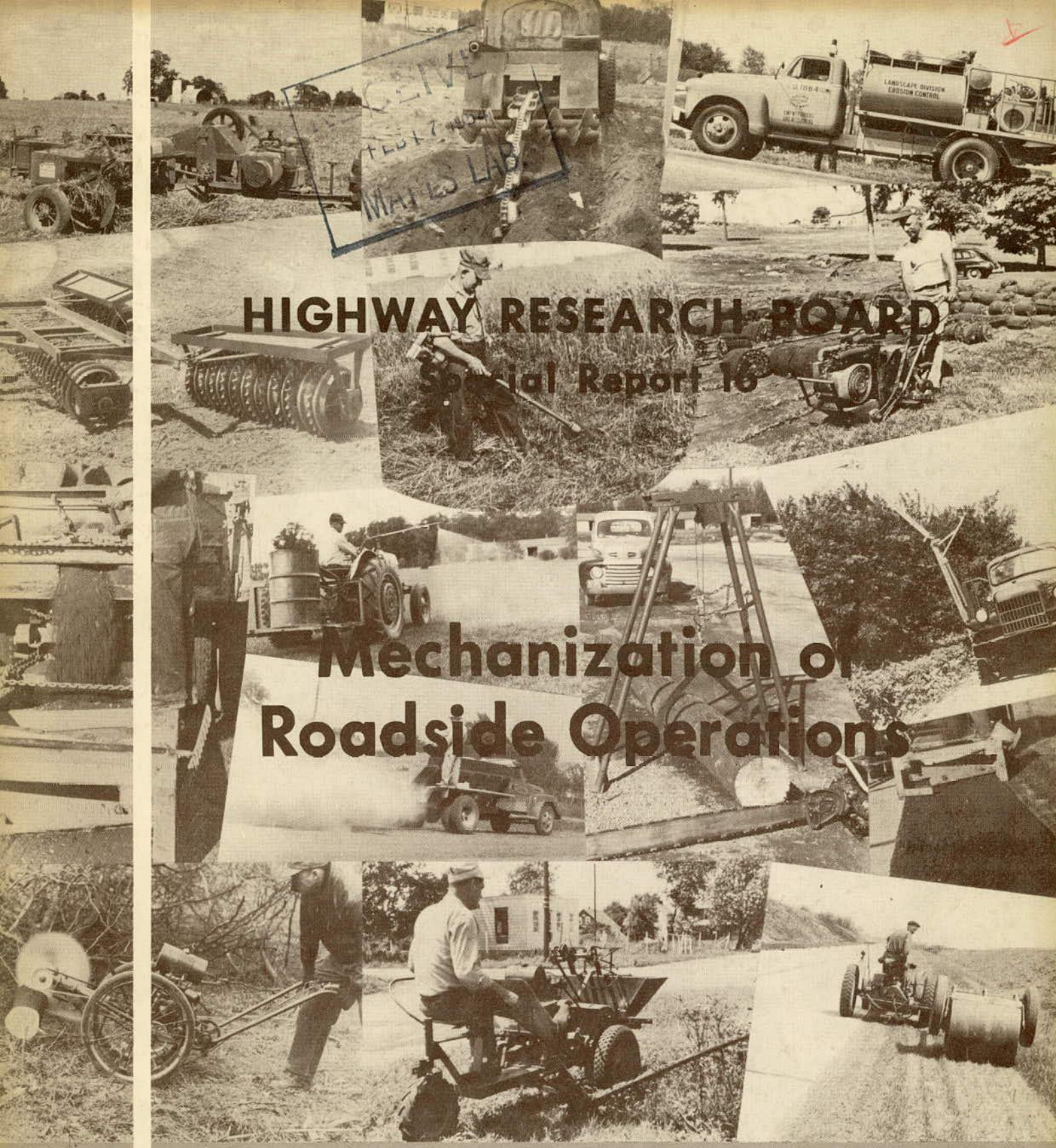

HIGHWAY RESEARCH BOARD

Special Report 16

Mechanization of Roadside Operations

National Academy of Sciences—
National Research Council

publication 289

HIGHWAY RESEARCH BOARD

1953

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2101 Constitution Avenue, Washington 25, D. C.

The opinions and conclusions expressed in this publication are those of the authors and not necessarily those of the Highway Research Board.

HIGHWAY RESEARCH BOARD
Special Report 16

Mechanization of Roadside Operations

A SUMMARY OF THE REPORTS ON EQUIPMENT FOR ROADSIDE OPERATIONS BY A SPECIAL PROJECT COMMITTEE OF THE COMMITTEE ON ROADSIDE DEVELOPMENT

WILBUR J. GARMHAUSEN
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1953
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MECHANIZATION OF ROADSIDE OPERATIONS

INTRODUCTION

Highway landscape architects and engineers and others responsible for roadside development in the state highway departments are trying to reduce costs through the substitution of mechanization for hand operations.

Equipment for roadside work has been described and evaluated through Highway Research Board reports for the past five years. To determine whether these reports were of practical value, a questionnaire was sent out to all state highway departments in August, 1952. Replies indicated that, of the thirty-four different types of equipment which had been described, all of it was being used by a total of twenty-two states. These states commented that they wished these reports to continue.

Eight states reported using a total of twenty-three different types of equipment as a result of the reports. The four mentioned most frequently were:

Mulch Applicator (Blower)
Mulch Stabilizer (Rotary Soil Stabilizer)
Seed and Fertilizer Spreader (Drill Type)
Seed and Fertilizer Sprayer (Hydraulic Type)

All states reported that by the use of roadside equipment a saving of man-hours and money enabled them to do work that could not otherwise be done because of labor shortages.

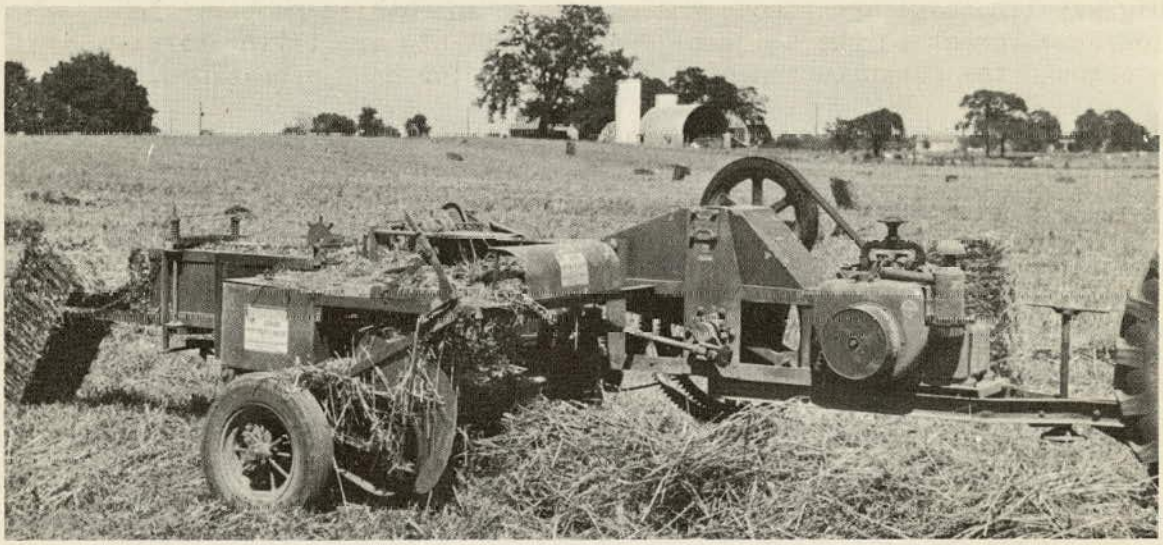
In this Special Report you will find pictures and descriptions of equipment so that you may evaluate it for your own particular use. We hope that if you are using any machines not included in the reports you will bring them to the attention of the Committee.

The following items of equipment were selected from a list submitted in the questionnaire and are the ones in which the greatest interest was shown by the states returning the questionnaire. The illustrations and descriptions have been broken down into the various types of work which these machines can perform. In most cases, only one machine of each type is described. They are arranged alphabetically by types of machines.

Further information on these machines and on others doing similar types of work may be obtained from the Committee.

MECHANIZATION OF ROADSIDE OPERATIONS

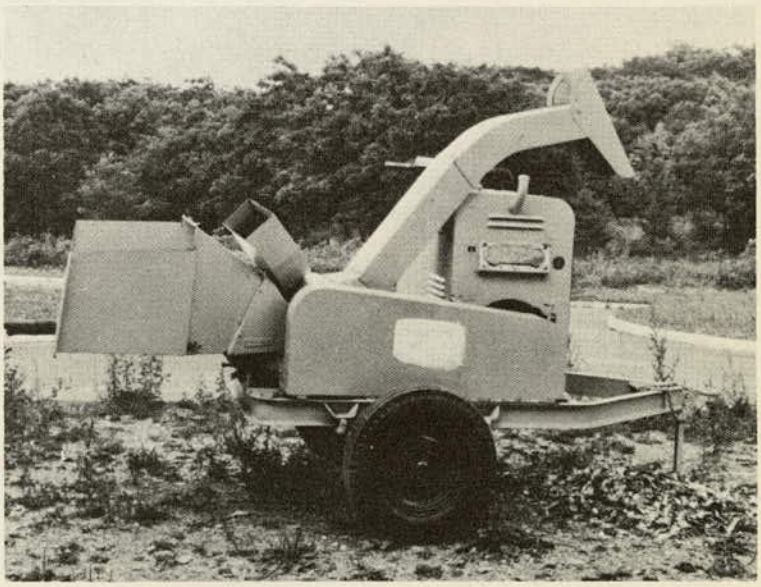
BALER



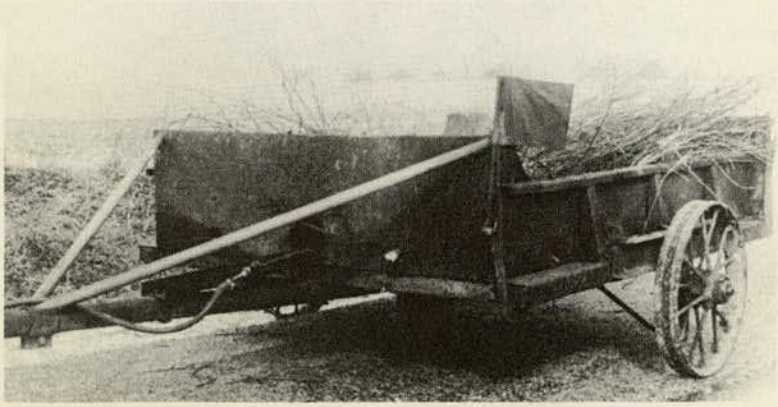
1. This straw baler is pulled by a tractor. It is 21 ft. long, 59 in. high, and the overall width is 8 ft. 5 in. The machine weighs 4,090 lb. The size of the bale chamber is 16 x 18 in. Bales can be either 30-36 or 42 in. long. The weight per bale varies from 50 to 80 lb. The machine is capable of baling up to 9 tons of hay or straw per hour.

BRUSH DISPOSAL EQUIPMENT

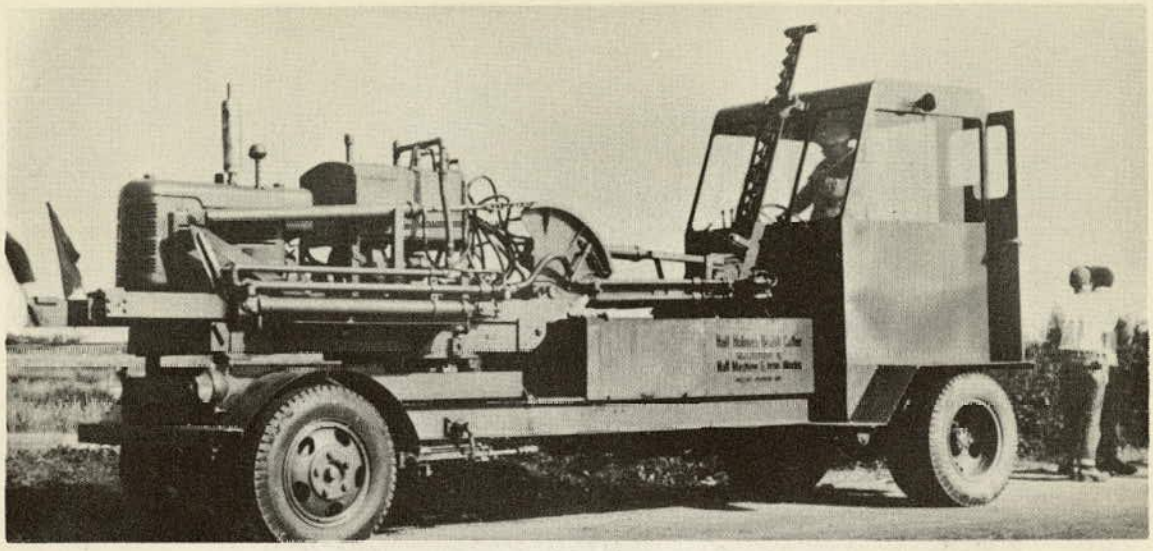
2. A chipper (at right) is one type of machine for brush disposal. It is made in various sizes and models which are powered either by a separate engine or a power take-off. The chipper consists of a cylindrical steel cutter head having numerous cutter blades which, with the bed knife, constitutes a very effective mechanism to cut up branches and small brush. It will handle from 2,000 to 3,000 lb. of brush per hour, up to a maximum size of 6-in. diameter.



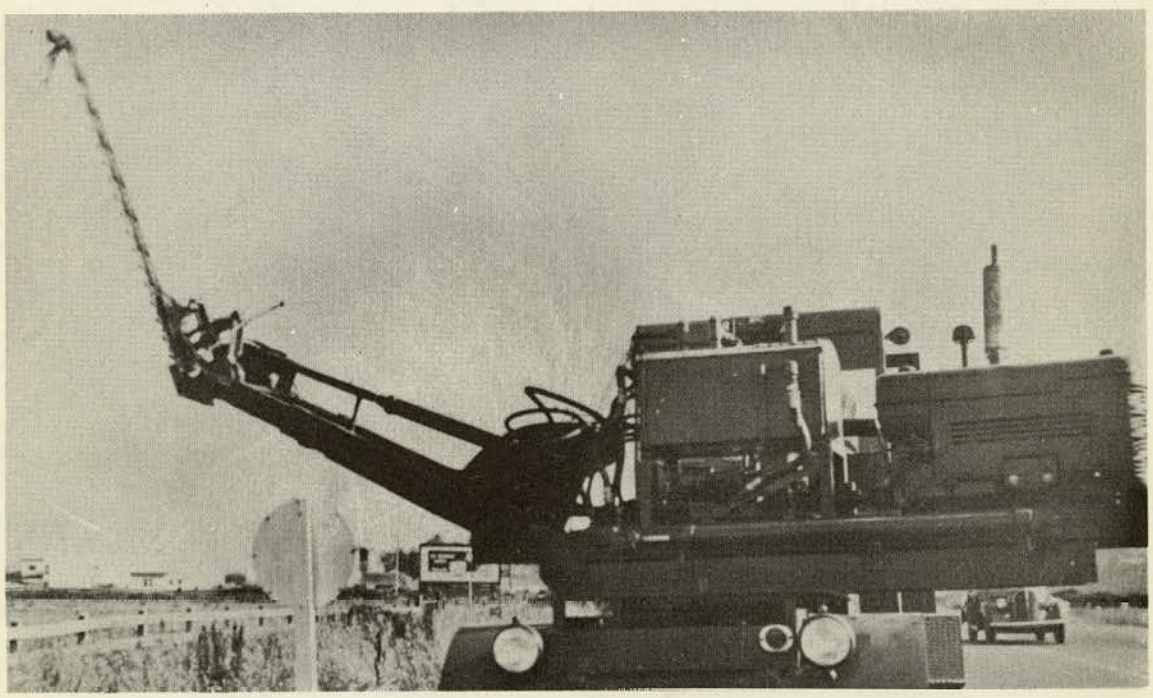
3. This portable trash burner is an old steel dump-truck body mounted on two wheels and is towed by a truck. An oil pressure tank in the truck sends fuel through a pipe with a jet attachment. The burner head is located in the trailer. After the trash is burned, the ashes can be dumped.



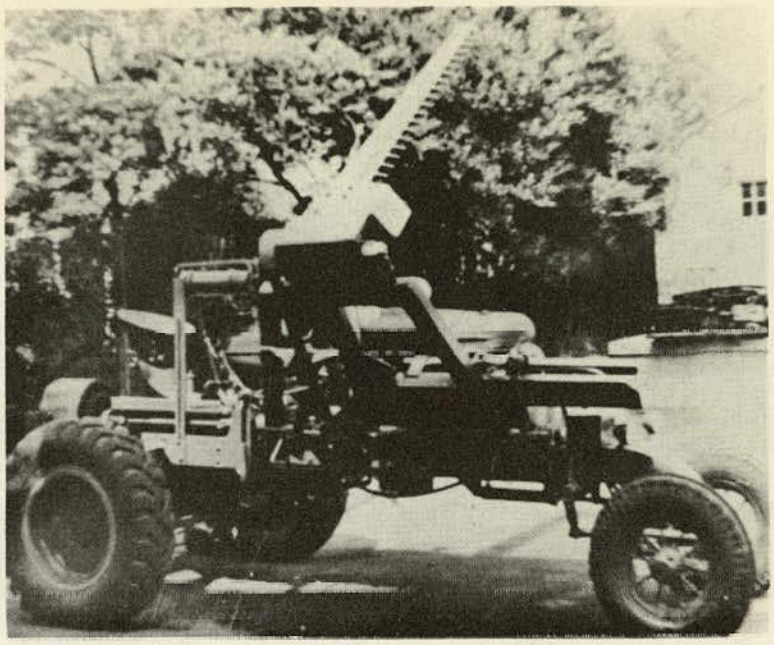
BRUSH MOWERS



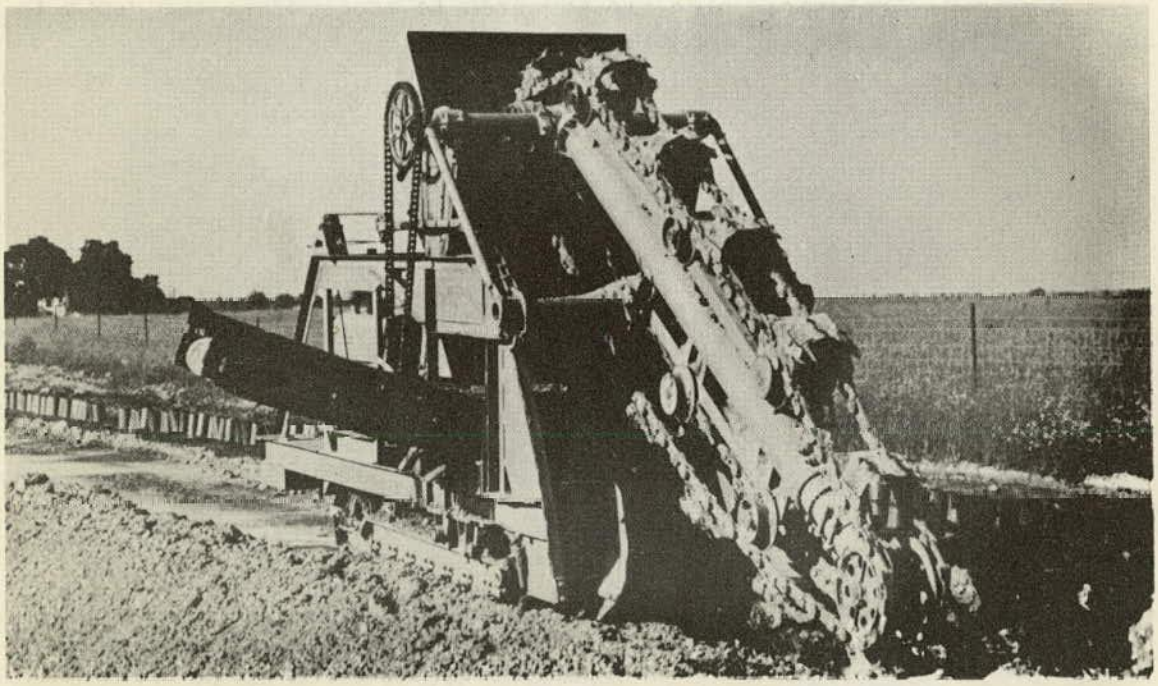
4. This brush mower, shown in traveling and working positions, has a hydraulically controlled lift and cutting unit powered by a separate motor. The entire unit of cutting bar, supporting arms, and hydraulic pump is mounted on a turntable which permits great flexibility in cutting positions some distance from the machine, both in horizontal or overhead position. A heavy-duty sickle bar with large serrated sections permits cuts of 2½-in. wood or the sawing of soft woods up to 4 in. in diameter. Normal working speed varies with the density, hardness, and size of wood. However, from 2 to 6 roadside mi. per day may be expected in heavy alder and willow growth.



5. The brush mower pictured at the right is mounted on a grader chassis. Power to operate it is obtained from the grader motor.

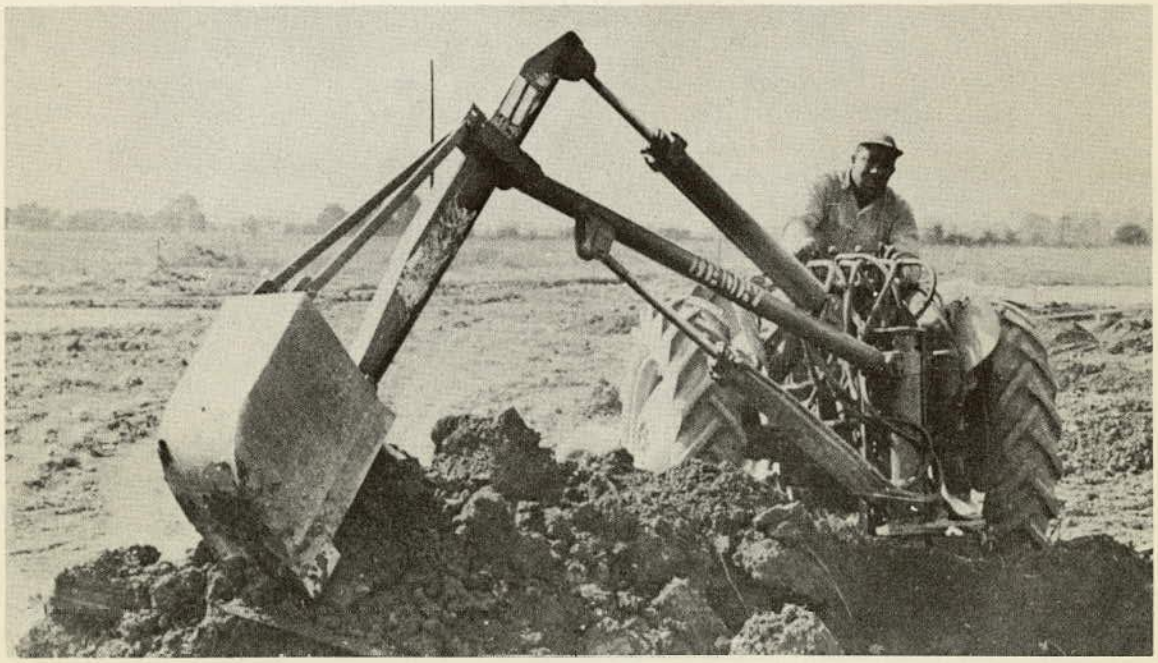


EXCAVATING MACHINES

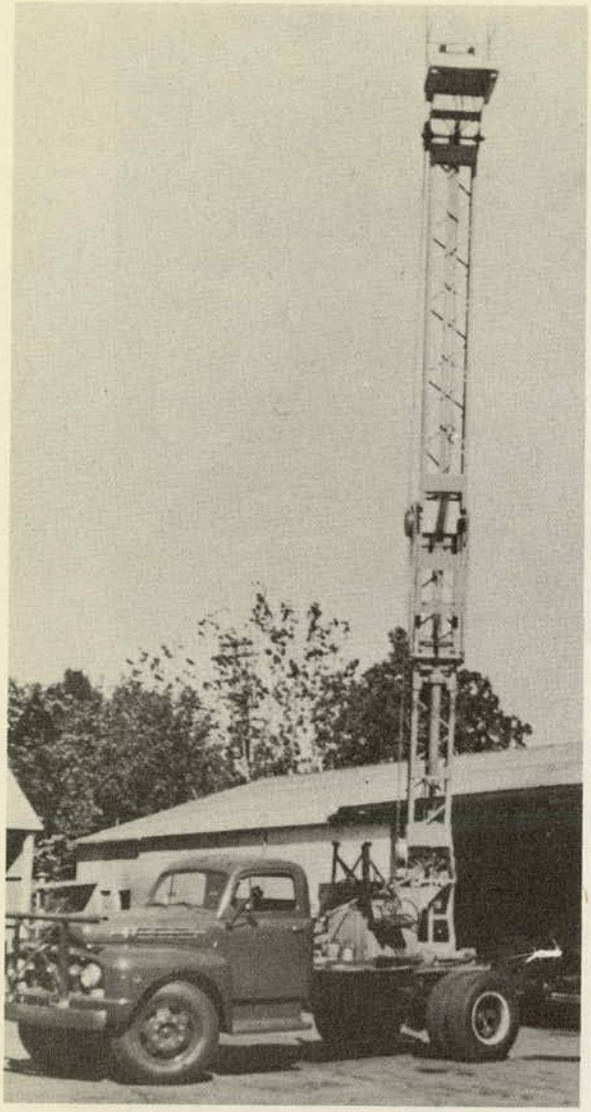


6. This trenching machine excavates by means of an endless chain with digging buckets attached. The buckets dig out the earth and dump it on a conveyor belt which deposits the soil on one side of the trench. The depth is governed by a cable and winch attachment. The machine is self-propelled on crawler treads.

7. Here is a smaller trenching unit. The mechanism is attached to the rear frame of a Jeep. The power comes from a power take-off. The digging boom is raised or lowered either by a hand-operated wheel-and-cable device or by an electric lift operated by push-button control. The machine digs a trench in average-type soil 300 ft. long, 42 in. deep, and 14 in. wide in an hour. Its maximum digging depth is 6 ft. The excavated soil is pushed to both sides of the trench by two worm gears which are adjusted to accommodate the depth to be dug.



8. This backhoe, fastened to the rear axle and frame of a tractor, is actuated by a hydraulic system with power developed from the tractor's hydraulic pump. The bucket is free to swing 180 deg. under hydraulic control. The capacity of the bucket is approximately 1/5 cu. yd. It will dig to a depth of about 6 ft. and will lift to a height of about 4 ft.



EXTENSION PLATFORM (FOR TRUCKS)

9. The extension platform (at left) is a modification of a commercial device mounted on a 2½-ton truck. The platform extends to a height of 40 ft. and may be swung through an arc of 300 ft. Dual Hydraulic controls at the platform and the base permit raising, lowering, and swinging the platform from either position. Telescoping and folding outriggers may be extended from the truck bed to provide stability when the platform position is at one side or the other. Locking stabilizers prevent movement of the truck bed in any direction while the platform is in use.

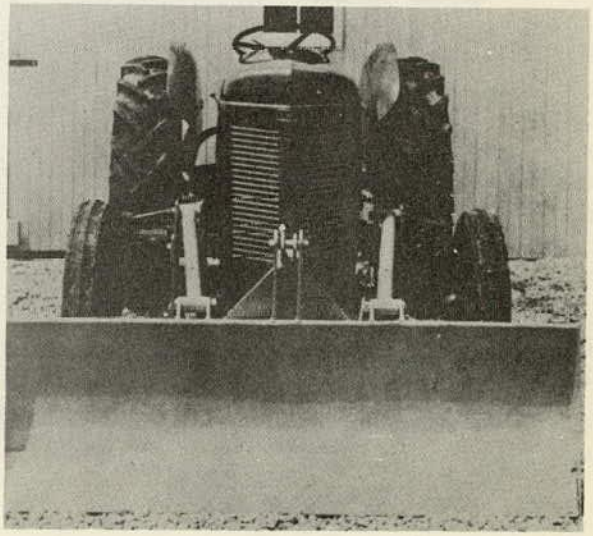
FERTILIZER SPREADERS

See: LIME AND FERTILIZER SPREADERS

SEED AND FERTILIZER APPLICATORS

GRADING EQUIPMENT

10. The dozer blade at the right can be installed on any tractor. It is equipped with a double-acting hydraulic system giving fast operation down as well as up. All thrust is from the underside of the differential, leaving no strain on the tractor front axle. The width of the blade is 5 ft. 6 in. The height is 22 in.; the blade clearance, 15 in. The weight is approximately 300 lb.

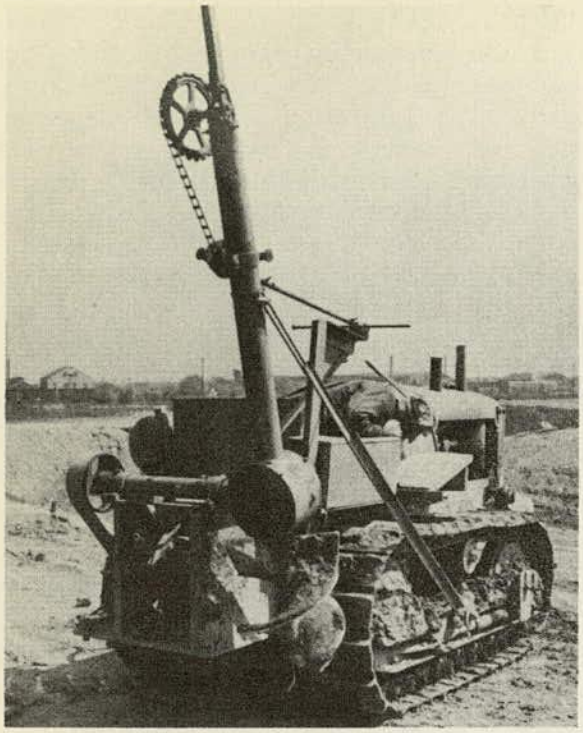


11. This blade attachment is used on a tractor equipped with a hydraulically controlled front-end loader. The unit attaches to the push lift frame without any alterations. Because of the low vertical construction it can readily be used under the lower plank or cable of guard rails or other similar obstructions.

GRASS EDGER

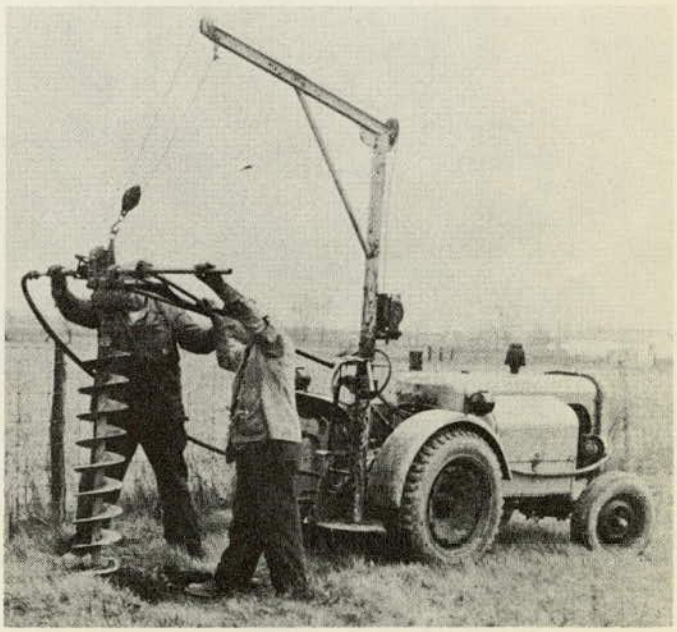
12. The grass edger, at right, is a disc held in place by means of a frame which is attached to the tractor. The frame is equipped with handles and the disc can be controlled in this manner. It is used in cutting the grass overhanging the curb of narrow median strips.

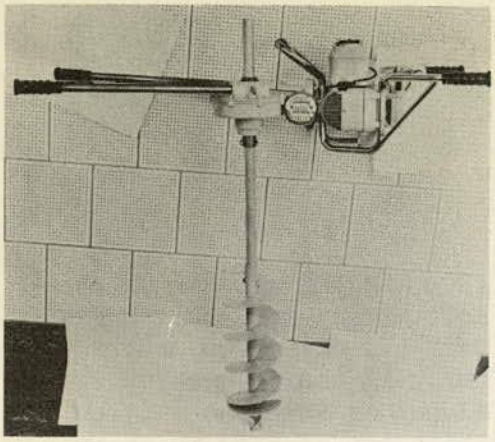
HOLE DIGGERS



13. The hole digger at the left operates on the power take-off of a Jeep or tractor. It can be used on slopes as steep as 2:1, but it is not adapted to stony or wet soil. The earth auger bits can be obtained up to 24 inches in size. The maximum depth of operation is 3 ft.

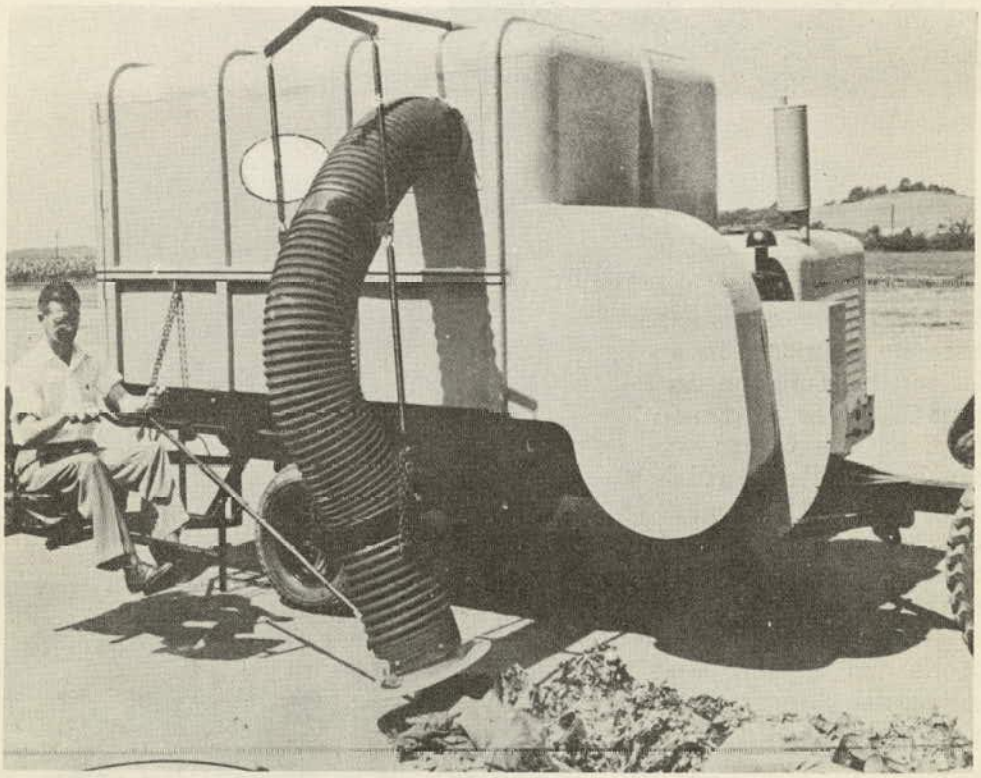
14. The earth auger at right is mounted on a tractor compressor but can also be mounted on a truck. It can be hung on an A-frame a considerable distance out in front of the truck, so that it can be used satisfactorily on cut or fill slopes. It may also be used in a horizontal position for boring into a side slope or even under a roadway. The drill comes in four sections and may be used in any reasonable length. The drill can be purchased from 4 to 16 in. in diameter. A 70-lb. motor is capable of handling up to a 12-in. drill and operates more efficiently on a pressure of between 100 and 125 lb.





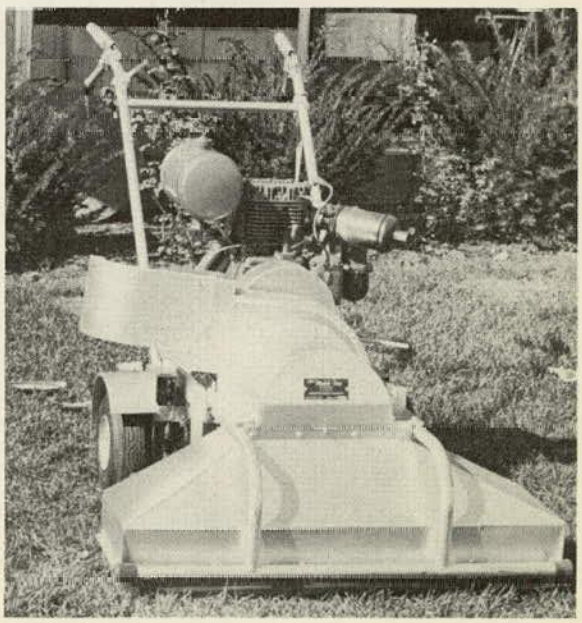
15. The earth drill at the left can be operated by two men. It converts into a standard chain saw, as the earth-drill transmission is interchangeable with a chain-saw transmission. The drill is easily carried to any location, as it weighs only 80 lb. complete with 6-in. auger. The long supplementary handles are easily disengaged as are the auger bits, making a very compact machine for transporting. The drill has a 5-hp. engine for fast drilling through any earth, including hard clay. A centrifugal clutch automatically disengages the auger for starting or for carrying when the engine is idling. The drill operates at full power at any angle without adjustments, thus permitting vertical drilling regardless of the slope of the land. The full-swivel transmission permits this, and also allows reversing the auger rotation when necessary. The drill will handle up to a 12-in. auger.

LEAF AND TRASH COLLECTORS



16. This motorized vacuum sweeper is powered by a 6-cylinder heavy-duty industrial engine. Its straight-in-shot from the ground pulls everything within a 6-ft. span from either side of the unit through a large hose into a 14-cu.-yd.-capacity air-tight compartment. When the compartment is filled, it is readily emptied by its own self-dumping mechanism.

17. This leaf sweeper is towed by a tractor, truck, or Jeep. The wheels drive the sweeping unit which can be easily engaged or disengaged by operating a hand lever on the outside of the sweeper. The sweeping height is readily adjusted for practically every type of sweeping. The heavy bassine fiber brush is easily removed and replaced. Heavy waterproofing baling canvases have approximately 25 bushels capacity each. They are inserted in the sweeper with a baling lever which is operated on the outside of the sweeper. When the sweeper is full, the baling canvas is easily drawn into a cylindrical roll and removed. Draw ties on each side of the canvas prevent leaves from escaping. The canvases are interchangeable. Approximately 500 bushels can be collected and baled per hour.

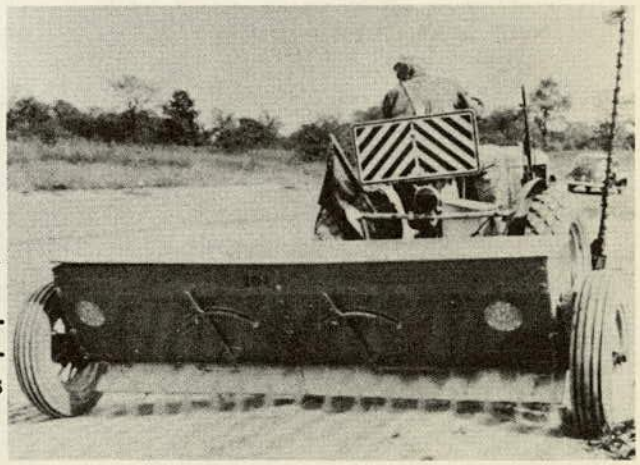


18. The small leaf vacuum sweeper at the right will pick up leaves in a 3-ft. swath by vacuum suction only. Forward speed of the machine is regulated by pressure on the grips. It is guided by applying pressure on one or the other of the two handle grips, and it can be turned completely around in its own length. It does not pick up stones or heavy twigs. It thoroughly mulches the leaves which are blown to one side. Walking 2 mph., one man can clean up almost 6 acres in an 8-hr. day.

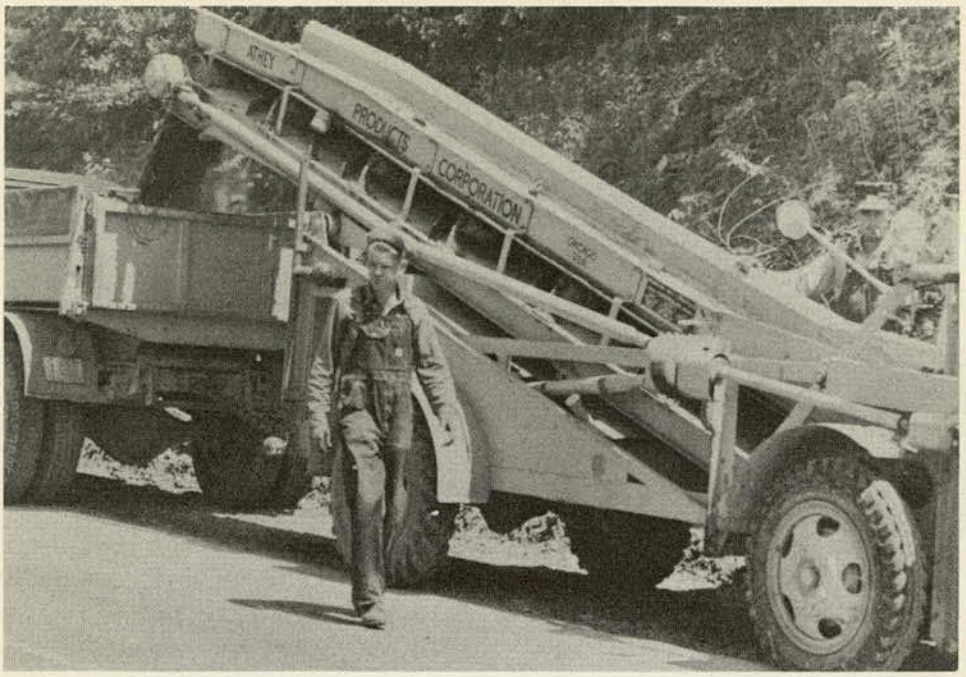
LIME AND FERTILIZER SPREADERS

19. This lime and fertilizer spreader has a specially built truck bed with sloping sides. A worm gear operating in the bottom delivers the material through a small door. A chain which operates from the left rear wheel of the truck provides the power for this as well as for the agitator which distributes the material in a cloud-like effect over the area desired. The agitator is fastened on the outside of the truck so as to catch the material as it is turned out of the truck by the worm gear.

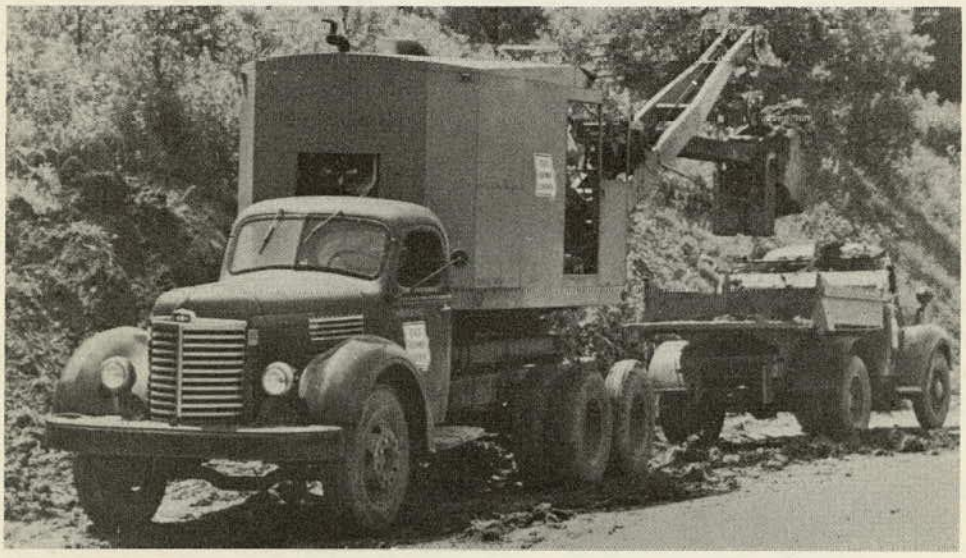
20. The spreader at right can be towed by a tractor. The machine has one compartment divided into two sections. The rate of application is governed by the side of the opening which is regulated by a lever. This machine can be used on berms and moderate slopes. One half of the spreader can be used for a narrow area, or the entire width can be used where needed. A clutch on each side permits either side of the spreader to be used independently.



LOADING EQUIPMENT



21. This elevating grader picks up material to be loaded. A rotating reel comes in contact with the material and deposits it on an endless belt which delivers it to the end of the machine where it drops into a truck or any other desired place.



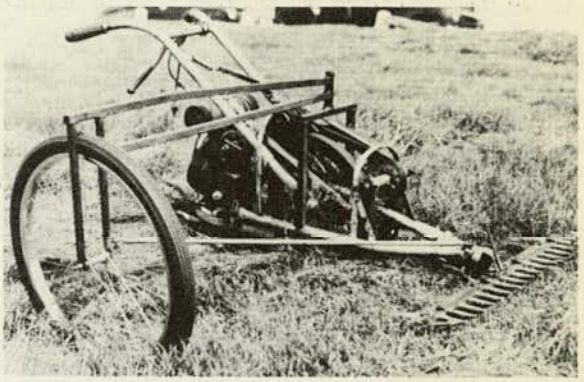
22. This truck shovel is powered by a separate motor. By maneuvering various levers, the bucket can be used to load material into a truck.

23. This front-end loader operates from the hydraulic lift of a tractor.

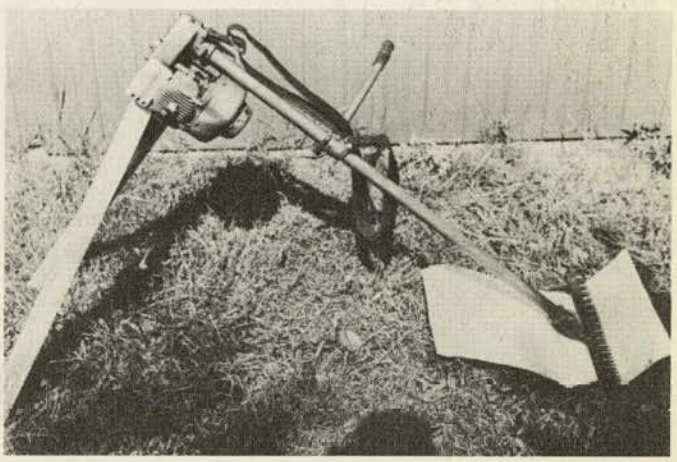
LOG GIN

24. The log gin at right is used to raise and lower a log and hold it for such operations as sawing. A hook attached to a cable is used to lift the log. A hand lever operates a ratchet-type cylinder which winds the cable to raise the log to any desired height.

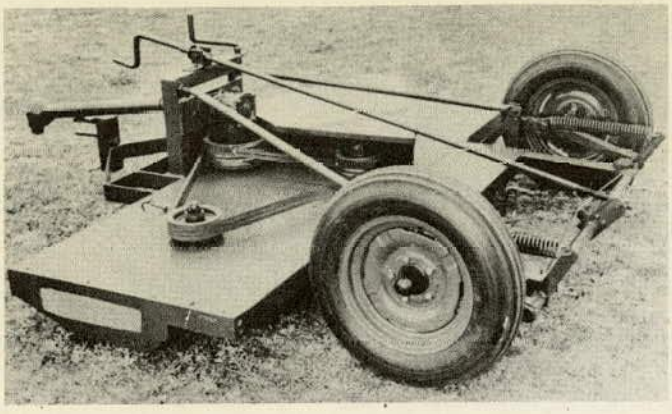
MOWERS



25. This sickle-bar mower has an attachment that can be used on any type of sickle-bar mower to assist in holding it on a slope. It consists of a steel frame about 4 ft. long which attaches to a vertical pivot shaft on the top of the power scythe. A bicycle wheel is fastened on the opposite end of the frame. A stabilizing bar is attached to the front of the scythe by a swivel joint and hooks to the outer end of the frame. By unhooking the stabilizer bar, the entire attachment swings around on the vertical pivot pin to the opposite side of the unit.

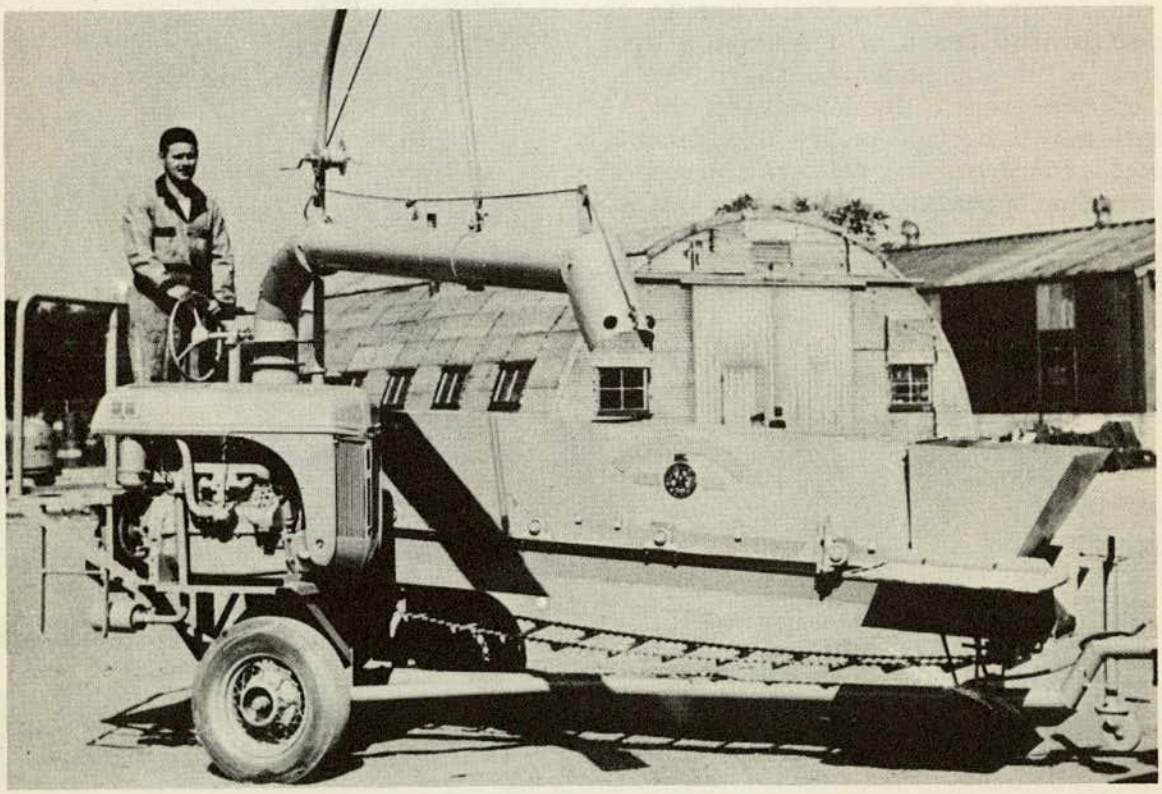


26. This scythe trims well and evenly as you walk, and can be carried anywhere with ease. It weighs 24 lb., is 54 in. long, and is well balanced. The shoulder strap is adjustable. In one hour, the unit can do the work ordinarily requiring 4 hr. by hand. It operates 4 hr. on a gal. of fuel.

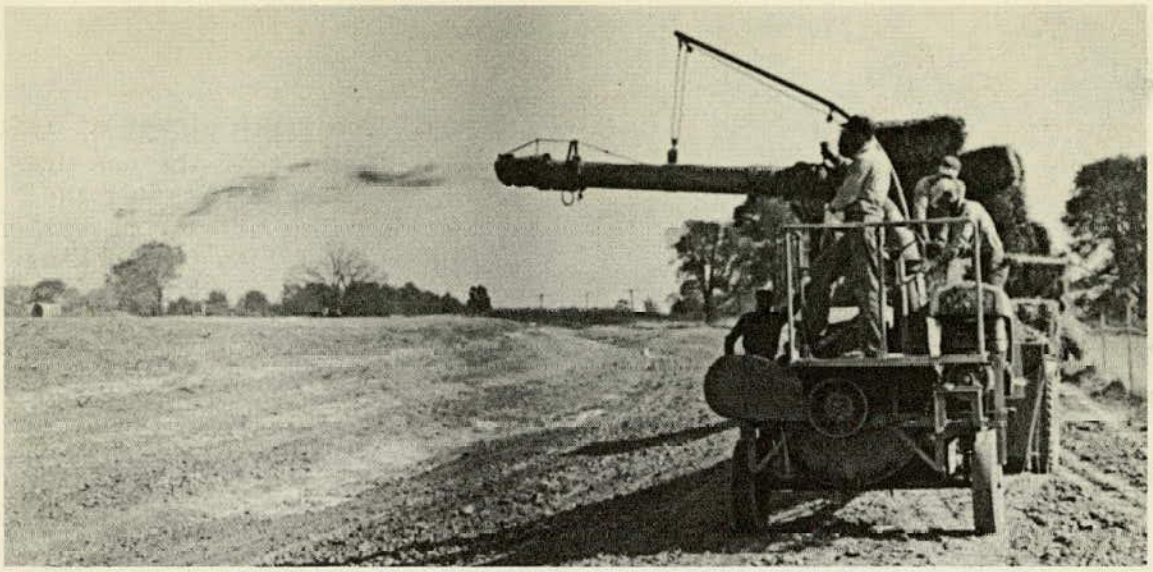


27. The rotary cutter at left can be attached to and operated from any standard tractor. A hand-operated jack raises the machine for one-man hitching. A steel cover protects all pulleys and belts. Wing skids protect blades by preventing "digging in" on uneven ground. It weighs 1,040 lb. and operates up to a speed of 10 mph. It cuts a clean 7½-ft. swath, and the cutting height is adjustable up to 16 in. Three rotary cutting bars each have two blades attached. The blades require no sharpening.

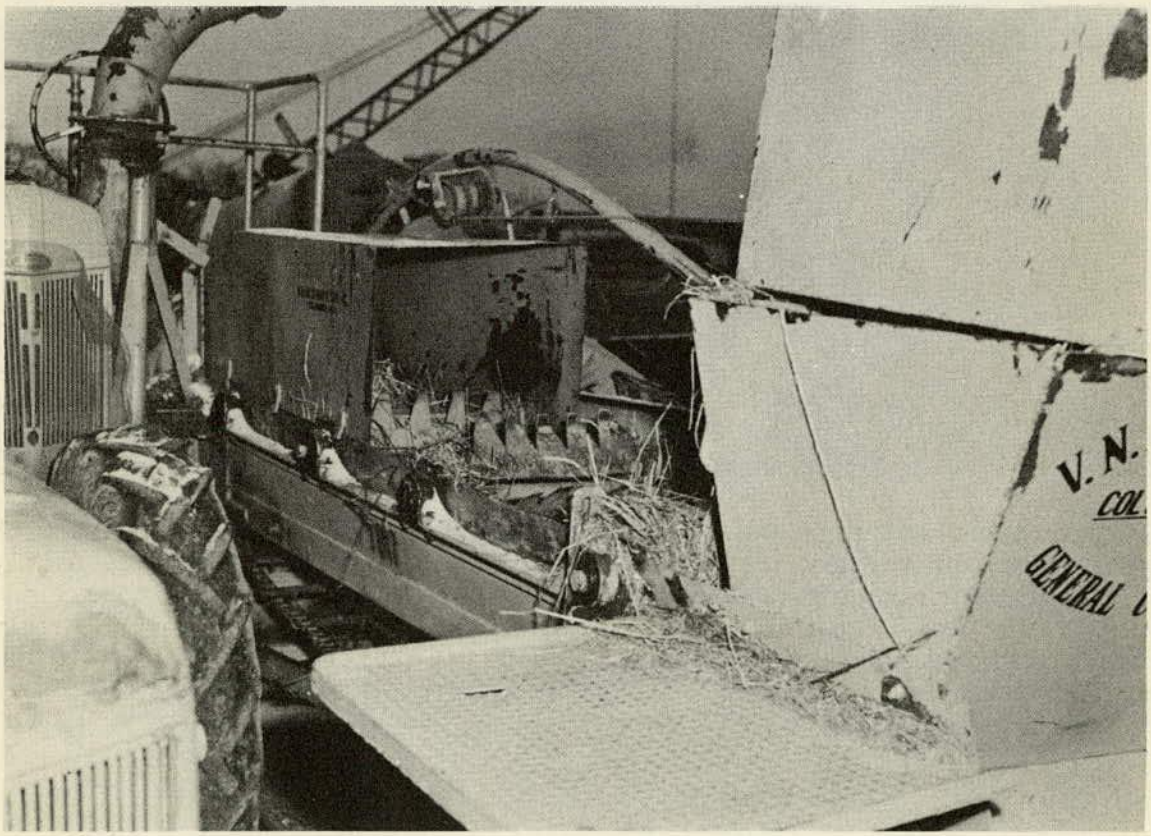
MULCH APPLICATORS



28. The straw blower above and on the facing page is towed behind a truck. A section of a bale of straw is started through the end of the blower next to the truck, and is carried by an endless chain into the blower compartment. En route it passes over a cylinder which has four rows of wedge-like tapered steel fingers. Each alternate cylinder revolves in the opposite direction; this fluffs the straw as it moves



through the compartment. These cylinders are encased in a steel hood which can be easily opened for cleaning. A farm tractor motor provides sufficient power. The blower will place 25,000 sq. yd. of mulch in 8 hr.

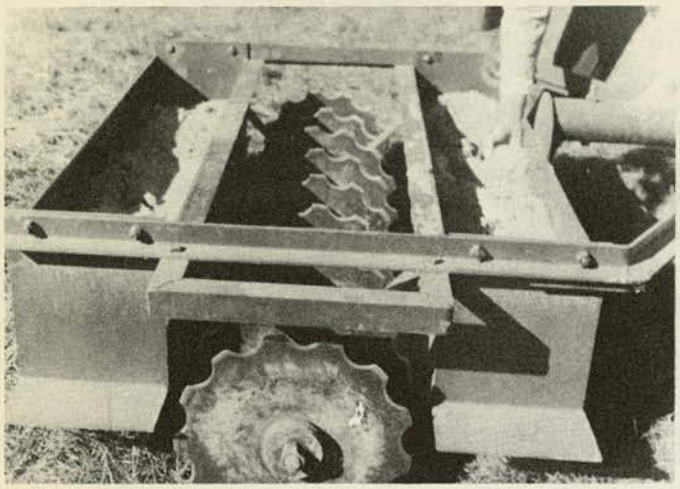


29. The straw blower at left is smaller than the one previously described, and the straw bales have to be broken up and fed into the machine in an even steady manner. The straw is blown out in its original lengths.

30. This two-wheel spreader is pulled by a tractor. All controls are within easy reach of the tractor driver. The self-locking stand couples easily and quickly to tractor drawbars of various weights. A four-bar top cylinder controls the flow of material to the main cylinder. The hammer mill revolves at a high speed and evenly distributes the material over a full 7-ft. width.

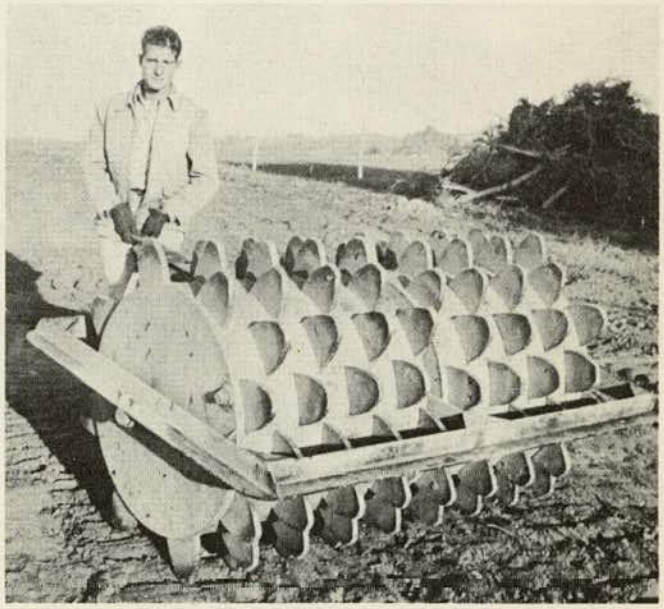
MULCH STABILIZERS

See Also: Stabilizers under SOIL PREPARATION EQUIPMENT

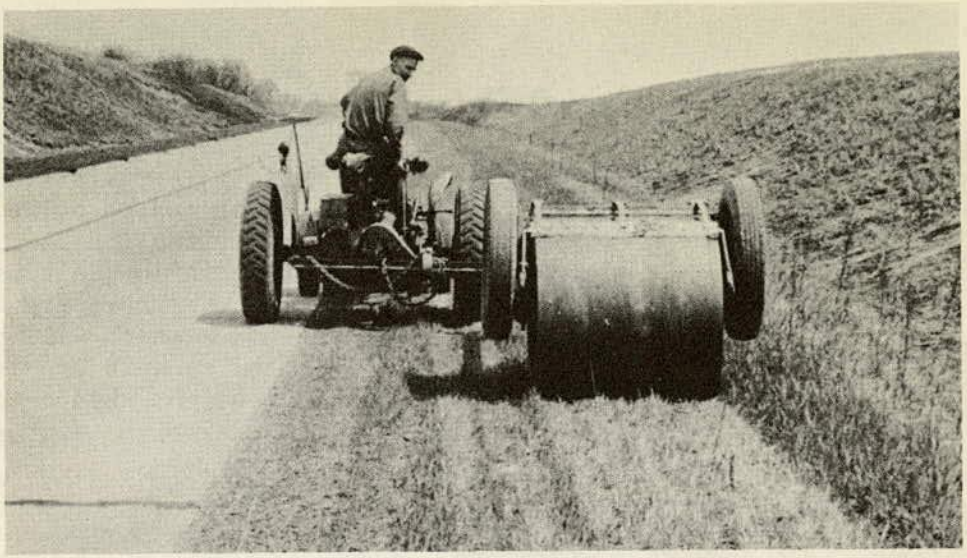


31. This mulching tiller at the left, which can be pulled by a tractor, is designed to incorporate mulch in the soil to hold it in place. There are two weight boxes which will hold 5 cu. ft. of sand to provide additional weight when needed. The machine weighs approximately 1,000 lb.

32. The tamping roller at the right is a double drum with studs shaped to prevent withdrawal of the straw while it is being rolled into the ground. The roller weighs 1,850 lb. empty, and approximately 3,850 lb. when loaded; each drum is 30 in. wide. Four drums instead of two are obtainable. The roller covers a total width of about 10 ft. and is used on flat grades.

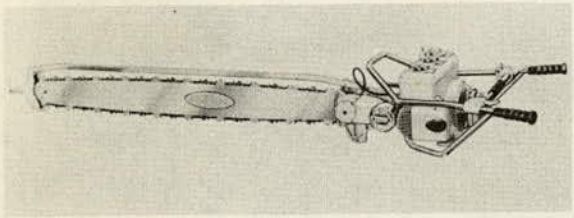


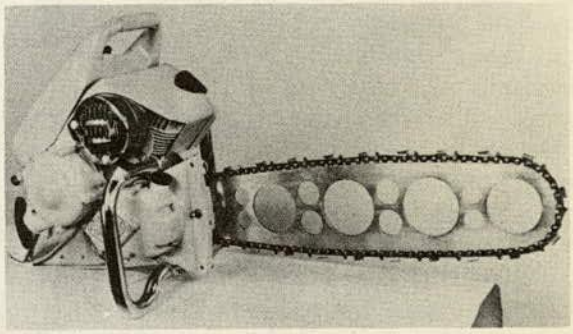
ROLLER



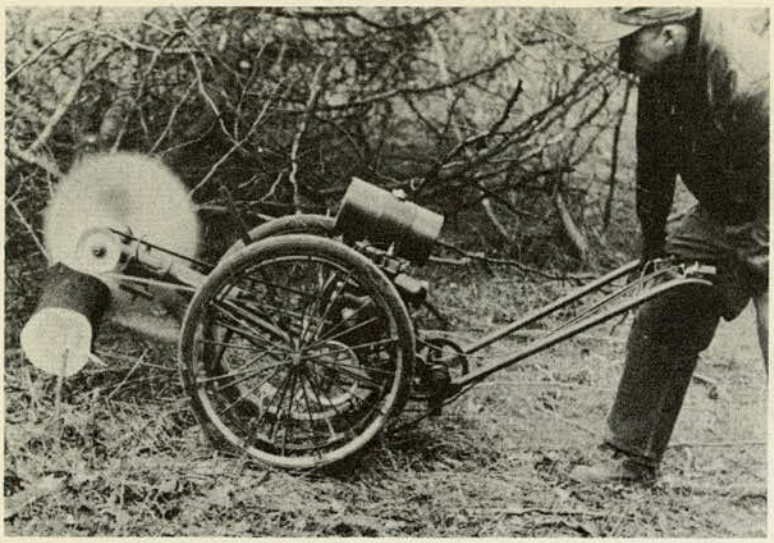
33. This roller is a special attachment for rolling shoulders. It can be raised for transportation on attached rubber-tired wheels.

SAWS



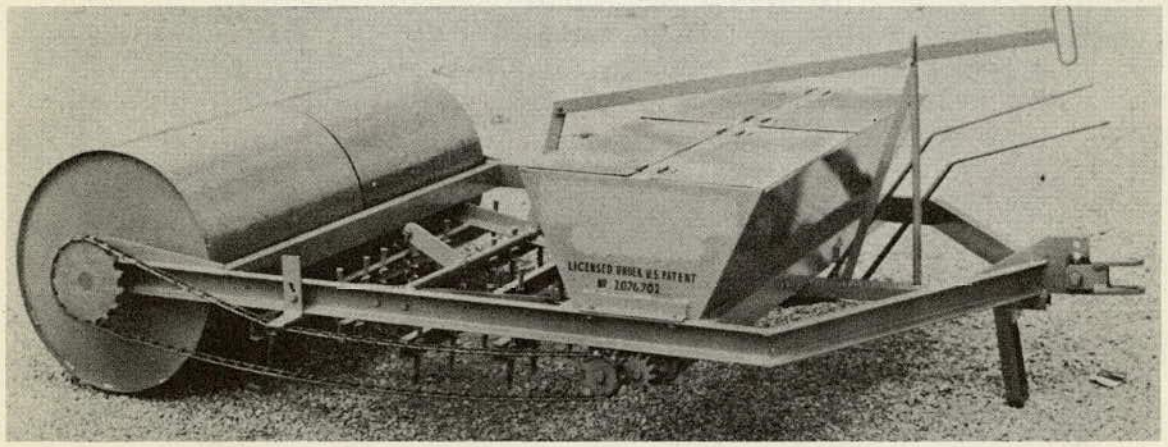


34. The chain saw comes in various sizes. The 5-hp type can be secured in six models, from a 20 to a 50-in. blade, and weighs 49 lb. The 7-hp type has up to a 60-in. blade and weighs 55 lb. Both types include a 20-in. bow model. The 3-hp type is available in 18-24 and 30-in. models and a 15-in. bow saw model. It weighs 25 lb.



35. This circular saw is available in self-propelled and push-type models. The saw operates in both a vertical and horizontal position. It can also be used for cutting heavy brush.

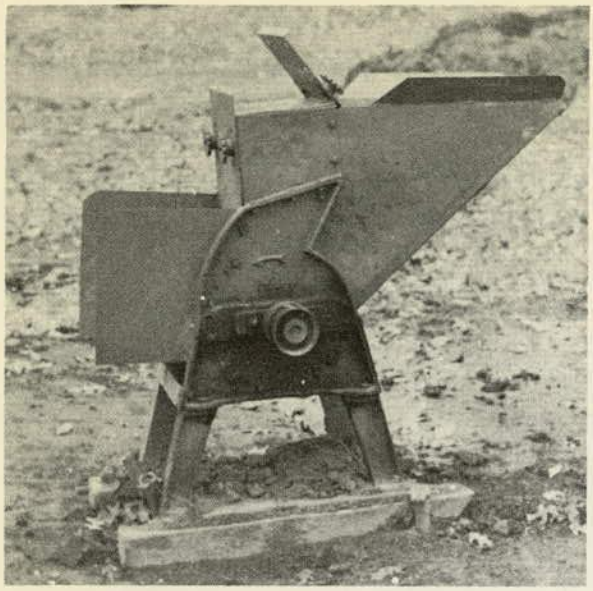
SEED AND FERTILIZER APPLICATORS



36. This seed and fertilizer spreader has two sections each. The rate of application is governed by the size of the openings which is regulated by two levers. The agitator is run by means of a chain connected to a sprocket wheel attached to the axle of the rollers. The seed and fertilizer are covered by means of a harrow-like attachment located directly behind the seed and fertilizer compartments. A divided roller completes the outfit which can be obtained in 4 and 6-ft. widths.

37. This hydraulic-type seed sprayer is used to spray seed on prepared seedbed areas. It is mounted on a truck and attached to the power take-off. The capacity of the tank is 750 gal. Water is pumped into the tank and fertilizer and seed are added. They are kept in constant suspension by a mechanical agitator. The amount of water desired may be adjusted automatically. The tank can be filled in 10 min. by using the vacuum pump which is connected with the engine at the point where the truck brakes and windshield wiper are connected. The spray nozzle is made of 1½-in. pipe flattened to have a rectilinear 3/16-in. opening. The hose is stored in a gutter-shaped trough fastened under the bed of the truck. A mounting ladder which also serves as a safety gate when the truck is in motion, a priming tank for the pump, red safety light, and specially developed nozzle stand are other features.

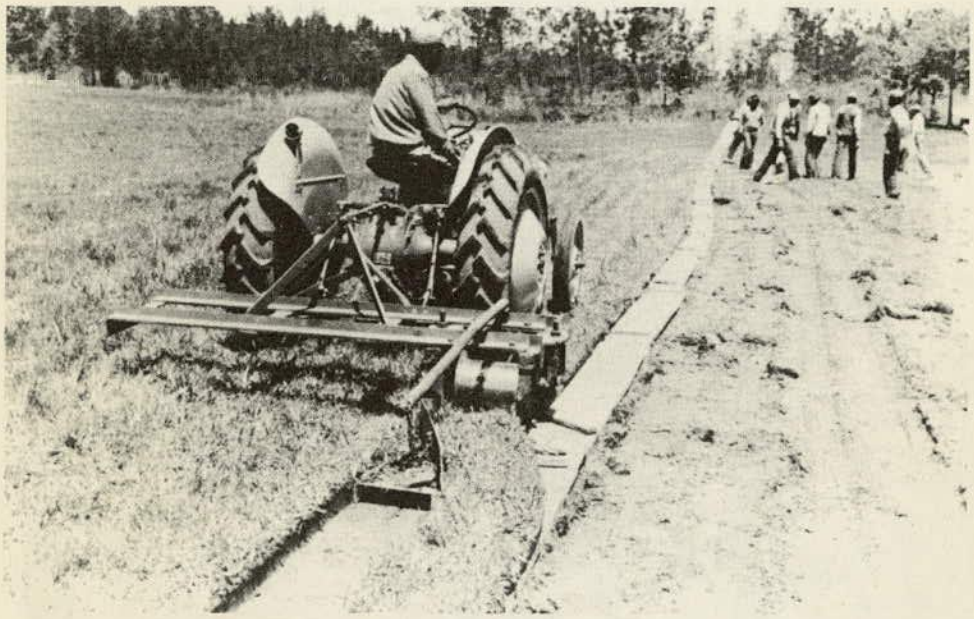
38. This hydraulic-type seed sprayer is a 500-gal. tank on a trailer. The agitator is powered by a gasoline engine. The spray material is delivered by a 2-in. centrifugal pump. Various nozzles are used, the size depending on the distance the spray is to be applied.



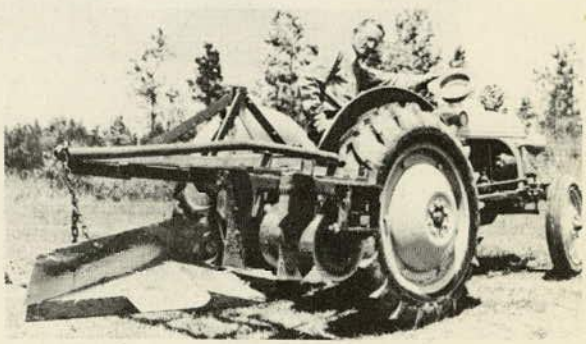
SHREDDER

39. The soil shredder at left is powered through a pulley driven by a belt attached to auxiliary power such as a tractor or truck. The machine is mounted on skids and is portable, requiring no special base.

SOD CUTTERS

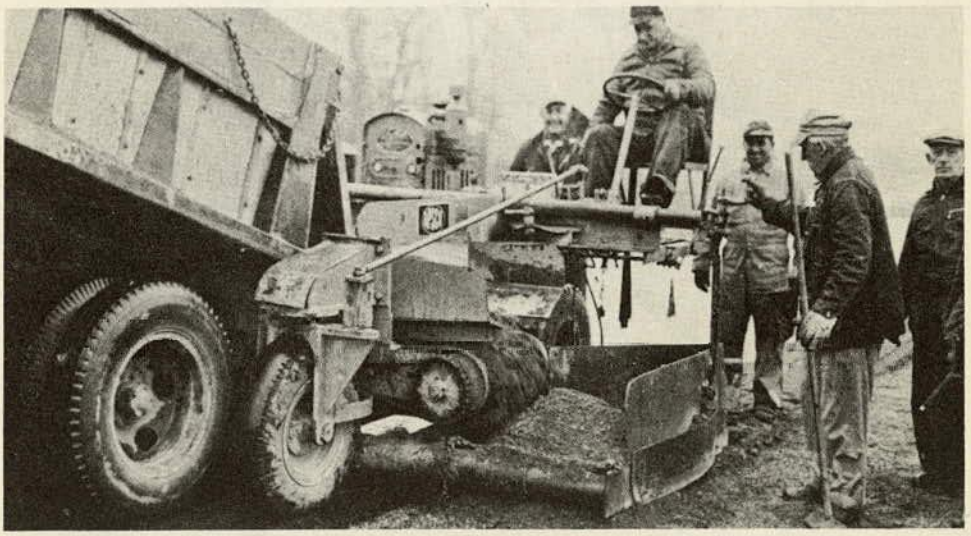


40. This sod cutter is attached to the power take-off of a tractor. It cuts the sod to a specified thickness and width. As the sod is cut, it is lifted and moved into a compartment which directs it off to one side and onto boards previously placed, ready for loading and delivery.

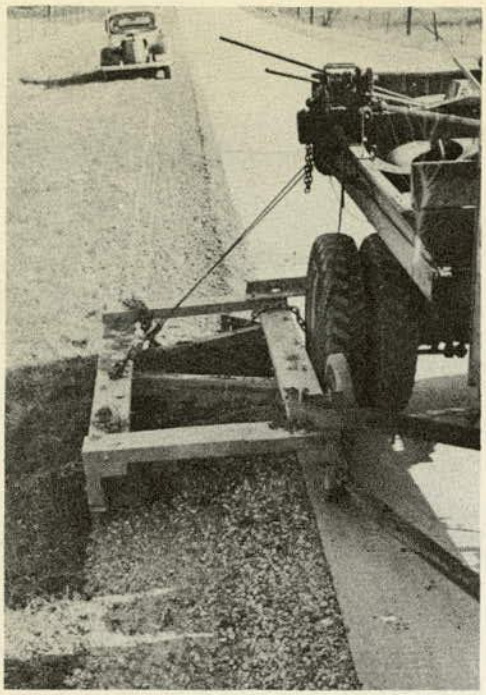


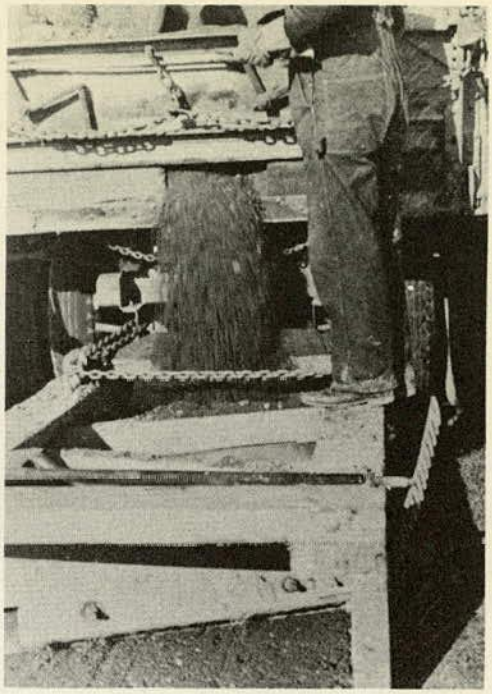
41. This power sod cutter is guided by a man walking behind it. He operates levers which control the progress of the machine and the cutting blade which is adjustable to various depths while the machine is in operation. The machine weighs approximately 300 lb. Its cutting capacity is up to 1,000 sq. yd. an hour.

SOIL AND AGGREGATE SPREADERS

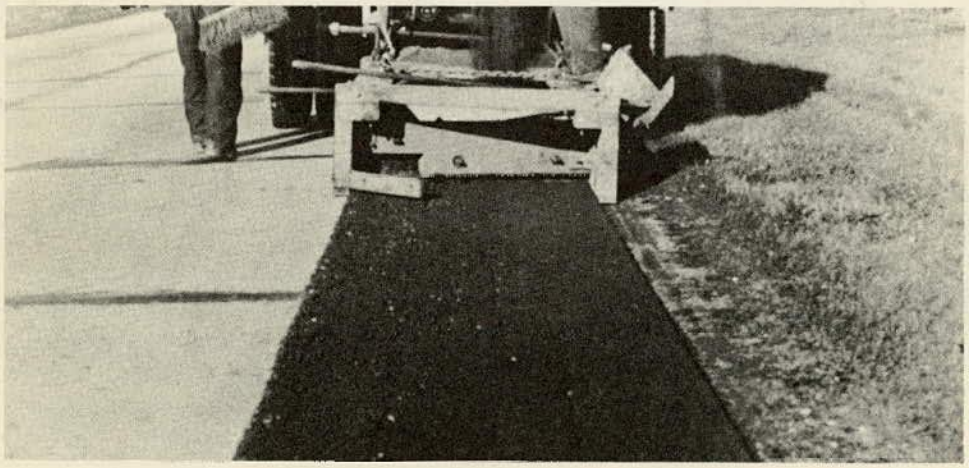


42. This spreader handles any type of aggregate. The hopper construction and belt conveyor accommodate material up to 6 in. maximum. The hauling truck is backed up to the hopper and, with the brake set lightly, it is pushed forward at proper speed by the spreader. All controls are within easy reach of the operator. The hopper has a 3-yd. capacity and the conveyor belt is 24 in. wide. A standard machine provides for any depth of fill to be made 2 to 4 ft. wide. The machine has four speeds forward and one in reverse.

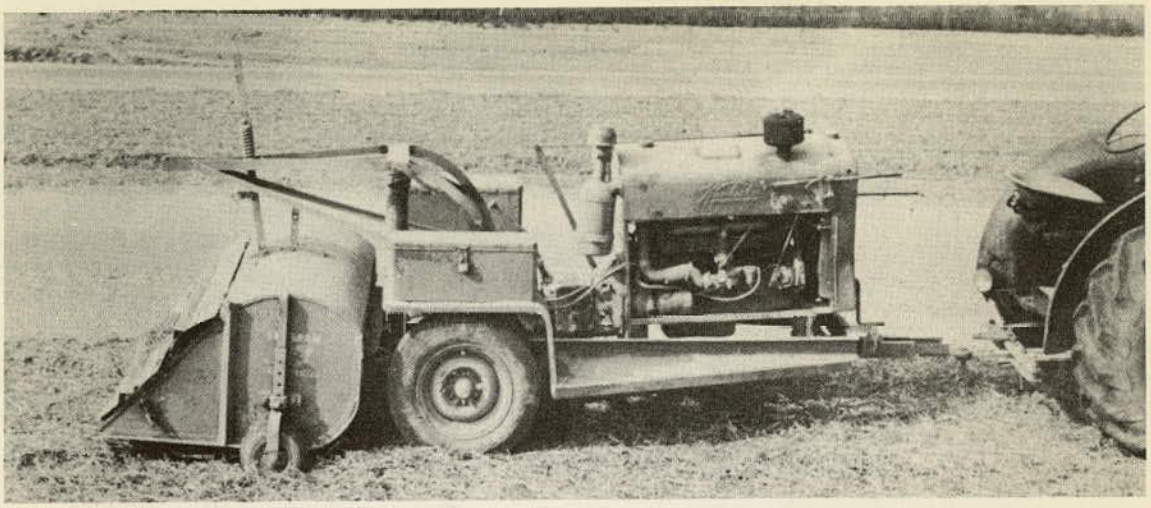




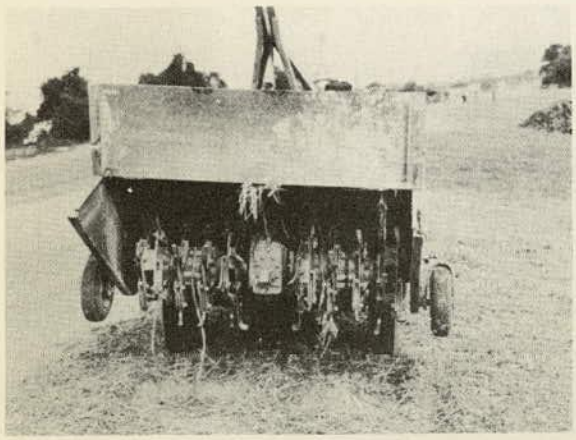
43. This box drag is towed by a truck. Aggregate is put into the box and the blade in the drag distributes and levels it. An adjustable steel-blade fin assembly is bolted to the frame at an angle so that it will level out any excess material. The width of the drag is determined by the width of shoulder to be maintained. For transportation, the drag is drawn up and chained to the rear of the truck. An alternate design provides wheels so the drag may be lifted and pulled. A roller may be attached, if desired, to compact the material.

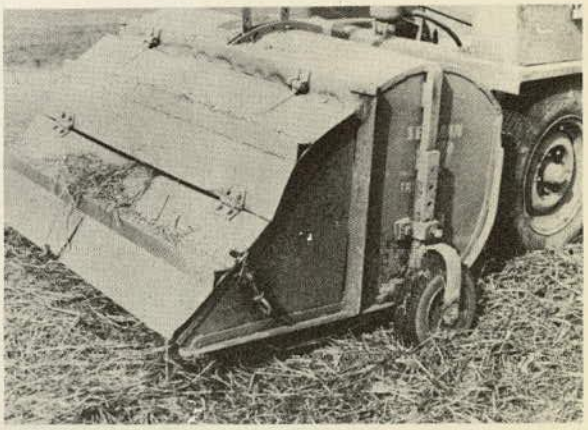


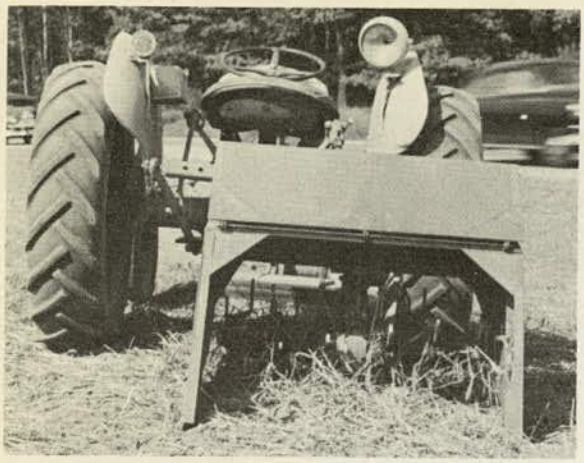
SOIL PREPARATION EQUIPMENT



44. The soil stabilizer shown in these three photos is pulled by a tractor. Tines which revolve inside the metal hood are motor-driven. The machine can be obtained in 4 and 6-ft. widths, and it will pulverize the soil or incorporate enough soil with straw mulch to keep the latter in place. Wheels attached to an adjustable bar govern the depth of cutting. The additional wheels keep uniform the depth the tines cut by following the grade or contour of the ground.

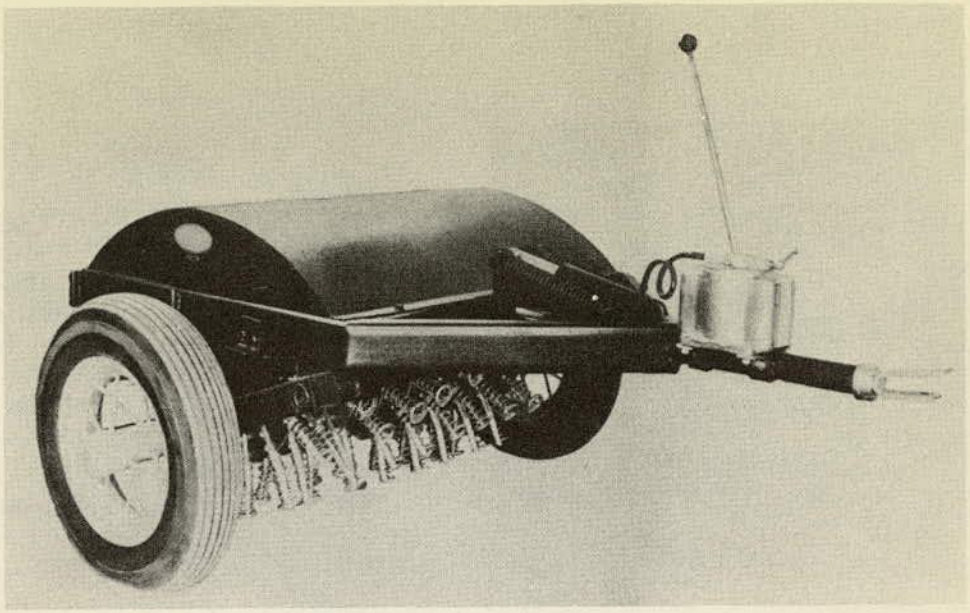






45. This model of the stabilizer is attached to the power take-off of a tractor and is approximately 3 ft. wide. A lever controls the depth the tines are to cut. The hydraulic lift on the tractor controls the lowering and raising of the machine. The lower edge of the sloping hood of the steel box smooths and levels the soil as the machine moves forward.

46. This self-propelled stabilizer is for pulverizing soil and seedbed preparation. All controls are on the handle bars which are adjustable vertically and horizontally. All of the unit rotates under a protective steel hood, part of which can be raised and lowered. An area 26 in. wide can be prepared to a depth of 1 to 8 in.

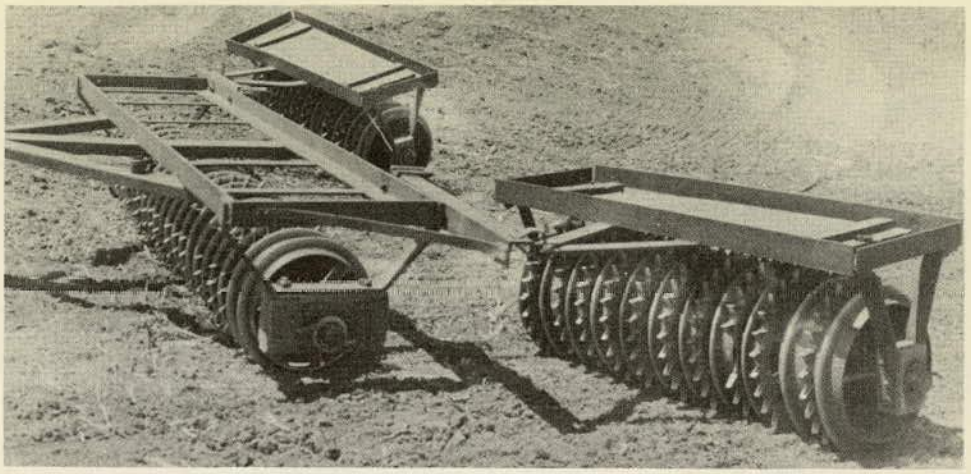


47. This aerator cultivates and aerates soil beneath a turf cover, with a minimum of disturbance to the surface. Hollow spoons loosen the soil by removing soil cores, leaving numerous loose-walled cavities. Cultivation depth is adjustable from 1 to 4 in. The cultivating reel is made up of discs which revolve independently on a fixed shaft, to minimize tearing when turns are made. The single unit cultivates a swath 3 ft. wide.

48. The English harrow differs from the conventional harrow in that it is very flexible, due to the method by which it is linked together. Each link has two projected tongs or teeth. The unit must be towed.

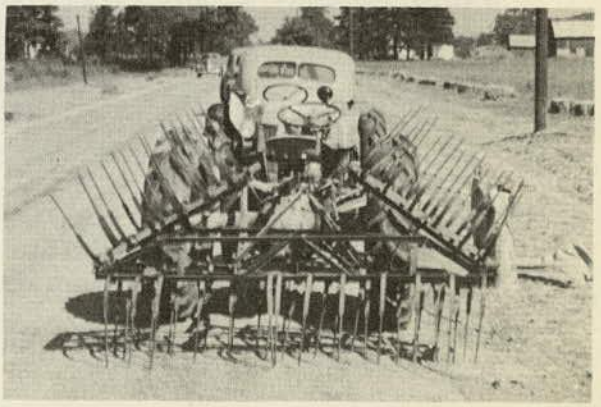
49. This spike-tooth harrow can be used in one or more sections. A lever controls the angle of the cutting teeth so various depths of soil can be loosened. The disc can also be used in one or more sections. A lever governs the amount of cutting to be done in each operation. Repeated operations are necessary to loosen desired depths of soil.

50. This cultivator is in three sections which allows for movability and makes possible working a greater area at a time. It will not loosen soil but may be used to break up clods and to firm the soil.

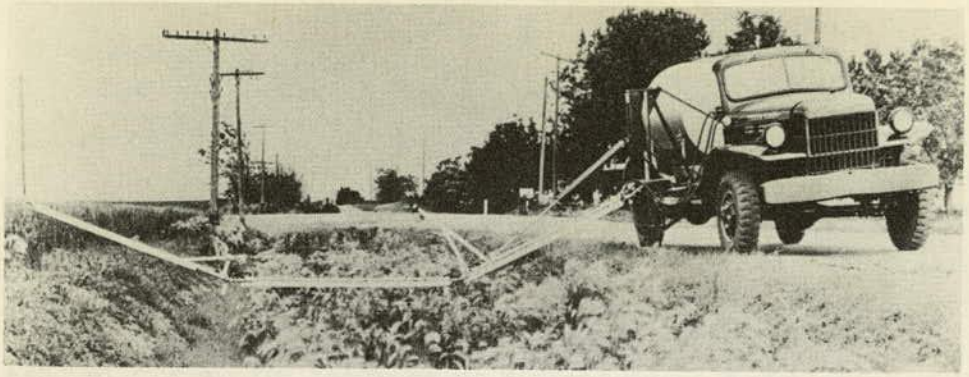


51. This landroller has two extension rollers which are attached at the back corners of the center frame section, making the overall dimension approximately 13 ft. This equipment can also be used for breaking up clods and consolidating soil.

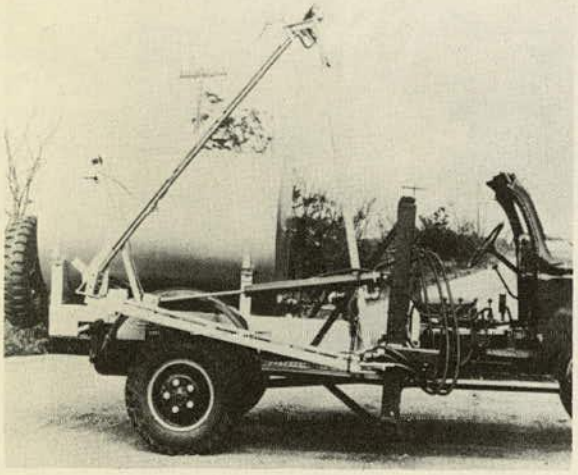
52. This weeder, above and at right, is similar to a spring-tooth harrow. However it is considerably wider and is in three sections. The tines are longer and are straight. It is attached to the power take-off of a tractor so that it can be lowered or raised as the occasion demands. When in transit, the two outer sections can be folded back, making it more compact. It works well where various grades are encountered as it is flexible enough to adapt itself to changes in grade.

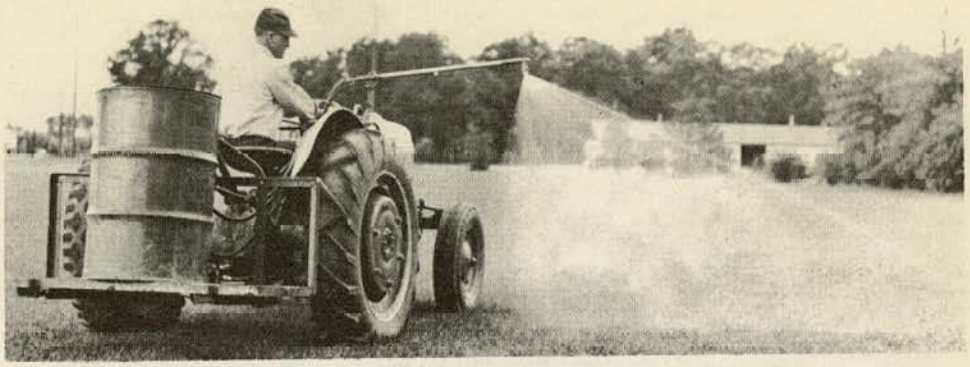


SPRAYERS



53. This high-pressure sprayer, shown in two working and travel positions, is suitable for mounting on any type of truck. One man, without leaving the driver's seat, can make the boom fit any contour to spray shallow or deep ditches, high or low banks, and roadside brush. He can control the supply of chemical to the boom while in continuous operation. The boom extends 22 ft. from the right of the vehicle, with a double coverage of 22 ft. when in a horizontal position. It is controlled by four hydraulic cylinders, three to operate each section of the boom vertically, and one to swing the boom back out of operating position and parallel with the line of travel of the vehicle. The sprayer has a centrifugal pump with an adjustable capacity of 30 to 300 lb. per sq. in. and is capable of applying from 5 to 200 gal. per mi. A built-in jet-type agitator sweeps the bottom of the tank clean and keeps the chemicals in suspension. A hand gun is provided for spraying areas inaccessible to the spray unit or boom.

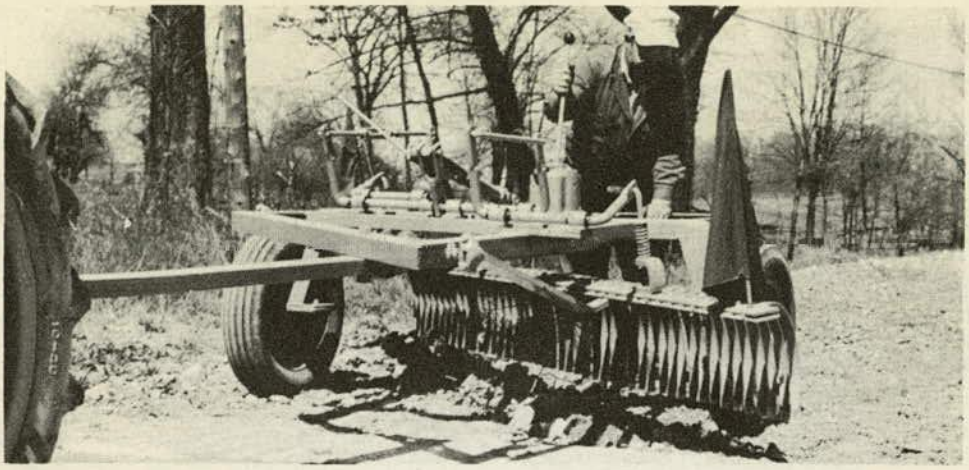




54. This low-pressure sprayer is equipped with a single nozzle and supplied by pressure determined by the quantity of material required per unit of area. Its tank capacity is one (or two) 50-gal. drums. The pump is connected to the power take-off and delivers up to 70 lb. pressure. This sprayer will deliver 5 gal. of spray material to the acre at a travel speed of 4 mph.; more can be used if needed.

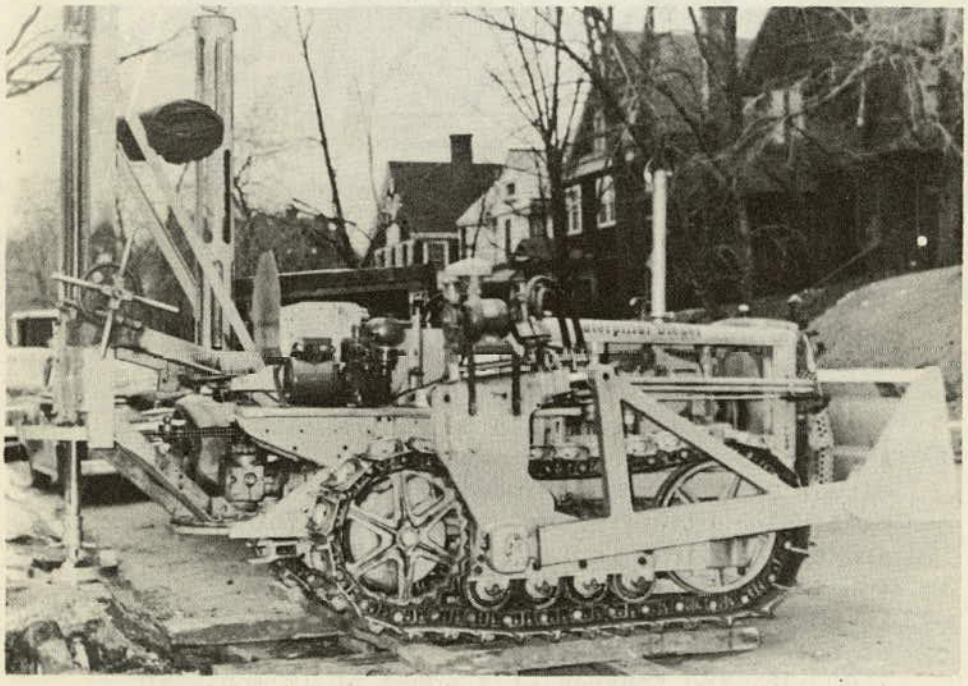
55. The knapsack sprayer, above, is especially designed for herbicide spraying. The 3-gal. tank is equipped with a 10-oz.-capacity carbon dioxide cylinder and pressure regulator valve to maintain 25 lb. per sq. in. Its weight, when loaded, is approximately 30 lb. The gun delivers approximately 2 gal. per minute.

STONE RAKE



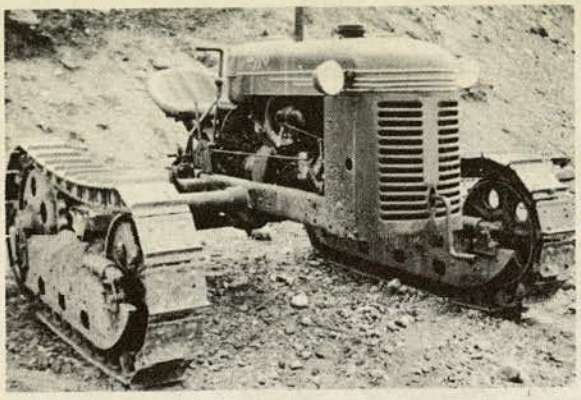
56. This stone rake can be towed by truck or tractor. Its height can be adjusted by a hand-operated hydraulic lift. The angle of the rake is adjustable by rotating the front of the frame and tongue. Coil springs release the pressure exerted on the surface when an obstruction is encountered.

STUMP CUTTER

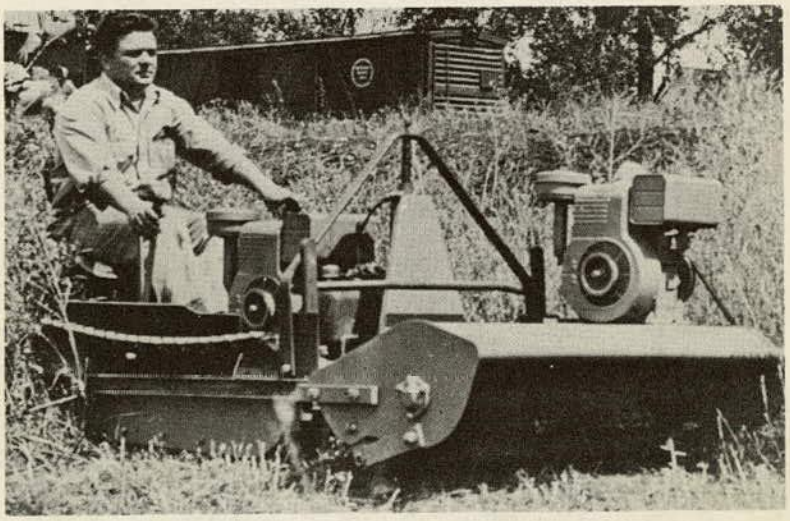


57. This stump cutter is mounted on a small crawler tractor. It can operate up to a 15-in. auger or cutter powered by the tractor through a rear power take-off, and will cut to the required depth.

TRACTORS



58. The tractor at left is engineered and built for mobility and compactness, for swift maneuvering and extra stability on hillside work. The tread-width range is 60 and 68 in.



59. This small tractor has a two-speed transmission. Its small size and maneuverability make it a valuable piece of equipment where large machines cannot work. Special attachments such as mower, bulldozing blade, broom, tote wagon, rotary tiller, and agricultural tools are available. It weighs 900 lb., the width at tread is 36 in., the length is 60 in., height of seat is 26 in., and the width of the tread is 7 in. It has a drawbar pull of 1,000 lb. and travels at a speed of 1½ mph., in low, to 6 mph., high.

60. The tractor at left has three wheels, with the single wheel in the rear. The wheel base is 55 in. The operator sits directly in front of the rear wheel, which has a steering arm attached to make it very maneuverable.

TRASH COLLECTORS

See: LEAF AND TRASH COLLECTORS

TREE MOVER

61. This tree mover is equipped with an all-steel welded frame. The cradle and boom assembly is operated by a push-pull ratchet jack. The machine is 12 ft. long, 7 ft. 6 in. high, and weighs 800 lb. It has a carrying capacity of 3,000 lb. and/or a 52-in.-diameter tree ball 30 in. deep. The sloping sides support the tree ball at more than one point of contact to prevent breaking up of the ball.

WEED CONTROL EQUIPMENT

See: SPRAYERS

In addition, there are the following units for destroying weeds.

62. This weed burner can be mounted on a trailer or truck. A rotary pump and a steel pressure blower provide atomization of oil and air for combustion. The machine is capable of burning a swath 5 ft. wide, at 6 mph., and consumes 9 gal. of fuel per mi. The burner unit is mounted on a circular track so that it can be set for straight-away burning or at right angles for ditch and ditch-bank burning, or swung in an arc of 180 deg.

63. The weed-shattering machine at right is used to shatter vegetation and eliminates raking as the weeds are dispersed and no vegetation remains to be disposed of. The machine clears an 80-in. width. It is equipped with steel hammers which are not damaged by contact with bottles, cans, or any other type of roadside litter.

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