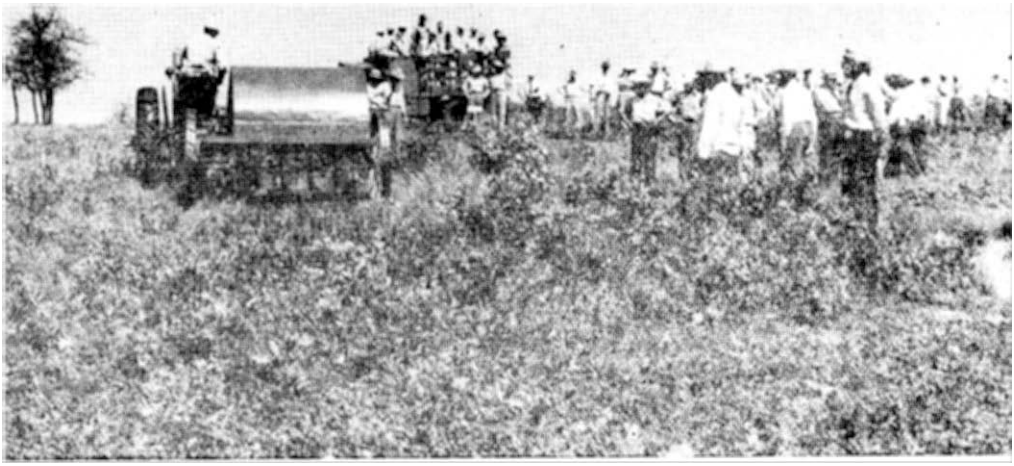


OSU Collection

Brush and Tree Removing Machinery

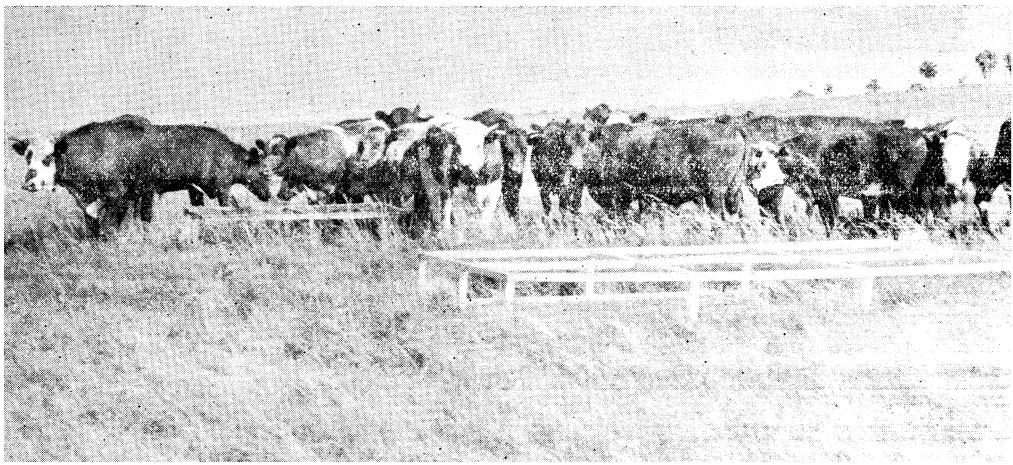
BY MAURICE B. COX

OKLAHOMA AGRICULTURAL EXPERIMENT STATION

Bulletin B-310 May, 1947

in cooperation with

SOIL CONSERVATION SERVICE



CONTENTS

OKLAHOMA AGRICULTURAL EXPERIMENT STATION
Oklahoma A. & M. College, Stillwater
W. L. Blizzard, Director Louis E. Hawkins, Vice Director
in cooperation with
SOIL CONSERVATION SERVICE
United States Department of Agriculture
91765

Brush and Tree Removing Machines

By MAURICE B. COX

Agricultural Engineer, Red Plains Conservation Experiment Station, Guthrie, Oklahoma

Over seven million acres of shallow rolling land in central Oklahoma, Texas and Kansas are covered with native grass and scrubby oak (*1*).* The production from this land is far below its possibilities. The grass is too sparse for pasture, and the timber is of little value except occasionally for posts or firewood. Many acres of native pecan groves in the eastern and southern sections of Oklahoma are hampered in production because of undesirable tree growths. Sage brush and mesquite thickets hamper production on large areas in the western part of Oklahoma and other western states.

> Forest vegetations are recognized as being very effective for preventing erosion. They are frequently found on soils that will erode rapidly if the cover is destroyed. *Care should be exercised in removing trees or brush so that the undergrowth of grass is not destroyed.* This will allow the grass to rapidly develop a protective cover. The advantage of removing trees and brush from woodland pastures has been observed at many locations (*1, 2, 3, 5*).

Several kinds of machines and chemicals are being manufactured for removing trees and brush and controlling sprouts (*3*). Some of these are being studied through a cooperative project of the Oklahoma Agricultural Experiment Station and the U. S. Soil Conservation Service at the Red Plains Conservation Experiment Station at Guthrie, Oklahoma. This bulletin reports on the machines studied at the station and observations made throughout the state. The machinery studied at the Red Plains Station includes small portable saws, and machines or attachments for small farm-size tractors.

GENERAL RESULTS TO DATE

Research findings to date show that machines for removing brush from farm land must satisfy two general requirements; namely, sturdiness and economy of operation. A machine that requires excessive maintenance or covers too small an area in a day is certain to be unsatisfactory.

* Italic figures in parentheses refer to "Literature Cited," page 32.

The growth characteristics of woody plants make their removal and methods of control vary with changes in climatic and soil conditions. It appears unlikely that any one machine or clearing method can be developed to satisfy the requirements for all conditions or types of brush. A machine to handle brashy material such as sage or creosote brush must be quite different from one for tough, taller growing material like black-jack or persimmon. The types of vegetation to be removed may be classified in three groups: brashy shrubs, tough shrubs, and trees. Sage and creosote brush break up very readily under the impact of a beater. Tough material such as buck brush, black-jack, and liveoak thickets can be readily cut with a mower. The larger trees require axes or portable saws unless larger machinery is available.

In handling or removing the cut material after or during cutting operations, buck rakes have shown a distinct usefulness.

In addition to the machines, chemicals may prove a distinct advantage in the killing of brush and in controlling sprouts (*4*). Crushers, drags and rolling cutters are being tested for removing or crushing upright trees and brush that have been deadened with chemicals. This is necessary in order to prevent interference with proper maintenance or pasture management.

Attempts have been made to eradicate or control brush at many locations with varying degrees of success. Mowing annually for ten years at the Guthrie station has reduced sprout growth on cleared land to such an extent that it no longer offers competition to the grasses.

Mowers and beaters have also been used extensively on sage brush. Savage (*5*) at Woodward, has found that June is the best time for such an operation. Mesquite and other thorny trees and brush were successfully removed in southwest Texas (*6*) by the use of bulldozers, or tree dozers, followed by heavy root plows. The brush, roots and stumps were then piled into windrows with a heavy buck rake. Afterwards the land was leveled with a heavy drag and plowed with an extra heavy tandem disc harrow. After this process of complete clearing and cultivating it was seeded to tame grasses or legumes for pasture. The costs of these operations range from $35.00 to $45.00 per acre not including the final seed bed preparation and seeding (*6*). Giant stalk cutters weighing from 3,000 to 28,000 pounds have been used in several states for breaking down and crushing brush and trees. Smaller cutters have also been used for controlling sprouts and weeds.

Mobile or portable saws have been used in all sections of the country where brush and trees are to be removed.

BRUSH BEATERS

The brush beater made at the Guthrie station consists of a series of weighted chains driven by a horizontal revolving shaft which acts much the same as a hammer mill (Figure 1). This machine is similar to one being manufactured for sale.* The shaft is mounted on a frame supported by two wheels. The chains are of such length that the beater heads are 30 inches from the center of the shaft. They are spaced at 3-inch intervals, center to center, and are attached on the quarter lines around the shaft for equal distribution of the weight. This distribution makes the chains 12 inches center to center along each of four lines.

The beater heads are made of 4-inch squares of ⅜-inch iron with a 4-inch section of ⅞-inch round stock welded at the center. Seven-eighth inch holes were drilled at the center of the square heads and the round shafts inserted and welded on both sides. Seven-sixteenth inch chains are used; they should not be smaller

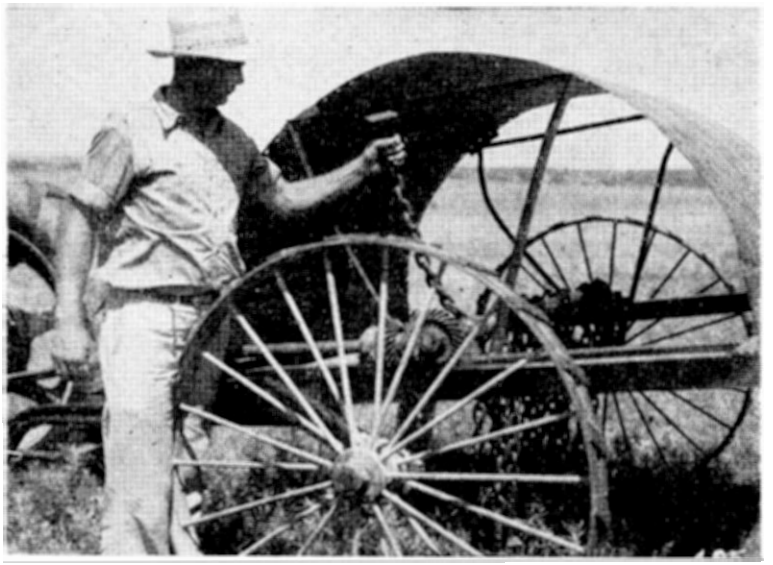


Fig. 1.—Brush Beater.

This brush beater was constructed at the Red Plains Conservation Experiment Station. Machine is now equipped with steel gears and an 8-inch pipe drum for chain mountings. This type of machine is very effective for removing brashy shrubs similar to sagebrush or for sprout and weed control on stumpy or stony land where mowers cannot be used.

* Manufacturers of brush beaters:
Bristow Machine Shop, Harry Butterfield, Manager, Bristow, Okla.
(A machine similar to the one shown in Figure 1)
R. Leland Ross, Arnett, Okla. (Figure 2)

than ⅜-inch nor larger than ½-inch. The beater heads clear the ground about 2 or 3 inches, depending upon the amount the wheels are expected to sink due to soft or sandy soil. Provision for adjusting the height of cut is arranged at the wheel mountings.

The revolving shaft should not be smaller than 1¼ inches in diameter with the chains welded to a pipe mounted over the shaft and extending nearly to the bearings. A small pipe causes excessive wear on the chain link nearest the shaft, because each time an obstacle is struck the chain wraps around the shaft and then unwraps itself again. The use of a 4-inch or larger pipe for the chain mounting is recommended. An 8-inch pipe with 2-inch extension lugs for the chain mounts is now being used for this purpose at Guthrie, and is doing satisfactory work with apparent reduction in chain wear.

The chain shaft is driven from the power take-off of the tractor through bevel gears with a reduction of 1 to 1.4. This gear ratio turns the shaft at about 380 R.P.M. when the tractor is operating at full throttle. This speed appears to be about the maximum for the size of the machine and accuracy of balance attained. Higher speed would be desirable if better balance could be obtained, or if shorter chains were used.

The machine is similar in design to the "Iron Goat" developed several years ago in Missouri. The Missouri machine was horse-drawn and powered from a ground wheel similar to the bullwheel of a binder. Beaters function well in brashy growths and on low growths of tough brush or weeds. They can also be used to a good advantage for controlling weeds and sprouts on stumpy or stony land where mowers cannot operate.

Another type of beater (Figure 2) developed at Arnett, Okla.,* operates in front of a tractor and is maintained at uniform height by a caster wheel. The beater consists of a series of revolving disc with L shaped lugs spaced uniformly along an axle. It is capable of removing dense growths of sage or shinnery oak with stem sizes ranging up to 3 inches or larger.

BRUSH MOWERS

Power Operated Mowers

Power mowers have been widely used for the control of all kinds of brushy growths. These machines have been described in numerous farm magazines from various sections of the country. Any power take-off tractor mower can be equipped for cutting

* See list of manufacturers on page 5.

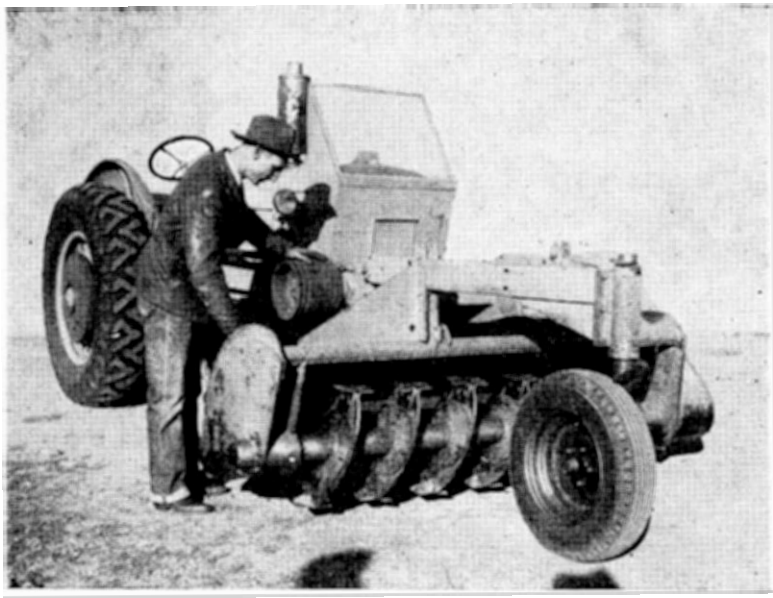


Fig. 2.—Rotary Brush Mower.

This is an experimental beating machine being developed at Arnett, Okla. This machine is capable of handling very dense growths of tough shinnery oak with stem diameters ranging up to three inches.

brush. Heavy duty mowers, of course, will stand heavier usage and will handle larger brush.

An experienced operator can keep a power driven mower in constant operation through fairly dense growths of brush with stem sizes ranging up to 1½ inches in diameter. Stems up to 2 inches in diameter can be cut when only one is cut at a time. These capacities are possible only during the time the brush is growing vigorously.

To cut stems larger than 1½ inches in diameter it is frequently necessary to stop the tractor with the cutter bar pressing against the brush and allow the sickle to hit the stem several times. For best results, all the material larger than about 1½ inches in diameter should be removed ahead of the mower. This can be done with an axe as the mowing proceeds. If the larger brush is removed during the mowing operation, it can be thrown into the mowed area where it will not interfere with the mower.

The tractor should be operated in low gear when mowing brush. This allows the sickle to run fast in comparison to the

forward motion. On some machines it may be desirable to install an extra gear or drive pulley to obtain high sickle speed.

Keep sickles sharp and all mowing equipment in snug working order at all times.

Several large land owners and contractors have objected to the cost of repairs and maintenance of mowers when used on an extensive scale. Part of this cost probably might be charged to careless or inexperienced operators. Certainly no farmer who owns a tractor with a power mower can purchase a machine for brush cutting for as little as $35.00 (cost of five-foot bar complete with stub guards, extra hold-down clips and two sickles with heavy sections) if his brush can be handled with this kind of equipment.

Adjustment: The slip clutch and the safety release on the mower frame should be tight to increase the power transmitted to the cutter bar. These adjustments should be carefully made so the safety devices will continue to prevent damage to the machine.

For cutting sage brush (*5*) and prostrate growths of other brush, the cutter bar should run as close to the ground as possible. When cutting large stemmed, upright growing brush it is sometimes desirable to raise the cutter bar on the shoes to take advantage of cutting at a smaller section of the stems. Mowing at this height also helps the grass to become established, by leaving a high stubble. Future mowings will need to be made with high shoes to avoid hitting the high stumps. The stumps will decay rapidly and within a few years offer little interference to normal mowing procedure.

Parts: A five-foot mower bar has been found to be the best length for power mowers. The bar should be equipped with stub guards (Figure 3) and extra hold-down clips. Most mower bars are equipped with hold-down clips spaced 12 inches. Additional clips should be installed midway between these. The sickle should be equipped with heavy sections, either smooth or underserrated. Savage (*5*) recommends underserrated sections for sage brush, but they apparently have no advantage over the smooth sections for oak or similar brush. If heavy grass is encountered, the underserrated sections may prove beneficial.

Most machinery companies have parts for equipping their mowers to cut brush. The stub guards are listed under different names by different companies. They include such names as pea, weed, brush, stub, etc., but they are all essentially alike in appearance and often interchangeable. A list of parts for some commonly used mowers is given in Table 1. The estimated prices

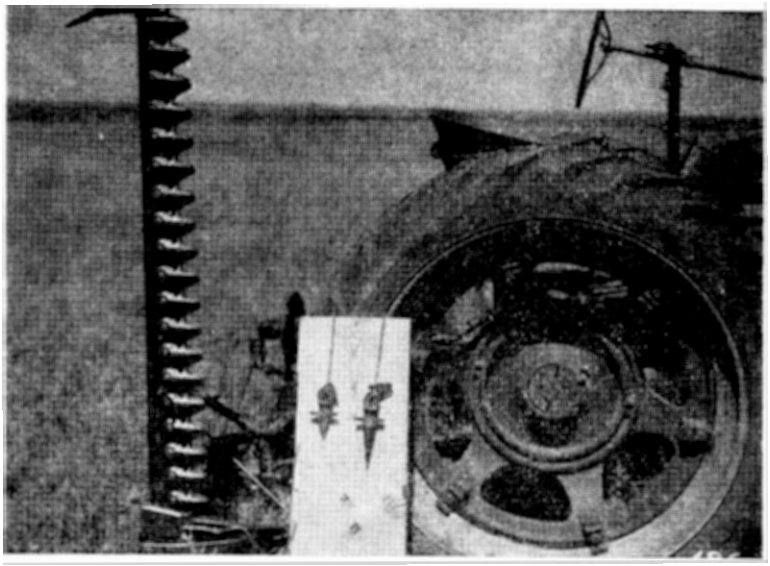


Fig. 3.—Brush Mower Bar.
A standard five-foot bar equipped with stub guards and extra hold-down clips. Sickle is equipped with heavy sections. The exhibit on the board gives a comparison of stub and standard guards. This machine is capable of cutting brush stems up to one and a half inches in diameter during the growing season.

given are pre-war values, and of course subject to change. They also vary somewhat with locations and freight rates.

The cost of purchasing the guards and converting a five-foot standard mower bar over to a brush bar will be between $8.00 and $9.00. Cost of equipping a five-foot sickle with heavy smooth sections will be about $1.40 and for heavy underserrated sections about $1.60, as compared to $1.20 for light or standard sections.

Horse-drawn Mowers

A horse-drawn machine can be used for cutting brush up to one inch in diameter when equipped with stub guards and heavy sections. The cutter bar should not be much longer than 42 inches, and the machine should be equipped with stub tongue and trucks to prevent damage to the horses' necks.

BRUSH AND TREE SAWS

Several companies are making different designs of saws. There are ten or more types being produced. Four machines have been tested at the Red Plains Station. Two of these are

TABLE 1.—Parts Numbers, Names and Approximate Costs of Brush Mower Parts for Several of the Commonly Used Mowers.

	Allis-Chalmers	J. I. Case	Ford	International Harvester	John Deere	Minneapolis Moline	Oliver	Approximate Price
Five-foot bar complete with stub guards[1]	LX2095	SMTA552	5PE01200B	M22569	[2]	1983X	[3] HH19675	$29.00
Five-foot sickle with heavy sections (smooth)	302563	MT950S	5PE01250B	MA1080	AZ1346H	PAB186	Z5773	3.90
(underserrated)	302565	0-152435	5PE01251B	M22835	AZ1354H	PA5017	Z5777	4.25
Stub guard	303027	MT102	7-C	ZA53	Z19H	PA5020	Z262	.40
Heavy section (smooth)	300739	MT590S	PE01235	M333½	Z6451H	PAB188	Z5738	.07
(underserrated)	300738	MT944S	PE01234	M333½S	Z7030H	PA818A	Z5739	.08
Hold down clip	300741	0-14510S	PE01231	MA818	Z7798H	PA135A	Z5475	.15

1 Numbers shown are for bars alone for some companies and for bundles complete with two sickles and shoes for others. Prices change accordingly.
2 Order special cutter bar for cow peas or green vines with Z19H guards.
3 Some models of mowers require HH17103B bar.

small portable power saws and the others are tractor operated. These machines are maneuverable and will do an excellent job of felling trees and brush. Large trees can be cut, but difficulty increases as the diameter becomes greater. This condition has been observed only on oak, hickory, hackberry, honey locust and elm, but may not be true on soft woods such as pine or cedar. The principal difficulty encountered with large trees is the saw blade binding in the cut. Bindng is generally due to irregular travel of the blade into the tree. This usually results from an uneven footing below the wheels of the carriage. However, it may also occur with a dull or improperly set saw.

Small Power Saws

Small portable power saws are being manufactured by several companies.* They are self-propelled and hand operated. These saws (Figures 4, 5 and 6) are powered by small air cooled motors ranging in size from four to eight horsepower. Some of the machines use standard cordwood saw blades, and others

Fig. 4.—Small Portable Power Saw.

The saw is driven by a flexible shaft contained in the curved tube. This type of saw is very effective for cutting brush and trees up to eight or ten inches in diameter. Larger trees can be felled, but with slightly more difficulty. They are especially maneuverable but operate most easily on smooth firm soil.

* Manufacturers of portable power saws:
Jaques Jr.—Jaques Power Saw Co., P. O. Box 695, Denison, Texas. (Figure 4)
Lowther C-Saw—Harry A. Lowther Co., 141 West Jackson Blvd., Chicago 4, Ill. (Figure 5)
Little Giant Tractor Saw—Little Giant Tree Feller Co.. P. O. Box 695, Dallas 1, Texas.
Ottawa Tree Saw—Ottawa Mfg. Co., 1323 Pine St., Ottawa, Kan. (Figure 6)

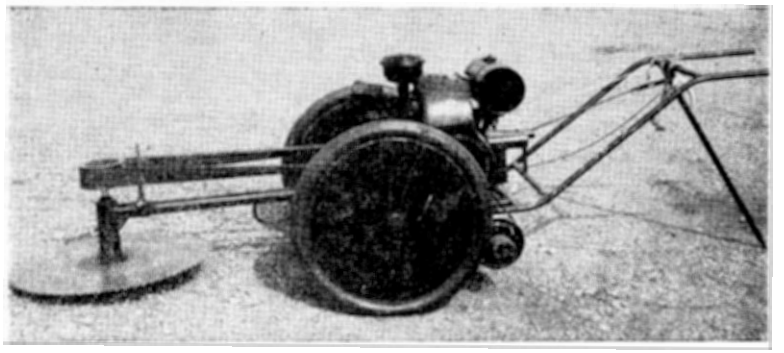


Fig. 5.—Small Portable Power Saw.

This machine is self-propelled and the saw is driven by four V-belts. It is very maneuverable and most efficient on brush and trees ranging up to ten inches in diameter. Larger trees can be felled but with slightly more difficulty. Standard cordwood saw blades are used on this machine.

use blades manufactured especially for the machine. These small saws are most satisfactory for felling trees less than ten inches in diameter.

The operating crew for a small portable saw depends on the size and kind of material to be cut. If the brush or tree growth is small enough for one man to handle easily, two men can work most efficiently. When there are many larger trees or when the growth is very tall and dense, three or four men are desirable to move fallen trees out of the way. A pike-pole will aid materially in making the trees fall clear of the machine operator and the uncut trees. It will also aid in preventing the tree from pinching the saw blade if the wind or limb-load is against the saw. Best results are obtained when two or more of the crew are capable of handling the saw.

Tractor Power Saws

Several manufacturers are building saw attachments for farm tractors.* These saws are driven from the power take-off shaft or the belt pulley of the tractor (Figures 7 and 8). Most tractor-mounted saws can be used for cutting brush and small trees with the tractor in motion. Trees too large for cutting in this manner can be felled by stopping the tractor and swinging the saw into them.

These saws can be used for all types of tree or brush growths where a tractor can be operated. Unskilled operators often find it difficult to prevent the saw blade from striking

* Manufacturers of tractor mounted saws:
Jaques Power Saw—Jaques Power Saw Co., P. O. Box 695, Denison, Texas. (Figure 7)
Irwin Saw—S. E. Irwin Machine Shop, Ponta, Texas. (Figure 8)
Tipps Mobile Saw—Tipps Engine Works, 200 Bailer Street, Austin, Texas.

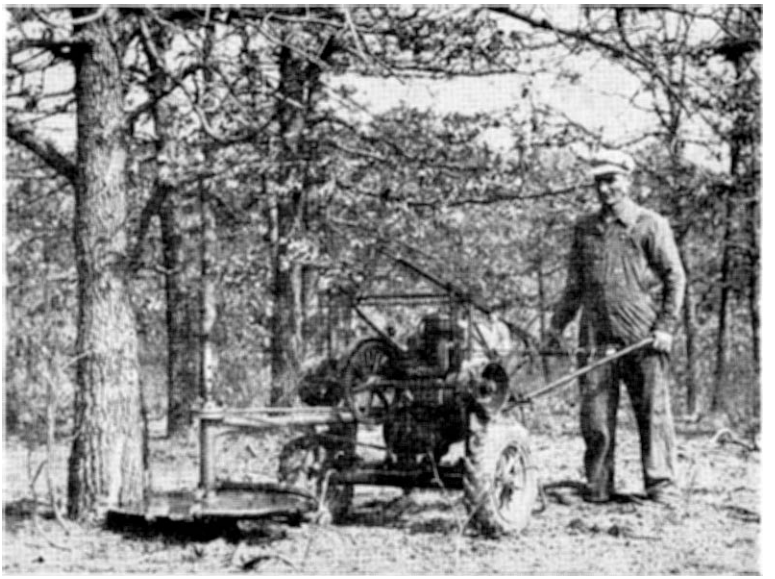


Fig. 6.—Small Portable Power Saw.

This machine is self-propelled by the small pulleys above the wheels that can be pressed down in contact with the tires by means of the lever arrangement above the motor. This machine is equipped with a pivot disc at the center of the axle which allows the saw to swing sideways without moving the wheels. The blade is shown in the horizontal position but can be changed to the vertical position for sawing logs.

the ground or cutting high stumps. This condition is aggravated when the machine must be operated over material cut during previous rounds. Where high stumps have been left, it is difficult to use a bar-type mower for cutting sprouts and weeds.

Best results were obtained in tests at Guthrie, by combining the use of a tractor saw (Figure 7) and a small power buck rake designed especially for handling brush (see Page 26). An alley way was cleared around a land with ample working space for the two machines to operate. Then as the brush and trees were cut with the saw they were assembled and pushed out of the way by the buck rake. This procedure gave the saw operator a clear view of the standing brush and ground condition. He also had an opportunity to cut off any high stumps left during the previous pass. The time required for the two machines was two hours and twenty-six minutes per acre. The growth per acre consisted of 8,470 brush stems 0 to 2 inches and 133 trees 2 to 8 inches in diameter.

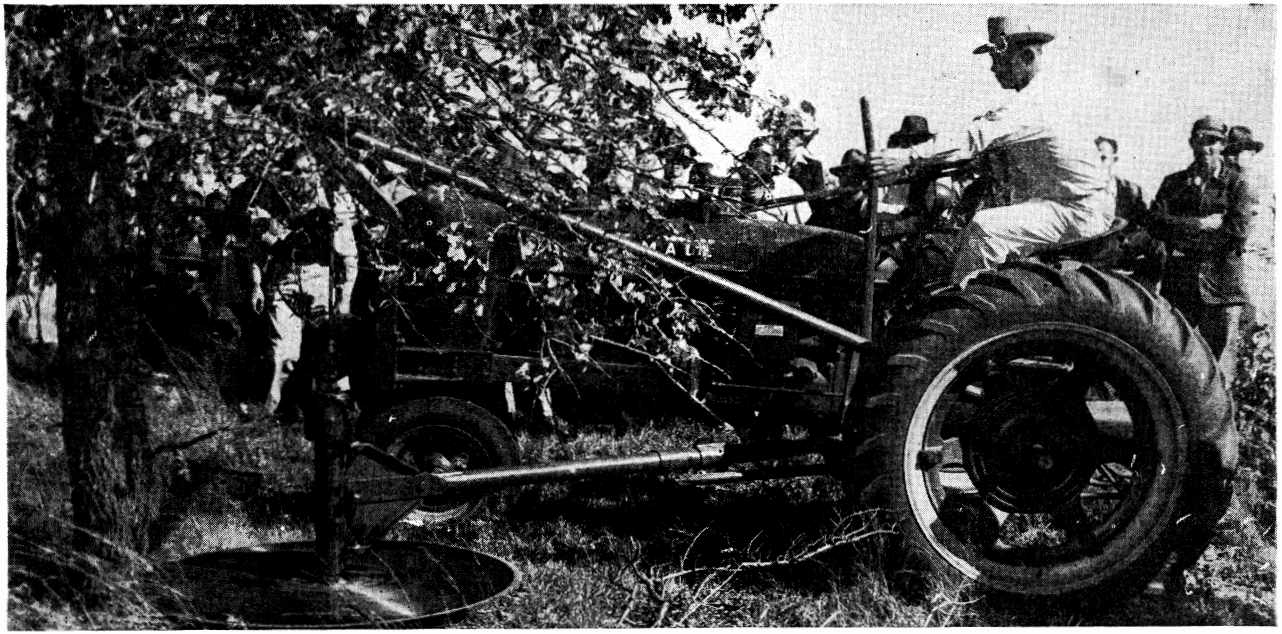


Fig. 7.—Tractor Power Saw.

The saw blade is driven through bevel gears in the housing above the blade. Power is taken from the belt pulley of the tractor. Height of cut is manually controlled. This saw can be operated while the tractor is in motion for cutting brush and small trees. Larger trees are cut by stopping the tractor and swinging the blade into the trunk. The high dozer bar or push frame prevents the tree from falling on the tractor or operator.

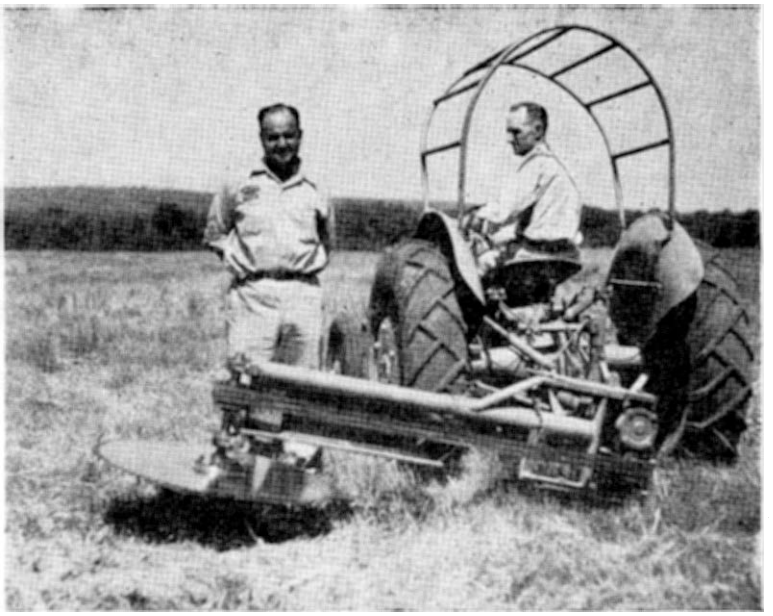


Fig. 8.—Tractor Power Saw.

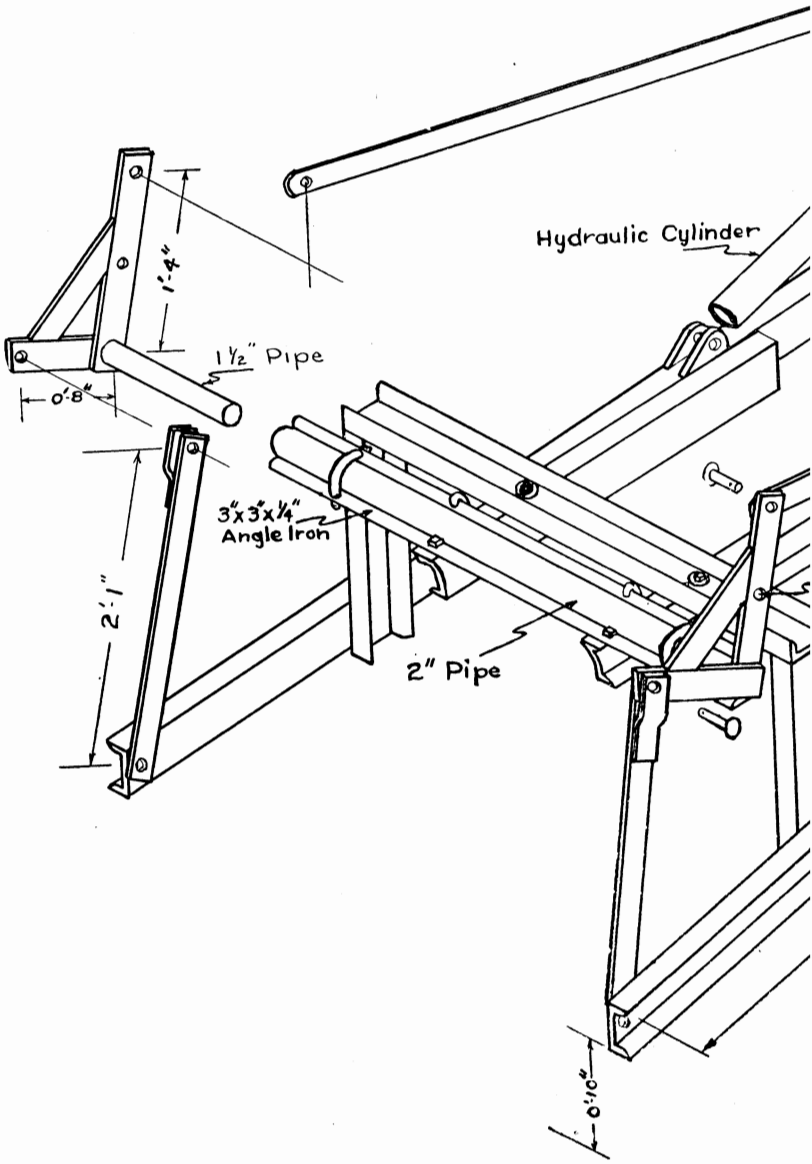
The saw blade is driven by four V-belts from the power take-off pulley. Height of the cut is controlled by the hydraulic lift arrangement. Brush and small trees can be cut with the tractor in motion. Larger trees can be felled by backing the tractor into position and swinging the blade into the trunk. The saw is moved by a lever located at the left of the operator.

Maintenance of Saws

When trees are cut near the ground surface with saws, the blade frequently comes in contact with the soil or gritty particles in the bark. When these particles are carried into the saw cut, they accelerate wear on the saw teeth.

From the work done at Guthrie, it was found that the blades of small portable saws remain sharp from one to two hours, depending upon the type of material cut and the soil condition. Sandy, irregular soil causes more rapid dulling than a tight, smooth soil. Inexperienced or careless operators, as well as stones, can cause excessive dulling. Tractor-mounted saws under the same condition apparently last about twice as long.

A circular saw should cut clearly and easily without unreasonable force to feed it into the timber. Maximum effi-


Hydraulic Cylinder
1'-4"
1½" Pipe
0'-8"
2'-1"
3"x3"x¼"
Angle Iron
2" Pipe
0'-10"

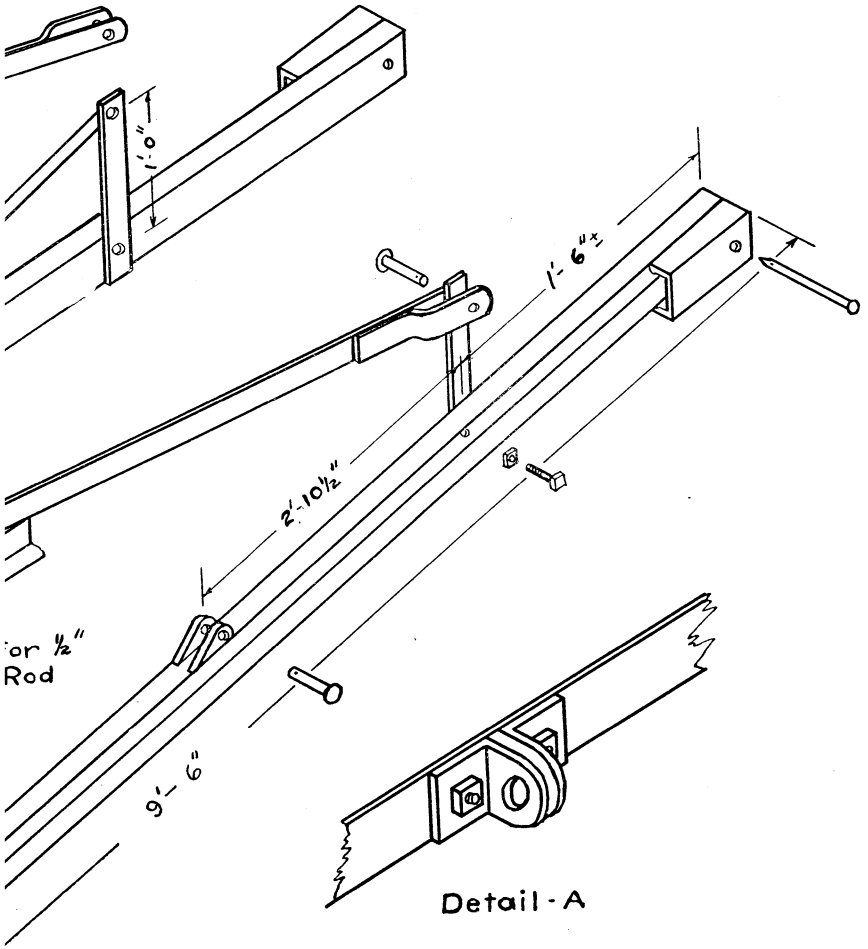


Plate II.—Buck Rake Frame.

A detailed drawing of the push beam and lifting linkages of the buck rake as designed for the Type H McCormick-Deering tractor. It can be adapted for use on any tractor having hydraulic power lift. For further description, see pages 22 to 26.

ciency and ease of operation are obtained with a sharp blade. A slightly dull blade will require only a few minutes for sharpening; but if it is allowed to remain in operation until it has become very dull, output will be decreased and much longer time required for sharpening. Reports show that a dull saw will lose up to 80 percent of the efficiency of the machine (*8*).

Sharpening: In filing or grinding saws, the teeth should be maintained as near as possible to the original shape. The greater part of the filing should be done on the front of the tooth, removing only enough metal from the back to form a good point. Care must also be taken to keep the front edge of the tooth slightly beveled and in line with the center of the blade. Sharp corners or notches in the gullets are the most frequent causes of cracks in circular saws. They may be cleaned out with a 10 or 12-inch rat tail second cut file.

Setting: Bending the teeth of a saw alternately right and left to provide side clearance for the blade is known as setting. When the saw has lost its set from filing or wear it will bind in the cut, causing the blade to heat and consume extra power. Saw teeth should have from 1/16 to 1/8-inch set per tooth, depending upon the size and type of blade. More set is required for blades used on portable saws than cordwood saws. Setting should be carefully and accurately done with a tapered anvil and hammer or with some type of commercial gauging saw set.

Gumming: Cutting the gullets of a saw deeper with a rat tail file or a round edge emery wheel is known as gumming. For best results use a medium grit stone with soft to medium binder (46-M, 60-J or 369 grade MB-B). When gumming with an abrasive, the operation should be performed by going around the saw several times. Do not crowd the wheel or take too deep a cut because bluing or burning the gullets is sure to injure the saw (*9*, *10*). It makes the metal brittle and may cause the blade to crack.

In gumming a saw with a power grinder, caution must be taken to cut a slightly wider slot than the thickness of the stone. If this is not done, the stone will bind in the cut. This may cause the stone to break with possible injury to the operator as well as damage to the grinder mandrel.

Gumming Jig: A simple shop-made jig was designed at the Guthrie station for holding a saw blade for gumming (Plate I and Figure 9). This jig consists of two parts that fit together and operate in a similar manner to the bed and tool carrier of a lathe. The base, or bed of the jig consists of two pieces

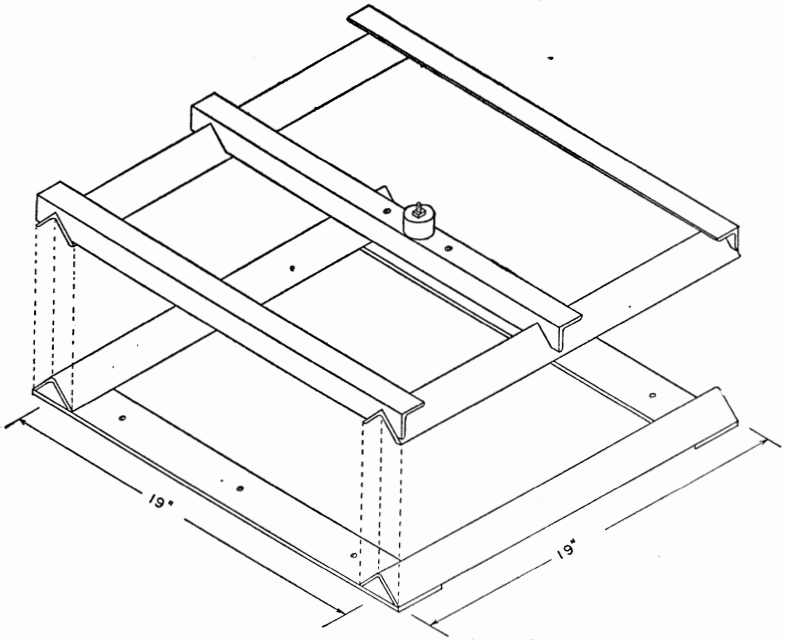


Plate I.—Saw Gumming Jig.

Shop-made jig for holding circular saw blade for gumming. Base and top runners are made of 1½" x 1½" by ¼" angle iron and the cross pieces of the top are made of discarded cylinder bars from an Allis-Chalmers combine. The cylinder bars are faced with rubber, which aids in deadening the noise of the grinding.

of angle iron 18 inches in length welded to two pieces of strap iron so that the crowns of the angles are up and parallel, 18 inches apart. The top, or blade carrier, is formed in a similar manner to fit over the base, except the cross pieces are welded to the crowns of the angles (Plate I). Three cross pieces are required for the top part. The center piece should have several holes for bolting a round lug that fits the center hole of the saw blades. The top cross pieces of the Guthrie jig were made from discarded Allis-Chalmers combine cylinder bars which were faced with rubber. This rubber facing helped to steady the saw blade and to eliminate part of the noise of the grinding. The top corners of the base angle irons were filed to a rounded shape to fit the rounded inside angle of the top runners. Small holes were drilled in the strap irons of the base for nailing it securely to wood blocks used to raise the jig so that the saw blade was in line with the center of the grinder.

Jointing: Grinding or filing the tips of the teeth so that they are all the same distance from the center of the blade is known

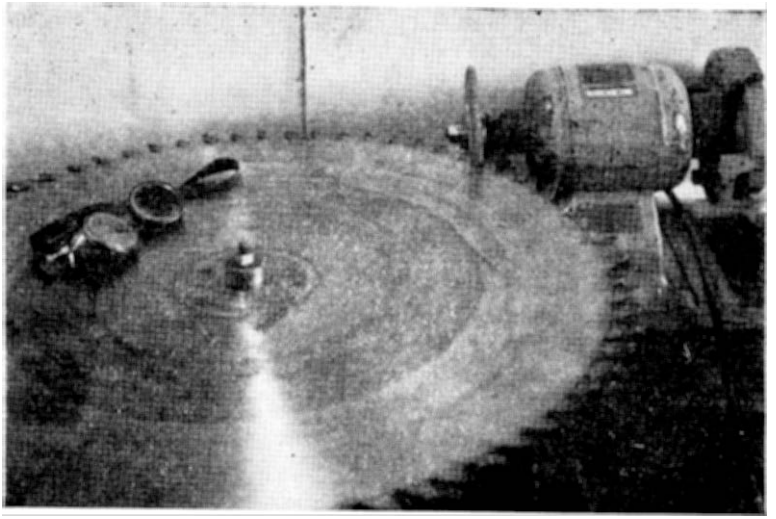


Fig. 9.—Gumming a Saw Blade.

The saw blade is on the jig in position for proper gumming. Goggles should be worn by the operator for protection of the eyes. Grinding should be done by working around the blade several times, cutting the gullets a small amount during each round. Caution must be taken to cut the slots slightly wider than the thickness of the stone. This will prevent the stone from binding in the cut.

as jointing. This operation is necessary to make each tooth do its share of the cutting. Jointing should be done by holding a whetstone or old emery wheel against the tips of the teeth while the saw is running (*11*). Extreme caution should be exercised during this operation. Remove only enough metal from the high teeth to bring them back even with the lowest tooth. After the pointing is completed the saw must be sharpened carefully.

Chain Saws*

Chain saws (Figure 10) are the most maneuverable and easily handled of any type of saw for felling trees, trimming large limbs, and cutting logs. They are not, however, adapted to extensive land clearing of small trees or brush, but should prove their usefulness for thinning stands of mature trees. Many of these saws are being used in the logging industry.

* Manufacturers of chain and one-man power saws:
Mall Chain Saw—Mall Tool Co., 7740 S. Chicago Ave., Chicago 19, Ill. (Figure 10)
Sally Saw—Cummings Machine Works, 9 Melcher Street, Boston 10, Mass.

Fig. 10.—Chain Saw.

There are two types of portable chain saws on the market. These saws are best adapted for large trees. They can be used for land clearing on very rough terrain or creek banks where tractor or other power saws cannot be operated.

BUCK RAKES

Power-lift buck rakes have been used to reduce the man hours of labor required for assembling and piling brush. Regardless of the method used for cutting brush, these rakes have performed satisfactorily. Burning brush where it falls is often difficult. It is also undesirable, first, because the intense heat generated is detrimental to the grass, and second, most of the woody stems would not be burned. Brush and small trees are excellent material for filling gullies. If no gullies are available within a reasonable distance the brush should be concentrated onto as small an area as possible for burning, so that a minimum amount of grass is damaged by the fire.

High-lift buck rakes have also been found useful for handling hay on rolling or terraced land where the ordinary low-riding rakes often have difficulties. Loading will require the same condition as any other buck rake, but the loads may be transported across terraces or depressions. After the load is free of the ground, it is carried well above normal stubble, and the distance traveled before unloading is no longer a major problem.

These power-lift rakes have been found useful for transporting many kinds of articles including fresnos, small stationary motors, and other such heavy articles as well as posts, fertilizer, baled hay and sacked feed. The power lift allows the rakes to be lowered to the ground for skidding a load onto the teeth then lifting for transporting. In addition, by replacing the front part of the rake with a small blade, the high lift frame may be used for dozing work (Figure 11).

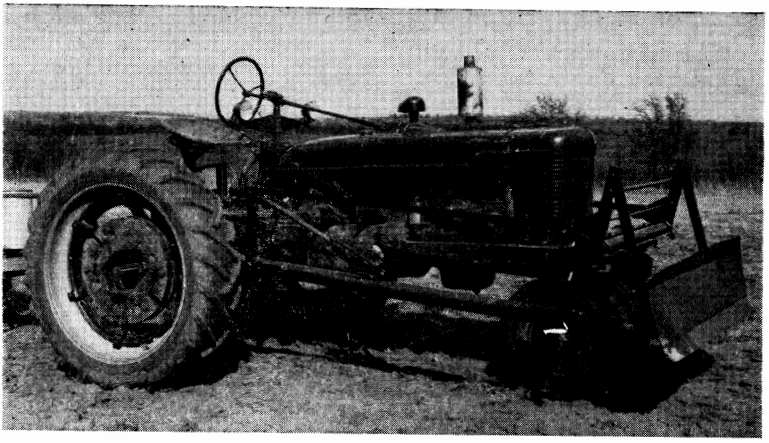


Fig. 11.—Small Bulldozer.

Bulldozer blade attached to buck rake push beams. The lifting bell crank is reversed. Thus, the cylinder pull is applied to the short arms and the blade lifted by the long ones.

Large Buck Rake

A large rake was designed at Guthrie, to operate on either a tricycle or four-wheel tractor (Figures 12 and 13, respectively. A front view is shown in Figure 14). It worked equally well on either tractor when the ground was dry, but the four-wheel tractor showed an advantage when soft or wet spots were encountered. This advantage was increased by the use of standard tires that did not have the steering rim treads as shown on the tricycle tractor in Figure 12.

The rake was made for a Farmall "H" tractor but it can be adapted for use on any tractor with hydraulic power-lift. With only slight modifications, this type rake may be fitted for use on most other modern farm tractors.

The rake shown is twelve feet wide with teeth 8½ feet long spaced 12 inches from center to center. The rear ends

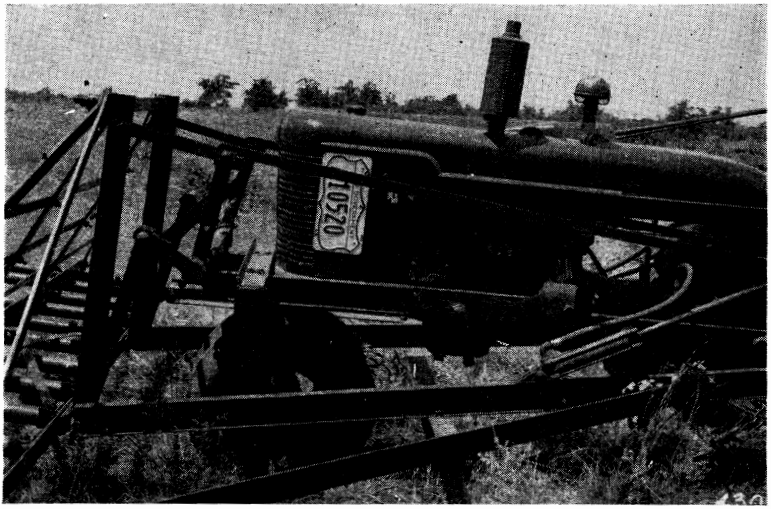


Fig. 12.—Mounting for Large Buck Rake.

Arrangement of the hydraulic cylinders and levers that raise the back of the rake 4 inches, and the points of the teeth 24 inches.

of the teeth, in operating position, clear the ground by 10 inches. The cross-members to which the teeth are bolted are spaced so that the holes in the teeth are 18 inches, center to center. This distance is 12 to 16 inches on most commercial buck rakes.

The rake teeth are made of used two-inch pipe. Pipe is used instead of the usual wooden teeth so they will bend or give without breaking if they strike a stump or stone. The metal teeth also give more flexibility in picking up larger trees. An over-loaded tooth will give down without breaking, and allow additional teeth to take part of the load.

For handling hay, it may be desirable to equip the rake with standard wood teeth. This can be done by removing the two bolts that hold the teeth and making the exchange. Wood teeth would reduce the weight of the rake about three hundred pounds.

When the rake is in the raised position for transport or for carrying a load (Figure 13), the points of the teeth are 24 inches above the ground and the rear end is raised to 14 inches. The raising of the entire rake is advantageous in moving the machine into or out of the field as well as giving more clearance for moving the load. If desired, the rear lift can be disconnected and the frame made rigid by bolting the channel

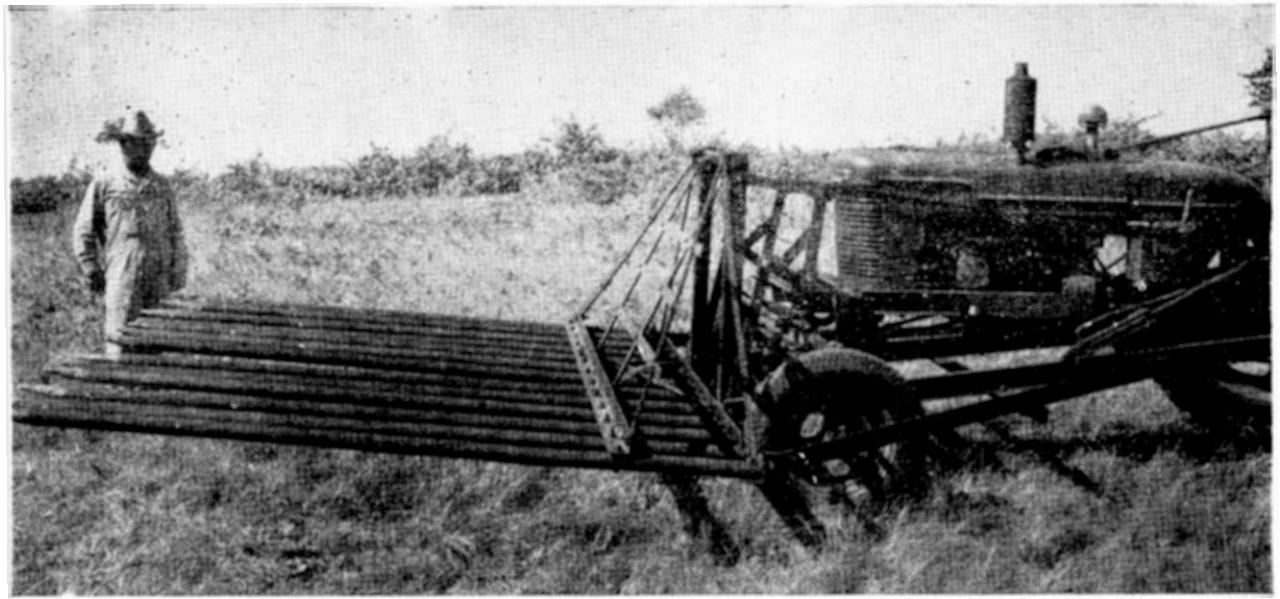


Fig. 13.—Large Buck Rake.

A large high-lift power buck rake mounted on a 4-wheel tractor. This type of rake can be adapted to any make of farm tractor equipped with hydraulic power-lift, by slight modifications in the attachment and lifting arrangements. This machine is capable of lifting and transporting a thousand pound load of hay or brush. The high lift permits transport of loads over fairly rough terrain.

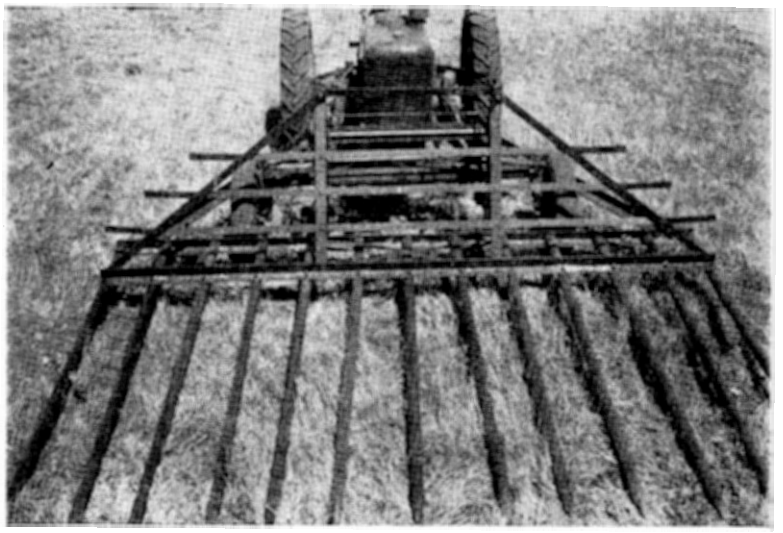


Fig. 14.—Large Buck Rake.

Front view of 12-foot high-lift buck rake with metal teeth. Wooden teeth may be used for hauling hay.

beams to the guides at the front of the tractor. When this is done, the action of the cylinders will be utilized only for tilting the rake, thus raising the points of the teeth about 18 inches.

Frame: The force required for loading is transmitted to the rake by two channel irons extending back to the rear axle of the tractor (Plate II, pages 16 and 17). These beams are secured to the tractor by clamps placed around the axle housing in such a manner that pins through the ends of the beams allow a hinged joint for movement in lifting and for ease of assembly. The clamps used are parts of another attachment furnished with the tractor. The rake is lifted by two hydraulic cylinders (Figure 12) that are supplied with the tractor for other attachments.

Lift Coupling: The bell-crank mounted at the front of the tractor (Plate II) for lifting the rear of the rake is made with the vertical arm 16 inches, and the horizontal or lifting arm 8 inches. Each of the links between the upper end of the bell-crank arm and the back frame of the rake consist of two pieces of strap iron, which eliminates the construction of yoke ends. The length of the tilting lever, or the vertical member of the back frame, is 36 inches. These lengths of levers utilize a travel of 8 inches on the hydraulic cylinders and will lift a 1,000-pound load cen-

tered on the rake teeth with a 1,000-pound thrust from each of two cylinders.

Frame Connection: Pivots at the back of the rake attach it to the push frame and allow the teeth to be raised. These pivots are made of sections of angle iron (Plate II) which are bolted to the rear cross-member with movable pins passing through the ends of the pushing frame. Two angles are needed for each connection, except that the vertical members of the back frame are located so that the lower ends are utilized for one side of the pivot. Pins equipped with cotter keys make the job of mounting or dismounting much easier.

Small Buck Rake

A small rake was designed at the Guthrie station (Figure 15) for use in clearing operations with saw equipment. This rake is much more maneuverable than the larger one and can be operated over rougher terrain and in closer places. The large machine has the advantage of larger loads when handling brush on large areas or for hay work. Either or both sizes of rakes can be adopted to the same carrying and lifting frames, per-

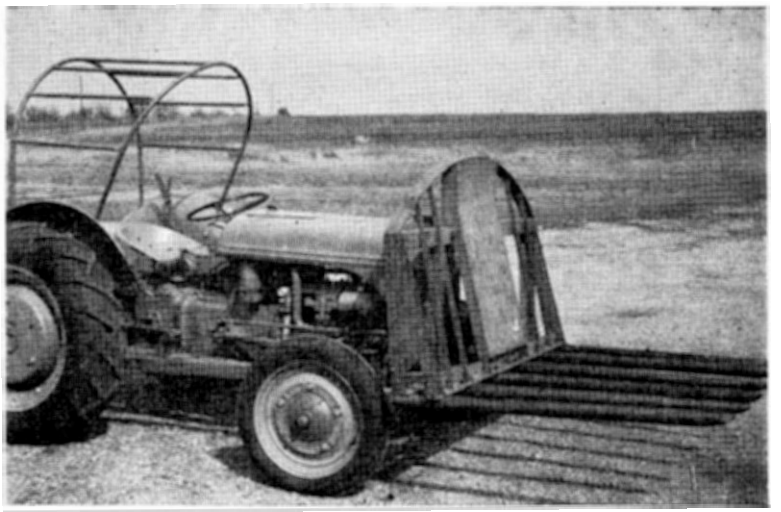


Fig. 15.—Small Buck Rake.

This small power-lift buck rake is 5 feet wide and the teeth are 4.5 feet long. This size rake is very desirable for picking up brush or trees and pushing them out of the way when sawing with tractor saws. The small size is a distinct advantage for maneuvering in and out of close places.

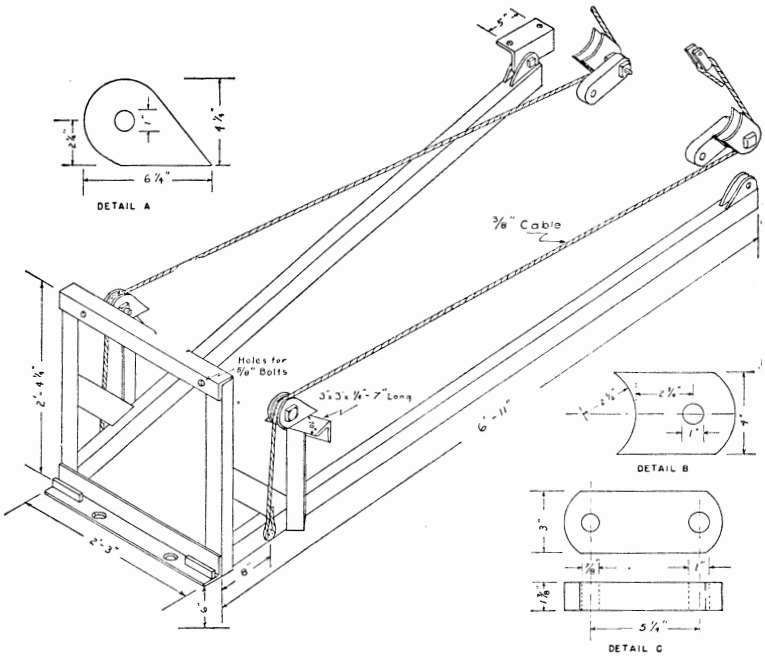


Plate III.—Details of a Buck Rake Frame for a Ford Tractor.

The front of the buck rake frame is the mounting for the rake head. It is also designed to serve as a radiator guard or bumper. Two ⅝-inch bolts through the upper cross-member hold the rake head to the frame. The holes in the lower cross-member are to accommodate the heads of the bolts that hold the back of the two center rake teeth. The cable sheaves are available from several companies that produce cable-lift mowers. Detail "A" shows the shape and dimension for the front axle sheave mounting. Details "B" and "C" give the plans and dimension for sheave-mounting that fits on the draw-bar pins. The bolts used for sheave pins should be drilled and tapped for grease fittings.

mitting an operator a quick choice of equipment for a particular job.

The small rake shown here was built for a Ford tractor but should function equally well on any type tractor by modifying the frame and lifting arrangements. The rake is 5 feet wide with teeth 4½ feet long spaced 12 inches center to center. The teeth are made of 2-inch pipe with the front end cut, shaped and welded to a tapered point. When lowered to the loading position the back of the teeth are 6 inches above the ground. This height makes the teeth in line with the push beams. In the raised position the points of the teeth are 18½ inches above

the ground and the back is 17½ inches. The rake head (Plate IV) is designed as a separate unit to attach to the push frame. The attachment is made by setting the rear cross-members of the rake head into a suitable notch on the push frame and inserting two bolts in the upper part of the back.

The push frame (Plate III) as shown consists of boxed beams made of 2½″ x 3″ x ¼″ angle iron, but they can be made of 2 inch or larger pipe. These beams extend back to the rear axle of the tractor. The push beams are secured to the rear axle by a pin passing through two lugs welded to the top of the beams and an angle iron support fastened to the axle. The angle iron support is fastened to the under side of the axle housing by the two fender bolts. The front end of the push frame is constructed in such a manner that it can be used for a bumper and a guard for the radiator grill as well as the mounting for the rake head.

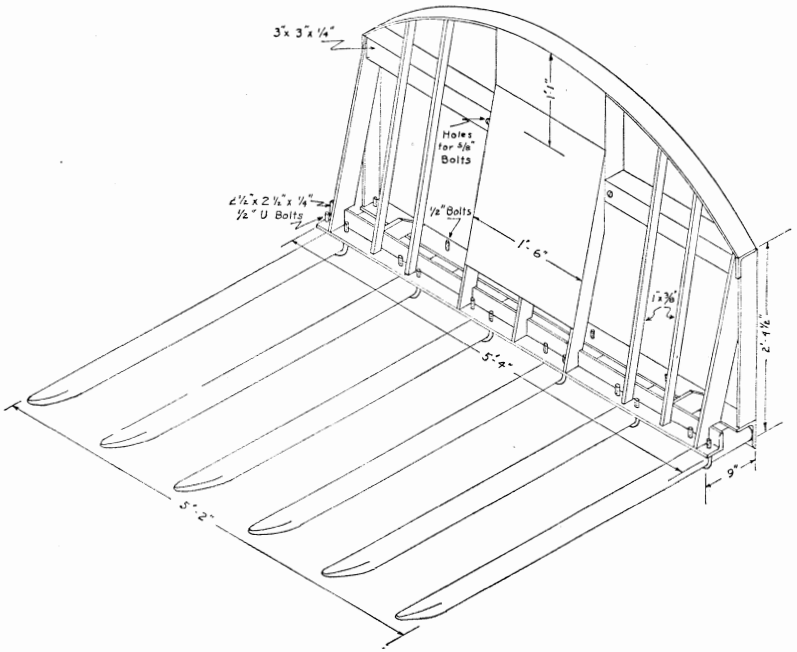


Plate IV.—Details of Small Buck Rake Head.

The teeth are made of 2-inch pipe with the ends cut and shaped to a rounded point. The center section of the back is covered with sheet metal to prevent sticks or limbs from damaging the tractor radiator.

BULLDOZERS AND TREE-DOZERS

Dozers have not been used at the Guthrie station but they have been observed in operation at various locations over the state by members of the station staff. Considerable work with these machines has also been done in Texas (*6*) with root plows and heavy tandem discs. The procedure followed with this equipment consists of pushing the trees and brush into windrows with 75 to 100 horsepower crawler tractors. Following this operation the land is gone over with a root plow designed to undercut the roots 12 to 18 inches below the surface. The roots are then raked out of the soil and burned. The final treatment is to drag or disc the land in preparation for seeding with some adapted grass. The cost for this operation ranges from $35.00 to $45.00 per acre.

Unskilled or careless operators often destroy much of the grass cover and create an erosion hazard. Once the soil begins to erode it delays the development of a good grass cover. On sandy soils many of the trees are uprooted, leaving holes and an uneven or rough surface.

GIANT CUTTERS

An extra heavy stalk cutter type machine (Figure 16) has been used a short time at the Guthrie station. This machine* appears to have excellent possibilities for crushing dead brush and small trees that have been killed with chemicals (*4*). It also may be useful for the original and follow-up operations on many kinds and types of brush. Smaller and lighter machines are available for sprout and weed control. The manufacturers recommend the use of three to five 4-foot cutters with a small tractor, pulled at high speed.

SUMMARY

The interest in improving brushy lands has encouraged many machinery companies to develop and produce machines of different kinds for removing trees and brush. These machines include various designs of saws, beaters, shears, mowers, dozer, sweeps, shredders and crushers. There are ten or more types of saws being produced and used. The farm implement companies all manufacture brush mowers.

Power brush mowers were the most satisfactory machine tested for cutting light brush with stem sizes ranging up to

* Manufacturers of giant stalk cutters:
Marden Brush Cutters—Marden Manufacturing Company, Auburndale, Florida. (Figure 16)
Stalk Cutters—Caldwell Cypress Cistern Company, Corpus Christi, Texas

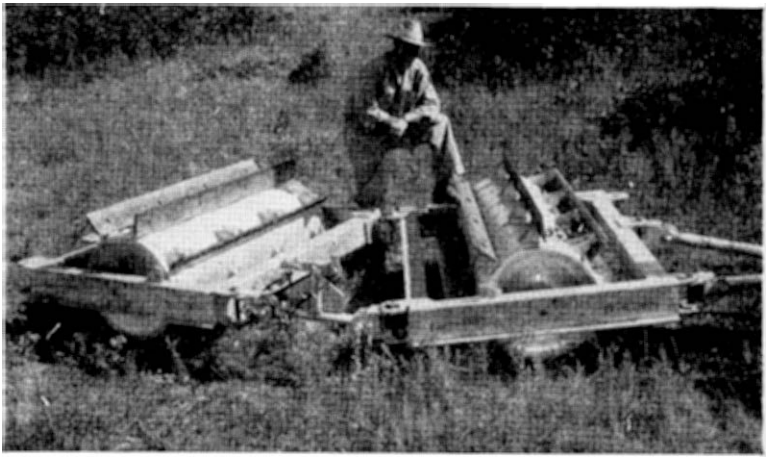


Fig. 16.—Giant Stalk Cutter.

The medium size brush cutter weighs 4,200 pounds empty and approximately 6,000 pounds when filled with water. It is very effective for breaking down small trees or brush that have been killed with chemicals. It may also be satisfactory for breaking up some types of live brush and brashy shrubs.

one and one-half inches in diameter. They were equipped with a five-foot bar using stub guards, extra hold-down clips and sickles with heavy sections.

The brush beater tested consists of weighted chains fastened to a revolving shaft or drum driven by the power take-off of a tractor. This machine does excellent work in sage brush and can be used effectively for weed or sprout control on stumpy or stony land. It does not function well in thick or tall tough brush such as oak or persimmon. A shredder type beater being developed in the western part of the state appears to have outstanding possibilities for removing heavy growths of any type of brush.

Several companies are making different designs of saws. Four machines have been tested at this station. Two of these are small portable power saws and the others are tractor mounted. These machines are maneuverable and will do an excellent job of felling trees and brush.

A satisfactory procedure for operating a tractor saw with the machine in motion was to work out an alley-way around a land with sufficient room for the saw and buck rake to operate without interference. As the saw cut a swath, the rake picked

up the brush and pushed it out of the way. This gave the saw operator a clear view for the next cut and an opportunity to re-cut any high stumps left from the previous round.

The two makes of small portable power saws tested have been used rather extensively with outstanding results. These units are more satisfactory than tractor saws for cutting trees and brush uniformly close to the ground. They are also more maneuverable for thinning tree stands or working in close places.

Power-lift buck rakes have been used to reduce the man hours of labor required for assembling and piling brush. Regardless of the method used for cutting brush these rakes have performed satisfactorily.

Tree and bulldozers have not been tested at the Guthrie station for land clearing work. Observations elsewhere indicate that careless or unskilled operators denude the ground surface thus creating serious erosion hazards and delaying the development of a good grass cover.

When brush and trees have been killed by chemicals, the deadened material remains standing. Dead brush in this condition prevents mowing or other pasture maintenance operation. A new machine similar to a giant stalk cutter offers good possibilities for crushing or breaking this dead material down onto the ground. It also has possibilities for the first and follow-up operations on many kinds and types of brush.

Literature Cited

1. Daniel, Harley A., Elwell, Harry M., Cox, M. B. *Investigations in Erosion Control and Reclamation of Eroded Land.* U.S.D.A. Tech. Bul. 837, Jan. 1943.

2. Daniel, Harley A., Elwell, Harry M., Cox, Maurice B. *Conservation and Land Use Investigations—Red Plains Conservation Experiment Station, Guthrie, Oklahoma, and the Wheatland Conservation Experiment Station, Cherokee, Oklahoma.* Okla. Agr. Exp. Sta. Bul. B-309. 1947.

3. Elwell, H. M. *Progress Report of Land Reclamation and Pasture Investigations on Abandoned and Scrubby Oak Areas in Central Oklahoma.* Okla. Agr. Exp. Sta. Mimeographed Circular No. M-86, April 1942.

4. Elwell, H. M. *Preliminary Report of Chemicals for Brush Control.* Okla. Agr. Exp. Sta. Mimeo. Cir. No. M-164. Also *Oklahoma Crops and Soils* 1947, in preparation for publication by Oklahoma Agricultural Experiment Station.

5. Savage, D. A. "Results of Sagebrush Control Studies at Woodward, Oklahoma." *Oklahoma Crops and Soils* 1946. Okla. Agr. Exp. Sta. Bul. B-295.

6. Hall, R. A. "Brush Control with Heavy Machinery." *Agricultural Engineering,* Page 458, Vol. 27, No. 10, October 1946.

7. Duck, L. G., Fletcher, J. B. *A Survey of the Game and Furbearing Animals of Oklahoma.* State Bul. No. 3.

8. Lowther, Harry A. Co. *Operating and Maintenance Manual for Lowther C-Saw.*

9. Jaques Power Saw Co. *Instruction Manual for Jaques Jr. Portable Saw.*

10. Curtis Manufacturing Co. *Instructions for Care of Cordwood Saws.* Form SA-6, August 1945.

11. Atkins, E. C. and Co. *Saws in the Filing Room.* Fourth Revised Edition. August 1941.