VOL. 10 OCTOBER 1949 NO. 4

Extra Copy

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 10 Number 4

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.

FIRE CONTROL NOTES is issued by the Forest Service of the United States Department of Agriculture, Washington, D. C. The matter contained herein is published by the direction of the Secretary of Agriculture as administrative information required for the proper transaction of the public business. The periodical is printed with the approval of the Bureau of the Budget as required by Rule 42 of the Joint Committee on Printing.

Copies may be obtained from the Superintendent of Documents, Government Printing Office, Washington 25, D. C., 15 cents a copy, or by subscription at the rate of 50 cents per year. Postage stamps will not be accepted in payment.

Forest Service, Washington, D. C.

UNITED STATES GOVERNMENT PRINTING OFFICE, WASHINGTON : 1949

Contents

BROADCAST SLASH BURNING AFTER A RAIN[1]

ROBERT AUFDERHEIDE AND WILLIAM G. MORRIS

Pacific Northwest Forest and Range Experiment Station

Slash burning after clear cutting in the Douglas-fir region has been previously discussed in pamphlets published by the Oregon State Board of Forestry, Washington Forest Fire Association, West Coast Lumbermen's Association, Western Forestry and Conservation Association, and the United States Forest Service and in several trade journal articles. The authors claim no originality for the material in the following article but believe the points discussed are worth reconsideration. Some of the suggestions will probably be new to readers who have not closely studied the methods of slash burning used in different parts of the Douglas-fir region. The origin and adoption of the policy to burn slash as soon as it becomes inflammable during the clearing weather immediately after a rain instead of waiting until just before the next rain is expected has not yet been definitely dated. The State Forester of Oregon states that his organization has followed it in the Douglas-fir region for a number of years. Several of the national forests in the Douglas-fir region have followed this policy in recent years.—*Ed.*

Broadcast burning of slash in the Douglas-fir region is often done just before an expected heavy fall rain. If the rain occurs in sufficient quantity at the right time, no work is necessary to confine the fire to the slash area. If the expected rain does not occur, it is often difficult to confine the fire to the slash area. Furthermore, burning just before

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A slash fire burning with moderate intensity when the ground is still moist from a preceding rain leaves unburned beneficial humus in the topsoil.

[1] Reprinted from the September 1948 issue of West Coast Lumberman.

a rain is open to other criticisms. In contrast, recent experience shows that burning after a rain, as soon as slash is dry enough, has several advantages.

The forestry objectives in burning slash are: (1) To remove flashy small material in which dry-weather fires spread with such speed and heat that they can seldom be controlled inside of the slash area; (2) to burn apart crossed and closely lying logs, separating them where great heat can be developed and thus make an accidental fire more

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When the weather begins to clear after a rain, slash in a clear cutting will become dry enough to burn while the litter in the green timber is still moist.

intense and difficult to control; (3) to check the growth of brush that sprouts from roots established before logging and competes with tree seedlings; (4) to remove excessive debris that would prevent tree seeds from reaching a suitable seedbed; (5) to accomplish as far as possible the foregoing aims without scorching adjacent standing timber or causing undue heat injury to the soil and seed trees within the slash area.

ADVANCE PLANNING

With such objectives, slash burning helps keep forest lands productive. It is not just a clean-up job to be done after the cutting under any conditions the operation may create; it is an important part of the cutting operation and, like other phases, should be efficiently coordinated. Plans for broadcast slash burning should be started long

before the burning season. Some of the greatest difficulties and risks can often be eliminated if the slash-burning job is carefully considered in the cutting plans.

Good planning will avoid the following difficulties and risks: (1) Slash areas too big to be burned in 1 or 2 days by firing successive narrow strips along the contours, beginning at the top of the slash area. A slash fire that runs unchecked a long distance up a slope usually creates excessive heat. (Staggered settings of 80 acres or less facilitate slash burning, especially when periods of good burning weather are short.) (2) Equipment and logs situated alongside considerable slash with no firebreak to isolate them at the time of the first burning season. (3) Current slash joined with that of another owned. (4) Tops felled into the adjoining green timber. (5) No firebreaks, such as ridges, streams, rock outcroppings, or roads, around the slash.

Advance work should also include a detailed plan of the burning jobs, outlined on paper well ahead of the burning date. This should provide: (1) A description of the weather and fuel moisture conditions desired. (2) Desirable time of day to begin setting fires. (3) A sketch of the area showing topographic features, boundaries of the area to be burned, and the order in which different parts of the fire will be set if the prevailing wind direction for the locality occurs. An alternate order of setting for another wind direction may be desirable. (4) Number of men needed to do a good job, and their specific assignments. (5) Estimated length of time to set the fire and to patrol and mop it up. (6) Number of torches, amount of oil, and other firing equipment. (7) Placement of portable pumps and tank trucks for fire control use. (8) Hand tools and bulldozer (on the job) for emergency use. (9) Communication and arrangements for extra fire control help if needed.

Finally, two parts of the slash-burning job should be done, if possible, before the burning season. All snags inside the slash area and any outside but near the area boundary should be felled. A fire trail should be built along adjoining cut-over areas, certain open types of standing timber, and other critical edges. The decision on the need for advance fire lines will depend largely upon the nature of the slash, the topography, adjacent timber conditions, and availability of adequate manpower for mop-up. Bulldozer fire lines, particularly on sidehills, have the disadvantage of mixing much dirt with the slash to be burned; this causes fire to smolder a long time on the edges of the slash area. If a bulldozer is used, the dirt and debris should be pushed away from the slash area to avoid a smoldering fire at the line.

CHOOSING THE SLASH MOISTURE CONDITIONS FOR BURNING

Since one objective of broadcast slash burning should be to avoid undue heat injury to the soil, seed trees, and adjacent timber, the soil should be moist in both the slash area and adjacent areas. Yet to allow economical fire setting the fine material should be dry enough to carry fire and be easily kindled. In the light of these requirements,

fall burning just before an expected rain presents several disadvantages:

(1) The soil, duff, and logs on the slash area will usually be dry. Such slash generally burns too intensely, and a hard burn is destructive to soil structure, soil humus content, and seed trees.

(2) If the slash is very dry, the adjacent areas also will be dry. Under these conditions, numerous spot fires and break-aways can be expected; this increases the cost of control and causes loss of adjacent timber, equipment, or other values. Even though timbered areas may be fairly damp, the exposed edges for several hundred feet inward may be almost as dry as the slash area. Hemlock and spruce, which are particularly susceptible to fire damage, will die from the effects of a ground fire around their bases.

(3) The timing and intensity of a rain storm in a given small area are difficult to forecast.

(4) Most storms are preceded by strong winds; this will increase the danger of break-aways and damage.

(5) If the rain begins sooner than expected, there generally is an urge to fire the slash rapidly. When this happens, a hard burn is the usual result, and frequently uncut timber around the edges is scorched. Sometimes the slash quickly becomes too wet for the set fires to spread. Instead, they smolder and burn in the concentrations without completely dying out; real danger may occur later with a change to low humidities and increased wind velocities.

(6) The expected rain may not occur. A serious fire problem may confront the burner in this situation, depending upon adjacent timber conditions and subsequent weather.

TREND SINCE 1942

Since about 1942 there has been a trend toward doing fall slash burning immediately after a rain. This method has definite advantages in avoiding heat injury and providing good conditions for burning:

(1) As fast as the fine slash and surface of the coarse slash become dry after the rain, the slash is burned. Since the duff is still wet below the surface, it is completely burned only in the spots beneath logs or piles of hot burning fuels. On the remaining area the fire destroys the light and flashy fuels but dies out before consuming the duff and humus in the soil.

(2) The fine slash will dry out first while the fuels in the adjacent green timber are still wet. The wet duff and damp litter in the timber will lessen the danger from spotting and break-aways. In many instances when slash is burned under these conditions, advance fire lines are unnecessary.

(3) The first few clear days following the rain are usually calm and offer ideal conditions for controlling the burn.

(4) The materials in which the fire spreads can be burned out before dangerous weather develops.

(5) Under this method it is possible to do the slow burning that does the least damage to forest soils, seed trees, and surrounding timber. More time is usually available for setting the fire in successive

contour strips down the hill. This avoids a sweeping and excessively hot fire.

(6) Where one person or one crew has responsibility for burning a number of slash areas, this system offers a longer period in which to do the job. In this way experienced slash-burning personnel can cover more ground, and better burning results are probable.

In any broadcast slash burning, good judgment in picking the right time to burn is essential to success. The decision on whether to burn early or late in the season will be determined by the general location of the slash area and the burning conditions on and adjacent to the slash area.

WAIT UNTIL 3 INCHES OF RAIN

Burning after a fall rain should not be attempted until about 3 inches of rain have occurred. This will usually be after two or more storms. There should be reasonable certainty that timbered areas will not again dry out that year. Fall rains occur at varying dates and usually begin earlier in the northern part of the Douglas-fir region than in the southern. Coastal slopes also become wet earlier than inland areas. Good burning conditions ordinarily occur in inland areas between October 1 and 20, and along the coast between September 10 and October 1.

A large slash area adjacent to other highly inflammable areas is more dangerous to burn early in the fall than a small slash area surrounded by green timber. Where high-risk burning chances occur, it is advisable to burn late. However, good slash-burning results cannot be expected consistently on such chances regardless of the time of burning. By planning the logging operation well, however, many of the risks can usually be eliminated or minimized. The poor slash-burning results obtained on most dangerous slash areas happen largely because management permits difficult situations to occur.

In stream bottoms and on north slopes on the coast fog belt where dense brush grew before logging, slash should be burned fairly early in the season after the first fall rains occur and under fairly dry burning conditions. This is done to obtain the best possible regeneration of conifers. One purpose of such burning is temporarily to set back the brush in order to give natural regeneration or planted stock a chance to become established. The coastal brush is more of an obstacle to adequate natural reproduction than is commonly appreciated. Unless burned with sufficient heat to kill the tops and injure the root crowns, this brush springs up rapidly when exposed to full light following logging. It will then hold the area it occupies and exclude conifer seedlings.

THE DAY TO BURN

It is advisable to burn as promptly as possible after the rain—as soon as the small materials and log surfaces have dried enough to ignite easily and while the lower duff layer in the slash and all fuels in adjacent timber are still damp. In selecting the best day, the dampness of the duff should be determined at several points in adjacent timber and in the area to be burned by digging into the duff

with the hands. The inflammability of fine fuels can be estimated by the brittleness of twigs. A better method is to burn a small sample of fine slash. If the fire will not spread, burning should be discontinued until conditions improve. Best results are obtained when the fire spreads slowly and many sets are required to ignite the entire area.

Even though the relative humidity is low, the fire can be easily managed if the air is calm and the duff is moist. Successful, controlled, nondestructive slash fires have been observed burning under these conditions shortly after a rain when the relative humidity was only 25 percent.

Weather Bureau forecasts should be studied before burning and also after burning is under way. The Weather Bureau wishes to assist with slash-burning projects and is glad to provide fire-weather forecasts.

SETTING THE FIRES

In setting the fires the most dangerous edges should be lit first and a safety strip should be burned around areas to be left unburned. Topography, and condition of the slash should be considered in the firing progression. In all cases the uphill and leeward sides of the area should be fired first. It is best to proceed slowly at first, and edges should be well burned out before setting additional fires. Hot, destructive burning can result from setting off too much area at one time.

Once started, burning should be continued until all fuels within the slash area have been ignited, but burning should be discontinued whenever set fires will no longer spread. Smoldering fires scattered through a large area of unburned fuel are apt to produce an undesirably hot fire when burning conditions become more severe during the afternoon of the next day. To avoid this circumstance, it is also advisable to delay setting more fires until about noon the next day or until such a time as they will spread. Frequently, excellent results can be obtained by burning south slopes and dry exposures during the early part of the night, and north slopes, creek bottoms, and other damp areas during the heat of the next day.

MOP-UP

The importance of mop-up to continuing success of slash burning after a rain cannot be overemphasized. In burning immediately after a rain, dryer weather can be expected. After the slash fire has cooled, any live edges should be trailed and mopped up. The proper time to do this mop-up is while weather and fuel conditions are still favorable for moderate burning. The objective should be to have the edges of the burned slash dead before dangerous weather conditions occur. If the slash has been properly burned under the right conditions, a clean burn will be obtained, and not much live edge will remain 24 to 36 hours after the slash has been fired. A clean burn properly mopped up will not spread fire even though the weather becomes dangerous.

Those who have tried this method for a number of years claim that the results are achieving the objectives of good slash burning with less trouble, loss, and expense than burning before an expected rain.

FIGHTING LIGHTNING FIRES ON THE KLAMATH NATIONAL FOREST

T. A. BIGELOW, *Fire Control Officer*, and A. L. MORFORD, *Dispatcher*, *Klamath National Forest*

One look at the burned-area map of the Klamath for the period 1910 to 1920 and you immediately ask, "What on earth caused such a widely scattered burned-area pattern?" The size of these burned areas indicates a tremendous loss in natural resources to the State and Nation. A quick glance at the statistics reveals the answer, 100 to 150 lightning fires per year. If you follow the records on through the next decade you will observe the same burned-area pattern, except a slightly heavier concentration around the more or less inhabited areas. The same number of lightning fires appear as before, but to it is added a new problem, incendiary sets, most of them set at the same time. It is quite apparent that the Klamath's fire problem is not the occasional single man-caused fire, but rather many fires occurring from lightning and incendiarism at the same time.

The development of a system to handle these concentrations of fires was begun in the 20's and further developed during the 30's. The early 40's saw a well-established method perfected and used to a marked degree of success, reflected in the highly desirable reduction in burned area. However, the average number of lightning fires per year showed some increase, probably due to the success of reaching more fires before they burned together, causing the larger burned areas shown in the early history of the Klamath. A description of the system follows.

In order to handle from 75 to 100 fires, occurring within a 2- or 3-day period over an area of 1,600,000 acres, it is quite necessary to operate under a decentralized plan with a highly trained officer to coordinate the action between the various district headquarters. The supervisor's headquarters organization to coordinate and furnish the service of supply necessary to the districts and the ranger's headquarters organization are shown on the chart.

The fires usually occur in groups of 3 to 8 that logically can be handled from a central point of operation. We have elected to call these coordinating areas, which are under the direction of an area coordinator, who has two distinct types of organization under his command: The first, fire bosses and fire fighters, and the second, service and supply.

This system operates as follows: The lookouts report all fires to the district dispatcher, who locates them and then passes the location on to the area coordinator, who sends out a fire boss and fire fighters. These fire fighters are serviced and supplied by the area coordinator's serv-

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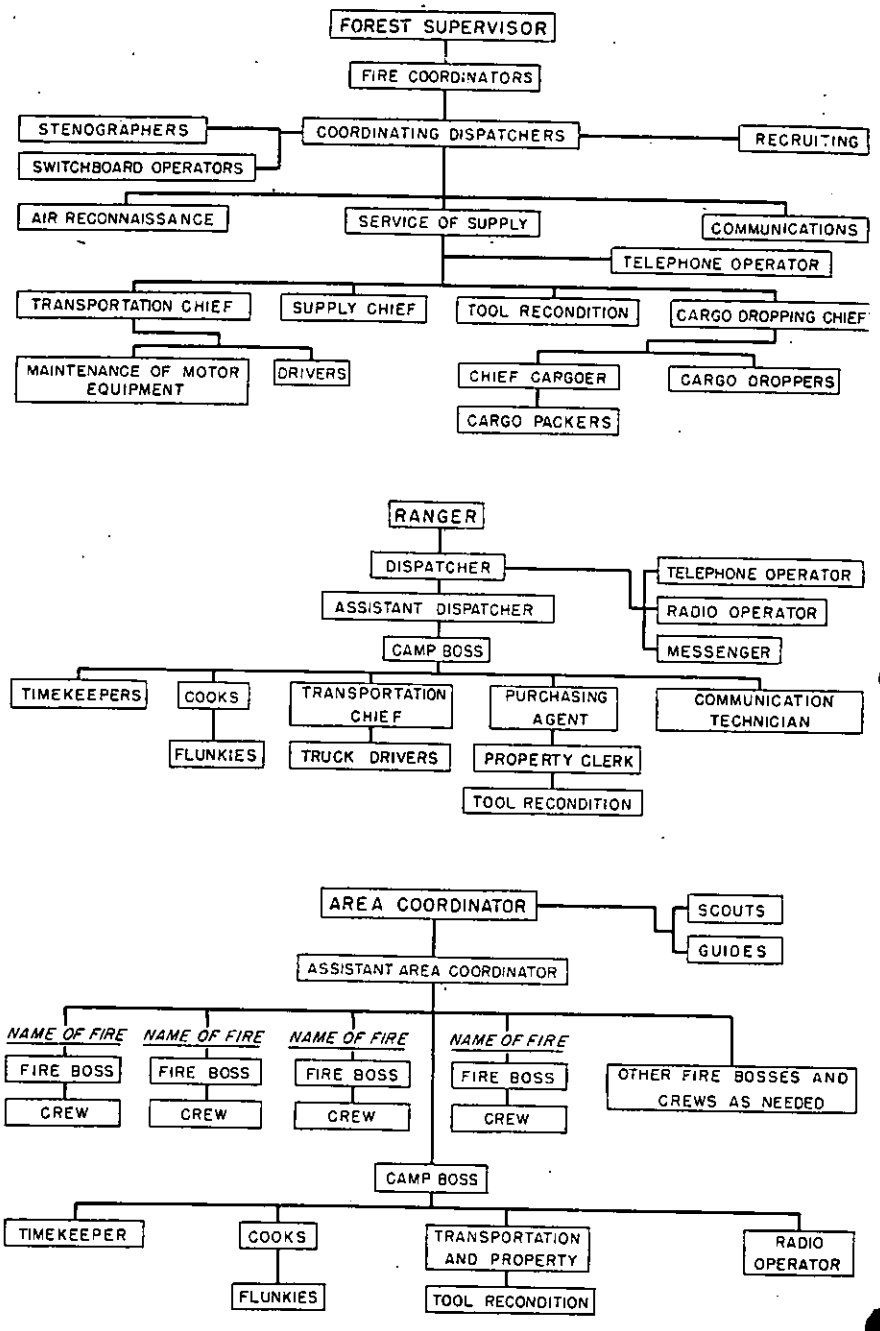


Organization chart for forest supervisor, ranger, and area coordinator.

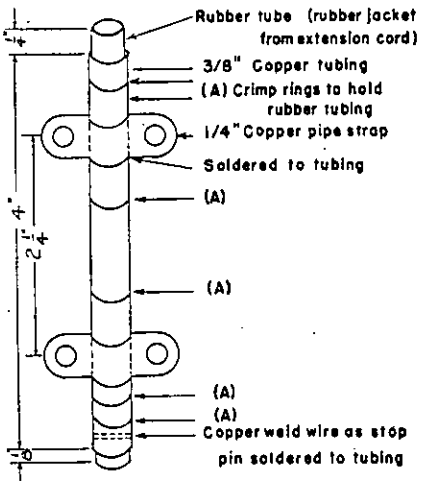
ice of supply organization. The district headquarters organization furnishes overhead labor and supplies, as requested by each area coordinator. The supervisor's headquarters organization provides the same service of supply to the district headquarters.

The chart indicates the organization which is to handle the maximum fire load. Each division of the organization is built up as the size of the job increases. In other words, the coordinating dispatcher and the warehousemen would probably handle the job for the supervisor, the district dispatcher for the ranger headquarters, and the coordinator with a few fire fighters would handle the beginning of a concentration, directing all of the activities which are indicated under them on the charts. As the needs increase, the organization is gradually built up to keep abreast of the size of the job by adding individuals to handle the various services.

Antenna Safety Holder.—The prescribed method for holding down a whip antenna, by merely placing it under a hook mounted at the rear of the roof on a sedan presents a serious safety hazard to a person's eyes when opening the car trunk.

A simple yet highly efficient solution to the safety problem is shown in the accompanying drawing. The holder consists of a piece of rubber-lined copper tubing attached to the roof of the vehicle by means of sheet-metal screws. The tip of the antenna rod is pushed into this tube and is held in place by the thrust of the steel rod when bent. Since a positive connection is not used, the antenna rod may be pulled out if struck by an overhanging tree limb or other obstruction.

In the case of pickup and stakeside truck installations the tube (without the pipe strap holders) is attached to a chain or thong which, in turn, is fastened to the side of the bed or guard rail of the vehicle.—JOHN H. WEST, *Forest Engineer*, and CHARLES E. BELL, *Radio Technician, Six Rivers National Forest*.



WILL EXHAUST GASES HELP PUT OUT FIRES?

T. V. Pearson

Administrative Officer, Forest Service, Washington D. C.

One gallon of ordinary gasoline vaporized at 100° C. (212° F.) occupies a volume of about 195 gallons. About 90 pounds of air (9,000 gallons) is used to burn the vapor from 1 gallon of gasoline, assuming perfect combustion without excess air. Such burning in an average auto engine produces about 96 pounds of exhaust which, cooled to ordinary atmospheric temperature, equals about 1,300 cubic feet (9,750 gallons). This exhaust is composed of 14.8 percent carbon dioxide and 85.2 percent other inert gases, principally nitrogen, all enemies of fire, with only traces of oxygen, carbon monoxide, methane, and hydrogen.

Exhaust gas usually leaves the exhaust pipe at a temperature considerably higher than atmospheric temperature, therefore the volume at the exit may be as much as two to three times as great as the 1,300 cubic feet quoted.

Some simple trials were made in the summer of 1946 to observe the effectiveness of hot exhaust gas in smothering small test fires. The exhaust gas from a small sedan engine burning 1 gallon of gasoline in about 30 minutes registered roughly 500° F. at the exhaust exit. This was applied through a 50-foot flexible metal hose. At the exit of this hose tests showed the temperature to be about 300° F.

1. One quart of gasoline was sprayed on a tree trunk to a height of 6 feet and ignited into a roaring flame. Careful application of the exhaust gas extinguished the flame in about 12 seconds.
2. One quart of gasoline was splashed on the outer wall of a garage and ignited. The roaring flame was extinguished in about 18 seconds by application of the exhaust gas.
3. A teacup of gasoline was poured into a 12-quart bucket and ignited. The flames were smothered by the exhaust gas in 4 seconds.
4. One-half gallon of gasoline was sprinkled on a 10-foot square surface of hard clay soil and ignited. The flames on the full area were extinguished by the exhaust gas in about 20 seconds.
5. An actively burning fire in a pile of kindling wood 2 feet in diameter was extinguished by the exhaust gas in about 35 seconds.
6. A line of fire in dry oak leaves on a forest floor was extinguished by the exhaust gas at a speed of a slow walk.
7. A line of fire burning in 5-inch dry grass was extinguished by the exhaust at a speed of a slow walk.
8. A cup of gasoline was sprinkled on the auto engine and ignited. The exhaust gas extinguished this engine fire in a few seconds.

9. The exhaust gas was applied to a large bonfire with only little effect. Flames in limited sections were extinguished, but following the application of the hot exhaust gas the flammable gases from the wood mass were repeatedly ignited by the heat from nearby hot coals. *The method therefore would fail in heavy fuel because the hot gases do not reduce the temperature of the fuel below its kindling point.*

Thus we have some evidence that hot exhaust gas undiluted with air, or diluted with that amount of cold air which will limit the oxygen content of the mixture to a point below that required to readily support burning (about 11 percent), has a smothering effect that will control fire in some light flash fuels. There is needed, however, a feasible method of cooling the exhaust gas, without increasing the oxygen content beyond the tolerable point, to give it greater control effect on hot fire in heavier fuels. Several methods have presented themselves, including injected water spray as a cooling agent. This will also serve to reduce the temperature of the fuel below its kindling point.

What could be done with an adequate supply of cooled exhaust gas and water vapor produced at the fire location from a few gallons of liquid fuel and water from a baby jet engine is still a question. Such engines having about 20 pounds thrust have just become available. A few field men are becoming interested in the possibilities of this combination and have proposed experimental trials.

Carrying Fire Canteens.—We have all experienced or observed the awkwardness of fire fighters trying to work and carry a 1-gallon canteen at the same time. Three systems of handling canteens are used:

a. They lay the canteens down and work, then come back and pick them up or forget them.

b. Hang them over their shoulders and wrestle with them.

c. Carry them on their backs by using a double sling for their shoulders. Many straps are too short for this system. As the fire fighters work the straps work down; or, if they don't, are too tight and cut beneath the arms.

It is recognized that the high nuisance effect of any piece of personal equipment is a great detractor from efficiency.

Suggested solution—rivet either canvas or leather straps to the flat side of the canteen covering and run a belt through them. The canteen then fits snugly in the small of the back and out of the way. I once used an Army cartridge belt to good effect. I have tried this system and it really works well.—NEAL M. RAHM, *Supervisor, Inyo National Forest.*

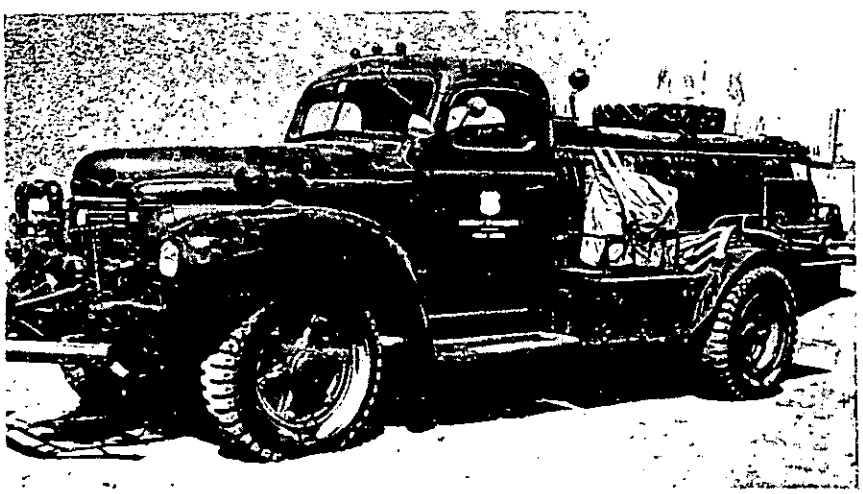
AN ARMY BRUSH TRUCK FOR FOREST FIRES

CHARLES D. SUTTON

General Foreman, Lincoln National Forest

The need of a truck equipped with tank and pump for fire suppression had been evident on the Lincoln National Forest for several years but lack of funds prohibited the purchase of such equipment. A very satisfactory unit was finally purchased for $1,000 from surplus Army equipment at the Hollomon Air Base near Alamogordo, N. Mex.

This unit consists of a 780-gallon tank and American Marsh F400 pump mounted on a K–5 International truck. It had been built in the shop of the post engineer at the air base for use in a range camp and required very few changes to adapt it for use in suppressing forest fires.



The pump is mounted on the front of the truck and driven by the truck engine. A throttle, clutch, and control valves are so arranged that the operator can stand in front of the truck and operate the unit. The pump is so connected that water can be pumped from the tank or from a stream or sump into the tank or directly into the discharge lines. All pipes and connections are 2-inch, and gate valves are so arranged that the operator has complete control from one position.

The suction line consists of two 10-foot lengths of 4-inch suction hose and strainer, and a 2-inch discharge line extends to rear of truck. A 1½-inch siamese connection on discharge line and a 1½-inch discharge

connection on the pump make it possible to operate one, two, or three lines simultaneously should they be desired. A vacuum primer mounted on the pump assures immediate suction when pumping from a stream or sump. The discharge line from the pump is equipped with a ½-inch hose to the radiator to aid in cooling the engine while pumping or going up steep grades when the engine would normally overheat.

In addition to the tank and pump the truck has a box constructed on the rear of each side platform and 200 feet of hose is folded in each box making it possible to lay 400 feet of hose in the shortest possible time. Additional hose is carried on the truck in pack sacks. Two 2½-gallon carbon-tetrachloride and three 2½ gallon soda-acid fire extinguishers are mounted on the rear and side platforms and have proven quite successful in suppressing small fires. In addition to the extinguishers, axes, shovels, electric lanterns, and other items are carried on the truck. Two spot lights and a flood light mounted on the truck and tank are of much value at night. Spanner and pipe wrenches and small tools are carried in the truck making it possible to connect hose quickly and to make minor repairs and adjustments.

After experimenting with different nozzles it was found necessary to have both straight stream and fog nozzles with the truck and both types have proven quite satisfactory on different type fires. It is possible to fill the 780-gallon tank in approximately 2 minutes pumping time and to discharge the 780-gallon tank through two 1½-inch hose with straight stream nozzles in 5 to 6 minutes. Very unusual conditions would exist when water would be discharged at this rate. Normally fog nozzles are used and rate of discharge is held to the minimum for controlling the fire. The working pressure varies from 80 pounds to 150 pounds depending upon conditions and is controlled by the operator using the hand throttle on front of truck.

The first time this piece of equipment was used it made it possible to save a sawmill and planing mill. The shavings pile between mill and planer was on fire when the truck arrived. The water in the tank was sufficient to knock the flames down and prevent spread of the fire until water was turned into a nearby irrigation ditch. Water was then pumped from the ditch directly into the shavings pile and the fire completely extinguished. Since that time the tank truck has been used successfully on many fires in the recreational and summer resort area where it is maintained during the peak of the fire season and has paid for itself many times in property saved and forest fire suppression.

After 2 years of operation we wonder how the situation in this area was controlled without this piece of efficient and effective fire-suppression equipment.

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SURVEYING FOREST SERVICE COMMUNICATION NEEDS

K. W. McNasser

Forester, Jefferson National Forest

As this country developed, the communication facilities expanded to meet the greatly increased demands. Messenger type communication was rapidly supplanted by the telephone and telegraph, and the Nation became increasingly dependent on them for exchanging information.

During the first half of this century the scope of the work of the Forest Service called for a dependable and rapid means of communication. To protect and administer properly the natural resources of the national forests belonging to the people, this agency spanned thousands of miles with telephone line. In many areas the Forest Service systems were the only lines available. Early lines were primarily for protection; administrative use was incidental. Routine administration could ordinarily depend upon slower communication.

Gradually, the primary use of Service lines in some parts of the country turned toward administration; the advances made in protection having somewhat changed the picture. The Civilian Conservation Corps and other agencies had taken care of construction and maintenance during the 1930's. When these agencies ceased to function, maintenance became a problem. Just as the demand brought about an expansion in communication facilities so changing conditions called for reduction in certain types of communication. Commercial companies have moved in and are ready to furnish service to areas hitherto without any communication or dependent on Forest Service lines. The time is here to take careful stock of our needs and determine just what we must retain and what we should eliminate. Lines that recent communication plans for administrative units have revealed are no longer needed can be disposed of through sale, salvage, or cooperative agreements with other agencies or private companies.

The increased use of more efficient radio communication has entered very conspicuously into our planning. Miles of telephone wire and poles, located on miles of right-of-way, present a real problem of maintenance and cost. Radio seems to be one of the means of cutting down this communication expense. But radio is no panacea for communication problems. There still remain sections where wire communication is a necessity.

Radio, as a rule, is not used to reach individual warden crews in rural areas. If commercial wire is not available, then the Forest Service may be faced with the job of handling this situation through its own system. Generally year-round communication is not an abso-

lute necessity on Forest Service lines but when these systems tie in with commercial exchanges or otherwise furnish an outlet for rural areas something of an obligation rests on the Forest Service to maintain service.

Radio will often make possible the abandonment of sections of line, leaving other sections isolated with no connection to commercial lines or to Forest Service headquarters. Radio communication to a lookout tower which also has telephone service on the isolated section will open up the entire communication network during the times of the year when the system is most needed for protection. Sections not absolutely needed present an unwarranted cost and cannot be justified. The new type TF frequency-modulated radio designed for use in lookout towers appears to be dependable to the extent that nonjustifiable wire sections can now be eliminated.

A study showed that on some units of the Jefferson National Forest a reduction in telephone mileage of nearly 50 percent will be possible in the next couple of years through communication replanning, commercial service can be purchased or secured through agreement, sections can be abandoned and salvaged or sold, and radio can be used to fill in the missing links.

Communication is no less important than heretofore. The exchange of pertinent information is a necessity on the fire line and in proper administration. However, we must survey the situation carefully to determine just where the needs exist.

A review of action on going forest fires has frequently revealed that communication between the various sectors has been inadequate—to the end that suppression action has suffered. The essential thing is that communication be maintained: the type should be that which best fits the situation. It may be foot messenger, temporary wire, portable radio, combination of portable and fixed station or mobile radio. Adequate communication will tend to prevent the confusion, and sometimes disaster, that results from a lack of knowledge of facts.

The type SF handy-talkie radio is probably the quickest means of establishing communication on a fire. Several of these sets will tie in the fire sectors with the fire boss. Type SF radio direct to a lookout tower having a type TF with its repeater will often give rapid and accurate data to the dispatcher. Sometimes, it may be more effective to clear messages from the fire line through a fire base radio which may be a mobile type KF installed in the ranger's or fire assistant's vehicle. The Jefferson National Forest used FM radio, types TF, SF, KF, and UF, during the spring fire season of 1949. In actual operation this equipment functioned up to or better than our expectations.

FM radio is another link in our communication chain, and it may make possible the elimination of less effective and more-expensive-to-maintain sections. This improved radio is certainly a reason for us to carefully scrutinize our communication set-up.

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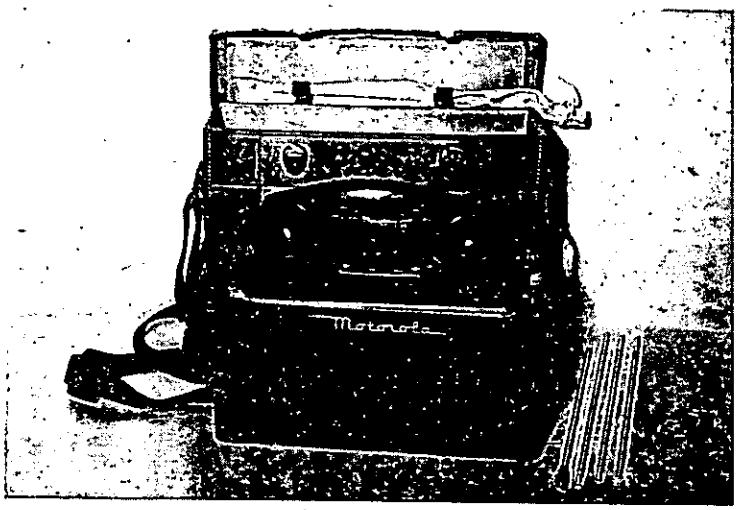
PROTECTIVE CASE AND JOINTED ANTENNA FOR FM HANDIE-TALKIE RADIO

W. S. Davis

Forester, Region 2, U. S. Forest Service

The Rocky Mountain Region recently made a test purchase of a small number of Motorola FM handie-talkie radios, intended as a means of communication with radio-equipped fire lookouts by rangers on trips in remote areas during periods of critical fire danger.

In its commercial version, the thin aluminum case and exposed hand set, antenna base, and switch of the radio did not seem to offer the set sufficient protection for rough usage on pack trips, surveys, timber sale work, etc. Therefore, a protective carrying case was devised.



Cases were made by a saddlery shop in Denver at a cost of $22.50 each. Considering the purchase price of the radio, this is cheap protection. Each case is made of double saddle-stitched leather, with inside measurements of 3½ by 10¼ by 12½ inches. The carrying strap, with which the radio comes equipped, snaps into loops on the side of the leather case. The radio fits snugly in this container and is operated in place; removal is necessary only for maintenance or for the replacement of batteries.

The one-piece tapered steel rod antenna furnished with the handie-talkie could not be made to fit in the carrying case, so a substitute had to be devised. The screw socket was fastened to a jointed aluminum rifle cleaning rod, which was then cut to the length required by the transmitting frequency. The disassembled antenna sections are carried in a linen holster held in place by two leather snaps under the lid when the case is closed.

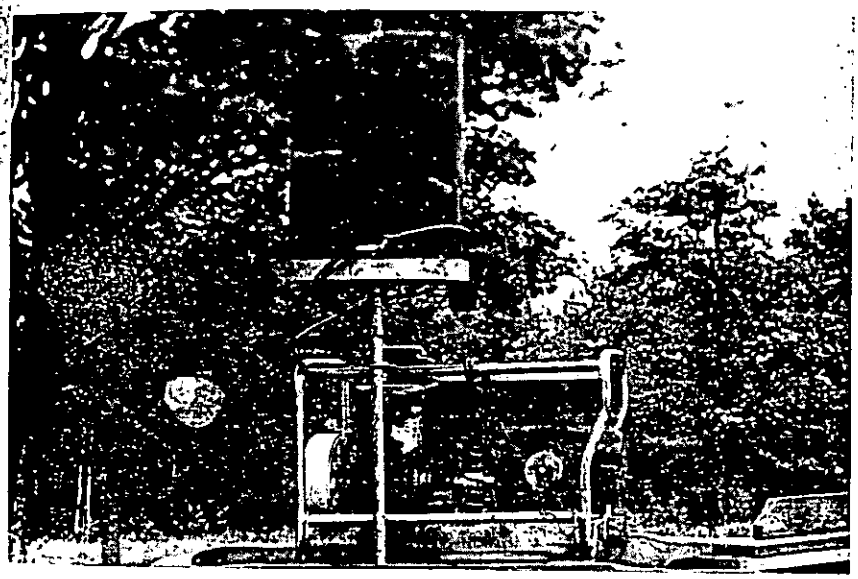
The complete case adds litte bulk to the compact radio, and affords ample protection under practically all travel conditions.

GAS CAN HOLDER FOR PORTABLE PUMPS

EDWARD RITTER

Forester, Region 7, U. S. Forest Service

How often have you, as a portable pump operator, looked for a limb, tree, post, or pole to hang the gasoline tank on, and found nothing suitable at the critical moment? Well, here is how Horace Remick, a warden for the State of Maine, at Ellsworth (near Bar Harbor) solved the problem. His oval holder may not be an entirely new innovation but its design, I understand, is original.



A piece of ½-inch galvanized water pipe, 23 inches in length, is gound down and tapered to fit snugly but easily into a ¾-inch pipe nipple. The ¾-inch pipe nipple, 4 inches in length, is fitted into a 3½-inch pipe flange. The flange is attached to an oval wooden base by four wood screws.

This base, which is used to support the gas can, was made to order for a special gas can in stock on the district. Three-quarter inch plywood was cut on an oval pattern, 12⅜ inches the long way by 7¾ inches across the narrow side. The periphery was banded with a piece of ⅛-inch strap iron, 1½ inches in width, to hold can in place. A short pin in the ½-inch pipe is fitted into a slot in the ¾-inch nipple to prevent base from turning.

The upright piece of ½-inch pipe is held in place near the top by a guide clamp attached to the cylinder head, rack or protection rail, and its base is inserted in a hole bored into the carrying frame, which is reinforced by a block of 2 inches by 4 inches about 6 inches long.

Total cost for materials would probably be around $3, but salvaged materials or pieces of scrap may be obtained for less.

REFLECTING WARNING SIGNS

E. L. Baxter

Division of Fire Control, Region 5, U. S. Forest Service

Fire crews working on fires along busy highways have not been given adequate protection from fast moving vehicles. This is especially true at night because we have not had effective signs to warn the traveling public of the danger ahead.

Merve Adams, central dispatcher, Shasta National Forest, suggested we provide tank trucks and other vehicles assigned to fire control along roads with warning signs that could be placed on the edge of the roadway on both sides of the fire area and could be readily read day or night.

His suggestion has been accepted, such a sign has been developed and, after checking with numerous sign companies, bids are now circulating for reflecting warning signs. The size and wording of the sign are shown in the diagram. The sign will be on S1/2 hard .051 aluminum. The background is to be a bright red, the letters are to be silver. The entire sign will be treated with reflecting glass beads. This combination, as proved by numerous tests, gives a sign that is easily read at night by fast moving motorists. Of real importance in such signs is keeping the number of words down to not more than 5 since the driver of a fast moving vehicle can't pick up more than this number before passing the sign.

The sign will be riveted to the top bar of a swivel folding base that is made of two ½-inch pieces of square bar steel. The bottom bar fits inside two short feet at the ends of the top bar and the two are joined in the center by a large rivet that permits them to be opened to form a "+". This is sufficient base to hold the sign upright.

The advantage of this type of sign base over the orthodox type is that two signs will nest in a space a little over 1 inch thick, thus two signs can be fitted almost anywhere in a truck in a light wooden case, whose over-all dimensions are slightly larger than those of the signs.

EVOLUTION OF FIRE LINE PLOW DESIGN IN R–9

GUERDON L. DIMMICK

Equipment Coordinator, Division of State & Private Forestry, Region 9, U. S. Forest Service

Two field demonstrations of equipment recently held in Missouri emphasized the progress made in fire line plow design and prompted this review of fire line plow history as it applies to Region 9 of the United States Forest Service.

Prior to the establishment of the Civilian Conservation Corps, fire suppression, and particularly line construction, was largely dependent on hand labor with axes, shovels, and back-pack pumps. Similarly tree planting, including ground preparation, was being done largely by hand labor.

Walking agricultural plows drawn by horses and small agricultural tractors had been used for years, but with the advent of the large CCC planting program there was an urgent need for larger and better plows to provide shallow, clean, wide furrows for planting, and that could be easily moved between jobs.

The CCC camp repair and blacksmith shop facilities and personnel afforded an opportunity for experimental development of suitable plows. In 1934 a 700-pound lister or middlebuster plow was designed and produced, but soon proved to be too light. A larger plow weighing approximately 1,500 pounds was produced in 1935. The larger tractors of the 30-hp. class and up which this plow required in turn presented additional transportation problems. Further study and local experimentation continued.

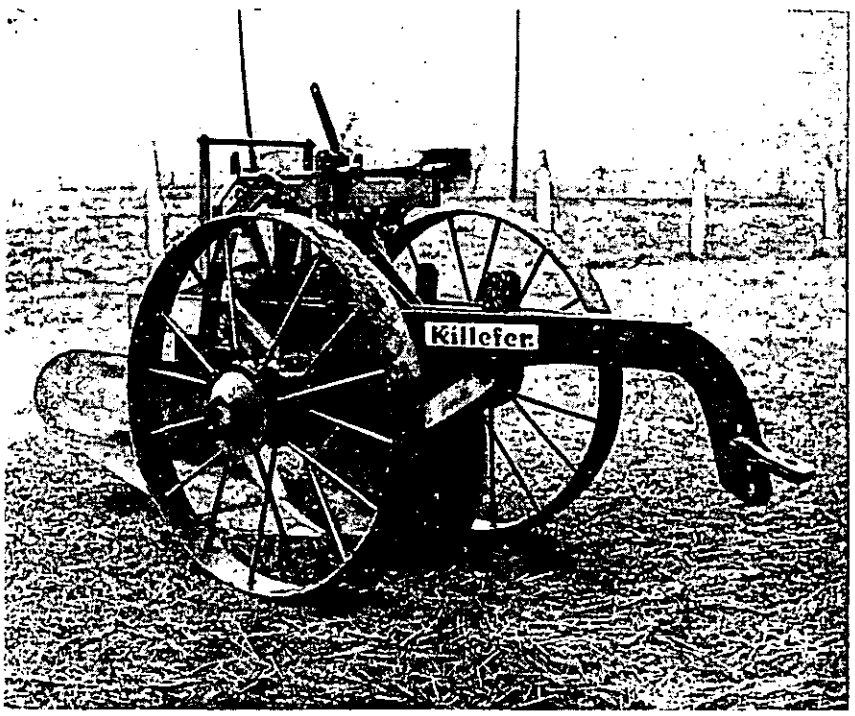
This study resulted in securing for testing a Killefer plow, made by the Killefer Corp. of Los Angeles, Calif., and successfully used as a wheeled ditcher plow in the West. Some changes in the plow bottom were suggested by Mr. Wagler, at that time an equipment sales engineer of Milwaukee, who had kept himself fully informed on the experimental work on plows.

The approval of this plow with the "Wagler" bottom, and the decision of the United States Forest Service to buy a quantity immediately posed a question as to a possible source of supply for such a specialized plow. Numerous contacts with commercial manufacturers developed a common pattern of disinterest due to the limited market for a specially designed agricultural plow. The Killefer Co., however, expressed their interest, and a considerable number of Killefer plows known as model 77 were subsequently built by Killefer as designed by Mr. Wagler and purchased by the Forest Service for the Civilian Conservation Corps program.

Certain limitations in the Killefer plow were found through experience, indicating that heavier plows and heavier tractors were essential.

Two years later (1938) the plans for a radically new plow came from Mr. Wagler's drafting board. They included a special design in moldboard construction which furnished a marked improvement in the type of planting furrow.

The plow, with a 42-inch rolling coulter encased in a heavy steel housing, was designed without a sulky and weighed 2,600 pounds. Because of its weight and nonmobility it was extremely cumbersome and difficult to handle when uncoupled from the tractor; but on furrowing and fire line construction it outperformed all its predecessors



Original ditcher plow purchased from Killefer in 1934.

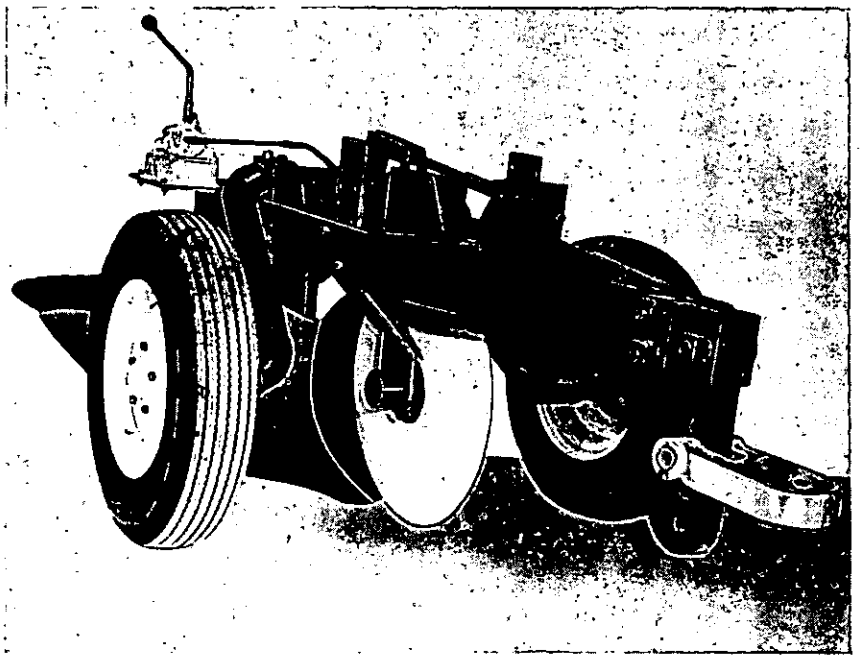
with little or no maintenance. Again the Killefer Corp. was the only commercial manufacturer who would agree to build this plow. It subsequently delivered 57 units known as the Wagler fire line plow to Region 9.

The inactivation of the Civilian Conservation Corps program and the advent of war resulted in much of the CCC equipment, including many tractors, being turned over to the armed services, thereby leaving this latest plow as a surplus item because of its weight and lack of mobility.

The design and production of this type of equipment, drastically curtailed throughout the war years, has experienced a revival in the past 2 years. Neil LeMay, Chief Forest Ranger for Wisconsin, had been favorably impressed by the performance of the Wagler nonmobile plow. He acquired a number of surplus plows, removed the

moldboard assemblies from the original plows and mounted them on specially constructed sulkies. The result is considered to be one of the most satisfactory fire line plows built to date for the types of fuels and ground conditions found in this area. These units, used with 30-hp. crawler tractors, are transported on two-wheeled tilt-bed trailers and constitute the State's best initial attack plow units.

During the spring fire season of 1947 Mr. LeMay was in Missouri to study their radio fire communication system and while there had an opportunity to participate in fire suppression work. After a night



Wagler model 30A plow in present use.

of back-breaking and hand-blistering work fighting fire, he stated that he felt Wisconsin's latest converted Wagler plow would work in Missouri and offered to demonstrate it by bringing a tractor plow unit to Missouri on a tilt-bed trailer.

As the result of the subsequent request of Missouri State Forester White, Wisconsin put on a plow demonstration for State and Federal representatives at Sullivan, Mo., in the spring of 1948. Wisconsin's converted Wagler plow fulfilled the expectations of the sponsors to the satisfaction of the fire technicians present.

The United States Forest Service and Missouri both wished to acquire similar plows. The revival of interest again presented the familiar problem of where to get this type of plow. Killefer Corp. had been sold and the facilities of their successors were closed to production of experimental models for outsiders. Other possible sources were more restrictive than before the war. This problem was solved by the Wagler Equipment Co. whose new factory at Pewaukee, Wis.,

was dedicated to the production of specially built equipment for forest use by National, State, and private agencies.

The first Wagler heavy-duty, mobile fire plow was produced in 1948 and taken to Wisconsin State Fire Headquarters at Tomahawk for a comparative test with the Wisconsin converted plow before a group of State and Federal fire technicians. After the test definite suggestions concerning possible improvements or changes were obtained from the group.

The final approved model incorporating the suggested improvements was completed in November 1948 and taken to Missouri for its final demonstration before 70 State and Federal representatives under carefully selected conditions that would thoroughly develop any possible limitations.

The plow's performance won the unanimous approval of the group, and units were purchased by the United States Forest Service and the State of Missouri. The State of Minnesota was also impressed by the possibilities of this unit and has purchased 15 for fire suppression work in that State.

Some of the features that merited favorable comment at the Missouri demonstrations are as follows:

1. The trim appearance, simplicity in design, and rugged construction around a 3-inch axle of unique design.
2. Its extreme portability and roadability at high speeds due to its low center of gravity, perfect balance, automotive type wheels, pneumatic tires, and high speed axles.
3. Its 34-inch wide lister or middlebuster type moldboard assembly equipped with easily replaceable agricultural type shares and moldboards mounted on specially designed permanent boards, heavily cross-braced to withstand great compression loads.
4. The elimination of side bracing for the brackets of the bronze-bushed, 30-inch, rolling coulter which can be adjusted to conditions of terrain.
5. The effective screw type depth adjustment with integral locking device for adjustments from transport position to a 10-inch plowing depth.
6. Simple, sturdy, well-located, hand-operated, hydraulic lifting mechanism.
7. Sturdy tractor hitch attached to frame readily adjustable to various tractor drawbar heights.

The Wagler plow although weighing 2,080 pounds was transported by passenger car with a rigid bumper hitch from Milwaukee, Wis., to Sullivan, Mo., a distance of 497 miles, at an average rate of more than 40 miles per hour without any difficulty.

This high speed portability of the fire line plow is of particular interest to fire control personnel as it permits a greater flexibility in the use of fire equipment, especially where policy precludes the exclusive assignment of equipment for fire suppression purposes as in the national forests. Under such a policy trucks, trailers, and tractors would be released for other work.

Further information and specification will be furnished upon request by the Regional Forester, United States Forest Service, Madison Building, Milwaukee 3, Wis.

THE PLUMAS MACHINERY TRAILER

M. D. Stowell

Fire Control Staff Officer, Plumas National Forest

Experienced fire men know the value of heavy bulldozer equipment on slash, timber, and brush fires in the West. It has been estimated that one D–8 bulldozer, properly operated on such fires, is equivalent to 50 good men in constructing fire line.

This Forest has used mechanized equipment on fire line construction for some time. Our problem has been in getting such equipment to fires in time to be of value in line construction. For years, the Forest had a light dozer and transport on fire standby during the fire season, but the transport was slow and the dozer, because of weight limitations of the transport, was not large enough to do some of the heavy work desired on fire line construction.

There are some 20 logging operations on this Forest, all of which have one or more D–7 or D–8 dozers or their equivalent. Operators are willing to use their equipment on fires when needed, but only a few have transports.

It was recognized that these logging operations had logging trucks, the tractor units varying from 140 to 250 horsepower. These tractor units are powerful enough to furnish motive power for a trailer transport to haul large dozers.

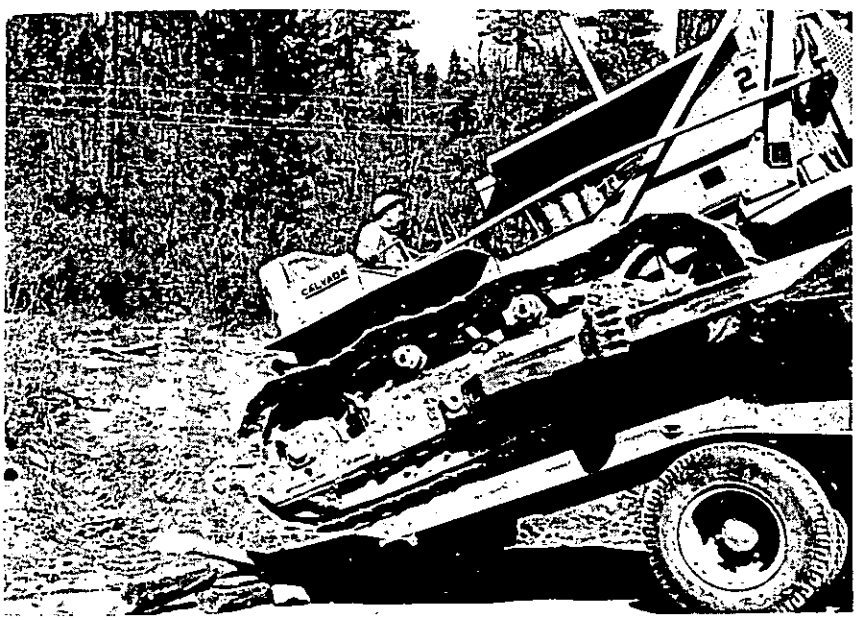
There are several commercially manufactured machinery trailers on the market but each of them had some drawback when tried for hauling fire equipment on back-country roads.

View of detailed hookup on log bunk or tractor unit of logging truck.

A survey of the few machinery trailers in use in this area brought to light a trailer designed, built, and used for 7 years by the Graeagle Lumber Co., Graeagle, Calif., which seemed to fit our needs more closely than any commercial or surplus unit.

The main features of this trailer are as follows:

1. It is quickly and easily attached to the log bunk of the tractor unit of a logging truck.
2. Dozers can be quickly loaded and unloaded on any road without using planks or a bank or ramp.
3. It is possible to rent a tractor unit to furnish power for the trailer only when needed, and to get one with sufficient power to haul a D–8 with dozer blade and double drum winch at speeds commensurate with road conditions.
4. The unit can be maneuvered like any semitrailer unit.



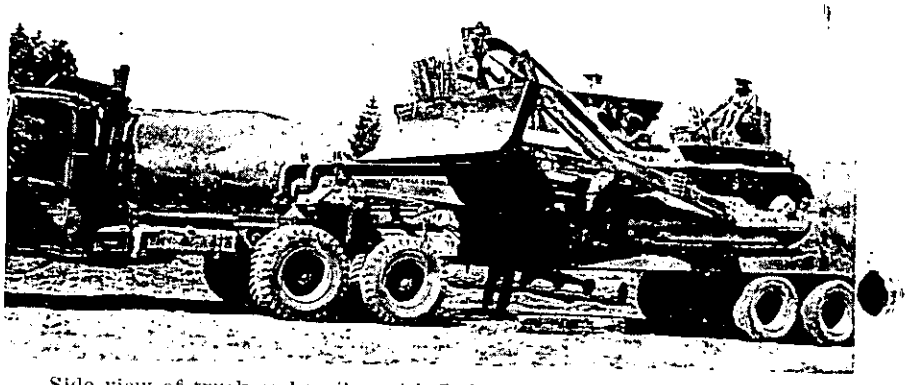
A D–8 dozer being loaded on trailer from a level site. Some blocking is necessary to raise blade and tracks to start up ramp. A folding metal ramp is being fabricated to replace blocks.

It was decided to build a similar trailer unit as an experiment to answer the need for a trailer-transport and to dispense with the standby dozer and costly transport. Accurate costs were kept on the construction of this trailer to determine the feasibility of constructing others to replace standby transports in areas where logging trucks and dozers are available through private concerns but transports are not.

Bids were let for a trunnion type, dual-axled, 8-wheel logging trailer under gear, with a conservative loading potential of 50,000 pounds

for each axle. The unit purchased was equipped with air brakes, 10.00 x 20 wheels, coil spring suspension, and cost $1,828.69 delivered.

Steel I beams and channels, plates, welding rod, etc., on bid cost $579.84. Twelve-ply tires, tubes, clearance lights and air brake controls cost an additional $608.62. Labor for 25 man-days cost $314.50, making the total cost to the Forest for this trailer $3,331.65. This amounted to approximately 2-years' rental cost for the standby dozer and transport. It is estimated that the trailer will be serviceable for at least 10 years with very little maintenance. Over that period there will be a considerable saving of public funds.



Side view of truck and trailer with D–8 dozer in final loaded position.

The trailer was constructed in our forest shops by Welder E. J. Kessler in 1948. Equipment for such construction was inadequate, but through the interest and ingenuity of Welder Kessler the unit was constructed in a minimum of time.

Initial tests on highway hauling were made in the spring of 1949. A 140-horsepower logging truck tractor unit was used for motive power and the pay load was a 28-ton D–8 with dozer blade and winch. This load was hauled 12 miles. The unit traveled up 7-percent grades at 8 m. p. h., on the level at 15 to 20 m. p. h., and down grades at safe speeds of up to 28 m. p. h. with this load. The dozer rode well, the trailer tracked and handled perfectly, and the moving operation was carried on in a minimum of time. Loading the trailer on the tractor unit requires about 15 minutes. Loading the dozer and securing it with blocks and load binders requires 15 to 20 minutes and unloading about 10 minutes. When the trailer is empty the truck travels at 40 m. p. h. on standard highways.

The entire trailer is 33 feet long, the bed is 53 inches high and 96 inches wide. It weighs approximately 12,500 pounds.

This trailer is one of several that could function in the capacity intended. It is not recommended that these trailers be built in a forest shop as the steel used in its construction is too heavy to be handled by the light equipment usually available.

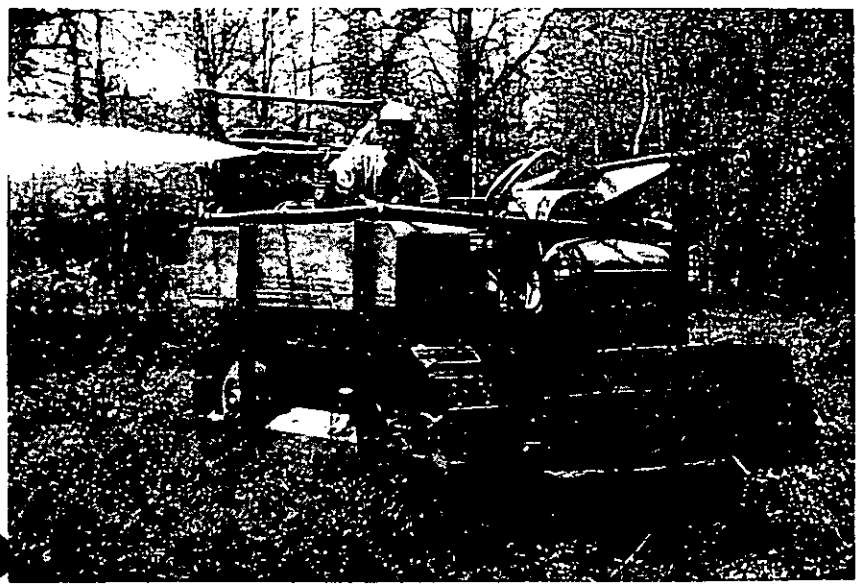
OLIVER TRACTOR-TANKER-PLOW UNIT

EINAR E. AAMODT

Engineer, Roscommon Equipment Development Center, Region 9, U. S. Forest Service

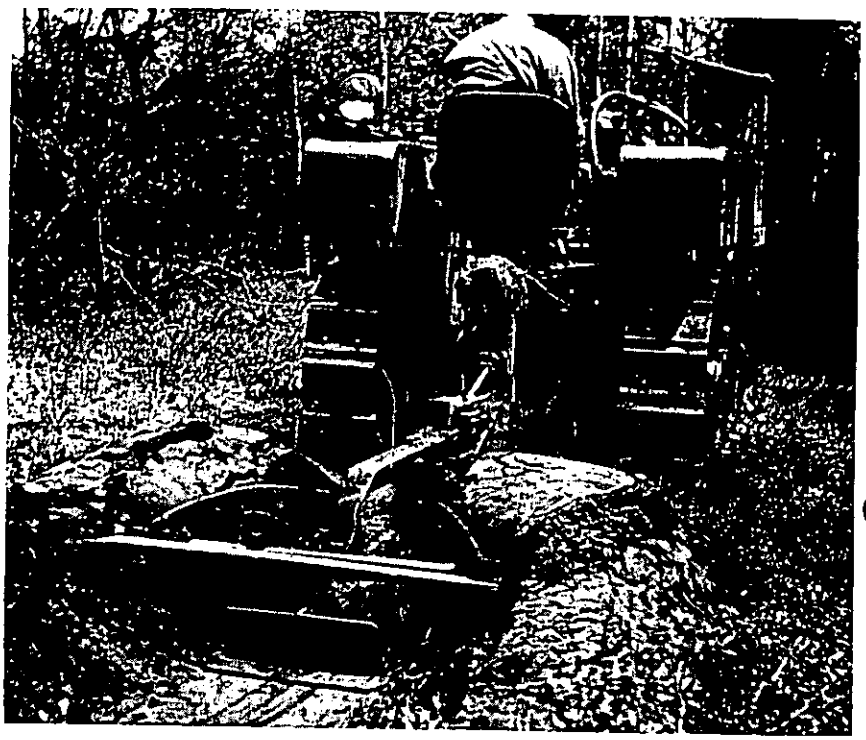
A new fire-fighting tool, a tractor-tanker-plow unit which is almost in a class by itself, has been developed around a new H. G. Oliver tractor. The initial demonstrations and tests of this unit proved it to be very satisfactory. The tractor is equipped with two 45-gallon tanks, a Porto pump with chain drive from the main drive shaft and a hand-operated clutch to engage the pump unit, a hydraulic lift control unit and stubby plow, a pusher bumper, and a nozzle gun support. It is lightweight (about 5,400 pounds loaded with water) and can be hauled easily on stake trucks or a light R–S tilt-top trailer. It is fast on easy, open going; and in heavy going it can build a good line under almost any condition. Its small size permits getting around and through places where larger plow units have trouble. There is no lost time due to hang ups, and under the toughest conditions the plow does not clog up. The unit can be used for mop-up with the tanker or as a stationary pump using 1½-inch hose.

The pusher bumper, a hydraulic-controlled short-width dozer, is very useful in mop-up, and to clear out logs and slash or debris in line construction. The hydraulic control unit on the plow is also a decided advantage and improvement. The plow can be quickly raised or lowered while the tractor is standing or in motion. It is possible to put



Tractor-tanker-plow unit, showing water tank over crawler track, nozzle gun on swivel support, and hydraulic-controlled bumper dozer.

800 to 1,000 pounds pressure on the plow, in fact enough to raise the rear end of the tractor off the ground. The dozer and plow can be raised or lowered together or each unit operated independently. The plow is a standard straight coulter stubby plow with standard 14-inch plow bottoms and a reinforced hitch. A heavy spring loading arrangement is used on the plow to allow it to slide over large rocks or stumps to prevent damage to the plow. The downward pressure on the plow



Tractor-tanker-plow unit with a hydraulic-controlled plow in operation.

is through this spring and the pressure can be varied instantly by manipulation of the hydraulic control lever.

Two water tanks, each of 45-gallon capacity, are mounted directly to each crawler track. There are advantages in mounting the tanks to the tracks rather than to the frame of the tractors. The cost of this mounting is less and the work required is also less. Overload springs are not required, the water weight is distributed equally to each track which gives better traction. The tanks are mounted low and close to the tracks, which is important from a safety standpoint when the unit is traversing steep hillsides and slopes. A flexible hose from each tank is run through a slotted hole in each fender to the pump unit which is located in the center of the tractor above the transmission and just ahead of the operator. The tanks are constructed of 16-gauge sheet iron and are welded over a ¼ by 1 by 1-inch angle iron frame into a one-piece unit. They are heavily coated with Neutral, and have removable covers and filter caps. By removing the covers the tanks

can be cleaned out or coated again with Neutral. The tanks and mountings showed no weaknesses after vigorous tests.

The bronze case model Porto pump has rubber impellers and can pump dirty and muddy water without damage. The pump runs at the same speed as the engine and is driven by a simple roller chain drive off the rear of the clutch housing. A jaw type clutch is used to engage the pump, and the handle is within easy reach of the operator. An adjustable water-pressure by-pass valve is also located within easy reach of the operator. Pressures can be varied up to 220 pounds. An operating pressure of about 150 pounds was found to give the best results with a Hardie gun nozzle, using a 10/64-inch tip and discharging about 8 gallons per minute. The tractor carries suction hose and strainer mounted in clips, and these can be easily and quickly removed or replaced. The tractor can be driven to a nearby source of water for refilling the tanks. The Hardie nozzle is mounted on a two-way swivel so the gun can be directed in any direction or locked in any position. The gun can be easily detached from the holder. On the swivel, the gun can be handled with one hand and it remains fixed in any position as soon as the operator lets go. This allows the operator time to manage the other controls and to steer the tractor. On initial attack the water is primarily used to knock down the hot spots.

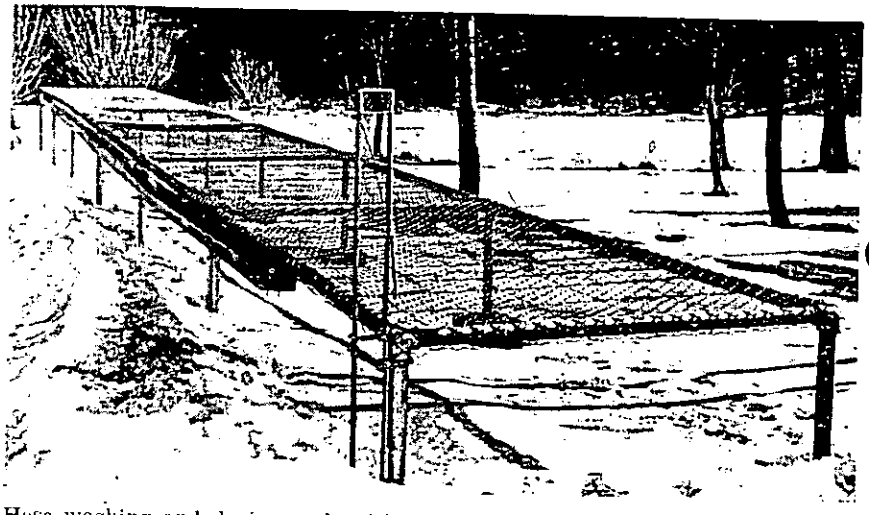
HOSE WASHING AND DRYING RACK

NEIL LEMAY

Chief Forest Ranger, Wisconsin Conservation Department

An effective and durable steel rack for washing and drying hose has been in use at the Rhinelander Ranger Station.

The rack is constructed of 2-inch galvanized pipe and has over-all dimensions of 60 by 6 feet, with a slope of 2 feet in the total length. The uprights may be bent at an angle of 2° to accommodate the slope. However, the Rhinelander rack has regular T's on the side connections and the uprights are welded to the T's at a 2° angle.



Hose washing and drying rack with rewind trough and portable hose winder, at Rhinelander Ranger Station, Rhinelander, Wis.

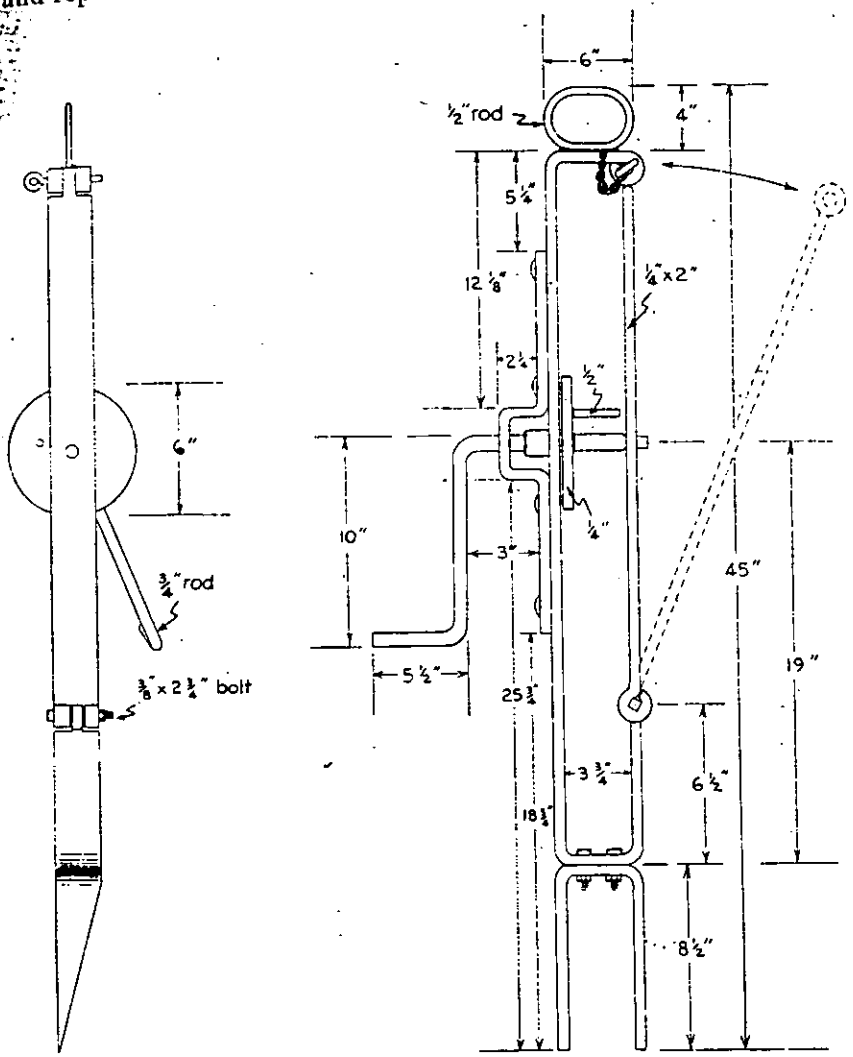
The galvanized wire mesh covering the rack is warped over the edge of the frame and fastened by using No. 9 wire, 1-foot spacing, and then twisting up the wire to pull the mesh into a taut position. The end sections have such wiring in both directions to hold both the ends and sides of the wire mesh. There is some sag but not sufficient to warrant turnbuckles.

The rewind trough is a more recent addition to the rack and is made of sections of two pieces of 3- by $\frac{3}{32}$-inch angle iron bolted together and supported by 2- by $\frac{1}{4}$-inch brackets bolted to the uprights.

One of our standard portable hose winders has been fastened to the end of the drying rack opposite the rewind trough, and it has been found to be a quick and effective means of rewinding the hose after it has been washed and dried. The plan of this winder shows the

sharpened foot only 8½ inches long; this base has been lengthened for attachment to the rack.

The steel rack with its concrete footings has proved extremely durable and the wire mesh has facilitated rapid drying of the hose. Wooden structures are bulkier and are in constant need of painting and repair.



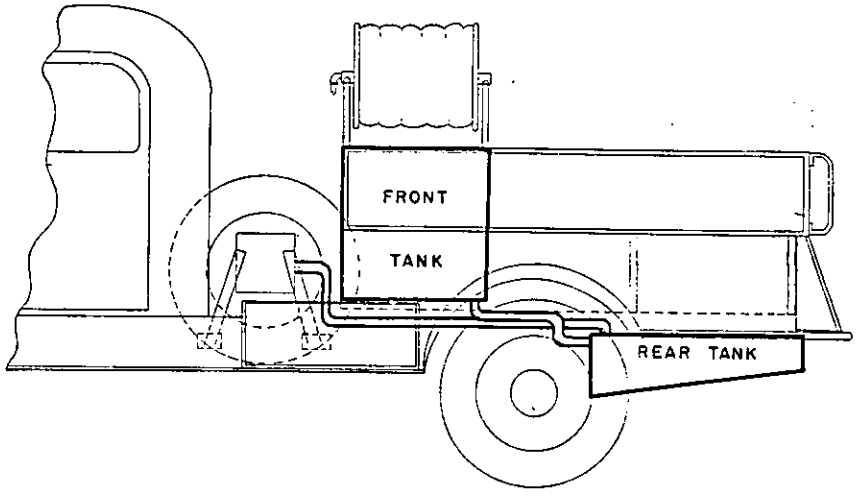
Portable hose winder.

CORRECTING LOAD DISTRIBUTION ON TANK AND CREW TRUCKS

DEWITT NELSON

State Forester, California Division of Forestry

The California Division of Forestry, like most other suppression organizations, has always experienced difficulty in maintaining proper load distribution on combination tank and crew trucks. To a large degree this is due to our policy of carrying personnel at the rear of the truck, thus throwing the water and pump weight toward the front axle.



Position of tank installations for combination tank and crew truck.

We believe that we have overcome this problem to a satisfactory degree by adopting the use of a rear tank suspended from the frame back of the rear axle. For our particular designed truck we are using a tank with a capacity of 53 gallons, constructed of $\frac{3}{16}$-inch plate with cross baffles and cover of 10-gage iron. The unit is 12 inches deep at the front, 6 inches at the rear, 38 inches long and 36 inches wide. There are two ½- by 2-inch pieces of flat iron welded full height of tank on each side, 4 inches from each end; these brackets extend above the tank to the height of the frame to which they are bolted with $2\frac{3}{8}$-inch bolts in each carrier. The entire completed unit is hot-dip galvanized before being installed.

Water is supplied by gravity from main tank by means of a pipe one-half inch larger in diameter than the filler line from the pump discharge into the main tank. The suction line from the lower tank to the pump is regulated according to the capacity of the pump. We also have an air vent from the rear tank back into the main tank.

The tank is installed 10 inches back of the differential center line and has a ground clearance of 15½ inches at that point against 9½ inches at the differential; the least clearance of the tank is at the extreme rear where it is 42 percent of the overhang.

The total weight of this unit is 9,850 pounds without personnel, with a weight distribution of 68 percent on rear axle and 32 percent on front; with a full complement of eight men, the load distribution is 76 percent rear and 24 percent front.

The drawing illustrates the general arrangement of the last 68 units we put in service during the past fire season.

CONVERTING A STANDARD JEEP INTO A MOBILE FOREST FIRE FIGHTING UNIT

D. A. Anderson and E. F. Evans [1]

This article briefly describes the result of the pioneering work of the State of Texas in developing the jeep and accessories for fire suppression work. Further development is now being sponsored by the Lake States and Region 9 of the United States Forest Service with the objective of perfecting well-balanced and standardized outfits that can be mass produced at lower cost. Principal manufacturers of the vehicle and accessories are cooperating in this project.—*Ed.*

A standard jeep requires a number of modifications to convert it into a forest fire fighting unit. Much of this transformation is for the primary purpose of reinforcing the body and chassis to withstand the heavy duty required on the fire line. The factory-equipped jeep filled with gasoline and oil weighs 2,220 pounds. A jeep forest fire fighting unit, as modified by the Texas Forest Service, weighs approximately 3,550 pounds and costs approximately $2,899 as indicated in the following tabulations.

	Weight in pounds
Jeep, factory equipped with full tank of gas and oil	2,220
Shop-built plow and mountings	300
Extra tools	25
Radio, accessories, and radio box (estimated)	100
Steel top	268
Lift	152
Winch	152
Front grill, front and rear bumpers, frame reinforcement, and miscellaneous	333
Total	3,550

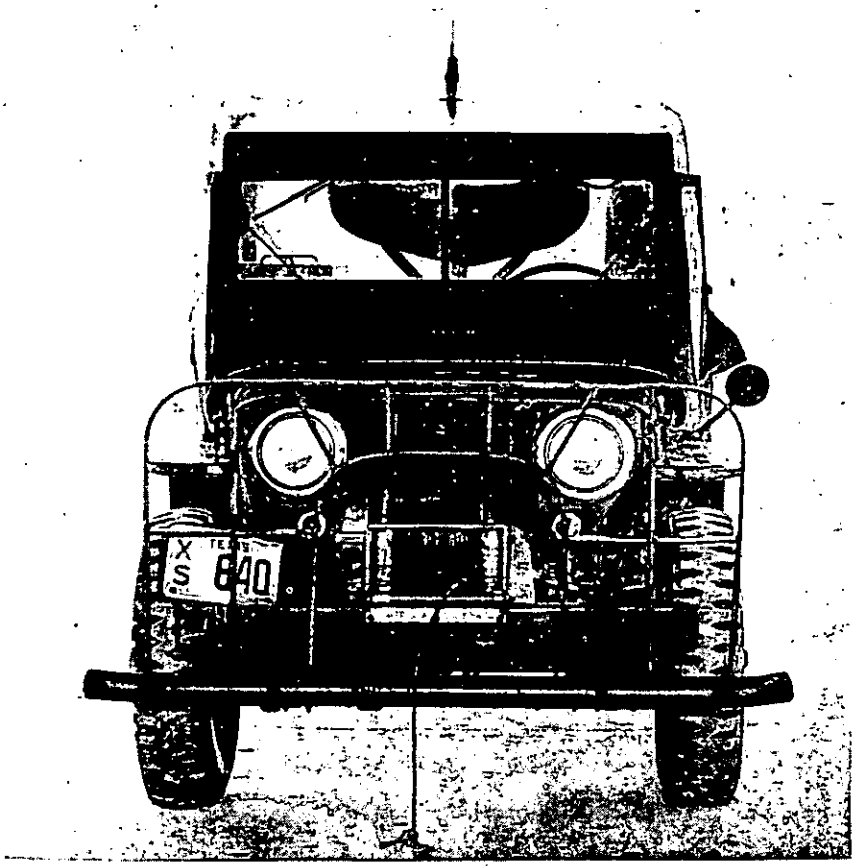
	Estimated cost	
	Single units (dollars)	*In quantity (dollars)*
Jeeps, less tops, with dual adapters, tires, and wheels for placing dual wheels on jeeps (one unit); tire size 700 x 1 5	1,445	1,245
Special design body unit, 13- to 18-gage metal	150	120
Special design plow, grills, belly plate, and painting	125	90
Coulter, 18-inch, rolling	9	9
Koenig winch	250	225
Farm-Aid lift with "Power Pack" hydraulic mechanism	250	225
Radio, FM, 250-watt, transmitter and receiver	575	450
Metal special design radio box	25	23
Back-pack fire pump, 5-gallon, complete	25	23
Special design backfire torch	15	10
Miscellaneous extra repair tools, including wrenches, etc.	30	25
Total	2,899	2,445

[1] Respectively, Head, Research and Education Department, and Acting Chief, Education Section, Texas Forest Service, A. & M. College System, College Station, Tex.

Body.—The canvas top is replaced with a 16-gage metal top. Supporting this metal top is a frame made of 1-inch angle iron three-sixteenths inch thick. Stiffeners made of 16-gage metal extend the full length of the top on the interior side. Three metal datum holders are built into the roof near the driver's seat and a tool box is built at the right rear. Canvas doors are used on each side of the jeep.

Protection of undercarriage.—Protection for the lower side of the jeep is afforded by three belly plates. One plate, of metal one-fourth inch thick, extends from the front bumper to the radius rods. One additional small plate of 12-gage metal protects the speedometer housing. Another small plate of the same material protects the emergency brake drums. Fenders are reinforced with flat iron one-fourth inch thick by 1 inch wide.

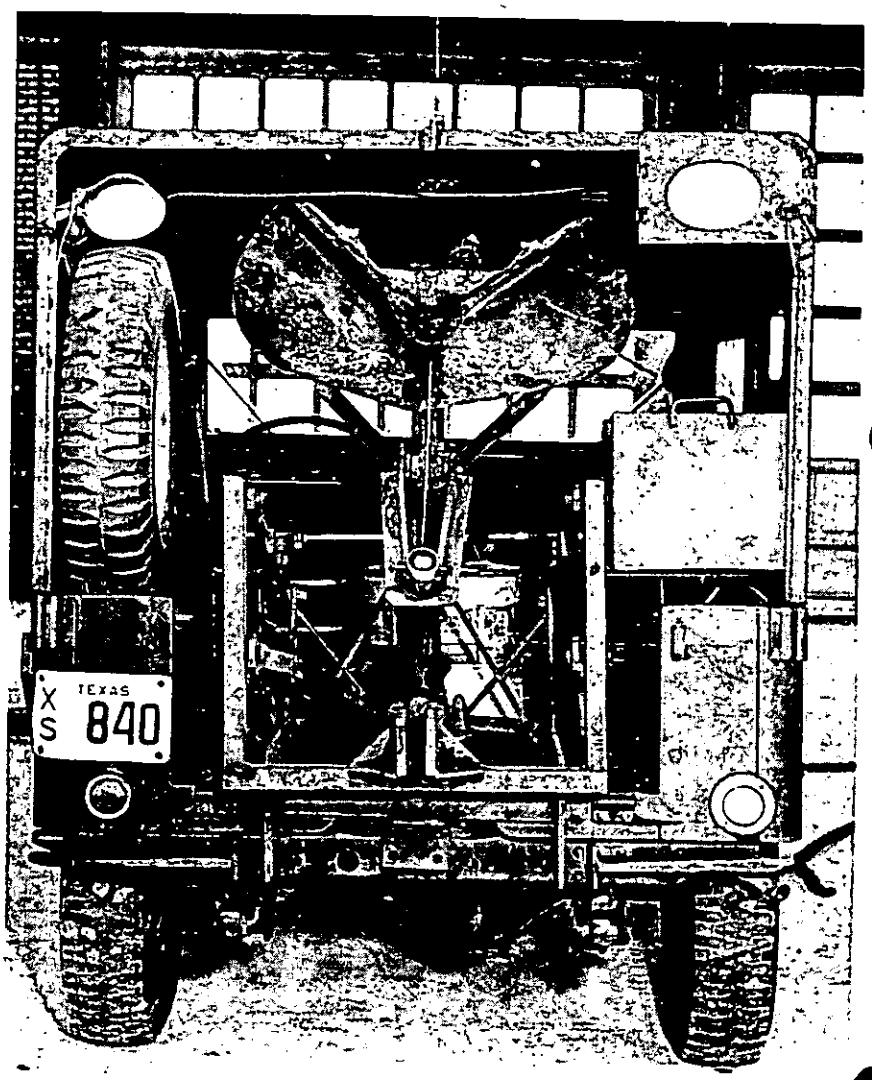
Front grill.—A front grill, made from pieces of flat iron three-eighths inch thick by 1 inch wide, protects the radiator and engine on the fire line. The grill has, at each end, a slanting flat iron brace of the same dimensions. This type of grill and the type made of ¾-inch black iron pipe are used on Texas Forest Service jeep units. The grill is welded to an auxiliary front bumper which consists of a 2½-inch black pipe. This adapted bumper extends slightly beyond



Texas Forest Service fire fighting jeep showing protective grill and winch.

the outer edge of the wheels to give added protection to the tires. The tubular bumper is attached to two pieces of flat iron which are bolted to the original bumper near its end. There are two rear bumpers constructed from pieces of metal 4 inches wide by one-half inch thick.

The front end of the frame is reinforced with an L-shaped metal member extending from the bumper to the rear of the front shock absorber. This reinforcing member is bolted at front and rear and welded every other inch. Weight of the front grill, front and rear bumpers, and frame reinforcement is approximately 308 pounds. Heavy duty springs are used on the modified jeep.



Texas Forest Service fire fighting jeep, showing retracted fire plow, spare tire, back-pack water pump, spotlight, and enclosed radio.

The U-frame for the plow is made of 3-inch channel iron on the uprights and 4-inch channel iron on the bottom. A flat plate has been added to make a hollow rectangular member. The U-frame is attached to the four arms of the Farm-Aid hydraulic lift, and has a level adjusting crank. The plow beam is 1¼ by 3 inches. It is attached to the bottom center section of the U-frame by two bolts, one of which is removable to permit folding of plow into jeep. When lifted to traveling position the plow fits into a carrying rack. A bolt on the carrying rack locks the plow in traveling position. The same bolt is used to lock the plow in plowing position. This bolt is machined for a tight fit in both positions. The L-shaped plow beam is reinforced at the right angle.

The upright shaft of the 16-inch rolling coulter is attached to the plow beam. A piece of metal reinforces the coulter shaft. The coulter is 1½ inches from the point of the plow.

Hydraulic lift.—The Farm-Aid hydraulic lift is powered by a pump driven by a crankshaft pulley. Another pulley drives the generator, water pump, and fan. Two gallons of SAE engine oil are used in the reservoir of the hydraulic pump. The hydraulic lift used in the Texas Forest Service jeep unit is the single-action type. The single-action hydraulic lift permits the coulter to jump roots and other objects which it cannot cut, thus allowing the plow to jump over the objects instead of hooking under them. The hydraulic cylinder ram has a spin down (jam nut) depth adjuster which permits adjustment of the plow in the event of hydraulic failure. A covering of old inner tube is used to keep dust out of the cylinder system of the hydraulic lift.

To facilitate the plowing of fire lines at night, a light is attached at the upper left rear corner of the jeep top. This light has a separate switch on the dashboard.

Radio.—Radio equipment is an important feature of the jeep unit. Each jeep is equipped with a 50-watt two-way mobile unit with dual channel transmitter.

The receiver has a single frequency of 31.3 megacycles. The transmitter has a dual frequency of 31.3 and 31.42 megacycles. A rooftop antenna is used. The jeep top has a 12-inch square, 16-gage reinforcing plate under the antenna. Receiving and transmitting radius of the jeep unit is 60 miles when communicating with fixed station antennae that have a height of 150 feet. Radio equipment is shock mounted on radiator hose. The cover of the radio equipment is 16-gage metal.

Wheels.—Dual wheels are used in the operation of the jeeps in low swampy land. The 7.00 x 15 wheels are equipped with military grip or studded grip tires.

Color of jeep.—Luzon red is the standard color of the jeep units.

Jeep operation.—The jeep pulls the fire plow in first or second gear in low range. Most vehicles are equipped with factory-installed Monarch or King Seely governors. The speed is adjustable. Plows are pulled at a motor temperature of about 180 degrees with governor and about 195 degrees without governor.

[Further detailed information, such as sources of supply, regarding the accessories described above may be obtained by writing the Director, Texas Forest Service, College Station, Tex.]

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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.

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