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APPLICATION OF MECHANICAL POWER IN CROSS TIE PRODUCTION

By C. J. TELFORD
Small-Mill Specialist

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APPLICATION OF MECHANICAL POWER IN CROSS TIE PRODUCTION[1]

Starting With 21 Percent in 1913, Treated Sawed Units Now Exceed 50 Percent of Total

By

C. J. TELFORD,
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Tie production in the United States is steadily becoming mechanized. This increased use of mechanical power in the manufacture of ties is clearly indicated by Forest Service figures on the annual number of sawed and hewed ties treated with wood preservatives. The proportion of sawed ties treated, starting with 21 percent in 1913, now exceeds 50 percent. Tie hackers are in the main being replaced by small sawmills. The reason for this change is obvious. Sawed ties at the mill cost about the same as hewed ones scattered in the woods and have salvage possibilities in slabs and siding from the milling whereas hewed ties have none.

Another marked swing toward mechanization is that trucks are replacing wagons, both for transporting logs to the mill and ties from the mill to the loading point. Trucking costs per tie are less than that for wagon hauling, even at comparatively short distances. This gain has permitted operations in chances formerly beyond reach and is a point worth emphasizing in view of the prominence given to the displacement of wage earners by mechanization. In the tie industry and, in fact, in all the forest industries, the man-power saved through mechanization is expended in the need of operating farther from a central base. It can be shown that if the sawed tie replacements for our railroads in 1934 had been hewed and wagon hauled, it would have required about 2,500 more men from stump to railroad loading point. In 1928, it would probably have taken 4,000 additional men if it is assumed that sawmills operated wholly within the limits of wagon haul. Actually a cheapening of the production cost has mainly had the effect of extending operating zones. Thus mechanization, acceptance of formerly unmerchantable species, preservative treatment and the standstill in railroad expansion have gone a long way to insure the industry against a scarcity of tie timber. Tie stumpage at from 5 to 10 cents per tie is cheap as contrasted with prices paid for stumpage suited to lumber production.

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[1]Presented before 1936 Annual Convention of The Railway Tie Association at Cincinnati, Ohio, on May 21, 1936.

A broad base of relatively cheap stumpage is but one of several substantial advantages enjoyed by tie producers. The number of species now acceptable for ties is greater than in former years and is becoming even greater with increasing knowledge of the mechanical and physical properties of wood. The tolerances now permitted in tie sizes are generous, degrade as the result of drying is almost nonexistent, and among other advantages ties are sold in well-defined and responsible markets involving a minimum of sales expense and loss from defaulted payments. Finally, tie production is not yet bedeviled with competitive materials. The foregoing favorable conditions invite intensive competition among producers, particularly when initial investment requirements are low. Ties are therefore being sawed on almost every conceivable type of mill down to the vest-pocket mill weighing 700 pounds and powered with an old automobile engine. Predominantly small tie mills weigh between 3,000 and 4,000 pounds, and are operated by four men. Such mills saw from 200 to 300 ties per day. Mills one size larger, weighing approximately 5,000 pounds and operated by seven to nine men, are common. A mill operated by seven men produces up to 600 ties per day.

The general scheme in tie production is to contract with independent small-mill operators to saw your stumpage or you to buy their output. These men usually lack information as to the merits of the 70 odd small mills on the market, particularly as to the power capacities of internal combustion engines. A project to supply such operators with definite information on the efficient operation of small sawmills is now a definite part of the research program of the Forest Products Laboratory. Some of the information assembled in the course of this work may have a bearing upon tie mill operation.

As to mill selection, there are several cogent reasons for the choice of a portable circular over a portable bandmill. The main advantage of a bandmill over a circular mill is, of course, its thinner kerf, but in tie production this advantage is discounted by the comparatively few cuts made. In addition, the circular mill is simpler to keep in shape and to move, has relatively low initial cost and with an insert-point saw can be kept in operating condition by semiskilled labor.

Most concerns making small mills produce a good model for light work weighing from 3,000 to 3,600 pounds. The mandrel varies between different makes within the limits of 2-3/16 to 2-7/16 inches in diameter and the saws range from 44 to 52 inches in diameter. Many concerns produce a mill in the next heavier class, weighing between 4,000 and 6,000 pounds, and carrying a 2-7/16-inch mandrel. The foregoing are the two size groups usually found in portable operations.

For logs mainly less than 20 inches in diameter and a production of under 300 ties per day, the lighter mill has advantages. For larger logs or faster production, the heavier mill is more satisfactory. Certain modifications of standard equipment are used for tie mills. The short carriage, approximately 12 or 14 feet with two headblocks, is an example of such modification. Fitting the mandrel with a heavy fly wheel is another. The tie mills in the western states that are dependent on tractor power customarily use a fly wheel weighing 1,000 to 1,500 pounds and report a gain thereby of 25 percent in production. The heavy fly wheels require an oversized mandrel supported by three bearings instead of the usual two. The heavy fly wheel is especially suited to short log sawing and is one of the mechanization developments not generally taken advantage of by eastern operators.

A production of 300 ties per 10-hour day necessitates power enough to feed an 8-foot log through the saw on an average of one every seven seconds. An unloaded saw making 600 r.p.m. will when loaded make only 450 r.p.m. with a standard gasoline tractor. Powered with a steam tractor, the speed when carrying no load is about the same as that of a tractor powered with gasoline, but when carrying a load the speed of a steam powered tractor is faster.

To produce 600 ties a day requires enough power to feed an 8-foot log through the saw on an average of one every three seconds. The saw when unloaded need not make more than 550 r.p.m. and when loaded not more than 520 r.p.m. At least 40 horsepower are needed to run the headsaw and edger. These power statements apply to belt horsepower. The power ratings given in catalogues for both steam and gasoline engines in many cases do not give belt horsepower. Most millmen assume that they have the catalogue power on the belt when in reality they have a much lower one. For instance, figure 1 shows the piston head horsepower for 19 models and five makes of steam tractors. These values were obtained by substituting the specification given in trade catalogues in the standard formula $\frac{Plan}{33,000}$ = horsepower. The H scale represents boiler pressure and the V scale horsepower. Figure 1 clearly indicates that considerable variation may exist between the catalogued horsepower and the power available.

It may also be noted from Figure 1 that there is a drop of approximately 10 horsepower between running at low pressures and at high pressures. The upper five curves show that the performance as catalogued at the maximum steam pressure is about 10 percent less than that at the pressures usually carried in operation. In the smaller steam tractors as represented by the lower set of curves, some glaring differences show up. For example, the curve labeled 20 and 65 shows the performance of two steam tractors, one of which was catalogued as having 20 horsepower and the other 65 horsepower. Actually these tractors give between 20 and 25 horsepower. The curve labeled 20 and 50 shows that the performance of two tractors that were catalogued as giving 20 horsepower and 50 horsepower, respectively, actually deliver only 18 horsepower.

Similar differences between actual and catalogued power ratings are found in gasoline engines. Power is emphasized here chiefly because most small mills have insufficient power at the saw. Some of the fault lies in poor transmission, but too often it is inadequate power at the beginning.

Equipment considered satisfactory for a mill manufacturing 600 ties a day consists of a short carriage with two headblocks, patented dogs and space for the setter to ride the carriage. The husk should have three boxes and should support a mandrel at least 2-7/16 inches in diameter by

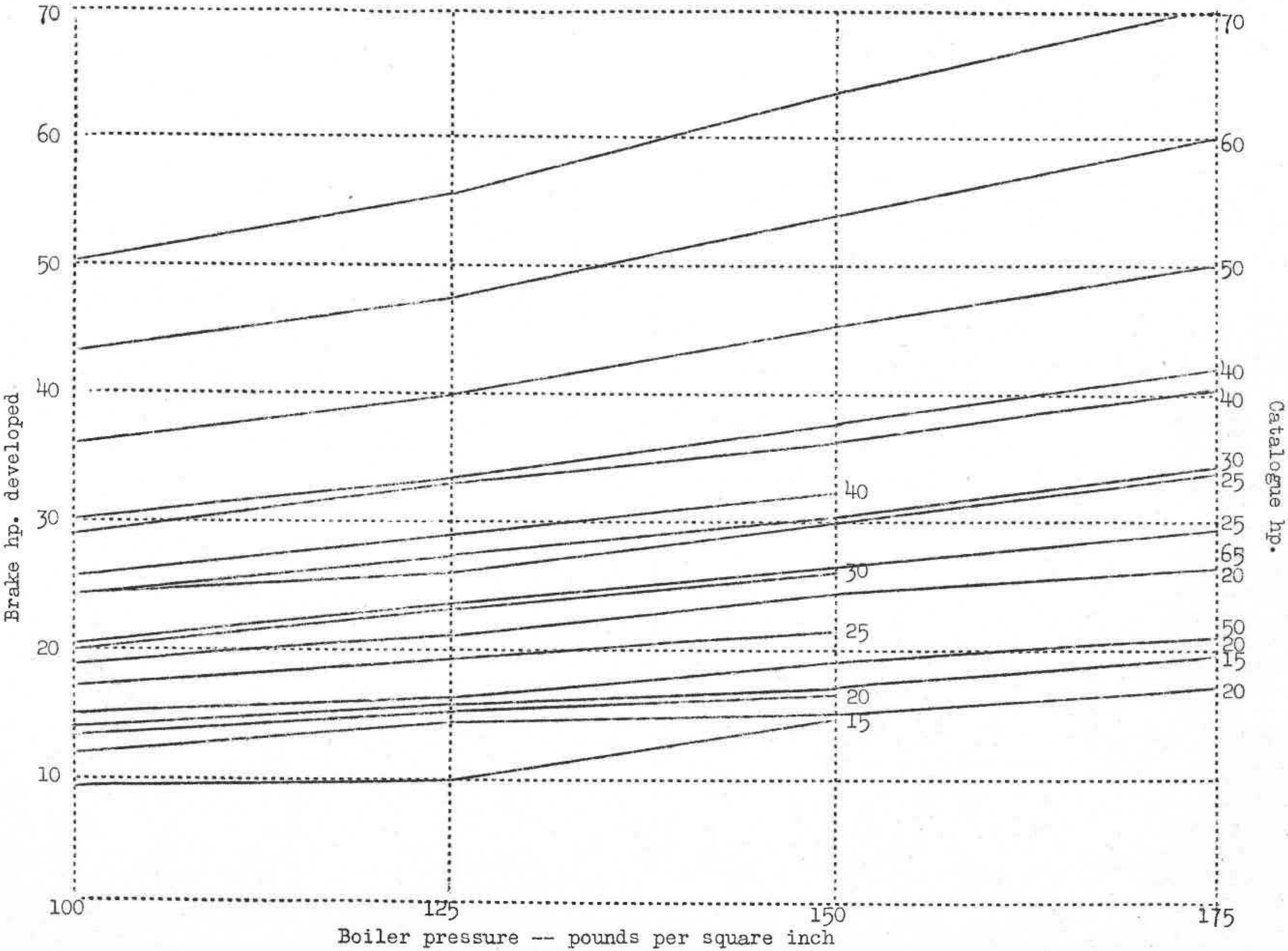
Catalogue hp.
70
60
50
40
40
30
25
25
65
20
50
20
15
20
40
30
25
20
15
Brake hp. developed
70
60
50
40
30
20
10
100
125
150
175
Boiler pressure -- pounds per square inch

Figure 1.

10 feet in length. The mandrel should carry a 1,000-pound fly wheel and a saw no larger than needed to go through the wider cuts. The saw should run at approximately 550 r.p.m. If a composition drive belt is used it should be 5 ply. If a leather drive-belt is used it should be medium single and 12 inches wide. The feed-works belt in a short log mill is subjected to severe strain and should therefore be at least 6 inches wide. Man-power is saved by the use of a two-saw edger and approximately 50 feet of dead rolls having a down-grade slope of about 2 inches to each 10 feet of horizontal travel. The power unit, whether electric, steam or internal combustion, should deliver 50 horsepower to the belt. In the event the power unit is equipped with a direct drive it also should deliver 50 horsepower.

There are several promising new developments in sawmill equipment that may have application to the tie industry. For example, research in metallurgy has progressed to a point where saw manufacturers could probably equip tie operations with saws that will stand up days instead of hours between sharpenings. Sawmill manufacturers can now provide both circular saw and bandmills mounted on wheels. A mobile bandmill is being designed at the Forest Products Laboratory in which the saw moves over the stationary log in order to minimize the length of the mill. Perhaps the most revolutionary possibility of the new developments is in the automotive field. The replacement of petroleum fuels by wood, coal, cane and other carbons in internal combustion engines is being rapidly brought from the visionary to the practical plane. There is a possibility that both trucks and sawmills may be powered either by burning chips or charcoal in lieu of gasoline. In fact, such equipment is already employed in some European forests. The generating mechanism in use in this type of equipment in Germany consists of a fuel chamber holding chips or charcoal, a firebox with a controlled air intake at the top and a container which removes the solid impurities. Some of the gases generated from the burning fuel and air pass down through the fire zone and in the intense heat of this zone are converted into readily combustible gases. When used with mobile units, the gas is taken directly into the cylinders as it is generated.

The power saw is another development worth watching. There are possibilities of developing a power saw by means of which two men can fell a tree, buck it up and rip off the slabs. It appears as still visionary to combine the crosscut and rip stroke for a chain saw type of tooth, but it is being done in Europe, as at least one foreign manufacturer shows an illustration of the operation.

Returning from tomorrow's possibilities to today's realities, there is a considerable list of labor-saving devices having application to special conditions and types of operations, such as power slab conveyors, tie loaders operated by tractors, power hoists and drag lines for logging. A light cable-logging device is being designed at the Forest Products Laboratory based on the idea of hooking logs to a continuously moving cable and bringing them from the woods direct to the deck.

Efficient equipment is only one of the factors that determine successful and economical operation of tie operations. In addition to good equipment, there must be a definite knowledge of how far a producer can afford to haul his ties, and of how much his costs are boosted by obscured items, such as depreciation, capital requirements, taxes, insurance, and equipment maintenance.