

POWER SAWS
Their Development and
Application to Felling and Bucking
by
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A Thesis
Presented to the Faculty
of the
School of Forestry
Oregon State College



In Partial Fulfillment
of the Requirements for the Degree
Bachelor of Science
June, 1939

Approved:

Professor of Forestry

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INTRODUCTION

Modern mechanical progress in all lines has nearly always been instigated by younger men who were disinclined to travel in the footsteps of their fathers. This natural law of progress, which has already brought about much improved methods in timber transportation and lumber manufacture, is at last compelling loggers and lumbermen to seek better methods in felling and bucking timber. The younger loggers are more mechanically minded than their fathers, and, stimulated by the ever increasing use of automobiles, trucks, and tractors, are keen to operate any machine in preference to strenuous physical labor. Hence, the invention and development of mechanically operated crosscut and chain felling and bucking saws.

The operation of felling and bucking, although the first major operation necessary to the manufacture of lumber and other wood products, has been the last to avail itself of the great savings in labor, time, and money afforded by modern mechanical devices but has not, even today, adopted the use of power saws extensively. As has been true in the other fields attempting to make the change from hand to machine methods, only a few men, more enterprising and far-sighted than the great majority, sense the possibilities of a mechanically operated felling and bucking device and are giving their wholehearted cooperation and support to its development. As a result, the development and adoption of power

saws has been slow and arduous but gradually, especially during the last few years, many other men who direct the production of saw logs are recognizing that power saws are proving more efficient than hand sawyers and may soon be used almost universally.

With this attitude becoming more and more apparent, the writer believes it worth while to attempt to bring together into one paper the various machines that have been invented, their development, and finally their present day achievements and adoption for practical use. It is not the writer's intention to show preference for any special type or make of machine nor to indicate that the power saws of today have reached such a point of perfection that they will give satisfactory results in all situations; rather it is hoped to show not only their achievements and strong points but also, in many cases, their weaknesses and disadvantages in actual operation with the hope that sometime in the near future a saw may be produced that will meet all requirements and conditions successfully.

In preparing this thesis the writer has used information and data obtained from articles appearing in the trade journals and Proceedings of Pacific Logging Congress, and from literature received directly from manufacturers and distributors of power saws.

EARLY HISTORY OF THE SAW

One of the most ancient tools known to man, the saw dates back to the Stone Age before the discovery of metals, when only the crudest of implements were constructed. The earliest prehistoric saws were small flakes of flint, rarely more than three inches long, with irregular teeth notched into them by chipping. Later, as the stone-age man's needs increased, a more serviceable tool was developed by mounting the serrated flint chips in a groove formed in a stock of wood. A fine specimen of this type, found in the prehistoric region at Polada in northern Italy, consisted of a wooden casing having four separate flint blades cemented into it with asphalt. The universal development of this type of implement is seen in the fact that the South Sea Islanders made a saw from sharks' teeth, the Carib Indians used notched shells, and the ancient Mexicans made saws with teeth of Obsidian, a volcanic rock.

The bronze age, with its progress of mankind toward civilization, brought a corresponding development in the saw. Since bronze could be easily worked, saws were made into various shapes and sizes, but they proved only little better than the stone saws and it was not until iron was used in tool construction that saws attained universal importance. During the iron age, which is considered by many as the genesis of modern saw-making, the saw received improvements which brought it to close approximation of some

of the forms used today. Since steel is the only metal which can withstand the manipulation and strains necessary to the manufacture and use of saws, its invention further stimulated their development, and is almost entirely responsible for the advanced saw-making art of today.

THE FELLING SAW

The felling of timber by the axe, with its resultant waste, great expenditure of labor, and loss of time, led inevitably to the invention of the cross-cut felling saw. Although its early history is obscure, probably the direct inspiration came from the old up-and down saw and still earlier pit saw which were literally back-breakers for their operators. For many years, following its invention, improvements in the cross-cut felling saw were represented chiefly by new methods in grinding, hardening, tempering, and a variety of new forms of teeth--of which the raker tooth was probably the most important. Later the need arose for a compact, serviceable saw which could be used by the army to quickly cut trees interfering with the movement of troops and equipment. To meet this demand from army engineers a new form of the cross-cut saw, consisting of a series of links each fitted with saw teeth, was developed. In use a handle was attached to each end of the chain, the saw wound around the tree and then worked back and forth. This type of saw was termed the chain saw and was a forerunner of the later power chain saws.

EARLY MECHANICAL FELLING SAWS

The use of mechanical power to operate saws in cutting up the logs into lumber dates back hundreds of years, but it was not until the period of mechanization during, and immediately following, the World War that mechanical power was applied to felling saws. The Pacific Logging Congress recognized the possibility of using felling saws mechanically driven by steam or electricity in 1914 but little progress was actually made until 1917, at which time a resolution was passed to direct attention towards inventing some practical means of mechanical felling by machines driven by electricity, gasoline, or compressed air. As a result various machines were introduced in the following year.

Wolfe Tree Felling Machine

The first power saws were of the drag saw type and were extremely awkward due to their bulk and resulting weight. Typical of these was the machine invented by George W. Wolfe, superintendent of logging of the Red River Lumber Co., Westwood, California. His tree felling machine, introduced in 1919, consisted of a specially made long drag saw attached to a carriage mounted on a large iron frame. The carriage was driven by a one cylinder, five horsepower motor also mounted on a frame. The machine weighed two hundred ten pounds and cost \$275. In operation it was placed on a sled and pulled from one tree to another by a horse or tractor. The machine was operated by three men and could cut trees up to 52 inches

in diameter at the rate of one foot per minute on high speed and seven inches per minute on low speed. Other early drag saws were essentially the same although some were driven by compressed air.

French Electric Circular Saw

Another type of the early power felling saw was invented in 1919 by a Frenchman. This machine consisted of a circular saw mounted horizontally in front of a box-like carriage. The saw was driven by an electric motor on the carriage. Power was supplied to the motor by a portable gasoline driven generator set. The saw was attached to the carriage by a toothed arm and joint in such a manner that it could be tilted at any desired angle. The machine was mounted on geared wheels which controlled its forward motion. In operation it required three men--one in the shafts to direct the machine, one at the crank to throw the gears, and one to direct the fall of the tree. Some of the disadvantages of this saw were: Awkwardness on rough ground and in underbrush, limited size of tree it could cut, and danger of damage by falling tree.

Kraber Tree Felling Machine

George L. Kraber, Portland, Oregon, designed a tree felling machine about the same time that was a good deal lighter than any of the previous machines. His device consisted of a light angle iron frame with a moveable carriage holding the motor set in a socket at one end and an arm holding a revolving knife at the other. The arm, with the knife turning at

from 4000 to 5000 r.p.m., swung in an arc to make the cut across the tree. The knife was driven by an air turbine running at a speed of 35,000 r.p.m. and power was supplied by compressed air obtained either from a donkey engine or an electric motor and storage tank. The machine was simple in construction and only weighed 80 pounds. Its principal disadvantages were:

- (a) Hose supplying air becoming entangled, pinched, or cut in moving from tree to tree.
- (b) Length of hose determined distance it could be moved.
- (c) Inadequacy of the revolving knife as a cutting tool.

de Northall Balancing Saw

Still another type of saw was being designed in 1919 by A. G. de Northall. He was developing a saw that worked both ways from the center in order to balance it and to eliminate the tendency that most other machines had to work one way or the other. His machine was mounted on wheels and operated by electrical power transmitted to the saw by a flexible shaft leading from an armature shaft. He planned to also transmit power to the wheels of the machine so it could be moved under its own power. The saw itself was 2 inches wide and $\frac{3}{8}$ " thick. The machine weighed 25 pounds. On a test it bucked a 48" log in $1\frac{1}{2}$ minutes.

Bilyeu Proposed Felling System

At the tenth annual Pacific Logging Congress held in 1919, Thomas Bilyeu, Astoria, Oregon, delivered an address on "Compressed Air Devices for Falling Timber" in which he outlined a system which he thought would be applicable to large logging operations. This system comprised a centrally located power plant from which transmission lines would carry electricity to the falling operations. At that end he would have six separate compressed air felling machines, air for each machine being supplied by a two h.p. electric motor and a fan. The cutting apparatus for each machine would be a revolving cutter, much in form like a Ross Reamer. Power for the central plant would be generated by semi-Diesel engines. Fourteen men would be required to operate the power plant and machines, and could produce, according to the estimate, 30,000 feet per unit per day or a total of 180,000 feet per day. This would be actually lower than the scale hand fallers were averaging on most operations at that time. The total cost for this system amounted to approximately \$5,000.

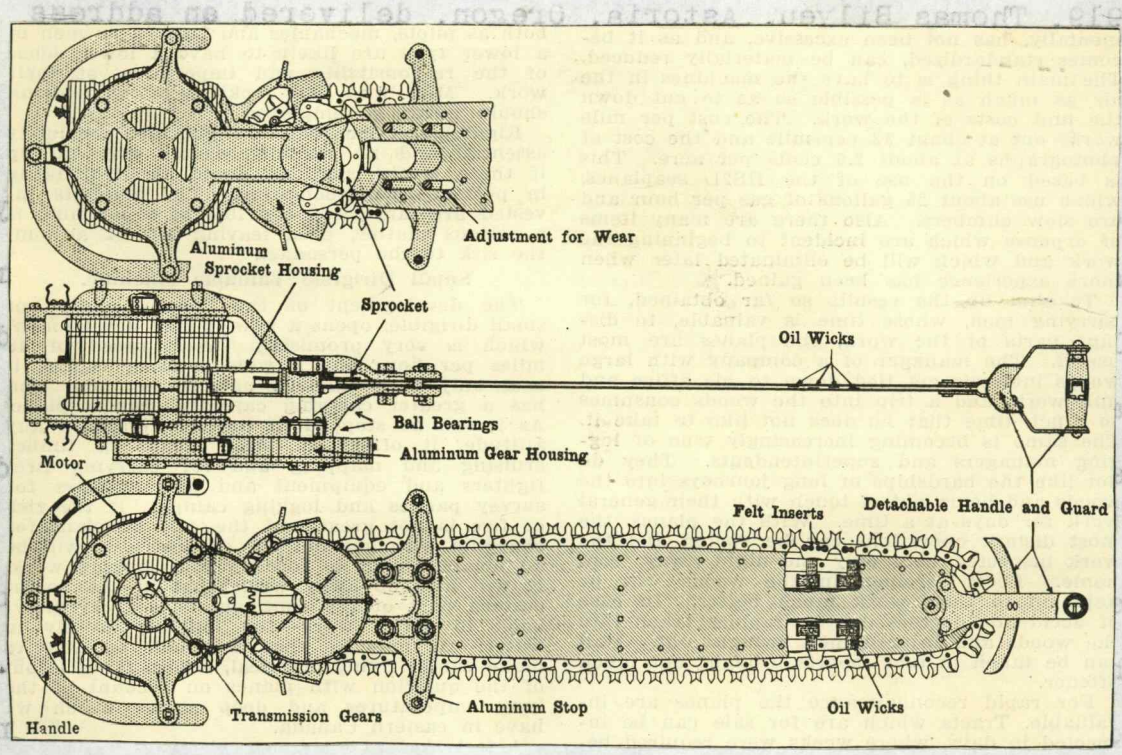
An air driven machine much on the order of the type envisioned by Mr. Bilyeu was invented that same year by F. T. Dunham, Hoquiam, Washington. It had a revolving cutter which moved back and forth in a horizontal guide mounted on a jointed pipe framework.

Wolf Link Saw

Charles Wolf, connected with the Penninsula Iron Works,

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SKETCH OF WOLF LINK SAW

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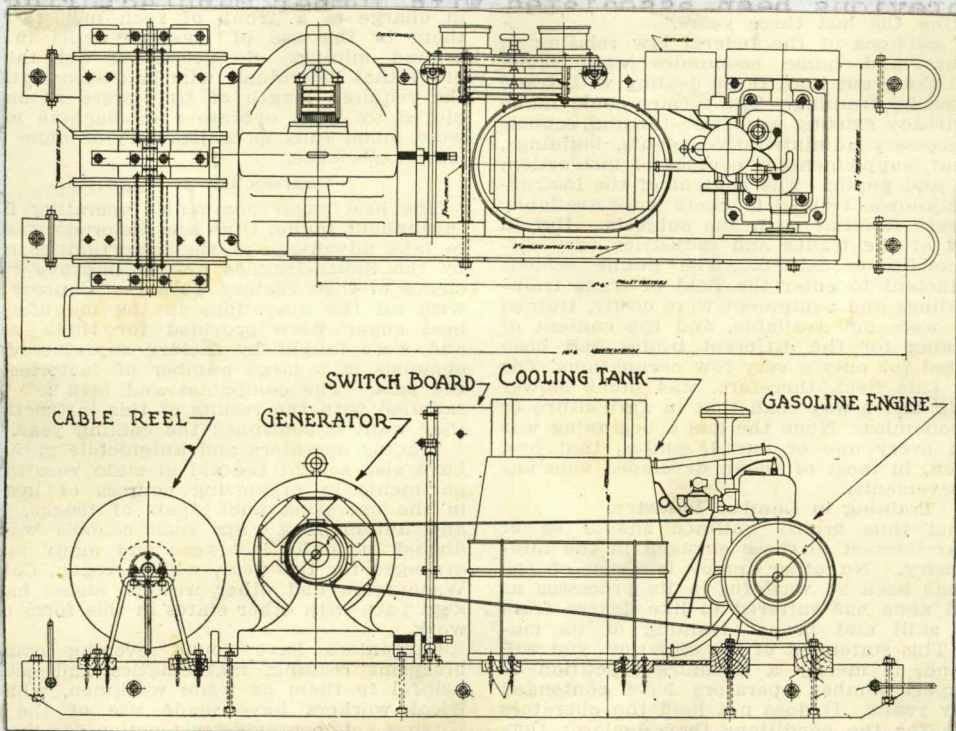
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Portland, Ore., in 1920 invented an electric drive link saw. Although his profession was engineering, he had several years previous been associated with lumber manufacturing interests in Northern Idaho, and had there conceived the idea of developing a portable mechanical sawing machine which would do the work of three men, reduce costs, and attract a better class of men to the woods. After experimenting and testing over a period of six years the following machine, weighing only 84 pounds, was designed. It was composed of few parts, namely, a standard electric motor of the induction type; three comparatively small gears; one driving sprocket; a built-up saw steel frame with a quick detachable handle on the outer end; and a series of jointed saw links. The gears and sprocket were contained in an aluminum housing which rigidly connected the motor to the saw frame. Motive energy was transmitted through the gears to the sprocket which drove the saw links in a groove around the outer edge of the frame.

Electric power was chosen because he thought it would entail the least difficulty in conveying the power to the saw at any distance, with a minimum loss of power and the greatest convenience in transporting the machine. The endless chain saw was adopted because the continuous cutting principle utilizes power more efficiently than the reciprocating or drag motion of sawing. Some of the advantages of the above combination were: Elimination of vibration making clogging or fastening of the machine to the work unnecessary; compactness and lightness; no stroke room necessary; equal

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PORTABLE GENERATOR SET FOR USE WITH WOLF LINK SAW

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wear on every tooth of the saw; easily operated in either horizontal or vertical plane.

To overcome buckling tendencies and to assure smooth operation without tension in the saw links, overlapping cutter and raker links were used. When the cutter and raker teeth were dulled on one side, the direction of drive could be changed by reversing the motor, thus assuring uniform wear with a minimum of filing. For protection of the motor, should the saw become fouled in the cut, a fuse in the motor circuit would automatically open and stop the motor.

A small portable generating set driven by a small oil or gas engine was designed to supply the power to one or more saws where electrical energy was not available. Power could be transmitted any desired distance by means of a weather-proof flexible cable wound on a spool at one end of the generator set.

Two men were required to operate the saw efficiently and could cut approximately three square feet of cross-section per minute in fir timber. The overall saw lengths was three feet but could also be made in four or five foot lengths.

Excelsior Tree Felling Saw

By 1921 many tree felling machines of the drag saw type had been tried in the woods, but, due to their respective weaknesses, were not found practical, and, as a result, loggers eyed new "cure all" machines with skepticism. This fact was evidenced by the article "New Tree-Felling Saw" in the Octob-

er 21, 1921, issue of The Lumber Magazine in which the editor was very careful to state that this article was merely a presentation of facts about the new saw and not an endorsement. The saw introduced by this article was called the "Excelsior Tree-Felling Saw" and was designed primarily for the hardwood species of New Jersey. Basically a portable crosscut long saw, it had embodied in its design a number of special features designed to remedy the difficulties experienced in the operation of earlier machines. Principle of these was the provision of an instantaneous release mechanism for the saw blade and entire hitching assembly in order to eliminate the "kick-back" hazard caused by the falling tree. In operation, when the tree began to fall, the release was thrown and the frame and motor swung free from the tree leaving the saw blade on the stump. Another feature of this saw was the elimination of the saw carriage by substituting a system of levers to operate the saw blade. The machine was powered by a 2 cylinder gas engine developing 11 horsepower. The first model weighed 290 pounds but succeeding models were supposed to weigh only 125 pounds when designed with about half the original horsepower. The actual cutting speed of the saw was demonstrated to be 10 inches per minute in hardwood trees averaging up to 3 feet in diameter, and about 25 inches per minute in the pine. As long as the motor speed was maintained no appreciable change in cutting speed could be noticed regardless of tree sizes. Allowing a fairly low average footage of 600 feet log scale per tree, two men and the rig could

produce 28,000 to 36,000 feet of hardwood per day.

Gisch Chain Saw

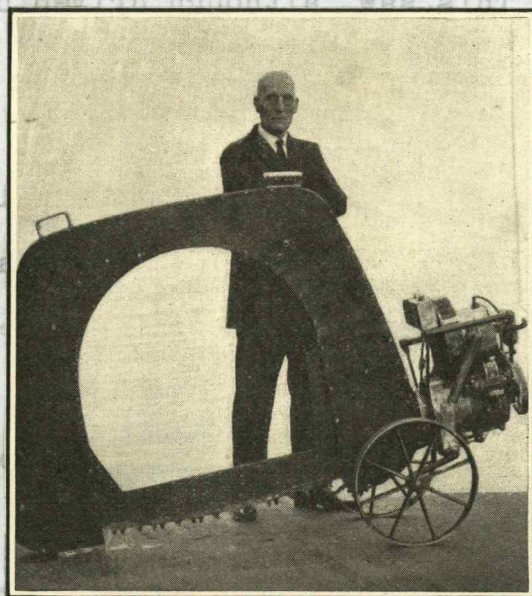
In 1922 patents were granted on a power chain saw invented by Anthony Gisch, Superintendent of Weber-King Lumber Co., Barham, La. This saw, although driven by an air motor, was on the order of the previously described Wolf Saw. It consisted of a pair of end plates mounted on each end of a frame, two sprocket wheels, and a series of linked teeth. The sprockets were so mounted in each end plate by means of blocks within boxings that they could be moved away from each other, in order to adjust the tension of the chain saw passing over them, by merely tightening a screw bolt. Springs strong enough to resist the ordinary pull of the saw were placed between the blocks and boxings in order to relieve the chain of excessive strain and a tendency to break when sawdust and dirt accumulated between the chain and sprockets. The frame between the end plates served as a guide for the chain and kept it from sagging when used in a horizontal plane. Horizontal and vertical tubes threaded to receive handles were mounted in the end plates. One disadvantage of this saw was the need for removing the sprockets in order to disengage the chain when it would stick in the timber.

In initial tests the saw, operated at a speed of 1500 feet per minute, cut a 24 inch log in 59 seconds and an 18 inch log in 9 seconds. Including its 15 horsepower air motor the saw weighed 76 pounds. Power was supplied to the motor

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Arsneau Chain Saw

A. H. Arneau of Spokane, Washington, invented an ingenious mechanically operated chain saw in 1923. The saw was composed of a semi-circular, hollow plated steel frame around which ran the chain saw driven by a two and a half horsepower gasoline motor. The motor and frame were mounted on a set of iron wheels for portability. The frame could be tilted so the saw could cut at any angle. The machine weighed one hundred fifty pounds, but it was proposed to use aluminum in construction of the models and thereby reduce the weight to one hundred pounds. It was designed primarily for felling and bucking in the Inland Empire pine timber. Preliminary tests at the McGoldrick Lumber Company's mill, Spokane, indicated the possibilities of the saw but figures were not published.

California Saw

George M. Cornwall, editor of the Timberman, wrote in the November, 1924, issue that although serious efforts had been made for several years to produce a mechanically operated felling saw, they had met with only partial success. He also mentioned the invention of a California power-driven saw, designed primarily to cut redwood stump even with the surface of the ground, which was giving excellent results and promised, with further refinements, to become a valuable felling and bucking machine. He did not, however, give any description of the saw.

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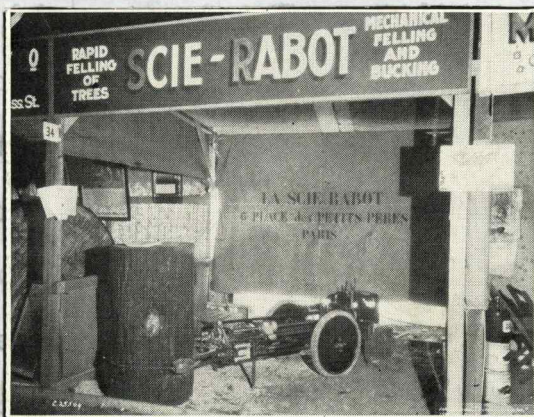
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manager of Booth-Kelly Lumber Co., Eugene, Ore., said he considered a mechanically operated felling and bucking saw one of the greatest needs of the lumber industry. The Booth-Kelly Lumber Co., experimenting the previous year with the Wolf electric saw during a period when their woods operations were shut down, felled more than 50 trees and encountered only a few mechanical difficulties, none of which were very serious. As a result of this experiment, Mr. Dixon said he was satisfied that the Wolf chain or link saw pointed the way to ultimate success.

At this same time the Timberman suggested that the National Lumber Manufacturers Association, which was awarding prizes for the prevention of waste, accumulate a prize fund of \$10,000 toward solving the mechanical felling saw problem.

French "Scie-Rabot"

A French endless chain type mechanical felling and bucking saw called the "Scie-Rabot" was introduced in this country in 1925. It was composed of an endless chain called "chain rabot"; an air-cooled gasoline engine; and a supporting framework. The "chain rabot", formed of links with cutting teeth or tracers and rabots, was placed around the tree with the cutting points inward and then connected and drawn tight. When the power was applied the chain moved around the tree tracing two parallel saw cuts from between which the rabots removed the wood. As the cut progressed a flexible arrange-

ment of jack-screws gradually drew the chain through the tree. The framework had pointed steel rods which, when drawn into the tree by the action of the jack-screws, held it rigidly in place.

Power was distributed to the chain by an axle with a moveable conical bearing which permitted the chain to be reversed at will. The pinion turned at 600 revolutions per second giving the chain a lineal speed of 22 feet per second. The speed of actual cutting was about three seconds per inch for softwood and 6 seconds per inch for hardwoods. A 12 inch diameter pine tree was cut in about 36 seconds and a 3 foot oak tree in about 4 minutes.

The cut of the saw being on the opposite side from the machine was supposed to facilitate the fall of the tree away from the machine due to the $\frac{1}{8}$ inch mortise made by the chain.

The machine was built in two sizes: Model B, designed to cut trees up to 10 ft. in diameter, was operated by an 8 to 10 horsepower, two cylinder motor and weighed 500 lbs.; Model C, designed to cut trees up to 4 ft. in diameter, used a 5 horsepower single cylinder motor and weighed 225 lbs.

New Models of Wolf Chain Saw

The Wolf chain saw, invented by Charles Wolf in 1920, was later taken over by the Reed-Prentice Corp. of Worcester, Mass., for further development and manufacture. In 1927 they placed it on the market in three models, ranging from 24" to 30" in diameter capacity. The first model, powered by a 2

horsepower motor, weighed 70 pounds and was capable of cutting two square feet of softwood per minute; the second model was powered by a $3\frac{1}{2}$ horsepower motor, weighed 90 pounds, and had a cutting capacity of three square feet per minute; the third model, powered by two 2 horsepower motors, one on each end of the saw frame, could cut $3\frac{1}{2}$ sq. ft. per minute and weighed 110 lbs. All saw chains had a safety factor of 20, and were provided with a safety pin which, when broken by a sudden shock, would immediately stop the chain.

All motors operated on 220 volts, 3 phase, a.c. from either line or generator set and could be started or stopped by a foot switch. The generator set designed for the saws was a 4 cylinder automobile type engine directly connected to a 3 phase, 60 cycle, 220 volt, alternating generator and could be mounted on any tractor.

In 1929 the Hoosier Engineering Co. of Chicago used a number two size Wolf saw to cut a high power transmission line right of way near Vineland, N. J., and reported it speeded progress 25% over previous methods with hand saws. Twenty inch diameter pine trees were felled in 38 seconds and eighteen inch oak trees in 3 minutes.

A demonstration of the Wolf Chain Saw in felling and bucking pine timber was made at the camp of Weyerhaeuser Timber Co., Klamath Falls, Ore., in April of 1930 and gave satisfactory results. On this demonstration a 36" model weighing 92 pounds was used for bucking and a 48" model weighing 98 pounds was used for felling. Both machines had

a 2 horsepower, 3 phase, 220 volt, Westinghouse induction motor operated from a gasoline generator set. The saw motor speed attained was 3450 r.p.m. and the chain speed 1200 ft. per minute. The practical distance the saws could be operated from the generator set was found to be 2000 feet.

In actual performance at the camp 45,000 feet of timber was felled and bucked per 8 hour day. When both machines were used for felling alone, they aggregated 125,000 bd. ft. per day. A three man crew was used for felling and a four man crew for bucking. Dulled chains could be replaced in five minutes time with a sharp chain. Saw chains were filed in same manner and time as hand saws.

The Weyerhaeuser Timber Co. at Klamath Falls also tested an air driven model of the Wolf Felling Saw in 1930. Power was supplied from a Davey, tractor mounted, air compressor having a capacity of 142 cubic feet per minute and weighing only 1000 pounds. Several saws could be adequately driven from one compressor.

In September of 1930 the Reed-Prentice Corp. offered a gasoline model Wolf Chain Saw. This machine had a 4 horsepower, air-cooled motor of the single cylinder, two cycle type equipped with a Bosch magneto and a fuel tank carrying two quarts of mixed gasoline and oil. A multiple disc clutch permitted the chain to be started and stopped independent of the motor. The saw frame was on a swivel so a cut could be made at any angle yet leave the motor level.

Beaver Chain Saw

The Beaver Chain Saw Co. is among those listed in the machinery display at the 1928 Pacific Logging Congress, but apparently no description or accomplishments of their saw were published in the trade journals.

Dolmar Power Saw

During the world war the German military command carried out logging and wood-cutting operations on a very large scale, and at this time German chain saws were developed and proven superior to the hand drag saw types. In January, 1930, one of these saws, the Dolmar Power Saw, was introduced and distributed in America.

The Dolmar machines, which could be supplied in six different types with a cutting range up to seven feet in diameter, were of the endless chain type somewhat on the order of the Wolf Chain Saw. Power was supplied by an air-cooled, two cycle motor developing 8 horsepower and especially constructed to meet severe operating conditions. The motor, controlled by a governor, attained a speed of 2300 revolutions per minute and was so well balanced that no vibration resulted. The saw chain could be operated at different speeds by means of gears in the transmission and could also be thrown into neutral whenever desired. By an ingenious arrangement the motor was automatically thrown out of gear when too much pressure was applied by the operator, or when the chain became pinched.

In actual performance the Dolmar saws were rated as being

capable of doing ten times the amount of work two men could do with an ordinary cross cut saw. The maximum weight of the various models was not over 100 pounds each.

Joe Pesola Drag Saw

Early in 1930 Joe Pesola invented a lightweight drag saw especially designed for felling and bucking Redwood timber. The frame of this saw was made of light but high grade tubing and had adjustable arms which could be pulled out to fit any size log. A rear leg was used to raise or lower the saw blade which could be set at an angle of 45 degrees. The motor, a Briggs and Stratton air-cooled, tractor type motor developing one horsepower, used only three quarts of gasoline per 8 hours. It was connected to pinion gears, operating a gear rack on the saw blade, by means of a V belt which could be tightened or loosened to start and stop the saw by merely swinging the motor. The speed of the saw ranged from 25 to 130 full strokes per minute. Length of stroke could be adjusted from 18 inches to 3 feet with an oscillation of 4 to $4\frac{1}{2}$ inches.

The Eureka Drag Saw, Eureka, California, manufactured the saw and offered it for sale at \$170.

New Model Arsneau Power Saw

After experimenting for several years in the Northwest with the chain saw he invented in 1923, Mr. Arsneau moved to Santa Monica, California, where in 1931 he produced a much improved model.

This newer model embodied the same principle features of the first model, having a horseshoe shaped saw frame and guard, the power plant mounted on wheels, and power supplied through the medium of gears by a two-cylinder motorcycle type gas engine developing 22 brake horsepower. The saw chain, composed of three rows of teeth, moved around the frame in a clockwise direction at a speed of 600 feet per minute. The saw frame could be tilted to cut in any angle from vertical to horizontal and when used at the latter angle could cut stumps as low as two inches above ground. In actual tests the machine cut a 24 inch diameter pine log in less than six seconds and felled 30 standing pine trees averaging 18 inches in diameter in a total time of less than 30 minutes, including the moving from tree to tree.

Although the machine could be operated by one man, two were advocated for most efficiency. The machine was light in weight and could be easily moved about on its pneumatic tires. Several machines were being used that year in lowering stumps on logged-over land to almost ground level.

Yankee Faller

For several years the Vaughan Motor Works, Portland, Oregon, manufactured gasoline driven drag saws for use in bucking timber. In 1929 The Pacific Lumber Co., Humboldt County, California, experimented with a few of these machines in felling as well as bucking the big redwood trees. With a few changes and additional parts these machines were found so

practical that the entire crew, 16 sets, of fallers gave up the cross-cut saw and adopted the power drag saw for felling and bucking. Officials of the Pacific Lumber Co. estimated that the use of these power saws speeded up the operation of felling by 30 per cent. Under this method of felling and bucking each set of fallers did their own bucking and one combination marker and scaler was employed for each eight sets. This resulted not only in a great saving of time but also in an increase of 12 to 15 per cent in the length of the logs.

Such remarkable accomplishments as the above led W. C. Vaughan to develop a power saw especially designed for felling which was placed on the market in 1933 under the name "Yankee Faller". This new machine weighed 160 pounds without the saw blade and was powered by a two-cylinder, four horse-power, air-cooled gasoline engine especially designed and built for the saw. A single raker drag saw type blade, in lengths of three to eight feet, was employed. The machine was designed to be attached to the tree below the cut by a counteracting suck drive dog set which eliminated any danger of damage resulting from a kick back of the tree. Steel tubing and alloy aluminum were used throughout the machine to give rugged construction with a minimum of weight.

In a four hour test run under woods conditions, a crew of two men felled Douglas Fir timber averaging 32 inches in diameter at the rate of 90,000 feet per 8 hours with this machine. Each tree required only nine minutes for the move,

set-up, and cutting. Although the machine was designed primarily for felling, it was also adapted for bucking wherever conditions warranted its use for that class of work.

"Little Giant" Drag Saw

E. J. Windle of the Windle Manufacturing Co., Portland, Oregon, in 1933 designed a power drag saw weighing only 130 pounds. It was powered by an air-cooled four cycle motor of 1 3/4 horsepower capable of pulling a seven-foot saw. In this saw Windle eliminated the common crank motion and obtained reciprocal motion by means of a roller chain running over two sprockets and having a driving attachment fastened to the chain and a sliding block on the saw plate. The stroke obtained was 20 inches. The saw was capable of 125 strokes per minute and used two quarts of fuel about every three hours of operation. Although designed for bucking, the saw could be adapted to felling without great difficulty.

British "Lynx" Chain Saw

An interesting power-driven chain saw for felling, bucking, and ripping timber was developed in 1933 by John T. Pickles of Hebden Bridge, England. The machine was available in three models--gasoline driven, air-driven, and flexible shaft driven. The gasoline model came in 30, 40, and 60 inch sizes weighing 75, 80, and 85 pounds respectively. Its power plant was a compact vertical engine with an enclosed gear box. An outstanding feature of the "Lynx" saw was the adjustability of the saw track into various positions for ease in cross

cutting and ripping. For instance, in running length cuts the saw track or frame could be inclined downward at a 45 degree angle. In felling timber the whole saw, including the motor, was merely turned over on its side and rested on a stand base. The saw chain was unique in that it used four consecutive links or teeth to complete a quarter-inch cut. In appearance the saw was somewhat like the Wolf saw.

Dow Chain Saw

George A. Dow, president of Dow Pump & Diesel Engine Co., Alameda, California, in 1933 built a low stump power chain saw mounted on pneumatic tire wheels for ease in movement from tree to tree. The chain saw was driven around a long narrow blade or guide frame by an air-cooled gasoline motor. The machine weighed 490 pounds.

A demonstration of the low stump power chain saw at the Diamond Match Co. operation near Sterling City, Cal., gave evidence of its adaptibility for felling and bucking where the conditions of the ground and the dimensions of the timber were within its range of service. The ground selected for the above demonstration was comparatively level and free from underbrush. The stand consisted of Sugar Pine, California White Pine, White and Douglas Fir, and Incense Cedar averaging about forty inches in diameter. Trees were felled in less than one minute after the undercut was made by the chain saw and were bucked in about the same length of time as the falling. In a contest between the low stump power chain saw and two expert hand buckers, the saw bucked a 37 inch log in less

than one third the time of one minute and fifteen seconds required by the buckers.

Tractor Mounted Power Saw

During the years 1933 and 1934 the possibility of mounting power saws on tractors was being expressed by several men interested in power saws.

R. A. Colgan, General Superintendent Diamond Match Co., and Willis J. Walker, president The Red River Lumber Co., Westwood, Calif., believed that power-driven saws, to be practical, must be designed to move under their own power and the solution would probably be obtained by mounting the power saws on light tractors. Some of the advantages claimed for this system were:

1. Power saws could be delivered wherever timber could be economically logged.
2. Power of the tractor could be utilized to drive the saw.
3. Mobility of tractor permits spotting of saw at any desired angle.
4. Tractor and saw could be quickly moved to escape danger of falling trees.
5. The tractor on which the power saw is mounted could be used in rolling out "pinched" logs, chunking out its right-of-way and occasionally clearing a right-of-way for the skidding tractor.
6. In felling timber the line on the tractor drum might be used to guide the direction of fall.

Although George A. Dow, builder of the low stump power chain saw said he was studying the combination of a power saw mounted on a tractor to insure mobility, no account of any such actual combination has been published apparently.

Russian Uvarov

Beginning in 1928 and 1929 Russia conducted numerous studies, experimentations, and tests of foreign and especially German made motor saws to determine their comparative advantages in construction, best methods for use, and most suitable conditions for introduction. These experiments and tests, which were carried on under government supervision by trained investigators and practical loggers, indicated that, in spite of the cheap labor available for woods work, motor saws could be made practical in logging. By 1934 they had taken nearly all of the best points of several foreign made saws and combined them into a model called Uvarov. This was a chain saw model operated by a one cylinder, 2 cycle, 4 horsepower, gasoline motor developing 2800 to 3000 revolutions per minute. It had a sawing speed of 30 c.m. per second in hardwoods and 35 to 40 c.m. diameter in pine or spruce. Its kerf was $8\frac{1}{2}$ mm.

The comparative results of the above studies showed the average output per 8 hour day was:

Hand sawyer 5 to 6 cubic meters

Foreign made saws 8 cubic meters

Uvarov 10 to 11 cubic meters

In cost of work per cubic meter of wood cut, the Uvarov was 25% less than the hand sawyers even after making allowances

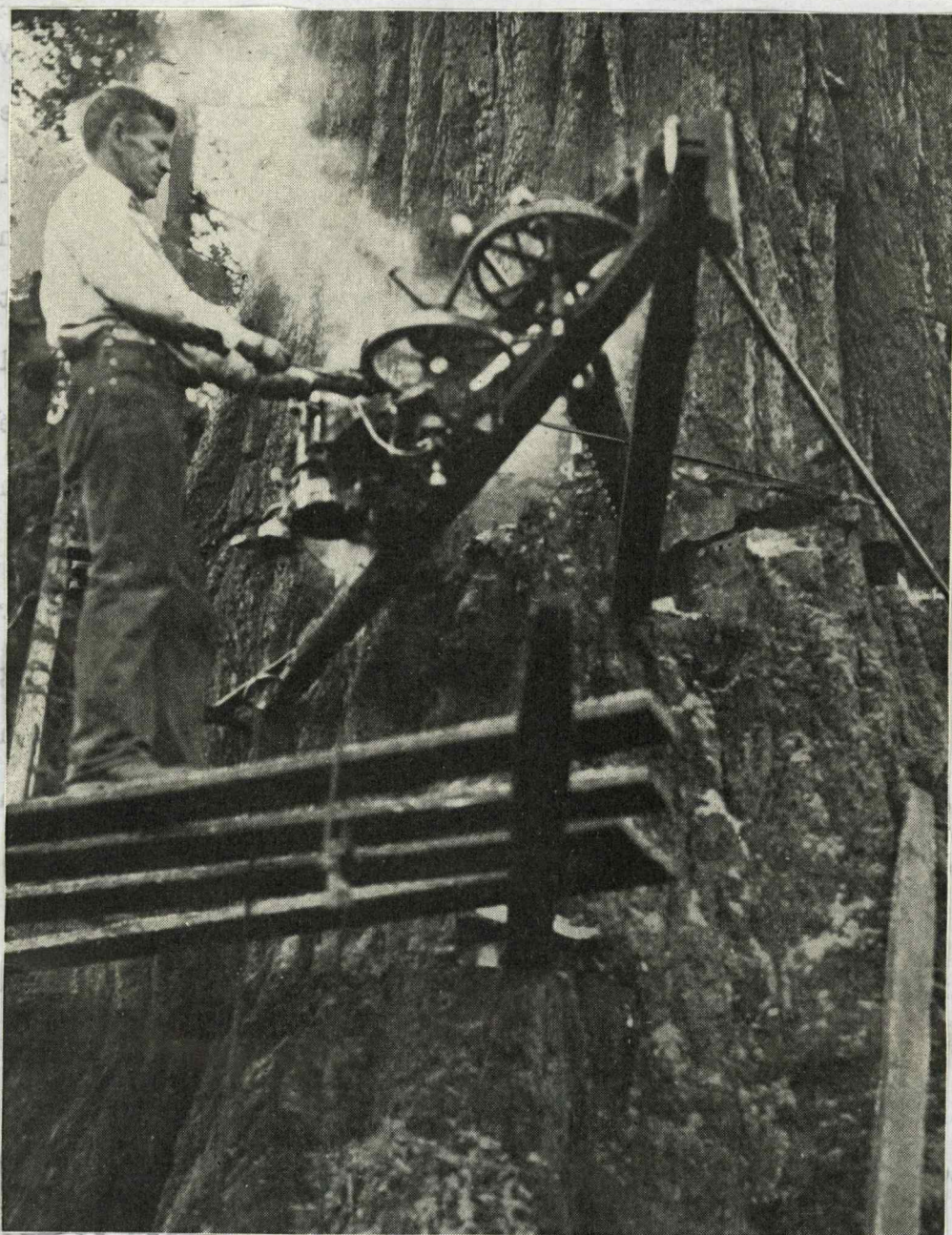
for a 50% higher labor cost for the motor sawyer and taking into account all such expenses as armorization, repair parts and repairs, fuel and lubricants, and higher wages for saw mechanics.

TODAY'S POWER SAWS

In developing any new line of machinery there nearly always occurs during the first few years many different ideas regarding the general design, type, and size of the machine that will be best fitted to solve the need for which it has been designed. This has been true for automobiles, tractors, airplanes, and others, and is no less true for mechanical felling saws. Since 1913 when power saws were first given attention in this country, many different types of machines were introduced at the rate of about two a year and most of them, if not all, have been described in detail in the previous pages. By 1935, however, new inventions of felling machines began to slack off and loggers and foresters centered their attention on experimenting with and using only a few of the more promising ones.

In the redwood region the drag saw types of felling and bucking machines are being used successfully for both felling and bucking by many companies. The Hammond Redwood Co. of Samoa, California, in 1937 had sixty-five power drag saw rigs in the woods and on their Maple Creek show were using power drag saws entirely for falling and bucking the big redwoods. In the system used by the Hammond's, the company buys the machine at a cost of about \$300 for each complete machine and resells them on time to the men who pay for them through deductions from their wage checks. This throws the responsibility for their care and upkeep on the men. Should a man quit before his saw is paid for, it reverts to the company.

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The company furnishes gas and oil for all the drag saws, does the filing free of charge, and pays the fallers a flat rate of 80 cents per thousand board feet for good timber up to the first break and an additional 6 cents per square foot for bucking. On this basis each man averages around \$200 per month.

In selecting the make of saws to be used the company respects the majority opinion of the men. The different makes used vary in weight from 150 to 210 pounds and are equipped with 4 horsepower gasoline motors. The saw blades range from four to fourteen feet in length.

The logging area is divided into strips by the chopping boss who allots one to each felling set, composed of two men and one rig. The strips vary in size but are usually several hundred feet wide and not too close together in order to minimize the danger from falling trees in adjoining strips.

In falling the trees the fallers chop driver holes into the tree and then set up scaffold platforms on which they stand to operate the power saws which are fastened to the tree and made rigid by two front dogs and one tail dog. When the tree is nearly cut through, shims, wedges, and steel plates are driven into the saw cut in order to dump the tree.

Another big redwood lumber company sold on the drag saw type power saw for felling and bucking is the Pacific Lumber Co., Scotia, California. The Pacific Lumber Co. was the first lumber company in the redwood region to use power drag saws for falling and bucking, and is now using them 100 per cent for both operations. Five hundred thousand board feet of logs

are cut by the drag saws. Each set of choppers with one drag saw can fall an average of 8,000 ft. per day and can buck about 16,000 ft. per day. This is about 20 per cent more than could be accomplished by hand sawing.

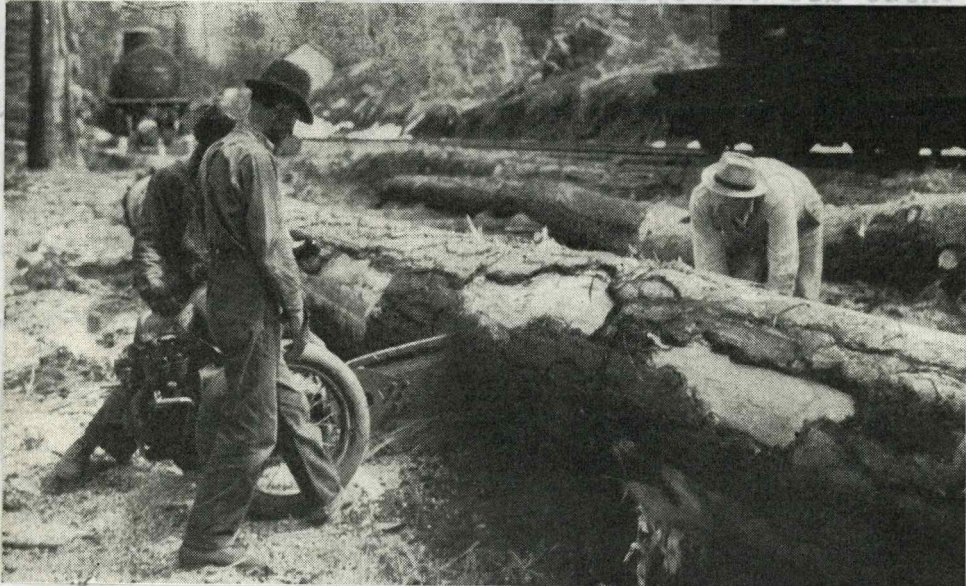
The Pacific Lumber Co. uses water cooled Vaughan drag saws. These are two-cycle and develop two and a half horse power. Although the men buy their own saws, the company sometimes finances the original cost, charging no interest or carrying charge. With each saw is a set of blades consisting of one five-foot; two six-foot; one seven-foot; two eight-foot; one ten-foot; and one twelve-foot blade. All repair work is done by the company free of charge. Gas and oil for the machines are purchased by the choppers. The drag saws use about one and a half gallons of mixed gas and oil per 8 hour day.

In making the conventional drag saw adapted to felling in the redwoods the gas and water tanks were reversed and an elbow fitted so they could be filled while the saw was in the felling position, a lubrication hole drilled in the end of the crankshaft and grease cup fitted to it, bigger front dogs and a telescopic tail dog added. The main disadvantages of the Vaughan water cooled drag saws are its heavy weight, 210 pounds, which is a considerable load for two men to pack through the steep redwood country, and the danger of a serious scalding to the men by boiling water spouting from the water tank. Both of the above handicaps may be eliminated by use in the future of some light-weight, air-cooled felling machine.

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in the future of some light-weight, air-cooled felling machine.

The Newburg Machine & Foundry Co., Fortuna, California, is now developing a model of this type which may solve the problem. The Newburg saw will develop 4-horsepower and weigh much less than the water cooled saws. Cooling will be effected through the use of a blower.

Although the drag saw type of mechanical felling and bucking saw has proved quite successful in redwoods where only one or two setups per day per gang are required, its size, weight, slow cutting speed, and necessity for erection of considerable staging for each tree to be felled precludes its use in the pine and Douglas fir regions where timber averages in most stands less than 5 feet D.B.H. and each gang falls and bucks 20 or more trees per day. Loggers in the pine and Douglas fir regions have, therefore, turned their time and attention to the chain type saws for a solution to their falling and bucking problems.

Of the many models of chain saws invented and placed on the market in the past years only four are now receiving much attention from loggers. These are the Dow, Wolf, Stihl, and Dolmar. The first is a heavy machine mounted on wheels and the others are comparatively light pieces of equipment that can be carried by one or two men.

The Dow saw, termed the "Low Stump Power Chain Saw" by its manufacturers, the Dow Pump and Diesel Engine Co., Alameda, California, has been used in both pine and Douglas fir regions but has found most success in the pine regions of northern California and southern Oregon where the ground

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is fairly flat or only slightly rolling and the lack of dense underbrush permits easy movement from tree to tree. There it has given remarkable results and has been adopted for full time use by many companies.

The California Fruit Exchange in 1936 replaced their hand fallers with three Dow power saws and effected a saving of 12¢ per M feet over their previous sawing and limbing costs. The saws are worked on all types of ground and timber but the greatest saving results from their use on flat open ground and in large timber. Although three men are needed for best operation of each saw in steep country only two are ordinarily used on most types of ground.

The Lamm Lumber Co., Modoc Point, Oregon, testing the Dow low stump power saw a few years ago felled, bucked, and limbed 613,470 feet of timber with the aid of saw at a cost of 72½¢ per M feet for all operations. The total cost for these operations during the ten day period was \$326.70; divided into \$250 for labor which included one faller, one motor-man, one swamper, and two limbers, and \$66.70 for depreciation, maintenance, upkeep, gas, and oil. The saving over hand sawyers under the same conditions and equal amount of timber was \$118.07, or around 19¢ per M.

At their logging operation in northern California, Shaw Lumber Co., Klamath Falls, Oregon, tried the Dow saw in 1936. They found the power chain saw could do the actual felling and bucking of timber much faster and easier than the hand fallers but did not deem it feasible for use on their shows

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at that time because the trees were fairly small and scattered and their type of ground, loose lava pumice, too greatly hampered movement of the heavy machine from tree to tree.

In the Douglas fir region J. W. Challenger, Supervisor of Falling and Bucking, Bloedel, Stewart & Welch, Limited, Port Alberni, British Columbia, has probably done more than any other man in experimenting with and studying the practical application of power saws to the Douglas fir region. The Bloedel, Stewart & Welch, Ltd., were so impressed by the results obtained from the Dow saw by operators in the pine country of Oregon and California that they bought one machine in 1936, believing it could be used with equal success in many of their shows where the ground was fairly level and free from brush. After using the Dow saw for several months they came to the following conclusions regarding it:

1. The Dow saw was fast-cutting, quick starting, dependable, had few mechanical weaknesses and would stand up under rough usage.
2. Its weight limited its use to only about 20 per cent of their shows.
3. It could not be used to advantage in rough or brushy country or when there was snow on the ground.
4. It could probably be best used in falling for tractor logging or for bucking on dry landings.
5. Their falling and bucking costs for the Dow saw were the same as their hand falling and bucking costs under the same conditions.

According to the chief engineer of the Dow Pump and Diesel Engine Co., the Dow saw was originally designed for a life of three to four years under the heaviest of service because the Dow people believed that, until the initial prejudice against power falling had been overcome, the immediate goal was to develop a machine that would stand the gaff. This necessitated sturdy construction throughout and resultant weight of 490 pounds. Later model Dow saws, however, have been reduced somewhat in weight. They are powered by a 4 cylinder, 12 horsepower, air cooled, heavy duty Wisconsin Diesel type engine controlled by a mechanical governor to operate at 1400 to 1600 r.p.m. and equipped with a rotary high tension magneto with impulse coupling to assure quick starting in any kind of weather. Automatic lubrication is provided through a self-contained oiling system. The life of the saw chain, originally designed to cut seven to eight million feet, has been prolonged by recent redesigning of the sprocket chain drive to eliminate shocks and by providing it with heavier chain rakes which practically eliminate breakage. The Dow saw costs in the neighborhood of \$1200.

The Wolf power chain saw, another American made saw, is manufactured by the Reed-Prentise Corporation, Worcester, Mass. and has been offered in many models powered either by electric, gasoline, or compressed air motors. At present there are over 800 Wolf saws in use.

At a demonstration of the gasoline model Wolf Portable Timber Sawing Machine, given for the Northeastern Forest Ex-

periment Station in the Northern hardwoods at Bartlett, New Hampshire, by the Reed-Prentice Corporation, it was found that large hardwoods could be felled at a rate of two minutes per square foot of stump, not counting the time for moving from tree to tree. The machine could do most of swamping in the woods but the bucking could be best done in the yards. For felling, a special jack should be provided to take the place of wedges until the saw is in the tree at least one foot. The demonstration indicated the saw would be extremely useful in cutting trees into short lengths for pulpwood, stock bolts, fuelwood, etc. The actual time study figures taken of the demonstration are:

Bucking a total of 70 cuts; 31 in Beech, from 4 to 28 inches in diameter, 22 in Sugar Maple from 3 to 10 inches in diameter, 17 in Yellow Birch 4 to 8 inches in diameter.

Record of Cuts	Total	Average
Cross sectional area cut	70.9 sq. ft.	1.012
Time for starting and moving from cut to cut	17 min 17 sec	14.8 sec
Sawing time	26 min 19 sec	22.6 sec
Lost time	12 min 18 sec	10.5 sec

Felling two sound Beech trees requiring no wedging.
(First tree 22.5 inches in diameter at point of cut.

Time	
Undercutting with Wolf Saw	1 min 15 sec.
Lost time	20 sec.
Taking out notch with axe	30 sec.
Making ready for main cut	25 sec.
Main cut	2 min 35 sec.
Total	5 min. 5 sec.
Total time per sq. ft. of cross section area,	1 min 55 sec.



WOLF CHAIN SAW IN NORTHERN ROCKY MOUNTAIN REGION

Second tree 33 inches in diameter at point of cutting but only a net area of 4.13 sq. ft. cut due to the tree splitting when felled.

Time	
Sawing time	4 min 29 sec.
Lost time and preparation	2 min 45 sec.
Total	<u>7 min 14 sec.</u>
Total per sq. ft. of cross section area, 1 min 57 sec.	

A comparative analysis of the relation between the size of cross section area and the time required for sawing indicated that up to 14 or 15 inches in diameter the time for sawing was directly proportional to the crosssectional area, and above 15 inches the efficiency increased. A 20 inch cut could be made at the rate of 22 seconds per sq. ft. and a 28 inch cut at the rate of 16 seconds per sq. ft.

The model used on the demonstration was powered by a 2 cylinder, air cooled gasoline motor developing 7 to 8 brake horsepower. It was controlled by a motorcycle type throttle.

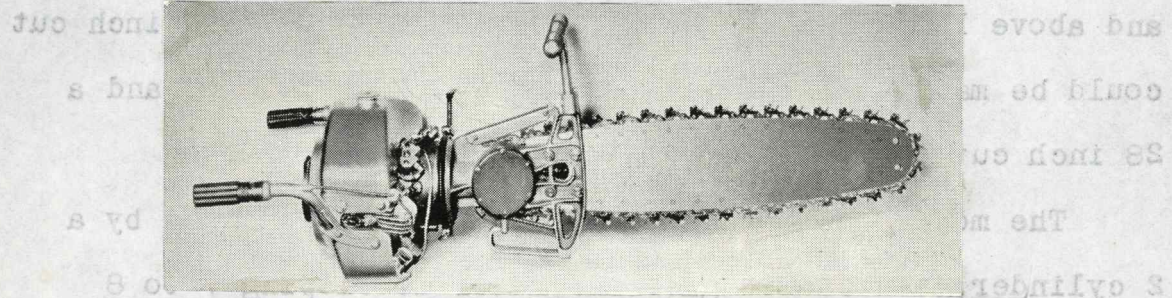
In the Douglas fir and larch timber of the northern Rocky Mountain region the Forest Service experimented with a Wolf power saw for felling snags and use in other right of way construction work during 1934, 1935, and 1936. The models used for these tests were standard construction, 24 inch blade machines weighing 85 pounds. They were equipped with five-horsepower (at 2200 rpm), four cycle, air-cooled Reed-Prentice gasoline engines. The saws were built on a swivel movement to facilitate either vertical or horizontal cutting. During these field tests many details of construction were modified in an attempt to improve the performance

Second tree 38 inches in diameter at point of cutting but only a net area of 4.13 sq. ft. cut due to the tree splitting when felled.

Time	
Sawing time	4 min 29 sec.
Lost time and preparation	2 min 45 sec.
Total	7 min 14 sec.
Total per sq. ft. of cross section area	1 min 57 sec.

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1938 MODEL GASOLINE WOLF SAW. WAS FLOW ENLARGED 83 PER CENT

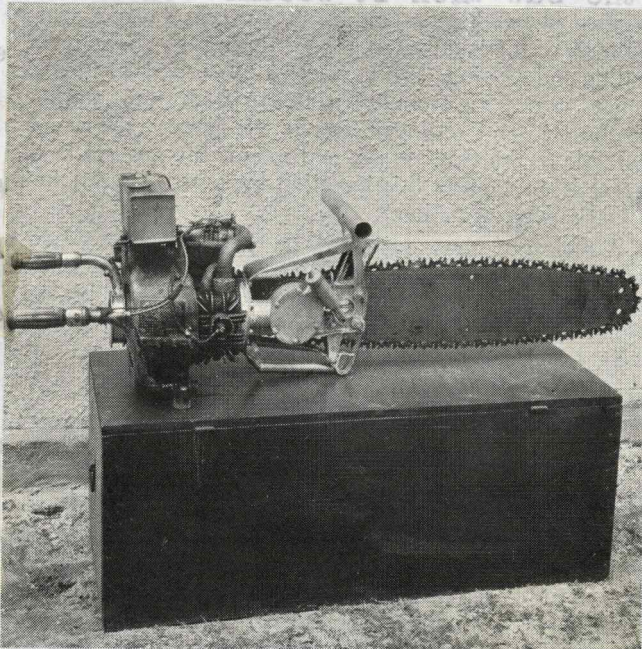
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of the saws. The changes which resulted in actual improvements were:

1. Addition of a disc type clutch with a hand grip controlled throw-out device. This helped to avoid damage to the saw when it became stuck and as a safety and time-saving measure when moving from tree to tree.
2. Installation of a reversible blade to facilitate the use of the top of the blade as a cutting edge.
3. The flywheel was cut to increase the air draft over the cylinders and a section between each air-driving fin was cut out to permit centrifugal force to act. This increased the air draft, and at the same time decreased the weight of the machine.
4. Two nine-ounce pieces were removed from the center section of the crankshaft to decrease weight.
5. An addition of center-balance handles for use of the second saw operator when making the upper cut on timber-bound logs and also for normal saw operation.
6. An aluminum carburetor with the float located nearer the center of the motor was substituted to permit tilting of the saw without changing the carburetor mixture. Although this was not entirely satisfactory, it did reduce the weight of the machine about 2 pounds.
7. Addition of a new type of intake manifold to accomodate the new center float type of carburetor and use of new type of packing glands which were necessary to prevent leakage of air from the manifold.

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5. MODIFIED WOLF CHAIN SAW AND PACKING BOX

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7. Addition of a new type of intake manifold to accommodate the new center float type of carburetor and use of new type of packing glands which were necessary to prevent leakage of air from the manifold.

Other tests for bucking on the landing were made at the Woodworth, Montana, camps of the Anaconda Copper Mining Co. in September, 1937. This trial indicated the following:

"1. The saw, to be a success in logging operations similar to those where the trials were conducted, will require a throw-out device built into the clutch so motor can continue running with saw chain stopped.

2. At present the power saw will cut from 30 to 40 per cent more timber than two thoroughly competent and experienced sawyers. It is felt that it is entirely within the realm of possibility to improve the saw to that extent where it will be from 50 to 75 per cent more efficient than this type of sawyer.

3. Heavy and rugged hickory wedges should be used, and all iron wedges barred.

4. All future developments should carefully avoid addition of any more weight. With its present bulk and weight, the saw can logically be used on the landing as well as for felling trees in the woods. It is not adapted to all felling shows and, if tried out for this work, should be used at first only on selected areas. On operations where timber is tractor-skidded in tree lengths it could be used for making the felling cut and in making the bucking cut on those larger and longer trees requiring this operation. Topping, which is usually hampered by limbs and other adverse factors, could be done by the swampers.

5. The two-foot saw seemed adequate for the average needs on the landing where the timber runs eight logs per thousand, or smaller.

6. More experimental work is necessary to determine the proper method of filing the saw, the right amount of set, etc., for the various species of timber.

7. Saw oil should be used with this saw the same as on hand saws in order to insure good work.

8. For work on the landing, it appeared that the ideal crew would consist of three men, all operators, so they can change off holding the saw handles. One man should be equipped with hammer and wooden wedges while another carries the starting cord, measuring stick, and axe. Duties of these three men would then be as follows:

No. 1 holds rear handles and regulates motor.

No. 2 assists No. 1 by carrying saw by forward handles and looks after hammer and wedge.

No. 3 carries axe and measuring stick and measures logs and scores cuts. Also relieves Nos. 1 and 2 at regular intervals.

This saw crew could only function efficiently if the saw was built with a throw-out or idler clutch.

9. When used for sawing on the landing, an extra

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Woodworth, Montana, camps of the Anaconda Copper Mining Co.

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"1. Similar to require a can contain 2. per cent experience within the that extent efficient 3. and all in 4. addition weight, as well as to all should be operations lengths in making trees rep ly hampers done by the 5. eye needs logs per 6. the proper

operations, will, clutch as motor from 30 to 40 impent and entirely the saw to per cent more could be used, tly avoid ent bulk and landing as is not adapt- this work, on, in tree, ing out and longer, which is usual- rs, could be the aver- and eight to determine amount of

TESTING CHAIN SAW DOUGLAS FIR

7. For the various species of timber, set, etc., as on hand saws in order to insure good work. 8. For work on the landing, it appeared that the ideal crew would consist of three men, all operators, so they can change off holding the saw handles. One man should be equipped with hammer and wooden wedges while another carries the starting cord, measuring stick, and axe. Duties of these three men would then be as follows: No. 1 holds rear handles and regulates motor. No. 2 assists No. 1 by carrying saw by forward handles and looks after hammer and wedges. No. 3 carries axe and measuring stick and measures logs and scores cuts. Also relieves Nos. 1 and 2 at regular intervals. This saw crew could only function efficiently if the saw was built with a throw-out or idler clutch. 9. When used for sawing on the landing, an extra

saw chain (sharp) should be available for changing at noon. It would also be necessary, of course, to have an extra saw available somewhere on the operation in the event of motor trouble."

The Reed-Prentice Corp. has recently announced some new models of the Wolf type portable timber saw to supplement the improved line of air and electric driven models and designed to eliminate the difficulties encountered in the above mentioned trials. The gasoline driven saw is available in 16, 24, and 36 inch capacities, weighing respectively 75, 80, and 95 pounds complete. The capacity of the 16-inch saw can be increased to 38 inches, the 24-inch saw to 54 inches, and the 36-inch saw to 78 inches by removal of the bracket handle and guard from the frames. The engine provided is a two-cylinder, horizontal opposed four-cycle, air-cooled type of aircraft construction in design and materials. It develops five horsepower at 2800 rpm and weighs 45 pounds. The cost of the Wolf saw is in the neighborhood of \$750.

The German-made Stihl saw, which was originally designed and developed for army service in European countries, when introduced to the Pacific Coast region was found to need many changes and adjustments for practical, economical use. Shortly after the British Columbia Loggers' Association imported one of the Stihl saws late in 1936, the Bloedel, Stewart, & Welch, Ltd., recognizing its simplicity, portability, and adaptability to most of their shows, transferred their development program for power saws from the Dow machine to the Stihl and have since then conducted exhaustive studies in cooperation with

the B. C. Loggers Association.

The Stihl saw first experimented with was a light-weight, portable chain power saw with a 60 inch blade, driven by a single cylinder, two-cycle, high speed motor. The complete machine weighed 120 pounds and could be readily handled by two men although a crew of four or five men was found to be most efficient for many shows. The experiments conducted in 1937 under the supervision of J. W. Challenger brought out the following cost figures for the month of July during which time 819,558 feet were cut by the machine with a four man crew:

Falling & bucking labor and operators' repair labor	\$590.00	PM .72
Fuel--20 gal. gas and 2 gal. oil	4.20	.005
Depreciation	24.60	.03
Repairs	8.20	.01
Supervision at .60	49.20	.06
Filing at .035	28.70	.035
Cost per M		.86

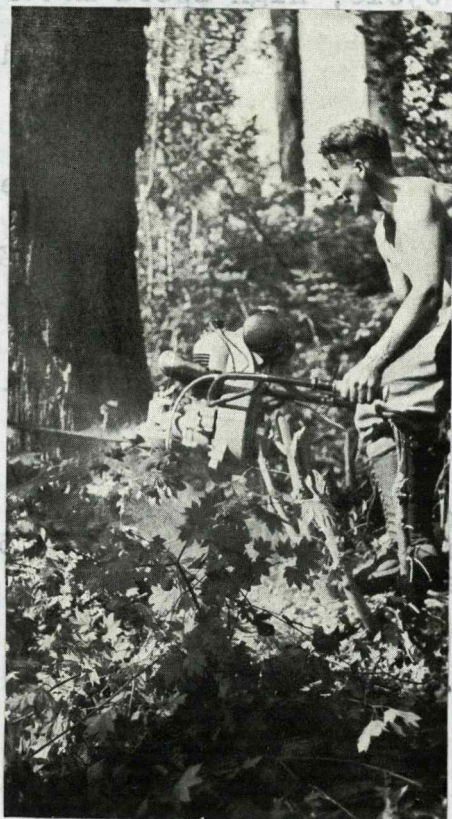
This figure was \$.02 per M higher than the average contract hand falling cost over the entire operation and \$.07 per M more than the cost of falling and bucking the same show with contract fallers but was lower by \$.052 per M than the earlier test in January. A comparative time study analysis of experiments made in May and August, 1937, show that time as well as cost was gradually being reduced through experience and improvements in the saw.

	May		August	
	Min	Sec	Min	Sec
Swamping, moving, and setting up	6	30	1	51
Starting saw		39		19
Sawing and chopping undercut	3	27	2	11
Sawing the back of tree	2	2	1	59
Wedging	2	20		7
Miscellaneous delay	1	55	1	13
Total time per M feet felled	16	53	7	40

the B. C. Loggers Association.

The Stihl saw first experimented with was a light-weight, portable chain power saw with a 60 inch blade, driven by a single cylinder, two-cycle, high speed motor. The complete machine weighed 130 lbs. and was found to be most efficient for use in the 1937 under the supervision of the following cost figures: 819,558 feet was cut by a four man crew:

Cost per M	86
Filing at .035	28.70
Supervision at	42.20
Repairs	6.20
Depreciation	84.60
Fuel--20 gal. @ .03	4.20
Operators	90.00
Felling & bucking	72



This figure was the average cost-

tract hand felling & bucking was \$1.07 per M more than the cost of felling and bucking the same show with contract fellers but was lower by \$.052 per M than the earlier test in January. A comparative time study analysis of experiments made in May and August, 1937, show that time as well as cost was gradually being reduced through experience

August		May		
Min	Sec	Min	Sec	
1	51	6	30	Swamping, moving, and setting up
19	19	39	39	Starting saw
11	11	27	27	Sawing and chopping undercut
1	29	2	2	Sawing the back of tree
7	7	20	20	Wedging
13	13	55	55	Miscellaneous delay
40	40	23	23	Total time per M feet felled

and improvements in the saw.

The May study covered 12 trees with an average scale of 1,947 feet per tree, the August study covered 18 trees with an average scale of 1,540 feet per tree.

During the course of the experiments considerable trouble with chains and other parts of the machine were encountered which resulted in the following changes being recommended to the Stihl saw manufacturers:

- "1. Cutter-bar of same width but with even bevel, and to swivel at intervals of 10 degrees through a complete circle.
2. Detachable handle. T-shaped grip.
3. New type chain lubricator.
4. Improved clutch.
5. Non-leak carburetor.
6. Guard for gas tank.
7. Positive oil bushings for clutch and crankshaft to prevent oil leaking into clutch plates and magneto.
8. Automatic strap starter.
9. Use the best material available for chains especially, and all other parts of the machine. The best is none too good."

These and several other improvements which were incorporated in new models of the Stihl saw delivered to the Bloedel, Stewart, & Welch, Ltd., in 1938 reduced the loss of time through breakdowns of the machines to a very low figure, and the cost of felling and bucking below that of hand falling. Output per man was at the same time materially increased. Four power saws (19 men) are now cutting the approximate equivalent of eight gangs of hand fallers (24 men) in timber averaging 450 feet to the log and on ground that is generally steep and broken. During the first six months in 1938 18,626,000 feet of timber were felled by Bloedel, Stewart, & Welch, Ltd., power saws, whereas in 1937 only 5,983,000 feet

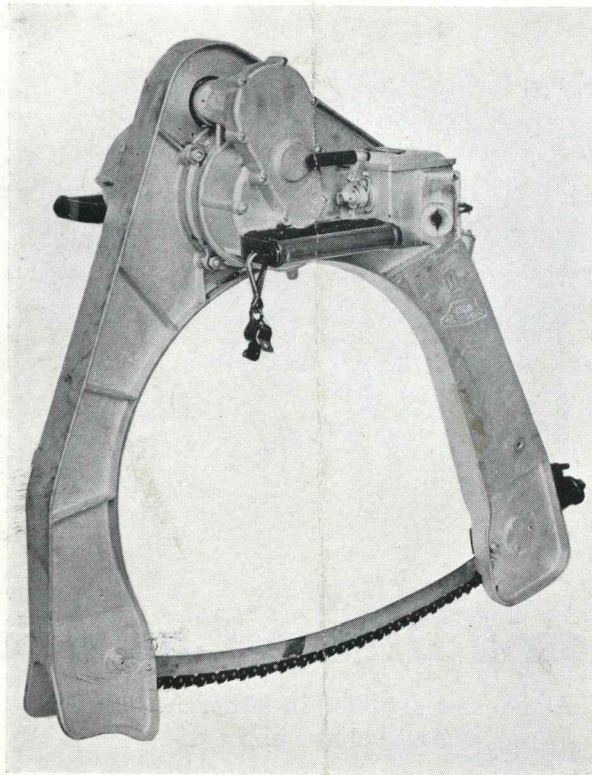
were felled. Power saw operators are paid by the day plus a bonus to give an incentive for increased production. The power saw gangs are worked in groups of four to six machines in one area so a mechanic can make the rounds of the machines regularly, doing any repair work necessary. A five-man crew was found to give the highest production per man per day.

The Bloedel, Stewart, & Welch, Ltd., are now experimenting with a new type, especially light weight, Stihl machine for use in felling and bucking very small timber. It has already given evidence of some advantage over the larger machines in use on small timber.

There are at present about 50 Stihl power saw machines in operation in British Columbia. These are working in Douglas fir timber and are operated by reputable logging concerns who have reported reductions in their falling and bucking costs to about half of their previous hand falling and bucking costs, while at the same time producing a greater amount of timber. In Washington six machines are in operation and have been equally efficient in pine, Douglas fir, hemlock, spruce, and cedar. Region 6 of the United States Forest Service, Portland, Oregon, is experimenting with the Stihl saw in cutting snags in the Mount Hood Forest. Since snags are dry and tough, they present more difficult problems than most of those encountered in cutting green timber. Region 6 is using a 60 inch saw of the type used in British Columbia.

The Type A machine shown in the folder is priced f.o.b. Seattle as follows:

STIHL POWER SAW



MILL & WINE SUPPLY, INC.
2700 7TH AVE. SOUTH
SEATTLE, WASH.

BOWSAW - Gas or Electric

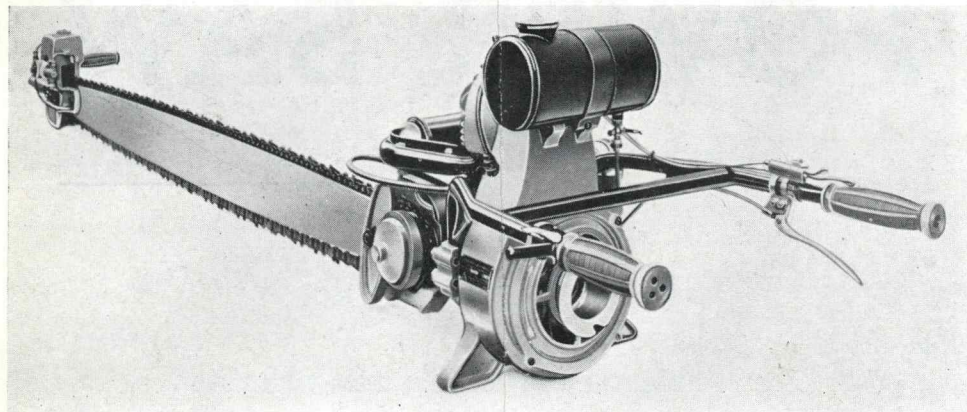
Above saw can be supplied in either A.C. or D.C.,
any voltage or cycle required.

The BOWSAW illustrated above is an Electrically driven Chain Saw, very light in weight and designed so that it can be easily handled by one man.

The machine is built in two sizes, 14" and 20", and is especially adapted for use in pole or tie camps, for bucking anything up to its capacity.

This machine can also be supplied with Gasoline Motor for use where Electricity is not available.

STIHL POWER SAW



Type "A" - Weight 120 lbs.

The above Chain Saw is powered by a one cylinder, two cycle, $7\frac{1}{2}$ H.P. motor, with low tension magneto, and air cooled. Has a dry disk clutch—unusually smooth in operation—requiring very little attention.

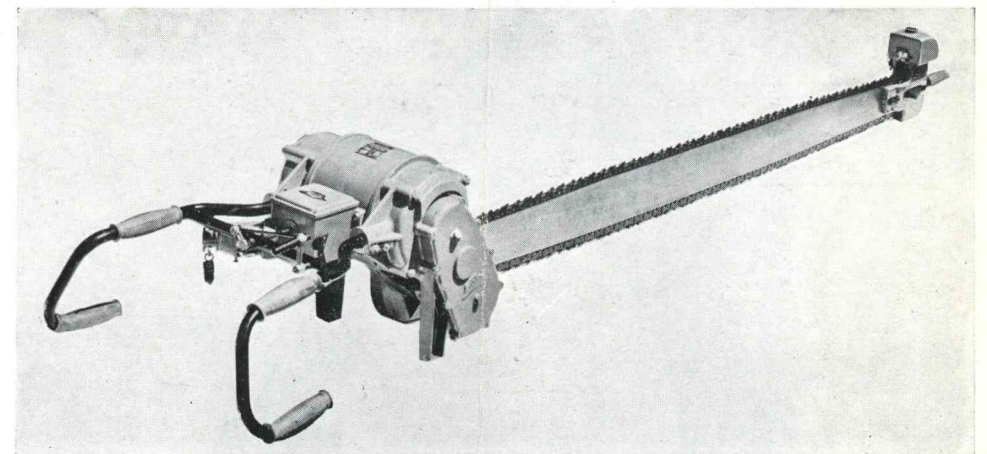
Carburetor of simple design, with adjusting screws for controlling fuel and air. Clutch—cutter bar, gas and air all controlled from handle bars, no lost time or motion. Cutter bar swivels so that cut can be made at any angle required for undercutting.

The Stihl Saw is the simplest, most highly developed, most economical, both to buy and to operate.

Type A $7\frac{1}{2}$ H.P. Cutter bar length from 28" to 80". Wt. 120 lbs.

Type B 6 H.P. Cutter bar length from 24" to 42". Wt. 70 lbs.

Type C $4\frac{1}{2}$ H.P. Cutter bar length from 20" to 24". Wt. 55 lbs.



Electric Driven Chain Saw

Above saw supplied in either A.C. or D.C.
Any voltage and cycle.

The above Electric Chain Saw is simple in design, very sturdy and easy to operate. The Chain Saw pictured above is designed for bucking logs on a landing or in the water. This chain saw can also be used to great advantage in splitting.

They are light in weight and have a surplus of power, cut very fast and maintenance cost is low.

The Electric Chain Saw can be supplied in any size ranging from 18" cutter bar to 120" cutter bar with motors from 2 H.P. to 9.5 H.P.

48" saw	\$475.00
60" saw	485.00
70" saw	500.00

In addition to the above saws Mill & Mine Supply Inc., Seattle, Washington, distributors of the Stihl saw, are preparing to market a smaller machine with a $4\frac{1}{2}$ horsepower motor. It will have a maximum cutting bar of 48" and weigh 85 pounds complete. The price of this saw will be \$425.00. They are also introducing a new type chain bucking saw designed for use in pole or tie camps. This saw, termed the Bow saw, is built in two sizes, 14" and 20", and can be powered either by a gasoline or an electric motor. The Bow saw is light in weight and can be easily handled by one man.

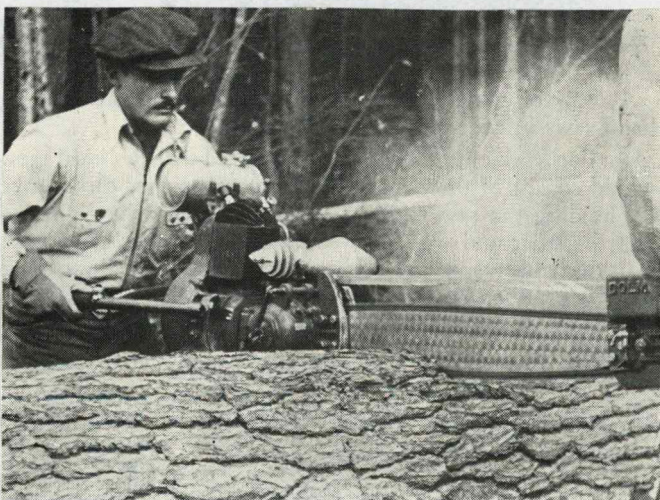
The Dolmar portable chain saws, both gasoline and electric, are manufactured in Germany and are being introduced and distributed in the United States by the Vulcan Iron Works Company, Denver, Colorado. Although the Dolmar saws are comparatively new to the West, over two thousand machines are reported as being in service throughout the world. In eastern Canada the Dolmar gasoline power saw has been giving a remarkable account of itself and users there and in other countries report a reduction of from 50 to 75 per cent in sawing costs. The machines are in most cases supposed to pay for themselves in six to eight months of service. Performance records of the Dolmar saws in varying diameters of logs are: 20 inches, 20 seconds; 26 inches, 52 seconds; 32 inches, 1 minute, 35 seconds; 40 inches, 2 minutes, 30 seconds; 50 inches, 5 minutes. Fuel consumption for gasoline saws is

\$475.00
485.00
500.00

48" saw
80" saw
70" saw



FELLING WITH DOLMAR SAW



BUCKING WITH DOLMAR SAW

records of the Dolmar saws in varying diameters of logs are:
30 inches, 20 seconds; 24 inches, 22 seconds; 32 inches,
1 minute, 35 seconds; 40 inches, 2 minutes, 30 seconds;
50 inches, 5 minutes. Fuel consumption for gasoline saws is

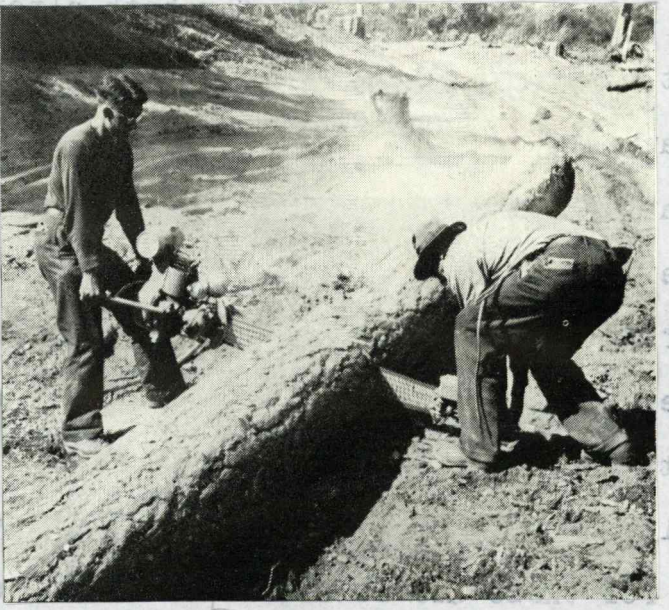
1½ qts. per hour.

Important features of the Dolmar gasoline power saw are the automatic laminated disc clutch which protects the saw chains and entire machine from overloads and shocks, and an automatic tension device to keep the saw chain from being tightened to a point causing chain breakage and bearing overloading. A rotary head is provided which allows the cutting bar to be changed from a felling to bucking position in a few seconds. The gasoline motors are two cycle, 5 to 7 horsepower, air cooled engines made with magnesium alloy castings to reduce weight. The gasoline machines, complete, weigh from 95 to 132 pounds, depending on size. Their price ranges from \$525 to \$825, less a discount of 15%.

Electric Dolmar saws are made for both alternating and direct current and are provided with an automatic slip to relieve the saw chain from motor inertia overloads resulting from jammed saws. The models for alternating current, 60 cycle, 3 phase, weigh from 55 to 148 pounds and have a horsepower range of from 2.2 to 8.0 depending on size of cutter. They are priced from \$305 to \$645, less a discount of 10%. Direct current type saws have a horsepower range from 2.2 to 5.3 and weigh about 10% more than the alternating current type. Prices for these are from \$340 to \$770 less 10% discount. All three types are made in capacities of 20, 26, 32, 39, 49, and 58 inches. Saw chains have a rated life of approximately 30,000 average cuts and cost from \$46.75 to \$92.25.



DOLMAR SAW BUCKING TREE LENGTH LOGS to reduce weight, weigh from 95 to 135 pounds, depending on size. Their price ranges from \$225 to \$325, less a discount of 15%.



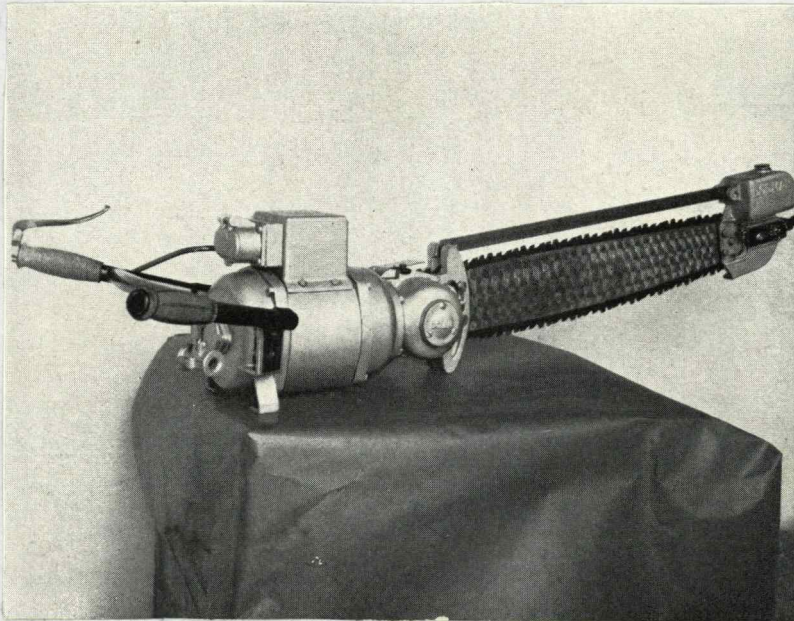
"CORNER CUTTING" TO INCREASE SPEED count. All the saw chains have a rated life of 39, 49, and 58 inches. Approximately 30,000 average cuts and cost from \$46.75 to \$92.25.

A recent test conducted by Region One of the United States Forest Service further indicated the Dolmar Power Saw has good possibilities as a practical logging device. The test, held on the Sleeping Child Creek Operations of the White Pine Sash Co., of Missoula, Montana, consisted of bucking tree length Ponderosa Pine logs on a tractor landing where conditions would be representative of an average show. The landing used was short, crowded, and rocky.

The tests, according to the director, I. V. Anderson, indicated the Dolmar saw has several superior points. Outstanding of these were: ease of starting, speed of cutting, lack of skill required in filing saw, positive and reliable operation of clutch, and ability to stand sustained operation without heating. The principal disadvantage of the 39 inch Dolmar saw used on this test was its weight, 104½ pounds with full gas tank.

In bucking logs over 16 inches in diameter it was found that greater speed and better power utilization could be obtained by using a corner cutting method. Logs up to 35 inches in diameter were cut without difficulty or loss in speed by this method. It also developed that the chain would operate more smoothly and efficiently in the cut if the saw guard was held three or four inches away from the log. American distributors of the saw recommend they be used in timber having diameters at least two to four inches less than the cutting length of the saw for most efficiency.

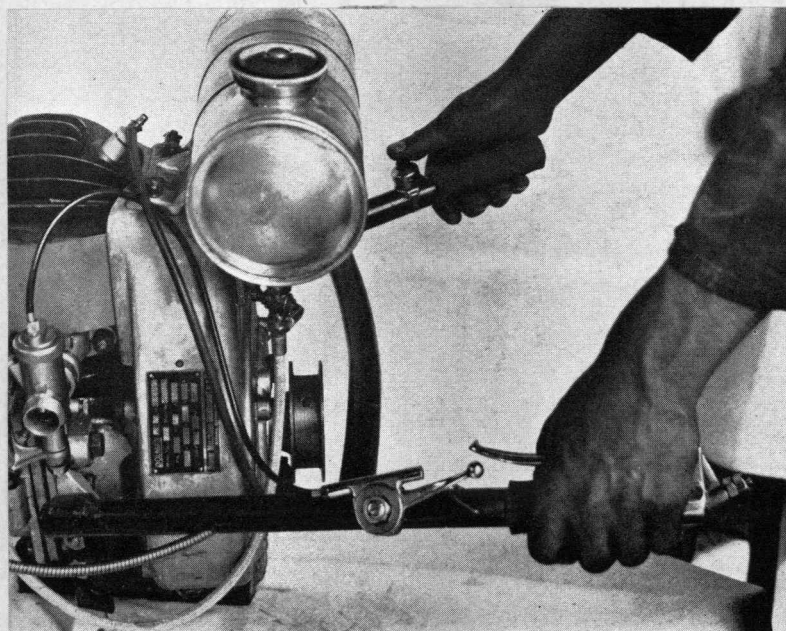
A recent test conducted by Region One of the United States Forest Service further indicated the Dolmar Power Saw has good possibilities as a practical logging device. The test, held on the Sleeping Child Creek Operations of the White Pine Lumber Co., of Missoula, Montana, consisted of buck-



MODEL "D" ELECTRIC DOLMAR SAW. Full gas tank.

In bucking logs over 16 inches in diameter it was found that greater speed and better power utilization could be obtained by using a corner cutting method. Logs up to 25 inches in diameter were cut without difficulty or loss in speed by this method. It also developed that the chain would operate more smoothly and efficiently in the cut if the saw guard was held three or four inches away from the log. American distributors of the saw recommend they be used in timber having diameters at least two to four inches less than the cutting length of the saw for most efficiency.

Since making the preliminary test at the White Pine Sash Co. operation, Region One has purchased a Dolmar Power Saw for further testing and experimenting and plans to develop some efficiency and cost figures soon.



DOLMAR SAW GASOLINE ENGINE CONTROLS

CONCLUSION

In this paper the history and development of the felling and bucking saw has been traced from ancient times up to the present day. In it has been briefly sketched the development of the hand felling saw and, more completely and detailed, the development of the early power felling machines from awkward, heavy, inefficient devices to the light, compact, and comparatively efficient power chain saws of today.

But to stop at this point, leaving the impression that the power felling and bucking problem of the country, and more particularly of the northwest, has been solved, would be foolish and misleading. This is actually only the beginning. The practical use of power saws is in most cases still in the experimental stage. Power saws themselves are still in their infancy. What the power saw of tomorrow will look like, what it will be powered by, how it will be transported, and to what heights of efficiency it may climb are questions which cannot be answered now; however, it is believed by some that the power saw of the future may be in the form of an electrically operated chisel, some that it will retain almost its present shape and form, while others believe that the saw will be mounted on a swivel, tilting platform ahead of a light tractor and that its power will be supplied by gasoline or diesel oil. Regardless of their variance in opinions on what tomorrow's power saws will be, all agree that power saws are here to stay and will ultimately bring about a great increase in the efficiency of falling and bucking under

conditions encountered in the Douglas fir regions as well as in the pine and redwood. They also believe that when power saws become more practical and more extensively used they will remove much of the back-breaking labor now required and will attract a better class of men into the industry.

In order to hasten the development of a practical power saw especially suited to the Douglas fir region, a power saw committee appointed by the Pacific Logging Congress is negotiating an agreement between the West Coast Lumberman's Association and The British Columbia Loggers' Association whereby they will raise a joint fund of \$5,000 for development and experimental work. Just recently this committee has reported that The British Columbia Loggers' Association is willing to cooperate on such an agreement.

It is only natural that, with such agreements as the above being negotiated and with men thinking and talking about, and experimenting with, power saws, new ideas and improvements will result which will, before long, make power saws an economical and integral part of the logging industry.

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