VOL. 16 JULY 1955 No. 3

# FIRE CONTROL NOTES

A PERIODICAL DEVOTED TO THE TECHNIQUE OF FOREST FIRE CONTROL



FOREST SERVICE • U. S. DEPARTMENT OF AGRICULTURE

**FORESTRY** cannot restore the American heritage of natural resources if the appalling wastage by fire continues. This publication will serve as a channel through which creative developments in management and techniques may be communicated to and from every worker in the field of forest fire control.

Volume 16 Number 3

# FIRE CONTROL NOTES

## A Quarterly Periodical Devoted to the TECHNIQUE OF FOREST FIRE CONTROL

The value of this publication will be determined by what Federal, State, and other public agencies, and private companies and individuals contribute out of their experience and research. The types of articles and notes that will be published will deal with fire research or fire control management: Theory, relationships, prevention, equipment, detection, communication, transportation, cooperation, planning, organization, training, fire fighting, methods of reporting, and statistical systems. Space limitations require that articles be kept as brief as the nature of the subject matter will permit.

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# CONTENTS

# TRACTOR-BORNE RADIOS

JAMES E. MIXON

*State Forester, Louisiana Forestry Commission*

The Louisiana Forestry Commission has adapted a standard, two-way, commercially available radio to tractor mounting and is now conducting tests of the device.

At present, all radios handled by forest fire fighters are attached to trucks that haul the tractors to the fire scene. When the crew wants to get in touch with the towerman or someone else to summon help on a fire, one man has to walk back to the truck. This loses precious time and timber. Also, there is no way to contact the man actually driving the tractor on a fire to give him directions.

Communications Engineer Al Vendt and his radio technicians have been working on the tractor-borne radio, ironing out wrinkles in its operation. Experiments with a tractor in Rapides Parish proved so successful that tests have been enlarged.

The radio is fixed to the fender of the tractor in a special weatherproof and practically destruction-proof, 10-gage steel cabinet for protection against the rugged conditions of the fireline (fig. 1). All control heads and the microphone are also in

FIGURE 1.—Radio cabinet attached to tractor fender.

weatherproof and snagproof cases, to insure minimum damage to the equipment. Four bolts hold the entire assembly onto the tractor fender and one wire is all that is needed to connect it to the tractor battery. The antenna is mounted on the case.

For maximum efficiency, an extra set of controls is installed in the cab of the truck. With this arrangement, the radio can be operated either from the truck or tractor battery. While riding in the truck, the crew operates the radio from the truck battery. On arrival at the fire scene, they unplug the truck connection and plug in the tractor cord. The system is fixed so that the tractor motor won't start unless the truck cord is unplugged.

If the tractor-borne radios continue to prove as successful as in the first tests, the Louisiana Forestry Commission plans to have all its tractors equipped with two-way radios.

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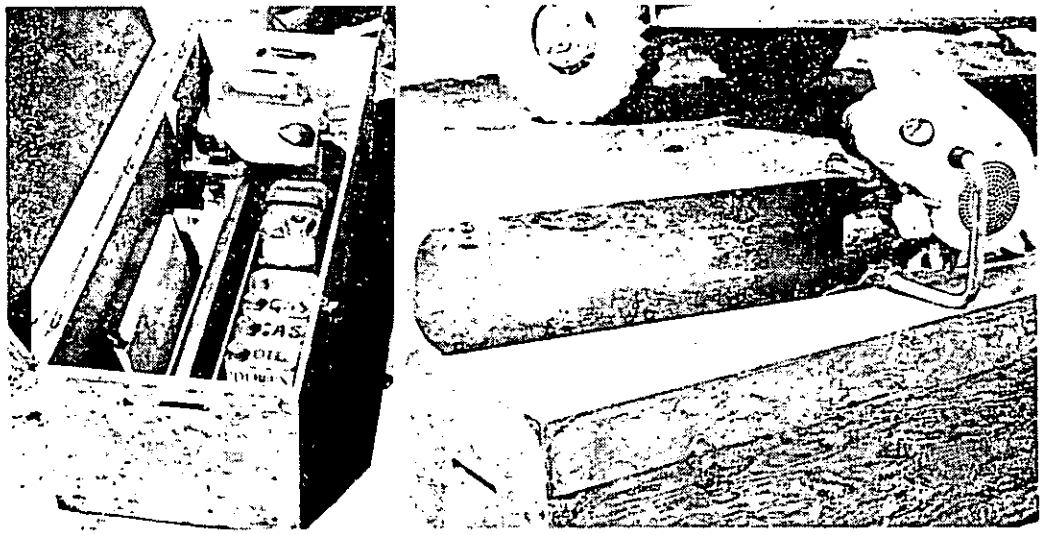
## Box and Blade Sheath for Chain Saws

No doubt boxes for chain saws are in common use. However, this article is submitted with the hope that it may contain some features worth passing on. Scale drawings are not included because each make and model of saw requires a box of a different size.



This box is made of plywood, ¾-inch for the ends, and ⅜-inch for the bottom, top, and sides. It is assembled with screws, and quarter round is used for cleats. The corners are reinforced with brass chest corners. Separate compartments on the inside, one at each side of the saw blade, accommodate gasoline, oil, spare parts, tools, and instruction book. The sheath for the blade consists of two pieces of ¼-inch plywood separated on top and bottom with strips of wood slightly thicker than the width of the chain. The sheath is bolted together. Both ends are open to facilitate the removal of chips or other foreign objects. It is easy to use and offers maximum protection to the saw blade and chain.—GLENN E. BRADO, *District Ranger, Sawtooth National Forest.*

# EFFECTS OF PRESCRIBE-BURNING 4-YEAR-OLD PLANTED SLASH PINE

W. F. MANN, JR., and L. B. WHITAKER

*Alexandria Research Center, Southern Forest Experiment Station*

In the winter of 1952-53, a prescribed fire was successfully used in a young slash pine plantation in central Louisiana. Mortality of the burned pines was light and height growth was not seriously retarded. The main object of the burn was to reduce the depredations of free-ranging woods hogs, which had damaged the stand the previous summer. From this standpoint the results were encouraging but did not provide a final answer. A second purpose in burning was to reduce the heavy fuels on most of the area.

## STUDY AREA AND METHODS

The study was made in La Salle Parish, where the Nebo Oil Company has extensive young plantations of slash and loblolly pine. The idea of using fire developed in the summer of 1952, when hogs severely damaged the stands by stripping the bark from the main stems and digging up lateral roots. For example, in one 2-year-old slash pine planting, hogs killed 52 percent of the seedlings and injured another 23 percent. Mortality in a loblolly plantation exceeded 60 percent. In contrast, no hog damage was found on several small areas that had been burned by a wildfire the previous winter.

To determine the effects of fire, a 4-year-old slash plantation was selected for a large-scale trial in the winter of 1952-53. This stand averaged 565 pines per acre. Trees ranged from 2 to 11 feet tall, and averaged about 6 feet. The area had been grazed by cattle. As a whole, grazing had been moderate, but there were some small areas where the grass had been cropped too low to carry fire, while other areas had been grazed lightly. Even on heavily grazed portions, the grass was tall and dense beneath each tree.

A total of 600 acres was burned between January 24 and March 4, 1953. The area was divided into units of 15 to 50 acres by plowing extra firelines to supplement the permanent firebreaks. Because time was limited, it was necessary to burn under a variety of fuel and weather conditions. However, fires were always set against the wind, which ranged in velocity from 7 to 12 miles per hour near the ground.

Twenty-eight unburned plots, paired with comparable burned plots, were established throughout the plantation to determine the effects of fire on survival, growth, and hog damage. All plots were measured immediately before burning, and in July and December of 1953.

## FIRE LOSSES

Needle scorching by fire was light, considering both the size of the pines and the heavy accumulation of grass and straw beneath the trees. Seventy-five percent of the trees had less than 50 per-

cent of the needles scorched, while only 13 percent were scorched 75 percent or more. Small trees suffered more than large ones. Damage was heaviest on several afternoons when the wind stopped blowing and the trees were scorched before the fires could be extinguished.

Mortality from fire was low, averaging 44 trees per acre or less than 8 percent of the entire stand. Only 11 percent of the trees that were killed exceeded 4 feet in height. Because most of the fire-killed trees were small and not apt to reach merchantable size, mortality was unimportant. Since the summer of 1953 was dry, particularly after July, the low mortality can hardly be attributed to favorable weather conditions.

During 1953, height growth averaged 0.25 foot less on burned than unburned plots. The reduction in growth ranged from 35 percent for trees 2 feet tall to 9 percent for 9-foot trees.

Growth losses were closely related to the degree of needle scorching. Trees with less than 25 percent of the needles scorched grew as much as unscorched trees. Scorching of 25 to 49 percent reduced growth slightly on small trees, but had no effect on trees larger than 6 feet tall. There was a marked reduction in height growth on all sizes of trees with more than 50 percent scorch; the reduction ranged from about 0.5 foot for 50-74 percent needle scorch to 1 foot on trees with more than 75 percent of the crown damaged.

On the whole, burning in this plantation was successfully executed. In localities where there is a high danger from wildfire, such prescribed fires may be justified to remove hazardous fuel accumulations from young plantations. However, prescribed burning of slash pine plantations is risky when the average height of the trees is less than 8 feet. It should be attempted only by experienced personnel under the best possible weather and fuel conditions and where the alternative to prescribed burning is intolerable loss.

## Hog Damage

Hog rooting in all of Nebo's plantations was much less in 1953 than in 1952, perhaps because an abundant May hawthorn crop kept the animals in the bottom lands until late in spring. Nevertheless, it was clear that the burned areas suffered less damage than the unburned ones.

Mortality and damage to the 4-year-old slash pine plantation by hogs and prescribed fire were as follows:

| Condition of trees: | Trees per acre | |
|---|---|---|
| | *Unburned plots* | *Burned plots* |
| Stand in February 1953 | 563 | 568 |
| Killed by fire, 1953 | 0 | 44 |
| Total hog damage, 1953 | 186 | 26 |
| Killed | 44 | 4 |
| Partially girdled | 29 | 1 |
| Lateral roots damaged | 113 | 21 |
| Alive and undamaged in February 1954 | 377 | 498 |

It will be noted that hogs killed 40 more pines per acre on the unburned plots than on the burned ones, so that the mortality from hogs just about equaled that from fire. But since injured trees were much more numerous on the unburned areas, the advantage was distinctly with the burned plots.

It is important to note that this study leaves unanswered the question of what would have happened if the entire area had been burned—with no choice of range for the hogs.

There are several possible explanations, none of which have been studied, why hogs may avoid burned areas. The ground on burned areas dries out quickly, so that rooting may be difficult and the soil may be an unfavorable habitat for the grubs and worms that the hogs are seeking. The ashes of the fires may also irritate delicate hog snouts.

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### Use of Bulldozers in Fire Suppression on Steep Slopes

When building fireline with bulldozer tractors on the under side of fires burning on steep, rough slopes, it is often difficult to include fingers of fire in the main fireline. A method for successfully trenching such fires was worked out on the Payette Forest on the Vaux fire in 1953.

The method, employing two tractors, is as follows: Tractor No. 1 constructs line along fire edge to finger; it cuts through the fire at this point, making a roadway across top of finger as it goes, picks up edge of fire and continues with line building. Tractor No. 2 follows Tractor No. 1, through the finger, and then cuts back along and under the finger making a fireline and roadway to a satisfactory distance beyond the finger of fire. This provides an escape line for Tractor No. 2 in the event of a blowup, because the second line it will build is often so steep that it cannot back up. Tractor No. 2 then backs up to line constructed by Tractor No. 1 at top of finger, recrosses, and completes line around finger.

The practice of cutting through fire when building fireline with tractors should only be employed, of course, when it is necessary to extend the use of the tractor to the "tougher sectors" on steep, rough slopes.—MARSHALL F. YOUNGBLOOD, *District Forest Ranger, Payette National Forest.*

# EMERGENCY RADIO REPAIR KIT

W. B. MORTON

*Communications Officer, Region 3, U. S. Forest Service*

Whether he is making emergency radio repair at an isolated fire or a routine maintenance pack trip to a distant lookout, the communication technician needs a lightweight minimum assembly of the basic test equipment. While the assembly of such a kit of test instruments is to some extent determined by the technician's personal preference, there are certain minimum needs that must be met. Choosing the equipment to meet these needs and still keep weight and bulk down becomes a problem.

In studying the various ways in which the bulk and weight of the overall test kit could be reduced, we found significant improvement could be effected through redesign of the indispensable D.C. vacuum tube voltmeter. Most commercial battery-operated V.T.V.M.'s not only are bulky and heavy but also duplicate many functions of the multimeter, which is used for other testing. In order to provide a smaller D.C. vacuum tube voltmeter, we designed and built a simple one to operate from the battery supply already carried in the grid-dip meter. The savings in size and weight in this instrument was enough to reduce the complete kit of test instruments to a compact package weighing only 24¼ pounds.

The vacuum tube voltmeter is built in a 3- by 4- by 5-inch utility box (fig. 1). The complete kit contains the grid-dip meter, power output meter and bridge for antenna and transmitter testing, the D.C. vacuum tube voltmeter, battery tester, and multimeter. Important accessories include flashlight and extra batteries which may be used for the V.T.V.M. supply, spare crystals to use in the grid-dip meter as a signal generator, and a spare battery cable for the V.T.V.M. in case it is desired to use the instrument kit without the grid-dip meter.

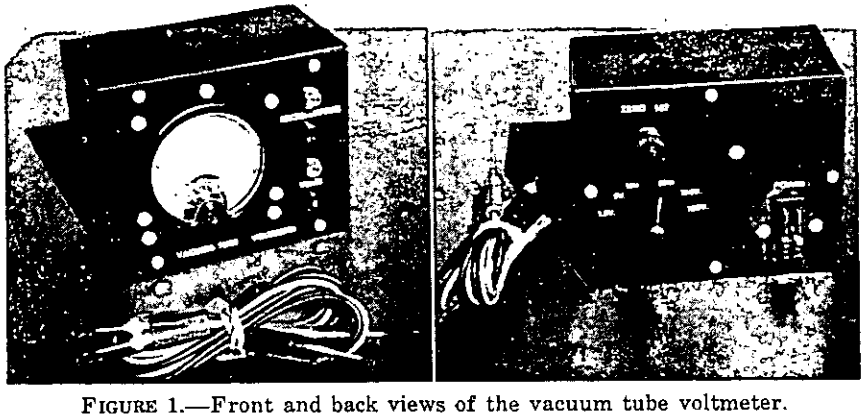

FIGURE 1.—Front and back views of the vacuum tube voltmeter.

This kit has given excellent service for two field seasons. Placed in a packsack with essential handtools, chemical soldering iron, spare tubes, and parts for the unit to be repaired, the total weight is 32 pounds. While back-pack trips to a repair job are not frequent, the weight is an important factor. This kit has filled emergency needs even at elevations of 10,000 to 12,000 feet where back-packing is more strenuous and a weight saving is not only appreciated but necessary.

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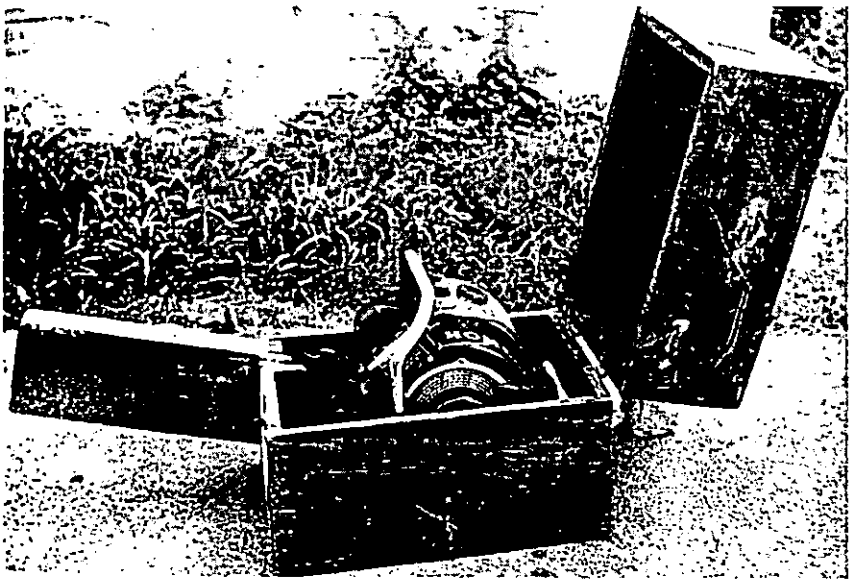
## Carrying Case for Chain Saw

This inexpensive yet convenient carrying case for a one-man chain saw, constructed and tested by the Tallahatchie Research Center of the Southern Forest Experiment Station, greatly simplifies transportation of the saw. It protects the saw, the truck, other cargo, and—most important—the passengers. The design makes possible safe storage or transportation of the saw without removal of the guide bar and chain. This facilitates loading or unloading with a minimum of time and effort.

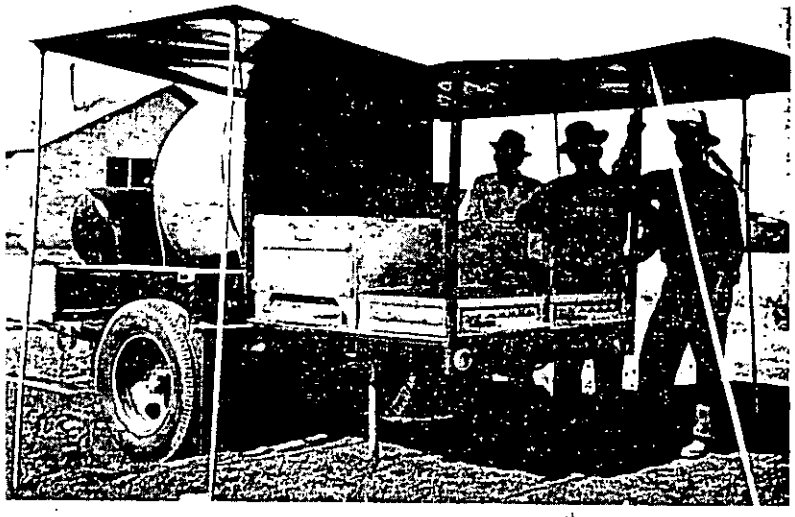


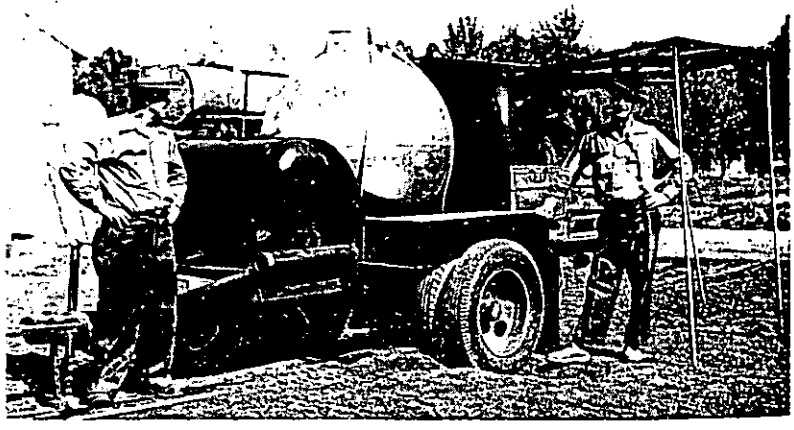
The case shown is for a 4-horsepower saw with 18-inch chain, but it can easily be adapted for any other small chain saw. The projecting sheath for guide bar and chain is closed on the top and outer end, but is open on the bottom to permit dipping the guide bar when loading or removing the saw. Three-quarter-inch lumber was used, but lighter material or plywood could be substituted.—W. L. GRAHAM, *Southern Forest Experiment Station.*

## Trailer Fire Camp Kitchen

The Modoc National Forest has a portable kitchen designed for use in fire camps. The kitchen is set up on a trailer made from the rear axle and dual wheels of a 1½-ton stakeside truck. The cooking unit consists of a 250-gallon butane tank, 40-gallon hot water tank with gas heater, two ovens, and two flattop burners. Gas is piped to a point near the stoves through ⅜-inch galvanized pipe. Flexible pigtails are used to connect the various burners. The butane tank is equipped with safety devices in order to comply with State safety regulations.

The 40-gallon hot water tank is equipped with a ¾-inch faucet, and the heater is directly underneath the tank. The heavy metal shield directly behind the water tank is to eliminate any possibility of heat or flame coming in contact with the butane tank.





Our fire camp set-up for 100 men can now be transported with one stakeside truck and the kitchen trailer, which is easily pulled behind the truck. The camp kitchen is a time saver when a fire camp is required since one man can have it ready for use in 15 minutes.—CHESTER D. CANNON, SR., *Storekeeper*, and CHESTER W. MAPES, *Shop Foreman, Modoc National Forest.*

# A MECHANICAL MULE[1]

HOMER W. PARKS

*District Ranger, Payette National Forest*

In 1953, two citizens of Granger, Wash., invented a mechanical carrier to use on hunting and fishing trips into the Warren District of the Payette National Forest (fig. 1). This rugged little trail buggy is powered by a well-known 2-horse, 1-cylinder, 4-cycle engine with an automatic clutch and a 2-speed transmission with brakes, hand throttle, and a reverse gear. Many of the parts used in it were designed for motorcycles that are known for their speed and dependability over a long period of years. It will climb an 88-percent grade on a dry plank surface. Its closely set tandem wheels pull in unison to give this remarkable performance, and

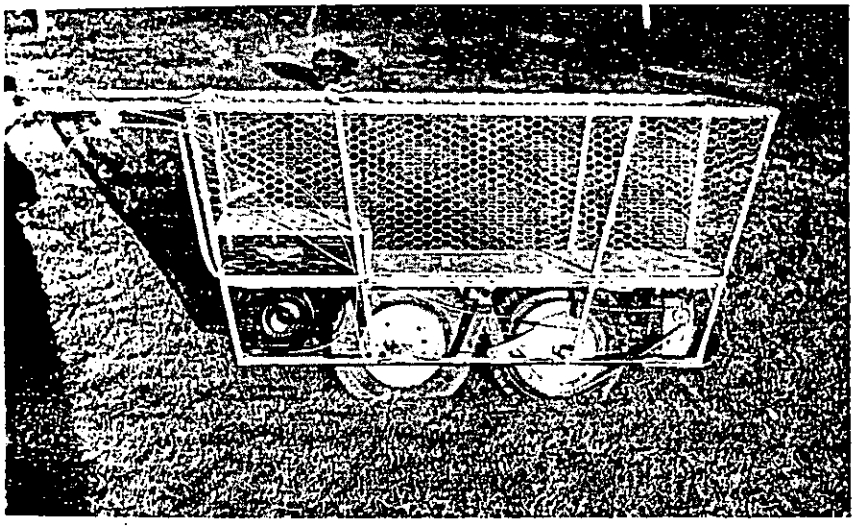


FIGURE 1.—The "mechanical mule."

make it possible for it to climb over obstacles such as logs and rocks. A large basket, 20 inches wide and almost 5 feet long, is mounted over the small wheels. The short wheelbase makes a 90-degree turn very simple. The driver balances the machine much the same as he would a bicycle by walking in the rear and holding onto the handle bars. Transportation of this vehicle from one job to another is simple. It weighs only 170 pounds and can be hauled in a pickup, in the rear of a touring car, or in a plane.

[1] In this article, Ranger Parks enthusiastically describes one type of powered carrier. At least five other models of this versatile machine are being designed, tested, or produced by private and government agencies.—Ed.

In July 1954, Payette Forest obtained one of these mechanical mules with a trail-grader blade attachment. Plans were immediately put into effect to complete a trail-maintenance job by using it instead of horses to carry all tools and camp equipment. Our mechanical mule was operated over 98 miles of pack trails on rough terrain to haul 200 pounds of tools and equipment for an experienced 2-man trail crew. The only mechanical trouble experienced during this time in the field was the adjustment of the carburetor for high elevation, replacement of a key to hold a belt pulley in place on a shaft and the replacement of a spark plug. When it was loaded with the tools and equipment and operated over steep mountain trails in low gear and left with the motor idling a large part of the time, it consumed 1½ gallons of gasoline each week. However, when run with a light load in high gear it averaged 12 miles to 1 quart of gasoline.

The maintenance standard required cutting and removing all logs, and putting up necessary trail signs. The average cost per mile on our forest for this type of work is $12. The trail crew maintained these trails for an average cost of $5.56 per mile. The trails were about average in the amount of work needed.

The mechanical mule was given another test by hauling sand and gravel cross country to a source of water for the Forest Mineral Examiner to make the examination necessary in patent claims. The 10-mile round trip was made in high gear at an average speed of 4 miles per hour, with a small load. The machine will pull the operator along at a dogtrot when it is in high gear. It is very easy to start and operate.

The trail grader was not used because of the dry condition of the river trails. However, tests were made to determine whether the machine had enough power to handle it. The test proved that the machine will push a trail grader or pull a fire trencher. Plans are made to use it for these purposes in the 1955 season.

Very little time is required for lubrication and maintenance of the carrier. Wheel bearings should be greased about once a year. The oil will run a season on trail work without becoming dirty. However, the air cleaner should be cleaned at least once a week when working on dusty trails. Tools required for the maintenance: a pair of pliers, a small crescent wrench, a screwdriver, and a screened funnel.

Advantages of the mechanical carrier:

1. Convenient to move in a truck or trunk of car from one job to another, thus avoiding trailing of pack stock.
2. Avoids time loss common with horses and/or mules in gathering them, packing up, and finding feed on the job, etc.; also eliminates trouble caused by unrest of stock while working.
3. Two-man crew can do the same amount as three with pack stock.
4. Can use workers not familiar with horses.
5. Simple to maintain and operate.
6. Adequate for attachments such as a light trail grader and fireline plow.

7. Can be dropped from plane for emergency use.

8. Suitable for hauling sick or injured personnel from back country to road heads; avoids delay.

9. Two forward speeds and one reverse.

10. Proved capable of climbing an 88-percent slope on a dry-plank surface.

Disadvantages:

1. Limitation on amount of cargo it can haul shortens period crew can stay on job. Under tests, ration-type food supplies and small down beds were used.

2. Crew must be good hikers.

3. Difficult to ford streams more than 6 inches deep.

4. Limited to travel over cleared trails; would not be practical to go cross country where down trees were numerous.

5. Lack of emergency brake.

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## Nitrate Airplane Dope for Mounting Maps

Glacier National Park has experienced difficulty for years in keeping lookout firefinder and dispatcher maps from wrinkling and pulling loose from the mounting base whether it be of wood or metal.

Shellack, varnish, and other adhesives of various kinds have been tried with varying success, generally poor. It seemed that we were constantly replacing firefinder maps and usually the replacement was in as poor condition as the replaced map by the end of the season.

Apparently we have solved this problem by the use of nitrate airplane dope. Maps that were mounted last year are still in perfect condition. Cohesion with the base is perfect and there is no sign of wrinkling.

The actual work involved in mounting the maps is much less than that for any of the old methods we were using. One light application of the dope on the mounting base is all that is necessary. The map, being dry and free from adhesive, can be rolled for easy handling and placed in its proper position, after which it can be unrolled while working out the slack and air bubbles with the hands. A rubber roller (photographer's brayer) lightly applied will seat the map firmly on the base while removing most of the bubbles, and without apparent distortion. Remaining bubbles can be reduced in the usual way with the prick of a pin and use of the roller. A light application of the dope over the face of the map after it has dried on the base will protect it indefinitely without cutting the ink on the map.

This dope dries quickly so the map must be placed on the dope in a hurry. On large map mounts, it is often necessary to apply dope and place the map on only part of the mounting base at a time.

The dope can be readily acquired from any air service installation where repairs are made to fabric covered planes. Cost is approximately $3.85 per gallon. A special thinner for the dope is necessary and is also readily acquired. We have used approximately one-half gallon of dope and one quart of thinner in mounting twenty maps ranging in size from the Osborne firefinder maps to large 3- by 4-foot dispatcher maps without one failure.—S. H. SPURGEON, *Fire Dispatcher, Glacier National Park.*

# SAWDUST BOX FOR FIRE STRATEGY TRAINING

JOHN W. COOPER

*Assistant Forest Supervisor, Mississippi National Forests*

All rangers, forest supervisors, and other forest managers responsible for training fire crew foremen have for many years racked their brains for new and better ways of teaching fire strategy through simulated methods: blackboard, mimeographed problems, string on the ground, etc. Last fall Forest Supervisor E. R. De Silvia fell back on his grammar school training days for the answer to this ever present problem. He came up with the idea of using a sandbox and appropriately labeled "flags" on swab sticks to identify equipment, manpower, and so on. He further suggested the use of some sort of paste to symbolize firelines, creeks, roads, and natural barriers.

After the table was built on the Chickasawhay District, dampened sawdust was found to stand up better and to serve the purpose more effectively than sand. It is lighter in weight, cleaner, and easier to work. As a matter of fact, mountain topography involving a range of over 4,000 feet in elevation set up as the last problem at the first fire training school was still intact and usable at another school 3 weeks later.

The sawdust training table is simple and inexpensive to construct and can be built by even an amateur carpenter. A frame of the desired dimensions is constructed from 2- by 6-inch lumber with the top of the "floor" joists 30 inches above the floor. The frame is then floored with 1 by 4's, S4S, over which cheap roofing felt may be placed, or the table floor may be built with tongue-and-groove boards and the roofing felt omitted. Lengths of 2 by 6 are then set edgeways around the border of the table to serve as side boards.

If later use of the sawdust training table is to be expected in the same or other locations, the table may be constructed with bolts and nuts rather than nails in order to facilitate dismantling and storage. This will obviously be a little more expensive than using nails, but storage and future use of the training table will be easier.

Representation of the natural features was successfully solved by the use of outside paint thinned approximately one-third with turpentine. The paint was applied to the "sandbox" from a pint mayonnaise jar in which a short ¼-inch copper spout was welded through the top of the jar. A small breather hole was made in the opposite side of the top. Blue paint was used for creeks, white for the roads, yellow for natural barriers, and, of course, red for the fireline.

Visualization of the characters can be enhanced by use of toy model tractors, trucks, and men. Different colored models can be used to represent different types of equipment, the Fire Boss, and other classes of personnel.

The original training table was 10 to 10 feet, but it is recommended that one dimension be reduced to 8 feet in order to facilitate simulated fire movement and the moving of equipment and personnel or labels as the training progresses. The table may be 10 or more feet in length as desired.

In preparation, the instructor lays out the sawdust table to scale. Roads, creeks, and natural firebreaks are shown as they actually exist in the area of the fire to be discussed. One advantage of this method is that the entire fire need not be shown at first, but rather the outline of the fire at different time intervals during the course of its run. It is then possible to show the location of line constructed and lost and point out the respective mistakes made by different crew foremen in the location of their lines or other significant facts at various points in the attack.

A blackboard, chalk, and eraser should be on hand to record time, season of year, wind velocity, days since rain, danger class, etc. Several 6-foot pointers should be available to the instructor and to the trainees on each side of the table so that they can point out questions at different locations.

When the first simulated fire problem is completed, the topography of that fire can be wiped off the table and new topographic features set up in about 5 minutes. It was our experience with this training device that all grades of employees were able to readily visualize and understand the problems being described. All trainees expressed the opinion that this was the most realistic and effective means of teaching fire strategy that they had ever seen.

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### Keeping the Forests Green in Beech River Watershed

This is the title of an 8-page brochure, issued jointly by the Tennessee Department of Conservation, Division of Forestry, and the Tennessee Valley Authority, Division of Forestry Relations, in November 1954. It explains briefly the fire problem in relation to the watershed, the fire prevention project jointly planned and financed, and what the job of preventing fires means to the residents of the area.

## MORE ABOUT THE TRACTOR-DRAWN FIRE RAKE

JOHN S. CROSBY, *Forester, Columbia Forest Research Center, Central States Forest Experiment Station, U. S. Forest Service,*
and LEE C. FINE, *formerly District Forester,*
*Missouri Conservation Commission*

A tractor-drawn fire rake was described in the July 1952 issue of *Fire Control Notes.* At that time the rake had not been thoroughly tested. Since then it has been used on more than 50 fires and to make and maintain firebreaks on the Sinkin Experimental Forest near Salem, Mo.

The rake is a narrow, rugged version of a side-delivery hay rake developed by a manufacturer at the suggestion of the Forestry Division of the Missouri Conservation Commission. It is designed for use with a farm tractor. The rake is attached to the tractor by a three-point hitch and can be raised and lowered with hydraulic controls. The raking mechanism is driven by a "V" belt from a pulley connected by a drive shaft to the tractor power takeoff. For increased traction in the woods, the tractor is equipped with bombardier treads, and weights are attached to the front wheels (fig. 1).

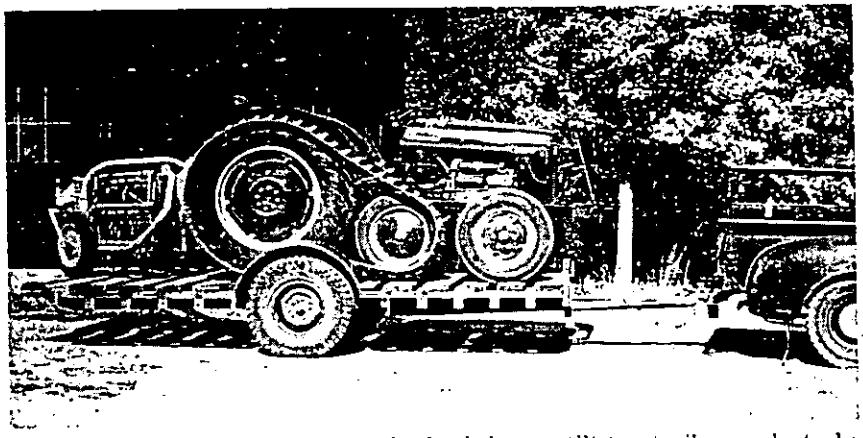

FIGURE 1.—The mechanical fire rake loaded on a tilt-top trailer ready to be towed to a fire by pickup truck. The rake and tractor can also be loaded on a 1½-ton stake truck.

The rake is sturdy and relatively trouble free. Since the rakers are belt driven, the belt slips if the rake is jammed. The raker teeth may be bent on rocks and stumps but can be straightened many times before they break or wear too short. Tooth life varies with the condition of the surface and the skill of the operator. However, a set of teeth costing about $15 can be expected to rake about 25 miles of line.

The only serious breakdown to date occurred when two cast iron spokes of the spider wheels broke off dropping one whole line of rakers. Even so, the machine was kept in operation for several hours and continued to rake a very satisfactory line. The possibility of this type of breakdown has been practically eliminated on later models of the rake by substituting disk wheels for the cast iron spider wheels used on earlier models (fig. 2).

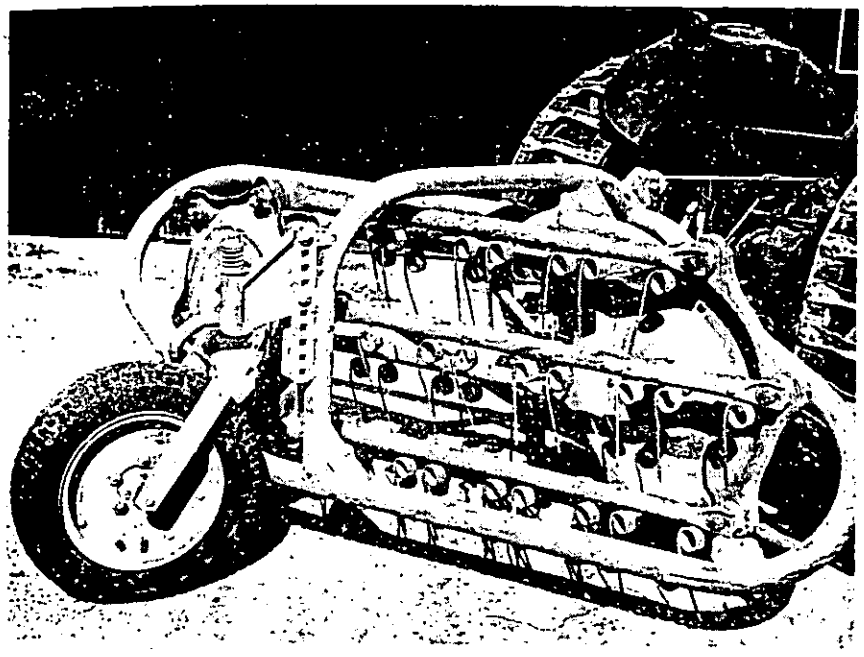

FIGURE 2.—The tractor-drawn fire rake, showing new type disk wheels to which the raker arms attach.

## CAPABILITIES AND LIMITATIONS

Few if any machines yet developed for use in fire suppression operate successfully under all conditions. The mechanical fire rake is no exception. In general, the quality of line made by the rake and the ease of operation are greatest in relatively open timber on level to rolling topography. Difficulty of operation increases as the trees become thicker and as the slope becomes steeper. Quality of line is decreased by running over small trees and slash and by heavy grass.

The rake is most easily operated in open sawtimber stands or lightly stocked stands of poles, saplings, or reproduction, and along old trails. These conditions permit the operator to rake a good line with little help. In stands of poles, saplings, or reproduction of medium density, the operator will need some help from a line locator or axman, but still the rake will do most of the work.

The rake is more difficult to operate in dense reproduction, saplings or poles, and scattered slash. The tractor will go through dense reproduction, small saplings, and light slash unassisted but the quality of line is greatly reduced because the rake cannot clear a line through bent-over saplings and sprouts. However, a satisfactory line can be made if a line locator and/or axman works ahead of the rake and cuts any trees that would either stop the machine or prevent the rake from operating effectively.

Under favorable ground conditions the unit can be operated effectively on slopes up to 40 percent for up and down travel and 20 percent for travel on the contour. Under more difficult conditions of footing and cover, the limits of slope for safe operation will be reduced. The hazards of operating a tractor on rough, sloping land should always be kept in mind.

The rake is most effective for clearing a line through typical forest litter found in the Missouri Ozarks. It also will comb leaves and light debris out of blueberry bushes and similar low-growing vegetation, making acceptable line in a situation where it is difficult to clear a line with hand rakes. The rake will not clear a line in heavy perennial grass, but by setting the teeth to dig and by making several trips a usable line can be made through annual grasses.

The rake will not clean out short, sharp depressions perpendicular to the line of travel because the tail wheel holds the rakers off the ground as they pass over narrow ditches or holes.

Very few soil conditions found in Missouri will limit the operation of the rake. However, areas of large boulders would seriously interfere with effective operation.

Since the rake moves all debris to the left, it is necessary to travel clockwise around the fire in order to throw the litter away from the fireline. If more than one trip is made over the same line, the second trip is most effective if made in the same direction.

### Speed of Operation

In open woods, flat country, and along old trails, the tractor and rake made about 200 chains of single line per hour. In dense pine pole stands on rolling land, the rate was only about 30 chains per hour. In raking the original firebreak lines under moderate to difficult conditions of slope and cover but with some distances along roads, the average rate was about 53 chains of line per hour for more than 320 chains of line. Of this amount, 190 chains were raked twice, and 26 chains were raked three times. The total distance raked was 516 chains and was made at a rate of more than 86 chains per hour.

Speed of operation is important, but only as it contributes to the final product—held line. In easy-going terrain, the machine works much faster than a small crew can hold line. Hence the speed may be wasted. When a small crew is working with the machine under these conditions, the machine is usually operated three times over the line—twice ahead and once back, working

small sections of line. This relieves the crew of most of the raking so that they can concentrate on burning out and holding the line. In difficult terrain, a single line built by the tractor and rake may require some additional hand raking before burning out. The rate of building held line, therefore, is variable with crew size up to the maximum speed of the machine.

The rake has seldom been used in initial attacks on average fires but has been held as a reserve unit. It has been very effectively used on long flanks of large fires, releasing manpower for the heavy work on the headfire or for other fires. It has been used by a small crew to build line all around fires of 10 to 15 acres under moderate to high burning conditions.

### The Jeep as the Power Unit

The fire rake can be attached to and powered by a ¼-ton, 4-wheel drive jeep equipped with a three-point hitch power takeoff and hydraulic control. To attach the rake requires only two modifications in the hitch. An adapter is required to accommodate the different sized splines of the rake drive shaft and jeep power takeoff. Using the adapter necessitated shortening the rake drive shaft by 4½ inches.

The jeep-mounted fire rake has been tested only on firebreaks. Downslope operation was slightly better controlled with the jeep than with the tractor on a 40 percent grade, but the jeep did not operate uphill successfully on slopes exceeding 35 percent. Because of its longer turning radius, the jeep was less maneuverable in tight places than was the farm tractor equipped with bombardier treads.

The quality of line produced was the same for the jeep as for the farm tractor (fig. 3). It was necessary to drive the jeep in its lowest gear in order to have the raker teeth revolve fast enough to clean a path. However, the low-speed range of the jeep is near the maximum speed for most conditions and is adequate for line building.

### Transporting the Unit

In moving the rake short distances such as on the fireline, either machine has enough speed for quick transfer. In moving from fire to fire or from headquarters to fire, the tractor should be transported on a trailer or truck. A tilt-bed trailer pulled by a pickup truck can be used to good advantage (fig. 1).

The jeep can carry the rake in lifted position at 30 miles per hour on highways. A lock is needed to take the load off the hydraulic system and as a safety measure to insure that the rake does not drop down in transit.

The rake can be attached or detached from either power unit in 5 minutes.

Experience has shown that where operation of the unit is practical, the fire rake can replace from 6 to 15 men with broom rakes.

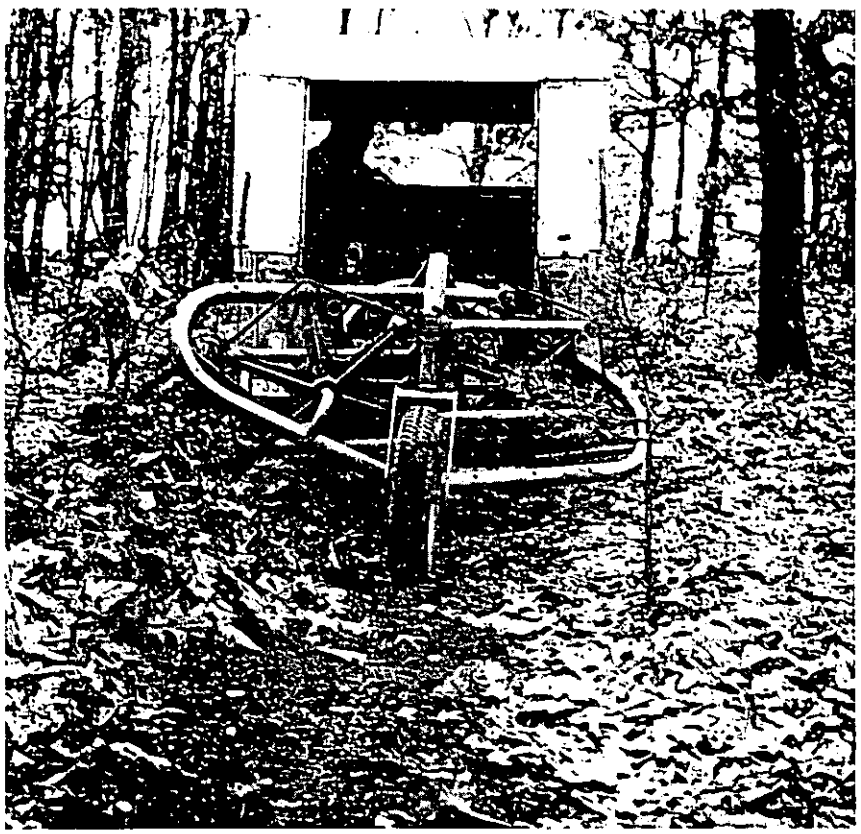

FIGURE 3.—Line raked by mechanical rake attached to jeep. The rake is being taken over the line for the second time through a heavy drift of oak leaves. Note spider wheels reinforced by round iron welded to each spoke; the newer models have disk wheels.

Under favorable conditions of cover, topography, and fuels, the machine is well adapted to raking firelines in the hardwood and pine litter prevalent in Missouri's forests.

Woods fires in Missouri spread in leaf litter commonly varying from ¼ to 4 inches deep. For many years it was easy to build line with hand rakes because frequent burning prevented a normal forest floor from developing. However, now that protection against fires is much more effective, the forest floor is becoming better developed, litter is more compact, and low-growing shrubby vegetation and sometimes sprouts are more abundant. All this makes the job of hand raking slower and more difficult. Power tools, such as the one described here, can help to increase speed of line building and reduce acreage burned.

# VALUE OF A PER DIEM GUARD SYSTEM FOR FIRE CONTROL IN SOUTHWESTERN UTAH

FLOYD C. NOEL

*District Forest Ranger, Dixie National Forest*

The Pine Valley Ranger District on the Dixie National Forest is made up of 198,000 acres of wild land, including and surrounding the Pine Valley Mountains in the extreme southwest corner of Utah. Elevations range from 10,324 feet at the top of Burger Peak to about 2,350 feet at the forest boundary on the south end of the district. The highest mountain range supports a stand of spruce and fir. Next to this is a yellow pine, mountain-mahogany belt. The fuels on the lower benches are the highly flammable manzanita, silktassel, live oak, and pinyon juniper types (fig. 1).

On this medium hazard forest there are periods when the brush and other fuel types build up to high burning indexes and create a definite threat. This district constitutes one of the highest fire hazard districts found in the southern part of the Intermountain Region. In spite of this, during the 13-year period 1941-54, only one fire has spread to larger than Class A size in the timber type, and seven fires have reached Class B size and larger in the brush type. No lookouts are maintained on the mountain peaks, but a per diem guard system has been in effect for this period, and has proved to be the backbone of fire control in this area.

During the period from 1941 to October 1954 there have been 35 fires on the district. First discovery was made on 15, or 43 percent of the total, by a per diem guard. Twenty-three percent were first discovered by Forest Service personnel and 34 percent by all others. First attack and control on 27 of these fires, or 77 percent of the total, was accomplished by per diem guards, while other cooperators made the first attack on 8 fires, or 23 percent of the total.

FIGURE 1.—Typical topography and cover on the Pine Valley Ranger District.

The per diem guards are ranchers and stockmen who live where they have a clear view of the high hazard areas of the forest (fig. 2). They have, for the most part, served for many years and have had fire training at a training school each year or each alternate year since first appointed.

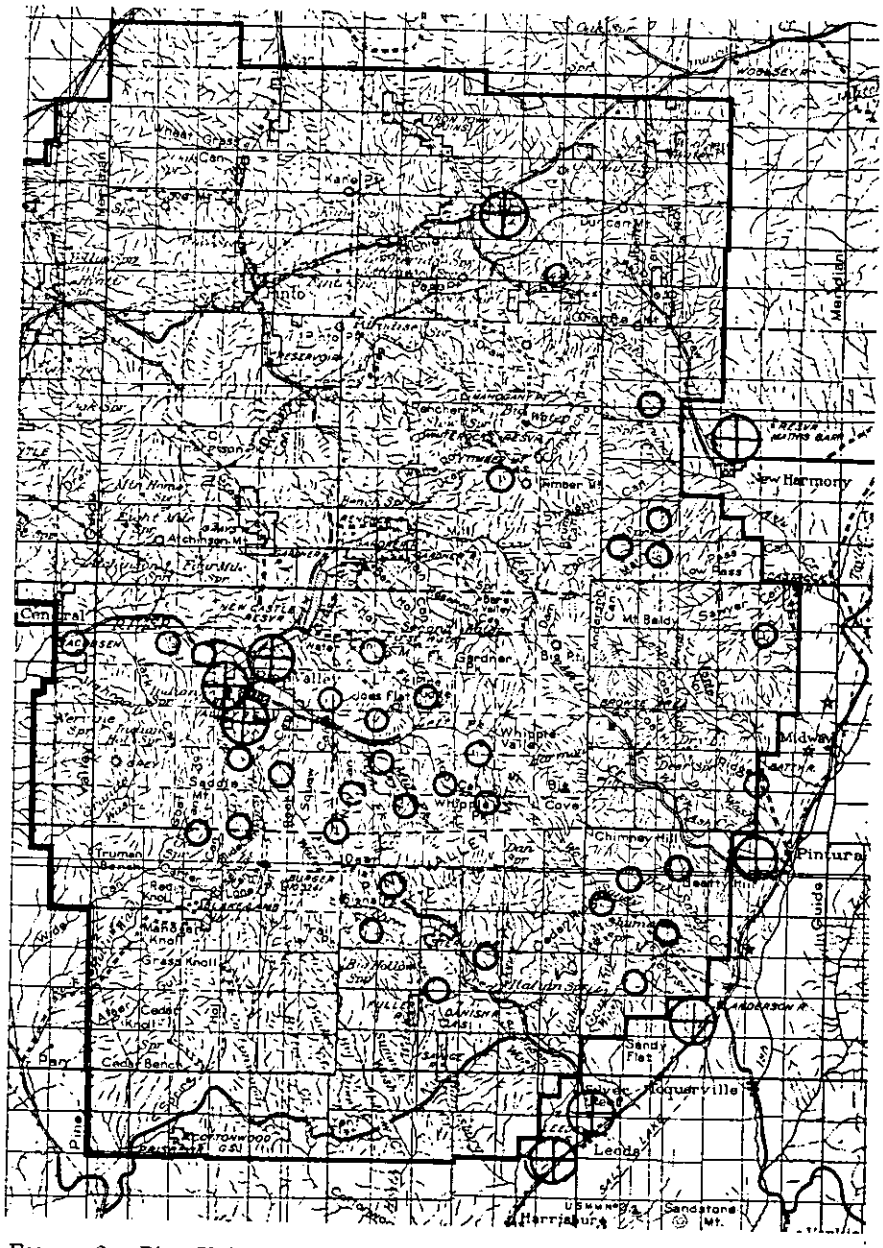


FIGURE 2.—Pine Valley Ranger District. Large crossed circles are per diem guard locations, small circles are locations of fires.

In addition to fire suppression work, the per diem guards give immeasurable service in fire prevention. Understanding the importance of watershed protection themselves, they take advantage of opportunities which arise to caution the public about forest and range fires. Of the 35 fires mentioned above, 5, or 14 percent, have been man caused, and 30, or 86 percent, lightning caused.

Since prevailing lightning and thunderstorms approach from the southeast toward the Pine Valley Mountains, they must literally pass over the heads of four of the per diem guards. Location of the guards puts them in a strategic position to be forewarned and alerted to the possibilities of lightning fires, and thus their get-away time is held to a minimum.

Our experience has been that a well-manned system of per diem guards, strategically located and properly trained, is reliable, effective, inexpensive, and of great value in the control of forest and range fires under circumstances such as prevail in southwestern Utah.

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## Fire Report Cards

In the general area of Humboldt National Forest reliance for initial fire control action is most often entirely on local ranchers and other residents. Some of these people act as per diem firewardens. Each takes charge of activities on a fire occurring in his area until relieved by a regular firewarden or forest officer. He relies on his neighbors for help, not only in suppression work but also in having fires reported to him. He in turn reports to the proper agency office whether the fire is on national-forest, private, or Bureau of Land Management land.

In order to facilitate the reporting procedure as well as to make the report more valuable, we devised a fire report card for cooperators to hang on their telephones. It was a mimeographed 3- by 5-inch index card with a place to enter the name and telephone number of the firewarden to whom the report should be made, as well as the following information: (1) Location of fire; (2) size, severity of fire; (3) number of men gone to fire; (4) number of men needed; (5) type of equipment needed; (6) best route to fire.

The State Forester-Firewarden's office later used the idea and supplied all fire cooperators in the State with fire report cards. These were printed in red ink on small shipping tags that had reinforced holes for hanging them up. On the back of the tag were telephone numbers for the county firewarden, forest ranger and supervisor, and the Bureau of Land Management office.

Although we do not always receive all of the information asked for, we find that these cards greatly improve reporting procedure.—TOM E. BRIERLEY, *District Ranger, Humboldt National Forest.*

# THREE-POINT TIE DOWN ANCHORS PLOW UNIT ON TRUCK

JOY J. BALDWIN

*Forester, Gila National Forest*

In hauling our small tractor plow units, we have experienced difficulty in binding tractor and plow down to the truck. It has been necessary to thread a chain through and over the tractor and then under the truck frame, attach boomers, and tighten. The plow had to be chained down likewise, or hauled in a raised position. In the raised position the plow had a tendency to shift the tractor around, raised the center of gravity of the load, and tended to slow up road travel of the truck. Hauling the plow in the raised position, even though locked up, did throw a strain on the attaching plow linkage. Hauling the plow in the down position put excessive wear on the truck bed even though a pad was placed under the point. The pad had to be replaced every few trips. This was especially true during dry weather when the plow is necessarily set at an extreme angle for digging hard soil.

Under the old system of attaching the tractor to the truck several minutes were lost at the fire in getting chains loose from the tractor and plow before it could be unloaded and ready for use. Invariably, if the truck was idle for a few days, the chains would be removed for other purposes and would not be available for binding tractor and plow down when time came for a move. This could cost us a plow unit sometime under blow-up conditions.

The Gila Forest is using a three-point tie down that eliminates these disadvantages. A boot holds the plow point (fig. 1). It is made of ¼-inch boiler plate and is strong enough to prevent a sudden stop or collision from throwing the dozer through the cab.

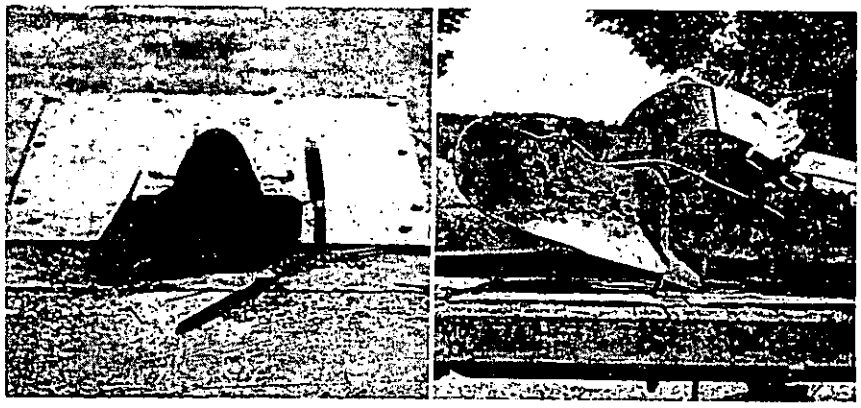

FIGURE 1.—Boiler-plate boot for holding plow point of tractor plow unit on truck bed.

Twenty feet of chain and a boomer are no longer needed to hold the plow down. Four or five links of chain are spot welded to the track carrier frame on each side of the tractor. This chain cannot interfere with tractor operation. A 15-inch length of chain is spot welded on each side of the truck, eliminating about 18 feet of chain. A boomer is required on each side to attach the 15-inch length of chain to the 4 or 5 links on the track carrier frame (fig. 2). The tension forward holds the plow firm in the boot.

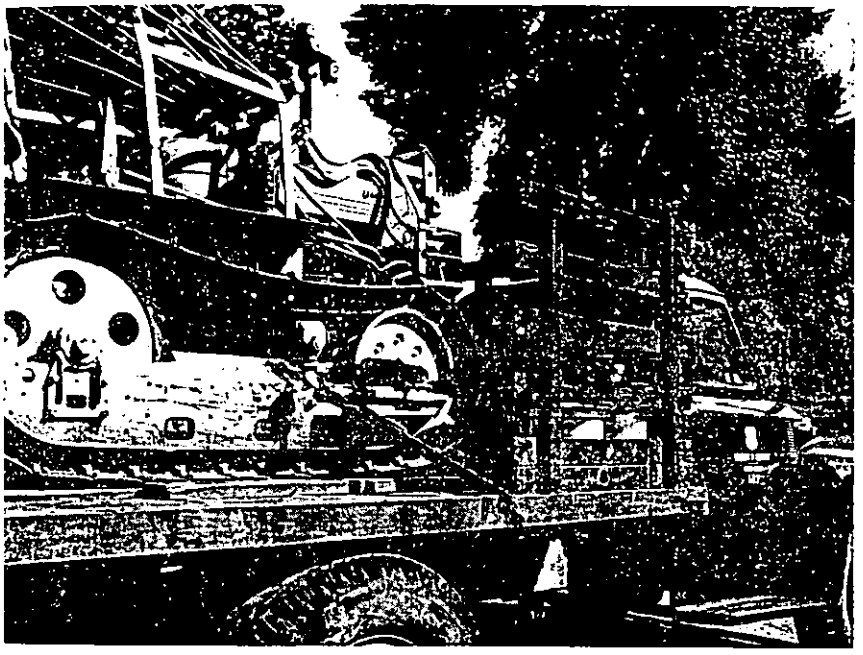

FIGURE 2.—Boomer joining links of chain on track carrier frame to the 15-inch length welded to truck. Forward tension holds plow firm in boot.

In loading or unloading, the driver attaches or releases a boomer on the left side and the swamper hooks or unhooks a boomer on the opposite side and the unit is ready to move out. The chains cannot be lost or removed from the tractor or truck. The boomers can be kept in the tractor toolbox. Time is a big factor and although this method of attaching saves only a few minutes it could be the difference in whether the plow can control the fire alone or whether additional equipment or men would be needed.

# STATIONARY MOUNT FOR BINOCULARS

T. A. NEFF

*Assistant Ranger, Mendocino National Forest*

A stationary mount for holding binoculars, built by Stanley Johnson, has been in use for the past two summers on Valley View Lookout in the Mendocino National Forest (fig. 1). The purpose of the mount is to hold a "fix" on a distant object; that is not possible when glasses are held in the hands or are stronger than six-power.

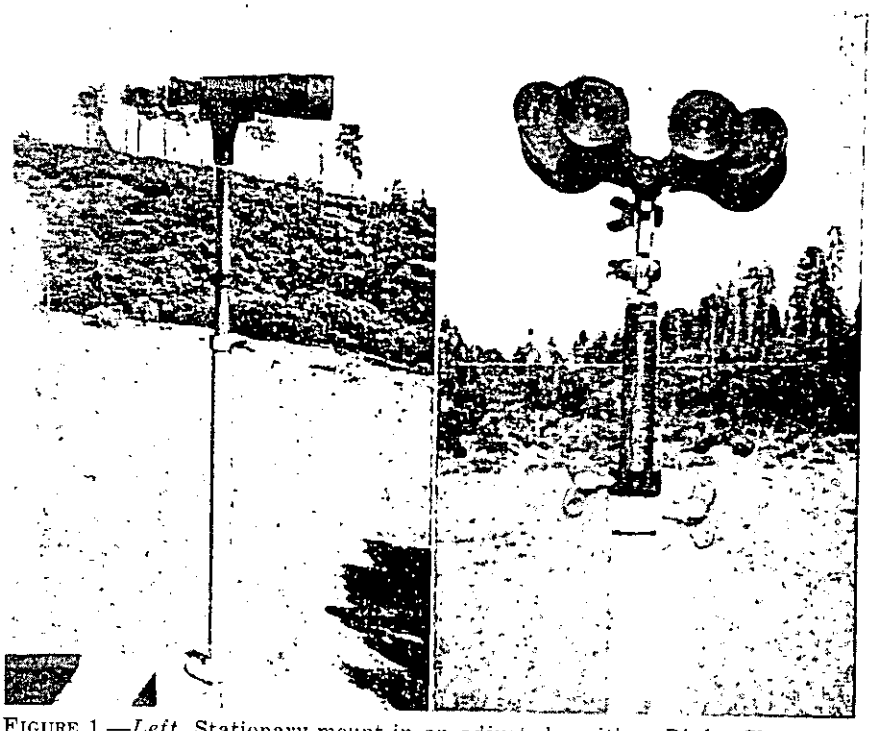

FIGURE 1.—*Left*, Stationary mount in an adjusted position. *Right*, Closeup of mount, showing wingnut arrangement.

The mount consists of an 18-inch length of ¾-inch pipe with a flange for a base. The top of this pipe is covered with a pipe coupling, cut in half, to make a thicker thread bearing to hold the winged setscrew. Inside of this pipe is a 15-inch length of ½-inch wall conduit that can be moved up or down to adjust the binoculars to the height of the person using the binoculars. Into the top end of this conduit is welded a piece of ¼-inch, ¾ inch wide, drilled through with a 5/16-inch hole. Over the center bar of the binoculars is fastened a clamp made of two pieces of iron 3/32 inch thick, 3 inches long, and as wide as the center bar of the binoculars is long. This clamp is molded so as to make a

snug fit around the center bar; its two pieces are held together by a 5/16-inch bolt and wingnut with split washer near the binocular end and another such bolt and nut near the end that fastens onto the fitting in the top end of the conduit. These wingnuts and split washers give the necessary tension to hold the angles desired and yet provide for both lateral and vertical angles.

To hold the binoculars at the desired height and yet swing them around to any point on the compass, a ½- by 1¼-inch iron collar with a winged setscrew is made to slide up and down over the conduit.

The various joints make it possible to quickly move the binoculars to any any angle, high or low. Separate bases are provided at each of the four corners of the lookout catwalk, and the binoculars with the clamp and inside conduit can be easily moved and used on the base that affords the best look at the area being covered.

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## Prevention Action Correlated to Fire-Danger Rating

The February 1954 fire danger on the James River District, George Washington National Forest, indicated the need for special prevention action. Although March 1 ordinarily marks the beginning of the spring fire season in the west-central mountains of Virginia, there was definite evidence that the 1954 season was coming in a month early.

A slight build-up index was noted on Forest Fire Danger Meter Type 8-0 for open-type stations (Southeastern Forest Experiment Station), beginning the latter part of January. By February 10, 1954, the buildup index was 31 and the burning index was 40. The first fire of the month occurred on this day. The last rain (0.04) was 14 days previous to this and the last rain of more than 0.06 was 19 days previous. (Total rainfall in February was 1.07 inches—much below the 4.0-inch normal.) Wind velocities during this 19-day period were recorded up to 14 m. p. h. but fuel-moisture percent did not go below 9.0.

Another factor influencing the unusually early 1954 fire-danger buildup was low ground-water supply—a result of drought conditions in 1952 and 1953. Rapid melting of light 1953-54 winter snows also caused the district's fire danger to climb at a much earlier date than normal. Buildup index in February ultimately reached 48. Recent recognition by the 2 national forests in Virginia of 75 as the "Closure Index" will better evaluate the fire-danger buildup in February.

Risk on the James River District is normally high because approximately 32,000 people live there. Ninety-three percent of these people live within 1 mile of national-forest land. Forest use is correspondingly high. The West Virginia Pulp and Paper Co. mill at Covington, Va., located approximately in the center of the district, uses 1,000 cords of pulpwood daily. The 150,000 acres of national-forest land on the district plus another 150,000 acres of private land immediately adjacent to, and, coming under the district's fire protection boundary, provides much readily accessible acreage to pulpwood cutters. Access to this land is unusually good with a total of 394 miles of primary and secondary roads serving the area. U. S. 60, a main east-west artery, cuts through 40 miles of the district. An estimated network of 150 miles of woods roads may be added to the above figure for timber or pulpwood access. In addition, the Chesapeake and Ohio Railroad traverses

some 60 miles of the district. Although this risk is lessened with diesel use, it is still there to some extent.

The buildup of fire danger as influenced by weather, combined with existing risk created by forest area accessible to people, pointed to the urgent necessity early in February 1954 of warning the public of the increased fire danger. Knowing that debris burning in the early spring is common practice, with most of it being done in February to get ahead of the Virginia Brush Burning Law, that becomes effective March 1, the necessity seemed even more urgent.

The local population was cautioned frequently through news releases, radio broadcasts, and personal contact of the steps necessary to prevent fires. Prevention movies were shown at local schools earlier than usual. Through the combined efforts of all public service agencies, including press, radio, State and local law-enforcement organizations, the County Agent's office, and the Soil Conservation Service, effective leadership was given to the prevention program. Perhaps most noteworthy was the invaluable help of a fire-conscious public in their prevention attitude and assistance.

By concentrating our prevention campaign on certain risks—debris burning, lumbering, children playing with matches, etc.—the number of fires on the district was held to a minimum. Total February 1954 fires, by causes: 3 debris burner (1 Class C, 2 Class A's); 1 smoker (Class A); 1 incendiary (Class C).

In addition to effective fire prevention campaigns, an energetic law-enforcement program is a strong factor in preventing fires from starting. Individuals who pay the costs of suppression remember well the precautions that should have been taken. Lasting benefits are obtained in local communities if the impression can be left that costs of fire suppression are made or that some law-enforcement action is taken on every fire. Of the 5 fires occurring in February on the James River District, collections were made on 4 of them.

Specific conclusions follow:

1. The Type 8-0 Forest Fire Danger Meter will give an accurate warning of approaching danger; especially significant at unseasonable periods.
2. To make appreciable gains in fire prevention, it is necessary to concentrate on specific risks.
3. Fire prevention education must be maintained on a continuing high level to assure the assistance of a fire-conscious public.
4. That where righ risks exist, full public service organization support is necessary.
5. Law-enforcement action results in increased prevention returns.
6. Where district fire-organization personnel is not plentiful enough to contact the desired number of individuals in a relatively short period of time for a pinpoint type prevention effort, *the selection of local key individuals to aid in such work is extremely important.*—JOHN H. NOYES, *District Ranger, George Washington National Forest.*

## INFORMATION FOR CONTRIBUTORS

It is requested that all contributions be submitted in duplicate, typed double space, and with no paragraphs breaking over to the next page.

The title of the article should be typed in capitals at the top of the first page, and immediately underneath it should appear the author's name, position, and unit.

Any introductory or explanatory information should not be included in the body of the article, but should be stated in the letter of transmittal.

Illustrations, whether drawings or photographs, should have clear detail and tell a story. Only glossy prints are acceptable. Legends for illustrations should be typed in the manuscript immediately following the paragraph in which the illustration is first mentioned, the legend being separated from the text by lines both above and below. Illustrations should be labeled "figures" and numbered consecutively. All diagrams should be drawn with the type page proportions in mind, and lettered so as to permit reduction. In mailing, illustrations should be placed between cardboards held together with rubber bands. *Paper clips should never be used.*

When Forest Service photographs are submitted, the negative number should be indicated with the legend to aid in later identification of the illustrations. When pictures do not carry Forest Service numbers, the source of the picture should be given, so that the negative may be located if it is desired.

India ink line drawings will reproduce properly, but no prints (blackline prints or blueprints) will give clear reproduction. Please therefore submit well-drawn tracings instead of prints.


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