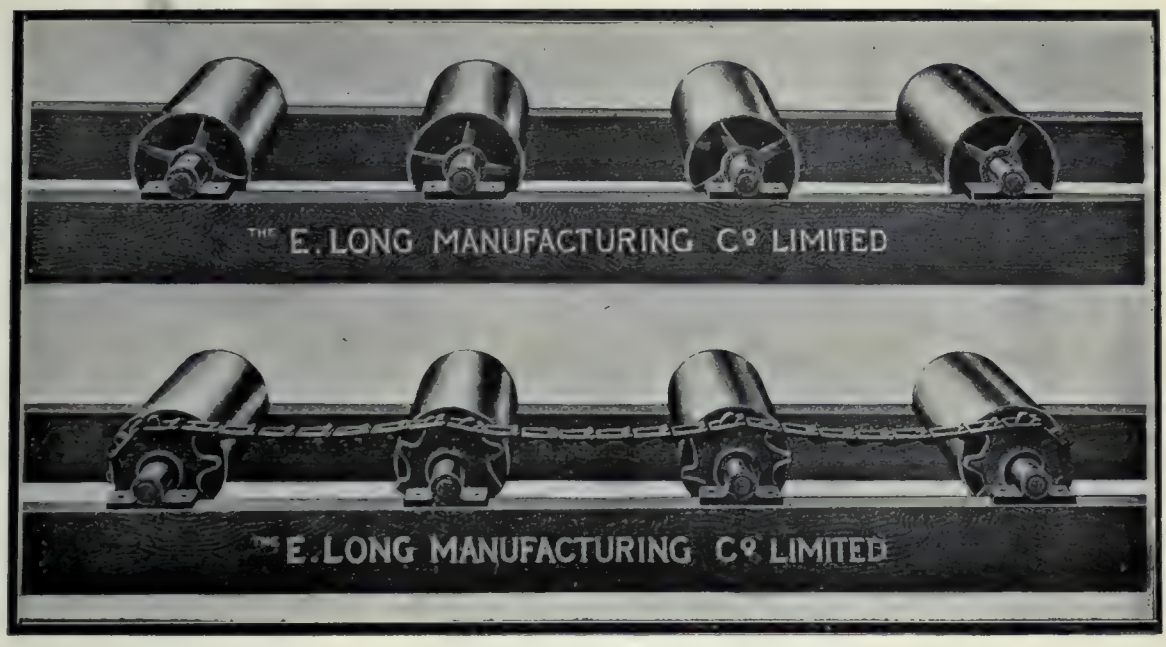
(*b*) Chains in troughs for refuse.

Rolls.

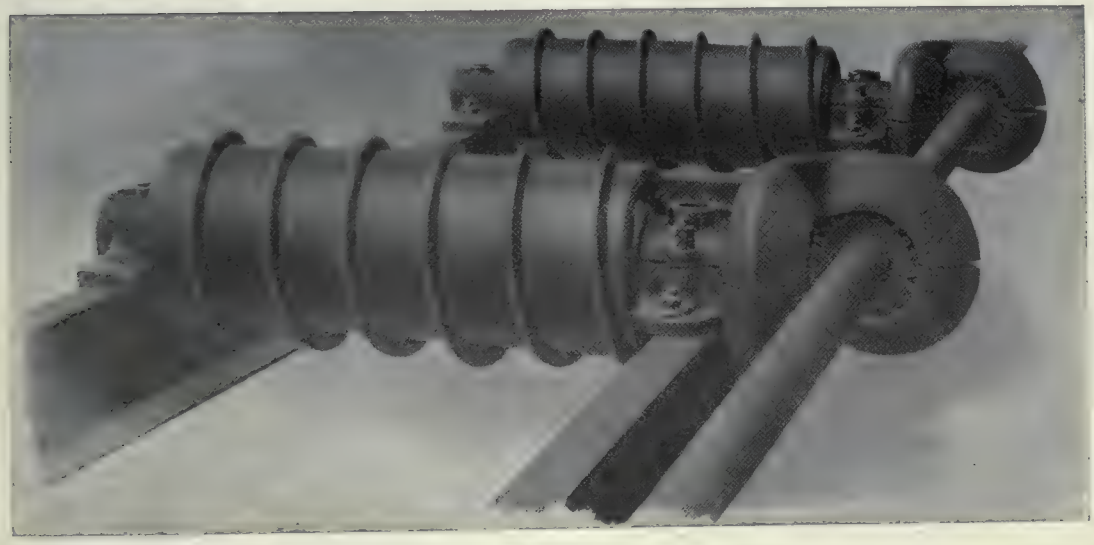
Rolls are small iron or wooden rollers, from 2 to 4 feet long and from 6″ to 12″ in diameter, mounted on a framework in rows (*i.e.*, one behind the other). If driven mechanically they are known as *Live Rolls* (Plate LXXXIII). The driving may either be by means of gearing, or by friction wheels, or by chains and sprockets. The rollers may either have a smooth surface to carry the lumber straight forward, or they may be spirally ridged to help in side-tracking the load.

If reference be made to the diagrammatic plan of a mill given in Plate LVII, it may be noticed that spiral rolls are placed on the main line a short distance beyond the Edger. These rolls are for slabs. When the operator in charge sees a slab coming forward he raises the Stop just beyond the spiral rolls. This causes the slab to move sideways and to drop on to the chain conveyers running across the mill underneath the rear table of the Edger. The slab is thus taken direct to the *Slasher Saws* (paragraph 133).

Where gravity can be made use of dead rolls are almost as good as live ones. Two firms in the States known to the writer make a great speciality of gravity conveyers for all kinds of industrial purposes. Plate LXXXIV is a good illustration of the manifold uses to which such conveyers can be put. It is believed that there



(1). Examples of Live and Dead Rolls.
(By permission of Messrs. E. Long Manufacturing Co.)



(2). Spiral or Screw Live Roll.
(By permission of Messrs. The Allis-Chalmers Manufacturing Co.)

(para 140).

Gravity Conveyor for unloading timber from Railway wagon into yard.
(By permission of Messrs. The Matthews Gravity Carrier Co.)

(para 140).

is a wide field for such mechanical devices in India. The supply of labour is not unlimited and it is becoming more and more expensive. For loading, unloading and transhipment of sleepers and sawn timber generally a huge amount of labour is at present employed. By means of Gravity Conveyers it is believed that the cost of handling could be materially reduced.

Chain Conveyers.

All lumber leaves the Log Saw endwise on the main line of live rolls. In the case of heavy timbers such as beams and squares, no subsequent change in the method of conveyance is necessary, as trimming is done by single swing saws (*vide* paragraph 131). But to deliver lumber to the Edger or to the Re-Saw it has to be switched off the rolls. This is done by means of a mechanical transfer device as explained in paragraph 128 [Plate LXXVIII(3)]. After passing through the machine the lumber is carried forward by a special set of live rolls attached to the rear table of the Edger, and is shot on to *Chain Conveyers*, working in a direction at right angles to the rolls. By them the lumber is brought to the trimming saws.

Grading.

141. After being trimmed, the lumber falls on to another set of similar chains, extending from end to end of a long table. An operator standing at the near end, chalks a grading mark on each piece of lumber as it passes in front of him. Further along, other men pull the wood off the table and load it on to trucks, by size and grade, for stacking in the yard.

This is the simplest method. In practice there are many variations. The lumber may be sent direct into dry kilns, for which purposes special cars are used. Or it may be sorted by mechanical means. It may be loaded direct into railway cars or it may be sent back to the mill for re-edging (paragraph 129).

Sap Stain.

142. At Bogalusa, La, the writer noticed the lumber passing through a *Soda Dipping Tank* after being trimmed. Plate LXXXV(1) is an illustration of the latest type of tank. It is provided with a double set of chain conveyers. By means of a foot pedal, the operator can bring either set into use. Dry stock which does not require to be dipped, is passed over the top. A simpler form, without the upper portion, is also on the market. A mixing tank is included. The chemical used is Bi-Carbonate of Soda. The object of the operation is to reduce the bad effects of sap stain, which would otherwise cause an appreciable reduction in value of species such as Yellow Pine, etc. This patent tank is an improvement on the old wooden tank method, as it does away with the annoyance of splashing and is more economical in the amount of solution required.

The idea is worth experimenting with in India, as many tropical woods stain rather badly in seasoning. The subject is discussed in "The Preservation of Structural Timber by Weiss (pages 29 and 222).

Storage of Lumber.

143. The stacking of the sawn timber in the mill yard is a matter which receives particular attention in the West. The risk of loss by fire and by decay in the absence of proper precautions is very great. The subject is discussed in Chapter*

The transport of the lumber from the conveyers to the stacking ground is done in a variety of ways—hand carts, mule carts, motors, tramways, etc. Good illustrations can be seen in lumber journals.

Refuse.

144. Starting from somewhere near the Edger, and passing below the Trimmers and Slashers, and out of the mill to the Incinerator, is a trough with a large link chain running along the bottom. Refuse pieces, slabs, etc., that it is desired to get rid of, are thrown or dropped into this trough and are carried away.

If the making of *Lath, Box-Material*, etc., forms part of the operations of the mill, one or two men standing in convenient places beside the trough sort the refuse as it passes them.

In writing about Western mills in general it is only right to remark that, whereas in some mills, especially on the Pacific Coast,—a great deal of good material is burnt, in many mills conversion is very economical and next to nothing goes to the Incinerator. In fact the writer came across more than one instance of there not being enough material to keep the Incinerator going day and night. At Davis, W. Va, the bundling of firewood for sale is done in shortpieces only about 3″ long.

Sawdust Conveyers in small mills.

145. It must not be supposed that mechanical sawdust conveyers are confined to large mills, for they are also to be found in quite small ones. The fact that they were to be met with in practically all the mills put up by Canadians and Americans in England and France during the War may be taken to indicate how universally such appliances are used in North America.

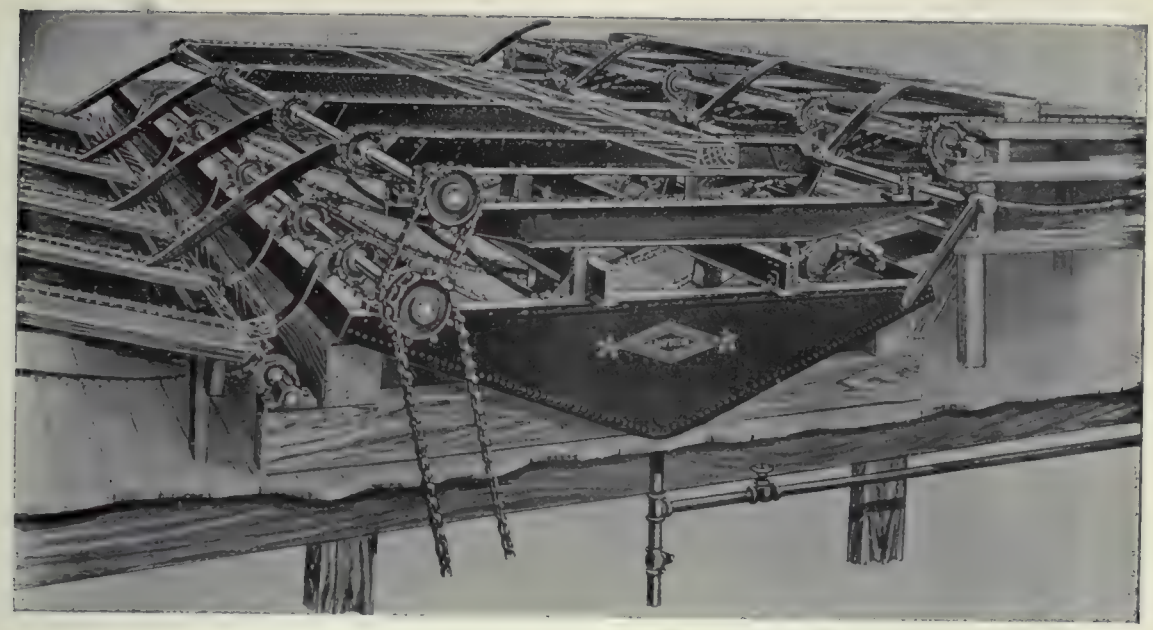
The simplest form of conveyer for such a purpose consists of an endless chain working in a wooden trough, starting from a pit below the Log Saw, and inclined at such an angle that it is out of the way of the Log Carriage—*vide* Plate LXXXV (2). For portable mills such an arrangement would generally be enough, as they are likely to move on before the heap of sawdust outside the mill becomes a nuisance.

If the mill is of a permanent enough type to permit of the building of a *Dutch Oven* furnace the conveyer is more elaborate, but the point which it is desired to emphasize is that such a conveyer system is comparatively inexpensive to instal, and that it may be relied upon to pay for itself very quickly, even if it only saves the wages of one or two coolies.

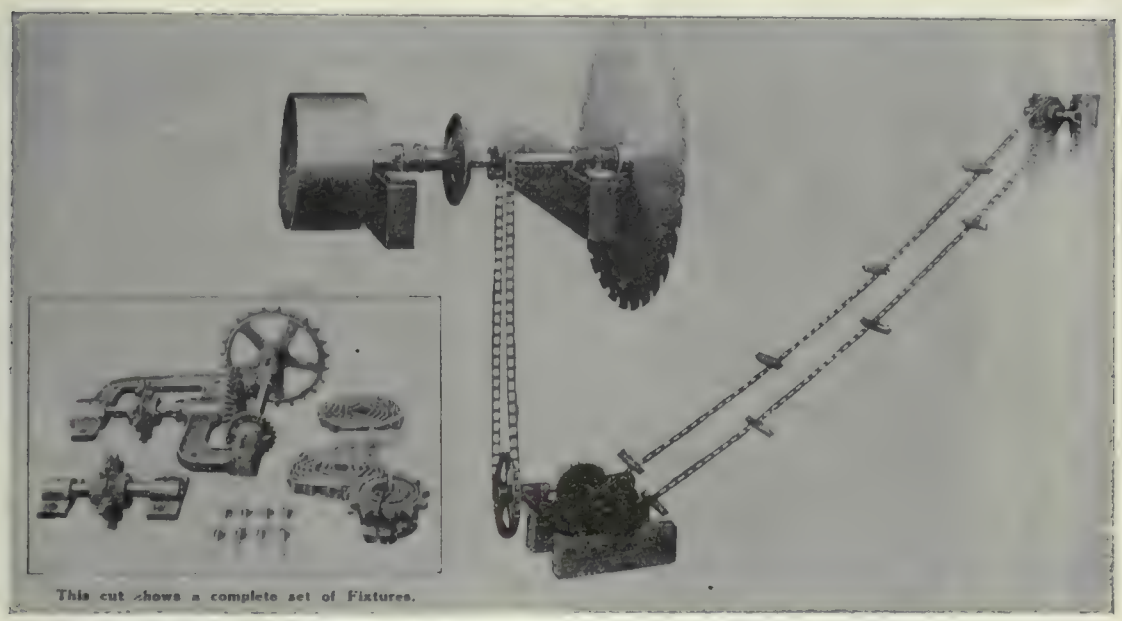
Handling of timber and refuse in Mills in India.

146. Most of the movement of lumber and refuse in mills in India is done by manual labour. Half logs, planks and slabs are carried about by hand or pushed along on tramway trucks; and sawdust is removed by headloads.

Such methods would certainly not appeal to a Canadian or American for he would know well enough that they would certainly go a long way towards spoiling the value of his machines. There would be bound to be great difficulty in working the machines fast enough to justify their existence.

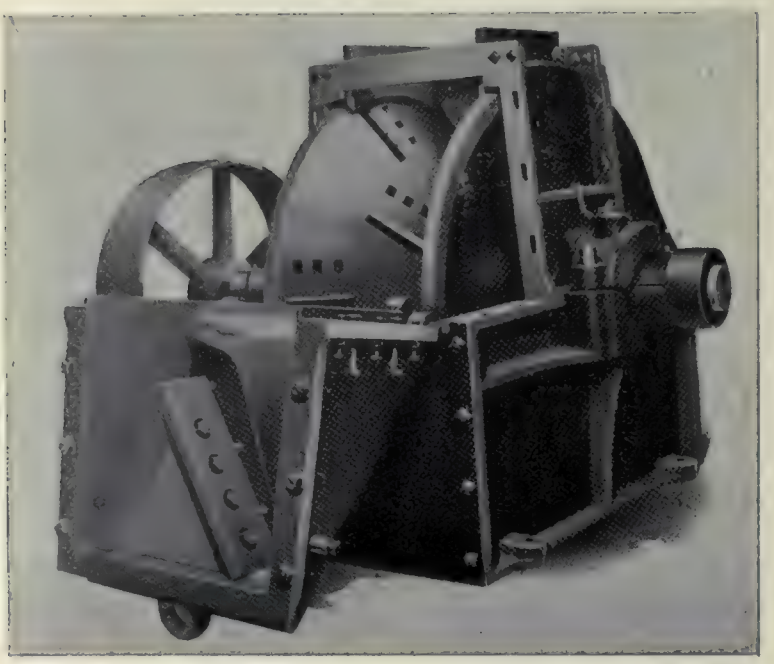


(1). Trout Soda Dipping Tank for prevention of Sap Stain.
(By permission of Messrs. The Lufkin Foundry and Machine Co.)

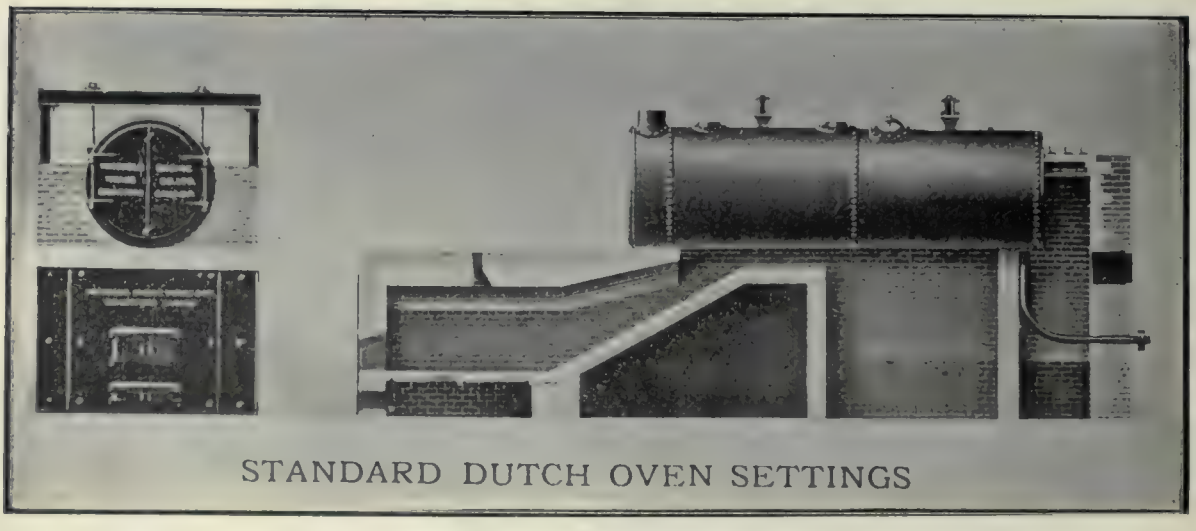


(2). Simple form of conveyor for removing sawdust from the pit beneath the saw in a portable Mill.
(By permission of Messrs. The American Sawmill Machinery Co.)

(para 145).



(1). Hog for reducing refuse wood to chips for the furnace.
The machine is shown with part of the casing hinged back to see the interior.
In operation the refuse is fed in from above.
(By permission of Messrs. Clark Bros. Co.)



(2). Standard Dutch Oven.
(By permission of Messrs. The Waterous Engine Works Co.)

The argument of the Westerner is, that with an unlimited supply of free fuel (sawdust), it is cheaper to use steam than muscle. The success with which this idea has been put into practice is too well known to need comment. The adaptability of steam is truly remarkable, for in the case of appliances, such as the "Nigger", a mechanical device is apparently endowed by it with almost human intelligence.

Some of the manufacturers consulted by the writer were inclined to think that a good deal of their conveyer mechanism could probably be dispensed with in India on account of the cheapness and abundance of labour. The gentleman referred to in paragraph 130 was on the other hand emphatically of opinion that it would be better to have the whole of it, "*even if labour can be procured for a mere song*". The more the writer studies the problem the more he is inclined to agree with this view. *In a permanent mill of any size labour should be reduced to a minimum, no matter how cheap it may be.*

Section 9.—POWER PLANT.

Engine Fuel and Hogs.

147. There is probably not a single permanent sawmill of any size in North America in which billets of wood or slabs are fed into the furnace by hand. If the supply of sawdust is not sufficient, then the refuse is passed through a machine known as a *Hog*, which literally gnaws it into small pieces. This often has to be done because the numerous mechanical appliances in use consume a lot of power, and *there is generally no stinting of the supply.* Plenty of surplus power for expansion of business is usually provided in the designing of plant, and additional items such as a planing mill, dry kilns, town lighting, etc., are often included.

Dutch Ovens.

The standard form of furnace is known as the *Dutch Oven.* As may be seen from Plate LXXXVI it consists of a large brickwork chamber beneath and extending a little in front of the boiler. Fuel is fed into it from a hole at the top. The sawdust conveyer passes overhead with branches leading down to each furnace; if there is a battery of them. All the attendant has to do to feed the furnaces is to open or close the connections as required; gravity does the rest. He does at times have to do a little shovelling, *i.e.*, to keep the fire up when the mill is not running. For this purpose he generally keeps a pile of sawdust or chip fuel close by.

Belting.

148. Special attention is invited to the subject of *Belting*, because a very useful lesson may be learnt from Western practice. Loosely flopping belts are never tolerated and yet belts are not put on so tight as to shorten their life, wear out bearings and use up power unnecessarily. This end is attained by mounting an *Idle Wheel* on the belt. The desired degree of tension is obtained either by weight, spring or lever.

Plates XC and XCI (4) (paragraph 153) illustrate a small and inexpensive form of balance wheel suitable for a portable mill. Plates LXXIV and LXXV (paragraph 124) show more elaborate forms.

149. What a striking contrast many of the smaller mills in Burma present ! ! !. It is a common practice in them to allow belts to sag freely. If the belt is at all loose and the foundations are not of the most solid construction the flopping of the belt is tremendous, and speed often has to be reduced to keep the belt from jumping off altogether.

To avoid this, and also to prevent slipping, some operators go to the other extreme and put the belts on far too tightly. The result is that bearings wear very rapidly and belts soon begin to give way. The writer has himself seen more than one example of belts being literally torn to pieces within a few months of being first put on. With the balance wheel arrangement it is a very simple matter to instal and look after belting but, without it, far more skill and attention are required than the average small mill owner in India seems to be capable of, and the worst of it is that he hardly seems to be aware of the deficiency.

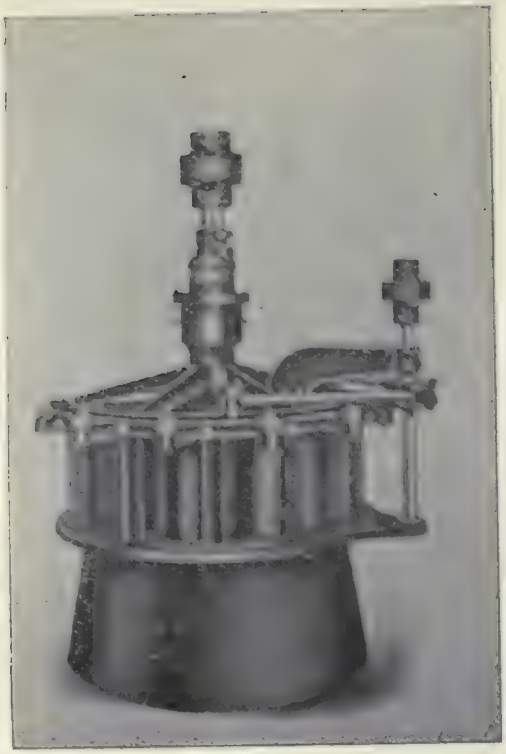
A deplorable example that came under the notice of the writer some years ago may be mentioned. On one occasion when he went into a mill engaged in sawing *pyingado* sleepers the owner pointed with pride to his brand new driving belt, for which he had paid a fabulous price in Rangoon. The belt had obviously been put on far too tightly, for there was no sag at all. Moreover, with a hand on the shafting framework a violent jerk was felt at regularly recurring intervals of a second or two. It did not take long to discover the cause. The jerks were found to take place whenever the over-lapping join in the belt came on the driving or pulley wheels. The belt was in fact so tight that it had no play at all and the frame work of the shafting had to give way. Needless to say the belt was soon ruined and the engine rapidly deteriorated.

Examples of this kind could be found in many parts of Burma, and possibly in other parts of India. More technical skill on the part of small operators is badly needed. As they perform a very useful function in timber extraction, it might pay Government in the Forest Department to go out of its way to give them advice and assistance.

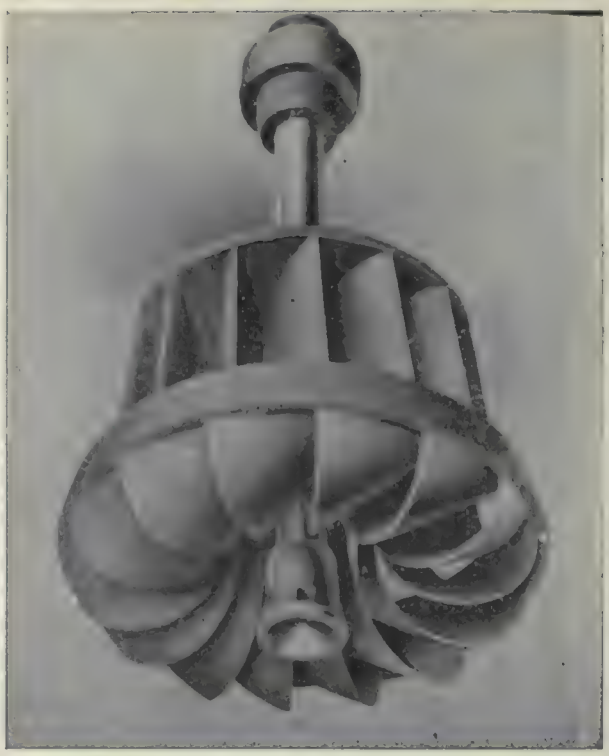
Electric Drive.

150. Individual electric drive is already very common in manufacturing plant such as Planing mills, Pulp mills, Box factories, etc., but in sawmills it is only just beginning to find its way. It has taken electricians a long time to design a motor suitable for the severe service of a log saw. Success has been achieved in this respect but the writer is under the impression, that motors suitable for the " Nigger " and for the log carriage feed for large logs, have still to be designed. This remark may be wrong, as mills driven throughout by electricity have been heard of, although the only one actually seen was a comparatively small one (40 tons a day) at Lacona, New York

At Elk River, Idaho (Portlatch Lumber Company) a very fine mill was seen with three log bandsaws and an output of 270 tons a day. The drive for everything *except* the Nigger and Carriage was electric. Belting is used for coupling the motor and log saw shafts. It is claimed that by this method, the pull on the slack of the belt when the saw meets the log, enables the motor to pick up its full load better than if coupled directly to the saw shaft.

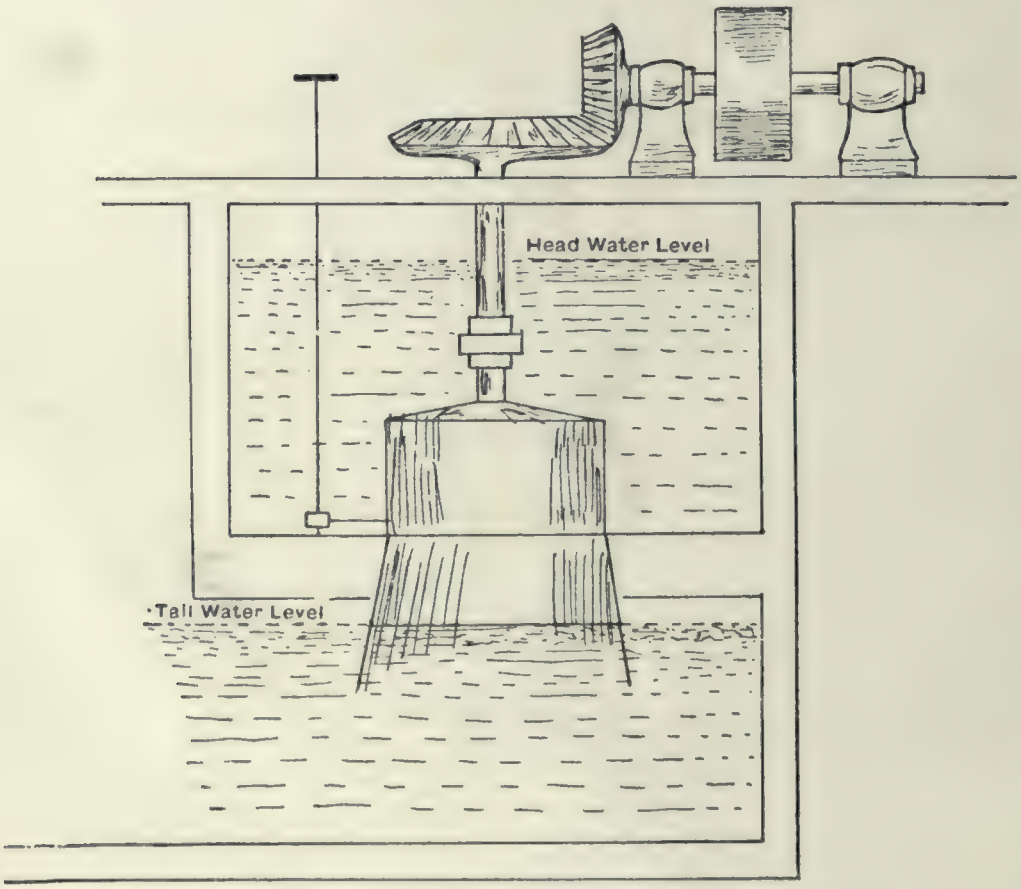


(1). External appearance of Wicket Gate Turbine.



(2). Enlarged view of revolving blades of turbine.

(By permission of Messrs. S. Morgan Smith & Co.)



(3). Diagram of Turbine mounted in a flume for a horizontal drive.

(para 151).

151. It may be of interest to note that the earliest type of saw mill in North America consisted of a straight up and down saw driven by a water wheel, of the old fashioned paddle wheel type that is still to be seen in country places at home.

Water Power.

There is a very complete line of modern water power motors. They can be successfully designed to suit any desired conditions as to H. P. and head of water. They are of two main types, *viz.*, (*i*) *Tangential* and (*ii*) *Turbine.*

The *Tangential* or *Impulse* motor (*Pelton Wheel*) depends on the impact of a powerful jet of water on cup-shaped buckets or vanes mounted on a shaft that is free to revolve. As considerable pressure is required to develop any appreciable H. P. this method is only of practical value where a good head of water is available. The H. P increases rapidly with the head. A 24″ Pelton wheel with 10 feet Effective Head only develops ½ H. P.; with 100 feet it could develop 15¾ H. P.

A good example was seen at Bridal Veil, Oregon. The water has a fall of 900 feet and is brought down to the planing mill in 18″ steel pipe a mile in length. In the different part of the mill there are seven Pelton wheels of varying sizes giving a total of about 900 H. P. altogether.

The *Turbine* motor is well adapted for a low pressure of water. A 24″ turbine motor with a head of 10 feet can develop 42 H. P. The motors are designed for working in open flumes or in closed pipes. Open flumes made of wood are well adapted for small sawmills.

The following are approximate dimensions :—

Diameter of Turbine.	Section of Flume W. H.	Discharge—C. ft. p. m.		Horse Power.	
		Head—5 ft.	Head—10 ft.	Head—5 ft.	Head 10 ft.
12″	42″×42″	480	690	3½	10½
18″	54″×51	1,100	1,560	8½	24
24″	72″×58″	1,970	2,790	15	42

The height of walls of flume is put 6″ more than the head of water required.

An 18″ turbine developing 24 H. P. with a head of 10 feet, would require a discharge of 1,560 cubic feet per minute, which would be given by a current of one mile an hour in the flume.

Plate LXXXVII shows the external appearance of a turbine motor and the shape of the revolving spindle and blades inside. The diagram shows how a turbine can be mounted in a wooden flume to give a horizontal drive. Such a motor would be well adapted for mechanical drive close at hand, or for electrical drive at a distance.

Section 10.—SPECIAL AND PORTABLE MILLS.

Special Mills.

152. The principal machines and appliances ordinarily to be met with in Western mills have now been touched upon, and it only remains to refer to special types of machinery or design which may be of interest in India.

At Fernwood, Idaho, half the output of the mill is usually in the form of S. G. sleepers and the mill is of a design specially adapted for the sleepers [*vide* Plate LXXXVIII (1)].

For scantling there are the usual Edger and Trimmer. For the sleepers a special 3-Saw Trimmer is provided. It is not so elaborate as the one shown in Plate LXXX(1) (paragraph 132), as the three saws are permanently mounted in a row at fixed distances apart.

The untrimmed sleepers reach the machine as follows: Hanging above the line of live rolls is a heavy board with a clearance of about 4". Scantling can pass underneath (and on to the Edger), but sleepers are stopped. When this happens, the Transfer Chains rise automatically and switch the timber across to the special trimmer.

The ordinary output of the mill is 50,000 B. F., half of which is equal to about 600 sleepers. The writer was informed that the output would be more than double (110,000 B. F.) if the whole mill were turned over to the production of sleepers (3,000 sleepers), and the rest of the wood were wasted.

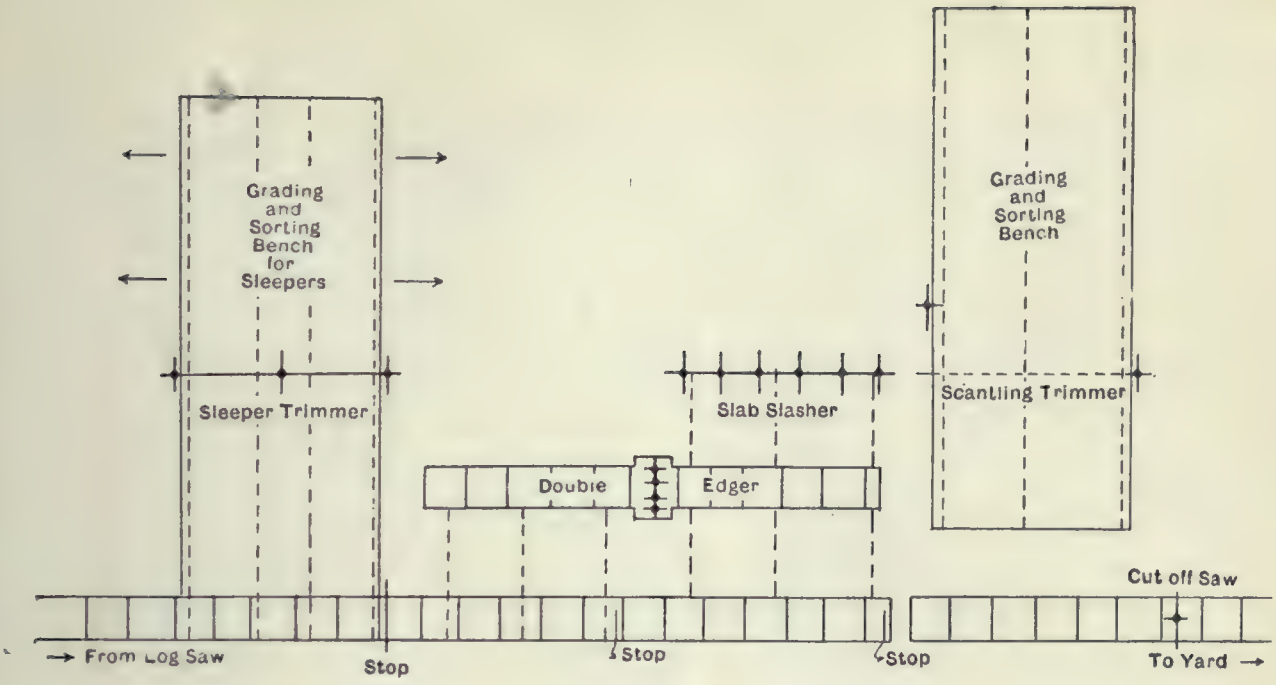
At Elk River, Idaho, another example was seen of a large mill with part of the normal output in the form of sleepers.

At this mill the cross-cutting is done in the usual manner, *viz.*, by a swing saw in the main line of live rolls. There are special devices for quick operation, such as a series of "stops" for the lumber and an electric switch for the saw.

This mill is chiefly mentioned for the sake of Plate LXXXVIII (2) illustrating the method of handling the sleepers after leaving the mill. The live rolls extend for some distance outside the mill, and alongside them is a large sloping platform or *Deck* on which the sleepers are piled. Opposite each pile there is a "stop" (between the rolls), which can be raised or lowered by the man who operates the cut-off saw inside the mill. When cutting the sleepers he notes the class or grade to which they belong and switches them on to the corresponding piles. The railway track runs alongside the deck, and as there is next to no *lifting* of the sleepers, the amount of labour for loading is reduced to a minimum.

Portable Mills.

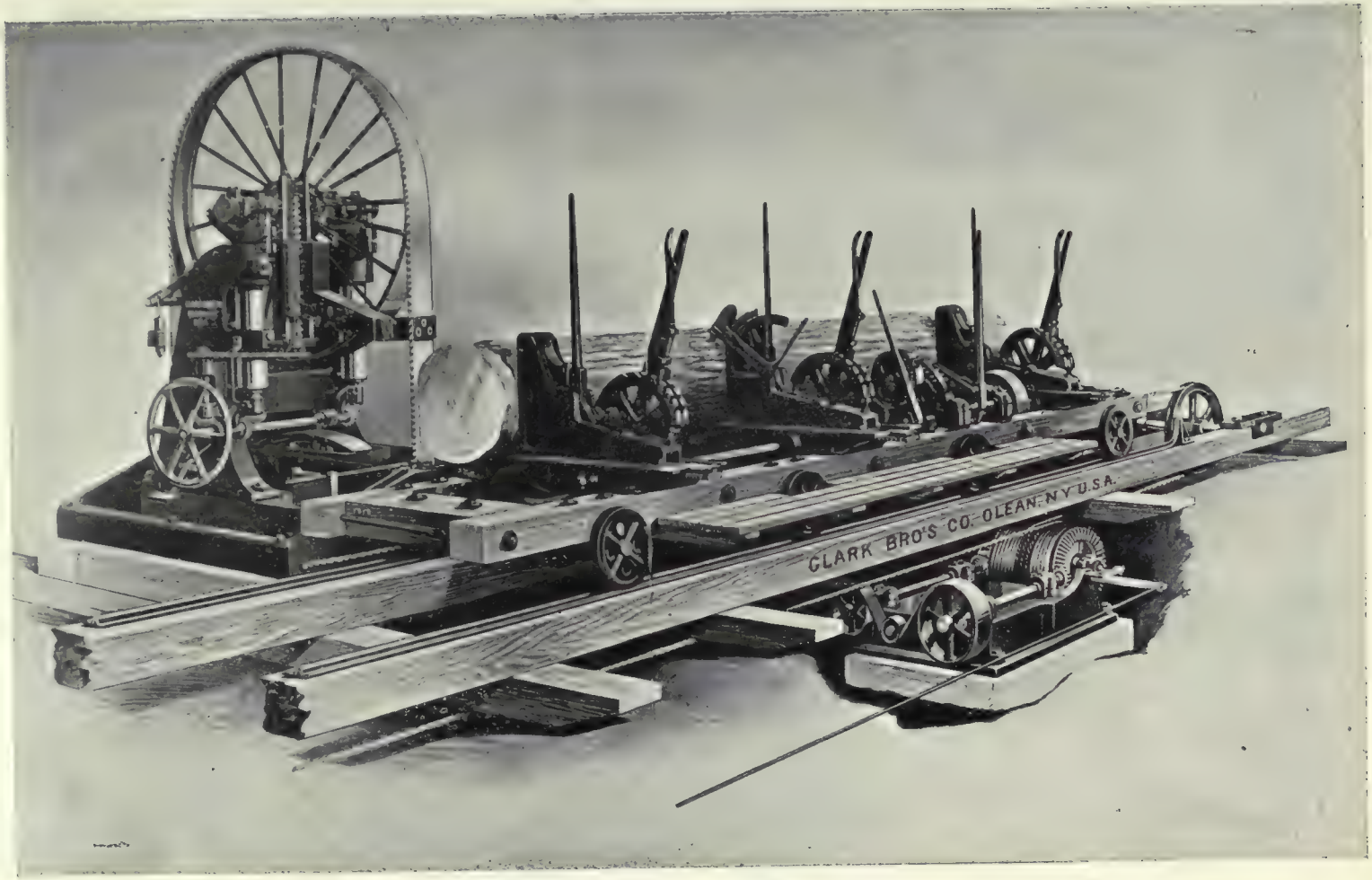
153. Several firms specialize in the manufacture of machinery for portable mills. It is proposed to give a description of two such mills, but it must not be supposed that these patterns are therefore thought to be superior to other designs, because the choice has naturally fallen on those of which the writer happened to have the best illustrations. Moreover, no one firm can be said to have a monopoly of the best in all details.



(1). Diagram of mill with a large output of sleepers.

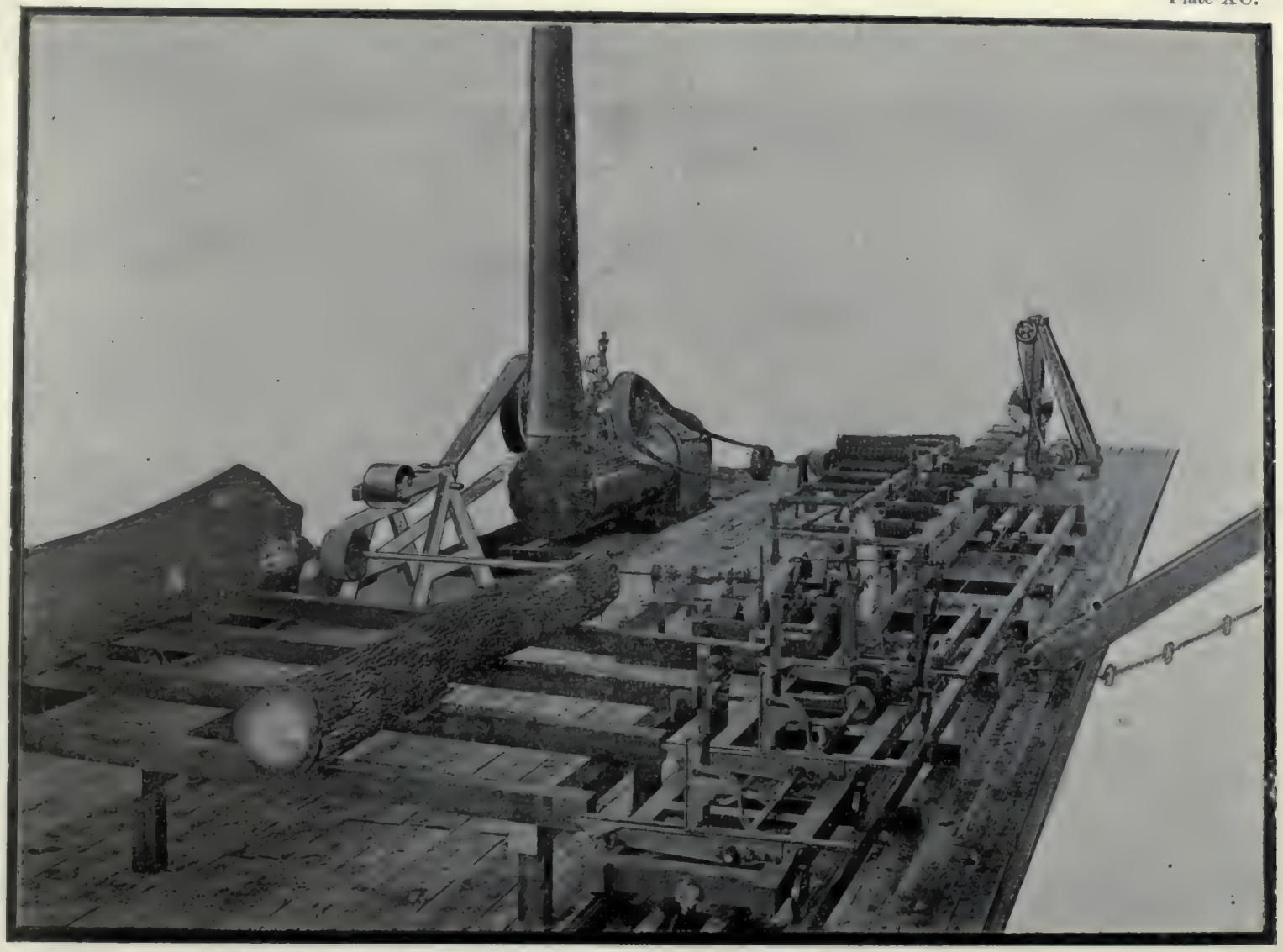
(2). Sorting and Loading Deck for sleeper.—Elk River, Idaho.

(para 152).



Portable Bandmill showing Bandsaw and Carriage.
(By permission of Messrs. Clark Bros. Co.)

(para 153).



General view of Portable Circular Saw Mill.
(By permission of Messrs. The E. Long Manufacturing Co.)

(para 153).

Plate LXXXIX illustrates the Saw and Log Carriage of a Portable Bandmill designed for logs up to 3 feet in diameter. The band wheels are 5 feet in diameter The following extracts from the makers' catalogue are given :—

"Every part is so assembled as to move the entire equipment in a day's time."

* * * * * * * * * *

"The capacity ranges from 25 to 50 tons per day."

* * * * * * * * * *

"The High standard of our portable equipment eliminates the inaccuracy of cutting, reduces one-half the horse-power required, and saves 70 per cent. of the Saw kerf characteristic of the Circular Mill."

Plate XC gives a general view (taken from another firm's catalogue) of what the makers call a Standard Portable Circular Mill.

The mill is designed for the conversion of logs up to about 18 feet in length and 2′ 6″ in diameter (54″ saw) and is rated as having a daily capacity or output of 16 tons (8,000 B. F.). Judging from experience elsewhere, this estimate seems to be quite moderate.

Working drawings are supplied and detailed specifications of all the woodwork required for construction, although the timber for the floor and track and rolls is supposed to be obtained locally.

The first point to notice about the design is that the double storey plan is not lost sight of, for the mill is intended to be built upon a plank and joist floor, 75′×22′. Openings are left for pulley wheels and also for the engine to rest directly upon the ground.

The outfit consists of :—

30 H. P. Boiler and 25 H. P. Engine.

54″ Saw Frame and Carriage with Friction and Rope Feed and 50 feet of track.

32″ Edger.

Swing Saw.

Dead Rolls.

Sawdust Conveyer.

The Boiler, Plate XCII (1), is of the locomotive type and is mounted upon timber skids. For transportation purposes it would be a simple matter to jack up the skids, one end at a time, and put wheels underneath.

The Engine is mounted on the top of the boiler, and has two belt wheels, one for the main drive and the other for the Edger and Cutt-Off saw. The *Belt Tightener* Plate XCI (4) is simple in design but quite effective in operation. The *Drive Shaft* for the Log Saw has a jaw coupling operated by a lever within easy reach of the Sawyer, so that the saw can be stopped at any time without shutting off steam.

The Log Carriage is of very much the same design as the one illustrated in Plate LXV (2) (paragraph 103). The *Setworks* are of the single acting type (Plate XCI (1) that is, there is no forward movement of the head blocks in the backward stroke of the lever. The knees can be accurately set to one-sixteenth of an inch. In the quadrant are five pins, against any desired one of which the lever can be stopped, so that stock of any standard thickness can be cut without reference to the scale at the end of the carriage. *Turning the handle* of the lever slightly forces down the rod shown in the picture of the setworks. This lifts the pawls clear of the ratchet wheel and allows the spring to recede the knees.

The Saw is mounted on a timber frame and is provided with adjustable *Saw Guide, Lumber Spreader* and *Lumber Roll.*

The Double Edger Plate XCI (3), has two saws, one stationary and the other moveable, and can take lumber up to 32″ in width and 4½″ in thickness. The free roll at the top of the machine may be noted. It comes in useful whenever it is desired to pass a piece of lumber back for re-edging.

The Rolls for the main bench are 10 in number and 8″ × 20″ in size. They are made of cast iron. Six other rolls are provided for the edger.

The Log Deck is built up above the floor with a slight slope towards the carriage. Appliances for placing the logs on the deck are not included.

Plate XCII (2) is an illustration, taken from the catalogue of another firm, showing the engine mounted on the bed-plate. This design is preferable, as the trouble with vibration must be smaller than with the engine on the top of the boiler.

154. The smallest mill actually seen in operation was at Portland, Oregon. The plant is not so good as the one just described, as it does not include an Edger.

The outfit consists of a 54″ Circular Saw and Carriage with friction and rope feed, and a Swing Saw. The boiler is of the locomotive type, but there are two engines, one (25 H. P.) for the log saw and the other (5 H. P.) for the cut-off. The former is mounted on the timber skids of the boiler (*vide* Plate XCII (2), and the little one is placed under the roll bench near the swing saw.

The logs seen by the writer were about 22 feet long and 2′ 6″ in diameter. They were being dragged by horses direct from the forest, and placed on a skidway leading down to the carriage.

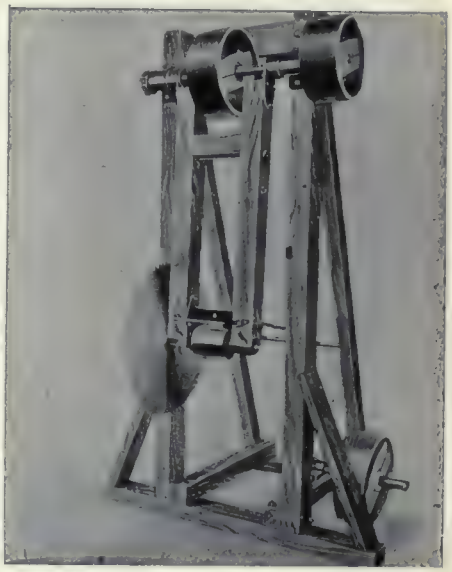
Standard Gauge sleepers were the chief objective, the balance of the timber being cut into 1″ boards. Everything except the cross-cutting was being done on the carriage. As soon as ready for trimming each piece of timber was pushed along the rolls to the cut-off saw. Planks were laid aside until the whole log was finished, and they were then piled on the carriage for edging.

The mill was being run at the time of the visit by 5 men (including the fireman) and the average daily output was stated to be from 150 to 200 S. G. Sleepers and 100 c. ft. of Scantling, total about 15 tons (7,500 B. F.) The quality of the sawing appeared to be good and the waste was certainly not excessive.

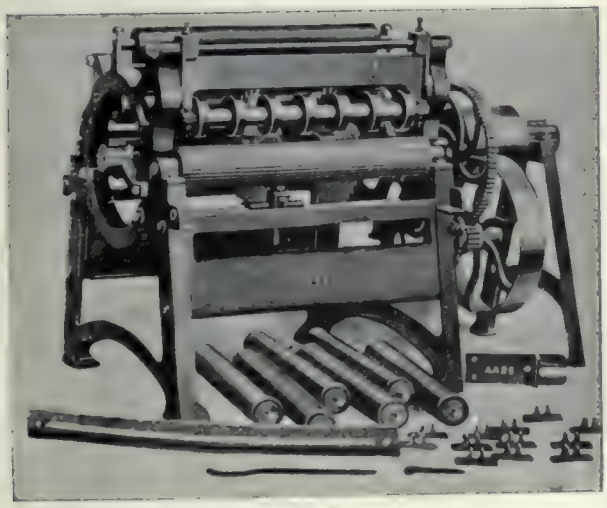
The output of this little mill compares very favourably with that mentioned in paragraph 138, as being yielded by the Government mill in the Pyinmana Forest

Details of Portable Circular Sawmill.

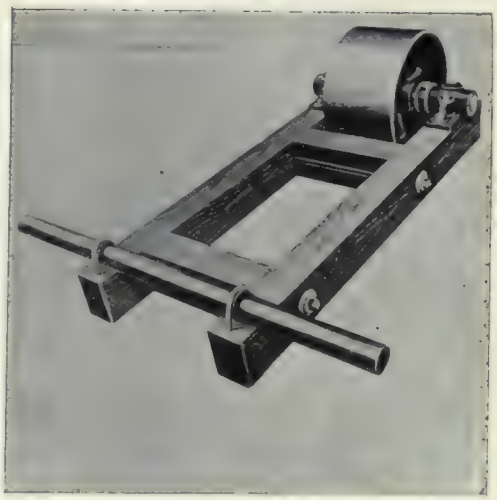
(1). Setworks.



(2). Swing Saw.



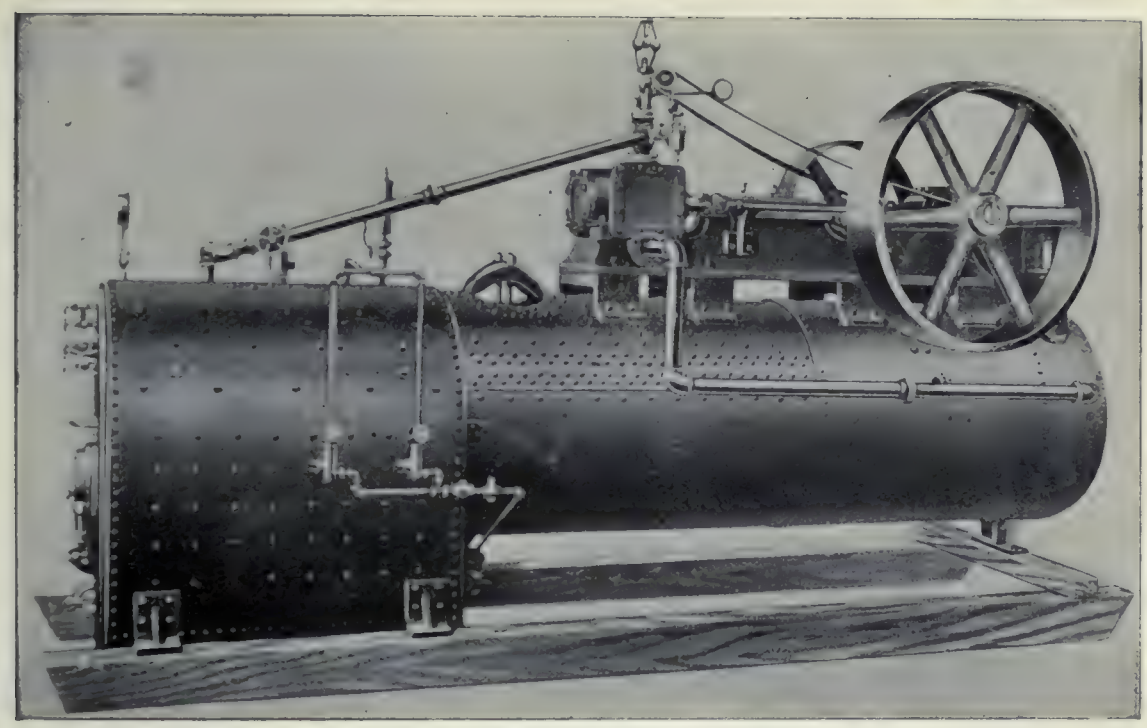
(3). Double Edger.



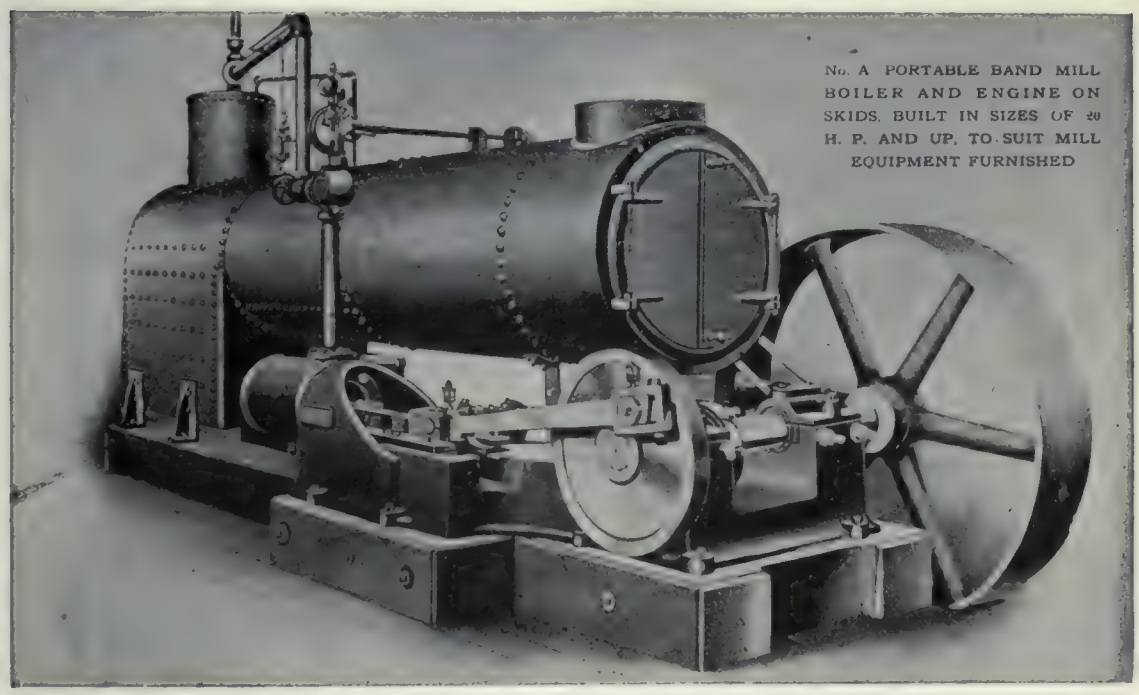
(4). Belt tightener.

(By permission of Messrs. The E. Long Manufacturing Co.)

(para 153).



(1). Portable Boiler and Engine on Skids.
(By permission of Messrs. The E. Long Manufacturing Co.)



(2). Portable Boiler & Engine on Skids.
(By permission of Messrs. Clark Bros. Co.)

Division, *viz.*, 80 M. G. sleepers and 25 c. ft. of scantling (3 tons), even if allowance be made for the great difference in hardness between the timbers sawn, *viz.*, Douglas Fir and Pyingado.

Section 11.—RECOMMENDATIONS FOR INDIA.

Suggestions for Mills in India.

155. It is now proposed to summarize the notes on practice in India that have been interpolated here and there in the preceding paragraphs of this chapter. The general conclusions with regard to suggestions for improvement of mill practice in India can be expressed very briefly. The efficiency of Western mills appeals so powerfully to the writer, and their superiority to mills in Burma is so pronounced, that no hesitation whatever is felt in stating that *mills in Burma ought to be more or less completely dismantled and re-built on Western lines*. It is possible to effect improvement by changing individual machines but, in order to attain the highest possible degree of efficiency, *even under conditions prevailing in Burma*, very little of the original plant could be left untouched.

The *Sawing Equipment* in mills in Burma is usually as follows :—

1. Circular Log Saw with Plain Steel Rack Feed Table.
2. Plain Circular Saw Benches with hand or mechanical feed.
3. Swing Cut-off Saws.
4. Reciprocating Cut-off Saws.
5. Reciprocating Vertical and Horizontal Frames. } In a few mills only.
6. Revolving Circular Re-Saws.

In a Western mill there are four distinct types, *viz.*:—

1. Vertical Log saw and carriage for breaking down logs.
2. Revolving re-saws for reducing to thickness.
3. Double edger for squaring sides and for ripping.
4. Trimmers for squaring ends.

In respect of the superiority of the *Log Carriage* there can be no question. In respect of *Re-saws*, only a very poor case, can be made out for the retention of *Reciprocating Frames*, because they can show so little to counterbalance their slow rate of working. In respect of *Double Edgers*, their speed of working and adaptability put them far ahead of *Plain Saw Benches*, with or without mechanical feed. Lastly, in respect of trimming machines, the *Western Gang of Swing Saws* in a large mill or the *3-Saw Trimmer* in a moderate sized mill, are—like the Edger,—so much more economical in man power, that there need be no hesitation in giving them the preference.

Before going on to other matters, the reader is recommended to turn to the notes on British practice given in paragraph 164, etc. *Horizontal Bandmills* are now rapidly coming into general use in Great Britain and the bandmills now in India are of this type. Nevertheless, for the breaking down of round logs the writer prefers the vertical machine, but he would certainly not go so far as to suggest that these

horizontal mills ought to be scrapped—hence the limitation to Burma of the opening remarks in this paragraph.

It should also be borne in mind that the foregoing recommendations apply, primarily to Lumber Mills supplied with logs direct from the forest. It is presumed that in such mills a maximum output is desired and therefore that speed of working is of the first importance. The case is different where the supply of logs is limited

Before expressing any further opinion as to the horizontal bandmills in India the writer would like to have an opportunity of seeing them at work.

Handling of Timber in Mills.

156. The commonest method of moving timber about in a mill in India is on tramway trucks. Overhead gantries are used to some extent in large mills. The part played by rolls (live or dead) is a very small one. In all mills a good deal of labour is required for handling the timber in the various parts of a mill, and it is beyond question that congestion would occur if the output of the sawing machines were increased to any considerable extent.

It is on this account that the Western system of *Rolls* and *Chain Conveyers* is so very much superior to the tramway method. A Western Log Saw does anything up to half a dozen times as much work as the writer has ever seen done by a Log Saw in India, and yet there is no congestion ahead of it. The reason is because each slab or piece of lumber moves away as soon as it is cut. There is no piling up on skidways or trucks.

It is the same with the Edger and with the Trimmer. There is no piling up of slabs or lumber anywhere, and—to make a long story short,—there is no wholesale shovelling of sawdust and carrying of it away by headloads.

A progressive system such as that of rolls and chain conveyers is absolutely essential for the Edger and for the Trimmer. The former could certainly not take the whole output of a mill, if each piece of wood were not removed very promptly, and the crookedness of the sawing off of ends with hand feed to the latter machine, can easily be imagined. Apart altogether, therefore, from the saving in labour *Western Edgers and Trimmers cannot be recommended without Rolls and Chain Conveyers.*

The saving in expenditure on labour may be expected to be a real one, for the remark made at the beginning of this chapter is by no means an exaggeration. For the *same* output, a Western mill does only require about one-tenth of the labour to be met with in a mill in India.

Details of Equipment.

157. (1) Before any final plans or designs for mills can be drawn up, the question of *Saws* (paragraphs 123 to 127) must be settled. The best shape of tooth and speed of sawing have to be determined. The soundest plan would be to send samples of logs to one or two of the leading manufacturers of Saws. Moreover, their opinion with regard to the suitability of Bandsaws would certainly be worth having. If it is favourable for teak or any other species,—as the writer believes would be the case—bandsaws should certainly be given the preference in localities that are easily accessible, and for mills that are at all likely to be permanent

The present difference in cost of saw and filing room equipment between a band and circular saw mill is about Rs. 6,000 (80 per cent. above pre-war prices).

(2) The use of single circular saws more than 50″ to 54″ in diameter cannot be recommended. Double Saws are much to be preferred. This is a matter of considerable importance, as it affects small and portable mills as much as it does large and permanent ones.

(3) Western example with regard to Engine Power and Boiler Capacity may well be copied, that is, there should be a very good reserve of both of them. An example of the value of plenty of power can be given. Amongst the plans given to the writer by various manufacturers, are two by one firm that are identical except in respect of the engine and boiler. There is double the capacity in one plan to what it is in the other, and in consequence, the estimate of output is also double.

(4) The Dutch Oven type of furnace (paragraph 147) is recommended in any mill that is likely to stay in any one place for at least twelve months.

(5) Very good Motors are available in the States for driving mills by water power (paragraph 151).

Even if the far-reaching proposals made in this chapter are approved and put into practice in new mills, it may be taken for granted that many mills now in existence will continue to take part in the conversion of timber. If the owners cannot be persuaded to make extensive alterations they would be well advised to adopt the following small suggestions :—

(*i*) To use Western Lumber Spreaders, Saw Guides and Lumber Rolls (paragraph 120).

(*ii*) To use Belt Tighteners (paragraph 148).

(*iii*) To instal Sawdust Conveyers (paragraph 145).

Mill plans.

158. The writer asked several manufacturers of sawmill machinery in Canada and the States to supply him with plans and estimates for, (1) Portable mills for cutting sleepers, (2) Permanent mills, Circular and Band. The replies received were generous. There has not yet been time to study the plans in detail but they may be expected to be very useful. All they can do, however, is to give a general idea of mill design and equipment. No manufacturer would think of putting forward final plans and specifications without more information than the writer was able to furnish, with regard to the following :—

(*a*) Size of logs and character of timber.

(*b*) Daily capacity or output desired.

(*c*) Nature of output (sizes, etc).

(*d*) Disposal of refuse.

The writer's belief in the efficiency and adaptability of Western machinery and methods can be very well summed up by stating that a Western manufacturer or mill engineer would not find it too hard a task to design a mill suitable for the multifarious sizes cut in a Teak mill in India.

Size of Mills.

159. The only operation visited by the writer in which the hauling from stump to mill is done entirely by animals (*i.e.*, without the use of steam skidders or railways or tractors), was the one near Portland, Ore, referred to in paragraph 154 and there stated to have a daily capacity of 15 tons (7,500 B. F.) chiefly in the form of S. G. sleepers.

In all the other operations visited power skidding or loading is combined with railway transport. The two largest mills were at Bogalusa, La, and Tacoma, Wash, respectively. In a ten hour day they can cut up 100 tons of timber. Working day and night, as they do when trade is brisk and labour is available, the output is the gigantic total of 2,000 tons.

The other mills visited ranged from 50 tons (25,000 B. F.) to 700 tons (350,000 B. F.) Most of the mills in the Eastern and Southern States range from 100 to 200 tons. On the Pacific Coast they varied from 200 to 400 tons; the smallest on a steam skidding operation being at Lamoine, Calif, with an output of 170 tons (85,000 B. F.).

The fact it is desired to bring out is that, the *minimum daily output for a mill on an operation worked by means of skidders and railways is about 100 tons (50,000 B. F.)*. The actual average is about 150 tons in the Eastern and Southern States and about 250 tons on the Pacific Coast. Duplication of smaller mills would amount to the same thing as one larger mill in respect of this question of Minimum output.

The following are details of daily output in four *Hardwood* mills visited by the writer, most of the sawing being down to small sizes (1″ stock) :—

Helena, Ark.	.. 1 Bandsaw	.. 55,000 B.F.	=110 tons of 50 c. ft.
Sardis, Miss.	.. 1 Bandsaw	.. 65,000 B.F.	=130 tons.
Charleston, Miss.	.. 2 Bandsaws	.. 150,000 B.F.	=300 tons.
Lacona, N. Y.	.. 1 Circular	.. 20,000 B.F.	=40 tons.

All sizes from 1″ and upwards are sawn in these mills. Assuming that half the outturn is 1″ and that the other half is from 2″ to 6″ in thickness, a conservative estimate for a hardwood mill in America would be 100 tons a day.

It should not however be taken for granted that it will be possible, and if possible that it will pay to try and get such a large outturn in India in a mill equipped with a single log saw.

There are reasons for supposing that the quality of Western sawing suffers from the machines being worked too fast (*vide* paragraph 165) and there would certainly be difficulty in getting men to work as fast as mill hands do in North America. The writer was repeatedly told in England that nowhere else in the

world can me: be found to exert themselves like they do in the West. This is perfectly true of men in British sawmills. They would promptly go on strike !

For a British Horizontal Log Bandsaw cutting hardwoods such as Elm and Teak, 1,000 to 1,200 superficial feet is looked upon as a good average per hour. This is equivalent to 20 to 24 tons (50 c. f.) of 1″ boards in a ten-hour day. With half the outturn from 2″ to 6″ in thickness, this average could safely be increased to 40 tons.

Lastly, there seems to be no valid reason why men in Indian mills cannot be expected to work faster than they do in England—like the coloured labour in the Southern States for example—and therefore the writer estimates that it would be safe to count on an all-round average of 50 tons a day for hardwoods such as teak, *and with the sawing fully up to the best British standard.*

In cases where the equality of the sawing is not of so much importance—for example in conversion into sleepers—there is no reason why a closer approximation to American averages should not be possible. With regard to the remark made in paragraph 152 about the mill at Fernwood, Idaho, that the output could be doubled by concentrating on sleepers, it is to be noted that the United States specifications for sleepers are easier than in India.

Workshop.

160. A good Workshop should be looked upon as an integral part of any sawmill project. *No portable mill should be installed without one.* Portable mills are usually in out-of-the-way places, and valuable time is lost if it is a matter of sending long distances every time repairs are necessary. From his experiences at the Government mill, referred to in paragraph 138, the writer could give several instances of the kind.

The following equipment for the workshop should be included in estimates for a portable mill —

(1) Screw Cutting Lathe, 3½″ to 4½″, 3 feet gap bed, treadle, and tools for wood and metal.

(2) Forge and blacksmith's tools.

(3) Carpenter's bench and tools.

(4) Taps and Dies (Whitworth and American).

(5) Saw Sharpening and Setting machine.

Some of the work on the lathe could be done by treadle, but it would not be a difficult or expensive matter to put up a small pulley to drive by the engine.

On such a lathe all the rolls required in the mill could be turned. There are so many tough woods to choose from in India, that it need not be taken for granted that rolls (live or dead) should necessarily be made of iron.

Section 12.—Development of Sawmilling in the United States of America and in Canada.

Notes on the Development of Sawmilling in the United States.

161. A few notes on the *Development of Sawmilling in the United States* are given below. It is hoped that they will prove to be of sufficient interest to justify their inclusion in this report. The notes themselves are very little more than extracts from publications by the United States Forest Service, the chief paper under contribution being United States Department of Agriculture Report No. 114, on "*Some Public and Economic Aspects of the Lumber Industry*," Part I, by William B. Greeley, Assistant Forester, published in 1917 :—

(1) In view of the fact that frame saws are so little used now-a-days in the West, it should not be forgotten that they formerly played an important part in the lumber industry, for, as Mr. Greeley puts it :—

> "Early in the 19th century numbers of large mills with many "up-and-down" saws under one roof were operated by water power, *
>
> * * * * * * * * *."

The author then goes on to trace the later development of the industry and he identifies it very closely with the extensions of railways. "The lumberman in many instances has been a pioneer railroad builder; and many "common carriers" of to-day were laid a few decades ago as part of a logging or sawmill enterprise."

* * * * * * * * *

"The distribution of lumber by rail rapidly developed large scale production, * * * With this appeared the very large, highly developed, sawmill and a more intensive organization of the industry."

(2) But there is another side to the story, for :—

> "Growing out of railroad development and the concentration of manufacture, together with the large toll usually taken by forest fires came the rapid depletion of stumpage, section by section, and the shifting of large scale production to new regions * * * * * Aside from the North-east, three or four decades seems to mark the life of large-scale production (of lumber) from each of the great forest regions."

The writer's own short experience tends to confirm this view. A question invariably asked about every operation visited was as to the length of time it was expected to last. In some cases the reply was under ten years, but in no case did it exceed 15 years, in the Southern States. On the Pacific Coast the period is expected to be longer, but even here a period can be put to large scale production; the life of the very big mills is severely limited. This fact is well shown on the accompanying chart (Plate XCIII), taken from report No. 114 in the office of the Secretary, United States' Department of Agriculture.

Chart of Lumber Industry in U. S. A.

The circles are proportional to the estimated "Stand" in each region, the "capacity" of mills is indicated by the sectors (black unshaded), and the actual cut by the black portions only.

Map copied from U. S. Department of Agriculture, Secretary's Report No. 114.

(3) One of the most striking facts mentioned by Mr. Greeley is the great disparity between mill *Capacity* and *Output*.

> "The most striking fact brought out by these satistics is the installed capacity of the sawmills in the United States, 117,486,000,000 feet per year. This is 71·5 billion feet or 160 odd per cent. greater than the largest amount of lumber believed to have been produced in any one year, 46 billion feet in 1907. * * * * * * * Whilst all the mills did actually manufacture lumber in 1909, a portion of them have undoubtedly been dismantled subsequently or become out-of-date, so that they could not again produce lumber at a practicable cost. Others have exhausted the supplies of timber available to them and thus have been eliminated as factors in the future cut of the country. The yearly destruction of sawmills by fire is relatively heavy. On the other hand, a certain number of new mills have been built since 1909. * * * * * * * * * There can be no question, however, that the lumber industry is equipped to produce at least 50 per cent. more lumber than it has actually cut and marketed at any time in its history. * * * * *."

In other words, lumbermen do not in practice cut it fine in the matter of mill equipment; they do not hesitate to scrap out-of-date machinery, and they aim at having plant large enough to meet the heavist demands of the market, even if saws have to stand idle during periods of depression.

(4) The following table is compiled from Mr. Greeley's report :—

Classification of Mills in United States of America in 1909.

Class, Annual production B. F.		Daily production Tons (50 c. ft.)	No. of mills.
I(*a*)	Under 50,000	Under ·4	4,543
I(*b*)	50,000 to 500,000	0·4 to 4·0	28,459
II	500,000 to 1 million	4 to 7	6,468
III	1 to 5 millions	7 to 36	5,443
IV	5 to 10 millions	36 to 73	783
V	Over 10 millions	Over 73	888
			46,584
	Adding 3,154 idle mills, the total number	....	49,738

The estimates of the "stand" of merchantable timber in 1914 amount to 56 million tons; the "capacity" of the mills then existing (42,041) at 2·4 million tons,

and the actual cut in that year at three-quarters of a million tons. If all the mills were worked to their full capacity the "stand" of 1914 would only last for 25 years, and under the then actual conditions as to the rate of cutting it should last three times as long (75 years).

(5) The foregoing figures relate to the country as a whole. They may be compared with those given below for the States of Washington and Oregon, taken from statistics published recently by the U. S. Forest Service :—

Production of Mills in the States of Washington and Oregon in 1917.

Class.	No. of mills.	Total production Tons (50 c. ft.)
I (*a*)	?	?
I (*b*)	318	136
II	112	148
III	178	791
IV	57	852
V	182	11,653
Total	847	13,580
Idle mills	113	..
TOTAL	960	13,580

These tables show that large mills preponderate to a much greater extent on the Pacific Coast than elsewhere. The disparity would be shown to be still greater, if Class V did not cover such a wide range. It includes mills with an annual output of anything from 10 to 200 million Board Feet. As noted in paragraph 159, the average size of mills on the Pacific Coast is double that in the East and South.

The inference drawn from these figures is that, for the purpose of studying operations of moderate dimensions, either in the forest or in the mill, attention should be directed to the East rather than to the West.

(6) Referring again to Mr. Greeley's report, on page 6 :—

> "Concentration of manufacture in regions of large forest resources is reflected in one type of lumbering operation; rapid exhaustion of those resources is reflected in another type. When the bulk of the timber is cut and the large mills move on, the small mills characteristic of the pioneer days return, working on the odds and ends of virgin stumpage, on the less valuable species which their larger predecessors

may have utilized only in part, and, as time elapses, on second growth. In portions of the United States where economic conditions never favoured the development of large operations and good local markets give the small mill a further advantage, as in central New England, it has never been displaced. Everywhere it tends to become the permanent unit in forest industry, as in the older countries in Europe."

It is to be noted that the possibility of a revival of interest in the small mill is largely due to the great improvements in its sawing appliances, which have taken place since the day of the "up-and-down" saw driven by water power. The modern portable mill with its log carriage and double edger is a remarkably efficient machine of a very different kind to its prototype in the Western Hemisphere or its contemporary in the Eastern one.

Mills in Canada.

162. It is a matter of regret to the writer that the information collected about mills in Canada is rather meagre. Bulletin No. 62-D of the Forestry Branch of the Department of the Interior Canada, is a *Directory of Sawmills* in existence in 1916. The following is a summary:—

Sawmills in Canada in 1916.

	No. of Mills.
Nova Scotia	362
New Brunswick and Prince Edward I	280
Quebec	1,003
Ontario	661
Manitoba, Alberta and Saskatchewan	89
British Columbia	229
Total	2,624

Bulletin No. 19 issued by the Forest Branch of the British Columbia Government puts the provincial total at 323 mills.

Section 13.—NOTES ON BRITISH SAWMILLS.

163. The writing of a general description of Western sawmills is a comparatively simple matter because all the mills possess such a strong family likeness. It is only in details and in scale that there are differences. The ground plan is drawn on the same lines everywhere. One reason for this uniformity of design is that lumbermen have ably seconded the efforts of manufacturers of machinery by showing no hesitation in scrapping out-of-date machines.

Everything connected with sawmills in Great Britain is just the opposite to the above. There is no standardization, either in machine design or in mill plan.

Owners of ancient types of machines cling to them. Labour saving devices do not go very far.

General design of British Log Mills.

One of the chief reasons for the great difference is that the demand for log mills is nothing like so great as it is in North America. Although there are thousands of sawmills in Great Britain, yet the percentage of log mills is insignificant, because the country depends so largely on imported timber, which only needs re-sawing.

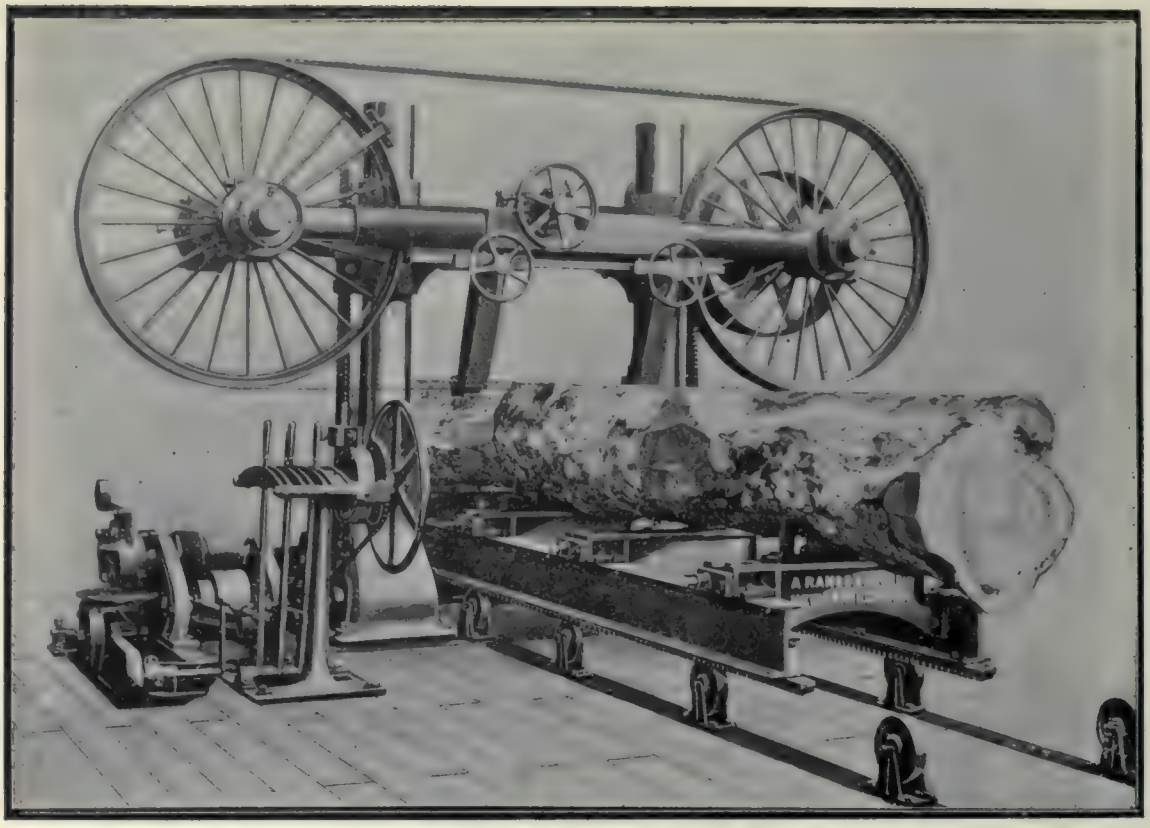
The breaking down of logs is confined to the conversion of Home Grown Timber, a minor industry in modern times, as the War soon showed. When the sudden demand arose for British timber, the capacity of existing logs mills was found to be quite inadequate. Not only were hundreds of temporary mills put up by the Department of Timber Supplies, but Canada undoubtedly saved the situation by sending over the Canadian Forestry Corps equipped with mill machinery similar to that already described.

164. The appearance of the general run of British log mills can be gathered from paragraphs 118, 135, 137, 139 and 146, as the remarks therein made about plain rack feed log tables, Frame Saws and man handling of lumber, apply as much to Great Britain as they do to India.

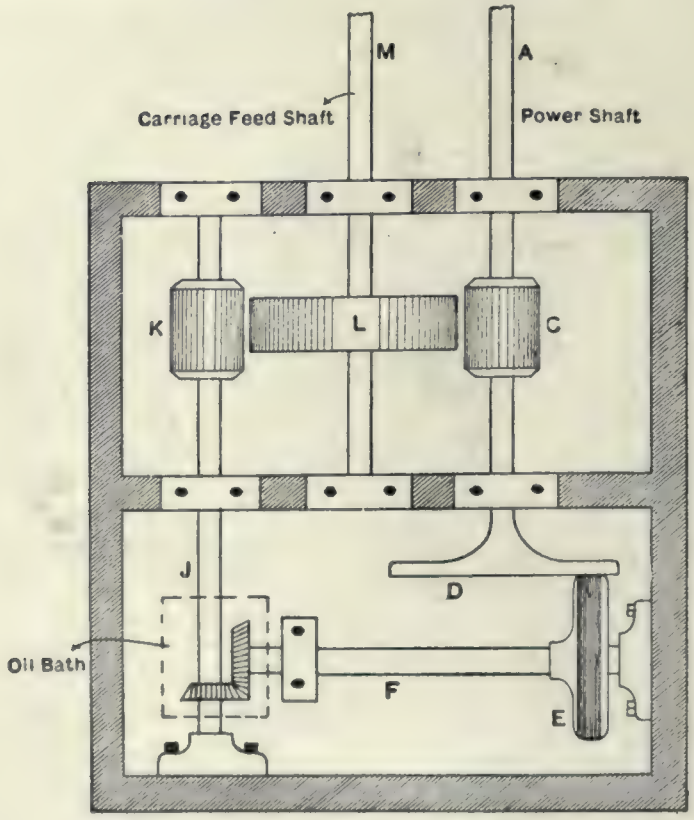
The timber trade at home has undoubtedly been slow in recognizing that it had anything to learn about log sawing. Old established customs die hard. At the same time it would not be fair to attribute this state of affairs to lack of initiative on the part of manufacturers of sawmill machinery. They have certainly not been backward in studying Western machine design, and perusal of their catalogues will show how ready they are to profit by Canadian and American experience. Log Carriage, Bandsaws, Inserted Teeth, Swage Setting, Friction and Rope Feed, Saw Guides, Disc Spreader, Lumber Roll and Double Edger all find a place in home catalogues now-a-days.

The demand for the "*Colonial Log Carriage*," as it is called, is not, however, a very great one. The plain travelling table (Plate LXXII, paragraph 118), still holds its own as general favourite. This appears to be due, as much as anything, to the deep rooted objection of the British workman to work at a pace which would make it worth while to have quick acting "dogs" and "setworks."

The "*Setting*" *of Saw Teeth* has probably given rise to more controversy than any other detail of sawmill equipment. The old plan was to bend the teeth alternately to one side and to the other (*Spring Setting*). Long ago, in North America, the idea was developed of flattening out every tooth so as to project on both sides of the blade equally (*Swage Setting*). For many years this method has been practically universal for log sawing in the West, but it is not by any means so generally popular in Great Britain. Many men can still be found to condemn it. As late as 1912 one of the leading manufacturing firms recommended spring setting for its horizontal bandmills. To-day, the same firm advocates swage setting.



(1). Horizontal Bandmill of British Design.
(By permission of Messrs. A. Ransome & Co.)



(2). Variable Friction Feed Gear of British Design.
(By permission of Messrs. A. Ransome & Co.)

One good way of comparing the two methods is as follows. The swage tooth saw has double the number of cutting edges to the spring tooth saw, so that, for the same amount of work, it should theoretically last twice as long without re-sharpening.

The *Double Edger* is not much in demand for another and more logical reason. It is not the custom to trim the edges of hardwood planks straight from the log. The rough edged planks and boards go back to the yard or shed, and are ultimately sold without being trimmed at all.

In one respect there appears to be no desire whatever to assimilate Western practice. *Live Rolls and Chain Conveyers* find no place in British sawmills. Logs and lumber are either moved about by hand or by overhead travelling cranes (gantries).

In a mill specially recommended to the writer as being one of the best run mills in England the owner pointed with pride to the raised and sloping *Log Deck* (paragraph 92) the idea of which had originated in a visit to the States. This little incident is mentioned as showing that this useful and yet simple contrivance is by no means common at home.

Criticism of Quality of Western Sawing.

165. The general opinion in England with regard to timber imported from Canada and the States is that the quality of the sawing leaves much to be desired. Planks are not sawn true, the thickness is not uniform. In consequence of this, there is considerable waste in re-sawing and planing.

The writer does not believe that this poor standard of sawing can be put down to defects in the sawing appliances, as too high praise cannot be given to them. The fault appears to lie in the excessive speed of working the machines. Everybody is so keen on a big output, that the " setworks "operator is apt to be rushed and the sawyer is inclined to feed the log to the saw too fast. It apparently pays to let it be so, and until the lumberman in the West realizes that his supplies of logs need to be husbanded he will continue to give the purchaser of his timber more than he wants and more than he pays for. To make the matter clear a few words may be given about the working of bandmills.

American Bandmills.

Readers who have never been into a modern sawmill may not be aware of the fact that the wheels on which bandsaws are mounted have no flanges. When a log is being sawn it exerts considerable pressure on the saw. The amount of thrust that the band can stand, without slipping back off the wheel, depends simply on the tightness of the band itself.

As the rate of sawing is one of the chief things thought about in America the development of bandsaws has naturally been in the direction of bands capable of withstanding the greatest possible thrust and of being run at the highest possible speed. Results are prodigious. Heavy gauge bands over 50 feet long and 14 inches wide are quite common. Even they are not the biggest that are made. A saw of such huge dimensions must be strained very tightly on the wheels, and it can readily

be understood that it may have plenty of time to cut crookedly (owing to excessive feed) without the sawyer being sharply reminded of the fact by the band leaving the wheel.

British Bandmills.

(10) The development of British bandsaws has been on different lines. The aim of the manufacturer has been to produce a machine capable of doing *fine sawing*, because wood of any kind is too valuable to waste unnecessarily. He has been materially helped by the fact that everybody is accustomed to a much slower rate of working in sawmills.

The net result is that the largest British bandsaws are not more than half the thickness or width of the largest Western ones. Plate XCIV is an illustration of a bandmill capable of cutting logs 6 feet in diameter. The saw itself is only 6 inches wide.

Comparison.

The conclusion to be drawn from a comparison of the relative merits of the two classes of bandmills is as follows. For the sawing of valuable timber, such as teak, etc., and for any kind of timber if dimensioned sawing is of importance—as, for example, in flooring boards—British practice is preferable in spite of the smaller output.

But, for less valuable woods and where exact sawing is of less importance, as for example in sleepers, American practice may be found to pay better, owing to the larger outturn.

Vertical and Horizontal Bandmills.

In America all log bandmills are vertical (*vide* Plate LXXVI, paragraph 125). In Great Britain both vertical and horizontal ones are made, and of the two the horizontal mill is looked upon as the more up-to-date. The bandmills in India already referred to more than once are of this type.

From Plate XCIV it can be seen that the log is "dogged" by hand on the travelling table and that successive cuts are taken by raising and lowering the saw.

It would take too long to enter into a discussion of the relative merits of the two types. The writer's chief objection to the horizontal mill is that the fixing of the log in position takes so much longer. The same remark also applies to the turning of logs round for squaring purposes, etc. On the log carriage in a vertical mill much time would be saved.

Another point to be considered is the method of disposal of the planks and boards after sawing. More man handling is required if individual planks are to be removed as fast as they are sawn. If the planks are to be left untrimmed it is a common practice with the horizontal saw to leave all the planks untouched until the log has been finished, and then to put a chain round the whole pile and lift it off the carriage by means of an overhead gantry. The conclusion come to is that both types have their place. If live rolls, double edgers and trimmers are indicated, then *the vertical bandmill is to be preferred.*

166. As already remarked in paragraph 109, *Rack and Pinion Feed* gives place to *Rope Feed* in the West, although it is preferred at home. The objections to rope feed appear to be that the rope is apt to break or get slack. The writer does not attach much weight to either objection, and if British machines are ordered for India rope feed should be specified—single rope for light carriages, double rope for heavy ones.

Rack v. Rope Feed.

The writer has not had sufficient experience of them to justify him in expressing any opinion with regard to the Log Carriages (Colonial Type), Edgers, Trimmers etc., turned out by British manufacturers. It may without prejudice be stated that as competition is so much more severe in North America manufacturers there are more likely to pay close attention to the various details of design and construction. On the other hand, one example at least can be given in respect of which British manufacturers appears to have improved on American designs. The reference is to the variable friction feed illustrated in Plate XCV. It is a combination of the Friction Disc and Friction Wheel Feed mentioned in paragraph 112. The following are the chief details:—

Friction Feed.

The power driven Shaft (A) carries a fibre covered friction wheel (*c*) and a flat iron disc (*d*). The Shaft (*f*) carries a fibre covered wheel (*e*) which can be made to slide along the shaft by means of a lever (not shown). By means of Bevel Gearing enclosed in an oil bath, Shaft (*f*) communicates motion to Shaft (*j*) which carries a fibre covered wheel (*k*). Between (*k*) and (*c*), but not necessarily touching them, is the plain iron friction wheel (*l*) on the Shaft (*m*), which carries the Pinion or Rope Drum (as the case may be), by means of which motion is communicated to the carriage. By means of a second lever and eccentric bearings (not shown) wheel (*l*) can be brought into contact either with (*c*) or with (*k*). Connection is made with (*c*) for the reverse motion of the carriage, always at top speed. When contact is made between (*l*) and (*k*) the speed of the forward motion of the carriage depends on the position of wheel (*e*). With regard to Disc (*d*) the nearer it is to the centre of the Disc the slower the feed. Disc (*d*) is held against wheel (*e*) by means of powerful springs (not shown) and there is no need to have recourse to slipping in order to vary the speed. The feed is therefore positive and less inclined to be jerky than by the slipping method. Why the disc method finds so little favour in the States the writer cannot say, for he was certainly very favourably impressed by a visit to a British mill having the Ransome Feed Gearing described above. In reply to an enquiry as to how long the fibre wheels lasted he was told that they had not been changed since the machine was first put up some 10 years ago. The writer is inclined to favour this type of feed for Bandsaws and for very hard woods in India, although, as already remarked, it is wonderful what good results are obtained in the West with the ordinary type of friction wheel feed, in which variations in speed are obtained by slipping.

In making the above remarks the writer does not wish it to be supposed that there is only one type even of this feed gear mechanism in the United Kingdom. There are other designs on the market, but as the writer could not find time to study them he cannot express any opinion with regard to them.

Section 14.—MANUFACTURERS OF SAW MILLS MACHINERY.

167. CANADA.

Waterous Engine Works Company, Brantford, Ont.

E. Long Manufacturing Company, Orillia, Ont.

Wm. Hamilton Manufacturing Company, Peterborough, Ont.

Heaps Engineering Company, New Westminster, B. C.

Saws.

Shirly Dietrich Company, Galt, Ont.

THE UNITED STATES.

Allis-Chalmers Manufacturing Company, Milwaukee, Wisc.

Clark Brothers Company, Olean, N. Y.

P. B. Yates Machine Company, Beloit, Wisc.

McDonough Manufacturing Company, Eau Claire, —Wisc.

Diamond Iron Works Company, Minneapolis, Minn.

Summer Iron Works Company, Wash.

Wheland Company, Chattanooga, Tenn.

Lufkin Foundry and Machine Company, Lufkin, Texas.

Lane Manufacturing Company, Montpelier, Vermont.

Frick Company, Waynesborough, Pa.

American Sawmill Machinery Company, New York City, N. Y.

A. B. Farquhar and Company, New York, N. Y.

Matthews Gravity Carrier Company, Ellwood City, Pa.
Dow Wire and Iron Works Company, Louiseille, Ky. } (Gravity Conveyer)

Saws.

Henry Disston and Sons, Philadelphia, Pa.

E. C. Atkins and Company, Indianapolis, Ind.

Simonds Manufacturing Company, Fitchburg, Pa.

Water Motors.

Pelton Wheel Company, New York City, N. Y.

S. Morgan Smith Company, York, Pa.

Platt Iron Works Company, Dayton, Ohio.

THE UNITED KINGDOM—*concld.*

A. Ransome and Company, Newark-on-Trent.

Thomas Robinson and Son, Rochdale.

John Pickles and Son, Hebden Bridge, Eng.

John McDowall and Sons, Johnstone, Scotland.

Amongst smaller firms the following may be mentioned as makers of a very good type of Rack bench :—

Stenner and Gunn, Tiverton, Devon.

Saws.

In addition to the firms listed above ; the following has come to the notice of the writer :—

Drabble and Sanderson, Sheffield.

NOTES.

Any of the firms in the general lists would be prepared to put up plans and estimates for complete installations if desired, although for large mills, the choice of firms is more limited.

A good deal of American machinery finds its way into Canada, but Canadian mill machinery does not go into the States. Large mills built by Allis-Chalmers Manufacturing Company and by Clark Brothers Company are to be met with all over the United States and Canada.

The large demand for small mills in the Eastern States finds business for several firms, only a few of which have come to the notice of the writer, and therefore find a place in the foregoing list.

The profusely illustrated catalogues published by the different firms deserve to be carefully studied. Unlike the catalogues of British Manufacturers of sawmill machinery, they show minute details of the mechanism of the principal machines, so that a practical man can form an idea of their value from the illustrations and descriptions alone. No patents lie in log carriages, saw frames, edgers etc., in general ; manufacturers look for business by the patents they hold in particular parts.

A large number of British firms make saw-sharpening machines (*vide* advertisements in the Timber Trades Journal). British and American manufacturers both claim for their saws and sharpening machines that they are superior to any others. The writer is not expert enough to express an opinion in the matter.

Leete, Frederick Alexander
Lumbering and wood-working industries in the United States and Canada