THE DEVELOPMENT OF CHAIN SAWS
IN THE DOUGLAS-FIR REGION

by

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SUMMARY

One of man's earliest tools was a crude hand saw. Because there was a need for a better method of sawing, this crude implement developed through a process of trial and error to a highly technical, mechanical saw. This mechanical saw, the chain saw, saves not only labor but money. Although there are a few drawbacks to this chain saw, the advantages are, by far, so important that the disadvantages are practically negligible.
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THE DEVELOPMENT OF CHAIN SAWS
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INTRODUCTION

This report, "The Development of Chain Saws in the Douglas-Fir Region," was written to show the difficulties encountered in trying to develop a machine of this type in a region of this type.

This report will be limited to the development of power saws since 1876; it will include some of the mechanical and technical advances used in the present saws. The position the power saw plays in modern logging will be discussed in relation to the economics and the criticisms of the power saw.

EARLY HISTORY OF THE SAW

The saw, one of man's earliest known tools, dates back to the Stone Age. Like other implements of this age, the saw was made of stone. This saw was made of teeth chipped in small flakes of flint; these saws were seldom over three inches long. As man's needs increased, he developed the saw by mounting these flint chips in a groove on a stock of wood. This development was universal: The South Sea Islanders made their saws from sharks' teeth, the Carib Indians made their saws from notched shells, and the Mexicans made their saws from teeth of obsidian.
With the Bronze Age came corresponding developments in the saw; however, bronze was so soft for saw teeth that it was not much better than the stones previously used. It was only when iron came into use for tool construction that the saw became universally important. Today steel is the only metal which can withstand the strains and manipulation necessary for the use and the manufacture of saws.

DEVELOPMENT OF THE MECHANICAL SAW SINCE 1876

Ransome Saw

The power saw dates as far back as 1876, when the Ransome Company experimented with a steam-driven saw similar in principle to the drag saw. Power for this mechanism was transmitted by hoses from the boiler, which was mounted on a horse-drawn sled, to the piston of the saw.

Power Chain Saw

In 1905, a power chain saw was introduced. The chain method of cutting was new then and the idea was taken from the German army hand chain saws. This power saw did not use any cutter bar as the present ones do, but instead had an idler pulley on the end of the chain opposite the motor. A marine-type, two-cylinder, water-cooled engine set at 90° from its normal position was used. Water and gas were supplied by storage tanks suspended on the trunk of the tree above the engine. The tanks had to be removed when the tree was about to go over. This saw once cut through a ten-foot log in four and one-half minutes.
Pitman Saw

The Pitman-type saw was invented in 1918. It had a two-cylinder, two-cycle, six-horsepower engine which was mounted on a sled 4-1/2' X 6'. The blade cut on the return stroke and had twice as many teeth on the back edge to keep it from pinching. It weighed 210 pounds and thus was not very mobile. It was designed primarily for the relatively flat, open ground of the Red River Region of Northern California and was not suited for the rough topography of the Douglas-fir region. This saw could fell 80,000 board feet in ten hours.

Timber Felling Problems

At this time two problems stimulated the further development of power saws: 1. There was a steadily diminishing supply of timber fallers. The old experienced fallers were leaving the field and seeking less arduous jobs. Young men were no longer being attracted, in the present mechanical age, to the hard manual labor of hand felling. The untrained Europeans were the chief source of this continent's heavy manual labor supply. This was particularly true in regard to the heavy labor of felling and bucking by hand. The cessation of immigration in the late 1920's stopped this source of applicants. (2:70)

2. The ground conditions of many of the logging operations became more difficult for working as a considerable number of the operators went farther and farther back into the hills for smaller timber. The result was that the average man-cut per day by fallers and buckers was steadily decreasing. (2:70)
The answer to both of these problems was the same. The employers must either attract more men to the job or increase the efficiency of the fallers and buckers to such an extent that they would once again cut as much timber per day per man on the rougher ground with the smaller timber as they previously cut on the good ground with the better timber.

World War I

World War I brought many new ideas to the felling profession. Some of these are listed below:

1. A wire rope was invented which cut through the tree by heat of friction as the wire was drawn rapidly past the wood.

2. On the same order a rope saw was developed consisting of a spiral, fluted, two-way cutting steel rope. It was attached to cables from a double drum winch, and the rope was run rapidly back and forth from one drum to another cutting the tree in passing.

3. Entirely different was the red-hot, electrically charged wire that was supposed to fall trees by burning through the wood.

4. One system that was at least discussed, if not tried, was a device consisting of a series of augers that could cut into a tree below the ground level, thus eliminating the obstacle of the stump.

5. Another device was a long roller equipped with cutting teeth mounted on the end of a driven shaft. It could swing in a horizontal arc and could cut its way through a tree.

6. Many types of circular saws were invented, but not used because of their awkwardness. (1:150)

English Steam Saw

Soon after the war a steam-driven drag saw, similar to the one of 1876, was manufactured in England. The boiler was on wheels and the saw portion was carried by hand. The tree feller alone weighed
600 pounds. This steam saw could not be adapted to our steep Douglas-fir region.

Drag Saw

Our region then looked to the south and the success our Southern neighbors were having with the drag saw in the redwoods. The redwoods are big trees, and a gang of fallers would often cut only one or two trees a day. They could, therefore, well afford to spend an hour or two hours or more for building a platform and making other preparations for setting up for falling with their heavy, cumbersome, and relatively slow-cutting drag saw. In the Douglas-fir region the average was about 15 minutes per tree by hand felling. The Douglas-fir region needed a machine that could be carried quickly, that needed no elaborate set-up, and that could fall on arrival. (9:62)

Chain Saw

The chain saw seemed to show the greatest promise in the mid-thirties. The two types which were favored were the "Wolf" and the "Dow." Both had good points, but could not be trimmed in weight and still remain good saws.

Electric Saw

A capable electric saw came out in 1935. The advantage of the electric power saw was the high initial torque and the instant starting. The drawback was the three-phase cable that had to be dragged through the woods.
Requirements of a Good Saw

Through all the earlier experiments with mechanical saws, it was concluded that the proper saw for this Douglas-fir region must meet these requirements:

1. It must be a chain-driven saw.
2. It must be light weight. (Not to exceed 125 pounds.)
3. It should be fast cutting.
4. It should be sturdy and dependable enough to resist the rough usage it would receive in the woods.
5. It must be as efficiently simple as possible so the average man could perform minor repairs with little loss of time. (2:73)

Stihl Saw

A saw that most nearly fulfilled these needs was the Stihl saw manufactured in Germany. It was equipped with a high-speed, single-cylinder, two-cycle engine and weighed only 120 pounds. This saw was designed for casual cutting and could not withstand use in mass production logging of the Douglas-fir area. Yet with close coordination between the manufacturer in Germany and the users here on the coast, engineers overcame most of the saw's faults, and the saw became popular in this region. When the outbreak of World War II stopped all shipment of saws and saw parts from Germany, this machine was duplicated almost exactly by a Canadian company.

From the time of the introduction of the Stihl saw to the present, competition has greatly aided the further development of power saws.
POWER SAWS OF TODAY

Weight - Horsepower Problem

The main problem in the development of power saws is the weight - horsepower ratio. To reduce the weight, lighter metals have been used in different parts of the engine. To increase the horsepower, gas with a higher octane rating (90-110) is being used.

Chains

The chain is an endless series of stamped steel links that rides in a groove on a bar. Different types of cutting links (see appendix) are attached to this chain. The cutting link is composed of two parts: the chipping tooth and the depth gauge. On some cutting links the depth gauge is omitted because the chipping tooth does not have a chiseling effect. The chains are kept at proper tension either manually or by automatic chain tensioners. The proper tension of this chain must be maintained in order to minimize the wear on the bar.

Bars

The bar of the chain saw is that portion of the saw which supports the chain. It consists of a flat elongated piece of steel with a groove in the edge which guides the chain. There are two main types of bars: the beavertail and the bow bar. The beavertail bar is the familiar straight bar that is the most common in this region. The bow bar is one which returns the chain outside the cut to prevent it from being jammed by the pinching log. (See appendix.)
Transmissions

The transmission is the intermediate part between the motor and the attachment. It is used to change the speed of the engine to the desired speed of the saw. Most saws have a gear reduction of 4 or 5 to 1. This gives the saw more power at the chain.

Clutches have varied from the early manually operated type to the present automatic centrifugal type. The manufacturers now set the clutch to engage at about half-speed so the saw will come to a complete stop when the engine is at idle. If the saw should bind, the clutch will slip and there will be no damage to the engine or to the saw.

Engines

The most common engine for power saws is an air-cooled, one- or two-cylinder, two-cycle engine, and develops from three to twelve horsepower. The four-cycle engine is not preferred because the extra valve assembly increases the weight. Chromium plating is used on either the piston or the cylinder wall to decrease the wear from friction. It also provides maximum heat dissipation.

Carburetors

Carburetion for chain saws has always been a major problem because the saw is run in many different positions. The earliest chain saws used a gravity feed system. With a carburetor of this type the engine could not be run in an inverted position. Today many saws are using a diaphragm carburetor which will work in any position. The only argument against this type is that the high speed of the working parts subjects the carburetor to greater wear.
Economics of Power Saws

In 1940, the power saws were breaking even with hand-felling methods on direct costs and were well ahead in indirect costs. Nine years later, in 1949, there was a direct saving of 19.7% in favor of the machine. (2:75)

Some of the indirect savings which must be considered are:

1. The fact that one-third fewer men were needed in this hazardous occupation.

2. The rapid cutting of timber shortened the time the timber must lie on the ground. This reduces the chance of fire and insect damage.

3. The reduction of danger also reduces the insurance rates.

4. The power saw men suffered 40% fewer accidents per million board feet than did the hand fellers. The break-even point on man hour exposure would have been 33-1/3%. (2:75)

Criticism of Power Saws

Power saws were criticized at first because of the excessive amount of broken timber. The belief that the power saws caused excessive breakage was disproved by a survey of 60 thousand board feet cut by hand and 90 thousand board feet cut by machine. Although the results did favor hand methods, it was only by 1/5 of 1%. (9:62)

One may conclude from this that breakage depends upon human skill and judgment rather than on the equipment used.
Presently, the chief disadvantage of the power saw is that the operators are subject to more accidents such as:

1. Sprains and strains from carrying and working with a heavy saw.
2. Being cut by contact with the chain while the chain is in motion.
3. Injuries incurred while starting the motor.
4. Inhaling exhaust gas.
5. Being struck by wood from overhead due to the vibration caused by the saw.
6. Getting sawdust in the eyes.
7. Burns from contact with the hot muffler or cylinder head.
8. Injuries caused by saws "kicking back" when in a bind.
9. Injuries caused by not being able to hear warnings above the noise of the engine.

**SUMMARY OF CONCLUSIONS**

The chain saw was conceived and developed about the time other logging equipment was undergoing the change to mobility. It fitted the needs of the employers who were trying to cut down the work hours and the heavy manual labor in the woods. It fitted the work for it was light -- yet rugged, powerful -- yet economical, fast -- yet efficient. The chain saw is a fitting partner to the many labor saving devices employed in the woods.
APPENDIX
BIBLIOGRAPHY


Saw not stopped by pinching action.
Types of Chains

- Chipper Chain
  - Cutting portion
  - Depth gauge
- Crosscut Chain
- Chisel Chain
COMPARISON OF HAND & MECHANICAL FELLING COSTS (6)

COST PER M.B.F.

Increase in cost

Increase in Diameter

DIAMETER OF TREE

Crosscut Saw

Mechanical Chain Saw