Volume 13 Number 1

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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AN INFORMAL STUDY OF POWER-SAW FIRES

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The increase in the number of power-saw fires during the last few years is viewed with alarm. In an effort to determine *how* these fires were starting and what should be done about them, an informal study was undertaken.

Forests submitted detailed information on individual fires. Manufacturers, mechanics, fallers, and buckers were interviewed. Carbon tests were made on mufflers and the one known spark arrester for power saws. Bulletins bearing on the subject were studied. One of these, University of California Bulletin No. 577, "Spark Arresters for Motorized Equipment," has been considered by later investigators to be the basic study as to the size and temperature of carbon that sets fires.

This paper deals primarily with power saws, but certain aspects of the study are applicable to all internal combustion engines and their fire-setting potentialities.

A tabulation was made of power-saw fires reported by the forests, including the make and model of the saw (if this were known) and all other pertinent information. Not tallied were a number of small fires immediately put out and on which information was lacking.

Of 29 fires reported, 8 were caused by hot mufflers or exhaust pipes coming in contact with flammable material; 6 by backfires of power-saw engine; and 3 by gasoline spills (how the gasoline was ignited was not determined). The specific cause of the other 12 was not pinpointed.

Seven of the fires were listed as having started from bucking saws, and 1 from falling saws. The remaining 21 did not have indicated which type of operation was responsible.

Sizes of the fires varied from smoldering material to 1,080 acres. Largest single suppression cost was $17,910.

The theory has been advanced that some mufflers are adequate spark arresters. An adequate spark arrester is considered to be one that will trap 90 percent of the test carbon, size A (carbon which passes a 14-mesh Tyler screen and is retained by a 28-mesh Tyler screen), and not set up more than a stated amount of back pressure as measured in water-inches.

Professor Henry F. Gauss of the University of Idaho Engineering Experiment Station recommends that for arresters on tractors the back pressure should not exceed 10 water-inches. The Society of Automotive Engineers Spark and Flame Arrester Committee states, ". . . No allowable back pressure is to be specified since it is felt that each engine manufacturer is best able to determine the back pressure which his engine can stand." Generally, it is believed back pressure in power saws should not exceed 4 to 6 water-inches.

In order to obtain information on the adequacy of mufflers as spark arresters, tests were run on three makes. A measured amount of carbon, size A, was fed into the air stream below the muffler. The amount that blew through was recovered and weighed back. Results were as follows:

	Carbon		
	Fed in (grams)	*Recovered (grams)*	*Efficiency (percent)*
Muffler:			
X	10	10	0
Y	10	9	10
Z:			
First test	10	6	40
Second test	25	18.5	26

Muffler Z was the largest of all mufflers and the one most likely, by its construction, to be effective. Muffler test conclusions are: Mufflers are not adequate spark arresters; all makes of mufflers tested got hot; and raw gasoline spilled on a hot muffler did not ignite.

The University of California study indicated that there is considerable risk from carbon sparks emitted from a 28-hp. tractor, but information was lacking on the danger of fire starting from carbon sparks emitted from power saws. Only one commercial spark arrester for power saws is manufactured, to our knowledge. The following two methods were used to test this spark arrester (fig. 1).

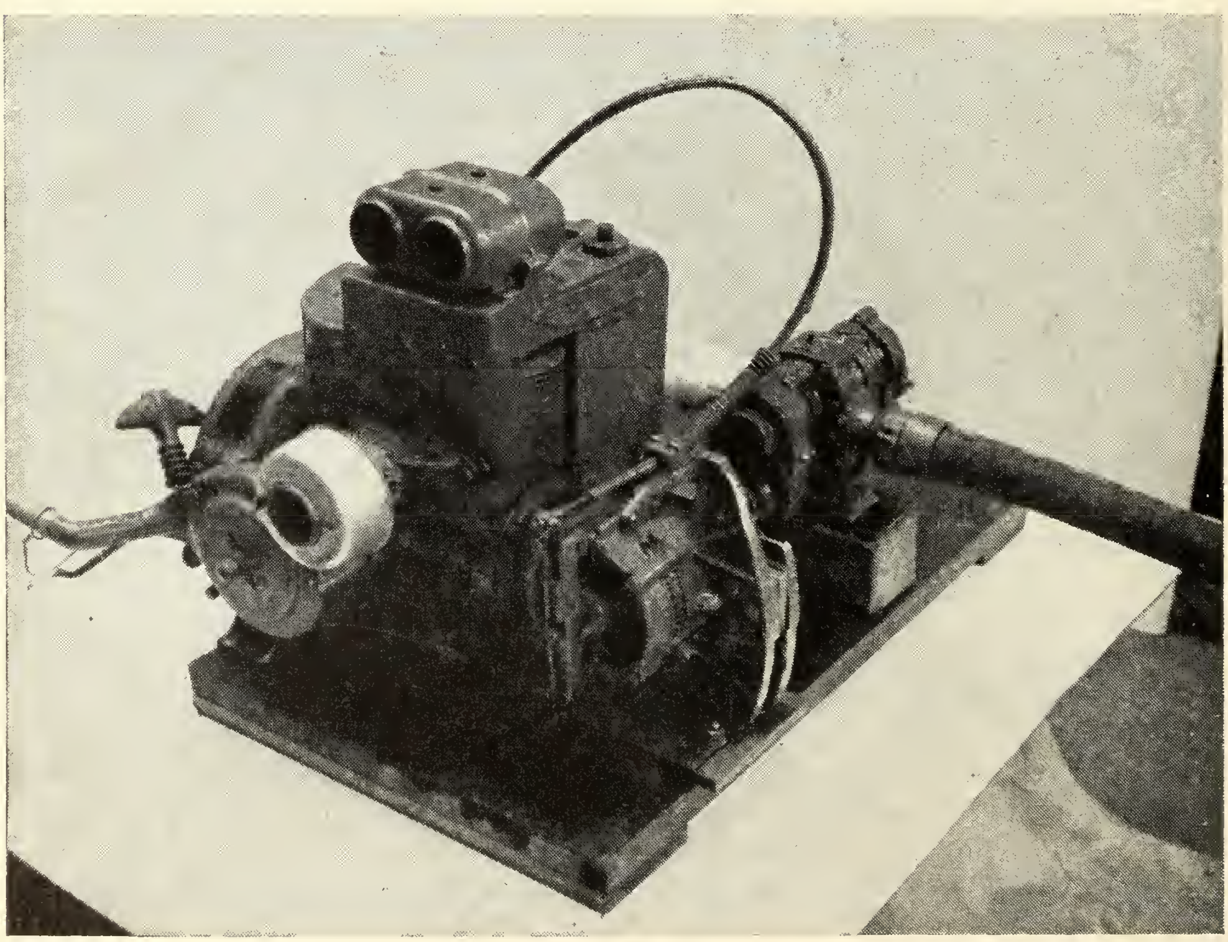

FIGURE 1.—To simulate conditions under which a power saw would ordinarily be working, a rotary gear pump was driven by the engine during the spark arrester tests.

1. Procedure was the same as that used on the mufflers. Back pressure was 6 water-inches. The arrester was mounted in three positions with the following results:

	Carbon		
	Fed in (grams)	*Trapped in arrester (grams)*	*Efficiency (percent)*
Arrester position:			
Vertical and up	25	23.3	93.2
Horizontal	25	22.5	90.0
Vertical and down	25	23.3	93.2

2. An 11-hp., 2-cycle, heavy-duty power-saw engine properly maintained with spark arrester attached was operated continuously for 8 hours under load comparable to field use. The engine speed was increased suddenly at frequent intervals and observation made on quantity, size, and distance sparks were emitted from the engine. The results were as follows:

a. The sudden increase in speed of the engine produced a flurry of light candescent sparks that glowed for a fraction of a second. Most of them were out before reaching the table. A very few of the heavier ones extended a distance of 3 to 4 feet from the engine and were still red when they reached the table but only long enough to be observed.

b. No carbon was trapped in the arrester.

c. The louver separator inside the arrester was hot enough to produce a red glow. The heat did not warp or otherwise damage the spark arrester.

d. The heat coming through the arrester ignited a rag held 1 inch from the exhaust.

e. Drops of gasoline placed on the spark arrester did not ignite.

Following this test, the engine was run with the regular muffler installed and with it removed. The engine was speeded up and then slowed down in an effort to produce sparks. It was observed that the largest number of candescent sparks occurred when the engine operated without a muffler or spark arrester, and no difference occurred in the quantity and size of candescent sparks emitted with the engine operating with a muffler or a spark arrester attached.

Engine backfiring is listed as one of the principal causes of power-saw fires. Several forests reported such fires; in some cases, the backfire ignited spilled gasoline. During laboratory tests attempts were made to cause backfires by alternately speeding up and slowing the engine. Only one or two relatively minor backfires resulted. A backfire seems most likely to occur when the engine is first started, or just before it comes to a dead stop.

Carbonization does occur in power saws. Mechanics for the distributors of three different makes of saws showed mufflers with their ports nearly closed by caked carbon to one of the co-authors.

CONCLUSIONS

1. Power-saw mufflers are not adequate spark arresters.

2. The one spark arrester tested satisfactorily passed the "dry run" efficiency test. The superiority of the spark arrester over the muffler appeared minor when tested on an operating engine.

3. Spark arresters or mufflers will not prevent fires caused by hot exhaust, backfires, or heat from the arrester or muffler in contact with flammable material.

4. Engines which exhaust against a log, or downward onto forest fuels, are more of a hazard than engines which exhaust in other directions.

5. Fire-setting potentialities are inherent in the operation of all makes of power saws.

6. Good maintenance, clean exhaust ports, proper grade of oil, and proper oil and gasoline mixture decreases the fire-setting potentialities of power saws.

7. The amount of carbon, of a size that will start fires, emitted from a properly maintained power-saw engine of the type tested was negligible. The presence of caked carbon in the exhaust port could be hazardous.

8. Some makes of saws are more subject to gasoline leaks than others.

9. Power bucking saws are more of a fire hazard than falling saws principally because of the more hazardous fuel in which they are working and the position of the saw when operating.

10. Based upon the limited statistics available, the authors rate the probable specific cause of any ten power-saw fires as follows:

Exhaust heat coming in contact with flammable material	3
Hot muffler, or arrester, or tail pipe contacting flammable material	3
Backfiring of engine	2
Candescent carbon sparks	1
Miscellaneous, including friction of the chain, short in ignition systems, etc.	1

The information obtained from this study led Region 6 to establish the policy that a spark arrester or a muffler will be required on all power-saws operating on national-forest lands.

SUGGESTED PREVENTIVE MEASURES

A prevention program directed toward reducing the number of power-saw fires suggests three avenues of approach:

Manufacturers.—Continue efforts with the manufacturers to encourage them to work on design changes which will:

1. Eliminate gasoline leaks.
2. Provide muffler insulation so that flammable material cannot come in direct contact with the muffler. In many of the makes of saws this would not be difficult to do. A cylinder of lightweight material, properly vented, around the muffler should provide this safety feature.
3. Change the exhaust so that it will be directed away from log being cut or the fuels on the ground.

Power-saw operators.—Power-saw operators can do much to prevent power-saw fires as follows:

1. After filling tank, move saw before starting. Fill tank on bare ground, if practical.
2. Do not wait for the engine to run out of gasoline before filling the tank. If the engine stops while the saw is in the tree, it is usually difficult to remove as it is frequently hemmed in by wedges. If the tank is filled in place and gasoline is spilled, the combination of sawdust, gasoline, and frequently oil is a hazard which may cause a fire and loss of the saw if an engine backfire should occur when the saw is started again.

3. Use the grade of oil and the oil and gasoline mixture recommended by the manufacturer of the saw. This will minimize formation of carbon.
4. Keep engine clean of sawdust and flammable material.
5. Keep muffler or spark arrester on the saw and in good condition.
6. Keep spark plugs and connections tight.
7. Clear flammable material from in front of the exhaust discharge—such as moss on log being bucked.
8. Keep fire extinguisher or shovel at hand at all times.

Forest officers.—Forest officers can best aid the prevention effort by carrying on a positive educational program to acquaint all concerned with the fire-setting potentialities of power saws by:

1. Informal discussions in the field with power-saw operators.
2. Informal presentation of known facts to the bull bucks, woods superintendents, and managers.
3. Wide distribution to all forest personnel of the facts brought out in this and other studies.

Fire Control Notes Distribution and the 1951 Questionnaire

The revision of the mailing lists for Fire Control Notes has given us an opportunity to analyze its distribution to recipients other than U. S. Forest Service officers. The total number of names is 460, separated as follows: U. S. Department of Agriculture, 22; U. S. Department of the Interior (mostly Indian Service, Bureau of Land Management, and National Park Service), 117; other Federal agencies, 33; State agencies (mostly State and extension foresters), 85; schools and libraries, 98; organizations and private companies and individuals, 67; Canadian government units, schools, libraries, and organizations, 37; Mexico, 1. In addition to these, there are 71 names on the foreign mailing list, and the Government Printing Office supplies 450 copies to 311 addresses on a paid subscription list and 275 copies to its list of depository libraries.

Of the 544 questionnaires sent out 456 were returned. The types of article found most interesting and useful were indicated on 118 questionnaires. The selections, as some replies pointed out, were determined by official responsibilities and personal interests. More than half noted equipment development and use as of primary interest, and more than a third selected methods, techniques, and planning in fire control. Some of the other types of articles of interest dealt with weather, safety, training, prevention and presuppression activities, fire research, fire behavior, distribution and causes of fires, case histories of specific fires and their analysis, and grassland fire problems and their solution. One type of article mentioned, and its value will be recognized by everyone, was that presenting ideas which could be put to use by fire control men in the field without elaborate plans or considerable expense.

Some 97 respondents found the bibliography of fire control literature helpful enough to say so. On the other hand, 19 said no or that they didn't use it.

Several suggestions for improvement were made, such as more coverage of the problems of private companies and how they have been solved; new ideas and methods of prevention, what produces results, and why; additional articles on fire-weather relationships, replanting brush land, fire and reseeding, wildlife destruction, and controlled or prescribed burning; and more short items.

To the question on suggestions for improvement 80 made brief comment, and 39 added other remarks. Most of these, to our gratification, were very complimentary. However, to maintain Fire Control Notes at a high degree of usefulness will require the active participation of many individuals directly and indirectly concerned with fire problems.—W. P. Everard and E. A. Hanson, *Washington Office Division of Information and Education, U. S. Forest Service.*

FIRE EXTINGUISHERS FOR USE WITH POWER SAWS

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A rather wide difference of opinion exists among field men as to the efficiency of various kinds of fire extinguishers for use with power saws. This article briefs the results of an informal study on the subject, retaining the key points of difference.

In selecting a fire extinguisher for use with power saws, one must consider the size of the extinguisher and the type of fire to be encountered. An extinguisher carried by fallers and buckers should be small, not over one quart in size. Buckers and, to a lesser extent, fallers work in flammable flash fuels. The types of fires they may encounter involve gasoline, forest fuels, or both gasoline and forest fuels. Only one type of fire extinguisher will effectively handle all three of these fires—a foam extinguisher. The smallest foam extinguisher is the 2½-gallon size, obviously too large to be considered.

In testing extinguishers, we tried to simulate actual field conditions. An old pump was used to represent the power-saw engine. The pump was placed on a layer of dry grass in one test and on shredded paper in still another test. A half pint of Diesel oil was poured over the pump and the ground fuel. Results were as follows:

Dry chemical is one of the most effective extinguishing agents on the market for gasoline and electrical fires, but it is of little value for fires in forest fuels. Dry chemical extinguishes by smothering, and, in order to get this effect, the chemical must be expelled and diffused in a cloud under high pressure, usually by CO_2 or nitrogen gas. Sprinkling the chemical on the fire will not do the job, and the pressurized extinguisher is too heavy to be considered.

Carbon tetrachloride, one quart (hereafter referred to as CTC). CTC is a vaporizing liquid. The speed of vaporizing is in relation to the heat of the fire. CTC is designed for use on gasoline and electrical fires and, like dry chemical, is of little value on surface fires of any depth. In the tests it was possible to get the fire out on the pump by walking around it, all the while working the CTC extinguisher. The fire in the grass and paper was not extinguished; it was checked for a moment and then took off again.

Small chloro-bromo-methane (or CBM) extinguisher. There are at least two makes of this new type extinguisher on the market. They are small, about the size of a two-cell flashlight, and contain not less than 8 ounces of CBM by weight. In tests, this extinguisher did a fair job on gasoline fires but not comparable to the one-quart CTC, principally because of the small amount of fluid. It was ineffective on the surface fuel. In a power-saw fire, where gasoline is involved, fire is apt to be on all sides of the engine. The fire on one side can be extinguished, but as you move to the other side, the fire flashes back again—and somewhere in this process you run out of fluid.

The CTC used in the small CBM extinguisher seemed just as effective as CBM. There is a point of interest here—the manufacturers of vaporizing-liquid extinguishers (with two exceptions) have desired reach or projection in their extinguishers. They have, therefore, concentrated on a straight stream. In the small CBM extinguishers the discharge pattern is a spray. This pattern, while limiting the reach, would seem to bring about quicker vaporizing, which may account for the seemingly superior effectiveness of CBM over CTC. However, as stated, this superiority was not noticeable to the writer when CTC was used in the same extinguisher.

In another test ordinary water used in the small CBM extinguisher did a better job of extinguishing the surface fire than either CTC or CBM.

Advantages of the small CBM extinguisher are: Initial cost is cheap; they can be refilled in company shop or on the ground (one type only—other type is traded in for a full one); they are effective as a "first aid" extinguisher on a *small* gasoline fire.

The disadvantages are: They do not have enough fluid to handle any but a *small* gasoline fire. They are of very limited value on a fire involving forest fuels. Being CO_2 pressured, they cannot be used in a position much above the horizontal, because the gas will escape while the fluid remains in the bottle. Unless a cap is carried over the valve or the carrying bracket is used, it is possible for the valve to be slightly "cracked" and the extinguisher lose its pressure without this fact being known.

Since neither the CTC nor the CBM extinguisher is very effective on forest fuels, and since a rather high percentage of fires start in this material, a shovel might well provide the best protection. A shovel can be used to throw dirt to smother a gasoline fire and to dig a line to control a ground fire. It can also be used to clear flammable material from in front of the engine exhaust, and at times to prepare better footing for saw operators.

On one west-side operation visited last summer, the writer was told by the fallers that the first job, when moving into a new stand of timber, was to buck out the windfalls. When this was being done, the fallers carried a shovel to dig out under the log so as to protect the saw. If the fallers can carry a shovel to aid them in their work, it would seem logical that they could carry one for fire protection. The buckers, working alone, would have a more legitimate "beef" against carrying a shovel.

Some forest officers in the field stated the small CBM extinguishers were effective for putting out power-saw fires; others, that they were of little value. This is understandable since the effectiveness of the extinguisher would vary with the intensity of the fire and the type of fuel in which it was burning.

One report stated, ". . . had about five power-saw fires, all small. All were extinguished with the . . . (small CBM) extinguisher. The largest of these required about four extinguishers to put the fire out." Four extinguishers will not usually be available to work on one fire. Several others felt that "there is not sufficient volume in the container to put out a fire of any size." Still others suggested the shovel in place of an extinguisher.

The choice, then, would seem to be among the following: Small CBM extinguisher, with CBM or CTC fluid; one-quart CTC extinguisher; shovel; shovel *and* one or the other of the extinguishers.

All things considered, the following policy is being put in effect by Region 6 until information is received that indicates the desirability of a change:

"Gasoline power saws will be equipped with a *chemical-pressurized* fire extinguisher of not less than 8 *ounces* capacity, by weight. A *shovel* may be substituted for the extinguisher when in the judgment of the district ranger it will be equally as effective in putting out fires."

CARRYING CASE FOR SF HANDI-TALKIE

Francis W. Woods

Communications Officer, Region 4, U. S. Forest Service

Boyd Leonard, Staff Fire Control Assistant, and Carl Gaver, Assistant Ranger of the Salmon National Forest, have developed a very satisfactory case for the protection and transportation of the SF handi-talkie. Considering the initial cost, difficulty of repair, and awkwardness of carrying the handi-talkie, these men have devised this case along practical lines. The case adequately protects the handi-talkie, yet the radio can be carried easily and used without removing it from the case (fig. 1).

The case is constructed of very pliable leather (the first ones in R-4 were of elk and deer skins) and is lined with ¼-inch sponge rubber glued in place. The zipper permits the instrument to be readily put in or taken out of the case. The pocket on the back of the case provides space for one extra set of batteries. Back-pack straps permit the unit to be carried on a person's back in hiking or in rough climbing. The case itself, with an extra set of batteries, weighs 3 pounds 12 ounces.

The men using the unit appreciate the convenience and real time saving of not having to take the instrument from the case and find no difficulty in operating the transmitter. This is the way the unit is usually handled. Such a procedure is also a safeguard against laying the case down and losing it as so often happens when units must be removed from a case to be operated.

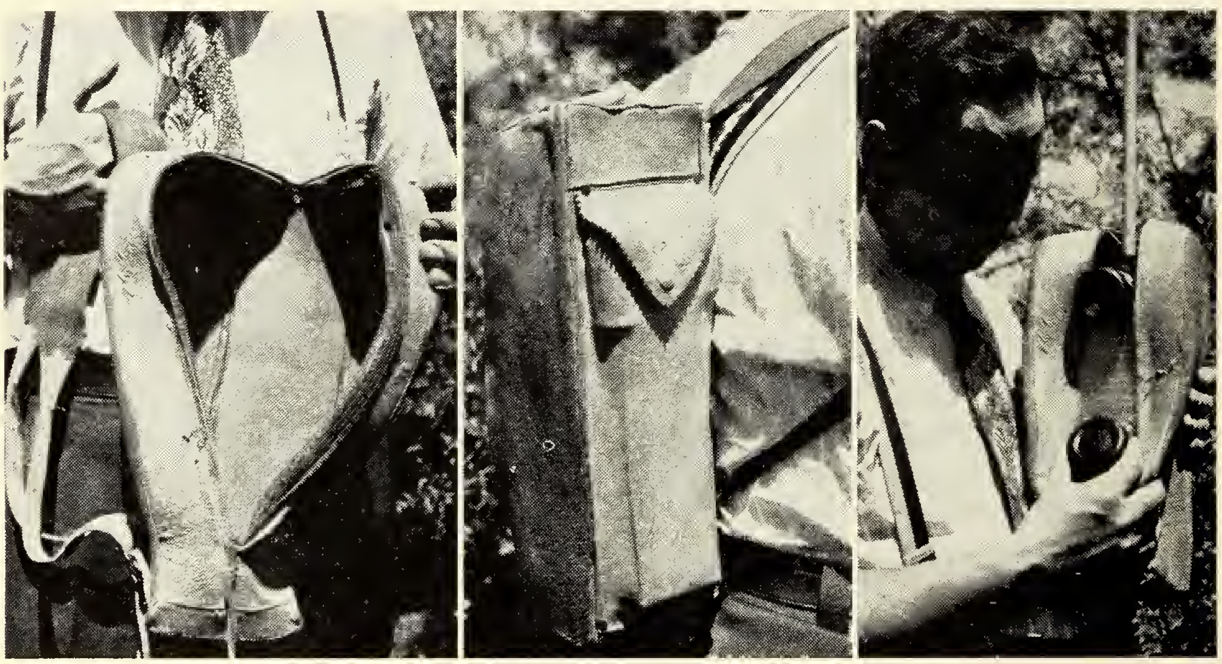

Figure 1.—Carrying case for handi-talkie is constructed of pliable leather lined with rubber and has back-pack straps for carrying. Radio can be used without removing it from case.

The first cases were constructed at a cost of $17.50 each. They have given excellent protection on the fire line and in storage and have proved adequate for shipping when properly tagged. During 1951 the cases with units inside have been accepted for commercial express and air shipment.

TESTING OUTFIT FOR UNLINED LINEN HOSE

L. E. Noel

Procurement Officer, Region 1, U. S. Forest Service

A unit for testing 1½-inch unlined linen fire hose returned from the field to the central fire cache has been developed at the Forest Service Warehouse in Spokane, Wash. This unit has been in operation now for over 2 years and has proved very satisfactory as well as saving a substantial amount of money. Prior to 1948, the testing of hose was contracted to commercial firms on the basis of low bid. The lowest bid received in 1948 was $2.65 per hundred feet. Net cost with the Forest Service unit has been $0.81 per hundred feet, and covers cleaning, testing, rerolling, and placing in storage. Total cost of the hose testing unit was $282 plus some salvage material.

The equipment and material necessary to set up the testing unit are as follows:

1 Water pump (same as used on Pacific Marine Type Y pumper).
1 Motor, electric, 3 hp., 1750 r.p.m.
1 Pressure manifold (4-inch pipe 48 inches long with plates welded over ends, and angle-iron legs approximately 32 inches high; eight 1½-inch pipe nipples welded to the pressure chamber, six on one side, approximately 8 inches apart, and two on the opposite side approximately 24 inches apart).
8 Gate valves, 1½-inch.
3 Pressure relief check valves, 1½-inch.
1 Pressure gauge (two gauges, of the same type, are preferred in order to maintain a continuous check on gauge accuracy).
1 Pressure relief valve, set to release at desired test pressure, and with ¾-inch pipe for returning overflow to water tank.
5 Table sections, each approximately 4 by 10 feet, with 4-inch sides, metal-lined, and equipped with saw-horse type legs.
1 Water tank, open top, approximately 24 by 60 inches, 24 inches deep.
3 Pieces suction hose, 1½-inch, each 8 feet long.

The one or two pressure gauges and the pressure relief valve, set to release at the desired test pressure, are mounted on the top of the test manifold, and the gate valves and pressure relief check valves are attached as shown in figure 1.

To set up unit for operation, line up table sections to form a drain trough approximately 4 feet wide by 50 feet long, with gradual slope toward water tank, which is at the lower end of the table in a position that will allow all water to return to it. Place the pressure chamber on the opposite side with the six gate valves extending over the tank far enough to allow them to drain into the tank. The end of the suction hose from the pump intake is placed in the water tank to supply the water used in testing the hose.

One section of suction hose supplies water from the pump through a gate valve to the pressure manifold. On the same side, the other gate valve with suction hose attached is used to return the water to the tank when actual testing is not in progress. This valve serves as a bypass and eliminates shutting off the motor while changing hose.

After the hose has been tested, it is drawn through a power wringer (fig. 2) located at the upper end of the testing table, and rolled on a reel located approximately 4 feet beyond the power wringer. Any reel of

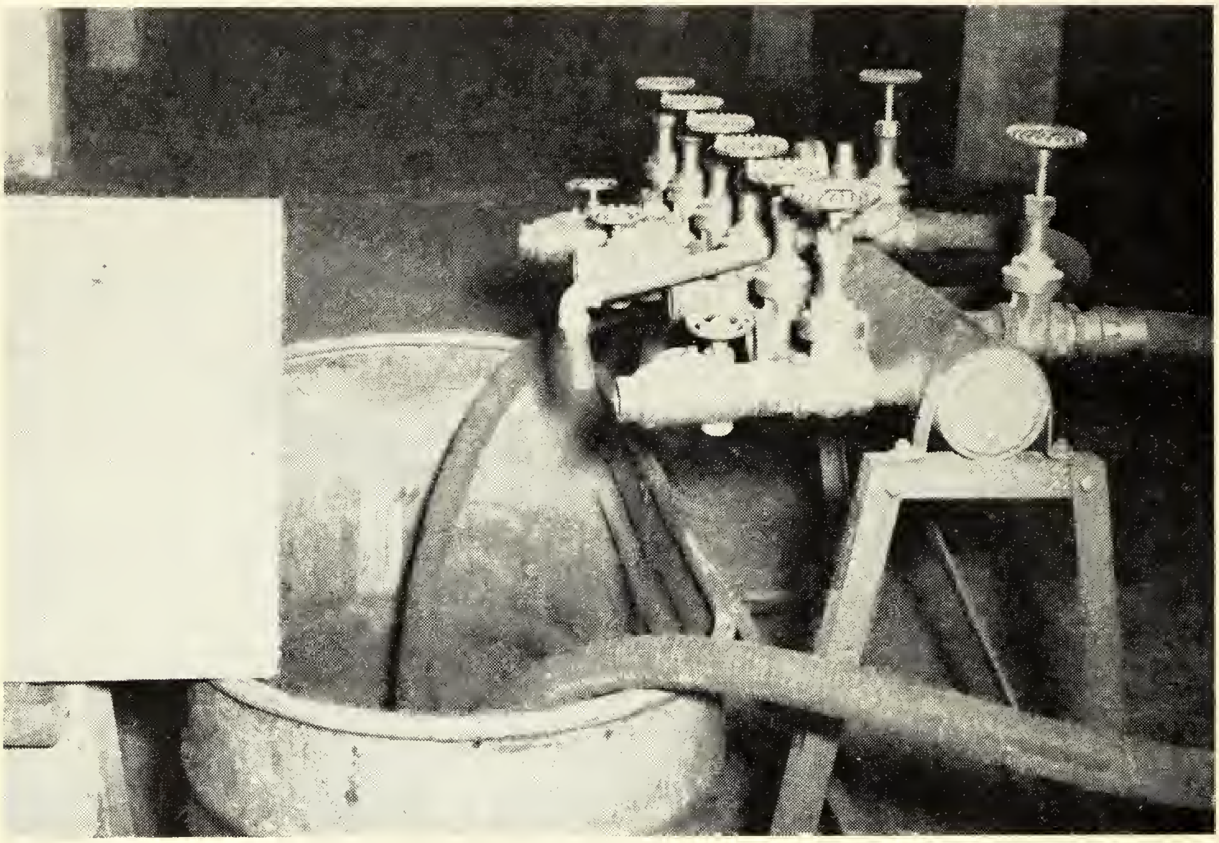

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FIGURE 1.—Pressure manifold of hose testing unit and its relation to water tank and table sections.

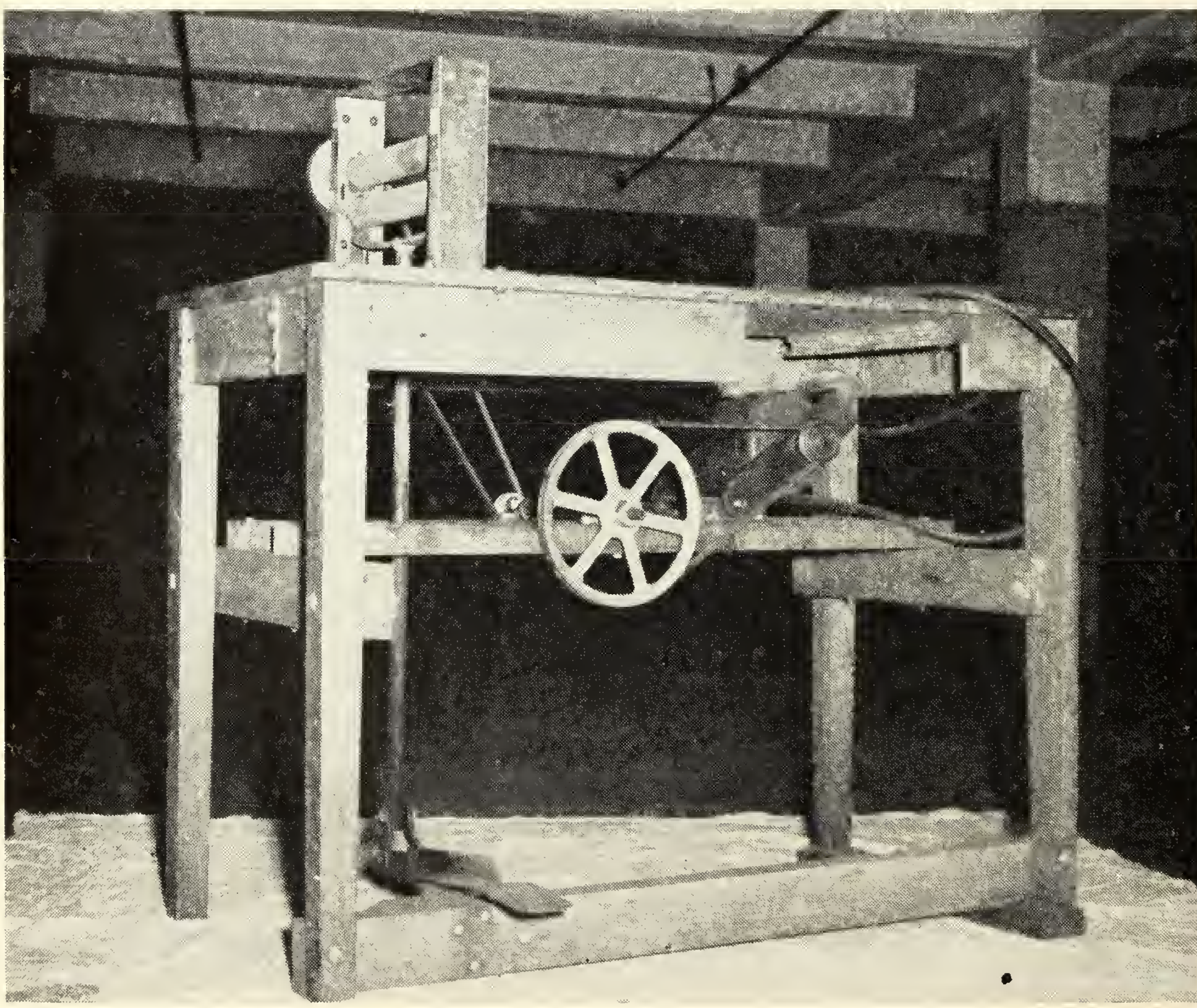

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FIGURE 2.—Power wringer which is part of hose testing outfit.

simple construction will suffice for rolling the hose. A very satisfactory type of reel was shown on page 31 of the October 1949 issue of Fire Control Notes. The hose can then be dried, bundled, and stored. It is not necessary to dry hose that has been properly treated to prevent mildew. Hose that has failed under test or has otherwise been found unsatisfactory is, of course, set aside for disposal.

Forest Service Continues Study of Power-Saw Fires

Early in 1950 the Forest Service initiated, in cooperation with State and private foresters, a study of forest fires caused by the operation of power saws. The initial phase of the study involves the compilation and analysis of information obtained from special reports on individual power-saw fires. Results of a preliminary analysis of information submitted for 1945-49 show Region 5 leading all others in number of fires as follows:

	Number of power-saw fires		
	National forests	*State protection area*	*Total*
Region:			
5	18	18	36
7	1	10	11
6	9	..	9
8	3	2	5
9	..	2	2
3	2	..	2
Total	33	32	65

Although there could be some difference in interpretation of causes, in general they line up as follows:

	Number of power-saw fires		
	National forests	*State protection area*	*Total*
Causes:			
Exhaust flame and backfire	16	7	23
Unknown	6	12	18
Spilled or leaked gasoline	7	5	12
Sawdust or forest fuel against hot muffler	3	3	6
Spark from saw chain	..	5	5
Short circuit on electric saw	1	..	1

The data were insufficient to give the number of fires by make and model of power saws.

The distribution of fires makes it obvious that the power-saw fire problem is Nation-wide. We are unable to estimate the number of power-saw fires that were unreported, but figures for 1950 and 1951 now being collected should be more complete. With full reporting on a Nation-wide basis we hope to be able to pinpoint the fire causing characteristics of power-saw designs, operating techniques, and other factors included in this problem.—DIVISION OF FIRE CONTROL, *Washington Office, U. S. Forest Service.*

FIRE CONTROL AND COOPERATION ON THE PEDLAR RANGER DISTRICT

B. A. Eger

District Ranger, George Washington National Forest

Although this article is confined to the Pedlar Ranger District the cooperation covered is similar to that which exists on all districts of the George Washington National Forest in Virginia.

For more than a decade a cooperative wildlife agreement has existed between the U. S. Forest Service and the Virginia Commission of Game and Inland Fisheries for the mutual management of game and fish activities on the Virginia National Forests. Mostly it has to do with environmental development and improvement for game cover, food, and protection. The work is paid for out of State funds obtained from the dollar stamp required by the State to hunt or fish on national-forest land, matched with Pittman-Robertson Federal funds prescribed by law. The work is planned and carried on by wildlife game managers and their laborers under the joint supervision of Virginia State game technicians and the national-forest district rangers, plus guidance from the Game Commission's staff and the forest supervisor's staff.

These wildlife project crews average a game manager and two laborers. Each ranger district has two or more of these crews. In addition, the State has a county game warden in each county and he in turn may have one or more deputies. To supplement the work of these men there are a number of State "roving" game and fish law enforcement officers.

Since there are three or four counties within the Pedlar Ranger District the Pittman-Robertson workers plus the State game law enforcement men make a sizeable and important part of the ranger's fire control organization. Most of the county game wardens are also appointed State forest fire wardens. Nearly all of them now have FM radios in their cars that hook up with their county sheriff's office and his police officers' cars. The sheriff's office ties into the Virginia State Police network by radio or teletype. The ranger's wildlife crews carry portable radios that can communicate with the national-forest fire towers and so in to the fire control dispatcher at the ranger's office.

All of this by prearranged cooperation and planning gives an efficient network of men over the ranger district for the dissemination of prevention education; enforcement of the State brush burning and forest fire laws; detecting, reporting, and investigating smokes; and in the case of larger fires and emergencies, taking part in the suppression and augmenting the communication system on and around the fire. The wildlife project crews carry a complement of fire suppression equipment and tools and have a definite part and responsibility in the ranger's fire control organization. All of these men are important in carrying fire prevention to hunters and fishermen when they are afield during the open season, which is usually at the time of high fire hazard.

Another cordial and cooperative situation also exists between the Virginia State Forest Service and the U. S. Forest Service. The areas of State and Federal responsibility in and around the ranger district are definitely agreed upon and shown on maps. However, the officers of both agencies work hand in hand in detecting, reporting and suppressing fires. The nearest and most available organized wardens and crews are dispatched to a fire and both agencies cooperate in suppression. If a fire is confined to the State area the State pays for suppression and makes its own report on the fire. If the fire is on the national-forest protective area or goes from State area to national forest, the George Washington pays for the suppression and makes the 929 report.

Most of the State county fire wardens have a pickup with pump, hose, and suppression tools. They also have radios that tie in with the sheriffs' offices and with each other. When necessary all of these facilities are pooled with the national-forest facilities for prevention, law enforcement, detection, and suppression. Many of the Virginia counties now have a county fire truck of the city type authorized and purchased by the County Board of Supervisors. While these fire trucks are primarily for burning buildings they go on call to all grass and woods fires that can be reached and they frequently suppress fires in their incipient stages. Some of these trucks are equipped with radio.

For its own organization the Pedlar District has a widespread system of national-forest wardens, about 30 crews with a mobilizing potential of 250 men. School boys in nearby high schools are organized and trained jointly by State and Federal forest officers. The colleges and military institutions adjacent to the district cooperate by furnishing manpower that is organized and trained by the district ranger. These forces are available to the State district foresters if needed. The fire departments of the towns and cities adjacent to the ranger district have organized and trained forest fire suppression crews and have frequently suppressed or assisted in suppressing fires in the fields and woods near their municipal boundaries.

Thus, the State Game and Fish Commission, the Virginia Forest Service, County Supervisors, State educational institutions, municipal agencies, and local citizens together with the U. S. Forest Service cooperate to organize and equip a fire control force to protect all woodlands and forests within their respective spheres of activity. As a result, the yearly average of fires is going down and the average area per fire is decreasing. Besides, such a coverage of equipment and men in the field has a salutary effect on potential risks. The National forest fire prevention campaign with State cooperation, press releases, and radio broadcasts has helped considerably in making the public more fire prevention conscious.

"PROTECTION TYPE" BASE MAP AND VISIBLE CARD DISPATCHING SYSTEM FOR FAST FIRE ACTION

Rivers R. Elliott

Assistant Supervisor, Area 8, Minnesota Forest Service

Since the beginning of forest fire control work the need for taking fast action has been prominently recognized. Swift action, as effective as possible with the equipment and personnel available, goes a long way toward favorable control action as a whole. Having the proper suppression force at the right location is equally important. The cooperative fire control and dispatching system here described and now in use in this area has been developed with these factors in mind.

The cooperative fire control organization is planned and projected by township subdivisions within the area and the various ranger districts. Township fire wardens, appointed jointly by the townships and the Division of Forestry, make up a majority of the cooperative personnel and, as a rule, are the keymen in getting direct cooperative fire action under way.

Keymen, other than township fire wardens, are appointed as special fire wardens in locations where cooperative personnel are desirable but not available through normal channels. Special fire wardens are quite often small-town businessmen or employees of industries, railroads, construction or logging companies. In all, 160 cooperating individuals are located in this forest protection area of 85 townships totaling 1,958,400 acres.

It is apparent that such an organization must necessarily be made up, for the most part, of untrained and semitrained people living in the territory to be served, and that certain understandable weaknesses may develop from time to time. In the operation of this dispatching system these probable weaknesses have been carefully considered and it is thought that selecting and dispatching alternate personnel will overcome certain obvious deficiencies such as current unavailability and emergency activities other than fire work.

The fire control and dispatching plan now in use in this area requires two basic units: the base map and the dispatching panel or board (fig. 1).

The base map is the standard ½-inch-per-mile type showing in considerable detail the roads, trails, and physical features of the area as well as the tower triangulation system. The headquarters map includes the entire territory under area fire control administration as well as boundary townships surrounding the area. Ranger district maps cover district units and boundary townships in adjoining districts and areas.

In addition to the standard map features listed this base map carries much of the special information upon which this fire control system functions. On it are shown the locations of the various cooperators. On it are also shown the three fire protection types now being used. These are symbolized on the map by the colors red, yellow, and white. Each color represents a distinct class of fire protection territory determined after combining and weighing all factors entering into the calculation of control probabilities for that particular type. These protection types have been determined by a detailed field survey and study covering the entire protection area.

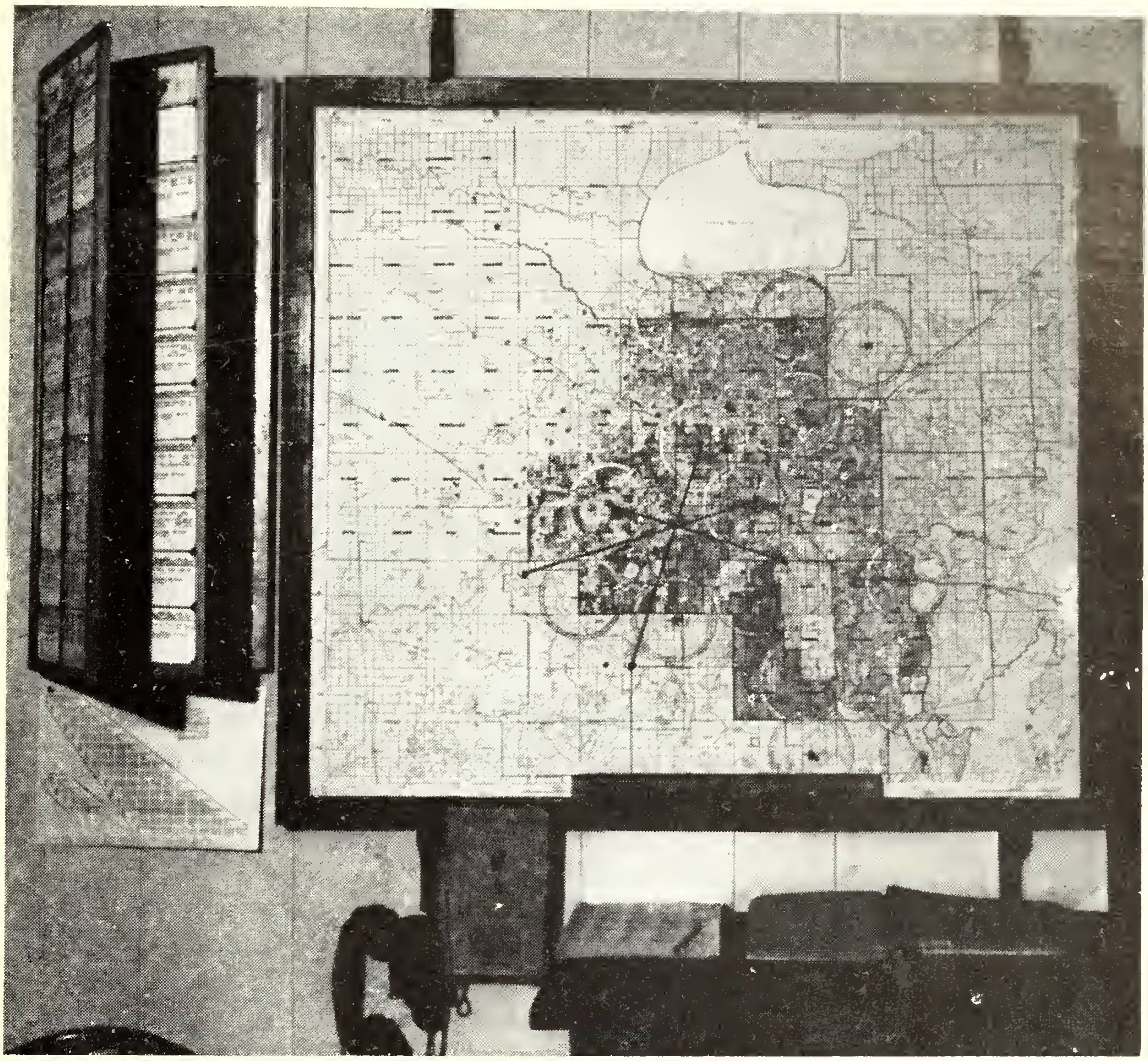

FIGURE 1.—The complete base map and dispatching arrangement. All items are within easy reach.

Red indicates the areas where little or no settlement is present. The lands in this type are largely undeveloped, with few, if any, roads and little or no communication systems. The intermediate protection type is shown in yellow and includes areas of partially developed lands with scattered settlement and with some roads and limited communications. The white color indicates well developed agricultural lands with farm woodlots, good roads, and well established communication systems.

One of the fundamental values of the plan is its use as a guide in effective cooperative dispatching and control work in all three types.

The red type requires that immediate action be taken by a fully equipped suppression force of sufficient size to carry out complete anticipated control on the fire. The location of the fire in this type at once informs the dispatcher that no additional information will be forthcoming from the immediate vicinity of the fire prior to the arrival of the crew. Consequently, planning for complete control must be done at the outset. Dispatching procedure in this type is always direct and forceful. Cooperating personnel within an effective radius of the fire generally are used to supplement forestry overhead on the fire line.

The yellow type demands no less swift action than the red but the initial action may take a somewhat different course. Knowledge of the fire location, terrain, and fuel types, together with known location and availability of local cooperators, sources of manpower and equipment, prevailing and anticipated weather conditions, as well as information obtained by telephone or relay, may convince the dispatcher that the initial attack can be successfully carried out without committing any appreciable amount of forest service equipment or overhead. Frequent progress reports from the fire line will keep him sufficiently informed to make any necessary alterations.

For the white type a different fire control action may be found desirable. However, the action is just as swift as in either of the two other categories. Action is begun immediately after receiving the report of a fire in this protection type. The extensive communication network in this type permits the dispatcher to check the exact location of the fire, determine its size, find out who, if anyone, is in attendance, the probability of the fire becoming uncontrollable, the location of the necessary labor and equipment supply, and the probable danger to farm, forest, or other property. The cooperator with whom the dispatcher first talks, usually being a resident of the community, will have sufficiently accurate information concerning the fire's probability as to enable the dispatcher and the cooperator to immediately make a control plan that will be effective with a minimum time lapse and with minimum commitment of regular personnel.

Forestry personnel and equipment are, of course, dispatched at once in all cases where there is any doubt regarding the possible effectiveness of the cooperative organization.

On the base map flat-headed pins bearing an index number show the location of cooperative fire wardens and keymen. Each number corresponds with one on the dispatching panel where the index is arranged by townships in each ranger district. A number is left blank in each township for any possible addition to the cooperative personnel. In so doing it is possible to keep the numbers consecutive for each township and district.

Map numbers do not change except as to location within the township. When a cooperator is dropped from the roster and another appointed, the latest appointee is assigned the number vacated. The numbered pin is then moved to the proper location. If a new appointment is not made the pin is removed from the map.

The area dispatching board is made up of a series of swinging panels, 13 by 34 inches and hinged as a unit to a common wall base. Each panel contains the complete fire dispatching plan for one ranger district and each district unit is essentially complete in itself. Fire dispatching data for the headquarters district are shown on the first panel.

Together the panels comprise the complete area cooperative fire dispatching plan. Under this panel unit system the fire dispatching plan of any ranger district is immediately available to the headquarters staff for use in district dispatching or for reference to cooperative action that may be taken.

Each ranger district panel contains two rows of standard 3- by 5-inch cards showing the location of personnel and equipment (fig. 2). Gummed card holder corners keep them in position. Allowing one card for each township the panel provides for information covering twenty townships. These cards are arranged by columns beginning in the upper left-hand corner with the southeast township of each district. However, any arrange-

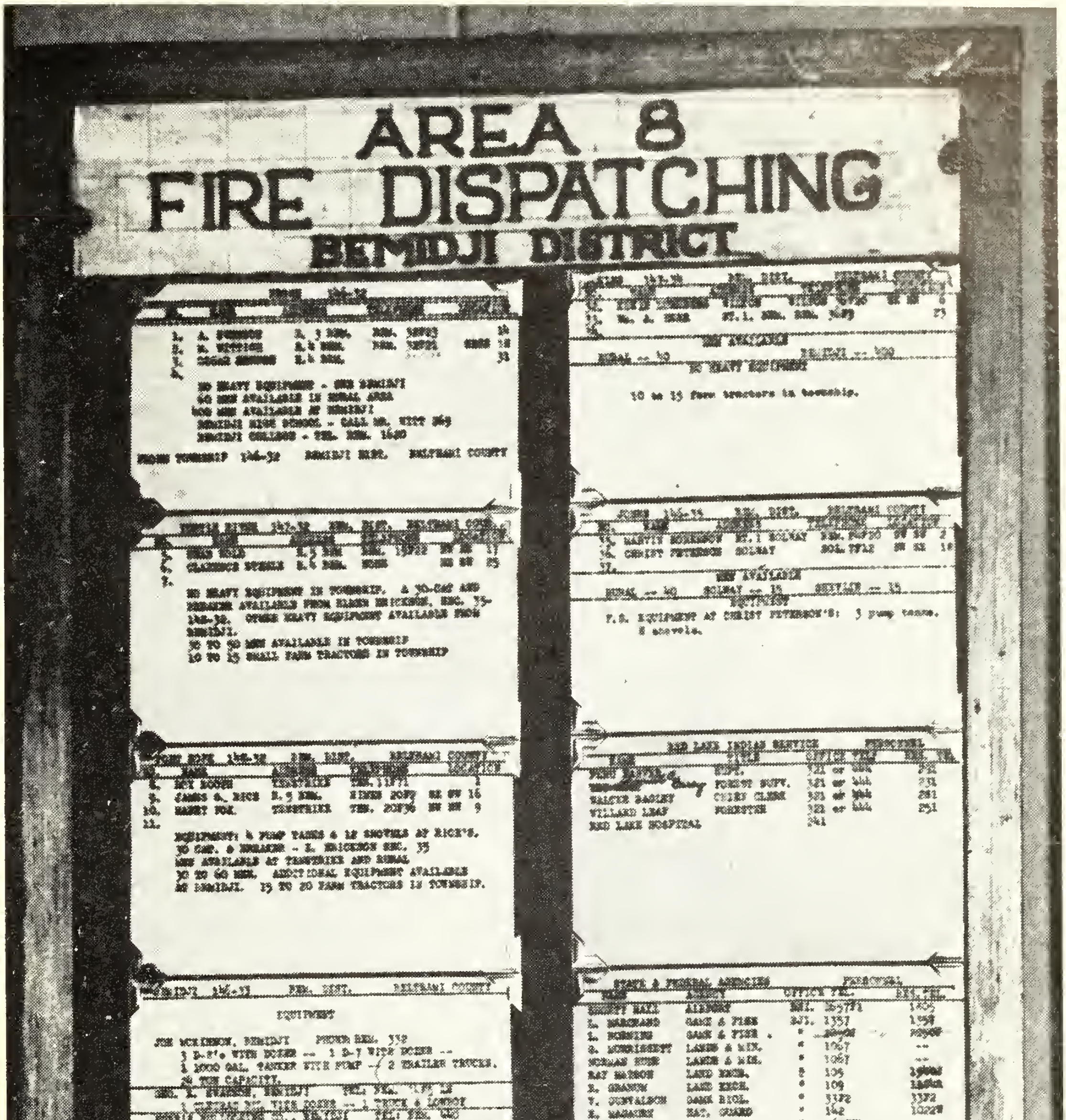

FIGURE 2.—A close-up of part of the first panel of the dispatching board showing arrangement of 3- by 5-inch cards in township sequence.

ment favored by the administrative control unit would work out satisfactorily.

Each card is designated at the top by the township name, township number, ranger district, and county. Cooperative personnel for the township are listed and each cooperator is assigned a number. The map pin with a corresponding number shows the correct location of the individual on the base map.

Each individual card entry shows name, address, telephone number, location of the cooperator and, if desired, the efficiency rating of the individual. Sources of fire fighting labor are shown directly below the personnel entries. Entries covering fire fighting manpower include city, county, and village sources as well as rural communities.

Equipment entries show location, size, and type of heavy and special equipment that may be obtainable for use on fires in the township or unit. A supplemental card showing heavy equipment location for the entire ranger district may be added if desirable.

It has been found that from ten to fifteen entries may be made on a standard 3- by 5-inch card without sacrificing either necessary information or completeness. In most cases a single card may easily carry all desired information pertaining to a township. However, the flexibility of the card arrangement permits additional cards to be inserted with no inconvenience and no interruption of township or unit sequence.

In townships having little or no personnel or equipment the card indicates that prevailing condition and refers the dispatcher to the first alternate location where desired equipment and manpower may be obtained. Special information may be indicated by special pins on the map and special numbers and entries on the dispatching panel.

In operation the complete system provides all basic fire dispatching information, literally at a glance. The entire ranger district fire control organization is spread out in front of the dispatcher, indexed and cataloged. The protection types are clearly indicated, the location of cooperative personnel is accurately shown, and equipment information is readily available. The immediate availability of these items of information, either singly or in combination, contribute greatly toward reaching the desired objective of speed and effectiveness in fire control.

Dispatching procedure, while triangulation reports are being received, is to determine, from the map, the protection type in which the fire is situated and the location of the nearest available cooperator. Reference to the dispatching panel at once gives the name and telephone number of the cooperator, the source of manpower and equipment, and any special information pertinent to the fire location. With this information at hand dispatching proceeds with a minimum of lost motion.

This dispatching and fire control plan has been gradually developed since 1942 when the first protection type base map was put into use by District Ranger C. A. Miller in the Schoolcraft District of this area. At that time it was used primarily as an aid in directing smokechasers and fire foremen in fire suppression work and as a guide for these temporary men in reaching logical conclusions on fire control work in the absence of supervisory forest service personnel.

Use of the complete plan for several seasons has brought about increased efficiency in cooperative fire action, which is, of course, reflected in the over-all area control work. The plan is primarily a first-action one, but one that merges smoothly and effectively into the larger scale planning necessary on fires that do reach major proportions. Consequently, there is little of a spectacular nature in this dispatching method. It does, however, add considerably to the stability of the area personnel resource and tends to eliminate some of the uncertainties of this type of fire control planning.

Experience has proved that this type of planning and dispatching does, in many instances, reduce that vital time period between discovery and first attack, and at the same time permits the application of all area control power with a maximum of efficiency.

Corrosion in Carbon Tetrachloride Type Fire Extinguisher

A large agency of the Federal Government has recently had trouble with corrosion in carbon tetrachloride type fire extinguishers. This is the one-quart type of extinguisher most commonly known as "Pyrene," although there are several brands of the same type of extinguisher.

Laboratory tests were made of the fluid which the agency was using. A thorough inspection was also made of an extinguisher which had corroded badly. The laboratory reported that the fluid was in accordance with Federal specifications and was as satisfactory as carbon tetrachloride can be for extinguisher use. There are, however, two types of carbon tetrachloride under Federal specifications: Type I, regular uncolored; and Type II, colored. The coloring agent in Type II becomes gummy over a period of time and clogs the mechanism of the extinguisher and accelerates corrosion. The only reason offered for coloring the fluid is to avoid unauthorized use by employees in cleaning clothes, etc. The colored fluid will leave a ring or spot on fabric. As extinguishers are often used in homes, offices, and automobiles where cloth upholstery could be spoiled by using Type II colored fluid, Federal Supply Service will now stock only the Type I uncolored carbon tetrachloride.

Tests of this type of fire extinguisher and the fluid used in charging it reveal that with all the precautions it is possible to take, a good deal of corrosive action still occurs. The main points are summarized as follows:

1. Carbon tetrachloride is a powerful hygroscopic—it absorbs and concentrates moisture from the air.
2. Upon absorption of moisture, the formation of hydrochloric acid, a strong corrosive, begins in the liquid.
3. If this occurs in a can of fluid, the can will usually show evidence, and fluid should not be used from such rusty or corroded cans. If the action occurs in an extinguisher, it will gradually corrode to an unusable condition.

To avoid these troublesome and expensive failures, observe the following:

1. See that fluid containers are in good condition, not rusty or corroded. This usually indicates that contents are good.
2. Never use a part of the fluid from a can and reclose the can. There will be enough moisture in the air space to cause trouble. If you try to save part of a container, you will be pouring some acid into your extinguisher when you use the fluid at a later date.
3. Likewise, never leave an extinguisher partially empty. The air space is just as troublesome as it is in a can. Always refill the extinguisher at once, or empty completely and shake out any remaining drops of the fluid.—[From a U. S. General Services Administration memorandum] REGION 4, *U. S. Forest Service.*

FIRE DISPATCHER'S MAP BOARD

Robert S. Dimmick
District Ranger, Shawnee National Forest

The prototype of the dispatcher's map board described here was first put into use on the Jonesboro District of the Shawnee National Forest about 1937. It was recently modified to include features not found in the earlier model which contained only the map with azimuth circles and magnet-secured strings.

The map board measures 4 by 6 feet and consists of a wood frame faced with ½-inch plywood the front of which is covered with 22-gage galvanized iron (fig. 1). Upon this are mounted matched U.S.G.S. maps of the district. At each tower location a 3/16-inch hole is drilled through the

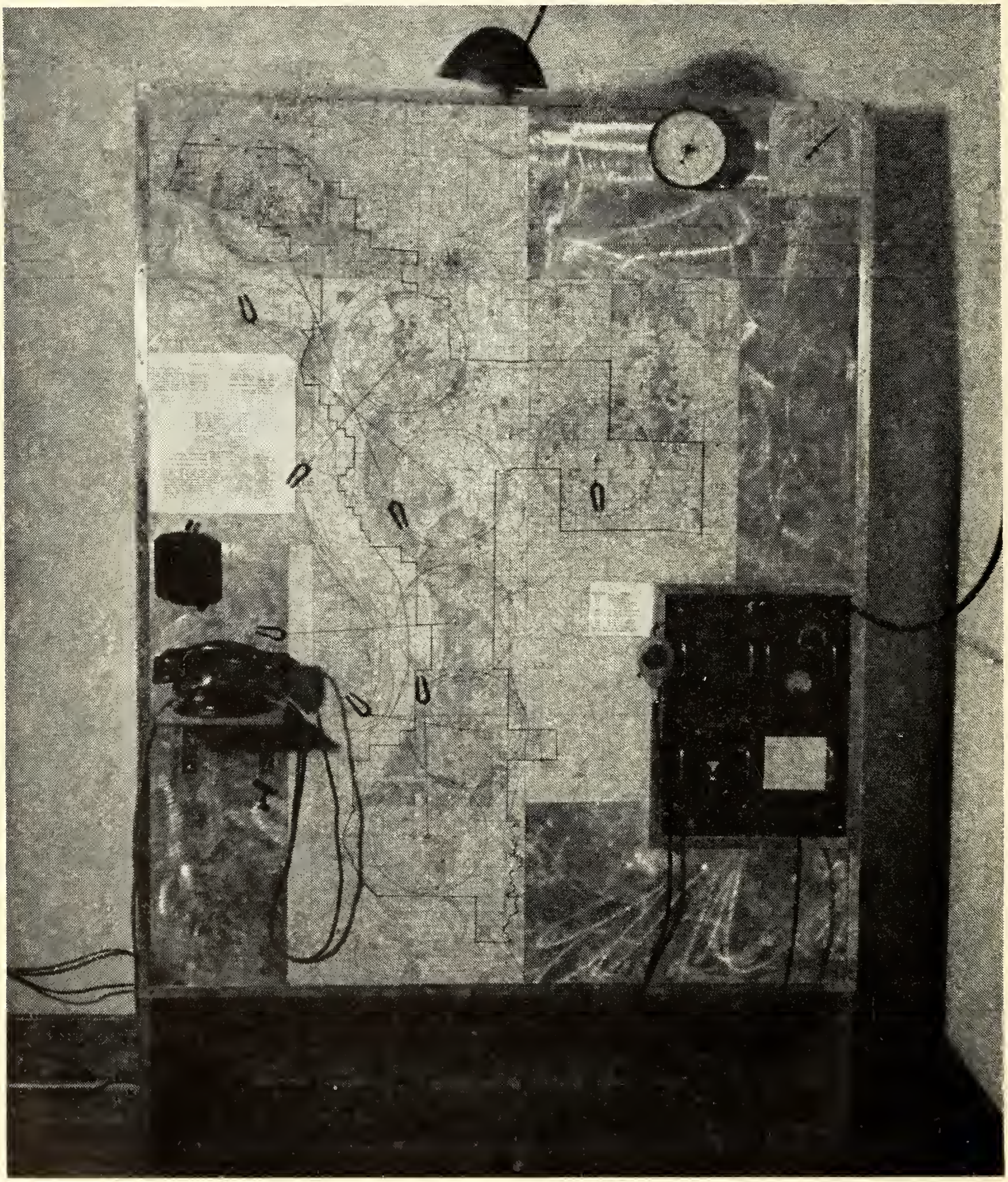

Figure 1.—Dispatcher's map board.

metal and plywood, and a metal grommet consisting of an ordinary screw-type binder post is inserted and secured. Azimuth readings are extended with 12-pound test, black nylon fishline held in place by small horseshoe magnets. The lines are retracted by metal weights. The weights should be less than the pull of the magnets, otherwise the magnets will not hold fast.

The map is attached to the metal surface with transfer varnish. Transparent 8-inch, "visitype" full-circle protractors are permanently affixed to the map at each tower location. The entire map surface is given two coats of varnish.

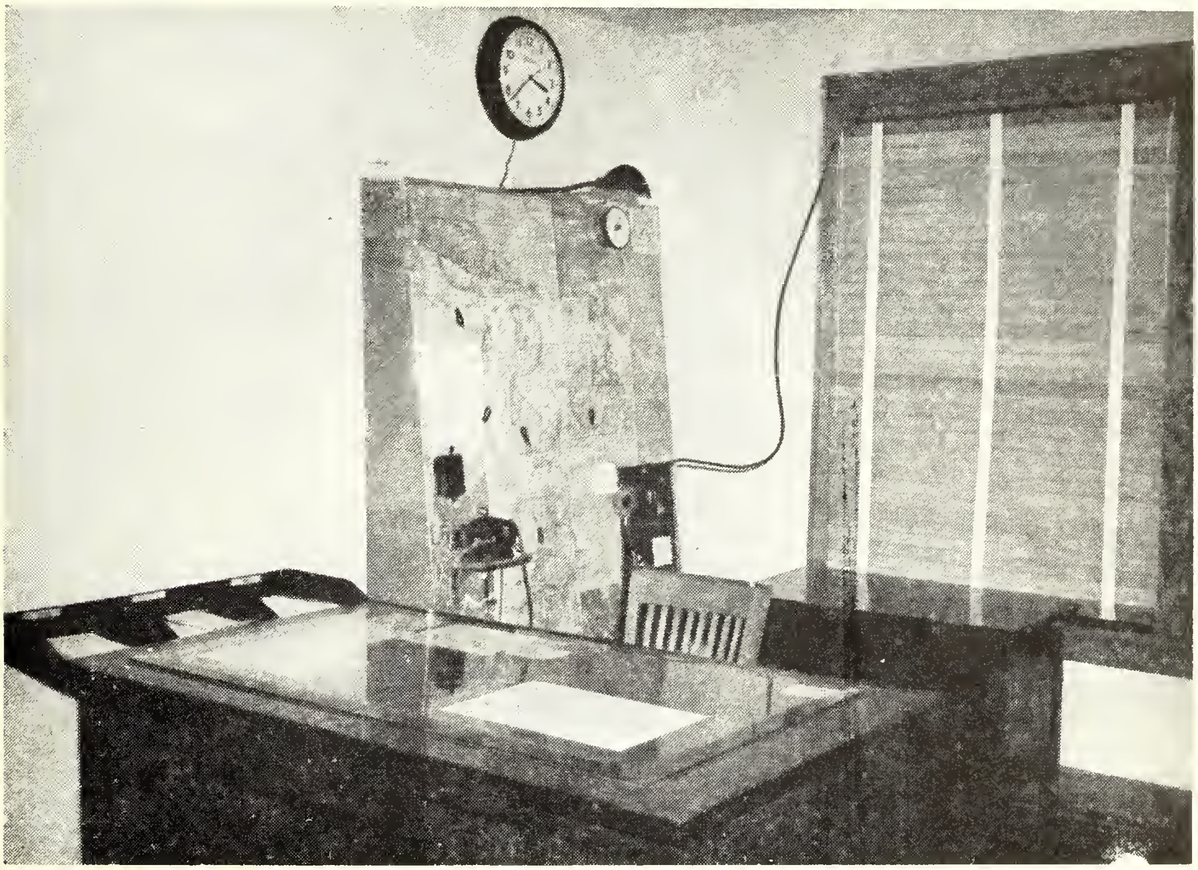

FIGURE 2.—Arrangement of dispatcher's work desk, map board, and accessory desk.

Various tools for dispatching have been installed in the map panel to provide both convenience and compactness. The anemometer buzzer, battery, and switch are located on the lower right side of the frame. Just above these and inserted in the panel is the radio. On the left and at the same height as the radio is the telephone, above which is a two-way key-type switch and a communication directory. The panel is lighted by a flexible-neck student lamp, with original base removed, mounted on the top of the frame. To the right of the lamp is a barometer.

The map board is located to the right of the clerk-dispatcher's work desk so that a 90-degree turn places the dispatcher in a convenient position from which to operate (fig. 2). Another 90-degree turn in the same direction places the dispatcher at a smaller desk upon which is kept the log and dispatching forms.

The arrangement has proved satisfactory at a station where the volume of fire dispatching is not great enough to justify a separate office. The panel not only provides convenience of operation to the clerk but also arouses considerable interest from the visiting public.

A PORTABLE VHF-FM RELAY ASSEMBLY FOR USE ON LARGE PROJECT FIRES

Francis W. Woods

Communications Officer, Region 4, U. S. Forest Service

Since the war, development of low-drain, dry-battery-powered, FM-VHF radio repeaters and their use in successfully extending the range of handi-talkie type field sets have exposed the need for a portable field repeater for use on large project fires. Several Forest Service regions have worked up satisfactory units. Mr. Woods' solution, as described below, employs a standard lookout repeater radio and battery combination that is commercially available and has proved quite satisfactory. In the near future we hope to have the Radio Laboratory study the portable repeater units of the various regions and by combining the best features of all come up with a suggested Forest Service standard for this type of service.—Washington Office, U. S. Forest Service.

For some time a need has been felt for a VHF-FM relay for large project fires to permit fire line communication reaching base camps or other points that are beyond point-to-point range.

The unit should have the following characteristics: (1) Be readily transportable by pack horse or car; (2) batteries arranged for polarized plugs; (3) control unit and repeater completely assembled; (4) antennas arranged for foolproof assembly and on masts which would permit installations in the same relative position to each other as to the relay and ground; (5) be pre-tuned and to stay in tune; (6) be readily assembled and put on the air by an inexperienced person.

A unit that meets these requirements was put together here last spring. A TF relay with its control unit was assembled in a wooden box 11½ by 28½ by 39 inches; the combined weight was 126 pounds (fig. 1). The

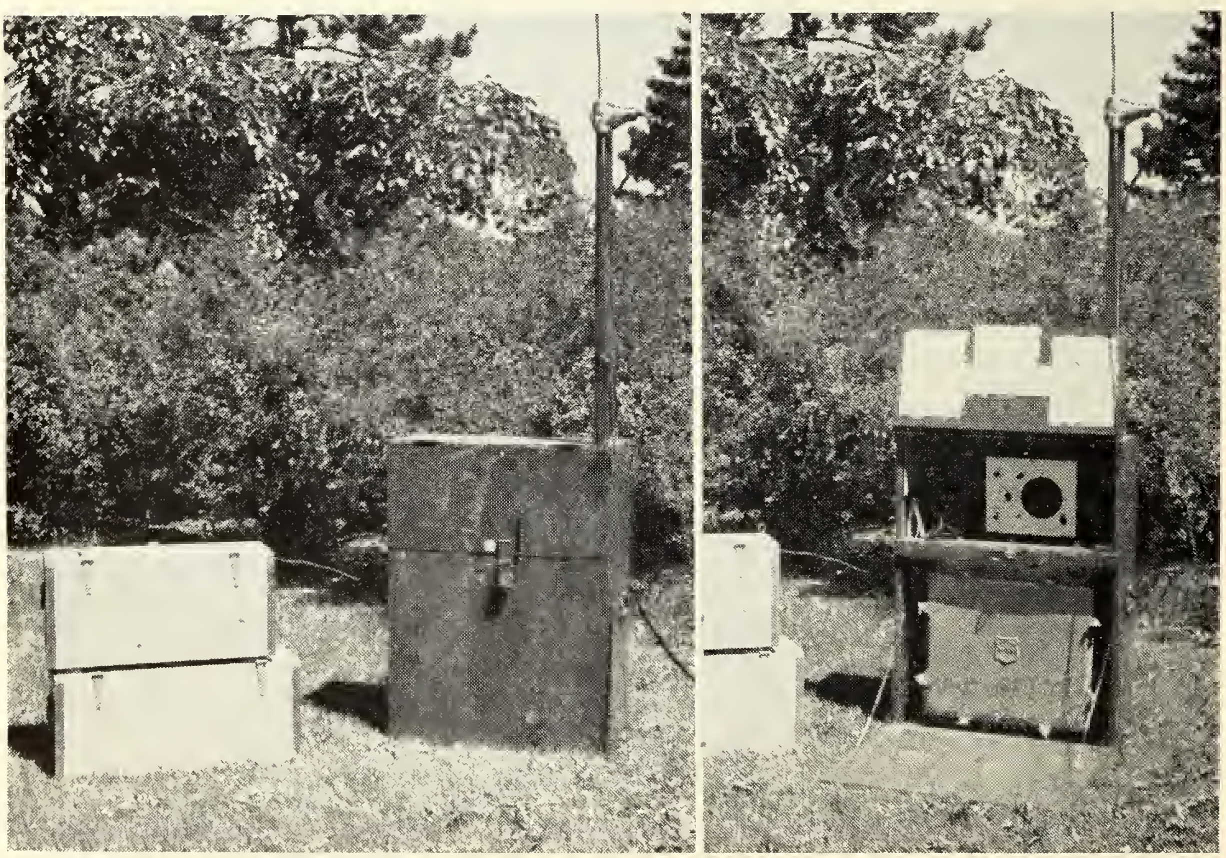

Figure 1.—Portable TF relay showing one antenna mast in place for operator. Battery boxes are on left.

two parts were completely wired and the control unit was arranged for easy disassembly. Wires for batteries were wired in place and brought out to two recessed polarized plugs.

The antennas were mounted in a wooden box 4½ by 9 by 72 inches, which weighed 45 pounds complete with all antenna materials (fig. 2). Standard TF battery boxes were used with the batteries assembled and the battery cable terminated in Jones plugs.

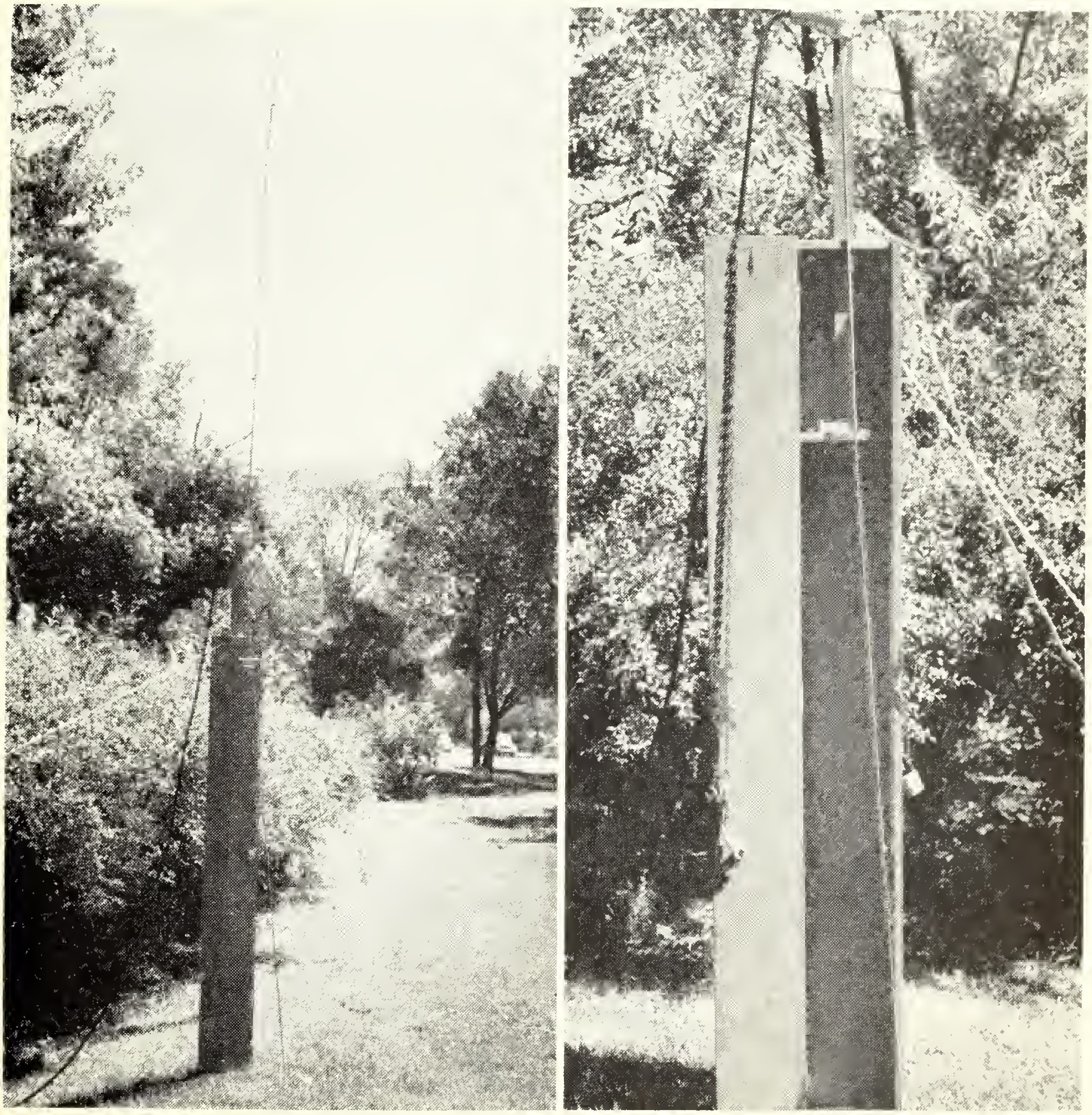

FIGURE 2.—VHF-FM antenna box used both for support for one antenna and shipping box for both antennas and guy ropes and tools.

Two antenna masts, one about 4 feet long and the other about 5½ feet long, were constructed from 2- by 2-inch stock. On one end of each mast a special antenna fitting built to our specifications was permanently mounted. One-quarter wave rods can be screwed into the fittings.

The short mast is painted green as is the relay housing. The long mast is painted orange as is the box which houses the antenna mast, rods, tools and rope for transportation. The relay housing provides a support for the green antenna mast. The antenna shipping box is the support for the orange antenna mast. Fifty-ohm coax cable is permanently attached to both antenna fittings. One piece of this cable on the green mast is just long enough to reach to a recessed antenna fitting on the top of the relay housing. The orange mast has a 15-foot piece of RG8U for attachment to the other antenna connector on top of the relay housing. The short piece of cable will reach to only one of the antenna fittings, thereby providing a foolproof way to attach the proper antenna fitting to the proper antenna.

The whips are hollow and the tips are adjustable. Two whips are painted green and two are painted orange. Each has a lug soldered so that the tip can be inserted only up to the proper point. This provides an easy way of making sure that the antennas are the right length for the frequencies being used. The green tipped whips are screwed to the green antenna mast; The orange tips, to the orange antenna mast.

Tests indicate that the unit can be set up, tuned, taken down, and reset at another location without serious detuning. The unit illustrated was used once last season and was found to be satisfactory.

The following instructions are attached to the relay housing and have proved adequate and simple enough for use by inexperienced personnel.

INSTALLATION AND OPERATION INSTRUCTIONS FOR THE R-4 REGIONAL OFFICE VERY HIGH FREQUENCY FM AUTOMATIC RELAYS

This unit consists of four packages, the largest containing the radio relay unit itself and its control panel.

The long, slender package contains the antennas and connecting cables, and short supporting masts for the antennas.

The other two packages contain the batteries which furnish power for the unit.

All of this equipment should be handled with care and packed carefully to avoid damage.

Upon arrival at the location chosen for the installation of the radio equipment, unpack the equipment from the conveyance in which it was brought.

Set the relay cabinet on a good solid foundation.

If there is danger of the unit being knocked over or broken, support it with rocks, logs, or ropes so that it cannot be upset.

Open the antenna box. Take out all the material. Assemble the whips by colors, putting the orange tips to the orange bases, and the green tips to the green bases.

Insert the tips into the long rods as far as they will go. Tighten the rods in place with a screwdriver in the box. Don't tighten too much or you will break the head off the screw.

Assemble two orange-tipped whips to the orange-colored antenna bases. Use both wrenches, making sure the fitting attached to the antenna base *is not moved* —this is very important. Attach the two green whips to the green antenna bases.

You now have assembled two antennas, one green and one orange. Place the orange antenna box about 15 feet away from the relay box. Place it upright, making certain that the square hole in the end of the antenna box is up. Tie the antenna box so that it cannot fall down. Place the orange antenna mast with the orange whips attached through the hole in the top of the antenna box. Fit the base of the orange mast firmly in the receptacle in the box. Attach the green antenna mast to the antenna relay box in the same manner.

Attach the fittings on the end of the antenna cable to the fittings on top of the relay box. Attach the short cable to the fitting closest to the green mast. The antennas are now ready for service.

Hook the screen door catch on the antenna feeder to the eye on the green mast. Place the two battery boxes adjacent to the left end of the relay housing. Open the battery boxes and make certain that all plugs are in place, and that the connections between the dry cells are tight and unbroken.

In the event that the battery compartments contain two large, black batteries, remove the battery caps, take a pocket knife or some other sharp instrument, very *carefully* cut out the inner seal, which will be found directly below the battery caps.

It will not hurt if the seal material falls into the battery. Very carefully fill both batteries with ordinary water. Fill them right up to the top of the filler plug. Be careful not to let any water splash out of the battery. If it does, remove it immediately with a handkerchief or some other absorbent material. Replace the battery caps.

Remove the plastic seal and the red guard on the top of the batteries—*this is important.* Take the battery cords out of the battery boxes, close the box lids and insert the battery cables in the appropriate jacks on the end of the relay housing, being careful not to short the plugs.

Open both lids on the relay housing. On the top of the relay unit in the bottom compartment will be found a toggle switch (SPKR handset on). Make certain that this toggle switch is in the "up" position. Find the "on" and "off" buttons on the control units. Then depress the "on" button and hold it momentarily—release it. Turn the black knob to the Squelch Disable position. With the volume control vertical, a rushing noise should be heard from the loudspeaker indicating that the receiver is operating normally.

Place the transchannel switch to position number two. The black knob on top of the relay unit in the bottom compartment should be placed to the *final plate* position. Check this—then push the transtest button, which is adjacent to the final plate knob. The meter on the right-hand side should rise to 9, approximately, on the scale, indicating that the transmitter is operating normally. Release the transtest button. Push the toggle switch on the meter panel down to *unattended repeater.* Place the black knob on the control unit in the upper compartment to AUTOMATIC REPEAT. THIS IS EXTREMELY IMPORTANT. IF YOU FAIL TO DO THIS, THE UNIT WILL NOT RELAY PROPERLY. Close and lock the compartment doors. The unit is now ready for service.

Generator Unit as a Training Aid

Many times it is not possible to choose the best location for a fire personnel training school and still show the training movies because of the absence of power to run the projector. A small portable AC, 2-KW, 115-V generator and gasoline motor will provide power for the movie projector. A unit weighing about 175 pounds was available in 1951 for approximately $225.

This unit has many uses other than just running a movie projector—it can furnish power for a saw, tool grinder, floor sander, lights for a fire camp, etc. It will greatly reduce many construction and maintenance costs at outlying stations in addition to its uses in forest fire prevention, presuppression, and suppression work.

The most desirable type is one with the generator and motor separate. It can then be mounted on a light metal platform and the generator can quickly be detached. Thus, the motor and the generator could easily be packed on a pack animal for transportation to areas inaccessible to motor vehicle travel.—V. A. GRECO, *Forester, Gila National Forest.*

Ash Trays on Saddles

On Pine River of the San Juan National Forest in Colorado, Mr. Bob Venuti, wrangler of a select dude ranch requires each rider when he goes on a pack trip to put his cigarette and cigar butts or pipe coals in a tin beer can attached to the saddle horn. The proprietor of the dude ranch saves the beer cans, which have two openings punched in the top, fills them about half full of water and then attaches them to saddle horns. Besides providing a safe container the stunt impresses riders with the need and importance of preventing fires and being careful with smoking material.

THE PINON-JUNIPER FUEL TYPE CAN REALLY BURN

Dwight A. Hester

District Ranger, Grand Mesa National Forest

In the Rocky Mountain Region, we are rapidly losing any illusions that any of our fuel types are of the "asbestos" variety. Aspen used to be considered fairly fireproof until certain crown fires, gathering speed in adjacent conifer stands, rolled through without loss of momentum. The moist, high-altitude spruce type has been even more deceptive on disastrous occasions. But at the lower elevation, in the southwestern part of the region, is the familiar pinon-juniper type, and this never gave any trouble. Most of it is outside the national-forest boundaries, and it is usually grazed so heavily that all fuel is gone except the trees themselves (fig. 1). The records show that our neighbor to the south, the Mesa Verde National Park, had a big fire in such a type in the drought-ridden thirties, but that seemed to be a "one in a million" occurrence.

Figure 1.—Typical pinon-juniper type, showing scattered stand, sparse vegetation, and intermingled areas of bare ground.

Then, in 1950, we suddenly found out that under extreme conditions the fuel-sparse pinon-juniper type will not only burn, but will literally explode. Since this type is widespread through the Southwest, perhaps other fire control personnel could profit by our experience.

During the early part of June 1950, the weather was fair and dry in western Colorado. Land managers were not concerned since there had been normal snowfall during the winter, and the early spring had been cold, if dry. The spruce type well above the pinon-juniper still held considerable snow. By June 10 the weather had turned warm, and strong winds came up with regularity during the afternoons. Relative humidity was down to 7 percent. It was during this period that a coal mine, abandoned and burning deep underground for some 20 years, chose to explode. This explosion, according to an eyewitness, occurred at 3:10 p. m., and the fire seemed to be in the crowns at once. By 5 p. m. the fire had traveled about a mile "on the back of a strong wind" and showed no signs of abating (fig. 2).

FIGURE 2.—The fire as seen from a point 15 miles away, 2 hours after origin.

We soon learned that natural barriers, such as ridges, cliffs, and roads, were of no value in heading off this type of fire. The country was too broken and rocky for bulldozers to be used effectively. The shaggy bark of the juniper made fire brands to Satan's liking. Flaming strips of this bark, often 2 feet or more in length, were hurled ahead to wrap themselves around other trees which caught fire with a roar and gave off ropelike strips of bark to repeat the process. Distance between trees and width of natural barriers seemed to have little influence on this type of spread. In one instance, a cleared, 40-foot fire lane was crossed its entire length by the fire without detectable hesitation. Backfiring was not practicable since the only fuel was standing trees which had to be crowned out to burn, and a crowning juniper in a high wind is not to be fooled with.

Not only can the fire explode during the afternoon, it can continue this blowup well into the night.

On our fire, the expected evening wind shift did not take place until about 8 p. m. This occurred as a 90-degree change of direction (a down-mountain draft) with no appreciable change in wind velocity, and the fire really rolled downhill. The rapid rate of spread continued until 11 p. m., at which time the wind velocity fell from an estimated 20 to 30 miles per hour to a gentle breeze.

Judging from the behavior of our fire, I believe that the head of such a fire should not be attacked until the crowning stops, unless there are means available for creating extremely wide barriers. Once the fire is out of the crowns, men can work relatively close to the fire and can work in most of the burn within 2 hours. I believe the best bet is to fell a swath of burning trees at least 100 yards wide, working from the edge toward the interior of the burn. One power saw per 4-man crew seems to be the answer for this work. In this short-tree type 2 men can operate the saw with a reasonable degree of safety, and the other 2 haul away the felled debris. Mop-up usually has to be done with little or no water since much of this type is without "living" water of any kind.

One cannot count on the oak brush above the pinon-juniper type to serve as a buffer. On our fire, the oak brush, although only about one-half leafed out, burned readily and crowned out in most places. As was found in Maine in 1947, hardwoods are not immune to crowning.

Although the bulk of the trees remain standing after the fire, the heat is quite intense and leaves the ground well cooked (fig. 3). Regrowth of

Figure 3.—The intensity of the fire denudes the soil to a point where watershed damage of long duration will result. Ditch and gully in foreground were cut before the area burned.

any kind is bound to be slow and erosion will be a problem. On the fire described, the wind started drifting the soil before the fire was out and continued throughout the summer. Only two rainstorms of relatively light intensity occurred during the summer, but small gullies were in evidence by fall.

While our pinon-juniper type can hardly be classified as a high fire risk, it is not fireproof. When conditions are right, it can be quite explosive, resulting in fires that are difficult to control. A burn in this type will be slow to heal and can result in a long-term watershed problem.

Sodium Bicarbonate as a Fire Extinguisher

Ed Melton, former Forest Service pumper crewman, writes us from Fort Ord, Calif., as follows:

"Enclosed with this letter is a 'trick of the trade' that we used when I worked for the F. S. in southern California. We had occasion to use this device several times on vehicle fires, and it never let us down.

"The idea was given me by a lieutenant in the Berkeley, Calif., Fire Department. He had only the highest praise for it.

"The various fire type classifications in the article are standard Underwriters' Laboratories classifications.

"If you care to publish this idea in FCN, it might prove as helpful for others as it was for us, because the fire-extinguishing qualities of common sodium bicarbonate are relatively unknown."

A lot of pumper crews would like to have carbon dioxide or dry chemical extinguishers on their rigs, but cannot do so because the cost of these units is beyond the funds available. However, there is available a good substitute which is simple and inexpensive, and which has been in use for some time: it consists of two or more 5-pound, sealed, paper sacks of ordinary bicarbonate of soda, double-bagged. Sodium bicarbonate is one of the basic ingredients of dry chemical extinguishers, and obtains its extinguishing action primarily by releasing carbon dixoide gas when it comes in contact with burning material.

This chemical is very effective against chimney fires, greasy restaurant kitchen exhaust vent fires, and any class B fire (gasoline, oil, grease). Because sodium bicarbonate is a nonconductor, it is safe to use against class C fires (power-on electrical). As this chemical extinguishes only by smothering, and with no cooling effects, it is not too effective against class A fires (wood, paper) and when using it, caution must be taken to prevent a possible flash-back.

To use the sodium bicarbonate against a chimney fire, open one sack and pour the contents down the chimney. If the fire is so intense that this does not extinguish it, then drop the other bag, still sealed, down the stack. It will burst when it hits bottom, and the draft will suck the chemical up the chimney, usually producing the desired results.

On class B fires, the extinguishing action is obtained by throwing the chemical on the burning surface, starting with the nearest edge of the fire and working back and forth away from you. A small scoop will greatly facilitate spreading.

It is necessary to keep the sacked bicarbonate in a dry place, or it will cake up. Another disadvantage is the same as with the old sand-and-scoop extinguisher: it is difficult to spread the chemical evenly and quickly, and to obtain any appreciable range by hand spreading.

Of course, this method is only a makeshift. If it's at all possible, get a CO_2 or dry chemical extinguisher. If such units cannot be had, then a couple of 5-pound sacks of bicarbonate will offer the next best solution.

To become acquainted with the way sodium bicarbonate operates, try some of it on several oil or kerosene test fires; the results might be found to be very interesting.

For any forestry pumper that operates in a section where there are summer homes, a resort area, or a large volume of motor vehicle traffic, here is an idea that might be well worth considering.

HORSE-PACK PUMP

Cleo J. Anderson

District Ranger, Tonto National Forest

In this dehydrated Southwestern Region many of the numerous lightning fires occur in very inaccessible areas. Most of these fires are readily controlled but mop-up is very slow because no water is available. The need for getting a small amount of water to such fires to facilitate mop-up has long been recognized.

This need has in a measure been met by using two water pack cans with ¾-inch hose bibs, 25 feet of lightweight garden hose, and the "trombone" pump from an ordinary back-pack pump (fig. 1). The garden hose

Figure 1.—Water pack cans in place with hose and pump ready for use.

connections make it possible to change the hose from one pack can to the other and to detach the pump so that the cans with hose can be used to supply other back-pack pumps. Thus 20 gallons of water per horse can be taken into fires in very rough country where if frugally used it will go a long way toward speeding up mop-up work. The hose is attached to the horse's halter so the pump operator can lead the horse coincident with operating the pump.

This same unit also proved invaluable as a means of packing water into back-country fire camps. This means of transporting and using water on back-country fires may be applicable elsewhere in the country.

FIRE CAMP AIDS AND SUGGESTIONS

Charles D. Sutton

General Foreman, Lincoln National Forest

Under the most satisfactory conditions the average fire camp is not too convenient and equipment and facilities are limited. Over a period of years a review of camp conditions and operations after each project fire has resulted in certain improvements to facilitate fire camp operation.

Serving tables suitable for one or two mess lines were a problem as they were normally nailed together out of precut lumber when camp was set up. These tables were not very satisfactory because they were not rigid, were hard to level on uneven or rocky locations, and were impossible to keep clean. This trouble has been corrected by providing each fire camp outfit with two tables 8 feet long, 18 inches wide and 34 inches high with folding metal legs. The tops are of ¾-inch plywood with a ¾- by 2½-inch rail securely fastened with screws to the underside to prevent sagging and to make the table rigid. The legs are made of ½-inch square or round steel hinged to underside of table and are held in place by two diagonal braces of the same material hinged to center of underside of table. The cross braces between the bottom of the legs are in two pieces with a hole in the ends where they lap in the center. This permits spreading the legs at the bottom and they are held in place by a pin that also holds the diagonal brace in place. The legs are pressed into the ground to level the tables and make it more rigid.

Elevator bolts with the flat heads pulled down flush with the top of the tables are used to fasten hinges for legs and diagonal braces to the top. The tables have been given three coats of good grade red enamel and then varnished. This provides a smooth top that is easily washed with soap and water after each meal and there are no cracks to gather grease and particles of food. At the end of each fire season the table tops are sanded lightly and given another coat of varnish, and after several years of use they are practically as good as new. The legs and diagonal braces fold inside the 2½-inch rail on the underside and the two tables are placed with tops together and held by straps making a light compact bundle that is easily loaded and transported to the fire camp.

The same conditions and problems existed with the knock-down tables used in the camp kitchen by the cooks for preparing food and making lunches. Tables 4 feet square and 3 feet high were made for the kitchen, using materials and design similar to those for the serving tables. For preparing meats or slicing vegetables, two 2-foot lengths of 2- by 12-inch unpainted lumber are sent out with each cook table. These boards and the tables are easily cleaned and as the boards become rough or cut up, they are replaced.

Tables of the same general type and design were made for the time keepers and tool checkers. These tables are 4 by 2 feet and 32 inches high with two small drawers in them (fig. 1). Two light folding steel chairs are packed with each table and it is possible to seat two timekeepers at a table and check two lines at the same time. The drawers provide space for extra time slips, pencils, schedules, etc., which eliminates going to the timekeeper's or tool checker's kit for supplies while checking men in and out.

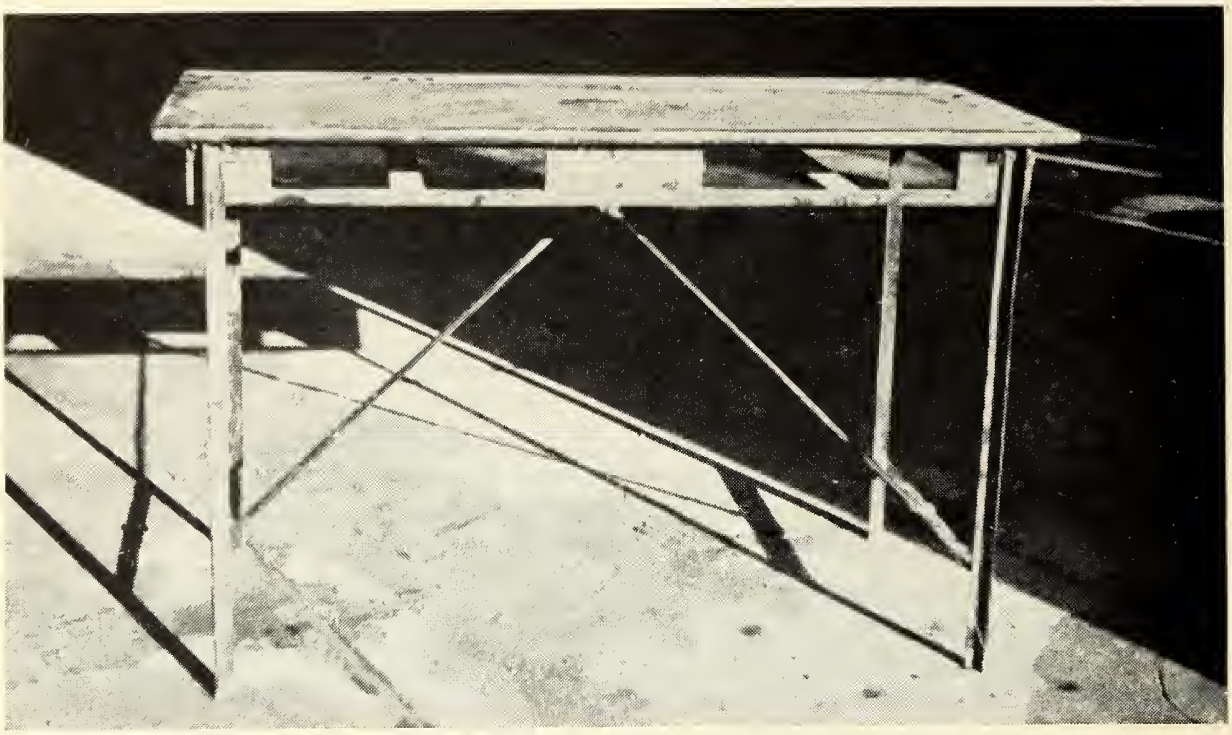

FIGURE 1.—Timekeeper table with drawers removed.

All of the tables are light, rigid, and durable and fold into a compact bundle. With normal maintenance each season they will last indefinitely.

Another problem that consumed much time and often wasted food was slicing bacon, various other cooked meats, and lunch meat and cheese. This was solved easily by purchasing a lightweight hand-operated slicing machine. It was estimated that this machine more than paid for itself on the first fire as 30 percent more sandwiches were prepared from the same number of pounds of lunch meat and cheese that was formerly sliced with a knife. It was much faster: one or two men with the machine could slice as much meat, etc., as four or five with butcher knives. With the bone removed, roasted meat and boiled or baked hams were also sliced by machine, saving much time and providing more uniform servings. The machine was also used for shredding lettuce for salad or sandwiches and cabbage for cole slaw. The slicer saved so much time and food that it is now considered indispensable in a fire camp on this Forest.

Water has always been a problem in fire camps in this dry country. It is often necessary to set up in an undesirable location because that was the only place water was available. This was corrected by using a lightweight, trailer-mounted, 250-gallon water tank. The trailer has a tee on the back end with two ¾-inch molasses stop type faucets that make it convenient for filling canteens and drawing water in vessels for the kitchen. The capacity of the tank and quantity of material necessary to properly chlorinate it is posted on the end of the tank and it is treated each time it is filled, thus providing safe drinking water.

A portable light plant mounted on a trailer has been used for several years in fire camps (fig. 2) and it was found that a few large bulbs are superior to a number of smaller ones. Two of the 100-foot cables were fitted with mogul sockets and 1000-watt bulbs. One of these lights properly suspended over the kitchen and another over the tool checking area, lights

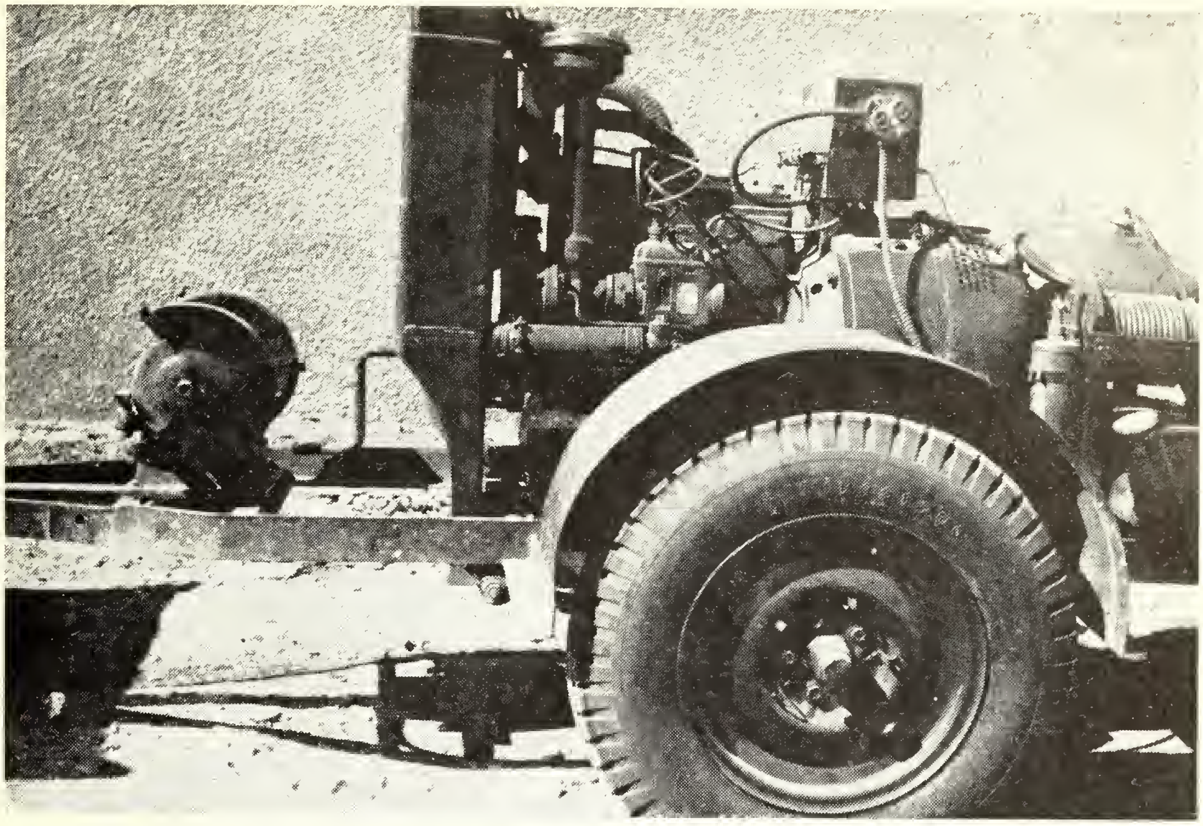

FIGURE 2.—Portable light plant.

the area much more satisfactorily than was ever done with a number of cables, extension cords, and smaller globes.

The equipment and suggestions listed above are simple and inexpensive but have proved their worth in time, labor, and food saved and have added materially to the efficiency of fire camp operations.

Smokey Bear Prevents Disastrous Forest Fire

The story of how Smokey Bear actually prevented a forest fire was told by Ranger "Dutch" Sullaway to the Mt. Shasta Herald, a northern California newspaper.

A party of campers stopped in the small mountain town of McCloud, Calif., after having abandoned their camp. Upon viewing a poster of Smokey Bear carrying a fawn out of a blazing forest fire, one camper turned to the other and said, "Are you sure we put out our campfire?" The other camper was not too sure, so together they went back to where they had been camping.

Sure enough, there were still hot coals and already the fire had crept away and was burning in thick pine duff. The campers extinguished the fire and Ranger Sullaway gave Smokey Bear credit, as did the campers, for preventing a forest fire that had real possibilities of becoming a costly disaster.—From Mt. Shasta Herald, Mt. Shasta, Calif.

HOG RINGS SIMPLIFY CARE OF KAPOK SLEEPING BAGS

R. Boyd Leonard

Fire Control Officer, Salmon National Forest

The annual job of cleaning kapok sleeping bags after a busy fire season is one requiring many man-days of labor. Any method used to reduce time of tearing the beds apart, cleaning, disinfecting, putting back together, and rerolling is generally well worth investigation, since a few minutes saved on each bed adds up to hours when applied to the whole job. Each improvement continues year after year and in time represents a real saving of time and money.

The idea of using hog rings occurred several years ago and was put into practice on the Salmon National Forest.

A commercial tool for clamping the rings in place worked satisfactorily (fig. 1). However, there was no tool available for removing the hog rings when the beds had to be taken apart for cleaning.

Figure 1.—Inserting a hog ring through the eyes placed in the separate parts of a kapok sleeping bag. When in place all parts are fastened securely together with the closed ring.

The tang end of two files or in some cases two pairs of pliers were used originally to force the hog rings open. This proved to be a tedious way of removing the rings and led Kenneth Call, fire dispatcher, Salmon National Forest, to devise a tool that greatly simplified this operation.

The tool is made from two pieces of strap iron ¼ by ¾ by 9 inches. These are shaped to a point on one end and into handles on the other (fig. 2). The handle ends are then wrapped with leather or tape. A short iron stopper is welded to the pointed end about half way from the points to the fulcrum to prevent the points from passing by one another. This makes it easy to get both points into the hog ring at the same time. The sharp points on the tool are dubbed off just enough to prevent them from becoming a safety hazard.

FIGURE 2.—Hog ring spreading tool showing its size and how it operates to spread a hog ring.

The new tool reduced the time required for this one operation to one-half to one-third that formerly needed. It also reduced the possibility of a man jabbing his hand with the end of a file or getting stuck with the sharp ends of the hog ring. The safety aspect alone made the tool well worth while. The first tool proved a success and as a result several have been made with minor improvements over the first model.

To finish the bed cleaning operation the beds are rerolled and a name tag is fixed on with a hog ring. The purpose of the tag is to make it possible for a man to get the same bedroll when for one reason or another the beds are stacked or transported.

A Low Cost Rust Preventive for Fire Tools

A commercial product called "Utility Coating" is available for use in preventing rust and corrosion on metal.

The Toiyabe National Forest has been using this product for several years and has found it superior in many ways to the common practice of oiling shovels, pulaski tools, and axes to prevent rust and corrosion while in storage. It does not wash or rub off and produces a dry hard coating which does not gather dust. The coating can be applied either by dipping the part of the tool to be treated or with a paint brush.

Utility Coating comes in 5-gallon pails and retails at about 15 cents per gallon. For best results it should be put on tools mixed with paint thinner or gasoline using five parts of gasoline to one of Utility Coating. For further information write to Regional Forester, U. S. Forest Service, Ogden, Utah.

SAFETY CHAIN AND LINK

Lester K. Gardner

Administrative Assistant, Division of Engineering, Region 5, U. S. Forest Service

Last fall on a fire, one of our mechanics was injured while inflating a tire which had just been mounted on a large truck wheel. Before the tire reached maximum inflation, the rim lock ring dislodged, allowing lock ring and tire to fly apart from the wheel. The lock ring struck the mechanic's right hand and the tire struck him on the side of the face. The accident occurred even though the lock ring had apparently been properly positioned before he started to inflate the tire.

The safety device illustrated in figure 1 was developed by Frank H. Little, chief foreman of the Redding Equipment Depot, Redding, Calif., to prevent reoccurrence of a similar accident. Used in pairs, the safety chains are adjustable to fit all types and sizes of wheels and tires where complete encirclement of the tire and rim is possible. It is not necessary, of course, to use safety chains on the one-piece drop center rims commonly used on light vehicles.

Cost of the model shown in the accompanying drawing was $1.81, or $3.62 per set. A set of chains fits compactly into a small space and may readily be carried in field mechanic's truck, luber units, etc., or used directly in the shops.

Procedure for use of the safety chains is as follows:

1. Assemble tire and lock ring on rim.
2. Encircle tire and rim with safety chains placed opposite each other. When split lock ring is used, quarter the chains away from the split ring ends.
3. Place the chains through the holding links and pull through.
4. Slip the nearest chain link into holding link slot. Allow some slack to prevent chain becoming tight when tire is fully inflated.
5. Inflate tire.
6. Determine that rim lock ring is properly seated, then unhook and remove safety chains.

Application for patent is pending. However, the safety chain and link may be used by the Forest Service and other government agencies which may choose to do so.

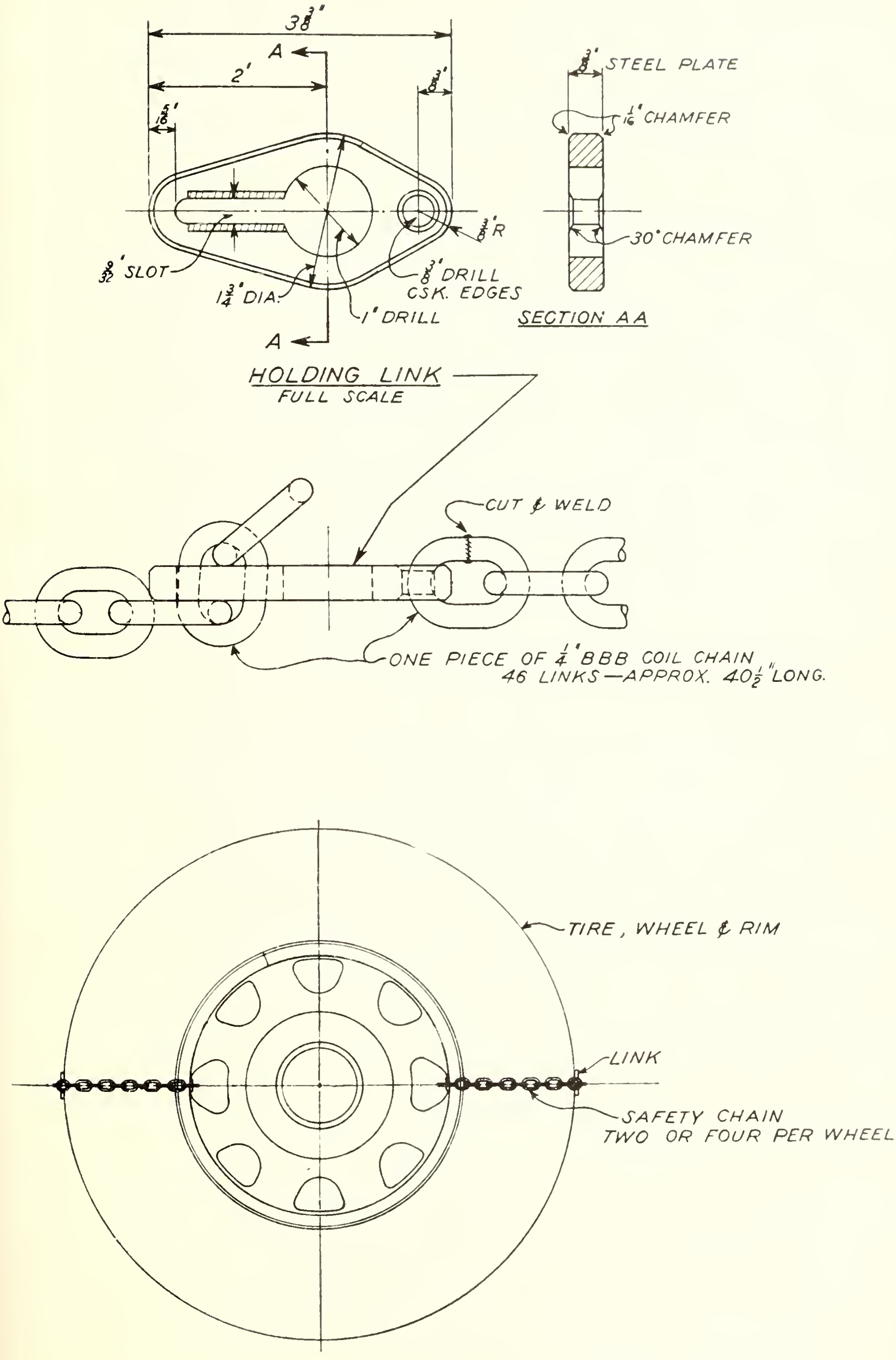

FIGURE 1.—Safety chain and link for use on lock ring type wheels and rims.

U. S. FOREST SERVICE VIEWS FIRE PROTECTION PLANS FOR LOGGING OPERATIONS [1]

A. E. Spaulding

Assistant Regional Forester, Division of Fire Control, Region 1, U. S. Forest Service

Fire protection on logging operations is everyone's business, and especially that of the operator. He has the most to lose; but the industrial worker, banker, storekeeper, farmer, fisherman, hunter, home builder, and you and I also have an interest in the values that might be destroyed.

Fires in going logging operations may cause staggering losses counted in tens or even hundreds of thousands of dollars. You all know how expensive logging equipment is these days. When it is destroyed by fire, the dollars add up fast. Felled timber, logs, and cold decks are particularly vulnerable in case of fire. Under today's costs and values they pyramid the losses fast when they go up in smoke.

In addition there are logging improvements that may be destroyed, and fires that start in logging operations can and do spread to standing timber and reproduction. Neighboring operations and lands may also be damaged.

Watershed, recreation, and similar values may be seriously affected. The interruption of the woods operation may cause the closing of dependent sawmills or other plants. All such losses have a chain reaction that can affect many people today, tomorrow, and far into the future.

The direct losses of the logging operation may be small in comparison to the increasing losses suffered elsewhere, indirect losses in the economic structure dependent upon healthy logging operations. All such losses are bad enough in peace time, but under the present international situation, they become intolerable. Therefore, fire protection on operating areas is critically important to logging operators and fire control people.

We all recognize that the cutting of green timber usually increases the fire hazard. Green fuel turns to dry fuel; the forest canopy is open and ground fuels are dried by sun and wind. Logging tends to stir up the fuels and concentrate them. The risk of fires starting is increased by the numbers of men in the woods and also by the presence of various types of mechanical equipment such as tractors, trucks, and skidders.

Compensating to some extent for the increased risk are the woods crews, if they are properly equipped for fire fighting, and the logging roads which permit quick attack and may also be used as ready-built fire lines.

Regardless of responsibility for fire control on logging areas, the operator is in the best position to take prompt action. He has men and equipment on the ground, and has, as a minimum, a moral responsibility for quick and effective suppression action on all fires starting close to his operation. He is also in the most favorable position to provide some of the needed supplemental fire protection.

[1] This article is from a paper presented by the author at the 41st Annual Conference of the Western Forestry and Conservation Association.

Nevertheless, advance planning is necessary to make the best use of the facilities of both the operator and the protection agency. This plan should give consideration to prevention, preparedness, and hazard reduction, which are discussed here, and suppression.

Fire prevention should be designed to prevent fires starting from the logging operation, and desirable measures must vary according to local conditions. Yet each operator has an obligation to do all in his power to prevent fires.

The protection agency and the operator should mutually prepare an effective fire prevention plan for each area involved. To facilitate effective application of the plan, the operator should designate a representative to work with the protection agency at all times. Fire prevention during non-operating hours, weekends, and holidays should be provided. The necessary machinery should be set up to strictly enforce the needed prevention measures.

Adequate preparedness for fire fighting requires a good fire plan. This plan should include (1) the actions expected of the operator, (2) a detailed outline of the equipment, tools, men, overhead, and organization, (3) a clear correlation of the duties, responsibilities, and authority of the operator and the protection agency, and (4) the organization of the operator's crew into an independent initial attack force, ready to function. Organization of the crew should include adequate training of men and overhead. A large-scale map should show topography; location of roads, fire lines, and water chances; location of equipment; boundaries of merchantable timber; all areas of especially high hazard; and other important details.

This fire plan should be prepared jointly by the operator and protection agency. The local protection officer and the operator must then take steps to put the plan into effect in accordance with current and expected burning conditions. The plan should provide for adequate action during non-working hours, weekends, holidays, and shutdowns. To reduce the amount of written material, maximum use should be made of maps, charts, diagrams, and outlines.

Hazard reduction is an important phase of protection planning for logging operations. The fire hazard and risk usually increase with the cutting of green timber. This hazard and risk may continue for a number of years following completion of the operation. Slash, debris, or brush resulting from logging should be treated in such manner as to assure as nearly as possible the same degree of protection as was available prior to cutting.

Money spent for slash disposal usually should be considered as money spent for fire protection. In many areas, complete disposal has been replaced by increasing supplemental protection combined with partial disposal or no disposal. Slash and snag disposal methods and needs vary with locality and timber type. Yet the same general purpose should apply —we want to purchase the best protection for the dollars spent.

As used here, protection costs include slash disposal, preparedness, and fire suppression. They should be compared to the potential damage. To buy the most protection per dollar spent, we must have basic information on certain items. We need to know the hazard of slash fuels and be able to estimate the potential cost of their protection. We need to know also, in definable terms, the amount of slash we can tolerate when attempting to calculate the risk. We need to know the rate of natural hazard abatement.

For the white pine type, the University of Idaho School of Forestry is financing research, under the direction of Dean Jeffers, to provide this and other information. Comparable projects are needed for some of the other timber types and localities. A few such studies are probably under way, some have been completed, and the information provided contributes to better fire protection for logging operations.

A slash and snag disposal plan should be prepared prior to logging. The purpose of this plan should be: (1) To reduce the chance of fires starting; (2) to reduce the chance of fires assuming rapid headway; (3) to make control easier, more rapid and certain; and (4) to provide the methods that will be adequate and least costly. Benefits and damages, irrespective of fire protection, must also be considered in making the plan. Advance planning is needed to provide for supplemental protection if the plan calls for living with a substantially greater hazard for a number of years after logging moves to another area.

In the Northern Region of the Forest Service, there is evidence to indicate that after cutting, the ignition rate more than doubles, and that twice as many fires will reach a size of 10 acres or more. This indicates that the protection load increases with cutting. Higher protection costs can be expected and should be planned for in advance.

Adequate protection roads are of great importance in holding these costs down. Permanent or semipermanent protection roads should be designated at the time the operation is planned. The roads that will be maintained for fire protection purposes following completion of the operation should be constructed to a satisfactory standard to fulfill protection needs.

Slash disposal should be considered in planning cutting areas. This may assist in avoiding the creation of large continuous areas of heavy slash. It may also facilitate handling of slash disposal by suitable methods and reduce the risk to high values.

On a logging operation we have great economic values at stake. The magnitude of the potential loss through fire fully justifies intensive protection, which should include fire prevention, preparedness, slash disposal, and suppression.

Fire prevention should be designed to prevent fires starting on the operation and places on the operator an obligation to do all in his power to prevent fires.

Preparedness should provide organized, trained, and properly equipped fire-fighting crews. We must also have correlation of duties and responsibilities of the operator and the protection agency in the event a fire does start.

Slash disposal is considered mainly as a protection measure. Where slash disposal planning contemplates a substantial hazard for a number of years following logging, supplemental protection should be arranged for. We should consider all benefits and all damages of hazard reduction work and plan our program primarily for buying the most protection with the money invested.

For successful suppression, there must be no holding back on initial attack by anyone in position to help. All operators should prepare their organizations as effective initial attack forces.

MORGAN PLOW HITCH

DONALD J. MORRISS

Supervisor, Pisgah-Croatan National Forests

George P. Morgan, mechanic foreman on the Pisgah National Forest, has invented a remarkably effective mountain fire line plow hitch.

Tests have shown that plows held in the ground by hydraulic lifts require constant depth adjustment by the tractor driver. That presents difficulties in steep country since our operators have only two hands. On the other hand, lines made by free floating plows usually have considerable skip due to frequent changes in grade and soil structure, and the presence of logs, leaves, roots, and rocks. The Morgan plow hitch is designed to eliminate these problems.

Figure 1 illustrates the geared hitch, one of the unit's unusual features. When the tractor starts up hill the draw bar goes down but the plow beam is raised, thus preventing the plow from going so deep that it puts an added strain on the tractor. When the tractor starts down hill the plow is thrown into the ground, thus avoiding the skip which usually occurs with a free floating plow unless it is set unnecessarily deep.

The pressure bar, which is fitted on the pantagraph principle, accentuates this action. It also maintains a constant pressure on the plow at the point which will best hold it in the ground and level. A hairpin bolt holds the bar at an adjustable position between uprights that are pinned to channel irons on the top plate of the plow and may be adjusted forward and back (figs. 1 and 2).

Once the pressure bar is properly set, further adjustment while plowing is not necessary. This is an important improvement since it removes the temptation to throw on rocks while plow is in motion and the even more unsafe practice of jumping on the back of the plow to hold it in the ground.

One man can raise the plow point to the position illustrated by pulling up on the pressure bar. It can be held in this position for deadheading by inserting a bolt in the upper hole at the end of the beam. The plow is raised for loading by a hand-operated, 500-pound, safety wall winch. The crank handle is mounted to the right and behind the tractor seat. In loading position, a lock is dropped over the hitch to prevent side sway. The operator raises or lowers the plow without leaving the tractor seat.

Morgan has added some improvements on the plow itself. Plows will hang under roots and then it is necessary to back up. A plate that curves from near the plow point to meet the upper plate at the back end of the plow near the top of the wings has been added to act as a sled to raise the plow when backing.

The throat of the beam, beginning from well ahead of the plow point, is shaped in a perfect arc. This permits the accumulated leaves, which are too light to roll with the sod, to roll out on each side before they pack sufficiently to pull the plow out of the ground. Two beams, as well as the hitch parts, are cut from a single steel plate with practically no waste of material.

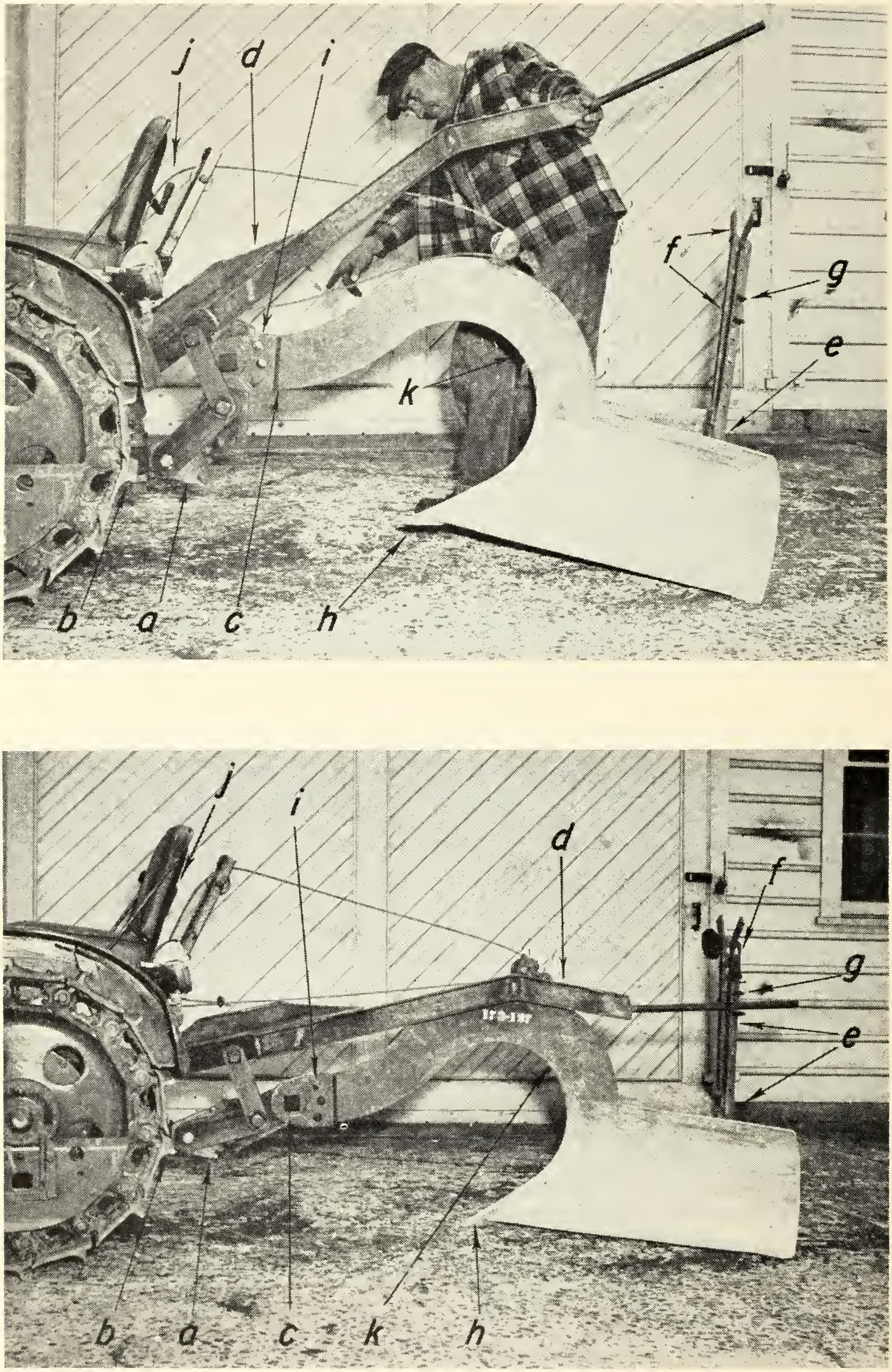

FIGURE 1.—The Morgan plow hitch: *a,* Geared hitch; *b,* draw bar; *c,* plow beam; *d,* pressure bar; *e,* point of pressure; *f,* uprights; *g,* hairpin bolt; *h,* plow point; *i,* hole at end of beam; *j,* crank handle; *k,* throat of beam. *Top,* George Morgan with plow point raised to deadheading position; *bottom,* plow ready for use.

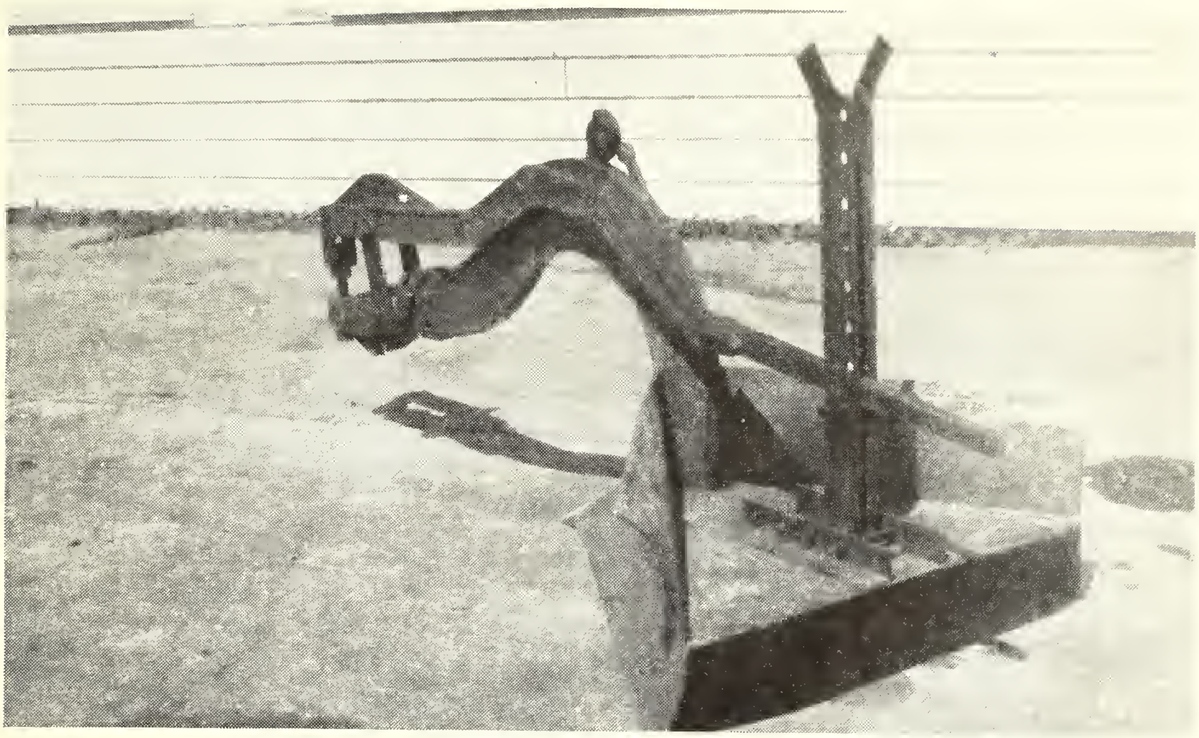

FIGURE 2.—Rear view of plow showing placement of uprights.

The net effect of these features is a plow which follows the tractor like a snake crawling over a stick. Pulled by an 18- to 25-hp. crawler tractor, it makes a good line up a 30-percent slope, down a 60-percent slope.

Further information concerning this equipment may be obtained from the Regional Forester, U. S. Forest Service, 50 Seventh St., N.E., Atlanta 5, Ga.

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SO YOU HAVE TOO MANY FIRES!

Henry Sipe

Assistant Forest Supervisor, Cumberland National Forest

The Cumberland National Forest in eastern Kentucky is typical of many forest units in one way: most of its fires are caused by local residents. Lightning and "tourists" are minor factors. The Forest protects a million-acre "checkerboard" where "Uncle Sam" owns the black squares and private parties own the red. About 50,000 persons live on the red squares, and another 50,000 live in towns under 5,000 population within the protective area. When land purchase was begun in 1934, 400 to 500 fires burned each year, doing plenty of damage. Woods burning had been practiced for generations. In the succeeding years, by various methods, we were able to reduce the number of fires substantially. In 1941 we had 192 and in 1950 there were 52, which seemed to be an irreducible minimum.[1]

Indeed, most of this million-acre protective area was practically free of all fires in 1950 except an occasional "accidental" one or a railroad fire. But in certain small sections, the occurrence rate was still very high, mostly from smokers or incendiaries. People over the whole Forest had in past years been exposed to considerable fire prevention pressure. Yet these small trouble spots remained. Law enforcement as always, offered hope, if enough evidence could be uncovered. But the culprits had become wary. What was the answer? It was felt some phase of education had to be selected; but what specific kind?

The results secured is one 12,400-acre unit on the Cumberland had been good.[2] Personal contacts and letter follow-up was the method used. In this area, the number of fires dropped from 10 in 1946 to zero in 1950. To date in 1951, one fire debris burning has occurred. If there is no more than one fire every other year here, the irreducible minimum has been reached.

This personal contact program has been carried out in several other areas with success. They total some 50,000 acres, about 5 percent of the Forest's protected acreage. It was found that many of the local residents had concluded that fires were harmful and should be stopped. But a certain type of person in the community refused to accept the opinion of the majority. In this group were the incendiaries, the careless "smokers," and the intentionally negligent. Here were the trouble makers of the community—the moonshiners, drinkers, and pranksters. Most of the good citizens welcomed any pressure put on these bad actors, but the pressure must come from the "outside." Why? For fear of reprisals. And this fear is not only that your barn may be set afire; you just like to keep the good will of your neighbor, whether he is a good citizen or a scoundrel. So someone charged with the responsibility, and who has the authority, must put on the pressure. Someone who *wants* to prevent fires, must *convert* that want into an *action* program.

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[1] See July 1949 issue of Fire Control Notes, p. 33.

But, you say, all our folks have been "contacted." Probably so, but how long ago? Has the contact been kept alive? How about new families moving in? In one area of 175 families, at least 45 families have moved in or out, or to some other part of the section in a 2-year period, about 13 percent turnover a year. We found no substitute for personal contacts on these high risk areas on the Cumberland. Here is how it is done:

On the fire occurrence map, draw a line around those areas where there are too many fires. List them in priority order; worst first. Cut out a section of the map covering the worst area and fasten it to a piece of cardboard about letter size. Cut it in 3 pocket size sections. Then make a looseleaf notebook, pocket size. Likely there will be an employee or a local person who knows the names and location of residents in the area. With his help, put a numbered dot on the map for each family. Then number a notebook sheet for each, write on it the name of the head of the family, address, and brief notes about them. List schools, churches, and stores. The local ranger or guard who has been responsible for fire control in the area, should be with you on much of your work. If he has been unable to "crack" the fire problem, an outsider should be chief contacter.

Now go to the county school superintendent's office. List the names of pupils, parents, and teacher, and the ages of pupils. Talk over school problems with the superintendent and attendance officer. For example, what older boys play "hooky" too often. Next visit the county court house. Look over the civil and criminal order books. You'll be surprised at who is in trouble for what. Talk to county officials. Try to learn which are the best families, and the worst. Visit the schools first if possible. Make a talk even though it's only a 5-minute one. In some way let it be known that you have their names or know who they are. You might call the roll and check those present against your list. Or you might pick out and call by name some pupil you can identify. Take a picture of the pupils and present an enlargement to the school later.

Then start out and make as nearly a 100-percent family contact as possible. Write down names and approximate ages either during or right after the talk, together with any interesting notes. Find out who is related to whom (but watch out for marital troubles). Kinship will explain many things. For example, two men married sisters; they lived 5 miles apart. When we had a "run-in" with one man, the other set a fire. We didn't wise up till we found out they married sisters. Learn, too, who doesn't like whom. Often they'll inform on each other.

Pay particular attention to teen-age boys who are not attending school; maybe inquire casually about draft eligibility. If you have fires that are classed as incendiary, smoker, or unknown, there is a good chance some teen-agers are mixed up with them. Too often, such a footloose boy is overlooked or avoided in our contacts. Often he's not at home or slips out the back door when you call.

You will not be able to see all of the families, but later trips will tend to raise your percentage. Trying to figure out who are "key" individuals, and seeing only them, will be inadequate in these high risk areas. The important point to remember is that you not only want to make an impression on as many local folks as you can, but you want *them* to realize *they* are making an impression on *you,* and that they *think* you will remember *them.* The

[2] See October 1950 issue of Fire Control Notes, p. 1.

various psychological approaches to be used are beyond the scope of this article.

When you return to the office, mail something to each family. We include them on our quarterly Newsletter mailing list. The letter tells current conservation news—local, Forest, State, and Nation. We prefer to write the person's name rather than "Boxholder" because it adds the personal touch. All letters to one post office can be tied in a bundle with the address only on the top one. A Smokey Bear stamp can be used to seal the letters and save stapling. Other types of conservation material can be mailed as needed.

Visit the area twice the first year and if results are OK, reduce the frequency the second year. After the first year you will likely be able to put your finger on the fire suspects. Get better acquainted with these.

If there are fires in the area, of course investigate fully. You'll be surprised how much easier it is, than if you go into an area "cold" or unacquainted. Even though you don't get enough evidence for prosecution, you will likely learn who caused the fires and what's more important, they'll know that you know. Keep them guessing as to possible prosecution.

Go through this procedure for other critical fire areas. A contact program as above outlined is basicly being a good neighbor. If it solves the fire problem, other objectives such as sound cutting practices on private lands loom immediately ahead as even bigger challenges.

Volume 13 Number 2

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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Forest Service, Washington, D. C.

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CONTENTS

TIMEKEEPING ON PROJECT FIRES

C. A. Gustafson
Chief, Division of Fire Control, U. S. Forest Service

Timekeeping is important to successful fire operations. It must be fast, otherwise much valuable time will be lost getting men on the fire line. It must be accurate to make certain each fire fighter will receive the wages due him and that the large amount of public funds paid out each year as wages to fire fighters is a true reflection of the total time worked—$6,000,000 is an estimate of the wages that will be paid fire fighters in fiscal year 1952. Timekeeping also provides means for identifying a fire fighter and permits immediate notification of the nearest of kin should death or injury occur, or notification of the fire fighter should sickness, accident, or death occur to a member of his family while he is engaged on a fire. It forms the basis for collecting suppression wage costs in trespass cases. It permits paying fire fighters quickly and with certainty that the amounts paid are correct. It permits identification of suppression wage expenditures so administrative studies may be made on all Class D and E fires—very important from the viewpoint of efficient financial management of fire operations.

ITEMS FUNCTIONALLY IMPORTANT TO A TIME REPORT

Since speed, accuracy, identification, dependability, etc., are important to timekeeping, the form used must provide a means of attaining these ends. It must provide space for the name and address of the fire fighter to permit identification and payment. It must identify the fire and name the forest on which it burned so financial management studies may be made. It must have space for entering place of hire and means of travel in order that correctness of travel time may be audited.

Different rates of pay apply to the various types of fire-fighting work. The timekeeping form should make it possible to enter the proper rate of pay. Travel time rates are usually at the lowest rate prevailing. The year, the day, and time of day "on shift" and "off shift" for each fire fighter is vital to accurate timekeeping. Many fires, particularly those of project character, require more than a single shift for their control. Total hours worked under each job classification is important to a calculation of the total gross amount earned. Also the fire fighter may buy a pair of shoes or some tobacco, or may fail to return certain properties charged to him. Deductions involving goods purchased by the fire fighter or government property lost by him will have to be made to arrive at the net amount due.

Space for recording travel time, hours worked, rate per hour, gross amount earned, deductions for purchases or property losses, net amount due, etc., must be made available on the timekeeping form. Sometimes different rates of pay apply if the employee is released, discharged, or quits, and this must be noted. The form should provide space for signatures of the employee and the timekeeper. Signature of the employee will prevent future arguments concerning net amount due him for fire fighting, particularly when deductions have been made in the gross amount earned.

Last, but by no means the least important, is quick identification of the fire fighter for time reporting purposes, when going "on shift" or coming "off shift," by means of a detachable slip with a serial number identical to the number on the Time Report.

MECHANICS OF TIMEKEEPING

The job of keeping time can actually be made very simple if certain procedures are well understood and followed. It is the purpose of the following narration to outline how time of fire fighters may be kept with ease and still obtain speed, accuracy, and certain identification so essential in this phase of fire operations on project fires.

Forms, materials, and equipment.—A standard timekeeping form is necessary. Such a form has been prescribed for U. S. Forest Service use by the Comptroller General and is known as Form FS-874-15A TIME REPORT (Revised July 1948). The supply of these forms for any particular fire should be equal to about twice the number of fire fighters to be employed, with one ring binder for each 100 forms. They should be numbered in sequence, such as D-198000, D-198001, etc., to D-198100. The starting number, in this case D-198000, should be written boldly in ink on the cover of the ring binder.

Material available should include several small lined tablets about 8 by 10 inches, a pencil sharpener, a supply of 4-H pencils with erasers, a couple of filing spikes, and indelible pencils for signatures of employees.

Equipment required consists of a collapsible table of standard height, and about 6 feet long and 26 inches wide, 2 collapsible chairs, stapler, rope, and lights. A box with alphabetical separations should be available so time slips posted and completed for payment may be filed. A locked commissary box should also be provided.

Location of the timekeeping office.—The office should be outdoors; never in a building. It should be in the shade. If shade cannot be provided by a tree erect a fly over the selected office site.

The timekeeping office should be located out of the way of the kitchen, communication center, dust, etc. The men should be able to pass freely through the setup without congestion. For property accountability and commissary purchases, the locked commissary box and the sleeping gear should be near the tool dump. The men can be outfitted and then passed through the timekeeping setup prior to going on shift and can return equipment to the tool dump after property accountability has been determined when going off shift.

Preventing congestion.—After the timekeeping table has been set up it should be provided with roped lanes to force the men to pass the timekeeping desk in single file while going on and off shift, or obtaining commissary or bedding gear. Direction of travel should be indicated by signs.

Signing up the men.—There are a few common essentials required to start the timekeeping off right, whether at the employment center or after the men have arrived at the fire camp:

1. Have ready books of Time Report forms, 100 per book, numbered in consecutive order.

2. Fill out *one* Time Report for each man, again with such reports in consecutive numerical order.

3. Fill in the name of the fire and forest.

4. Fill in the employee's name; make sure full first and last names and middle initial are entered.

5. Fill in address of employee.

6. Enter place of hire and means of travel and whether government or private.

7. Enter job classification title at which hired and indicate hourly rate.

8. Enter in first column month, day, and year, e.g., 6/2/52, on the first line opposite the words "To fire."

9. Tear off stub and give it to the employee, advising him this is his *one* means of identification and to keep it until paid.

10. If the men are recruited at an employment center the book of Time Reports properly filled out is usually given the driver for delivery to the camp boss upon arrival of men at the fire camp. The men immediately after arrival in camp from the recruitment center are marched past the timekeeper so that a count may be made and travel time checked off.

If the men are signed up after they arrive in camp points 1 through 9 are carried out. In addition a check on travel time is made so that a complete record for each employee prior to entry on shift is obtained.

After completion of items 1 through 10 the job consists of recording the men on and off shift, posting time worked, and posting commissary and property losses for which the men are accountable.

On-shift timekeeping.—1. The men should be arranged in crews and each crew assigned to a crew boss or foreman. It is not essential under this system for the crew boss or foreman to have a list of names; he can obtain a list of identification numbers as the men pass through the timekeeping setup. Later, before beginning work, he can list their names for use in his supervision of their work for the shift.

2. The crew boss should walk his men past the tool dump so each man can be issued equipment for the shift.

3. The crew boss should next request each man to have available in his right hand his time report identification number.

4. They should then be requested to pass by the timekeeping desk in single file, and as each one reaches the timekeeper to hesitate a second or two to enable the identification number stub and the tools checked out to be seen.

5. The timekeeper notes the identifying number and the tools carried by the fire fighter. He writes the last three digits of the number and the tools to be charged the fire fighter on a lined tablet (a single sheet for each crew) somewhat as follows:

073—S F C (S—shovel, F—headlamp, C—canteen, etc)
081—M F C
087—A F C
101—S F C
etc.

Upon completion of taking the identifying numbers of the crew (the crew boss will notify him when this has been done), the timekeeper notes the month, day, hour and minute on the tablet sheet, tears it off, and places it on a filing spike or a nail driven through a block of wood marked "on shift" for future action. This same system is followed until all outgoing men have been recorded. One man calling off identification numbers and tools charged and the timekeeper recording should be able to check out a man every 5 seconds or 360 men every half hour if the men are organized in crews that file promptly past the timekeeper.

6. Usually the night shift begins to report in shortly after the day shift has left camp for work on the fire. Each crew boss should march his men coming off shift past the timekeeping setup. The timekeeper notes the last three numbers for each man on a tablet sheet following the same procedure as for the outgoing men. After checking the last man in the crew (who will be made known to him by the crew boss) the timekeeper notes the hour and day on the sheet and places it on the spike marked "incoming."

7. Usually after the on-shift and off-shift men have been checked through there is a lull in the urgent timekeeping activity. Plenty of work remains but the timekeeper may do it more leisurely. The next job for the timekeeper is to sort the tablet sheets on which crews were reported and staple the on-shift and off-shift sheets for each crew together in readiness for checking property and posting time.

8. He then compares outgoing property charges with property checked in by each individual and notes discrepancies for future reference.

9. The next job is transferring time from these tablet sheets to the Time Report. This is usually done by one man calling out each number and the time on the tablet sheet while the second man locates the Time Report and posts the day, hour, and minute. As each crew boss tablet sheet is posted on the Time Report a figure 8 is written through it indicating the time for the crew has been posted.

This work is continued until all time has been recorded. Some timekeepers follow the practice of posting on-shift time as soon as possible after the men have gone on shift. This practice is approved and will ease the pressure should emergency timekeeping work come up.

10. Bedding must be issued to off-shift men. To assure property accountability they should file past the bedding gear to be issued bedding and then pass the timekeeper one at a time so he can note the last three numbers on each identification stub and the bedding gear to be charged. This need not be done by crews but some forest officer should be assigned to see that order and discipline in issuance of bedding gear is maintained. After the rest period, overnight or day time, one of the first duties of the men will be to turn in their bedding gear, going through the timekeeper in the same manner as when bedding was issued. As time permits the tablet sheets on which the bedding gear was charged will be checked against those reporting incoming gear to determine who hasn't turned in the property charged to him. If any individual cannot satisfactorily explain why he failed to turn in his gear, a "lost" property charge will be made.

Once it is known that strict accountability of property will be followed, it is surprising to see how few losses will develop. Sloppy property accountability on the other hand often results in intentional failure to turn in property, gross carelessness, etc.

11. The above sequence will be continued until the fire is controlled.

12. On every fire, men are released in small numbers or individually. Under such circumstances as each man is released, is discharged, or quits the timekeeper will complete the Time Report immediately by (a) calculating the total time worked under each job classification title, (b) entering travel time, (c) entering the appropriate rate per hour, (d) calculating the amount earned under each job classification title, (e) entering the gross amount earned, (f) determining deductions for commissary or property losses, and (g) arriving by subtraction at the net amount due. The timekeeper will identify the individual, obtain his signature, and after signing the Time Report, file it alphabetically in the card box.

13. When large groups of men are released simultaneously following control, the men are marched past the timekeeper so he can obtain each man's identifying number. The Time Reports corresponding to these numbers are completed in the same manner as in 12.

When enough Time Reports are checked to provide a truck or bus load of men, the numbers are called off one by one, the man holding the corresponding number stepping forward to sign his Time Report. If payment is not to be made in camp the men are immediately loaded on trucks or busses for transportation back to their point of hire. If they are to be paid they are grouped to one side to await preparation and receipt of the checks.

The above procedure is followed until Time Reports for all men to be released have been completed.

Camp and other "back of the line" workers must also be required to check through the timekeeper. The camp boss should see that this is done.

Fire overhead from the strawboss to the fire boss should be required to check through the timekeeper; the strawbosses, crew bosses, and foremen at the time their crews are being checked out; the sector bosses, scouts, etc., as they go on or off shift. Every man should be reported on a fire time slip regardless of his job on a fire.

Time of line equipment should be kept by the operator and reported to the timekeeper. After each shift the time claimed must be immediately checked by a forest officer in position to audit the time claimed. Usually this is the sector or division boss or someone else in over-all charge of the line on which the equipment worked. A similar procedure should be followed for all other special services involving rental rates.

Beer Cans for Wet Water

Field personnel on the Superior and Black Hills (and perhaps other) National Forests have been using wet water to a limited extent in forest fire control work. They have found that a pint beer can with cap makes a desirable field container for wet water. Wet water is canned in these pint containers and carried on fire trucks or stored in fire caches for ready use. For the brands of wet water used a pint is mixed as needed with 5 gallons of water in a back-pack can.

A suggestion has been made by Ranger W. V. Kennedy, Superior National Forest, to request manufacturers to package wet water in similar small containers. This request will be acted upon if results of the wet water project being conducted in California indicate such packaging to be desirable.—Division of Fire Control, *Washington Office, U. S. Forest Service.*

PARACHUTING HEAVY CARGO

AERIAL EQUIPMENT DEVELOPMENT CENTER
U. S. Forest Service, Missoula, Montana

A study of aerial activities during recent years has revealed a particularly noticeable increase in the use of larger planes, both for freight and for crew transportation. This is not due entirely to availability. Records support the economy of using larger smoke-jumper crews on potentially dangerous forest fires. Although the contract rate is greater, the larger planes cost but little more on the longer trips, because of a much higher cruising speed. With little or no increase in cost and a substantial saving in travel time considered, the large ships are sometimes used for less-than-capacity loads, and space is often available for water or extra equipment that might shorten the control time on difficult fires. The greater carrying capacity, longer and larger freight compartment, and big doors make these ships suitable for many jobs which would not be possible or economical with smaller ships. Although these large planes cannot use many of the smaller fields, they are able to operate over a large area because of their greater cruising range.

The study also brought out that the larger planes of the DC-3 or C-47 type require considerably more maneuvering time over a drop spot and substantial savings could be made by a reduction of this dropping time.

The increased use of the C-47 airplanes for smoke-jumper attack on larger and potentially more dangerous fires has indicated the need to drop larger cargo bundles. Normally 30 minutes are required to complete the drop operation for a 16-man jumper outfit—eight to ten runs, depending upon the hazards of the approach and the time required for lining up bundles. At a cost of $195 per hour a considerable saving may be accomplished by reducing the number of cargo runs.

With such possibilities in mind the equipment development or equipment use program included the following:

1. Modification of the roller-platform for quicker reloading.
2. The investigation of the use of roller conveyors to handle materials inside the Ford and C-47 planes to speed unloading of cargo, and the use of large cargo bags and cluster parachutes for dropping heavy cargo.

PLATFORM FOR DISCHARGING HEAVY CARGO

A platform for discharging heavy cargo, or several bundles simultaneously, has been constructed and used successfully during 1950 and 1951. Materials dropped included a heavy lookout tower and house. Some slight modifications have been incorporated in the platform and detail drawings corrected.

This "C-47 Cargo Roller-platform" consists of an aluminum frame, 40 by 61 inches, in which are placed 23 aluminum rollers supported on each end by ball bearings for easy rotation under heavy loads (figs. 1 and 2). The deck between the rollers is constructed of .045 thickness aluminum sheet and is so arranged that the rollers project about ¼ inch above the slots. A cam and lever is provided to raise the rear edge of the platform approximately 4 inches off the floor of the plane to discharge the load.

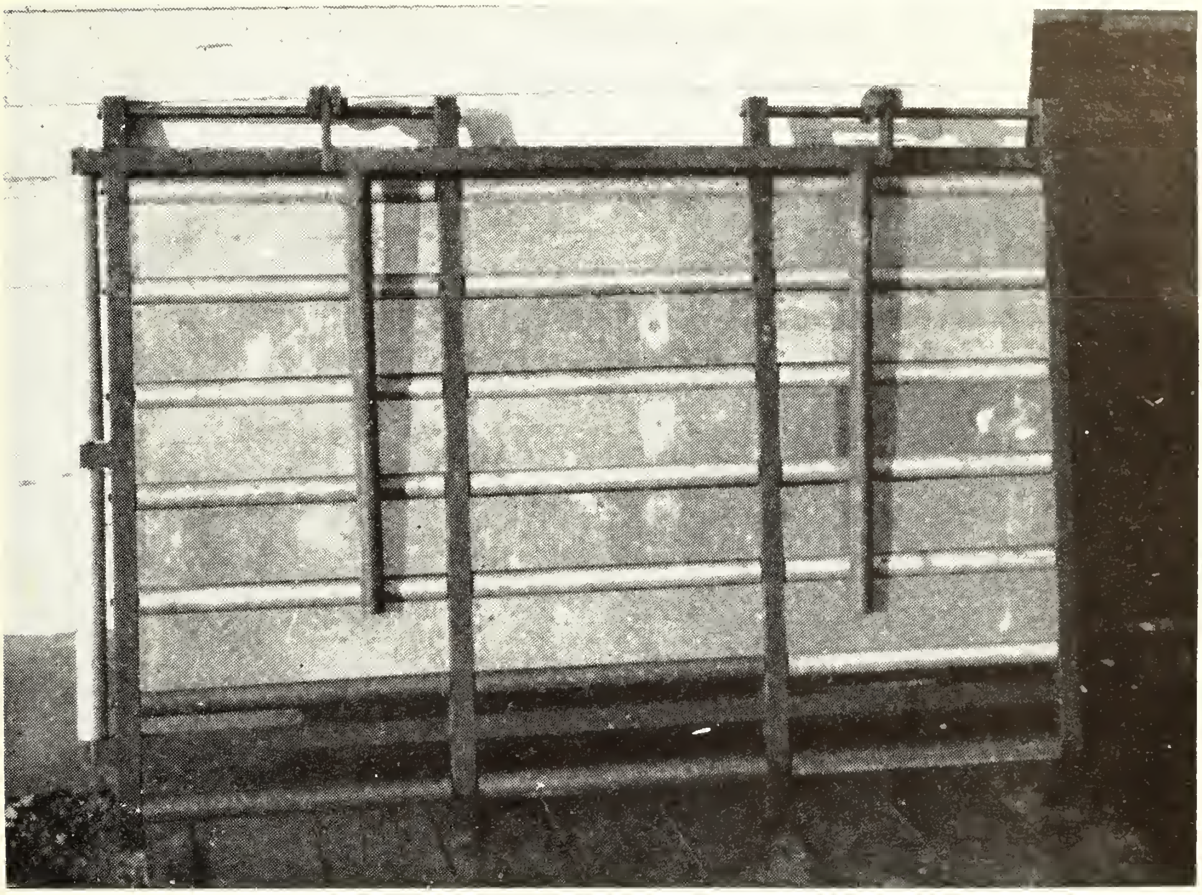

FIGURE 1.—Top of roller-platform as recently modified and strengthened.

FIGURE 2.—Bottom of roller-platform showing arrangement of framing members.

Placement or installation of the roller-platform requires only a few minutes. A sponge-rubber pad, about the size of the platform, is placed on the floor of the plane. The platform is then laid on the rubber pad and two guide and retainer pins, located on the outside edge, are placed in slots at the edge of the door. All C-47 and DC-3 airplanes have these slots built into the plane for other uses. The discharge lever or bar is hooked into place and the platform is ready for operation. When the roller-platform is resting on the rubber pad all the rollers are held stationary by friction on the rubber. This is important for safety in loading and to prevent accidental discharge of the cargo in rough air before the proper time.

Operation is extremely simple and, we believe, foolproof. The package or packages are placed on the platform with parachutes on top. Static lines are connected and the load is ready. At the proper time the operator pulls back and down on the discharge lever. If bundles are tied with heavy rope or have sharp projections it is desirable to place them on a sheet of scrap cardboard to insure a positive and immediate start without assistance.

In testing and using the roller-platform we have had no failures in operation. The maximum load discharged at one time was 1,200 pounds. In all cases one man has easily operated the lever to raise the platform off the rubber pad and discharge the cargo.

Detail drawings and material lists for manufacture are available upon request from the Regional Forester, U. S. Forest Service, Missoula, Mont.

LARGE CARGO BAGS

The successful use of the C-47 cargo discharge platform for large and heavy packages, or for multiple drops, has made possible the use of large cargo containers which handle a complete 8-man or 16-man outfit (fig. 3). Although experimentation to date has been confined to a 16-man unit, it appears that the outfit should be developed around equipment for 8 men. Two units would then be dropped, at the same time, for 16-man crews. The 8-man unit would be small enough to drop from the Ford airplanes by means of a roller-platform or a roller conveyer.

Several factors must be considered in dropping large packages:

1. The large packages are less likely to "hang up" in tall timber.
2. Large packages require multiple parachutes which reduce oscillation and consequently landing damage and also reduce the chances for damage due to malfunction of one parachute.
3. Large packages reduce the time required in assembling tools and equipment on the ground.
4. While there is some chance of losing the large package through poor spotting, the cluster parachutes and large bundle are easy to find in dense timber. It is more common to lose a single small package, or spend considerable search time, as a result of malfunction of the single parachute.
5. Fewer parachutes are required with large packages as loads can be adjusted more easily to the capacity of the chute. The low-grade plywood platform can be used for a mess table and discarded. The canvas bag, folded, requires about the same space as a parachute for the return trip.

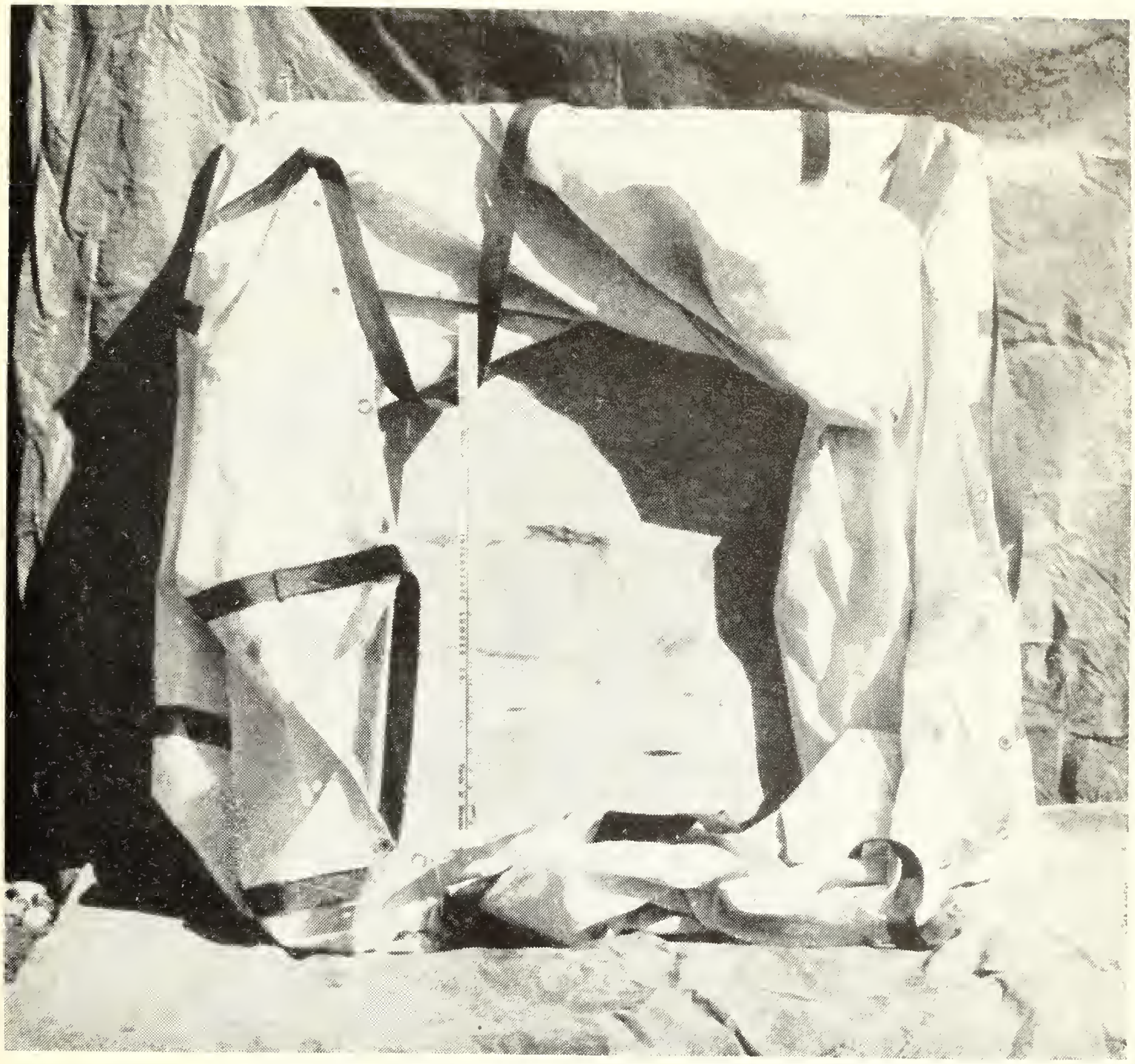

FIGURE 3.—Large cargo bag for carrying complete 16-man tool, subsistence, and camp outfit.

Experimental work has been conducted with a heavy cargo container large enough for a complete 16-man tool, subsistence, and camp outfit. Success with this bag should insure satisfactory performance with the container for an 8-man outfit.

The test bag was made of 12-ounce canvas reinforced with C-8 (2900-pound test) webbing at the corners and sides. A rough ⅝-inch plywood base 4 feet square is used as the bottom platform and stiffener for the bag. Corners are laced to facilitate packing and provide for removal of the contents in the event the load becomes suspended above the ground. Capacity is 64 cubic feet and when loaded with a 16-man outfit the gross weight is approximately 700 pounds. Four parachutes in cluster arrangement are needed.

The cost of materials and labor for the sample bag amounted to $65. Approximately 20 minutes saved in dropping time will pay for the container and we estimate the life of the container as six or seven trips.

Packing the container is important. Heavier packages should be on the bottom with the more fragile items, such as cans of water, placed on top. There are good possibilities of carrying fragile items in a container which is separated from the large bag by a 10-foot "lead" and arranged to receive support of a large canopy area after the heavier package rests on the ground.

The 1952 program will include construction and test of a cargo bag or platform for dropping a complete 8-man unit. Detailed drawings and specifications for construction of cargo bag for a 16-man outfit are available upon request.

CLUSTER PARACHUTES

Cluster parachutes, two or more parachutes arranged to deliver heavy loads from plane to ground, have several distinct advantages:

1. Heavy loads can be safely delivered with a saving in flying time while over the drop spot.
2. In the event one parachute fails to open the remaining parachute or parachutes will retard the rate of descent and often land the load without damage. This safety factor is desirable in using surplus army cargo parachutes. These parachutes were made available at little or no cost but are not 100 percent dependable because of age and storage conditions.
3. Heavy loads are less likely to hang up in tall timber.
4. Parachutes are more easily adjusted to handle the weights and therefore a smaller number of parachutes is required when dropping large loads of equipment.
5. There is a saving in time required to assemble equipment on the ground.
6. There is less chance of losing a large package than a small one, particularly when a large number of packages are dropped.

In our experimental work to develop methods and equipment for using multiple parachutes we wished to utilize, so far as possible, standard cargo parachutes (fig. 4). We believe this will result in a minimum of modification and eliminate the need for stocking special parachutes.

Preliminary tests were conducted with small (12-foot diameter) flare chutes. Since their construction is identical to that of the 24-foot and 28-foot standard freight chutes, methods of packing, the cluster container, methods of extraction, and performance under load would also

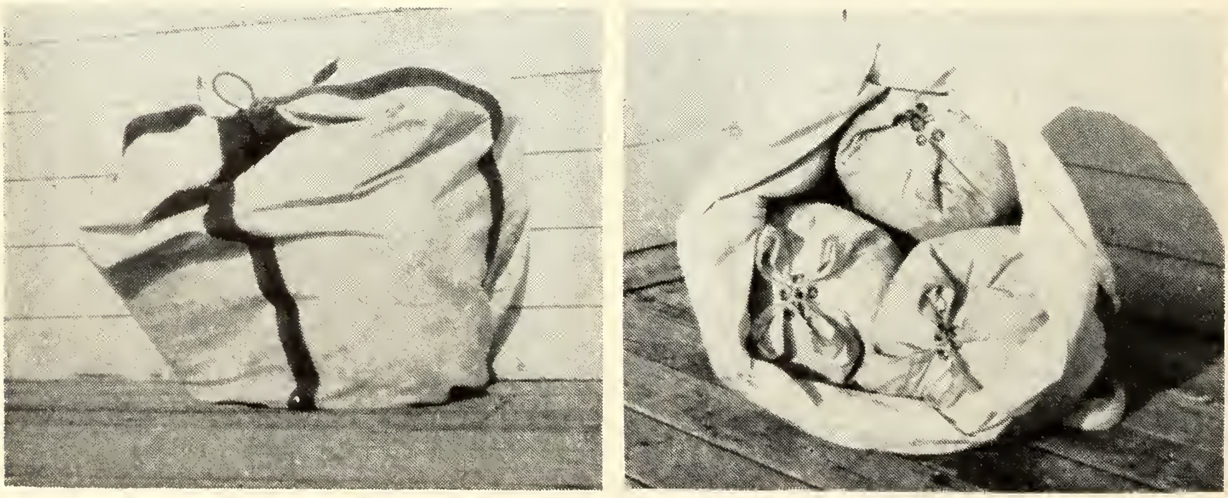

FIGURE 4.—Cluster parachute container. Holds 2, 3, or 4 standard cargo chutes for development in clusters.

be similar. Cost of testing and assembly was greatly reduced and test dropping could be done from smaller planes. After details were completely tested and developed with the small parachutes, the methods and equipment which proved best were used with the standard cargo chutes.

Two methods were selected, the difference being in the method of deployment.

Extraction by direct static line.—This method appears to be the most satisfactory and requires a minimum amount of special equipment and special packing.

A light-weight container is used to facilitate handling the parachute cluster in the plane. It contains a 40-foot webbing riser with two, three, or four leaders, each 10 feet long, at the upper end for attachment to the standard parachutes. Each leader has a loop sewn into the webbing for quick attachment and through which the standard freight riser is fastened.

The standard freight parachutes are opened and just enough of the apex on each chute pulled out of its container to circle it with stout rubber bands. The static line is then connected to the pull ring of each parachute to pull the canopies from the container.

Extractions by pilot chute.—This method is slower in action but also positive. It requires the addition of a small extraction chute which is operated by the static line. No lift is derived from the extraction chute after the cluster is deployed. Excessive stress is thrown on the apexes of the parachutes and reinforcement of the cluster chute apex is necessary.

It was believed that some increase in lift would be obtained from parachute clusters if they were "pig-tailed" or otherwise tied together. Normally the loss of air from each parachute causes them to repel each other, resulting in loss of lift. The arrangement of the pilot or extraction chute served to restrict the spread of the cluster and at the same time provided positive and simultaneous extraction.

Both types of extraction were tested successfully with no malfunctioning of parachutes or rigging. Analysis of packing operations and number of special items resulted in selection of the cluster arrangement which utilizes the direct static line for deployment.

Drawings, instructions for packing, and operational procedures are available upon request from the Regional Forester, U. S. Forest Service, Missoula, Mont.

Chief's Report Features Fire Control

The 1951 report of the Chief of the U. S. Forest Service is entitled "Natural Enemies of Timber Abundance." It prominently features fire as one of the natural enemies. The subject is discussed under the following titles: A complex problem, The status of protection today, Advances in fire-fighting methods and equipment, Forest fire research, Cooperative fire prevention campaign, Fire protection in civil defense, and Forest fires can be stopped.

PENNSYLVANIA'S FOREST FIRE PREVENTION PROGRAM

H. B. Rowland, *Chief,* and W. H. Smith, *Assistant Chief, Division of Forest Protection, Pennsylvania Department of Forests and Waters*

How can forest fires be effectively prevented? This question, which has faced foresters and fire control personnel for over 50 years, has provoked tremendous amounts of research and innumerable solutions, methods, and practices.

At the turn of the twentieth century the forest fire situation in Pennsylvania was extremely serious. It was actually the primary reason for the creation of the Department of Forestry, now the Department of Forests and Waters.

To appreciate properly the extent of the forest fire problem, it is necessary to obtain some background. This is needed to understand fully the forest fire prevention and control work that has been accomplished in Pennsylvania.

Fortunately the principles upon which the Department's Protection Division was founded were sound and sensible. This can best be exemplified by the following statement on the forest fire situation from the Report of Operations of the Department of Forestry for the years 1908 and 1909:

> The problem of forest fires in Pennsylvania will be solved only by means of education and the help of the people in the community. As soon as the mental training of those who inhabit the mountains, towns and cities are brought to the plane where they will appreciate the wrong and useless destruction and the great loss not only to individuals but to communities, which are wrought by forest fires, just so soon will the moral sentiment of the community turn against this annual performance; and those guilty of starting fires either through malice or negligence, will and should be ostracised in the community and treated as criminals who commit the grosser crimes. But education, or the ability to know and discriminate, must be followed up by active, earnest, helpful, willing cooperation in an effort to prevent or speedily extinguish every forest fire.

With this type of thinking being done by the early leaders, it was possible for the forest protection forces to move ahead with a minimum of confusion or changes in policy.

The first prevention program in Pennsylvania was a broad plan of education for people to use care with fire in or near the woods and not start forest fires. It endeavored to teach people to appreciate the forest from a value and need standpoint. About the only fixed source of fire was the railroads and here early efforts were made to fireproof the rights-of-way with safety strips and to inspect fire prevention equipment on locomotives. Education was directed toward brush and debris burners. Sawmills were inspected with fire prevention in mind. However, the prevention effort as a whole was a general one with wide coverage.

As fire reports, together with forms, maps, and statistics, accumulated each new year, a more specific analysis of the fire situation in the State could be developed. Special hazardous and high risk areas began to stand out in the various forest districts. These specific areas and their definite problems offered the chance for stressing prevention efforts.

State records in the early 1930's indicated that the size of forest fires and the total area burned had begun to be reduced, although the number of fires appeared to increase. This was due not to an actual increase in numbers of fires but to the development of an effective fire reporting system. Such an increase in number of fires reported, not only in Pennsylvania but nationwide as well, was a result of the expansion and increased efficiency of the protection organizations throughout most of the United States.

The law setting up the Department of Forestry placed all the forest land in Pennsylvania under protection from fire. However, it was not until 1920 that a satisfactory protection organization was effected and a district forester made responsible for each section of the State. By 1921 forest fire reporting had become sufficiently accurate that statistics set forth after that date can be used for comparisons.

For the 15-year period 1921-35 the State records show a total of some 48,670 forest fires reported. During 1936-50 33,830 forest fires occurred. This is a reduction of 14,840 fires, or an average of slightly less than 1,000 fires per year, over the previous period. During these same two comparable periods forest area burned was reduced from 2,367,000 to 756,000 acres, an average yearly reduction of burned area of more than 100,000 acres.

It is reasonable to assume that weather as a factor can be discounted to a large extent when a 15-year period is used for a basis of comparison. Therefore, it can be said that the large reduction in the number of fires reported during the past 15 years was primarily due to the prevention practices employed by the Department of Forests and Waters and others interested in conservation. The downward trend of the fire problem in Pennsylvania is shown in the following tabulation of the forest fire statistics by 5-year averages:

	Fires per year		*Area burned*	*Forest land*
	Number	*Average size (acres)*	*per year (acres)*	*burned (percent)*
1911-15	1,066	340	362,379	2.40
1916-20	1,454	149	216,869	1.43
1921-25	2,832	79	223,680	1.48
1926-30	3,189	46	145,160	.96
1931-35	3,713	28	104,587	.69
1936-40	3,213	15	46,868	.31
1941-45	2,160	32	68,480	.45
1946-50	1,393	26	35,885	.24

The reduction in area burned can for the most part be attributed to the continued improvement in the fire control organization, techniques, and equipment. The trend in average size of the individual fire is downward so long as the control organization keeps pace with the prevention activities and vice versa. When either one or the other gets out of line this figure will fluctuate. This accounts for the low average area per fire during the 1936-40 period when the emphasis was on extinction while the fixed area prevention program was just getting underway.

The percent of forest land burned follows the general trend of the

State's protection activities as it moves downward with each passing period. The present goal is one-tenth of one percent.

The anthracite coal region of Pennsylvania had long been known to be an especially serious forest fire area. This was a general idea and not limited to any specific place. It was realized that protection appropriations and personnel were being used in this region considerably out of proportion to other forested areas in the State.

By 1936 many of the records and statistics had been carefully analyzed and an effort was made to stop generalizing and to correlate fire occurrence with fixed areas or political subdivisions. The only practical and established units in Pennsylvania were the townships. It was well understood that this was not an ideal breakdown since no two townships were alike in size, forest area, fire risk or hazard. It did, however, offer an existing unit that could be used annually for comparative purposes within set limitations. It provided established subdivisions for study and assignment of prevention projects.

Township maps showing spot locations of fires were pointing out certain outstanding problem areas. Annual tabulations of fires by townships were showing quite clearly the relative importance of these problem areas. At the close of the 1940 season, the fire statistics for the 5-year period 1936-40 were closely analyzed and the average occurrence of fires by township determined. These studies pinpointed the areas of high fire occurrence. The figures for this period were then set up as a standard for future planning and evaluation.

In general it was noted that fires occurred in practically every part of the State. However, any unusual number of fires in any one township was taken as an indication that a definite fire problem existed. As a fire occurrence standard for designating a township as a problem area, the figure of 10 fires per year, based on 5-year averages, was arbitrarily chosen. The original list placed Hazle Township, Luzerne County, at the top with 99 fires per year. Altogether the list contained 48 townships each having more than 10 fires per year.

When it is considered that there are approximately 1,600 townships and civil divisions in Pennsylvania, it can be readily seen what a small part of the State was included in this list of problem townships. Further study, however, revealed that these 48 townships accounted for 35 percent of all the fires in the State but included only 5 percent of the total forest area of 15,127,640 acres. These townships, then, were the problem areas on which specific prevention practices could be concentrated.

During the spring of 1940 the first concentrated effort on specific prevention projects was made. The initial phase of the plan was to assign twelve young foresters to the projects, one man to several of the townships having the highest fire occurrence.

They were given lists of suggested activities, maps, and fire occurrence tabulations and charged with the task of making a definite plan for the prevention of fires in their assigned areas. Suggestions were made that they work with local officials, resident groups, and others in order to encourage cooperation, plan prevention, and promote educational programs for the people. This phase of the program was later followed by assigning certain forest inspectors (nontechnical fire control personnel) to specific townships to work with the foresters in setting up actual prevention projects.

These projects included safety strip work along railroad rights-of-way. Here a 100-foot strip was burned out for the distance necessary after a bulldozed or hand-raked back line had been constructed down to mineral soil. All together there are over 300 miles of such safety strip maintained in the State to prevent railroad fires.

Many of the small mining communities in the coal region located adjacent to forest or brush land were causing innumerable debris and brush burning fires every year. To overcome this problem safety strip projects were set up. These consisted of bulldozing or hand digging a fire line adjacent to the wooded areas and control burning the flammable material, weeds and brush, between it and the community. This treatment tended to fireproof the area and thus prevent fires from occurring.

The playgrounds, sports fields, and recreational areas which were determined to be potential fire hazards were treated similarly each year. Areas along roads and highways known to be hazardous were also given the safety strip treatment. In most cases this entailed control burning the grassy areas adjacent to the roads, or hazard areas, the distance necessary to make it safe. The need for a back line depended upon the local conditions. In most cases careful control burning precluded the need for such a back line. In cooperation with the local officials city and local dumps, which are always a fire hazard, were also safety stripped.

In addition to these projects concentrated prevention education was carried on in the areas which showed a preponderance of forest fires. The idea was to fit the prevention means, methods, and media to the immediate problem and type of people concerned. For this purpose a large amount of specially designed, mimeographed prevention material was prepared.

As a means of quick suppression and also for on the spot prevention work, the number of 1- and 2-man smokechaser units was increased during the fire seasons in these problem areas. The very presence of these men was extremely helpful in preventing fires, from a psychological standpoint in addition to the assigned work which they did.

In the areas where this specific prevention work was in effect the 5-year average of fire occurrence from 1940 to 1945 showed a marked reduction. The average number of fires per year for all 48 townships, plus 4 more which entered into the more-than-10 fire class during this 5-year period, was 652 or 30 percent of the 2,160 fires for the entire State as indicated in the following tabulation:

	Average number of fires per year		
	1936-40	1941-45	1946-50
All 52 townships with high fire occurrence	1,136	652	288
State	3,213	2,160	1,393

Further analysis showed that the reduction in number of fires amounted to 42 percent in the 52 townships given treatment as compared to 28 percent for all other townships.

During the 5-year period ending in 1950 the prevention work was continued or intensified in these areas. Every effort was made to put in a suggested remedy for each fire that had occurred. Again the number of fires was substantially reduced, and, for many of the townships, carried well below the 10-fire mark and held there. Hazle Township, Luzerne County, which had led the list with an average of 99 fires per year, now had an average of only 5 fires. The following tabulation shows the progress made in reducing the number of fires in the 12 counties at the top of the list in 1940:

Township and County	Forest area (acres)	Average number of fires per year		
		1936-40	1941-45	1946-50
Hazle, Luzerne	26,331	99	52	5
Foster, Luzerne	24,748	72	29	3
Mt. Carmel, Northumberland	10,286	63	12	5
Coal, Northumberland	13,387	55	14	3
Archbald, Lackawanna	9,518	53	9	10
Mahanoy, Schuylkill	10,259	42	26	8
Hanover, Luzerne	8,960	38	38	4
Kline, Schuylkill	6,462	37	23	7
Plains, Luzerne	7,473	32	6	6
Newport, Luzerne	7,067	32	14	2
Mauch Chunk, Carbon	24,892	32	29	12
W. Mahanoy, Schuylkill	4,070	28	23	8

For the 5-year period ending in 1950 the 52 townships had only 288 fires per year, or a reduction of 75 percent from the number that occurred during 1936-41. For all other townships the reduction was only 47 percent, and for the State as a whole 57 percent. This further emphasizes the value of specific treatment in areas of high fire occurrence. This reduction in fire numbers is especially interesting in that the number of persons using the woods during this period increased more than 50 percent over that of the previous 5 years.

After studying and observing the results of these prevention projects it is felt that outstanding progress has been made in Pennsylvania's forest fire prevention program. At present all but 5 of the original 52 townships have been removed from the problem list. One of these exceptions is Rush Township, Centre County, which is on the list primarily because of its size. It contains ten times the forest area of the average township, more forest area than each of 11 whole counties in Pennsylvania. The other four exceptions are townships in which this specific prevention treatment has not been applied as intensively as in the others.

Now that these problem areas have been brought back to average or better, the task ahead is to maintain or further improve the records. This leads to the next stage of planning for this purpose. At this writing a new list of townships has been made with the critical point for the problem area status set at 9 fires rather than 10. This list contains only 18 townships based on the latest 5-year averages. Plans have been made for applying specific prevention projects in each of these areas in an effort to bring the number of fires below the set critical point.

This does not mean that the work done in the original critical townships will be relaxed. Most of the projects will be carried on as before but possibly not to the same degree of intensity. Perhaps as time goes on and it is felt that the various problems are resolving themselves, the actual prevention work will be lessened to a greater extent. However, this will be gradual and dependent upon local conditions in each specific area.

This article is not meant to imply that this work is a solution to all of Pennsylvania's forest fire problems. It is well realized that only one fire occurring in the State at the right time and in the right place could burn thousands of acres if it was not promptly and efficiently handled. The fact remains, however, that for each fire prevented the chance of this happening is proportionally reduced. In addition, each fire prevented means the continued availability of the control force for the fire that does occur.

This prevention program in Pennsylvania is designed to stop fires by eliminating the source of the trouble which causes them. The program set up to do this has been successful and its potentialities cannot be overlooked. As has been pointed out, the program will be continued with higher goals for attainment established as the fire problems are reduced in numbers.

Somewhere along the line there is an irreducible minimum insofar as forest fire occurrence is concerned. However, we do not believe that this point has been reached as yet. Nor do we believe that it will be realized State-wide in 1 year or 10 regardless of the funds spent each year to achieve that goal. Rather the prevention program is continuous year after year, each period's accomplishment adding its weight to the over-all job to be done. Whether this program will eventually solve all the forest fire problems in Pennsylvania remains for the future to answer, but it is hoped that this type of program will enable the State to reach the point where forest fires will not be a threat to her 15 million acres of growing forests. In the foreseeable future, however, it will be necessary to maintain an alert, well-trained, and well-equipped fire control organization primed to handle both the prevention and extinction phases at all times and under any emergency.

Fire Pruning of Slash Pine Doesn't Pay

In a recent test where severe fires should have hastened natural pruning of slash pine, a small gain in pruning was offset by a loss in height growth.

On February 28, 1949, a class 5 fire day, head-fires were set in three plots in a poorly stocked plantation on an upland site in south Mississippi. At that time the slash pines were 9 years from seed and averaged 23 feet tall. The fires caused only 2 percent mortality.

Measurements in March 1951 showed that 2-year height growth of the slash pine was 5.3 feet on burned plots and 6.8 feet on adjacent unburned plots. This loss of 1.5 feet was almost equal to a half year's height growth. For trees of equal height at the time of the fire, the lowest live limbs in 1951 were 1.9 feet higher on burned trees than on unburned.

Even for very tall burned trees (40 feet high in 1951), the average height of the lowest live limbs was only 14.2 feet. Thus the maximum pruning accomplished by fire has not been great. Any fire intense enough to prune southern pines is likely to cause growth losses similar to those measured on these plots. In this plantation, it seems likely that natural pruning of the unburned trees will catch up with that on the burned trees in about 3 years, and that the principal permanent effect will be the loss of about a half year's height growth.—David Bruce, *Southern Forest Experiment Station.*

MICHIGAN POWER-WAGON PLOW

Steven Such
Engineer, Michigan Forest Fire Experiment Station

Undergoing extensive field tests in Michigan at the present time is a hydraulically controlled fire line plow mounted on the rear of the four-wheel-drive power wagon described in the October 1950 issue of Fire Control Notes. This plow is the result of 2 years' work directed toward the development of an efficient, practical plow unit for trucks in the power-wagon class (fig. 1).

Figure 1.—Michigan power wagon with hydraulically controlled fire line plow ready for use.

Originating as an idea in the field, the plow was designed and tested at the Michigan Forest Fire Experiment Station, with several other models preceding the one now being tried. The present design seems to best satisfy all the conditions required of such a unit.

Some of the features of this plow, including a simple mechanical linkage, are:

- Double hydraulic action, permitting the plow to be lifted behind the truck as well as being pushed into the ground.
- Cylinder-over-beam design to obtain the most efficient use of the weights involved and to gain the maximum compactness for transportation purposes.
- Depth control mechanism in a convenient place for quick and simple adjustment of depth when drawbar height changes as a result of a fluctuating water load.

Spring action through an integrally mounted spring which absorbs shock loading while creating a constant down pressure.
Tracking action permitting the plow to follow the truck around turns.
Quick detachability.
High clearance.
Low drawbar power requirements.

The control mechanism for the hydraulic circuit is located in the cab of the truck and requires only a lift or a downward push on a lever to get the desired action on the plow. For carrying, the beam rises into a vertical position where it can be held by the hydraulic force of the cylinder if the plow is to be used intermittently, or it can be secured with safety chains when highway travel is anticipated (fig. 2). Down pressure can be exerted to the point of actually raising the back of the truck.

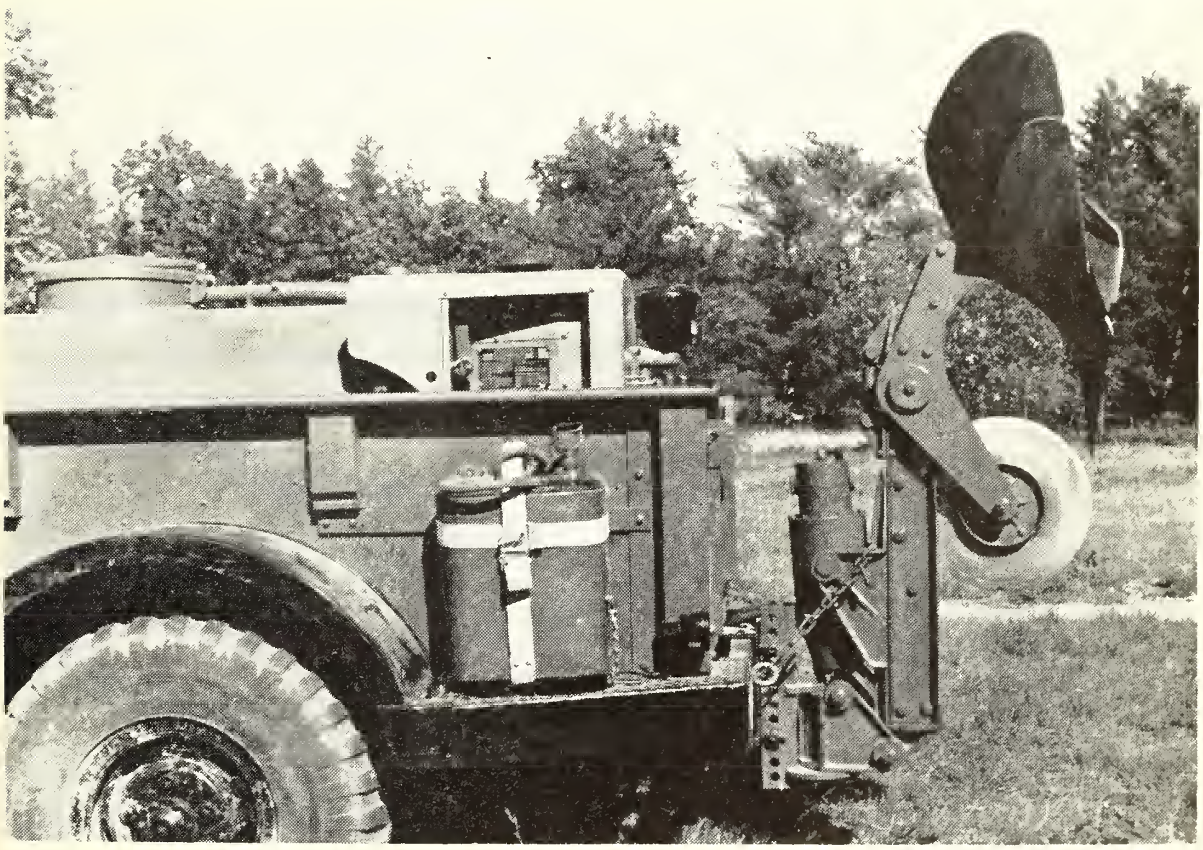

FIGURE 2.—Plow in vertical position secured by safety chains for highway travel.

When in operation, the hydraulic cylinder floats inside a larger cylinder. The floating action is obtained through the spring which is coiled around the smaller hydraulic cylinder. This feature is particularly desirable in rough country where long skips would be encountered with a stiffly mounted unit.

Because the truck bed rises as the water load decreases, thus changing the drawbar height, this condition is counteracted by the use of a depth control screw on the top of the beam at the rear of the plow. This screw eliminates a burdensome job of changing heights at the head of the plow. The principle involved here is simple, being centered around the pitch of the plow point. Any depth can be had by varying the degree of pitch. To insure a consistent pattern in operation between the rolling coulter and the plow bottom they are combined as a single assembly never changing positional relationship through an entire cycle of depth adjustments.

Lateral or sidewise action takes place about a vertical pin which permits the plow to track freely after the truck even on the most acute turns. This action is necessary to minimize lost line. When being lifted on side slopes the plow swing is controlled by positive stops, and at the top carrying position it swings into a central position by a cam-like action about the vertical pin.

Maximum plowing depth is about 4½ inches, this depth being governed by wide flanges on the sides of the rolling coulter. The width of line at this depth averages about 54 inches, depending somewhat on the soil and cover types.

The use of a middlebuster type bottom with moldboard extensions, and the addition of turf knives, gives a most satisfactory, clean-cut line of suitable width for the purposes intended for this unit (fig. 3). This combination of bottom and turf knives creates the least amount of resistance to forward motion of any bottom tried to date. The entire bottom, with the exception of the turf knives, can be purchased commercially, as can the 18-inch diameter rolling coulter used. The extensions on the moldboards have been a helpful addition to the plow in that they hold and push aside the furrow slice, thus reducing the amount of lost line.

Total weight added to the power wagon by the installation of this unit is close to 700 pounds. This includes all the parts of the hydraulic devices, the castings, and the plow. It should be pointed out, however,

FIGURE 3.—Clean wide line made by power-wagon plow.

that close to 80 percent of this weight is on the plow when it is operating, and only 20 percent is carried as dead or nonfunctional weight on the truck.

The discriminate use of castings to combine functions and to simplify production has minimized work time necessary for manufacturing as well as greatly improving the ultimate design of the plow and its attachment to the truck.

Every effort has been made to reduce the cost of this unit to an absolute minimum without sacrificing quality, strength, or safety. At the present time no definite figures can be given on the exact cost of the completed outfit as installed and ready to work.

Future plans include similar hydraulic plow adaptations to crawler type tractors. In regard to power-wagon usage, further refinements unquestionably will arise, and already in the thinking stage are multiple uses for a form of hydraulic power package unit of which the plow would be only one element. Other tasks requiring a large force, such as lifting, pushing, or carrying, offer possibilities for expanding the use of the hydraulic units on four-wheel-drive trucks just as it has on crawler tractors.

Additional information on the power wagon and the power-wagon plow may be obtained from the State Department of Conservation, Lansing, Mich., or from the Michigan Forest Fire Experiment Station, Roscommon, Mich.

Improved Support for Fuel-Moisture Sticks

Ever since the fire danger rating system has been in effect fuel-moisture stick supports have been unstable. To overcome this a new support has been devised (fig. 1). It can be used with either the early standard system or the newer, open type station.

Four iron drift pins ½ by ½ by 24 inches (or square or rod iron) are drilled 1 inch below the top with a hole large enough for No. 9 galvanized wire. Two pins have another hole drilled at right angles ¼ to ⅜ inch above the first. No. 9 wire runs through the lower holes to support the sticks; the other holes are used for wire laid across the top of sticks to hold them in place. File a notch around each pin 8 inches below the 1-inch hole, and a second notch 4 inches below the first. The first marks the top of leaf litter or ground level depending on the system used. The second notch marks ground level for open type stations.

Little can be held in place by using 2-by-4's around the screen supports. A neater, trimmer job is gotten by using a piece of 4-inch wide zinc. Leaf litter is covered with 2-inch mesh wire.—E. B. Olson, *Cheat District, Monongahela National Forest.*

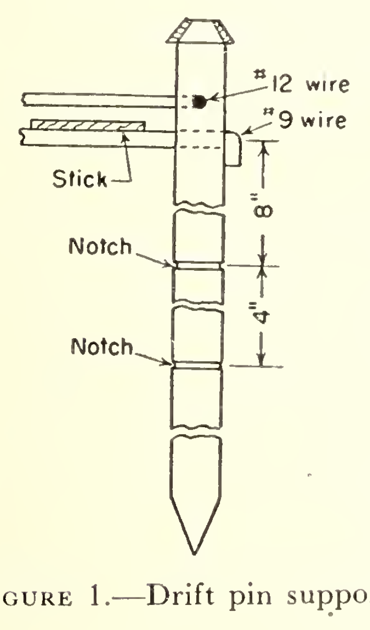

Figure 1.—Drift pin support.

A FIRE-WHIRLWIND OF TORNADIC VIOLENCE

HOWARD E. GRAHAM,[1] *Meteorologist*
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Whirlwinds occasionally have been reported occurring within various types of fires. Accounts sufficiently detailed to give the reader a definite idea of what the reporter had actually seen are rare. Since the fire-whirlwind is a phenomenon of considerable importance to fire fighters, I will attempt to describe one which was observed by Robert S. Stevens, Forester, Oregon State Board of Forestry, and myself at 2 p.m. August 23, 1951, on the Vincent Creek fire in southwest Oregon. Figure 1 portrays the spectacular wind conditions.

From our vantage point about 200 yards away it was evident that violent whirling surface winds existed over a diameter of some 100 to 200 feet. In the middle of this circulation was a dark tornado-like tube which extended upward, the top being obscured by drift smoke above approximately 1,000 feet. The winds in this tube were so extreme that a green Douglas-fir tree, which at breast height was about 40 inches in diameter, was quickly twisted and broken off about 20 feet above the ground. In the area of the whirlwind, the fire flames leaped several times higher than those surrounding. A large tree top burst into flame like the flash of a powder keg when the whirl passed by. Within the tube, gases and debris were moving upward at a high velocity. The whirling column remained nearly stationary during its activity, moving little more than 50 yards. Had that not been the case, extremely rapid fire spread might have resulted. The whirlwind rapidly disappeared and as rapidly reformed a moment later, repeating this procedure at least 3 times during a 10-minute interval.

The general fire was on a 50-percent south-southwest slope. The trees were widely spaced with fuels consisting of low brush, weeds, snags, and down logs typical of an old burn in this region. The fire front was moving steadily along the contours and extended up the entire slope, about one-half mile from top to bottom. Flames along the front were about 5 feet in height. Shorter flames persisted to a distance of about 50 feet behind. A slight spur ridge projected from the slope so that updrafts were moving from both the south and the southwest into the area of the whirlwind. The fire-whirlwind developed a few feet behind the fire front 150 yards from the summit of the main ridge and on the spur ridge.

The meteorological condition of the atmosphere was one of conditional instability. Overturning of the air in the lower layers could readily occur if the surface were heated sufficiently. No cumulus clouds were to be seen. Winds at ridge top were north-northeast from 10 to 15 miles per hour. Above the ridge top level, winds were from north-northwest to

[1] The diagram was prepared by the Pacific Northwest Forest and Range Experiment Station draftsman.

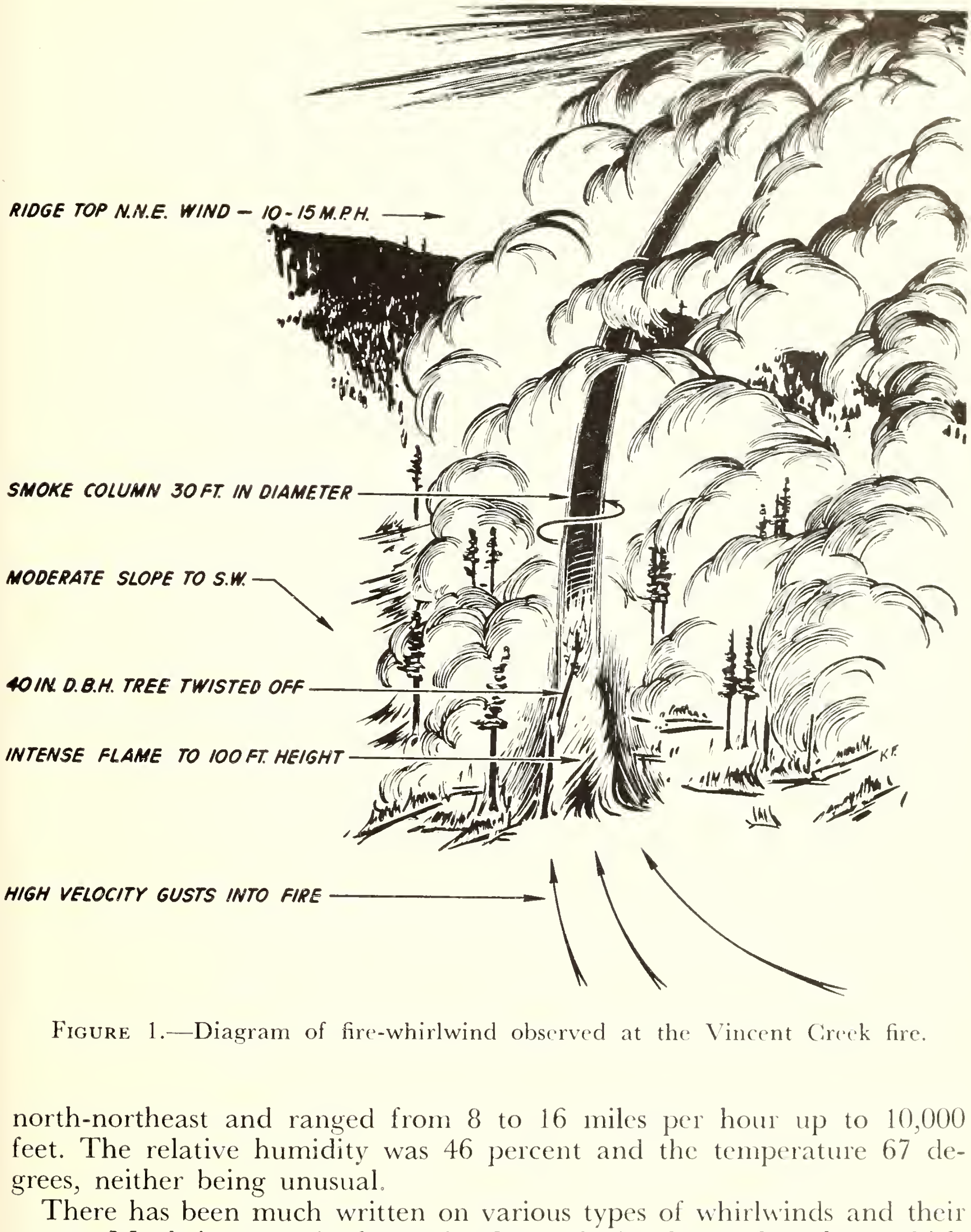

FIGURE 1.—Diagram of fire-whirlwind observed at the Vincent Creek fire.

north-northeast and ranged from 8 to 16 miles per hour up to 10,000 feet. The relative humidity was 46 percent and the temperature 67 degrees, neither being unusual.

There has been much written on various types of whirlwinds and their causes. Much is yet to be learned. Meteorologists know that these whirlwinds at present only where the atmosphere is in a particular condition of unstable equilibrium—where the temperature decreases so rapidly with height that the warmer air below, being lighter than the cooler air above it, tends to rise, and conversely, the cooler air aloft tends to sink. The result is intense vertical currents throughout the unstable layer.

In this case, we have the heat from the fire which caused the unstable conditions. However, this is an entirely normal situation over a large fire. Since these violent fire-whirlwinds are infrequent, there must be some condition other than heating to cause their formation. Perhaps the answer lies in the interplay of wind currents and topography. In the case under discussion, consider the position of the whirl near the top of a sunlit south-southwest slope where it was fed by upslope drafts from the south and southwest in the surface layers. Above the level of the ridge the rising currents from the fire were played upon by the prevailing gentle to moderate north-northeasterly wind. Perhaps herein lies the answer. There were two opposing air currents with a column of rapidly rising gases between. This is an ideal condition for the formation of mechanically induced eddy currents. An eddy current, once started, might be sustained by the energy of the rising hot gases. This theory is substantiated by the repeated reappearance of the fire-whirlwind in the same spot. As the leading edge of the main fire progressed, the fuels in the area of the whirl were consumed and the volume and heat of the ascending gases became apparently insufficient to support the whirlwind. As the fire moved on to new fuel and new topographic features no further disturbance was noted.

From this analysis it would seem likely that there are certain ideal combinations of conditions under which this type of fire-whirlwind of extreme violence might occur. The necessary factors seem to be for the fire to be on the lee slope sheltered from the prevailing ridge top winds, a moderate or stronger wind at the ridge top and strong converging surface updraft currents along the burning or sunheated slopes. It would be desirable to have the necessary combination of conditions more positively identified so that fire fighters could learn to anticipate at least this one type of blow-up fire behavior. Additional detailed accounts of similar phenomena would contribute to the understanding of their causes and their effects on fire behavior. These accounts should attempt to describe the topography, surface wind, ridge top wind, fire intensity, cloud types, smoke column characteristics, and the intensity of the fire-whirlwind.

RECENT DEVELOPMENTS IN SOUTHERN FIRE CONTROL [1]

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The statements made here are meant to have application only to the 11 southern States. The thoughts and facts presented are not just my own. In evaluating and choosing for this paper those developments which must be credited with exercising the more significant and valuable effects, I have had the benefit of advice and suggestions from a cross section of men long and intimately familiar with southern forest fire and timber management problems.

For anyone properly to appreciate and measure the meaning of these developments, it is necessary first to have a general picture of the situation as it existed in the South only a few years back.

In round figures, there are 180 million acres of forest land in this area—about one third of all commercial forest land in the United States; land which now grades all the way from denuded of commercial tree species up to heavily stocked with high-value timber growth. Due in part to our long growing season and the nature of our tree species, these lands as a whole have the highest wood-yielding potential of any major area in the United States. This area can—and some day will—be this country's superior wood-producing area. One can safely say that the South would be occupying that position today except for one factor: The historic prevalence of an immense and widespread fire problem.

It would be oversimplification to say that through elimination of wildfire alone, southern pine lands would return to a highly productive state. Yet, the seeding proclivities and fire resistance qualities of the southern pines are such as to make the above statement nearly true.

The existing stands, vast in their aggregate, and all of which have been burned one or more times, are dense, understocked, or nonproductive in direct relation to the fire history of each. Bad cutting practices have had their effect. Nevertheless, in spite of former widespread exploitation logging, one can find near endless examples of fine naturally regenerated second-growth stands on those abused lands where it so happened that woods fires were infrequent. Fire control intensity has been and will continue to be the most decisive factor in determining the extent and quality of timber stands available to the landowner or silviculturist on which to apply good management practices.

Prior to the CCC program in 1933, only fractional and scattered parts of this area received any organized protection. Some States had not then created even a nucleus of a protective organization.

In 1932, 41,391,690 acres were under protection of some degree. On those protected areas occurred 21,776 fires which burned 2,342,960 acres.

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[1] Paper presented at the annual meeting, Society of American Foresters, Biloxi, Miss., December 14, 1951.

On the 129,000,000 acres of unprotected forest land, there occurred (incomplete) 101,277 fires, burning 38,732,560 acres.

I do not wish to burden you with statistics. Certain figures, however, are essential in producing a picture of the changes which have occurred and the present situation:

	Protected area		*Unprotected*	*Total*
	Total	*Burned*	*area burned*	*burned*
1932	41,391,690	2,342,960	38,732,560	41,075,520
1940	84,603,000	1,704,251	27,383,649	29,087,900
1945	96,647,000	1,354,741	13,986,527	15,341,268
1950	133,600,000	2,754,522	10,920,155	13,674,677

In other words, the area under protection has more than trebled. The area burned annually has been reduced by two-thirds.

While we are considering progress, a misconception of the existing southern fire problem could be formed if at this point I did not underscore the fact that in 1950 there remained 47,000,000 acres of unprotected forest land, on which occurred 97,395 fires, burning 10,920,155 acres.

The previously quoted figures do tell a story of steady and outstanding progress in fire control effectiveness. The question follows: What were the developments contributing most to those effects?

First, within the last few years there has been a tremendous reversal in the minds and viewpoints of the general public towards woods fires. Call it Fire Prevention, I&E, or what; the fact is that across the South, from a former combination of actual belief in woods burning and mass indifference, the business, civic, and political leaders, newspaper editors, folks in the small towns, and many rural residents have gained an understanding of the limitations imposed upon the general economy by past woods burning.

There now is widespread realization that the southern timberlands can produce so bountifully and steadily as to create large income to landowners, and the wages and business transactions which would go with the expanded wood-using industries can rise to where these industries would assume a major and stable role among all other contributors to southern economic health.

This change in public attitude is the fruit of: (a) The unremitting and extensive educational campaigns conducted by forestry and agricultural agencies and by the more farseeing and better led wood-using industries; and (b) the power of the dollar—the recent vigorous growth of all types of wood-using industries. This growth is illustrated by the southern pulp industry which during the last decade has expanded to 61 mills with 7 more building, and which now is consuming 12,250,000 cords per year or 60 percent of all pulp produced in this Nation.

This demand for stumpage at good prices at all points in the South, coupled with the creation of significant woods working pay rolls, has given concrete meaning to the foresters' story that tree growth is too valuable to destroy and has had much to do with the development of positive opposition to woods burning by such a large part of the public. Again, this is progress only. We still have a long way to go before that remnant of the population still prone to deliberate and careless woods burning is educated to where fire occurrences will approach reasonable numbers.

Under the best of prevention conditions, the southern woods will continue to have fires. As protection becomes more effective and fires less frequent, a marked change occurs in the nature and density of ground cover and behavior and intensity of fires. In frequently burned woods, the amount of fuel is of course relatively light, and fires are not too difficult to suprress. With protection, our fuels accumulate, young growth develops and fires tend to crown.

Down here we must contend with a lush growth and rapid development of fuels. They are flash fuels, will burn within a few hours after a heavy rain, and will burn at any time of the year. Our fires spread fast and before the high winter winds, will run and spread with extreme rapidity. Fire spread is so fast and the amounts of control line to be built pyramid so rapidly, that even with great reservoirs of trained manpower quickly available during CCC days, and the then much lighter fuels, we learned that manpower with hand tools could not do an acceptable suppression job.

After the close of CCC, the southern fire men soon learned that the combination of time required to gather and place manpower on the fire line, the rapid advance of the fires, the increased difficulty of building a control line, and the peak numbers of simultaneous fires in an operating area, added up to defeat.

The magnitude of our fire problems magnified the inherent weaknesses and limitations of old suppression methods and had the fortunate effect of supplying the impetus needed to rapidly develop and adopt more effective methods and facilities.

In addition to the major change in general public opinion toward woods burning and fire prevention and the marketability of woods products at good prices accompanying the expansion of southern industries, the following have been significant developments.

1. Of crucial importance was the increase in State fire budgets from $2,258,214 in 1941, to $4,898,000 in 1946, and $10,262,000 in 1951. Those increases reflect, of course, the development of more effective presentation of the value of fire control to the people and the State legislatures.

2. We have expanded the use of fire danger meters to guide the daily intensity of observation coverage and the activation and strength of key suppression forces.

3. Most protective organizations have developed effective radio networks that make direct communication possible between all levels from the chief to the crew leaders. This has resulted in a speed of action and degree of coordination between segments of organization not otherwise obtainable.

4. The most outstanding and revolutionary development has been in the field of powered fire line equipment. In the southern States, State foresters, national forests, and industrial landowners have acquired more than 1,300 mechanized fire line units during the past 6 years. These units, designed to meet specific performance requirements, are divided into four general weight or size classes, each with alternate designs to conform to the requirements presented by topography, soils, types and density of ground cover, and rates of fire spread found in the different areas and timber types.

These units, many of which require a crew of only 3 or 4 men, have a productive capacity equivalent to 40 or more trained and fresh men;

they can keep going day or night and handle a number of fires in one day. The relative effectiveness of equipment over straight manpower increases by the hour. In our climate at least, the exertions incident to building fire line by hand wears men out rapidly and their productive rate begins falling. Equipment fire control operations require less physical effort on the part of supporting manpower, and replacement of those crew members is a relatively simple problem.

One key to their outstanding success is that, with radio communication and fast transports, these units can be spotted at strategic points, and they start line building while fires are still small and usually have a fire suppressed in less than the time required to simply assemble a sufficiently strong manpower crew.

Another key is that the high mobility of these radio-controlled mechanized units make it possible in a short time to draw from a wide area and concentrate on a dangerous situation the numbers of these powerful forces that the situation may demand. Studies have revealed that under parallel situations, the total cost of mechanized suppression is about one-quarter of the cost of hand tool suppression.

Of even greater importance, the area burned, and consequently the amount of fire damage, on the equipment-fought fires is about 20 percent of that which we suffer under the hand tool control methods.

In the past, during periods of high burning conditions, fires—even with more than 1,000 men on them—reached major sizes and burned for days. In areas properly equipped with machines, no fire situation has developed which could not be controlled in a matter of hours.

5. The development of prescribed burning or the use of fire as a timber management tool has resulted in outstanding contributions to the know-how and quality of fire control operations. Nevertheless, it must be emphasized that properly conceived prescribed burning is primarily for silvicultural effects.

By some, this activity is misconstrued to include the old practice of "light burning" or the burning off of an area simply to prevent a later wildfire from running through it. Prescribed burning *does* lessen the probability of a disastrous fire. On a large and managed area normal use of fire for silvicultural objectives results in the removal of dangerous fuels from a number of separate blocks thereby increasing the probability of a bad fire running into one of these blocks where it can be stopped quickly. Its one direct protective use is in the breaking up of extensive bodies of dangerous fuels by burning a new pattern of strips annually at various strategic locations, with a technique that inflicts only minor damage to the commercial stems and continues those areas in timber production.

A more significant contribution is what the execution of prescribed burning has taught the fire man about the characteristics and behavior of fire in our fuels. Wildfires usually are suppressed under conditions of rush and excitement. There then is but limited time or opportunity to calmly study the many vagaries of fire.

When using fire as a planned work job, even the old timers exhibit nervousness during their early experiences. However, as time passes and they work steadily under conditions of calmness, they begin to observe and learn fire's more intimate behavior characteristics. They learn the ways fire actions can be predicted and directed. In time they gain a feeling of confidence and surety of their ability to master fire. Out of this work has come a corps of men and attack methods having definitely superior effectiveness in the suppression of wildfires.

6. More effective training is being given through cooperative programs by the protection agencies. The quality of execution of any job is set by the quality of training given the men who are to do it. This fact assumes greater importance in the actions of suppressing live and moving fire where the penalties for delays or substandard performance can be so costly. One of the two more valuable developments has been the combined field training programs attended by key men from all protection agencies within a State and in which each organization takes leading parts. This approach results in rapid exchange of the lessons each organization has drawn from its experiences, a broader source of minds to consider each other's problems, and more uniform operating methods by agencies which frequently have to work together on the same fires. The second development has been more and more use of actual fires as models on which to demonstrate both good and bad practices and work out improvement suggestions.

The critiques which follow these "live ammunition" actions have demonstrated that these training lessons are more vivid, clear, and lasting than those using classrooms or simulated fires only.

Improved Stick-on Azimuth Circles

The Rocky Mountain Region of the U. S. Forest Service has for many years had a problem in the production of radial circle maps for fire control use. The azimuth circles were first drawn by hand, which was inordinately time-consuming even when done by skilled draftsmen.

In the mid-thirties the California Region developed a hand instrument for printing protractors on base maps. Known as the California Printer, it speeded up the process of adding radial circles; but great care had to be taken to get the placement and orientation right, and the imprints lacked the sharp definition that is desirable. The instrument is still used in many areas, however.

Attempts were also made to fasten printed radial circles to maps with adhesive. One of the first commercial products in this field, the "Glassine" radial circle, was printed on opaque paper. The fastening agent usually deteriorated in a few months, however, and the circles buckled and fell off. Another product, the "Visitype" protractor, was tried next. It used a paraffin-base adhesive, which was only a slight improvement. We then contacted the manufacturer, explained our difficulties, and eventually received for test purposes some improved Visitype protractors printed on clear cellulose acetate, with resinous adhesive backing.

The acetate protractors were mounted on a test map, which was then placed in use in a sunny location inside the cab of Squaw Mountain Lookout, on the Arapaho National Forest, at an elevation of 11,300 feet. Thirteen months later the circles were still in excellent condition, with no buckling, wrinkles, or fading, and without the slightest appearance of adhesive failure. During that time the map had been subjected to temperature variations of from 90° above to 30° below zero, and relative humidities from 10 to 90 percent.

It is our opinion that the new Visitype radial circles, printed on clear acetate and with a resinous adhesive backing, can be used to great advantage in the preparation of fire control radial maps. The product is inexpensive, can be mounted without tools or special equipment, and may be obtained in quantity.—WILFRED S. DAVIS, *Forester, Region 2, U. S. Forest Service.*

BUMPER SERVES AS CONTAINER FOR TORCH FLUID

D. A. Anderson

Head, Research & Education Department, Texas Forest Service

A novel container for holding a reserve supply of fuel oil for backfiring torches is being put to increasing use by the Texas Forest Service. It is actually the front bumper of fire fighting vehicles (fig. 1). The unit, which will hold about 2½ gallons, was developed by J. O. Burnside and M. S. Lawrence of the Fire Control Department.

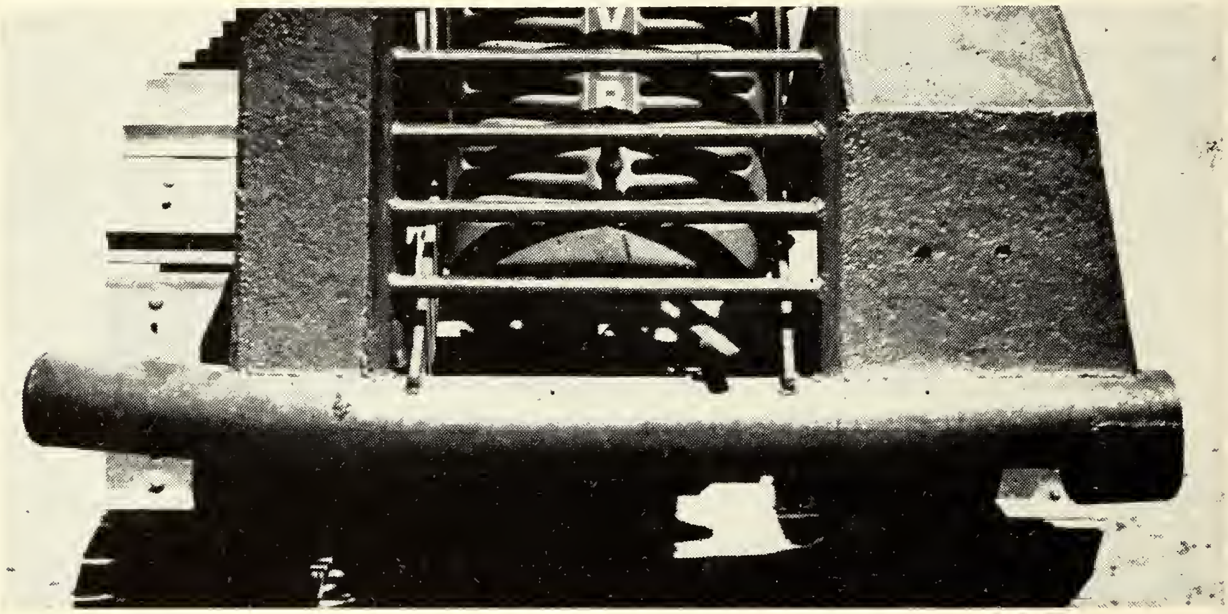

Figure 1.—Tractor bumper made to serve as a container for back-firing torch fluid.

The bumper is made from 4-inch, round, steel water pipe. For the tractor shown, a piece of pipe 57 inches in length was cut one-half through at a point 16 inches from each end. Each end was heated and bent back a distance of 4½ inches and welded electrically. One end of the pipe was capped with a piece of ¼-inch flat iron and welded. At the other end of the bottom half of the first 4½ inches was removed. Then, a disk of ¼-inch flat iron, which had previously been threaded for a ⅜-inch pipe, was welded as shown in figure 2.

To each side of the 4½-inch section removed from the pipe, there was welded a 2- by 4½-inch piece of flat iron, this being in turn welded back to the original cut on the bumper as pictured. Thus, the end of the pipe was given an oval shape to provide a place in which a valve could be installed and would be protected from damage.

A ¾-inch gas valve with stem cock was inserted at the bottom end of the pipe to serve as an outlet for the fire torch fluid.

For the intake point, a hole was cut in the top near the center of the pipe in which was inserted and welded a piece of threaded ¾-inch pipe, 1¾ inches long. A 2-inch piece of flat iron was welded to a ¾-inch pipe cap that served as a cover for the intake point (fig. 2).

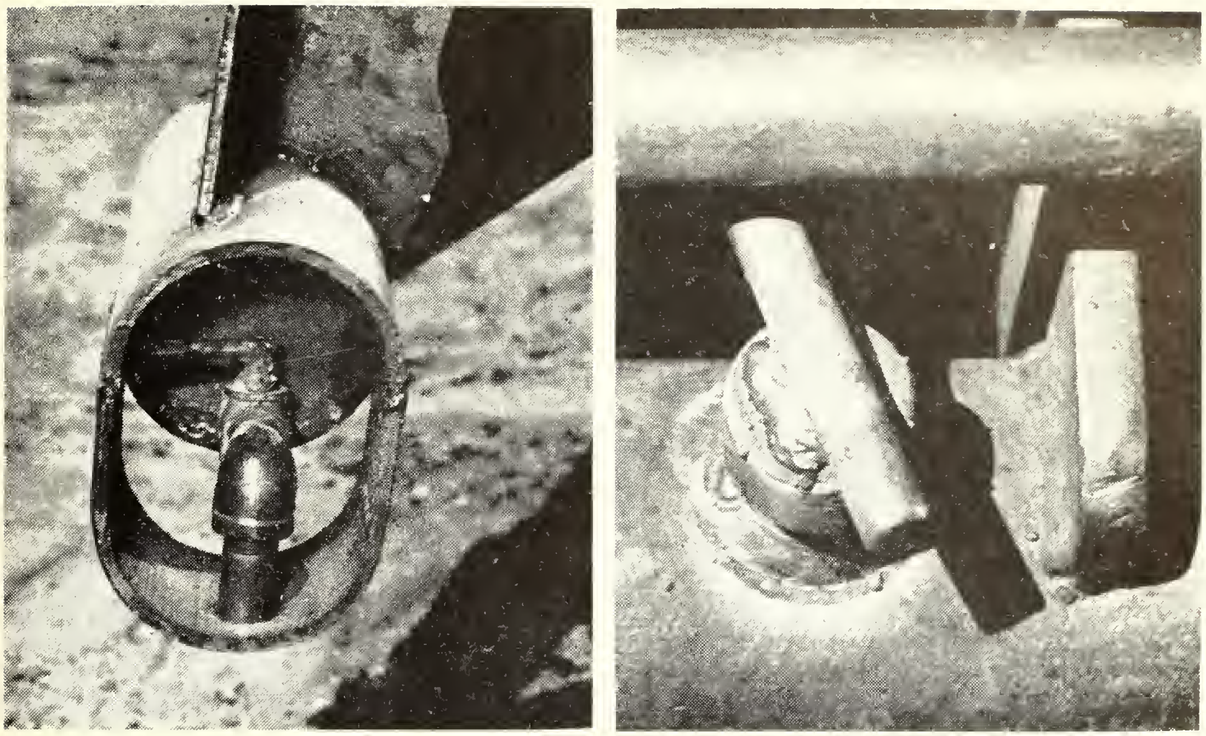

FIGURE 2.—*Left*, End of bumper container showing valve installed. *Right*, Intake with pipe cap in place.

Thomas Jefferson on Forest Fires

The following is quoted from a letter by Thomas Jefferson to John Adams written at Monticello, dated May 27, 1813:

"You ask if the usage of hunting in circles has ever been known among any of our tribes of Indians? It has been practised by them all; and is to this day, by those still remote from the settlements of the whites. But their numbers not enabling them, like Genghis Khan's seven hundred thousand, to form themselves into circles of one hundred miles diameter, they make their circle by firing the leaves fallen on the ground, which gradually forcing the animals to a centre, they there slaughter them with arrows, darts, and other missiles. This is called fire hunting, and has been practised in this State within my time, by the white inhabitants. This is the most probable cause of the origin and extension of the vast prairies in the western country, where the grass having been of extraordinary luxuriance, has made a conflagration sufficient to kill even the old as well as the young timber."—From "The Writings of Thomas Jefferson," edited by H. A. Washington.

CONVENIENT MAP CARRIER FOR FIRE TRUCKS

William E. Towell
Chief of Fire Control, Missouri Conservation Commission

Harold J. Ruetz, Forest Assistant on the Meramec Fire Protection District, has developed a simple but convenient map carrier for his pickup. The carrier is a small metal frame to hold regular window shade rollers.[1] The frame is open at the bottom and fastened to the ceiling of the pickup cab; one end is held in place with screws so that the rollers can be easily removed. Maps printed on cloth can be stapled or glued direct to the rollers. Paper maps are mounted on unbleached muslin with wallpaper paste.

To keep down the size of the map carrier, Ruetz has used three rollers, with a one-half inch to the mile scale map of each of the three counties in his district (fig. 1). The same type frame could be used for more maps, or wide maps if desired, the limiting factor being the width of the cab. This map carrier is ideally suited for the district forester or ranger who needs to have fire map, ownership map, type map, and various others at his fingertips when away from headquarters. It is extremely handy for the fire crew leader who uses only one map frequently.

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[1] Similar use of shade rollers reported by Ed. J. Smithburg in April 1949 issue of Fire Control Notes.

Figure 1.—Map carrier with three rollers.

USE OF AERIAL PHOTOS ON BOARDMAN RIDGE FIRE

K. A. Cuff, *Mendocino National Forest*, and
R. H. Neuns, *California Forest and Range Experiment Station* [1]

Aerial photographs proved their worth on the Boardman Ridge fire, Mendocino National Forest, last summer. This fire, started September 11 by a careless camper, roared over 6,670 acres of rough terrain covered by mature timber, reproduction, brush, and woodland. When finally corralled, the fire had a 17-mile perimeter that wound across elevations from 2,000 to 7,000 feet above sea level. Properly used, aerial photos saved time and trouble on the job.

Scouting the fire, we found the photos great time-savers in giving the plans chief and fire boss much detailed information. Using the pictures made it possible to prepare maps quickly by sketching from a plane, helicopter, or vantage points on the ground. A map made with the help of a helicopter, for example, took about 20 minutes to complete and showed the perimeter, hot areas, spot fires, open cat lines, and safety lines. These maps were accurate, too. The last rough draft indicated an area of 6,700 acres, as compared to 6,670 acres on the final map prepared for statistical use.

The speed with which information could be obtained was especially valuable when quick decisions had to be made on the location of fire lines. In one sector the fire jumped its line and made necessary an immediate selection of a new location. At first it seemed that the best action was to backfire from a safety line, increasing the acreage considerably. But a few seconds of careful photo interpretation showed a hand line could be built readily in one location. The time from determination of this line until it was completed and backfired was slightly more than an hour. The line held and saved 1,500 acres.

Good photo interpretation can readily determine for the plans chief information on cover types and terrain that will help in ordering kinds of tools to be used in building line, computing rates of line construction, and picking access routes. Even though areas are hidden by smoke, vitally needed information—fuel types, possible control lines, slope of ground, dropping areas, helicopter ports, and safe routes of escape—can be determined in a hurry from aerial photos.

Experience on the Boardman Ridge fire, however, demonstrated that a special effort is necessary to make the most of the photographs' potentialities. One requirement is good coordination and use of photo information between Intelligence, line overhead, and other overhead. Another is good interpretation, an exacting task if all possible information is to be gleaned from the pictures. It was observed that many men who can see stereoscopically do not seem able to see detail. The ability to supply detailed information is the photo's main asset. Giving a group of selected men intensive training in aerial-photo interpretation would make this useful tool much more effective and encourage its wider use in fire control jobs.

[1] The California Forest and Range Experiment Station is maintained by the Forest Service, U.S. Department of Agriculture, in cooperation with the University of California, Berkeley.

COOPERATIVE FIRE FIGHTING BY INDIANA SCHOOLS

DIVISION OF STATE AND PRIVATE FORESTRY
Region 9, U. S. Forest Service

The work of the Division of Forestry, Indiana Conservation Department, in training high school students under the Forest Fighters Service was begun during the last war as part of the Civilian Defense Program. [1] This important work has continued up to the present time with no let-up in intensity. In addition to accomplishing a better fire record, the possibility of carrying and selling the gospel of fire prevention to tomorrow's citizens in realized.

FIGURE 1.—Presentation of safety plaque to Indiana Forest Fire Fighters Service. Left to right: Vernard Rice, District Fire Warden; Emmeran Tretter, District Fire Warden; Henry F. Schricker, Governor of Indiana; Joe De Young, Coordinator, FFFS; Joe Brishaber, Austin K. Easley, and L. E. Kern, District Fire Wardens.

In 1941 prior to the start of the program, 610 fires burned over 42,329 acres in southern Indiana, an average of nearly 70 acres per fire. Since then there has been a gradual reduction until in 1950, 235 fires burned over 3,880 acres or a little over 16 acres per fire. Of course various other factors have to be recognized, but there is no doubt that the high school training program is in part responsible for this improved record. Since the beginning of the program, 30,000 volunteer fire fighters have been trained. Four hundred and fifty-eight different crews consisting of

[1] See the September 1951 issue of American Forests for a more complete description of this work.

4,058 high school boys have spent 13,596 man-hours fighting forest fires, and 81 high schools have been presented with a merit award by the State in recognition of their assistance in fire suppression.

An important part of the training course has been the demonstration of safety, and safety precautions have been stressed in actual work on the fire line. This part of the training has paid off because the Forest Fire Fighters Service, under the direction of the Division of Forestry, has completed 10 years of work without an accident. For this achievement, the Forest Fire Fighters Service was awarded a plaque by the Hon. Henry F. Schricker, Governor of the State. The plaque was presented to Joe De Young, Coordinator of the program, and to the five district fire wardens in a brief ceremony at the 1951 Indiana State Fair (fig. 1).

Pilot Balloons for Marking Fires

The use of pilot balloons for marking fires discovered by patrol aircraft, to facilitate their location by ground men or smoke jumpers, has been suggested from several sources.

After looking into the records and discussing the problem with others, we found that there were several instances where such a marker would have been of help. We set up a test program comtemplating the use of weather balloons, which were reasonable in cost and easily obtained. We believed it would not be too difficult to arrange for inflation by a small cylinder of helium or hydrogen gas, after the balloon was clear of the airplane, if another more simple arrangement could not be devised.

We found that weather balloons could be obtained in 30-gram, 100-gram, and 300-gram sizes. The 30-gram size inflates to approximately 2 feet in diameter, and costs about 20 cents each. The 100-gram size inflates to approximately 3 feet in diameter, and costs about 50 cents. The 300-gram size inflates to 4 or 5 feet, and costs about $1.60. All sizes are much more resistant to puncture if inflated to only about 2/3 size. The 30-gram balloons may be obtained in several colors, and the 100-gram balloons in white, red, black, and yellow. The 300-gram size was available only in white.

Several balloons were inflated, attached to anchor strings, and their action observed. It was found that with only a minimum of air movement (less than 4 m.p.h.) the balloon would drift until it rubbed on the tops of any timber. The balloons lasted only a short time until punctured by weeds or tree limbs.

Personnel who observed the behavior of the pilot balloons were of the opinion that balloons large enough to be used as markers, and strong enough to withstand puncture, would be too expensive. A balloon of 4 or 5 feet diameter would be required to provide enough lift to stay aloft when anchored near the fire on days with very little or no wind movement.

It appears that there are better possibilities in plane-to-ground radio and in working out methods of signalling the fire location from the patrol plane. This has been done successfully on several occasions in air-ground detection units now in operation.

The project is now discontinued until further information or a new method becomes available.—Aerial Equipment Development Center, *U. S. Forest Service, Missoula, Mont.*

POWER DEVICE FOR CLEANING STEEL BOOSTER TANKS

J. R. McLees

Fire Control Engineer, South Carolina State Commission of Forestry

The Branch of Forest Fire Control, S. C. State Commission of Forestry, is using as standard equipment ranger trucks outfitted with a set of three interconnected booster tanks. The cross tank back of the truck cab is 14 inches deep, 18 inches wide, and 48 inches long. Radio equipment in a weatherproof box is mounted on this tank. The two other tanks, located on the left and right side of truck bed, are each 14 inches deep, 12 inches wide, and 60 inches long. These side tanks serve also as seats for fire fighters. The tanks are made from 14-gage blue annealed steel sheets. All joints and connections are electric-welded.

Because rust and scale accumulated on the interiors of the tanks, annual maintenance was costly until the machine shown in figure 1 was devel-

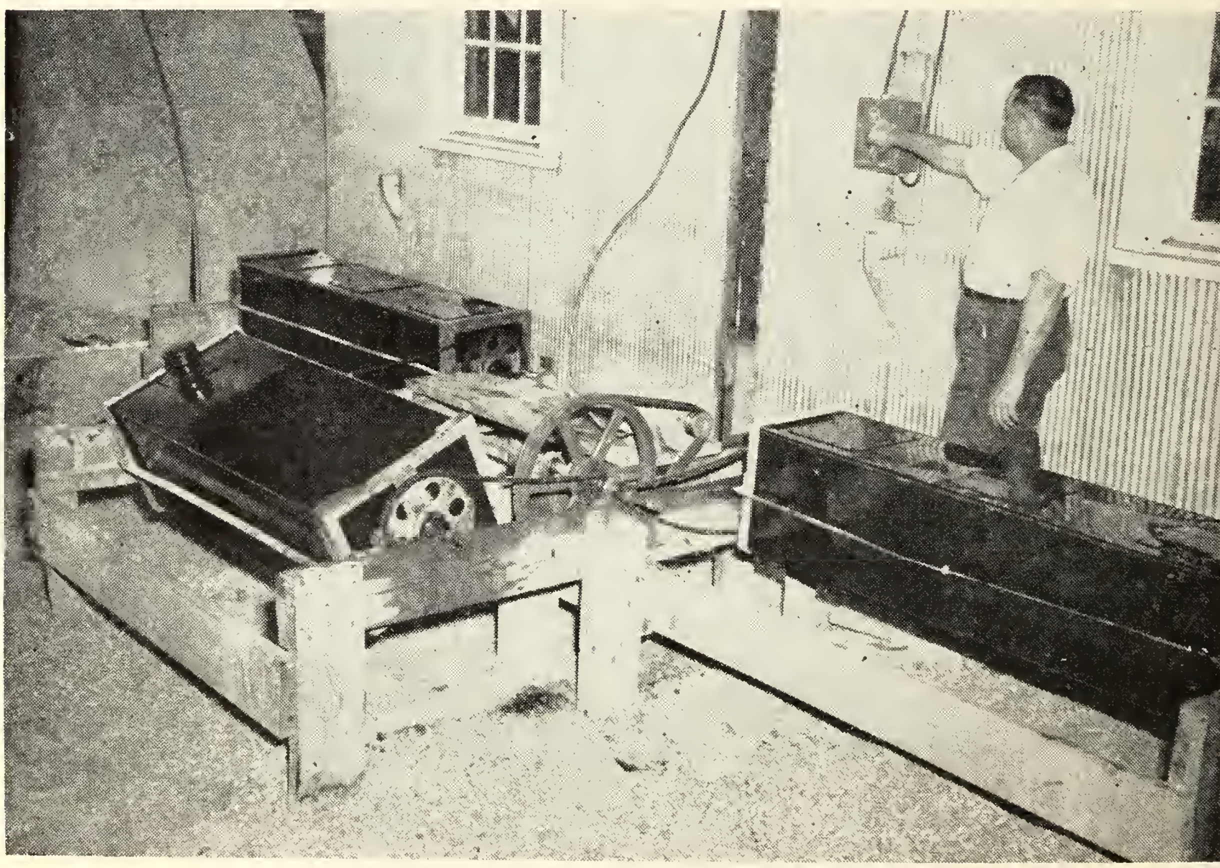

Figure 1.—Set of booster tanks being cleaned.

oped. This cleaning device will accommodate the set of three tanks simultaneously. The tanks are clamped at the ends in angle-iron frames and are held there by stay bolts on two sides. The end clamps, one to each tank, have sprockets attached and are chain driven from a countershaft powered by a 1-hp. electric motor and connected to the countershaft by a rubber V-belt transmission. The individual drive from the countershaft is by roller chain and sprockets.

The tanks are filled to approximately one-eighth of their depth with ¾-inch sharp crushed stone, and then water is added to one-fourth of the tank depth. When the tanks are turned at 55 r.p.m. for a period of 8 hours, the scouring action of the tumbling stone will thoroughly clean the interiors. The only hand cleaning required is the face of the two baffles in each tank. These are accessible through three handholes, the cover plates of which show clearly in figure 1.

After a thorough cleaning and drying, the interiors of all tanks are treated with a special asphaltic tank-coating compound. If the tanks are allowed to go too long without treatment, the stone and water tumbling may have to continue for as long as 16 hours. It has been found that tanks of this type when properly cleaned and treated can be kept in service for 3 years without retreatment.

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TOOL GRINDING TABLE

Alvin Edwards
Warehouse Clerk, Mendocino National Forest

The tremendous job of reconditioning hand tools in fire camps and in the warehouse following large fires has led to the development of the following method of doing the job.

An ordinary automobile body and fender disk sander with a 8- or 9-inch flexible phenol abrasive disk, #24 or #36 grit, is used for grinding. This will grind a smooth, sharp edge on any tool very quickly and does not heat the metal enough to burn it as does the ordinary grinding stone.

Tools are held solid and in position on a table with holding jigs for all of the types of sharp tools ordinarily used in fighting fire (figs. 1 and 2). The disk sander is held by the operator. This enables the operator to look directly at the side of the tool he is sharpening. By so doing, he can better shape the tool (fig. 3). As for safety, all material thrown from the blade or the disk is directed down by the disk so there is no danger of getting particles in the eye.

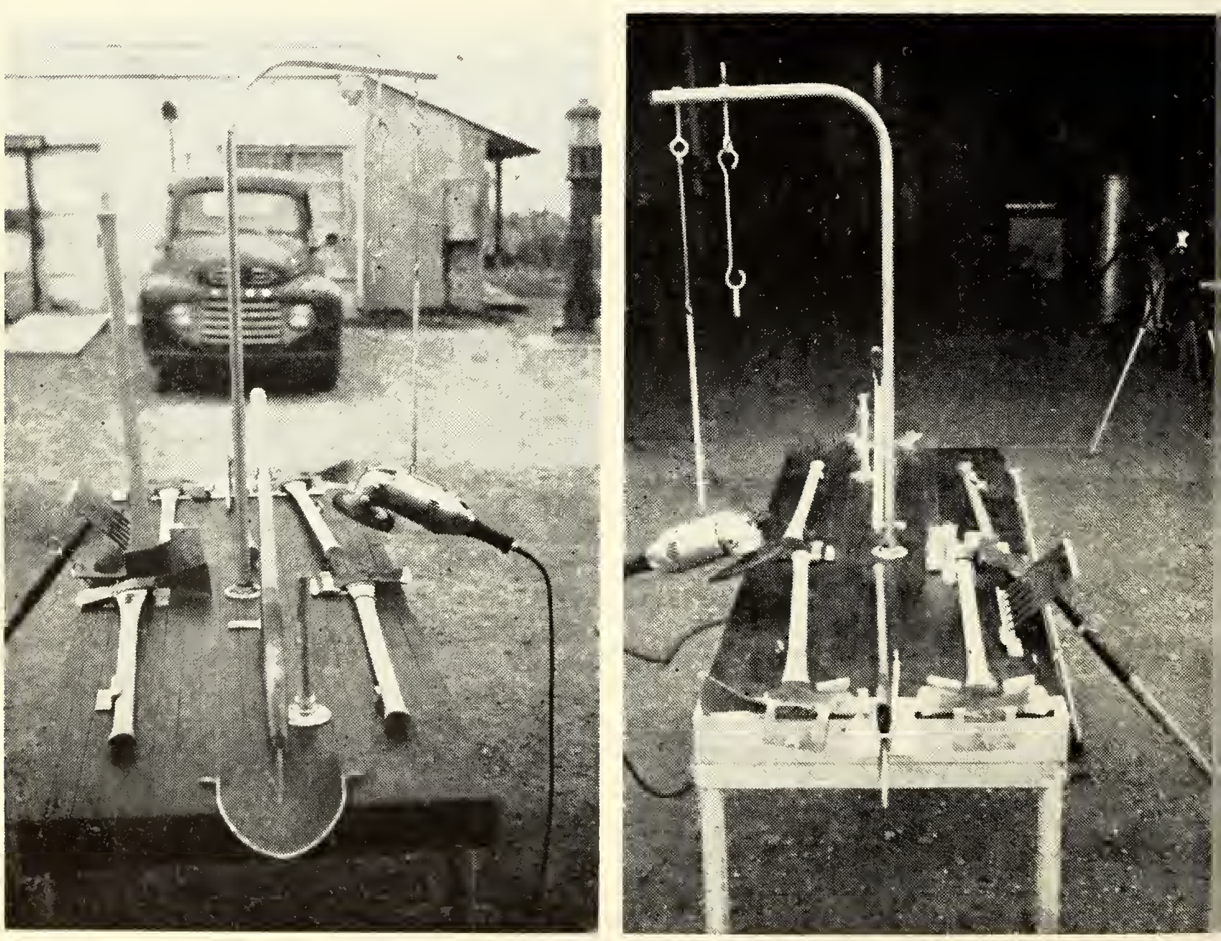

Figure 1.—Tool grinding table: *Left,* Tools in position for grinding; *Right,* jigs for holding tools from which handles are to be removed.

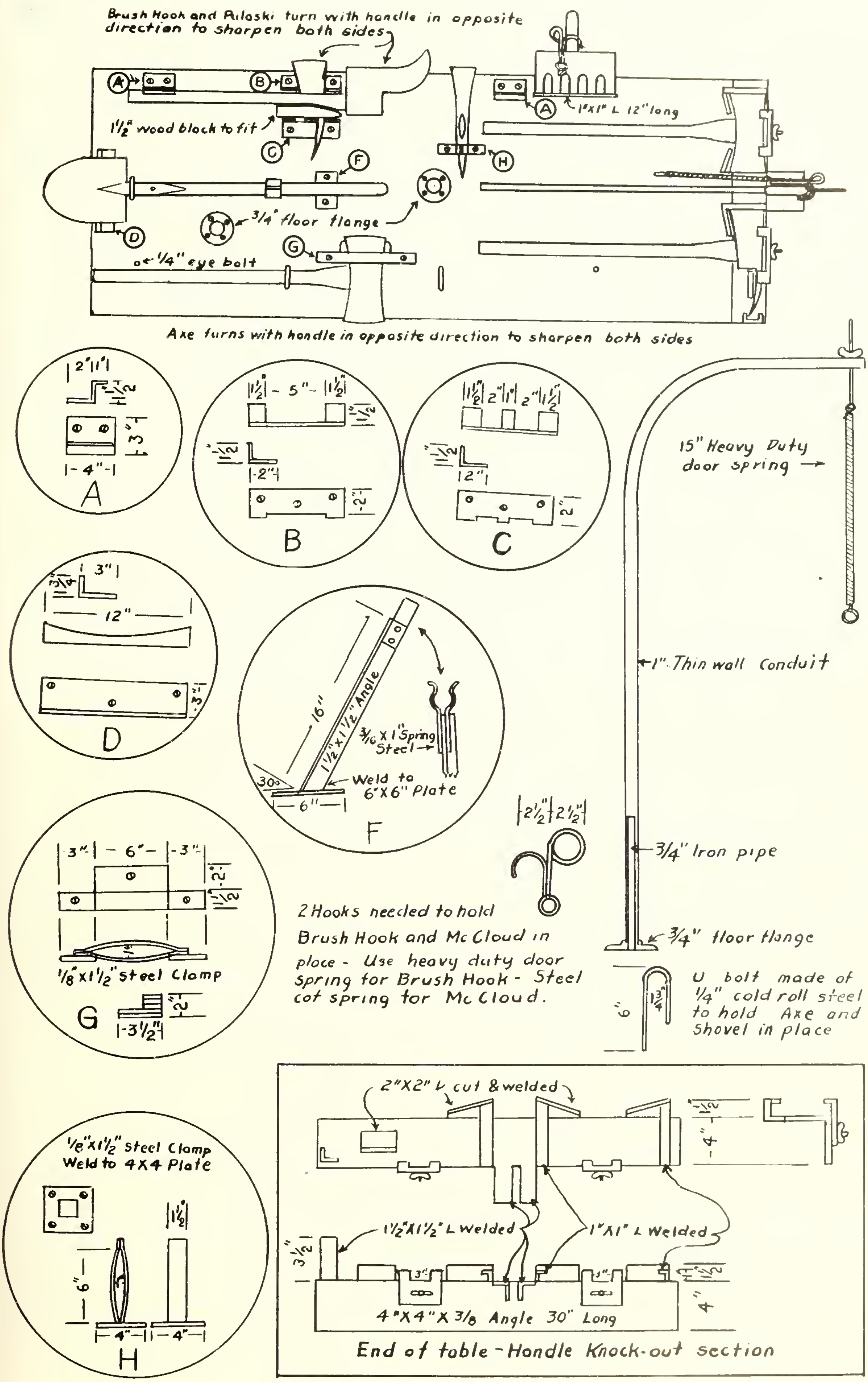

Figure 2.—Details of tool grinding table.

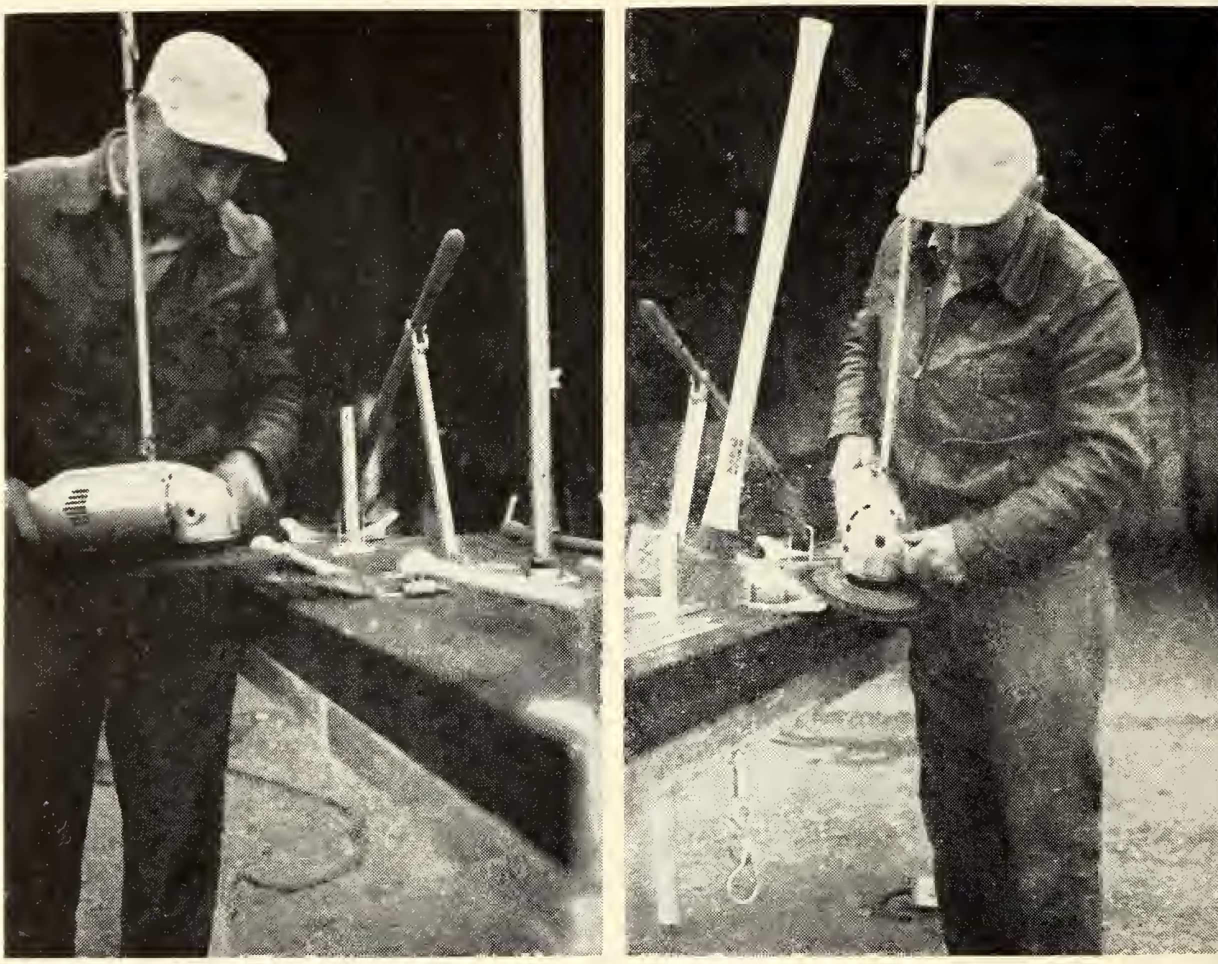

FIGURE 3.—Grinding ax and Pulaski blades.

Jigs were also made to hold tools in place for drilling and knocking out handles which are to be replaced. New handles are placed in a vise and shaped to fit the eye of the tool by using the same grinder with a #16 grit disk.

The table and grinding unit were used on two large fires and at the forest warehouse during the 1951 season. It is estimated that 50 percent of labor time is saved over the old method of grinding, as well as a saving in that tools are better sharpened and blades are not burned. Two men with two grinding units may work on the same table with little interference.

The fender and body sander may be used with commercial electric power, or with a small portable generator.

Starting Cables for Chain Saws

Small cables for starting cords on chain saws break frequently at the handle. The most often used method of repairing is to tie a knot in the cable to prevent it from pulling back through the handle. The result is further breaks in the cable at the knot.

By cutting a small piece off a #12 nicopress sleeve, slipping it over the end of the cable, and compressing with a nicopress tool, the broken cable can be prevented from slipping through the handle and will last as long as the original factory job.—KENNETH W. WILSON, *Wenatchee National Forest.*

SMOKEY—AT POINT OF SALE

Clint Davis
Director, Cooperative Forest Fire Prevention Campaign[1]

Ranger Earl F. Sullaway of the McCloud District, Shasta National Forest in California, put me on the spot recently. He sent in a clipping from his local newspaper which told an interesting story about how Smokey Bear had directly prevented a forest fire.

It seems that a party of campers from San Francisco had been spending the week end fishing on the McCloud River, camping at a nearby recreational area. On their way home they stopped in McCloud to make some purchases. In the store window was one of the posters of Smokey Bear and the message, "You Can Stop This Shameful Waste!" Looking at the poster thoughtfully, one of the members of the party turned to the other and said, "Are you sure we put out our campfire?" The other fisherman was not sure, so together they went back to where they had been camping.

Sure enough, in spite of the coffee grounds and dishwater which had been dumped on their fire before leaving, there were still hot coals burning, and at one corner the fire had crept away and was beginning to burn in the thick pine duff which had not been cleared away from the campfire.

This time they put their fire out right, and on their way out again stopped in at the Ranger Station and frankly told Ranger Sullaway exactly what had happened. The newspaper quoted Ranger Sullaway as saying, "If that fire had gotten away with the burning condition which we have had during the past two or three weeks, it could have very easily made such a start before being discovered that it would have destroyed much valuable timber and blackened a great many acres. Smokey Bear sure did his part in keeping California Green and Golden."

That was a very interesting article. As a matter of fact, it was the first case history that documented Smokey Bear as actually preventing a forest fire. I knew it would interest our friends at The Advertising Council, the organization which has so generously sponsored and guided our efforts in the Cooperative Forest Fire Prevention Campaign for the past 10 years. So at the first opportunity I showed it to Ted Repplier, President of The Advertising Council. Repplier read the article with interest. There was an enthusiastic gleam in his eyes when he had finished. "By gosh," he exclaimed, "you foresters are finally beginning to do point-of-sale merchandising."

Well, that put me on the spot. And it was all Ranger Sullaway's fault. You see, I thought the story was kind of cute, but with my limited knowledge of advertising lingo the pieces didn't quite fit together on this point-of-sale merchandising business. But Repplier is a kind and patient individual, and he spelled it out. He explained that, in the advertising business, when a manufacturer decides to introduce a new product Nation-wide, the first objective is to develop public recognition of the product. Let's say the product is Cancan Pork and Beans. Public acceptance of this product must first be built around brand recognition, so the advertising

[1] Sponsored by State Foresters and U. S. Forest Service. A brief history of the campaign, reprinted from the April 1951 issue of American Forests, may be obtained from the editor of Fire Control Notes.

agency in charge of introducing this new product decides on the media to be used.

The agency calls in an artist, the idea boys, copy writers, and they come up with several pieces of art, develop a gimmick in the advertising, usually something in the way of a symbol that will forever-after be associated with the product. Say, in this case, our symbol is an animated bean on which the artist with full liberty depicts a broad smiling face, chubby legs and arms, and a well-filled tummy. His general appearance seems to exude "Yum, Yum!" Usually several different channels of advertising are selected and the promotion is then kicked off. Soon afterward, when you board a streetcar or bus you will subconsciously begin noticing a colorful car card showing a steaming, appetizing plate of Cancan's Pork and Beans. Alongside the mouth-watering dish stands our friend "Beanie" inviting you to try his tasty treat after the day's toil. Perhaps it doesn't make much of an impression at first, but it registers on the subconscious mind.

That evening when you get home and start thumbing through your favorite magazine, you run across a doubletruck spread (this is advertising lingo for two full pages of advertisement facing each other) and there is Cancan's steaming, tantalizing plate of pork and beans. Our little friend Beanie is sure to be around some place in the ad with that Yum Yum expression. Perhaps a week later you hear a commercial on the radio which tells you the virtues of Cancan's Pork and Beans. The average person goes through all of this and rarely ever gets the urge to drop what he is doing and rush right out and buy a can. But in that subconscious mind there is building up a little reaction that says, "Boy, if I ever buy pork and beans I'll take Beanie's advice and try Cancan's." That, according to Repplier is building up public acceptance for brand recognition.

Up to this point, there seemed nothing very different in this line of thinking than what was being done in the CFFP campaign. Car cards have extolled the importance of preventing "This Shameful Waste." Radio has hammered home the need for each individual to use care in preventing forest fires; fire rules cards have graphically portrayed how each individual could take step-by-step measures to prevent his acts from causing a fire; the tag line slogan on every poster, "Remember—Only *You* Can Prevent Forest Fires!", definitely personalized the job.

I pointed this out to Repplier and asked how his mythical Cancan Pork and Beans could do any better selling job than we have to date on forest fire prevention. "Oh, but that is where point-of-sale merchandising comes in," he exclaimed. After the business firms develop public acceptance and brand recognition, they concentrate on reaching the potential customer at the point where he is most apt to be exposed to the product. In the case of pork and beans, naturally, it would be in the grocery store; a large poster on the front of the store, a colorful display of the product neatly stacked where the customer can't miss it. This has all been arranged by representatives of the manufacturer. A big red arrow points to the stack and says, "Here it is!" And without thinking, you rely on that subconscious force and before you know it you have three cans of Cancan Pork and Beans in the market basket. The manufacturer, following the strategy planned by his advertising agency, had cleverly channeled his advertising until the customer was finally confronted with the product and a forceful invitation to purchase same. That, according to Repplier, is point-of-sale merchandising, exactly the type of psychological reaction that entered into the case of the two fishermen that saw the Smokey poster in a store window in McCloud, California. "The only improvement on that particular case," said Repplier, "would have been for the customer to have encountered a poster right in the campground." But even so, it's an excellent example of point-of-sale merchandising. In other words, impressing our client, the public, with a fire prevention message *when* he is right in the woods and *his chance of preventing a forest fire is greatest.*

Repplier pointed out that progress in reducing man-caused forest fires during the next few years will depend largely on how efficient we are in our point-of-sale merchandising. He feels that this is the weakest link in our over-all fire prevention program. Pointing out his own experience on a trip West last summer, he said that he stopped in numerous campgrounds and picnic areas of National Forests and State Parks, and other centers of outdoor activity and found some excellent examples of point-of-sale merchandising—a fire prevention message at a registration booth, or a poster mounted close by a camping spot (fig. 1). But generally, many of the areas that he visited, private and public alike, were weak in this important phase of the prevention sales job. A live-wire merchandiser would never pass up these sure-fire sales opportunities.

With a better understanding of the importance of point-of-sales merchandising on my own part, I tried to analyze some of our experiences in the past few years. Some organizations have been doing an outstanding job on point-of-sale contacts: The Virginia Forest Service, with its metal highway signs, and a Smokey Bear card reminding the public at every roadside picnic ground; Idaho, with its huge signs painted on the highways; California, with display cards tacked on the back of car stalls at tourist courts, and State patrolmen handing all entering motorists a rules card with Smokey's message. I imagine that numbers of New York tourists who first met Smokey on the subways of that city were reminded of many of his messages when they were handed a card with this familiar figure on it as they entered the State of California. Ours is a Nation of travelers and it is important to channel our messages so that the public will recognize their importance a long way from home.

Often it is fairly easy to localize Smokey and his message in order to capitalize on the national recognition already developed for this "million-dollar" character. For example, the South Carolina Commission of Forestry feels that selling the local people on the importance of saving the little trees through the preventing of grass fires is a most important appeal. They have developed a special poster, showing Smokey on his knees pointing to little seedlings that are destroyed when a grass fire, usually considered harmless, is allowed to burn across thinly stocked areas. The Texas Forest Service has developed a colorful and attractive folder which they mail to farmers and others in rural areas. The folder capitalizes on the Smokey theme by showing the two little cubs, the same designs that were used on the fire rules poster last year, crushing out cigarettes and drowning campfires.

The Keep Idaho Green Committee used a combination of its localized character "Guberif" (firebug spelled backwards) as the villain with Smokey chasing him down. A recent report from Idaho states, "Although a new character, GUBERIF, was introduced into the fire prevention program, the Keep Idaho Green Committee did not neglect the great potential of our friend, Smokey the Bear. In contrast, this peace-loving character and

FIGURE 1.—This is a 1952 poster, designed for point-of-sale use. It shows how to prevent forest fires while the basic poster, on back cover, is designed to develop awareness of the need to do something about forest fires.

the culprit, the Guberif, formed an ideal team which depicted the hero and the villain. It is the Committee's belief that the Guberif idea has somewhat localized our prevention program, thereby creating a fine, wholesome interest in the preservation of our natural resources." Up in Washington State, home of the Keep Green movement, the Keep Washington Green campaign developed an interesting skit for an important

Forest Festival Pageant. Smokey, one of the officials dressed in a bear skin, ranger's hat and dungarees, was constantly on the chase of the Fire Fiend. Undoubtedly there have been many other similar uses localizing our national fire prevention character. I hope to hear about them.

Recognizing the value of such localized use, I can't help but recall some of the many occasions where excellent opportunities were overlooked. Last summer, I had lunch with a ranger in a small tourist town on the Transcontinental Highway. Ninety percent of the community's livelihood was gained from tourists stopping at motor courts, cafes, and novelty shops enroute to California. For a six-block area tourist cars were parked solidly along the curbs, yet while browsing around the various shops before lunch time I was rather surprised in not seeing a single poster with a forest fire prevention message. Posters were not taboo in the stores, because quite a few were displayed in the interest of Savings Bonds, Armed Force Enlistment, and other programs.

At lunch the ranger and I noticed the headline on a newspaper being read at the next table. It reported several serious forest fires in California, 150 miles away. In discussing the fire situation in California, I remarked to the ranger that I was rather surprised not to see a single fire prevention poster in the various stores which I had visited in this little tourist center. He very proudly advised me that there had been only one forest fire on his district in the past 3 years and that it was considered practically a fire-proof forest. There wasn't much need in arguing against a record of that kind, so we passed the subject up.

But now, since this point-of-sale business has come up, I realize that we were overlooking a wonderful opportunity. Here was a spot where thousands of tourists, going into California, could be conditioned for a fire prevention sale. This was an excellent example of the need for teamwork in the prevention job. In many places where fire danger admittedly is not serious it may still be highly important, from the standpoint of conditioning the public, to put Smokey Bear to work. These factors are worth considering in the development of local forest fire prevention plans.

The Nation-wide campaign will continue developing mass appreciation for the need to prevent forest fires. American business and industry will back it in 1952 by contributing around 6 million dollars worth of advertising time and space to help us do the job. Many new aids will be introduced. One highlight is bound to be the song, "Smokey The Bear," now being groomed for release by a nationally known music publishing house. The music and lyrics have already been completed and they are considered very catchy and intriguing. Several recording companies are already under contract to release the number early in the summer. It won't be long before the American public will be hearing a little ditty which opens like this, "With a ranger's hat and shovel and a pair of dungarees, you will find him in the forest always sniffin' at the breeze. People stop and pay attention when he tells them to be aware, because everybody knows that he's the fire preventin' bear."

In addition, posters and car cards, radio and TV messages this year will extol Smokey's appeal—"This Shameful Waste Weakens America!" There will be a big national play all right. But what will it all buy? How many fires will Smokey actually prevent?

That, it appears to me, depends in very large measure, on the readers of this little article—on you men, privately or publicly employed, who find the problem of forest fire prevention right on your own doorsteps, so to speak—and on how Smokey Bear is put to work on a point-of-sales basis.

And as for Ranger Sullaway, "I'm much obliged to you for putting me on the spot!"

Bottle Gas Heater Installations for Lookout Cabs

Gas burning space heater installations with small bottle gas containers are being used for heating lookout tower cabs on the Lower Michigan, and are found to be highly satisfactory. These heaters have a 15,000 BTU output rating. They take up little floor space, even when allowing for safe clearance to the combustible cab lining. The burners are easily lit, burn free and clean, are readily controlled, and are practically fume free. About 20 pounds of bottle gas is used for heating for an average year.

The gas supply cylinders used by the Lower Michigan are those originally furnished with the propane gas backfiring torches. The cylinders, which are approximately 8 inches in diameter and 26 inches long, can be charged with 9½ pounds of gas. Filling at a bulk plant costs about 7½ cents per pound. The cylinders are hung in the center of the underside of the cab, to provide the best shaded position. The gas is piped through the floor to the space heater with ⅜-inch copper tubing. A manual regulating valve is required for the installation, and can be obtained from the bottle gas dealer. We believe that two cylinder installations would be desirable, to provide an adequate fuel supply at all times.

The cost of an installation will vary somewhat, but the cost of a typical installation with a single cylinder, as made on the Lower Michigan, is as follows, omitting the cost of labor, gas cylinder, and initial charging of gas:

1	Gas burning space heater	$13.23
2	Flare nuts	.24
1	Half union adaptor	.20
1	Regulator, obtained from bottle gas dealer	3.50
6	Feet, ⅜-inch copper tubing	1.20
	Total	$18.37

Labor for the installation averaged 4 hours for 2 men, including transportation to and from the job.

Local distributors of bottle gas are generally able to furnish fuel supply tanks as a service to purchasers of their product. Of the various sizes of tanks available, the 20-pound tank lends itself to installation in a manner similar to the propane gas cylinder used by the Lower Michigan. The 20-pound tank is approximately 18 inches high and 12 inches in diameter (kettle shaped), and is equipped with handles for carrying and mounting. While a single tank may provide an adequate supply for a season's use, a 2-tank installation will no doubt be desirable. However, the distributor can be consulted in this regard. The current cost of 20-pound cylinders in the Milwaukee area is $2.10, which includes the loan of the tank. The cost of an installation using a commercial bottle gas tank should not vary appreciably from the installation made by the Lower Michigan.

These safety precautions, given by the Lower Michigan, should be followed for bottle gas heating installations made in lookout cabs:

1. Check local regulations and instructions governing the use of bottle gas.
2. Follow safety regulations governing installation of heating units.
3. Always light burner with a long taper.
4. If old propane gas cylinders are used, test safety release valves. Release valve pops off at 300-pound pressure. This pressure would be developed at about 130° to 135° F., with cylinder containing 9½ pounds of gas.
5. To avoid accidental discharge, containers of propane gas must not be filled above the specified capacity and should not be stored where temperatures are excessive. The capacity of a propane torch cylinder is 9½ pounds of gas. The net weight of the cylinder should be determined before filling to assure an excess of 9½ pounds is *not* put in the cylinder. Net weight of cylinder plus 9½ pounds of gas equals maximum gross weight after filling.
6. Test all connections thoroughly for leaks. This can be done with heavy soapsuds and a brush.
7. Close cylinder shut-off valve during periods of nonuse.—From "Give 'N Take," *Region 9, U. S. Forest Service.*

Volume 13 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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OPERATION REDSKIN

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Maps of Arizona and New Mexico are dotted with many and widely scattered Indian reservations. These range from the massive 11,000,000-acre Navajo Reservation, home of over 50,000 Navajos, to the tiny Havasupai Reservation in the depths of Havasu Canyon, a tributary to the Grand Canyon of the Colorado, which is home for less than 300 Havasupai Indians. Ruins of the dwellings of ancient tribes long since gone are common, and the entire Southwest is steeped in Indian lore and legend. Public opinion to the contrary, most of the tribes are no longer uncivilized savages. As a matter of fact, many of the younger Indians are well educated and several tribes can boast of a good sprinkling of college graduates. All very interesting, you say, and even educational, but how did this get into a fire control publication?

For several years the Forest Service in the Southwestern Region has been using Indian crews on fire suppression work. Some of these crews, whose homes are within the forest type, have been trained in fire work by the Indian Service. The Mescalero-Apache tribe in southern New Mexico and the Fort Apache and San Carlos tribes in east-central Arizona fall in this category. By contrast the Navajo and Hopi tribes of northern Arizona live well over one hundred miles from the nearest forested land, although they live in plain view of the forest-covered mountains in the distance.

But trained or untrained, these Southwestern Indians are peculiarly well adapted to fire suppression work. They are by nature outdoor people, skilled in the use of hand tools, exceptionally well disciplined, and possessing amazing endurance. In addition, the fire camp life which we normally think of as rigorous is oftentimes at a level or higher than that to which the average Indian is accustomed; and too, the very nature of suppression work is well suited to the Indians' likes. Another important factor is that they are almost fanatically home-loving individuals and very much dislike to be separated from their families for long periods. The long hours, short tenure, and relatively good pay characteristic of fire suppression work are made to order for these Indians.

During a serious fire bust in southern California in 1950, 2 organized 25-man crews of Hopis were dispatched by plane from Winslow, Ariz., to San Bernardino, Calif. (fig. 1). Their performance was so outstanding that they were called back on 3 subsequent fires in that season. During the disastrous 1951 season, 20 such crews were dispatched to California. At one time there were nearly 200 Indians from Arizona and New Mexico on fire suppression work in California. These were from 3 tribes: the previously mentioned Mescalero-Apache and Hopis and 3 crews from the Zuni tribe in west-central New Mexico.

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Figure 1.—*Top,* Region 3 organized Indian suppression crew boarding Air Force plane for out-of-region assignment. *Bottom,* Indian crew building line in heavy brush type in California.

The normal organized crew consists of 1 foreman, 2 strawbosses, and 22 line workers, all Indians. The size of the crews sometimes must be adjusted to fit the capacity of the planes in which they travel. It is general practice to send a capable forest officer with each crew to handle timekeeping, feeding, transportation and liaison work.

Many of you have heard tales and read about the poverty-stricken, starving Southwestern Indians. While some of these stories paint the picture somewhat darker than is actually the case, it is true that most of these tribes are very poor by our standards. Their wants are few, and fortunately so, because job opportunities are not plentiful in this vast, thinly populated area. Short growing seasons, poor soil, and limited water make successful farming an impossibility. The income from fire work is a welcome addition to their economy. The 1951 season produced a revenue from fire work of over $100,000 for the three small tribes used most often. One group of three organized crews spent 16 days on suppression work in California and returned with checks which averaged $340 each.

Because of the many advantages in the service of these crews, the Forest Service is emphasizing their use in a trend away from pick-up labor. Ten top-flight crews are now available, and the region is currently negotiating with several other tribes and with the Indian Service in an effort to organize several more.

Indians are unconsciously safety minded. They watch each other, help each other, and warn each other of impending danger. Among the organized crews, we have yet to experience a lost-time accident though they have logged many thousands of hours of the most hazardous work—a truly outstanding record.

Through the many centuries that these people have lived in the Southwest, their everyday customs and essentials of life have found expression in colorful ceremonial dances. The fire dances, harvest dances, rain dances, and many others are as much a part of their lives as eating and sleeping. On one occasion a Hopi crew working on a particularly troublesome fire in southern California requested permission to put on a rain dance. Within 2 hours after their dance there was a veritable cloudburst. All that was left of the once troublesome fire was a mass of steaming mud. It would indeed have been difficult to convince any Indian in that group that the welcome rain was not a direct result of their ceremony. You can undoubtedly think of a number of organized fire crews that possess many of the qualities which make these Indian crews outstanding. Do you know of any that bring along their own rainstorms?

KEEP YOUR AX HANDLE TIGHT

HARVEY H. SMITH, *Wood Technologist,* and JOHN P. BURKE, *Forester*
California Forest and Range Experiment Station [1]

On a forest fire in Idaho two men were working together. As one man started to chop, his partner stepped back out of the way, but the ax, supposedly tight, slipped off the handle and struck him in the face. He spent many painful days in the hospital—and the accident could have been fatal. There is always the possibility that a loose ax head may fly off the handle as this one did, or it may slip, upset the chopper's balance or aim and cause the ax to glance.

The difficulty arises from the fact that we insert a shaft of wood, which can change in cross sectional area, into a steel eye which is virtually constant in cross section. Yet there is no better material for an ax handle than wood. It is light and strong, shock resistant, and flexible. Its low-heat conductivity makes it comfortable to hold in hot or cold weather. The solution then, is in keeping the handle tight.

Wood shrinks as it dries and swells when it becomes wet. Remember how doors sometimes stick on wet days and then swing freely again in dry weather? Ax handles swell and shrink with the same changes in the weather. Axes used for fire fighting are particularly troublesome. Many of them are necessarily kept in field cache boxes, which are usually tightly closed and placed in the sun where temperatures are extremely high and the air is dry. This shrinks the handles of axes and pulaski tools.

Scores of axes with factory-fitted handles have been inspected late in the fire season, after this drying effect had had a chance to work. Not a single ax that had been stored in cache boxes was found to be tight and safe. The axes stored in buildings, not being subjected to such high temperatures, were somewhat better. Even there, however, many handles had become loose and dangerous.

To make matters worse, many men hired for fire fighting are not skilled in the use of the ax. A highly skilled axeman senses any slight change in balance or impact which occurs when an ax handle is loose. The axeman is thus warned. The unskilled user chops on—without warning—until the accident occurs.

Several methods are used for tightening handles in axes which have been improperly hung or wedged, but most methods are at best no more than a temporary expedient. The handle can be soaked in water until it is tight, but when it dries out again it will be looser than before. Wetting causes the wood to swell, but the swelling is restrained by the eye of the ax. The forces that develop as the wood increases in moisture content will crush some of the wood fibers. These crushed fibers do not recover

[1] Maintained by the Forest Service, U.S. Department of Agriculture in cooperation with University of California, Berkeley.

when the wood dries, and the handle has actually shrunk to a size smaller than before. Repeated wetting and drying will cause further "compression set," and it will become increasingly difficult to keep the handle tight.

Adding a metal wedge to a loose fitting handle is little better than the water treatment because it also subjects the wood to stresses resulting in a compression set. A hardwood wedge does the same thing, and also acquires a compression set of its own. Neither the metal nor the hardwood has sufficient capacity to expand as the handle shrinks.

Loggers and logging companies have long been confronted with this problem, and many of them have found a satisfactory solution. For years large timber companies have bought axes and good handles separately. After the handles have been seasoned to a moisture content of 8 to 10 percent, competent men are put to work installing the handles, using a very dry softwood wedge, such as white pine. One company employing up to 2,400 woods workers follows this procedure, and old loggers have done so for years. Their ax handles stay tight.

Recently tests were run with factory-hung axes as a check, with axes fitted with softwood wedges, and with axes treated according to two other suggestions for keeping handles tight. One suggestion was to supplement the factory hardwood wedge with two flat-head No. 16 by 2-inch wood screws, firmly driven into holes properly drilled and countersunk. The other suggested method was to use an oil-base wood preservative, supposed to prevent shrinkage. After preparation, nine axes in each group were subjected to temperatures of 130° to 140° F. at low humidities, approximating field cache conditions, for 6 weeks. After this time each ax was driven securely into a log. The looseness of the handle in the eye was then determined by measuring the distance that the end of the handle had slipped. Results were:

Sample	*Number of axes*	*Number of tight axes, no slip*	*Range of slip (inches)*	*Average slip (inches)*
Factory check	9	0	0.06-0.69	0.30
Preservative oil	9	0	.16- .69	.44
Screw wedges	9	1	.00- .31	.18
Soft pine wedges	9	9	.00- .00	.00

Besides these 36 samples, 2 axes were refitted with soft pine wedges and the original factory handles, but it was necessary to cut nearly all the shoulder to get a good fit in the eye. These axes were included in the test to show the result of cutting away the shoulder. Neither remained tight, one slipping 0.03 inch, the other 0.16 inch. This limited sample indicates that a shoulder is necessary.

The superiority of softwood wedges is explained as follows: (1) Softwood exerts sufficient pressure to hold the well-fitted handle tight without crushing and damaging the hardwood fibers. (2) The softwood will adjust to shrinking and swelling of the hardwood throughout the range normally experienced under reasonable conditions of storage and use.

What is the practical meaning of this test? If you want a safe, serviceable ax, buy the head and handle separately, and hang the head yourself. Factory-fitted handles are not seasoned to "fire season dryness," and are wedged with a hardwood wedge, which is also somewhat moist. Metal wedges are often added, crushing the wood fibers. Here is how to guarantee a tight ax handle, usually for the life of the ax:

1. Get a straight, clear, well-seasoned hickory handle.

2. Inspect the eye of the ax for cracks. Remove bur edges at each end of the eye.

3. Fit the handle to the eye as closely as possible, clear through the eye, leaving ½-inch shoulder and a smooth wood surface in the eye. The shoulder should not bulge.

4. After the handle is fitted, remove it and saw a wedging slit down the center, parallel to the flat sides of the ax, to a depth that will be two-thirds the way through the eye when the handle is driven home.

5. Select a piece of sound, dry, straight-grained softwood, with annual rings parallel to the broad face of the wedge (flat-sawed lumber). It should be about ½-inch thick, as wide as the length of the eye, and not less than 6 inches long. Dress it down across the full width of the wedge so that it tapers gradually to a 1/16-inch-thick point which is then sharpened to a short, blunt edge. The wedge should have a rectangular cross section, except for slight rounding at the edges to fit the eye. It should be proportioned to exert pressure throughout its flat surfaces, the greatest pressure at the outer end of the eye.

6. Drive the handle firmly into position with 24-ounce hammer.

7. Drive the wedge into place as far as possible but avoid splitting it.

8. Saw off excess length, dress off with coarse file, and paint end.

9. Store axes in best cool, dry place available. Field caches should be ventilated and, if possible, placed in the shade. Though it is best to avoid wetting the ax handle, it will stay tight through considerable moisture change if properly fitted and wedged.

Is this procedure too much work? Ask the man who was struck by the flying ax.

New Device for Examining Lookout Coverage

The National Research Council and the Forestry Branch of the Federal Government are investigating jointly a new method for examining coverage from wooded hilltops in connection with lookout tower location. This involves the use of a collapsible 50-foot radio mast on top of which is mounted a camera using 35-millimetre film, operated and rotated from the ground by electrical control. The total weight of mast, camera, and all necessary tools and equipment is about 300 pounds. The maximum weight of any one piece is 15 pounds and the length of the longest mast section is 11 feet. About three hours is required from arrival at the site to departure, using a three-man crew.

The pictures, when enlarged nine diameters and mounted in panoramic form, show promise of considerable usefulness in determining lookout coverage. Some mechanical and optical improvements are now being made by the National Research Council. The possibility of reducing the weight and bulk of the equipment is also being studied.—From Forest Fire Protection Abstracts. Canada Dept. Resources and Devlmt. 2:5. 1951.

THE LAKE STATES BURNING INDEX METER

J. A. MITCHELL
Forester, Lake States Forest Experiment Station [1]

The Lake States Burning Index Meter, issued first in 1936, is a device for rating the relative severity of burning conditions. It was developed for the use of forest officers and others responsible for forest fire control in the Lake States. As revised in 1949, it consists of a windowed envelope with a movable slide by which the factors considered can be integrated and their combined effect on the flammability of forest fuels rated (fig. 1).

The factors on which the meter is based are: (1) *the average moisture content of light fuels in the open*—determined from its correlation with condition of vegetation, precipitation, days since rain, and relative humidity, and (2) *current wind velocity*. To use the meter, the slide is first set so that the number of days without precipitation (since the last rain of half an inch or more) shows in the opening under "condition of vegetation." The "burning index" is then read from the table in the upper opening, under the current "relative humidity," and opposite the current "wind velocity." Each day thereafter on which no precipitation is recorded at 8 a. m. the slide is advanced one day. For days on which precipitation is recorded at 8 a. m., a pencil is inserted in the hole opposite the amount of rain observed and the slide retracted as far as it will go. Thus, *the period between rains,* as well as the amount of precipitation, is taken into consideration. For example: .23 inch of rain on the tenth "day since rain" (as shown on the meter) would set the meter back to the sixth day, while the same amount of precipitation on the sixth day would set it back to the second day. This is a unique feature of the Lake States meter.

The "burning index" indicates the relative severity of burning conditions *in percent of the worst probable,* 1 representing minimum severity, and 100 maximum. As pointed out, the scale is *relative*; that is to say, for any given level of "risk" (chance of fires being started) and "hazard" (determined by the character and amount of fuel present), the probability and severity of fires vary with the burning index.

Based on experience, the burning index ratings are divided into seven classes characterized in general as follows:

Safe (0-1).—Fires will not run beyond the heat of a campfire or burning brush pile.

Very low (2-3).—Fires will start from an open flame but spread slowly and tend to go out.

Low (4-6).—Fires will start from a lighted match and spread slowly (rapidly in dead grass) until extinguished.

Moderate (7-12).—Fires will start readily from a match, burn briskly, and tend to spread rapidly as they increase in size.

High (13-24).—Fires start readily from a match or glowing embers, spread rapidly, and tend to crown in young conifers.

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[1] Maintained by the U. S. Department of Agriculture, Forest Service, in cooperation with the University of Minnesota at University Farm, St. Paul 1, Minn.

L A K E S T A T E S

B U R N I N G I N D E X M E T E R

Relative Humidity - %								Wind Velocity m.p.h.
80 up	70 to 79	60 to 69	50 to 59	40 to 49	30 to 39	20 to 29	10 to 19	
0	1	1	2	3	5	7	10	0 - 3
1	1	2	3	4	6	9	13	4 - 6
1	1	2	4	5	8	11	17	7 - 12
1	2	3	5	7	10	14	21	13 - 18
1	3	4	6	9	13	18	26	19 - 24
2	4	6	8	11	16	23	32	25 - up

Burning Index

Condition of Vegetation

Green	Intermediate	Dead

Days Since Rain

4	3	2

Precipitation (Inches)

.50- up
.45-.49
.40-.44
.35-.39
.30-.34
.25-.29
.20-.24
.15-.19
.10-.14
.05-.09
.00-.04

Directions

Set slide to show (under "Condition of Vegetation" prevailing) the number of days without rain, since the last rain of .50" or more.

Advance slide one day for each day without rain thereafter.

For subsequent rains, insert a pencil in the hole opposite the amount of precipitation and retract slide as far as it will go.

"Burning Index" indicated opposite current "Wind Velocity" under current "Relative Humidity."

1949

FIGURE 1.—Lake States burning index meter.

Very high (25-49).—Fires will start from burning tobacco or sparks, spread rapidly, and tend to crown generally. Spot fires common.

Extreme (50-100).—Explosive conditions. Fires start readily from sparks, burn fiercely, and tend to crown and spot generally.

Standard practice calls for daily observations at 8 a. m., noon, and 5 p. m. from April 1 to October 31. In years when the fire season opens earlier or closes later the period of observation is extended accordingly. The minimum equipment required consists of a rain gauge, a sling psychrometer, relative humidity tables, an anemometer indicating wind velocity in miles per hour, a Lake States Burning Index Meter, and forms for recording observations. The observations called for are: condition of vegetation, precipitation, relative humidity, and wind velocity.

The theory on which the Lake States and most other burning index meters are based is that fuel moisture content and wind velocity are primarily responsible for the degree of flammability or severity of burning conditions prevailing. Because we are dealing with a complex aggregation of fuels which vary widely in amount, density, and exposure, the *average* moisture content of the primary fuels (together with wind velocity) is the best measure we have of the prevailing level of flammability. In the Lake States, heavy fuels are not, as a rule, an important consideration. The condition of light fuels in the open is, therefore, used as the criterion of burning conditions because this largely determines fire occurrence and behavior.

Because it is impractical to determine the *average* fuel moisture currently by direct measurement, it is arrived at indirectly from its correlation with the principal factors which determine it (i.e., condition of vegetation, precipitation, days since rain, and relative humidity).

"Condition of vegetation" is rated by the observer or district fire control officer as "dead," "green," or "intermediate" on the basis of prevailing conditions. "Green" is used when the grass and herbaceous vegetation is green and the broadleaf trees and shrubs are in full leaf. In the Lake States, this roughly coincides with summer and usually prevails from early June until mid-September. It varies, however, from year to year and from place to place; hence, is not tied to specific dates. "Dead" is used when the grass and herbaceous vegetation are dead or cured and the hardwood leaves (with minor exceptions) have fallen. This condition is typical of the spring and fall fire seasons. "Intermediate," formerly called "curing," applies to the transition period between green and dead and dead and green. This condition is usually of short duration (10-20 days) and confined to late spring when the grass is well started but the hardwood leaves are not yet fully developed and to early fall when the annual vegetation is cured or dead but the hardwood leaves have not yet fallen. It can also prevail in summer as the result of a prolonged drought and the consequent drying up of grass and herbaceous vegetation.

"Precipitation" is measured each morning at 8 a. m. Less than .005 of an inch is recorded as a trace but ignored in setting the meter. For the first setting of the meter, the amount of the "last rain" is taken as the total precipitation occurring on consecutive days and must amount to half an inch or more. Subsequent rains are considered day by day, the meter being set back according to the amount of precipitation occurring. If rain occurs between 8 a.m. and noon or between noon and 5 p.m., it should be measured and the meter set back accordingly at the time of the noon or 5 p.m. observation, in which case amount measured is deducted from the total for the 24-hour period in setting the meter the following morning.

"Days since rain" is counted from the day on which precipitation is last recorded at 8 a.m. Following rains of half an inch or more it will always show as one day. When the meter is set back for less than half an inch of rain, the number of days showing on the meter or "meter days" depends on both the amount of precipitation and the number of days the meter has been advanced. In no case, however, is the meter set back beyond the first day for the condition of vegetation prevailing. In case of snow, "days since" is counted from the first day that enough fuel is exposed for fires to run.

The prevailing "relative humidity" and "wind velocity" are used in determining the current "burning index." Normally, the "burning index" is determined daily at 8 a.m., noon, and 5 p.m. It can, however, be determined at other times if desired, for example, when conditions are acute or there is a fire burning.

The number and location of fire-weather stations are determined by the homogeneity of conditions, the availability of a suitable exposure for the rain gauge and anemometer, the availability of an observer, and by administrative considerations. As a rule, one fire-weather station in each protection district is ample. For administrative reasons, it is desirable to make the observations at the dispatching center or protection headquarters. Where conditions at headquarters are not representative or where a suitable site for the instruments is not locally available, the fire-weather station is located at the nearest point where conditions are suitable and an observer is available.

The burning index ratings serve two major purposes. First, they indicate the severity of burning conditions prevailing currently, as a guide for administrative action—manning of lookouts, need for stand-by crews, strength and speed of attack called for, etc. Second, and equally important, they make possible a comparison of conditions prevailing from place to place and from time to time. They serve also to call attention to the build-up of acute conditions and provide a basis for determining the normal severity of conditions and for judging the progress and efficiency of fire control effort.

Prevailing burning conditions are best shown by a chart on which the maximum burning index recorded each day is indicated graphically. Such a chart shows at a glance conditions from day to day throughout the fire season; the date, duration, and severity of acute periods; and currently the build-up of acute conditions. Years, seasons, and protection units can be rated for comparison by averaging the burning index ratings for the periods or units in question. For this purpose, days are rated on the basis of their maximum burning index. This is of value in over-all protection planning, in the allotment of protection funds, and in the assignment of personnel and equipment. The number of days in each burning index class is also useful in determining the normal fire load, its seasonal distribution, and the probable cost of effective protection. Last but not least, burning index ratings make it possible to properly rate accomplishment and the efficiency of fire control effort by providing a measure of the severity of conditions prevailing.

While the Lake States Burning Index Meter rates current conditions, it is useful, in connection with weather forecasts, in determining the severity of conditions likely to prevail. For example, if the weather forecast gives the relative humidity and wind velocity expected the following day, the probable burning index can be determined by advancing the slide one day and using the predicted humidity and wind velocity. Lacking a forecast, it is common practice to assume that the humidity will be at least as low as for the current day and to advance the slide one day to get a rough idea of what to expect. In settled weather also, afternoon conditions can be approximated from the 8 a.m. observations by using half of the 8 a.m. relative humidity to determine the probable afternoon burning index.

Because the Lake States meter is based on empirical data, it is not recommended for use where conditions are materially different from those prevailing in the Lake States, for example, where heavy fuels or elevation and aspect are important considerations, or where the fire season is continuous and of long duration. In the Lake States, heavy fuels are the exception rather than the rule; elevation is not a factor, and aspect is only locally important. Normally, also, "lows" occur at frequent intervals and more than two weeks without rain is unusual. On the other hand, the fire season is intermittent and erratic, and acute conditions can occur, after a few days of drying weather, any time the ground is not snow covered. Fire periods, however, are seldom of long duration. Most fires also start and burn in the open. Only under extreme conditions will fires run in mature timber. Acute burning conditions are indicated long before this condition is reached, however.

Local rains are the chief cause of unsatisfactory meter ratings because they can result in a wide variation of conditions in a relatively small area. This, however, is no fault of the meter because meter ratings are necessarily based on conditions prevailing at the point of observation. To meet this difficulty, supplemental observations of precipitation at outlying points are advisable to avoid being misled by local conditions, particularly in summer when local rains are frequent.

The Lake States Burning Index Meter has been revised several times and doubtless will be improved in the future as knowledge and understanding of fire and weather relationships increase. Experience has demonstrated that the basis of the present meter is sound and that, when properly used, it can be depended on to indicate the relative severity of burning conditions prevailing. No meter, however, can account for all of the factors and contingencies that affect fire occurrence and behavior, or eliminate the need for experience and judgment in determining the action called for in specific cases. The best that it can do is to indicate average conditions resulting from given combinations of the factors considered.

MOUNTING THE NEW MOBILE RADIOS WITH WEATHERPROOF CASE

A. M. Gardner

Communications Technician, Coconino National Forest

A number of satisfactory methods have been developed for mounting the various makes of mobile radios externally on pickups and trucks. In publishing this one we do not intend to infer that it is superior to all others we have seen. Rather we wish to make available to those who are still seeking a solution to the mounting problem for this particular unit an answer that appears quite simple and satisfactory.

This model 1147-5-1 mobile radio was specially developed by the manufacturer in cooperation with Northwest loggers who wanted a unit that could be mounted directly on the side of a pickup in the space just ahead of the rear fender. In connection with developing other mounting arrangements the company's manual cautions that (a) the 12-inch width dimension must always be kept in a horizontal plane and (b) vertical mountings on the ends of long vertical brackets should be avoided where excessive vibration might result. The diagonal brace included by Mr. Gardner to stiffen his mounting should eliminate harmful vibration.—*Ed.*

A mounting arrangement for the new mobile radios (Model #1147-5-1) which offers many advantages has been devised and is being used in Region 3. The mount is based upon use of the weatherproof case which can be obtained for these units.

The basic mount consists of three ¼- by 2- by 42-inch pieces of mild steel drilled to bolt to the case and into a corner of a pickup or truck bed. The pieces of steel are first bolted to the case with 5/16- by 1-inch carriage bolts (fig. 1). By drilling the holes ⅜ inch the bolts will force fit most effectively. Punched gasket material is placed under the heads of the bolts on the inside of the case to insure a weathertight fit. The bolts will

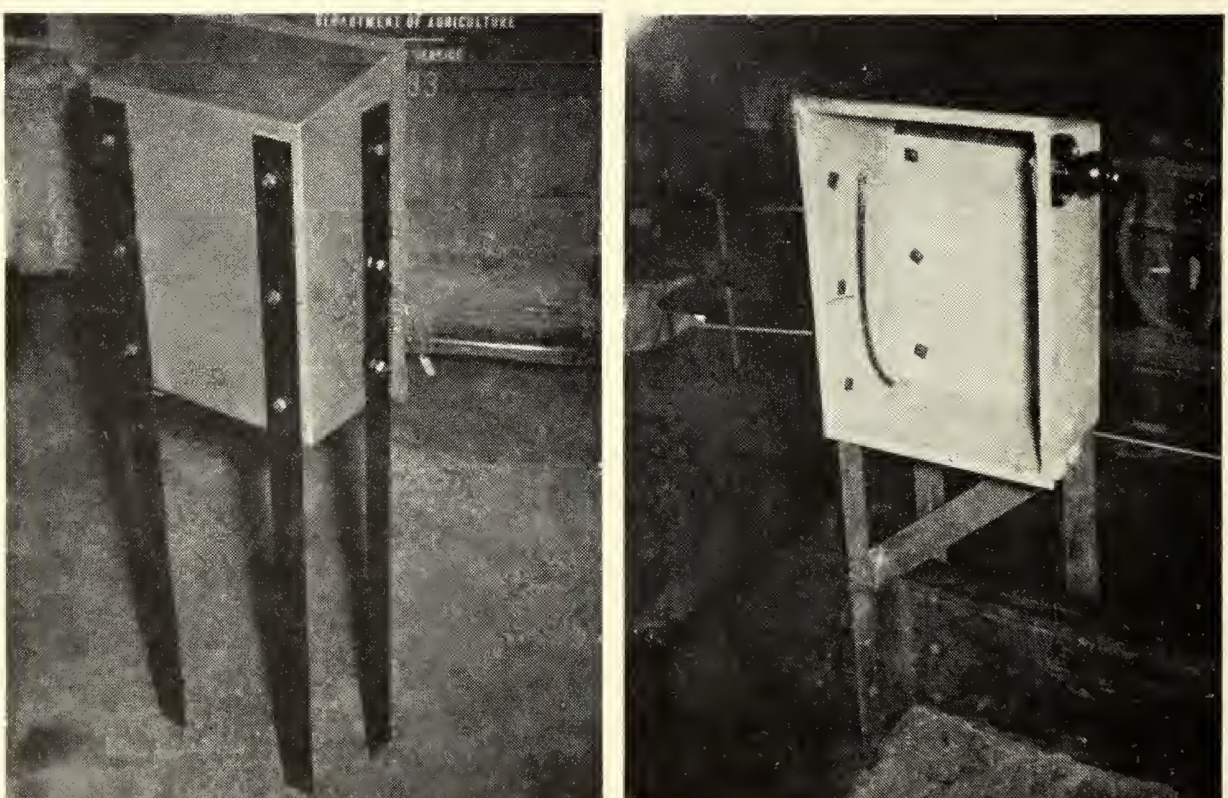

Figure 1.—*Left,* Steel supports are bolted to case. *Right,* Bracing insures rigidity.

pull up and the heads will not interfere with the fitting of the chassis into the case.

A diagonal brace of the same steel as the legs is welded between the front leg and the one diagonally across the case to the back. Bracing this back leg as near the bottom of the case as possible is essential to rigidity of the mount (fig. 1).

This mount may be bolted into the left front corner of pickup or truck bed with two of the legs on the outside, where the headboard curls in (see fig. 2), or with all legs on the inside where the headboard curls outward as in the power wagon.

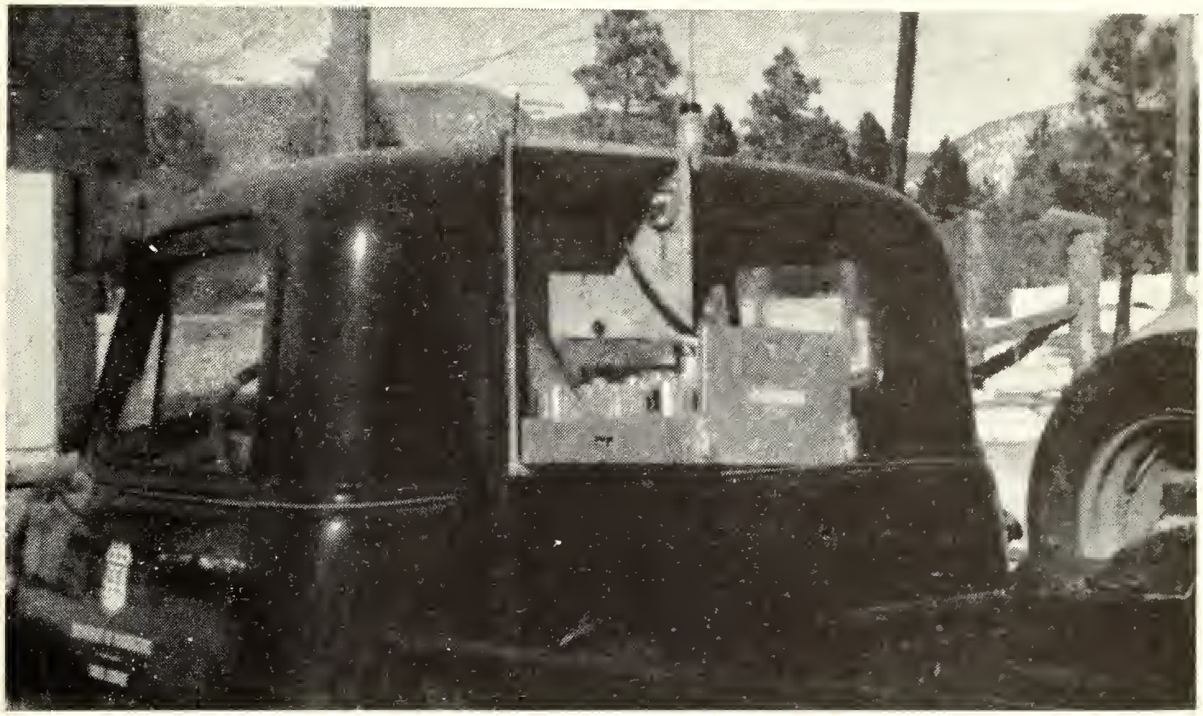

FIGURE 2.—Case mounted on pickup.

The antenna is mounted directly on the case, which comes with the necessary holes already punched.

Some of the advantages realized are:

1. Mount is adaptable to various makes and sizes of trucks.
2. Mutilation of cabs of trucks is avoided. (Some cabs do not have enough room between top and liner to accommodate roof-top antenna mounting.)
3. Radio is very accessible to technician for maintenance and repair.
4. No space is taken from the pickup or truck bed.
5. Antenna is mounted high enough and sufficiently in the clear to permit nearly optimum results in all directions.
6. Radios can be installed with ease and speed.
7. Radio is mounted approximately midway between front and back wheels for best riding conditions.
8. Short antenna cable reduces transmission losses to minimum.

Tests made with these mobile radios using this mount showed better than expected results. At extreme marginal conditions, some directivity was observed slightly to the right of front of vehicle. This could be expected from the ground-plane effect of the cab roof-hood combination lowering the angle of maximum transmission radiation in that direction.

RADIO MOUNT IN ¼-TON JEEP

William E. Towell
Chief of Fire Control, Missouri Conservation Commission

The 4-wheel drive jeep has proved extremely valuable in many States as a fire fighting vehicle. During the past 6 years about 60 ¼-ton civilian jeeps and 20 1-ton jeep 4 x 4 trucks have replaced pickups and conventional trucks as fire fighting units in Missouri. One disadvantage of the small ¼-ton jeep has always been limitation of space. Until recently all jeep radio installations were made in a waterproof box carried in a 3-foot bed extension at the rear of the jeep.

A new-type FM radio unit, Model FMT-R-41 V, (DF) 1 C (Front Mount) is almost tailor-made for the small jeep. The radio itself is a 12-watt set with the control panel and speaker mounted in the front of the single cabinet. It is a self-contained unit requiring only antenna and battery connections to place it in operation. This radio is available either for the 30-40 mc. band or the 152 mc. band and can be obtained for operation on one or two frequencies.

In the ¼-ton jeep this radio is mounted between the two front seats with the control panel forward (fig. 1). The extra passenger or right-hand

Figure 1.—FM radio mounted between front seats of a ¼-ton jeep.

seat is moved to the right about 2 inches to make room for the radio. This is a simple operation for anyone with a portable electric drill. The radio is mounted on three small rubber shock mounts of the type normally used for refrigerator units. Controls and microphone are easily accessible to the driver or passengers in either the front or rear seats.

In transporting fire crews it is often necessary to carry three passengers in the front seats. To prevent damage to the radio and still be able to carry the extra passenger, a steel plate or guard has been mounted over the radio. The original pattern was designed and built by Merald W. Johns on the Lake Ozarks District. The supports are secured to the floor with bolts and wing nuts so that the plate is easily removed to provide access to the radio. Holes are cut in the plate for the control knobs and speaker. The entire installation requires only about 3 hours, and the protective plate can be made in any machine shop for about $5.

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The Helicopter as a Fire-Fighting Unit, by R. L. Hall. Canada Pulp & Paper Assoc. Woodlands Sect. Index 1200. 4 pp.

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Forage for Fire Protection; Grazed Firebreaks in the North Carolina Coastal Plain, by R. H. Hughes and J. L. Rea, Jr. South. Lumberman. Dec. 1951.

Holy Old Mackinaw in the Smoke, by H. V. Simpson. Amer. Forests. Nov. 1951.

LONG-ROPE PARACHUTE

Aerial Equipment Development Center
U. S. Forest Service, Missoula, Montana

The long-rope parachute, nicknamed "long-tailed chute," has been successfully used for dropping light loads in timbered country for two seasons. Although the action of the long rope, in letting loads down through thick timber, is desirable for dropping heavy loads up to 150 pounds, we have previously confined the use of this development to light loads of 50 or 60 pounds.

The long-rope parachute consists of a standard canopy with regular load lines, but it is packed in a manner which allows the load to hang on the bottom of a long rope during descent. Its principal use is in tall timber where the regular parachutes, with the load attached in the normal manner, often hang up in the tree tops. This necessitates considerable delay in retrieving both the parachute and the load, and often results in damage if the tree is felled.

The load, upon entering the tall timber, is stopped from any forward motion, and the parachute drifts on. As the package descends to the ground the long rope will be caught by limbs which cause the parachute to act as a drag or brake in letting the load down to the ground. There is very little landing shock because of friction of the rope over branches, and the braking action of the parachute as it is pulled back to the tree by the descending load. The long rope, from the parachute to the ground, greatly facilitates the removal of the parachute from the trees, and usually eliminates climbing or felling to retrieve the canopy.

When we attempted to drop heavier loads of 150 to 170 pounds, the number of "break-aways" presented a serious problem. Observation and pictures pointed to the trouble: the parachute became inflated before the load reached the end of the long rope. There was no deceleration of the package as the parachute inflated, and a terrific shock resulted when the load reached the end of the line.

We tried ⅜- and ½-inch nylon rope. They held for one or two drops but could not be depended upon after that. Apparently the shock came too quickly to allow the natural stretch of the rope to take place. This was indicated by breakage which always occurred within 1 or 2 feet of attachment, either at the parachute or at the load. Other things, such as several sizes of rings on the load lines to slow down the opening of the parachute, various packing methods, and rubber shock absorbers made of heavy bungee cord, were tried with more or less success. Twisting the suspension lines provided an effective method of slowing down the opening, and it was very easy to do; but 20 test drops failed to show a consistent opening speed, which is necessary for accurate spotting of loads. One method, consisting of four rings used to divide the load lines and placed near the perimeter of the chute in a manner which retarded the opening until the rings could slide down the lines, was unsuccessful for the purpose intended, but it did reduce oscillation considerably. This may be worth further experimentation, since oscillation is one of the major contributors to landing damage.

Later experiments used a simple extraction chute, which was opened by the static line in the ship, and which in turn opened the large freight chute after the load had reached the bottom of the long line (figs. 1 and 2). This method has been definitely established as the most positive arrangement for deployment of the long rope. Final tests were completed on May 14, 1951, and the job breakdown and instructions posted for use by riggers.

For those familiar with packing procedures, the following brief description will be of interest:

An 8-foot bomb parachute (or a similar chute used for extraction) in a muslin sack is tied securely into the apex lines of the standard freight chute. From all appearances this resembles a pilot chute. The standard freight parachute is packed with normal procedure, except that the one strand of 8-cord, which laces the container, is run through the attaching loop of the bomb or pilot chute. In other words, instead of passing the lacing cord through a break ring, it is passed through the loop formed by the bomb chute lines.

The bomb or pilot chute is stowed, lines first, in the muslin sack and a 1-inch cargo break ring tied into the apex with a single strand of 5-cord. This single strand should be about 4 inches long. The bomb or pilot chute is pushed into the sack far enough to allow gathering the open end (with the ring hanging out), doubling it, and looping a doubled No. 32 rubber

FIGURE 1.—Long-rope parachute with pilot chute.

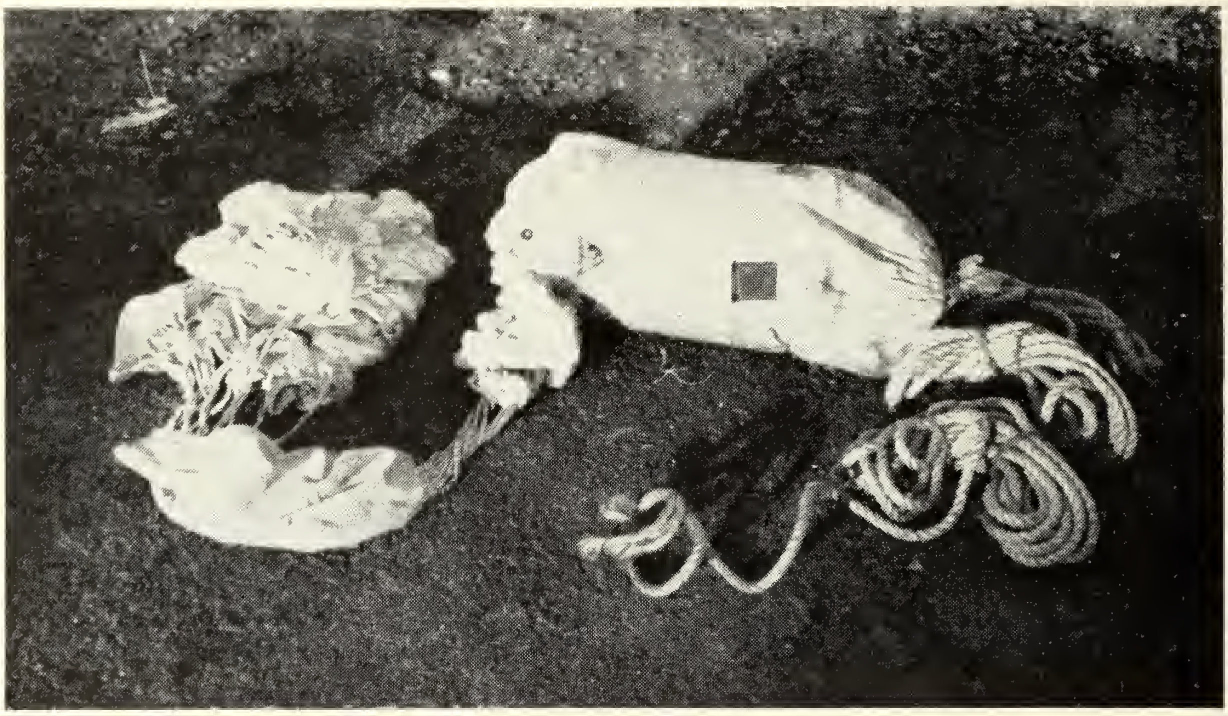

FIGURE 2.—Long-rope parachute partially deployed. Pilot chute is pulled out by static line. Main cargo chute does not open until load has reached the end of the 75-foot rope extension.

band over the folded end of the sack. The extraction and freight chutes are now packed.

Next, the 75-foot, ½-inch hemp rope is stowed in the same manner as the freight chute suspension lines. These stows should be held with heavy No. 50 rubber bands. Place the rope stows inside the bungee container, leaving about 3 feet of rope hanging out. Next, tie a single strand of 8-cord to the "V" ring of the freight chute riser with a bowline knot, and then tie the other end to the free end of the rope at the point where it emerges from the bungee container. Use a clove hitch to tie the 8-cord to the rope.

The hemp rope should be attached to the webbing of the cargo chute riser loop with a clove hitch followed by two half hitches.

When the rope is attached to the cargo bundle, care should be taken to pad or otherwise reinforce the point of attachment so the rope cannot shear itself with its own knot. If a heavy webbing loop is provided, the attaching knot should be a jam hitch with the running end wrapped twice around the base of the loop before it is extended back through the loop.

Drawings and complete instructions are available upon request.

MICHIGAN HYDRAULIC SULKY PLOW

Steven Such
Engineer, Michigan Forest Fire Experiment Station

Currently being tried in Michigan is a recent development in sulky plows using hydraulic controls. This new edition, the pilot model of this design, has undergone two seasons of field testing with good success. Performance data is still being gathered and studied. No attempt has been made to standardize on this unit as a general fire tool in the State. Past history of the plow, however, gives it better than an average chance of acceptance for forest fire control.

Being classed in the light-heavy or semi-heavy group, this unit weighs 1,400 pounds, almost all of which is acting on the plow when it is in operation. The basic design is similar to the standard heavier sulky plows in Michigan, the main differences being in the control mechanism and the size. The heavier and larger Michigan sulkies are winch-controlled and fall in the 2,000-pound class, and their bottoms have a wider spread.

Best application of the new hydraulic plow is yet to be determined, but it appears that it will find its place behind a crawler tractor of 20 or 30 horsepower, depending somewhat on assignment (fig. 1). In actual tests a four-wheel-drive power wagon handled the plow with good results. At the time of these tests the possibility of using this plow regularly with the power wagon was seriously considered. One drawback to this practice, however, was the difficulty encountered in trying to back up while in the woods. Operator experience and slight mechanical improvements have remedied this situation somewhat.

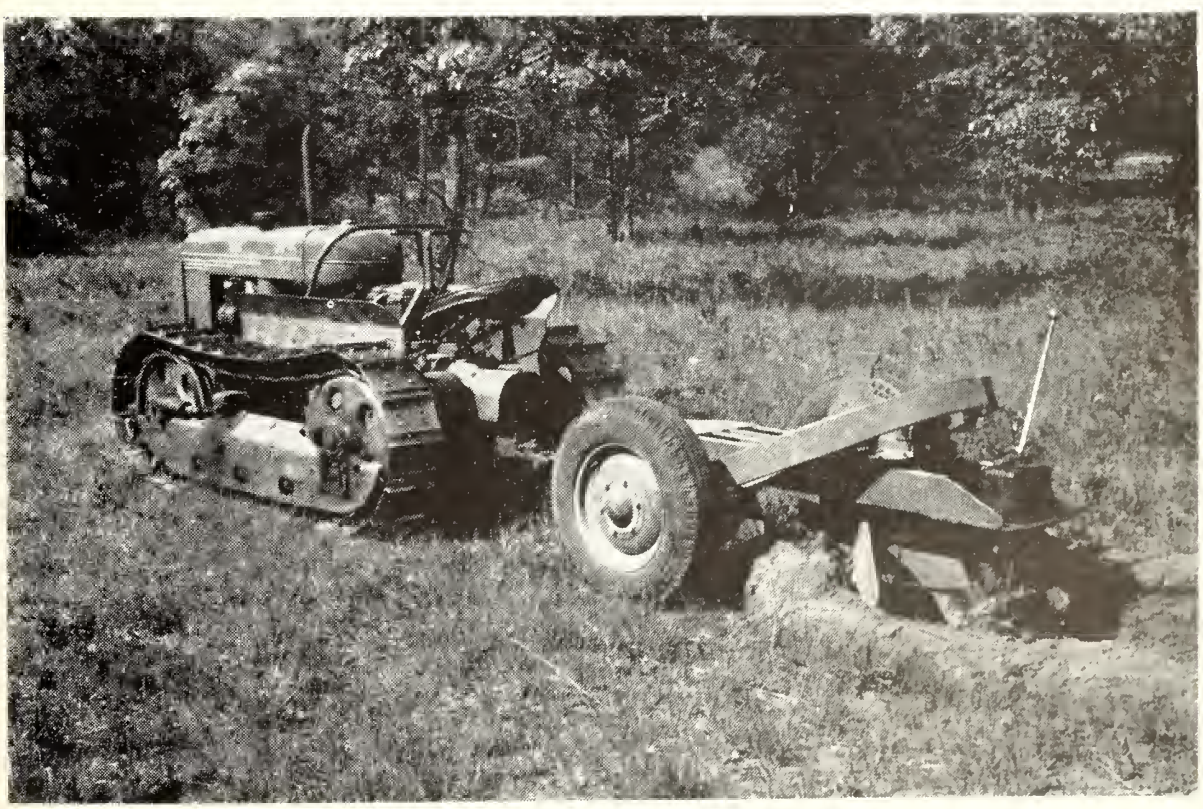

Figure 1.—Michigan hydraulic sulky plow in working position.

The hydraulic sulky is rugged in construction and presents a low silhouette. It is mounted on heavy-duty rubber tires and may be towed at any safe vehicle speed on the highway. The balance points are so placed as to permit one man to handle the entire plow just as easily as he would a light trailer. The reenforced U-shaped carriage insures adequate strength even for the most severe fire conditions. The beam is of 5-inch, 9-pound-section, channel iron. A 24-inch rolling coulter and 2 cut-down, 18-inch, plow bottoms make up the principal components of this machine. The bottoms are cut down to reduce the drawbar power requirements. The head casting provides for adaptors for quick attachment to either tractors or trucks. Experiments with satisfying results have been run on the use of the trailer type ball hitch for plowing. There seems to be no objection to this practice if the maximum capacity of the hitch is not exceeded, and if caution is taken to strengthen the ball assembly.

Though hand operated, the hydraulic section of this plow provides an easy and efficient control device for raising and lowering the carriage. It is in this action that the plow is unique since many factors are centered around the proper functioning of the carriage. It must be remembered that the transportation of the unit, the stability and correct action while plowing, the most advantageous distribution of weight, and the safe and efficient operation of the plow are all affected by the carriage design. With the single-acting hydraulic cylinder used in this design, the carriage is allowed to float when plowing. Normally this means that almost the entire weight of the carriage is then resting on the plow thus giving a desirable added weight for penetration on most tough plowing chances. The floating action is particularly helpful in rough and irregular ground.

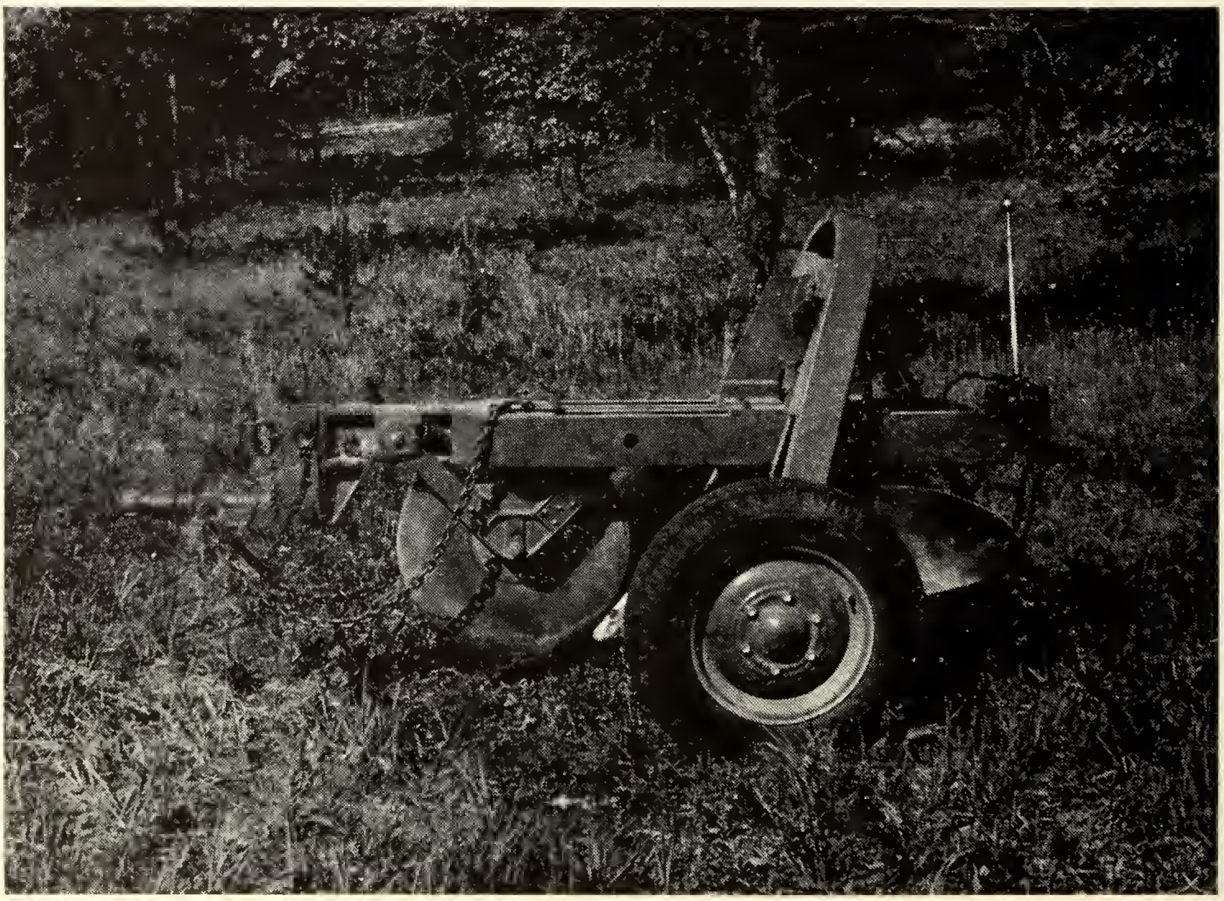

Figure 2.—Michigan hydraulic sulky plow in raised position.

When through plowing, or for any other reasons that may arise, the operator can raise the carriage by use of the hand pump on the rear of the plow (fig. 2). A pin is used for positive locking for highway travel to relieve the load on the hydraulic system and to insure safe travel. The hydraulic cylinder is actuated in one direction by gravity, as in plowing, and it is moved in the opposite direction, as in lifting the plow, by the hand pump.

Briefly, specifications on this unit are as follows:

Type: Double-bottom sulky on rubber tires
Weight: 1,400 pounds
Length: 80 inches
Height: 53 inches
Bottoms: 11-inch right and left steel bottoms, cut down from 18 inches
Rolling coulter: 24 inches diameter
Control: Hydraulic
Total width of line: 66 inches

Prints, specifications, and other information about this plow and other Michigan equipment may be obtained from the Department of Conservation, Lansing, Mich.; or from the Michigan Forest Fire Experiment Station, Roscommon, Mich.

New Fire Line Tool

In Ontario a hoe type of tool with a shovel steel blade of 6 inch by 6 inch dimension and having a small, light axe head forged or welded to the top of the handle socket is being tried out, and is receiving favourable comment from fire fighters as an excellent trenching tool. The small axe head, about 3 inches long with a 3-inch face, is handy for cutting roots in the trench and the hoe blade is found to be more efficient than a shovel in scraping off leaf and moss litter. The tool is intended to complement the shovels and axes now used on the fire line.—(Report on Forest Fire Research in Canada, January 1948 to July 1949, Canadian Society of Forest Engineers) From Forest Fire Protection Abstracts. Canada Dept. Resources and Devlmt. 1:19. 1950.

A NEW TYPE OF COMPASS FOR SMOKECHASERS

GAIL C. BAKER
Staff Assistant, Deschutes National Forest

The Deschutes National Forest was given the assignment of trying out a new compass during the 1951 fire season. A supply of these compasses sufficient to equip all the firemen on one ranger district was received on the forest in June shortly before the guard training camp. We included instruction for their use in the smokechasing course and discovered that the instruction job, which consisted basically of proper holding, boxing the needle, and sighting, was greatly simplified (fig. 1). The problems of getting the needle to settle quickly, being careful that it was swinging free, and the troublesome reversal of east and west, which characterize the standard box, were eliminated.

As part of our guard camp program each year we have a compass contest. A 10-sided, closed traverse is staked on the ground and the angles measured carefully with a staff compass. All trainees at the camp are required to run out this course in their spare time using their pocket compasses. The winner and the runner-up in this year's contest were both using the new compass, and their cumulative error was less than 2 degrees. This compares with a low error of approximately 5 degrees for the standard box compass.

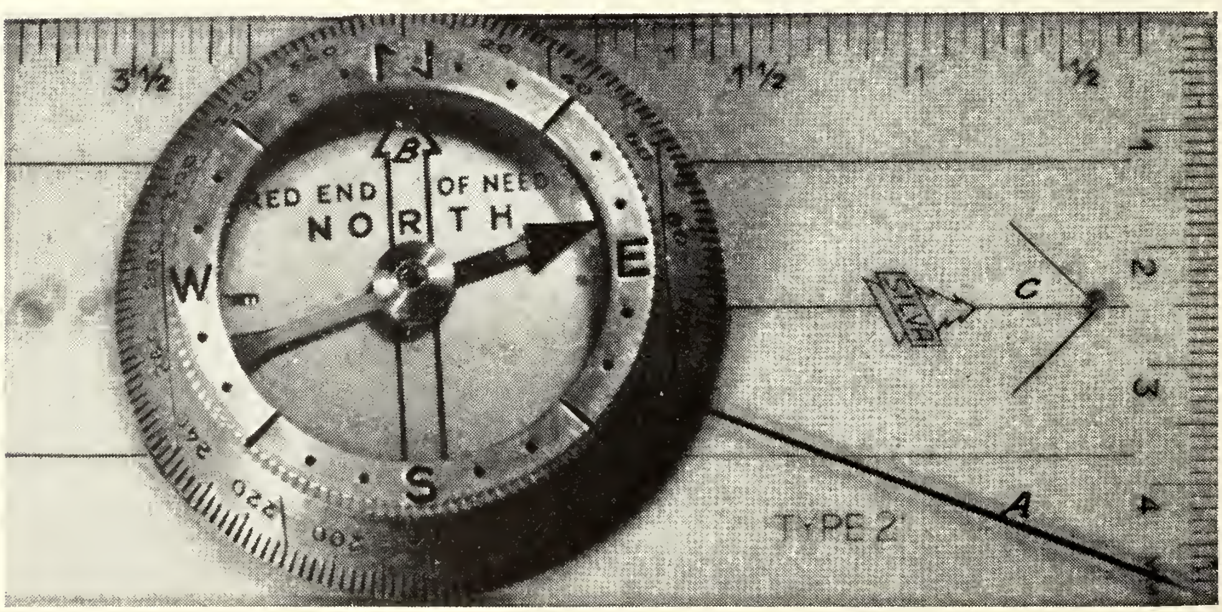

FIGURE 1.—Operation of the compass is simplified if the graduations on the back are disregarded. Set off the magnetic declination by scratching and then inking in line *A* (called target line). Declination in photo is set off for 20° (each mark on the compass housing is 2°). To run a compass course: (1) Set desired azimuth on target line *A*; (2) hold the compass in the usual manner with the "line of sight" arrow *C* in front of the body; (3) turn the body (and compass) until the magnetic needle is in the etched needle box *B* inside the compass housing. Your course is then line of sight *C*.

The District Ranger, his assistant, the fire control officer on the forest, and 10 firemen had the opportunity of trying out this type of compass during the past season, and they consider it far superior to the standard box type compass. It appears to have the following advantages:

1. The needle is quick-settling, thus saving considerable time in taking a reading.
2. It has no lid to spring open accidentally and allow the needle to fall off the pivot or become demagnetized. The needle is in liquid, and it swings freely in any position.
3. The cover is shatterproof.
4. It is very light in weight and can be carried in the shirt pocket without notice.
5. There is an inch scale on the plastic base which can also be used as a straight edge.
6. It can be set on any azimuth reading and will remain there until a new reading is desired.
7. The east and west is not reversed. Thus a source of confusion is eliminated for trainees.
8. The azimuth circle is numbered clockwise, the same as the trainee's protractor (not counter-clockwise as on the box type compass), thus aiding the trainee in his sense of direction rather than confusing him.
9. It is simple to understand and operate, thus saving considerable time in training.
10. It costs much less. The present price is $4, compared with about $10 for the box type.
11. It should require very little maintenance; the box compass requires frequent and expensive maintenance work.

The Procedure and Cost of Conducting Forest Protection Analysis

The Western Forestry and Conservation Association has issued a series of reports on "Various Recommended Forest Practices and Techniques." One of the reports deals with "The Procedure and Cost of Conducting Forest Protection Analysis."

This protection report covers the following points:—

(1) The determination of present standards.

(2) The determination of improvements necessary for raising standards or for maintaining existing standards at lower cost.

(3) The justification of recommendations for improvements.

It also gives an outline of the costs involved in making protection analyses.—From Forest Fire Protection Abstracts. Canada Dept. Resources and Devlmt. 2:23. 1951.

IMPROVED SMOKE CANDLE

A. B. EVERTS
Equipment Engineer, Division of Fire Control, Region 6, U. S. Forest Service

Samples of an improved smoke candle were furnished by the Washington Office to Herbert K. Harris, Region 1, and Jack S. Barrows, Northern Rocky Mountain Forest and Range Experiment Station, for testing in connection with an intensive visibility and detection study. Others were supplied the author and William G. Morris, Pacific Northwest Forest and Range Experiment Station, for testing in an attempt to develop a device capable of generating sufficient smoke to clear 150-foot trees without dispersal. The findings of the investigators are combined in this report.

According to Harris, burning time of 91 candles varied from 8 to 19 minutes, depending to some extent on the relative humidity. The average was 12.6 minutes.

FIGURE 1.—Smoke produced by a candle. There was no noticeable wind in the deep timber, but natural draft along the roadside was sufficient to "pull" the smoke horizontally. In this case the smoke did not rise above the trees.

Out of some 130 candles used in tests the investigators reported 14 fuse failures. If a fuse burned out, considerable heat was required to ignite the chemical. Fuses were used for this purpose. When a candle is first ignited, a "plug" of hot, glowing chemical breaks loose from the end. This plug could set a fire.

Smoke color was adjudged very good by all observers.

Smoke rise was not good (fig. 1). This is probably due to lack of sufficient volume and heat. Application of additional heat resulted in little if any increase in the smoke rise because of a reduction in the volume. Best results were obtained by concentrating the smoke behind a flat rock or board with approximately 1 square foot area. This caused puffs of smoke which took longer to dissipate and consequently attained a greater elevation at times.

Volume was sufficient for most use on still days. Wind velocities of 3 or 4 miles per hour reduced the visibility distance considerably by causing the smoke to drift close to the ground until too thin for detection at maximum distances.

Visibility of the smoke was very good when it was rising and spreading normally and without wind gusts. Smoke was seen very clearly at a distance of 14 miles by Region 1 observers looking toward the sun in preliminary tests. For maximum distance the smoke must be established in open areas because of its small volume. No visibility tests were made in Region 6; smoke would not rise in timber under any conditions without too much dispersal. It was agreed that for open areas, brush fields, and young reproduction the candle is superior to any tried out before.

Two types of balloons to lift the candle above the tree tops were tried in Region 6, but the weather balloons were the only successful ones. These

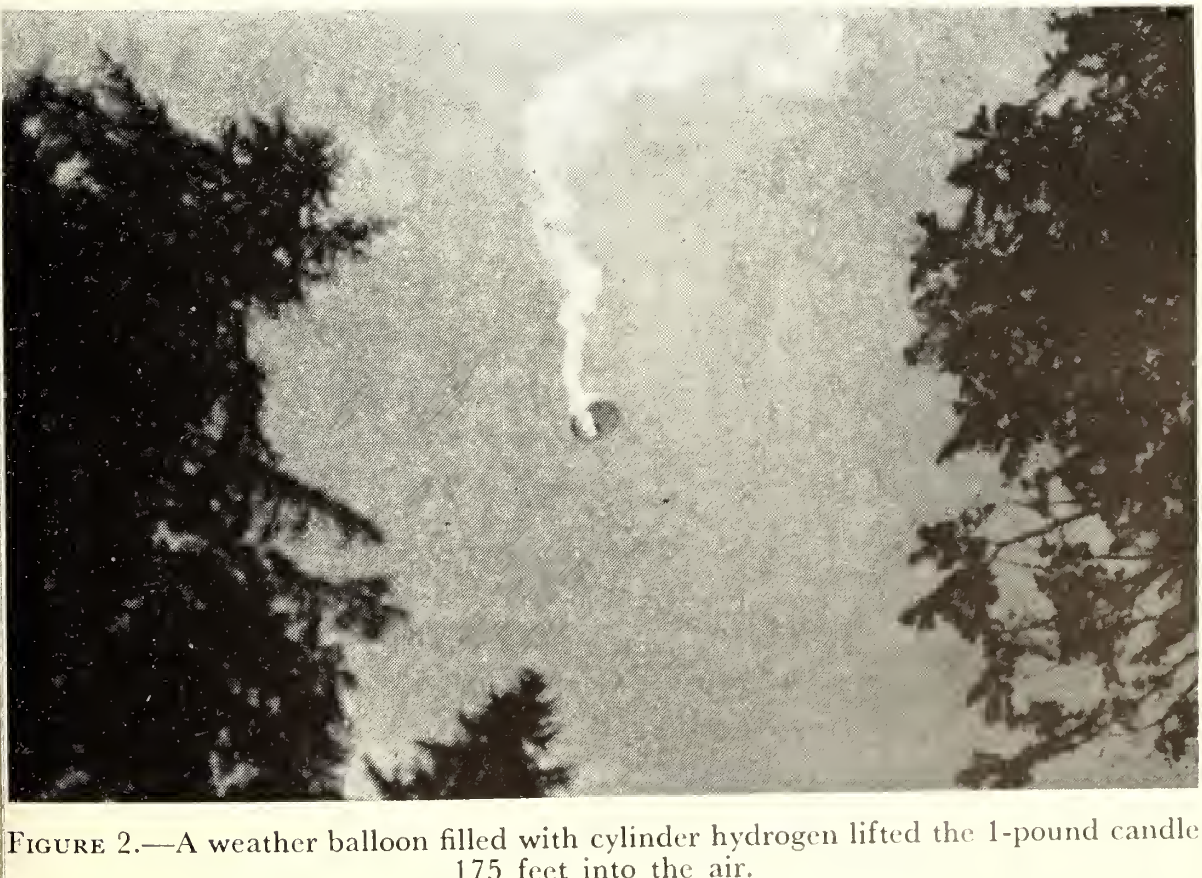

FIGURE 2.—A weather balloon filled with cylinder hydrogen lifted the 1-pound candle 175 feet into the air.

can be inflated to a diameter of 5 feet or more with cylinder hydrogen in a minute's time. Hydrogen costs $2.16 per 100 cubic feet; the smallest container is the 191-cubic-foot size, weighing 135 pounds. Hydrogen is explosive, and it is believed it should not be used generally. Helium is safe, but the cost is high, $13 per 100 cubic feet.

A 1-pound smoke candle was attached to a balloon with a copper wire. Then a 175-foot length of stout cord was tied to the candle. The balloon had sufficient lift to take the candle straight up (fig. 2). No difficulty was experienced in "steering" the balloon through the trees. This method will get the smoke up where it should be visible for considerable distance.

Combination Pressure Relief and Check Valve

We have found that placing a separate pressure relief valve somewhere in a hose line is a great inconvenience. Consequently, we have taken a combination check and bleeder valve and brazed an adjustable, automatic pressure relief valve to the check valve cover plate. This gives the pump operator full control over the pressure relief valve setting and eliminates a second piece of equipment. Also, by having the relief valve in this spot, if a pressure that is higher than the relief valve setting is needed, it is instantly obtainable by the pumper operator; and he may accurately control this setting because he has the pump gauge to work by.

The automatic relief valve which is used should be one of ¾-inch capacity, adjustable between 160 and 225 pounds with a hand wheel and lock nut on the valve stem. However, any good adjustable relief valve will do the job. The pressure relief valve should be disassembled and the check valve cover plate removed during the brazing. Care should be taken to prevent excess heat from distorting the seat of the check valve or the pressure relief valve.—Alwin E. Hodson, Jr., *Chief Fire Warden, Nobscot Reservation, Framingham and Sudbury, Mass.*

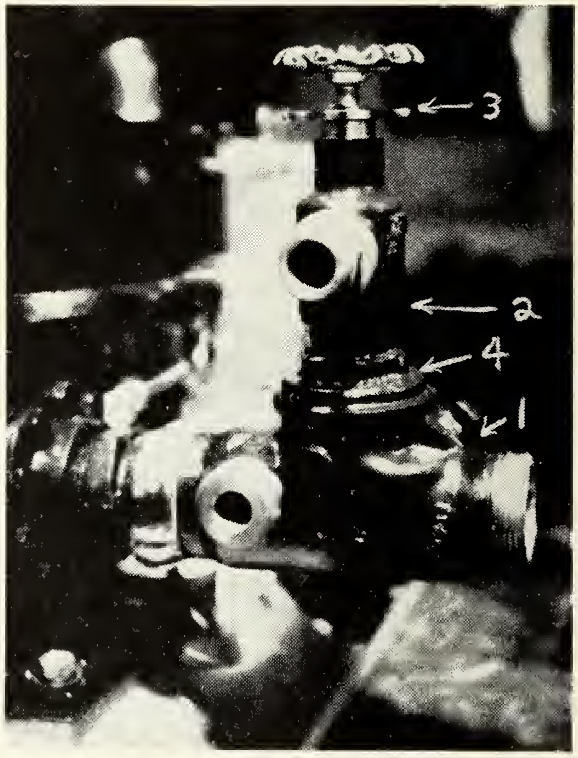

FIGURE 1.—Complete pressure relief assembly: 1, Check and bleeder valve; 2, automatic pressure relief valve; 3, relief valve lock nut with finger wings; 4, point at which automatic relief valve is brazed to the check valve cover.

THE TREE PUSHER

C. E. Hein
General Foreman, Deschutes National Forest

The Bureau of Reclamation engineers designed a Tree Pusher mounted on a land-clearing blade to clear lodgepole pine from the Wickiup Reservoir site. At the completion of the clearing project, the Deschutes National Forest purchased a surplus Tree Pusher from the Bureau and fitted the attachment to an Isaacson land-clearing blade mounted on a D-7 tractor. A major improvement was made in the Bureau's design by welding short heavy teeth to the pusher bar; this makes possible a better grip on the trees and enables the tractor operator to better control the direction of fall (fig. 1).

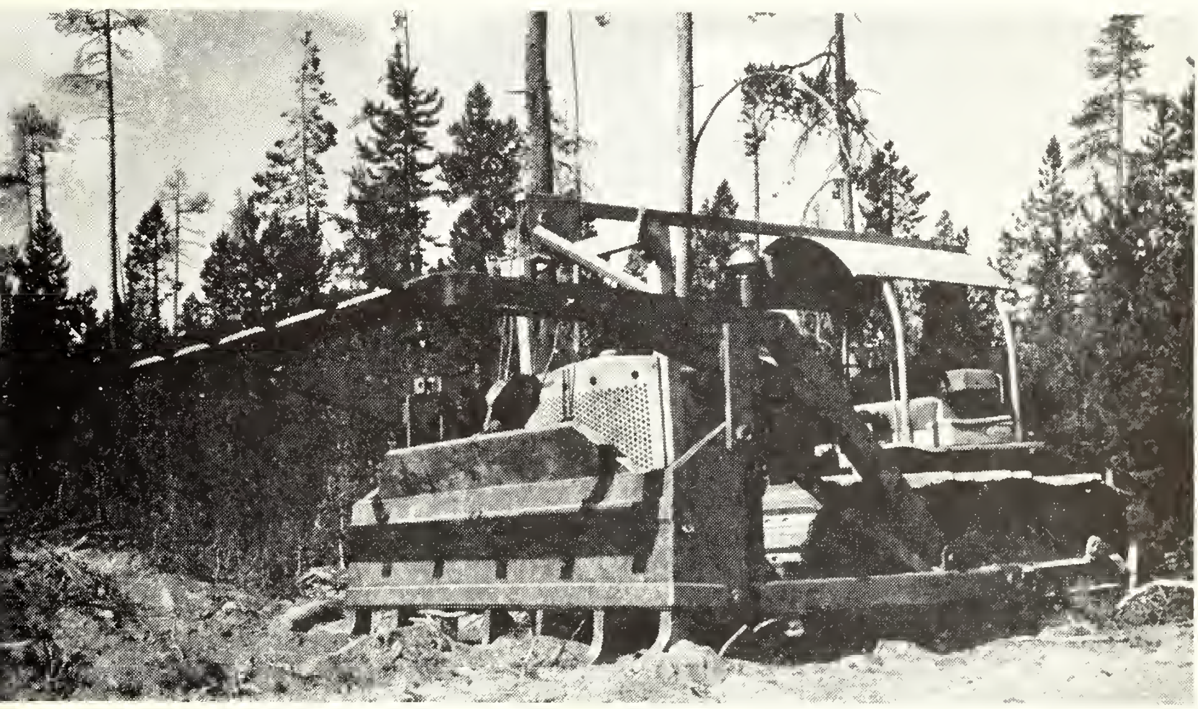

Figure 1.

The improved Tree Pusher has been used on road right-of-way clearing through lodgepole areas where a few trees of ponderosa pine and white fir have been in the cleared strip. Trees up to 24 inches in diameter are easily pushed and trees as large as 40 inches have been pushed in favorable locations. The added weight of the Tree Pusher is a slight handicap governing the maneuverability of the tractor. Pushing activities should be confined to relatively level ground.

In road right-of-way clearing, an average of three tractor-hours per acre was expended on clearing work. Using this accomplishment as a measuring stick, it is safe to assume that in clearing a 10-foot fire line (width of dozer blade), about one-fourth mile per hour could be cleared.

The operator is protected by a steel canopy and is instructed to push only those trees that will come with a continuous forward motion of the tractor. "Rocking trees" is prohibited as a safety measure.

A TRACTOR-DRAWN FIRE RAKE

William E. Towell
Assistant State Forester, Missouri Conservation Commission

An entirely new principle in fire line construction has shown exceptional promise in initial tests in Missouri. This new fire rake is a special adaptation of the Ferguson side-delivery hay rake. Those who have seen the fire rake in operation are confident that the principle is a long-sought answer to mechanical fire line construction in the central hardwood region.

The possibilities for use of a fire rake as a fire fighting tool were first realized by District Forester Lee C. Fine, of Sullivan, Mo., and his assistant, Harold J. Reutz, of Steelville, Mo. Fine and Reutz watched a Ferguson side-delivery hay rake in a field and arranged to try one in the woods. In spite of excessive width of the hay rake and the resultant poor maneuverability in the woods, it raked a good fire line. Observation of this trial enabled the manufacturer to obtain several ideas for modification of the tool for fire fighting purposes.

The fire model is a miniature of the commercial hay rake. It is sturdier in construction and was designed so that the width would not exceed the outside wheel width of the farm tractor (fig. 1). It is connected to the tractor by the standard three-point hydraulic lift connections and is powered by a drive shaft fastened to the rear power take-off of the tractor. The speed of the rake is governed by the speed of the tractor engine. The entire rake is raised or lowered by the hydraulic lift, and an alert operator can raise it over large obstructions.

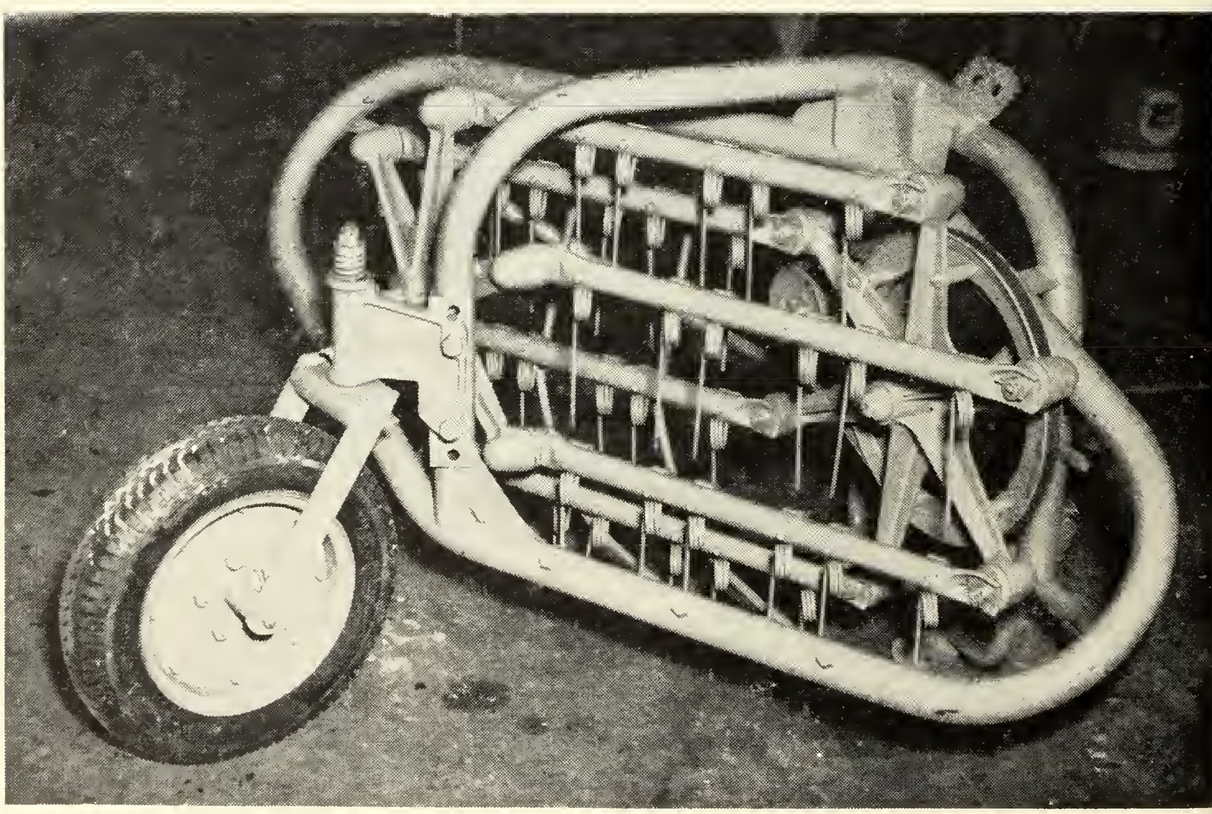

Figure 1.—The tractor-drawn fire rake. (Photo courtesy Mo. Conserv. Commission.)

The spring steel teeth move parallel to the ground for several inches kicking or raking debris to the left side of the direction of travel, then they go up, over, and down to raking position again. A single rear wheel, adjustable in height, allows positive contact of the teeth with the ground but prevents the weight of the rake resting on the teeth. The teeth can be quickly straightened or replaced.

In its current stage of development the fire rake makes a clean line to mineral soil about 3½ feet in width in broadleaf fuels. All leaf litter is windrowed to the left side. The tractor and rake can operate in first, second, or third gear, and it averaged about 3 miles an hour in initial tests over moderate terrain and fairly open hardwood cover. One particularly encouraging feature was the clean line made through buckbrush and blackberry vines where the teeth had a combing action. In one test against a five-man crew with broom rakes, the tractor-drawn fire rake made three times as much fire line of comparable width and quality.

Several modifications of the pilot model have already been made in the field. The teeth have been shortened about 2 inches; stripper bars between the teeth have been removed; and the rear depth wheel has been raised. Another change to be made by the engineer is in the design and composition of the teeth. Both the tractor and rake were left on the Meramec Fire Protection District for actual use during this spring's fire season. Complete records will be kept of operation on actual fires for future detailed reports.

At the present time the fire rake offers the following advantages as a mechanical tool for fire line construction:

1. The rake and farm tractor are considerably cheaper than crawler tractors and fire plows.

2. It is adaptable to any power unit with a hydraulic lift system and power take-off (crawler tractor, power wagon, or jeep).

3. The rake merely moves the surface litter, exposing mineral soil, and does not plow a furrow that might be objectionable on some privately owned lands.

4. On a farm tractor the rake can be raised by the hydraulic lift and tractor can be roaded to fires at a speed up to 30 miles an hour.

5. The rake is light in weight and can be transported with ease on any stake truck or small trailer behind a pickup or jeep.

Although this fire rake is not yet a perfected fire fighting tool, it shows great promise and is regarded as a new principle that may eventually be used throughout the country. The rake is not yet made commercially.

A HEAVY-DUTY BROOM RAKE [1]

The most efficient hand tool used for fire suppression by Federal and State Fire Protection Agencies in the Central States of Region 9 is the heavy-duty broom rake. It is especially adaptable for use in raking or constructing fire lines in leaf fuel types on steep hillsides, in ravines and very rough terrain, and in very rocky areas where mechanized equipment cannot be used to good advantage.

The many commercial makes of broom rakes on the market were developed for use on lawns and other places relatively easy to rake. None are heavy-duty rakes that can be used dependably and effectively in an accumulation of leaves and where considerable amounts of grasses, brush, branches, and other debris are encountered. With increased forest fire protection, ground fuels become heavier and require a broom rake with a stiff spring action of the tines for clean sweeping. Also, one is required that will stand up under hard use and retain its temper after carrying burning fuel in backfiring work.

Following tests and trials of several pilot models under actual conditions, the Roscommon Fire Equipment Development Center produced a broom rake that has been accepted by experienced fire fighters as ideal for woods use. It is classed as a heavy-duty rake, but is usable for lighter work on lawns, etc. It will outperform and outlast any other rake used for fire line construction. Important features in the rake are adjustability in sweeping width; carbon steel tines that withstand heat when used for backfiring; automatic tension on tines for light or heavy going; compactness for transportation, shipping, or storage—when tines are closed the rake will fit into a small tool box or can be carried in the cab of a truck; and tines all of the same length and shape for easy replacement.

The adjustable feature of the rake permits spreading the tines to 19 inches when fully extended, and a closed width of 7 inches. The adjustment also provides a variable tension on the tines for sweeping under either difficult or easy conditions. A greater tension when tines are closed makes it easier to sweep in a heavy accumulation of leaves, branches, or other debris. With tines extended for lighter fuels the tension is lessened and the sweeping area is increased.

Another important feature of the rake, and one not usually found in lawn rakes, is the shape of the lower tine holder. The duo-directional curved shape of the holder provides a desirable sweeping position for the tines. The forward concave shape causes the outer tines to be positioned ahead of the center tines and keeps leaves from slipping off and around the sides of the rake; it also forms a "basket" for carrying burning material in backfiring work. All of the tines are in contact and level with the ground when the tool is in a position for sweeping.

The carbon steel used in the tines is more desirable than surface tempered wire, in that (a) a better and more uniform tension is provided; (b) it allows a wider range of bending and will return or spring back to normal position; (c) spring tension is not lost through heating when burning leaves are carried in backfiring; and (d) tool steel is more abrasive-resistant than other forms of wire stock and will stand up better in rocky or stony areas.

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[1] Condensed from a report by E. E. Aamodt, Fire Equipment Engineer, Region 9, U. S. Forest Service.

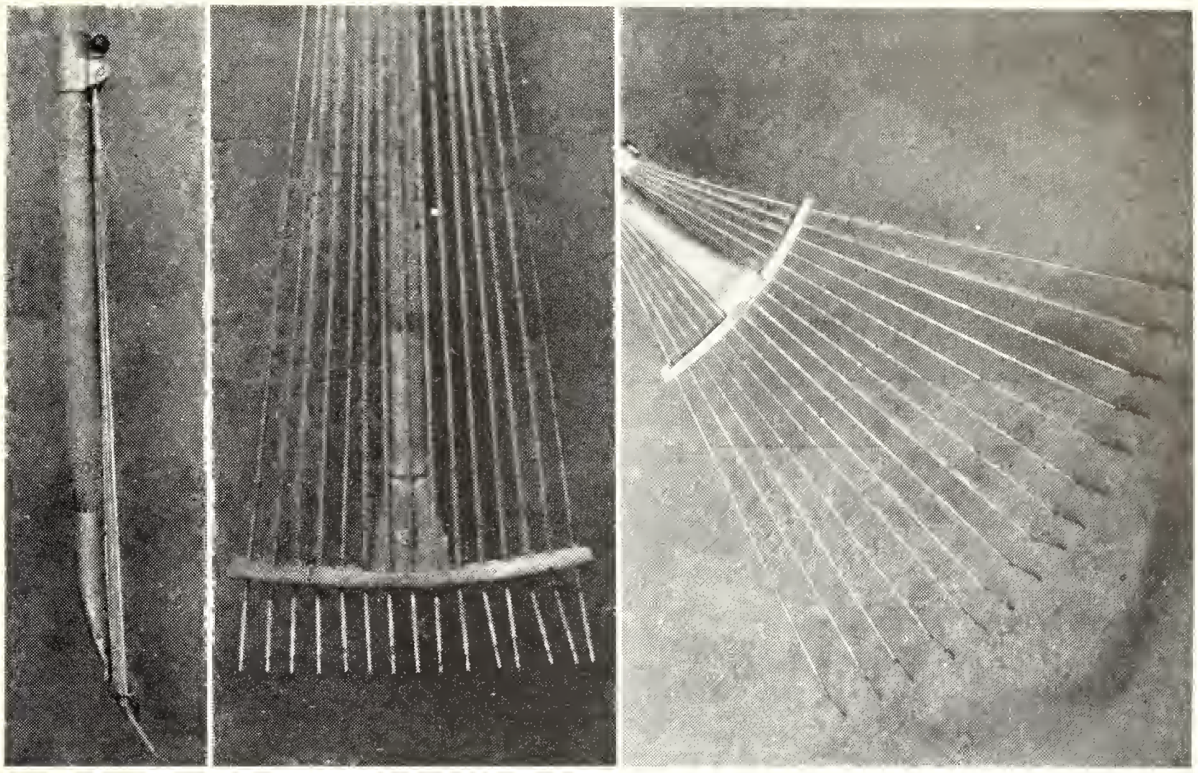

FIGURE 1.—*Left,* Side view of broom rake closed; *center,* front view of rake closed; *right,* back view of rake opened.

Figure 1 shows views of the rake. Details of its construction follow:

Handle.—Hard maple, 1 inch in diameter. Length with tines extended, 60 inches; with tines closed, 46 inches. Lower end of handle, inserted in ferrule, is straight, not tapered, to provide a better contact between metal and wood.

Sliding expansion sleeve.—A quarter-inch carriage bolt with a wing nut holds sleeve on handle and permits tine holder to slide up and down when nut is loosened.

Upper tine holder.—A bolt 3 inches long, 3/16 inch in diameter, 16-gauge cold-rolled steel, zinc plated. Upper ends of tines have completely turned eyes which loop over holder bolt and prevent tines from pulling out of place.

Lower tine holder—16-gauge, channel-shaped, cold-rolled carbon steel. Channel perforated with evenly spaced tine holes through which tines slide when rake is adjusted for width of spread.

Tines.—15, 19 inches long. Made of 11-12 gauge 1055-1065 carbon steel, zinc coated. All same length and shape; interchangeable. Lower 2 inches of each tine bent to secure best sweeping angle. Angle of bend is about 45° off horizontal; this prevents any tendency to pierce through and pick up leaves, etc., and clog the rake.

Weight.—Approximately 2 pounds, 4 ounces.

Additional information about the heavy-duty broom rake can be obtained from the Regional Forester, U. S. Forest Service, Milwaukee 3, Wis.

KNOCK-DOWN HANDLE FOR THE COUNCIL RAKE

Joseph Brishaber
District Fire Warden, Indiana Department of Conservation

Fire wardens and other conservation officers of the Indiana Department of Conservation always carry a few firefighting tools in their cars or pickups during the fire season. One of the most common tools used by fire personnel is the long-handle Council rake. This tool has always been a problem for transporting both from the standpoint of safety and storage space required. During a meeting of the Fire Equipment Development

Figure 1.—View of Council rake showing the assembled and unassembled knock-down handle. (Photo courtesy Indiana Dept. Conservation.)

Committee, the Department accepted an assignment to find a solution to this irksome problem. A knock-down handle was developed, and the rake (fig. 1) was presented for the first time at a State District Fire Wardens' Meeting last June. The rake was later exhibited at the Region 9 Equipment Development Meeting and Demonstration at Roscommon, Mich.

The simple conversion of the handle can be made as follows: Remove the handle from the metal shank. Thread the top end of the shank with a ¾-inch die after cutting 3 inches from its length. Fit a ¾-inch threaded coupling to the beveled end of the handle by screwing the handle into the coupling as far as it will go. Drill a hole through the assembled coupling and handle; rivet both pieces together by inserting a 20-penny spike through the holes. The threaded shank of the rake can then be screwed into the opposite end of the coupling, and the tool is ready for use. This simple conversion does not seem to decrease the strength of the original handle appreciably. The conversion can be readily made in any forest shop at small cost.

Helicopter Used for Fire Suppression

The Ontario Department of Lands and Forests, in co-operation with the R.C.A.F. Air Rescue Co-ordinating Centre at Trenton, Ontario, used a helicopter in suppressing an experimental fire.

The helicopter was loaded with a light pumper (Jackmite) and a 25-gallon drum of water. The pumper was operated while the helicopter hovered over the test fire which was approximately twenty feet in diameter. It was found that:

(a) the downdraft of the helicopter rekindled the fire

(b) the discharge of the pumper could be directed but was shattered by the helicopter downdraft

(c) the 25-gallon drum, emptied in approximately three minutes, effectively doused the whole fire; only a few of the larger pieces of the wood remained smouldering.—(Report on Forest Fire Research in Canada, July, 1949 to July, 1950, Canadian Society of Forest Engineers.) From Forest Fire Protection Abstracts. Canada Dept. Resources and Devlmt. 2:12. 1951.

Plastic-Impregnated Maps

The Lower Ottawa Forest Protective Association has been experimenting with fire tower maps which had been impregnated with a plastic before use. The maps so treated may be written on without marring the surface, and are said to be practically indestructible.

These maps were treated in 1950 at a cost of about $6.00 each.—(Proceedings of the Fourth Meeting, Sub-committee on Forest Fire Research, Associate Committee on Forestry, February, 1951.) From Forest Fire Protection Abstracts. Canada Dept. Resources and Devlmt. 2:21. 1951.

CANTEEN CARRIER

WREX K. HAUTH
Forestry Aid, Mark Twain National Forest

A device for carrying 1-gallon canteens on stake trucks or pickups equipped with side racks has been developed and put in use on the Mark Twain National Forest. The carrier provides a safe and handy place for canteens, and is out of the way of other cargo or passengers being trans-

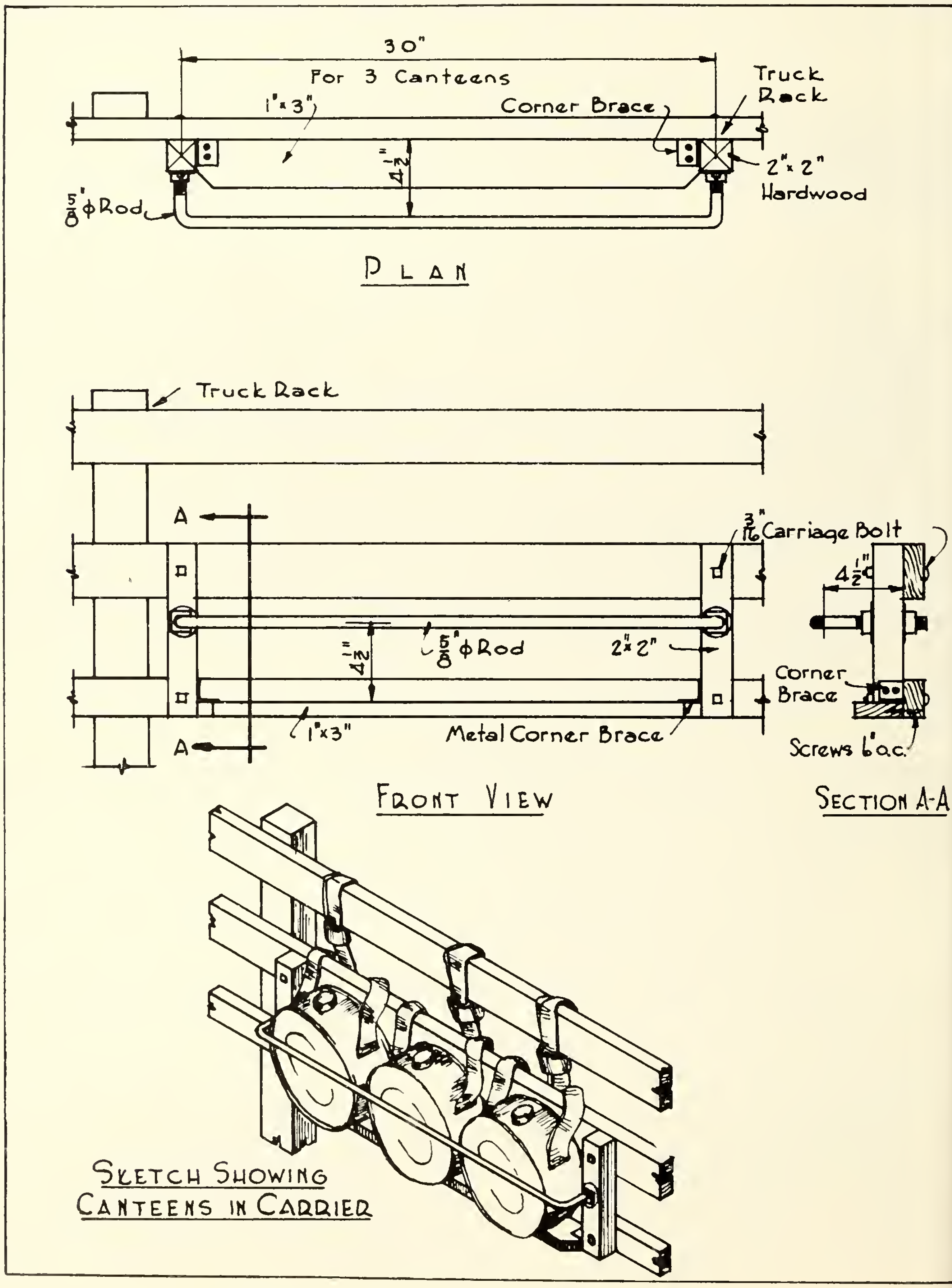

FIGURE 1.—Canteen carrier for truck rack.

ported in the vehicle. It also prevents damage to the paint job of the truck, and excessive wear on the canteens, such as that caused by swinging from the truck rack, rear-view mirror, or cab door handle.

The carrier is made of 1- by 3-inch lumber and a ⅝-inch steel rod mounted on two 2- by 2-inch pieces of wood fastened to the side rack of stake or pickup trucks (fig. 1). Assembly is as follows:

Step 1.—Bolt 2- by 2-inch hardwood uprights to rack of truck with 5/16- by 3½-inch carriage bolts, in a vertical position. Bottom ends of uprights may need to be beveled to fit flare of truck bed on pickup trucks.

Step 2.—Fasten 1- by 3-inch piece of lumber horizontally to side of truck rack and in a position between uprights so that it will support bottoms of canteens.

Step 3.—Drill one ⅝-inch hole through each upright 5 inches above top of the 1- by 3-inch horizontal piece. This will place the supporting rod mentioned in Step 4 approximately in center of canteens.

Step 4.—Bend ⅝-inch rod at right angle approximately 5½ inches from each end. This will allow about 5½ inches on each end of the rod to be inserted in the ⅝-inch holes drilled in the uprights. Place one ⅝-inch nut and flat washer on each end of the rod. Insert ends of rod through ⅝-inch holes in uprights and place another nut and washer on ends of the rod. Four inches of thread on each end of the rod will allow adjustment to fit thickness of the canteens. The length of the rod and the spacing of the uprights will depend upon the number of canteens to be carried. A 44-inch rod will accommodate three 1-gallon canteens.

Wright Hose Vulcanizer

The Forestry Branch has developed a vulcanizing device which will produce patches and splices capable of withstanding pressures exceeding 200 pounds per square inch.

One of the important features of the unit is that it produces a splice which lies flat when not under pressure so that the hose may be rolled or folded with practically no increase in bulk.

Splices may be made for approximately 75 cents each and patches for considerably less, depending on the type of patch necessary. This estimate is based on the cost of materials and labour in 1949.

Detailed information on the machine may be obtained by writing the Director, Forestry Branch, Department of Resources and Development, Ottawa.—From Forest Fire Protection Abstracts. Canada Dept. Resources and Devlmt. 1:23. 1950.

INITIAL FIRE REPORT FORM, REGION 4

Francis W. Woods
Communications Officer, Region 4, U. S. Forest Service

A few years ago it became apparent that there existed a real need to streamline our initial fire report form. Reports should—

1. Be usable Region-wide.
2. Be usable both by the lookout and the dispatcher, and permit the dispatcher to record his fire and follow-up actions on the same form.
3. Be easily understood and readily filled out with as little writing as possible.
4. Carry essential information arranged in logical order.
5. Be easily read.
6. Be designed so that when bound, either on the side or top of the sheet, all essential data will be out in the open.

The report shown in figure 1 is the result of suggestions from all of Region 4's forests and is based on one field season's use. The example below illustrates its application.

In use the lookout would fill in Line 1, preferably ahead of time. He probably would fill in a dozen or so sheets. When a fire is seen he fills in Lines 2 and 3. (In Line 2, use 24-hr. time. Example: 12:30 a.m.=0030; 8 a.m.=0800; 3:00 p.m.=1500.) On Line 4 he circles the appropriate word. On Line 5 he fills in the first three items and circles the appropriate quarter section. On Lines 6 through 11 he circles the appropriate word, fills in Line 12, and calls the dispatcher.

In the following example of a radio report, the dispatcher is located at Salmon. The lookout is Long Tom. 10-80 is Region 4 fire emergency code. The dispatcher would use a check mark wherever appropriate in filling out the form. Example:

Lookout calls: Salmon, Long Tom, Over.

Dispatcher answers: Long Tom, Salmon, Over.

Lookout says: 10-80; 2 - 220; 3 - Head of Long Gulch; 4 - Yes; 5 - 6N, 7E, 36SE; 6 - South; 7 - Grey; 8 - Grass; 9 - North; 10 - Calm; 11 - Spot; 12 - North along Long Gulch trail. Over.

Dispatcher says: 10-4.

A call takes less than 30 seconds—less writing by both the lookout and dispatcher. There is no conversational type contact. Such a system of reporting is capable of handling 30 to 40 fire reports in 15 to 25 minutes.

In the event the dispatcher missed out on a part of the report, (Line 8 for example) he would ask for a repeat thus: "10-9, Line 8." The lookout would use the one word, "grass" Over. The dispatcher would say "10-4, Salmon Out." 10-9 in this case is Region 4 code for "Please repeat from." If the situation warranted, the lookout would spell grass thus: "George, Roger, Able, Sugar, Sugar; Over."

Note: Use 24 hr. time example: 12:30 a.m. = 0030; 8:00 a.m. = 0800; 3:00 p.m. = 1500.

After Fill-in Transmit Report As Follows

LOOKOUT SAYS: Salmon - Long Tom - Over

DISPATCHER SAYS: Long Tom - Salmon - Over

LOOKOUT SAYS: 1080; 2-220; 3-head of Long Gulch, 4-y . 5-6N -- 7E — 36 -- SE; 6-South; 7-Grey; 8-Grass; 9-North 10-Calm; 11-Spot; 12-North along Long Gulch Trail. OVER.

INITIAL R-4 FIRE REPORT

	LOOKOUT FILL IN
1	LOOKOUT: ON NF REPORT TO
2	AZIMUTH: DATE TIME
3	LOCATION: BY LANDMARKS:
4	IS SMOKE BASE SEEN?: YES NO QUESTIONABLE
5	MAP LOCATION: T. R. SEC. 1/4 SEC. NE. SE. SW. NW.
6	SLOPE FACES: N. NE. E. SE. S. SW. W. NW.
7	SMOKE COLOR: BLACK GREY WHITE BROWN BLUE REDDISH
8	BURNING IN: SINGLE TREE, GRASS, BRUSH, GREEN TIMBER, OLD BURN, 2ND GROWTH, CUT OVER
9	SMOKE DRIFTING FROM: NORTH NE EAST SE SOUTH SW WEST NW
10	WIND VELOCITY: CALM, V. LIGHT, LIGHT, GENTLE, MODERATE, FRESH, STRONG
11	SIZE IN ACRES: SPOT, 1/4, 1/2, 3/4, 1, 2, 5, 10, OVER 10.
12	BEST ROUTE TO FIRE:
	NOW CALL DISPATCHER
	DISPATCHER ACTION: READINGS FROM OTHER LOOKOUTS
13	LOOKOUT: AZIMUTH TIME SMOKE BASE SEEN — NOT SEEN
14	REMARKS:
15	LOOKOUT: AZIMUTH TIME SMOKE BASE SEEN — NOT SEEN
16	REMARKS:
17	LOOKOUT: AZIMUTH TIME SMOKE BASE SEEN — NOT SEEN
18	REMARKS:
19	FINAL LOCATION: TWP. RANGE SEC. 1/4 SEC.
20	DISPATCHED FROM: FOREMAN NO MEN
21	DATE: TIME: TRAVEL BY: FOOT, HORSE, AUTO, PLANE, COPTER
22	TRAVEL ROUTE:
23	EXPECTED ARRIVAL TIME INITIAL ATTACK FORCE: DATE TIME
24	SPECIAL EQUIPMENT:
25	**FOLLOW UP ACTION:** DATE TIME SUPERVISORS FIRE NO.
26	FIRE NAME

IF YOU GO TO FIRE TAKE THIS FORM WITH YOU — FILL IN OR CIRCLE

FORM 19 R4
AGRICULTURE - OGDEN

Figure 1.

A TIMETABLE FOR LARGE FIRE MANAGEMENT

Byron Beattie

Forest Supervisor, Sierra National Forest

Rapid initial attack, calculation of fire location by specific periods crews on the line by daybreak, tactical plans to coincide with diurna variations in fire weather—these are some of the time factors character- izing fire suppression operations. These and comparable tactical time factors have been repeatedly stressed in fire literature, in fire training plans, and in fire boards of review. They are, therefore, common knowl- edge and accepted principles of strategic, tactical, and operational fire suppression within the ranks of fire overhead personnel.

Why then does the record of large fire suppression reflect in case afte case the failure to realize such well-recognized tactical timings in vita suppression actions? What are the reasons behind unattained tactica timing? And what can be done to help the men on the job—the Fire Bos and his staff—bring about tactical timing?

In considering the reasons for failure in tactical timing one usually find the Fire Boss reporting: (1) The day shift resources didn't arrive in time (2) the fire camp was not fully set up and we couldn't get men out in time; (3) we didn't get our plans and instructions prepared in time; (4) we spent too much time on strategy and didn't get around to activatin a plan of control. We didn't realize it was so late, and finally . . . ; (5) ther just wasn't time enough to do everything.

Behind the lines, where manpower and material must be mobilize and dispatched, the report usually is that orders were incomplete, or order were received too late.

Certainly, anyone who has been involved in managing a large free burning fire realizes that under such stress it is common to lose all concep of time and to become involved in an endless and time-consuming chai of tasks and decisions. Inevitably, the deadline for action arrives. Th result? A timetable of service functions impossible of attainment, hurriedl made decisions of major import and, eventually, a poorly instructed, hap hazardly equipped line force that arrives on the line much later than ha been planned.

In an effort to focus attention on the preliminaries essential to attain ment of tactical timing and to guide fire management in prorating thei available time to all functions of management, a timetable was developed In practice, it has been successful.

Intelligent understanding and application of the timetable must recog nize the following:

1. It is a guide. Times are not absolute and may vary by individua operations. However, all fires and/or divisions operating under a singl General Headquarters must adhere to the master schedule of Headquarter

2. Adherence to schedule requires that subordinate officers be provide with and comply with a schedule of accomplishment, correlated with tha of fire management.

DIVISION OR SINGLE FIRE HEADQUARTERS TIMETABLE

Hour	Fire boss	Plans chief	Service chief	Line boss
Origin 7P	1. Review of available information. 2. Review of Line Boss plan (Incl. Reconn. or study) and confirmation or adjust. 3. Compute spread and probable duration of fire. 4. Compute 2d day control force requirements. 5. Select base of operation. 6. Place 2d day orders. 7. Organization and supervision, with emphasis on plans and service functions.	1. Reconn. and/or problem study. 2. Work with Fire Boss or independently on calculation of probabilities and control force requirements for 2d day (detailed). 3. Initiate 1st night intelligence. 4. Organize and supervise plans unit.	1. Compute, order, place in operating condition service needs. 2. Study base to fire line access and travel times. 3. Organize and supervise service unit.	1. Review - analyze available information on fire. 2. Enroute to fire secure vantage point size up. 3. Prepare initial plan of control (through 1st night) and notify dispatcher of the situation; control force required. Mobilization point (complete within 30 minutes). 4. Organize and supervise line action until relieved.
7P-9P	Joint planning and decision—2d day shift operation			
9P-11P	Supervision with emphasis on plans and service.	Detailed instructions day shift. Bring records up to date.	Preparation for morning dispatch.	
11P-3A	Off duty. Available for decision.	Off duty.	Off duty.	
3A-3½A	Review of night intelligence; minor adjustment of plans and instructions.		Final check dispatch preparedness.	
	Line overhead breakfast 3 to 3:15; crew boss and manpower 3:15 to 3:45.		Dispatch line forces.	
3½A-4A	Brief line overhead.			Change of shift.
4A-5A	Breakfast			
5A-6A	Night shift overhead interrogation/24-hr. service needs.			Line supervision.
6A-8A	Progress report and 24-hour plan of control.		Night shift service preparation.	Critical-sector supervision.
8A-10A	Field reconn. Night shift plans.	Night shift plans.		Calm-sector supervision.
10A-1P	Off Duty.			Critical-sector supervision and general correlation of all sectors until relieved
1P-3P	Field reconn. and supervision—free lance.	Reconn. - supervision of plans unit. Detail instructions for night shift.	Service unit supervision—Field reconn.	
3P-4P	Review of day intelligence reports. Minor adjustments of plans and instructions.		Final check night dispatch arrangements.	
	Line overhead supper 3:30-3:45; crew boss and manpower supper 3:45-4:15.			
4P-4½P	Brief line overhead.		Dispatch line forces.	Change of shift.
4½P-6P	Off Duty.			
6P-7P	Day overhead interrogation.		Initiate day shift service arrangements.	Line supervision.
7P-9P	Prepare plans and instructions, next day shift. Joint planning and decision 3d day shift operation.			Line supervision.
9P-3A	Off duty.			

GENERAL FIRE HEADQUARTERS TIMETABLE

DAY OF ORIGIN

Hour	Fire boss	Chief of staff	Plans chief	Service chief
Origin	1. Initiate mobilization of G.F.H. 2. Observation or study of fire problems. 3. Check calculation of fire probability and control force requirements.	On the ground assistance to Division Fire Boss. 1. Probabilities. 2. Control force requirements. 3. Organization of division forces.	Work with Fire Boss or independently on: 1. Observation or study of fire problems. 2. Check calculation of fire probability and control force requirements.	Procurement and delivery of division's anticipated needs for 2d and 3d shifts.

SUBSEQUENT 24-HR. PERIODS

Hour	Fire boss	Chief of staff	Plans chief	Service chief
9P-11P	Staff conference—review of situation; action-plan next 24 hours.			
11P-5A	Off duty			
5A-9A	Field reconn. and consultation.	Field reconn. and consultation.	Field reconn.	Mobilization and delivery of Divisional needs. Observe mobilization plans and/or demobilization plans.
9A-Noon	Joint review of division's 24-hour plan of control; Division notification and Headquarters action plan.			
Noon-7P	Free of operational duties, available for decision.	Field liaison and counsel.	Check calculations emergency or disaster plans.	Same as a. m. plus trouble shooting.
7P-8P	Joint conference and plans.			
8P-5A	Off duty. Available if needed.			

3. Fire management must base 2d day decision, plans and action on available information. Unless the 7 p. m. day-of-origin deadline is met, tactical timing fails.

4. First-night rest must be secured as indicated to avoid a sluggish and mentally dull management team.

5. Cold-blooded organizational discipline and self-descipline is a must.

6. Items shown in the timetable are only key factors of position requirement.

As implied above, field fire management must recognize the existence of a behind-the-lines organization which may be limited to a forest fire control officer who functions as chief of staff, and a supply or procurement officer. However simple the organization, it should be established and function as General Fire Headquarters. The field operation then becomes a Division, and field management functions as a Division Fire Headquarters.

Locally, we have found that this provides the tie between the going fire and behind-the-lines recruitment, and sets the stage for expanding from the single-fire to the multiple-fire operation.

FIRE PREVENTION PROGRAM ON KIAMICHI RANGER DISTRICT

D. D. Devet
District Ranger, Ouachita National Forest

HISTORY

The Kiamichi Ranger District of the Ouachita National Forest is located in Oklahoma. It has a protection area of 257,463 acres with a net U. S. land area of 180,313 acres. Since 1939, the number of annual forest fires has varied considerably—84 occurred in 1950, and only 8 in 1945. During the same period, the percent of annual burn has varied from 3.24 in 1943 to 0.01 in 1944.

North and west of the district, there is no organized protection; local residents burn at will and State fire laws are ignored. South of the district, the Oklahoma Division of Forestry and Parks is providing protection for State and private land. Much of the timberland outside the forest is held by absentee owners who provide little or no protection for their properties.

An analysis of the causes of 562 fires on the district during the years 1939-51 indicates the following:

Cause	*Percent of total fires*
Lightning	10.3
Railroad	7.8
Lumbering	1.6
Smoker	19.8
Debris burning	4.3
Incendiary	38.8
Campfire	5.3
Miscellaneous	12.1

PATTERN OF BURNING

More than 1,500 families live adjacent to or within the Kiamichi Ranger District. The tradition of open range woods burning in the spring still prevails, and an analysis of incendiary fires revealed the following reasons for burning: (1) To improve grazing. (2) To reduce hardwood undergrowth in order to: increase visibility for hunting; make woods riding easier; remove briars; kill ticks and snakes; make locating hogs and cows easier; improve visibility in general. (3) Job fires. (4) Spite against neighbor, warden, or lookout. (5) Cattle concentration burn for roundup. (6) Turkey burn. (7) Want of excitement while intoxicated. (8) Just like to see the woods burn.

ORGANIZING THE PREVENTION PROGRAM

During the summer of 1951, it was concluded that ordinary prevention efforts were not obtaining the desired results. An intensive program was therefore developed with plans to follow it for 3 or 4 years. Most of the Kiamichi Ranger District residents realize that wild forest fires are damaging to their interests in the long run, and routine prevention efforts in general suffice to reach them. Scattered throughout the district, howeve are a few individuals who believe that an annual burning of the wood benefits their interests. The objective of the intensive prevention effort was to reach these individuals.

Analysis of the situation and development of the prevention progra involved the following steps:

1. The entire ranger district was divided into problem areas where characteristic pattern of fires occurred each year. For instance, in on area there are usually one or two Class E multiple-set incendiary grazin fires annually. In another, debris burning is the main problem. In a diffe ent area, hunters who leave burning hollow trees and campfires are th principal cause of fires. In still another area, job fires occur frequentl Thus, the individual problem areas were defined.

2. The second step taken was to list those individuals likely to hav been responsible for the fires in each problem area.

3. Finally, each individual suspect was studied closely for his habit source of livelihood, companions, weaknesses, reasons for causing th fires, the people he respects and whose advice he follows, and his relative An avenue of approach was studied for each suspected group of in cendiaries.

PREVENTIVE ACTION

With the analysis completed, a course of action was decided upo Personal contact was chosen as one of the most effective prevention medi The first step is to get well acquainted with each of the suspected in cendiaries to try to gain his confidence and friendship. A different approac is used for each individual based on a study of his habits, personality, an attitudes. For instance, incendiaries suspected of setting range fires t improve grazing are accompanied into the woods range. While crossin areas burned by wild forest fires, attention is called to the prolific sproutin of hardwood brush as a result of fires, and how the brush is choking o the forage. On adjacent unburned areas, the greater abundance of forag and less dense hardwood underbrush is noted. It is explained how sprir fires cause a large number of sprouts to originate from each stem of har wood burned. To provide better forage, the cattle owners are encourage to investigate the possibilities of improved, fenced pastures. In order t meet the cattlemen on equal terms, cattle breeds, range conditions, pastu management, and local range problems are studied with the advice ar assistance of the county agent.

Arrangements are made to go on coon or possum hunts with hunte suspected of leaving warming fires and smoking hollow trees. While c the hunt, the correct method of putting out warming fires and fires use to smoke game out of hollow trees is demonstrated.

Soil-tilling methods, fertilizers, and the use of ammate and other chen ical means of brush and broom sedge control are discussed with deb and field burners. When burning cannot be discouraged, correct burnir techniques are explained and demonstrated.

In areas where job fires are suspected, the possibility of new industri is investigated. For instance, broiler raising is studied and informati on this disseminated. In order to keep the residents occupied and demonstrate the value of the timber crop, effort is made to increase tl number of sales of timber products in these areas. Information on employment possibilities is passed on to idle residents of these communities.

Thus, through understanding, guidance, and education, personal contact work is conducted among the minority suspected of being responsible for most of the man-caused fires. Each individual presents a new problem that requires a different approach.

Another contact approach is the marshalling of public opinion against man-caused forest fires. This is done through becoming acquainted with the most influential members of each community. By showing these leaders the damage done by wild forest fires, it is possible to build up indirect pressure against the intentional setting of uncontrolled fires. Another prevention tool used is the local newspapers. Every week the two local papers covering the district publish a short column entitled Your Forest Service. This column attempts to bring a realization to all forest residents that they have a personal stake in the activities and management of the national forest in Oklahoma. The column covers various activities of the district with emphasis on fire prevention.

Facilities of the local radio station are also utilized. Each month one or two 15-minute broadcasts are made by Forest Service personnel in cooperation with the county agricultural agent. These broadcasts are released over a radio station whose beams reach a majority of district residents. Activities covered in these broadcasts are closely tied in with fire prevention. In addition to these programs, the county agent, who has a program of his own called On the Farm Front, frequently inserts fire prevention ideas in his broadcasts.

Advantage is taken of every opportunity to show movies and slides, and to give lectures to schools, veteran classes, clubs, and churches. Through this means, better relations are cultivated with teachers, veteran vocational advisers, club leaders, and ministers, all of whom help formulate public opinion. Show-me trips are also used to advantage. They are the best way to show the loss to the community caused by forest fires and the rapid growth of pine timber on unburned areas.

A thorough and prompt investigation of all man-caused fires is a must. Sometimes the investigation is made in the company of a local, well-known law enforcement officer; this may have a beneficial psychological influence. All employees of the ranger district are trained to help carry out the prevention program, and each acts as a prevention man in his own sphere of influence.

The fire statistics for the next few years will tell whether the Kiamichi fire prevention program has succeeded or failed. Although the results will be slow in showing up, the reaction from local residents indicates that some progress has already been made.

FIRES BY THE DOZEN

Ralph C. Bangsberg
Fire Control Officer, Shasta National Forest

Monday morning, July 24, 1950, was just another day at the Supervisor' Office on the Shasta National Forest. Nothing very outstanding in the wa of a day so far as fire control was concerned. Forest Dispatcher Adams ha informed the fire control officer of the weather forecast which involve little or no change from the day before. Fire danger in the high bracket.

The morning wore on with "business as usual." The weather man wa pretty close to right. It *was* getting hot and a good breeze was comin from the south; it looked as though we were in for a warm afternoon.

The quiet was suddenly interrupted by the startling blast of the M Shasta city fire siren. Someone had a fire! By phone from Dispatcher Adam it was learned that a defective steam engine on the Southern Pacific Line had left Black Butte station some 8 miles north of Mount Shasta city an was traveling south setting what looked like dozens of fires along th right-of-way. It had just gone through the city, a distance of more tha a mile, and had left at least 10 or 11 smokes. Efforts were being made t stop the engine as soon as possible.

Just how many fires there were out on the forest could not be learne at first. There was plenty for all and it was "all hands on deck." It wasn' hard to find a fire and any number of small grass fires, some too small t count, were extinguished on the run—knock down one and run to the nex

It all looked like a hopeless confused mess at first, but soon the stead pressure of a well-trained and determined fire organization began t show. From 11:40 a. m. until 1:00 p. m., an interval of 1 hour and 2 minutes, at least 16 fires were reported spread out over a distance of abo 17 miles. Add to this the 11 fires within the city limits of Mt. Shasta an you have a picture of the alarming situation confronting the fire fightin organization.

Success in handling such a string of fires in dry grass and brush in th middle of a hot July day doesn't just "happen." It should be noted th the defective engine was stopped, but not before it could set five sma fires close together in the bottom of the rugged Sacramento Canyon. A other fires were handled and kept to Class A or B. The five fires on th steep slopes of the canyon quickly ran together and produced the or large Class D fire.

The summary chart shows three separate tanker crews and the FC dispatched to fires, and behind this organization there was one lookout ab to see the entire string of fires, a Forest dispatcher and a Ranger Distri fire dispatcher. Linking this entire organization together was a comple net of mobile two-day radio. Each unit—dispatchers, lookouts, and a tacking forces—was 100 percent equipped. The drama of what happene and how it happened is difficult to detail.

SUMMARY OF FIRE BUST
OF JULY 24, 1950

Fire No.	Time discovered	Controlled	Elapsed time	Size class	Crews handling	First report
1	11:40	12:10	0:30	A	So. Yard	Initial dispatch
2	11:46	12:05	0:19	A	Weed	do.
3	11:47	12:16	0:29	B(3 acres)	do.	Reported en route
4	11:57	12:10	0:13	A	Castella	Initial dispatch
5	11:57	12:15	0:18	A	do.	Reported en route
6	11:57	12:30	0:33	A	do.	do.
7	12:00	12:15	0:15	A	Patrolman	Initial dispatch
8	12:08	1:00	0:52	B (.9 acre)	Weed	Reported en route
9	12:15	12:30	0:15	A	FC Assist.	do.
10	12:15	12:40	0:25	A	do.	do.
11 (5 fires)	12:30	7/25 2 a.m.	13:30	D (130 acres)	All crews	do.
12	1:00	1:50	0:50	A	So. Yard	do.
13	2:43	3:10	0:27	A	Castella	do.
14 (11 fires in city; handled by city)	...	...	...	A's	City	

Note: All times daylight saving.

The lookout reporting fires to the district dispatcher and directing crews into smokes. The district dispatcher sending crews to new fires the moment they controlled their present smoke. The crews reporting their progress and asking for new assignments. The lookout again reporting on the seriousness of old or new smokes. The forest dispatcher calling in other mobile field units from other districts, holding them here, turning them around to stand-by at other locations, directing their entry to the fire zone, etc. The district dispatcher directing and receiving reports from scout cars. All of this wove itself into a pattern that snuffed out the seemingly endless string of fires one by one until at last all fires were controlled except the large one in the canyon. As the crews were freed from the smaller fires, they were directed to the one remaining large fire, eventually converging upon it and we might add—none too soon.

Anything slower than the instant medium of radio would have delayed the attack on other fires. The result would no doubt have been nothing short of catastrophe.

Tankers, crews, tractors and men converged on the now rather savage brush fire that had come up out of the canyon and was making a bid to the dubious fame of becoming a very large and destructive brush fire. Houses, an airport, heavy traffic on U S 99, and timber all stood in its direct path. It *had* to be stopped at the one remaining barrier, the railroad tracks.

Tankers shoved into the fight, directed by observers in radio cars, and picked spot fires as fast as they came. Not one less than the four or five tankers used in this spot fire attack would have been enough. They had to be there, and able to move from spot to spot as directed by radio—and fast!

Time was of the essence as was complete coordination by those directing operations. It is safe to say that the cost of the radios used in this day's operation was insignificant compared to the money they saved in directing the attacking equipment and men.

Can you picture what might have happened if the crews had to depend upon hunting up a telephone to make their report after each fire or seeing another fire, rushing to it, only to find that two other crews had done the same, while other more serious fires burned unattended?

The city of Mt. Shasta experienced in a small way what could have happened. Our lookout on Black Butte gave the dispatcher information that there were three fires in the north end of the city. The dispatcher notified the city fire department. Immediately they sent their three trucks to these fires. In a few minutes seven or eight more fires were reported in the city limits. Frantic calls flooded their dispatch center. The situation was finally handled through the aid of messenger service, local volunteers, police cars, and others. Obviously, with many people at hand and short distances, such a difficulty can soon be overcome, but not so with widely scattered fires in isolated areas.

Paper for Covering Piled Slash

The kind of paper to use for covering piled slash, as reported in the July 1951 issue of Fire Control Notes, is referred to in the trade as "counter rolls." It is waterproofed kraft building paper, laminated 30-30-30, 9 inches in diameter, uncreped, not reinforced, class C. It is sold by the pound. A 48-inch wide roll weighs approximately 76 pounds, contains 2400 square feet, and costs about $10 per hundredweight. Its principal use is for lining the holds of ships.—DIVISION OF FIRE CONTROL, *Region* 6, *U. S. Forest Service.*

Volume 13 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.

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Forest Service, Washington, D. C.

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CONTENTS

SMOKEY THE BEAR

J. MORGAN SMITH
Assistant Director, Cooperative Forest Fire Prevention Campaign[1]

Smokey, the forest fire preventin' bear, has finally achieved stardom. Like other celebrities, he was recently featured in color on the front cover of Newsweek magazine. This same issue carried an excellent story on Smokey and forest conservation which said, "America's best animal friend is a sturdy brown bear named Smokey. Not since the early days of Mickey Mouse and Bambi has any cartooned animal made such an impact on Americans. And the story of how Smokey was born and how he grew is a prize example of wholesome and energetic cooperation between government and business." This was the longest story ever carried in Newsweek.

Several weeks ago, President Truman signed a bill which prevents Smokey from being used in any manner that would be detrimental to his work in forest fire prevention. This marked the first time in history that the Congress of the United States had enacted legislation to protect an animal character from misuse.

Smokey The Bear is the name of a new song which you will soon be hearing on radio, television, and "juke" boxes and in motion picture theaters throughout the land (fig. 1). It was written by two topflight Hollywood song writers, Steve Nelson and Jack Rollins, and tells in entertaining fashion the story of Smokey and the work he is doing in educating the American public to the danger of forest fires. Eddy Arnold introduced the song in a new 4½-minute film Smokey The Bear, which has been released to television stations and motion picture theaters. Gene Autry has recorded the song for Columbia Records, and other leading companies are lining up their top vocalists to do the same.

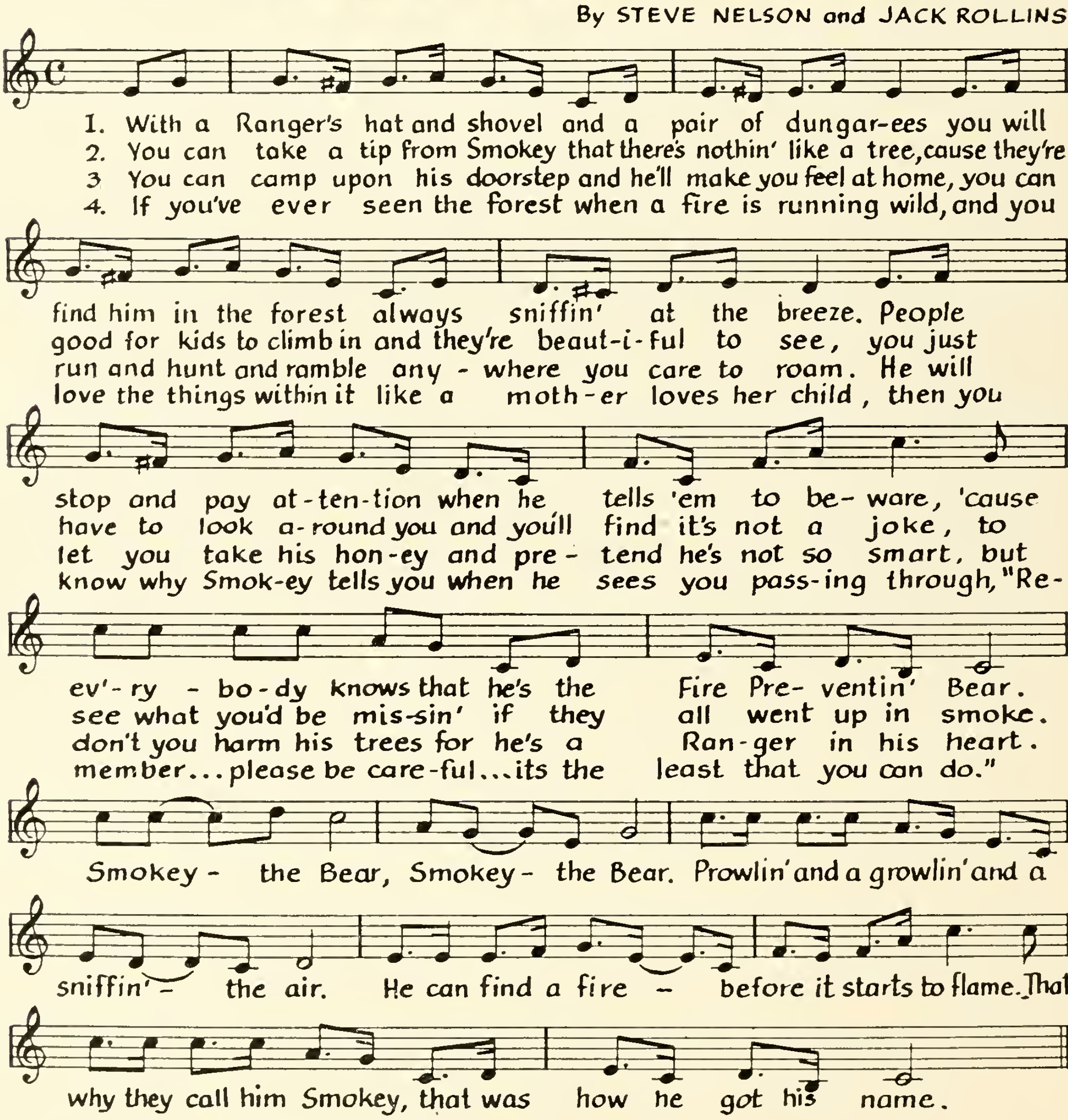
As the result of Smokey's growing popularity, MGM is now working on a Smokey cartoon feature. Other companies have requested licenses to manufacture Smokey Bear products such as dolls, toys, ash trays, belts, hats, ties, etc. Several leading publishing companies want to put out books on Smokey.

Yes, Smokey has come a long way since he was created in 1945, by the advertising agency, Foote, Cone & Belding, as a symbol which would help focus public attention on the Nation's forest fire problem. Since 1947, Smokey has appeared regularly on posters, car cards, blotters, and other material provided through the Nation-wide Cooperative Forest Fire Prevention Campaign which is sponsored by The Advertising Council and conducted by the State Foresters and the U.S. Forest Service. The Advertising Council is a nonprofit business organization created to help solve

[1] Sponsored by State Foresters and U.S. Forest Service.

SMOKEY THE BEAR

By STEVE NELSON and JACK ROLLINS



Illustrated by RUDOLPH WENDELIN

FIGURE 1.

national problems through education by use of various advertis- ing media. Besides Forest Fire Prevention, the Council sponsors other campaigns in the public interest such as Stop Accidents, Red Cross, Better Schools, Care, U.S. Defense Bonds, and Fight Inflation. All of its services are free.

The phenomenal growth of Smokey into a national character has been due in no small measure to the splendid support which business and industry have given the campaign since its inception in 1942. Last year, through The Advertising Council, over 6 million dollars worth of free advertising time and space was donated to the campaign by American business. For example, in 1951, the transportation advertising industry gave space for the entire months of April and September for display of approximately 100,000 Smokey car cards in busses, streetcars, subways, ferries, and railroads throughout the Nation. An estimated 50 million riders saw these forest fire prevention messages. The space and the labor involved in putting up and taking down the cards were absolutely free. This one contribution alone had an estimated value in excess of $500,000. The advertising firm of Foote, Cone & Belding has had direct charge of Smokey since his birth. Each year, Foote, Cone & Belding puts into the job more than $35,000 of time and effort, at no cost to the Campaign.

Besides business, the American Red Cross, Boy Scouts, Girl Scouts, Camp Fire Girls, and numerous other organizations have supported the campaign in splendid fashion.

Another important factor that has aided tremendously in developing public recognition of Smokey as the Nation-wide symbol for forest fire prevention was the discovery of a real live Smokey about 2 years ago in New Mexico. At that time, the only survivor of a disastrous 17,000-acre, man-caused forest fire was a frightened, badly burned cub bear. The Associated Press' photo, showing the pathetic looking cub having his burned paws bandaged by a doctor, was flashed across the Nation. It appeared on the front page of leading newspapers everywhere and created genuine interest and sympathy on the part of the American public in this forest fire orphan. Overnight he became famous. They named him Smokey, after his mythical brother, the poster Smokey.

Under the expert care of New Mexico game wardens, he was gradually nursed back to health. Then, New Mexico State Game Warden Elliott Barker decided that "Little Smokey" had a definite mission in life and that was to serve as a living reminder to people everywhere of the constant need for care with fire when in our forests and woods. So, one day, after complete recovery from his burns, Smokey crawled aboard his private plane, a Piper Cub, and took off for Washington, D.C., to take up permanent residence there.

His arrival in the Nation's Capital was greeted with great fanfare. He was received in the Presidential Room of the National Airport. Little Smokey appeared on television, in motion pictures, and in parades. Finally, in appropriate ceremonies at the National Zoo, he was presented to the school children of America and today is the living symbol of forest fire prevention and wildlife conservation.

Men, women, and children from all parts of the country come to see the live Smokey. Dr. William Mann, Director of the National Zoo, says that Smokey is the most popular animal in his collection. He is an honorary member of such organizations as the AAA's School Safety Patrol System and the Washington, D.C., Fire Department. Hopalong Cassidy is one of the many well-known personalities who has called on Smokey.

Little Smokey is no longer a cub. He weighs in the neighborhood of 200 pounds and his fur is a beautiful cinnamon brown. He is now the official model for all posters furnished by the Nation-wide Cooperative Forest Fire Prevention Campaign. The live Smokey and the poster Smokey have become one and the same.

There is no question but that Smokey is making a lasting impression on the boys and girls of this country who are the citizens of tomorrow. Smokey's fan mail from all parts of the Nation bears this out.

One mother wrote as follows: "Our hero Smokey is greatly admired by the small fry and the change of scenes on the bus cards always bring comment from my little daughter. The ads are scanned with avid interest for new pictures of Smokey and heaven help the individual who throws matches and cigarettes out of car windows. To my consternation and amusement, she tells them off. I notice that they don't do it again in her presence. These posters are doing a remarkable job in helping all of us and especially the young to become conscious of waste, destruction, and grief caused by forest fires. We hope to see Smokey for a long time to come."

Statistically the Nation-wide Cooperative Forest Fire Prevention Campaign and other fire prevention campaigns such as the Keep Green movement are bearing fruit. Prior to the start of the campaign in 1942, there was an average of 205,047 forest fires a year for the 5-year period, 1937-41. For the past 5 years, 1947-51, there has been an average of 188,796 forest fires a year on all lands. This means that we have experienced 16,251 fewer fires a year for the past 5 years as compared with a similar period of time immediately preceding the beginning of the campaign. This encouraging progress has been achieved in spite of the fact that public use of forested areas has increased 50 percent over precampaign levels.

This improvement has not been due solely to the Smokey Bear campaign conducted by the State Foresters and U.S. Forest Service. Much of the credit must go to the fire prevention programs carried on by the States themselves and also local programs sponsored by Keep Green organization, Red Cross, Boy Scouts, and others. However, through the channels for mass communication which have been made available to the campaign by The Advertising Council, the American public is hearing, seeing, and reading more about the need for preventing forest fires than ever before.

We still have a long way to go before man-caused forest fires have been reduced to an acceptable minimum. Continued progress can be made in licking this problem if government, business, forest landowners, educators, and conservationists work together in the future as they have in the past.

CLASS IN THE OUTDOORS [1]

JOSEPH F. DONOHOE
District Forest Ranger, Wisconsin Conservation Department

The protection from fires of our forests, fields, and marshes is a basic function of the conservation of our natural resources and wild life. Therefore the forest protection division of the Wisconsin Conservation Department is intensely interested in informing the citizens of Wisconsin and others why and how approximately $1,000,000 a year is spent for the prevention and suppression of fires.

Of course the best way to stop damages to our forests resulting from fires is to prevent the fires from starting. The forest ranger has learned that an informed citizen is a cooperative citizen. That is why he is willing to spend a great deal of effort and time in fire prevention work.

Where forest protection activities are intensified, as in northern and central Wisconsin, the people are pretty well informed, but there is a large segment of our population which has received less information on the subject. How to reach these citizens is something of a problem.

One method was worked out a few years ago by representatives of industrial concerns who depend on our natural resources for their supply of raw materials. It was simply to have a place where young people and adult groups could gather and receive an on-the-spot short course in conservation. This organization is the well-known Trees for Tomorrow, which operates a camp at Eagle River. There, under supervision, groups from high schools and colleges, and groups representing women's clubs, sportsmen's clubs, civic organizations and many others come. The Wisconsin Conservation Department cooperates intensively in the program offered.

The forest protection division participates by presenting a summarized but adequate over-all picture of forest protection activities in the State. This class is held in the out-of-doors, weather permitting. The feeling is that it has been very successful because of the enthusiasm with which it is received and because of the increased demand for holding such classes.

Before the program as now presented in the outdoor class room was completed, a great deal of preparatory work went into it. This work was under the direction of V. A. Moon, northern area supervisor of the forest protection division. For use by the instructor so that he can illustrate his talk, special "props" consisting of maps, charts, and equipment were designed and built.

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[1] From the December 1951 Wisconsin Conservation Bulletin.

The program is presented in three parts. First a talk is given on the history, organization, finances, and administrative set-up. Secondly, the fire detection system, communications, and dispatching of men and equipment is touched upon. The third part consists of a demonstration of the equipment and methods used in the physical work of putting out fires.

The site for the class room is picked ahead of time. It usually is an isolated spot which has to be reached by a logging road. The group or students arrive by bus and in a few minutes class is in session. After a briefing on the importance of forest protection in the conservation picture the instructor reviews the history of the division and then goes into the organization and administrative set-up as it now is and may be in the future. He, glad that he has them, now uses the new "props."

The first one, sturdily built of wood, is a case of four maps mounted on plywood panels and designed so they can be easily removed or returned as used. This "prop," as well as the others, has been built big enough for easy visibility, strong enough for rough handling, and light for easy transportation. The first panel has a map of the State on which are outlined in contrasting colored lines the territories located in the intensive and extensive protection system as well as territory that may in the future be included in our protection organization. The four areas and the 10 districts that make up the division are shown as well as the locations of division, area, and district headquarters.

The second panel has a map showing a proposed district in that part of Wisconsin not now under protection but which might be included in the future. On the next panel is a map of one of the 10 districts, District 8, which shows the district headquarters, the four ranger subdistricts, the ranger stations, and locations of the lookout towers. On the fourth and final panel a map of a ranger district shows the location of the ranger station and lookout towers and where emergency fire wardens live.

The speaker in explaining uses more props in explaining the *why, what, how,* and *where*—why fires burn worse on some days than on others; what is needed in the way of manpower and equipment to suppress fire on a given day; how fires are detected and where they are located.

Two props, a burning index meter and a fire hazard chart, are used in explaining the factors that govern a ranger's activities in fire weather. The index meters that are used at the stations are small enough to slip into a hip pocket, but the one built for the class room is Paul Bunyan size. With it the speaker can show how wind velocity, relative humidity, number of days since rain, and condition of vegetation are used to arrive at an index of how forest fuels will burn. The fire hazard charts, identical to those used at ranger stations, show in a more readable way what the burning conditions for the day are. From this chart the ranger can also determine his manpower and equipment needs in suppressing fires that may start.

The equipment used by the men in the towers when they see a smoke is shown to the group and explained. This consists of a protractor stand, alidade or sighting instrument, and offset. The protractor, mounted on the stand, is hinged so that it can be tipped up for better visibility by the group. The group is shown use of the alidade in determining the line of sight of a fire from the tower and how the reading in degrees is taken from the protractor. The use of the offset in seeing by or around an obstruction which interferes with the line of sight is also shown.

The last prop is a magnified scale map which is used to illustrate how a ranger can plot the information received from the towers and accurately determine the location of a fire. This map is also used to explain why people in forest protection districts have to obtain a permit before burning rubbish, brush piles, etc. When a permit is issued a pin is placed in the map on the location the permit covers. This enables the ranger to differentiate between legal burning and uncontrolled fires.

Because the final part of the class is a demonstration of noisy trucks and tractors, and to better show off the use of short-wave radios, a sound amplifying system is used. This sound equipment, along with a short-wave two-way radio, is housed in a specially built cabin mounted on a two-wheel trailer. This piece of equipment was originally designed for use on large fires where it would be practical to set up a field headquarters. The trailer is equipped with a public address system, the radio, a desk, storage space, and its own power plant.

In putting on the last part of the program emphasis is placed on how, when, why, and where trucks, tractors, water tank trailers, and radios are used. The control trailer or sound truck is used to a good advantage. By using the sound amplifying system the speaker, in describing what is going on, can reach the group which becomes scattered during this period.

A brush pile, one of several which were previously prepared, is ignited, and when the fire is burning briskly, the speaker uses the radio in the control car to summon the first piece of equipment to be demonstrated. His message to the equipment operator is picked up by the sound system and the group can hear what he says and the operator's reply. All of the equipment to be demonstrated is located out of sight and a short distance away from the group.

As the first piece of equipment, a 3/4-ton truck equipped with a power take-off pump, a water tank, and a compliment of hand tools and towing a water tank trailer, goes into action, the speaker keeps up a running commentary on what is going on. After the fire is pumped out with water, a crew of men, which arrived with the truck, puts on a demonstration of the use of hand tools in suppressing a fire. A short stretch of control line is constructed by four men working as a team, who use three short-handled shovels and a swede hoe. Then the use of a back-pack water can with an attached hand-operated pump is demonstrated. A man then shows how the old reliable shovel can be used to throw dirt on fire edges, cover burning stumps with dirt, and bury burning logs and chunks of wood.

To demonstrate the use of the new mobile pack-set radio, the remaining equipment units are called in by an operator who is stationed in front of the group. These messages can also be heard over the loud-speaking equipment. Another brush pile is set on fire, the man with the pack-set radio puts in his call, and a few minutes later a 2-ton truck arrives. This is equipped with a power take-off pump, water, and a large complement of hand tools, and tows a tilting-bed trailer on which is transported a tractor and water tank trailer. As these items of equipment go to work putting out the fire the commentator tells the group what is being done and why.

When this unit of equipment is finished, another is summoned by field radio. This one excites the most interest, especially among male members of a group. The unit consists of a 2-ton truck equipped with a power take-off pump, water tank, and complement of hand tools, and towing a tilting-bed trailer on which is transported a crawler type tractor with a large specially designed fire plow attached. When the tractor and plow is unloaded and starts to plow a 6-foot-wide double furrow the group really sits up and takes notice, and when the tractor and plow starts off through the woods, knocking down trees and leaving a wide fire break behind, the members of the group like to follow right behind it.

As the tractor and plow is loaded and the truck moves off, another fire is started and the final unit of equipment is summoned. This is a large truck which transports a 1,000-gallon water tank. The truck is also equipped with a power take-off pump. The unit proceeds to put the fire out; two hose lines are used and different types of nozzles demonstrated, one an adjustable spray nozzle and the other a conventional type. After the demonstration the group is invited to inspect the equipment and ask questions.

This ends the class; the maps, charts, and other paraphernalia are quickly stored in the sound car, the trailer is hooked to a truck, and the school room is ready for the road. It has been a pleasant, informal, and worth-while session in a room as large as the outdoors. At the same time, fire fighting equipment has been tested and men trained, something which would have to be done periodically even if there were no students to watch the proceedings.

Published Material of Interest to Fire Control Men

A Survey of Forest Fire Causes and Suggested Corrective Measures, by J. A. Doyle. Forestry Chronicle. Dec. 1951.

Forest Fire Insurance in North America, With Special Reference to B. C., by W. Walters. Brit. Columbia Lumberman. Dec. 1951.

Incidents in Tower Man's Typical Day, by C. Lucas. W. Va. Conserv. Jan. 1952.

South Carolina Stresses the Importance of Protecting Little Trees in the New Fire Prevention Program, by J. C. Witherspoon. Forest Farmer. Jan. 1952.

War Whoops on the Fire Line, by D. G. Guck. Amer. Forests. Jan. 1952.

POWER-SAW MOTOR DRIVES PORTABLE FIRE PUMP

IRVIN H. LUITEN
Field Representative, Public Information Department, Weyerhaeuser Timber Company

In a matter of 90 seconds, Weyerhaeuser Timber Company foresters at Springfield, Oreg., can turn an ordinary power saw into a portable pump for fighting forest fires. They do it by attaching a standard low-speed, high-pressure pump to a power-saw motor.

The attachment is made possible by a coupling and mounting invented by Robert Gehrman, the company's Springfield branch forester.

With a special frame and guide developed by Gehrman, the standard fire pump is mounted to a packboard. The frame and guide are designed so that the pump may be fastened to the saw motor at the point ordinarily occupied by the saw bar. The same nut that secures the saw bar hooks the pump to the saw engine (fig. 1). No extra parts or special tools are needed.

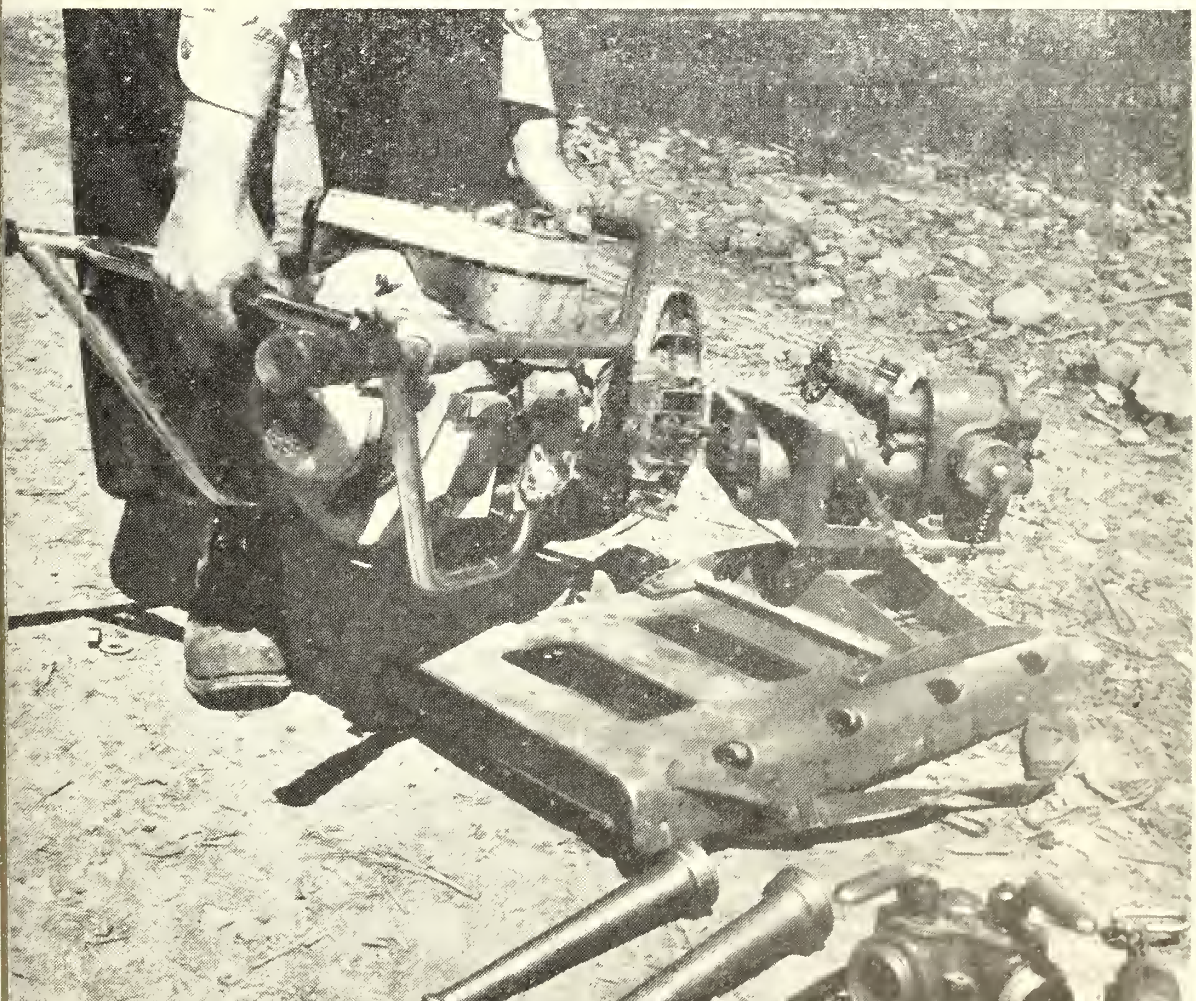

FIGURE 1.—Pump is hooked to power-saw motor with same nut that secures the saw bar. Three-pronged rubber-faced coupling (at center right, below hand valve on pump) meshes with saw chain sprocket.

FIGURE 2.—Cecil Cunningham, Weyerhaeuser Timber Company forester, Springfield, Oreg., demonstrates power-saw fire-pump combination. In fighting actual forest fire, two hoses, each fitted with nozzle, would be used.

Used on Weyerhaeuser's logging operations near Springfield since early 1951, the power-saw and fire-pump combination has proved itself an effective fire fighting tool. Drawing water from streams, ponds, and lakes in the woods or from water tank trailers, a 7-horsepower motor with pump attached will spray a fire through two hoses and two 5/16-inch nozzles. It will develop 100 pounds pressure. A pump attached to a 5-horsepower motor will drive water through two hoses and two nozzles at 75 pounds pressure.

Weyerhaeuser foresters are using the combination as a two-man unit. The pump—along with suction hose and screen, siamese valve, two nozzles, a small grease gun, and a hose spanner—is fastened to a packboard (fig. 2). This makes a one-man load weighing 57 pounds. The other part of the two-man unit is a power bucking saw minus the bar and chain (fig. 3).

Says Gehrman: "There are many advantages to this unit. The pump can be attached to the power-saw engine in about a minute and a half. Your pump operator is the power-saw operator. He knows how to start the engine and keep it running because he operates it every day. There is no cooling system to drain or any separate gas tank to bother with. And the pump itself is less costly than conventional forest fire pumps that will handle two hose lines.

"We have operated these units wide open for steady runs of 2 hours and longer, and the power-saw engine and pump functioned

FIGURE 3.—Power-saw fire-pump combination is a two-man load. Robert Gehrman, who invented the coupling by which pump is attached to power-saw motor, demonstrates: **Left**, carrying pump on a packboard; **right**, packing power-saw motor.

perfectly. You could touch the cylinder cooling vanes on the engine at any time without burning your fingers."

Weyerhaeuser foresters have used the pump on 5-horsepower and 7-horsepower saws.

"But," Gehrman points out, "I am quite certain that the same principle of driving a pump through a rubber-faced coupling fitted to the chain sprocket would be adaptable to any power saw."

The power-saw fire-pump combination is now in service on several Weyerhaeuser woods operations and is also being used by several other lumber companies in the Springfield area.

Couplings and mountings invented by Gehrman are manufactured under license by two firms, one in Portland, and another in Eugene, Oreg. (Further information regarding this equipment may be obtained from Dept. of Public Information, Weyerhaeuser Timber Co., 1106 U.S. National Bank Bldg., Portland 4, Oreg.)

REMOTE-CONTROLLED RADIO NETWORK AND FIRE COMMUNICATION EQUIPMENT

R. C. Franklin, *Fire Prevention Officer,* and A. D. Galbraith, *Communications Technician, Angeles National Forest*

When FM radio replaced AM on the Angeles National Forest it was decided, after extensive tests, to use remote-controlled sets so that a single channel could provide forest-wide communication.

Figure 1, showing locations and elevations of our fixed stations, illustrates the problem with which we were confronted in effecting complete radio coverage. The entire forest is not shown. Additional area to the north is mostly at lower elevations, with more gentle slopes, where no particular problems were encountered.

The central dispatcher and Arroyo Seco and Glendora Ranger Station offices are at elevations of 520, 1,100, and 776 feet, located at the base of the south slopes of a range of mountains. These three stations have direct communication between one another. The Valyermo headquarters, 25 miles airline to the northeast from Arcadia, is on the desert side of the range with intervening peaks reaching over 9,000 feet; Newhall Ranger Station, 32 miles northwest, is also blocked off by mountains.

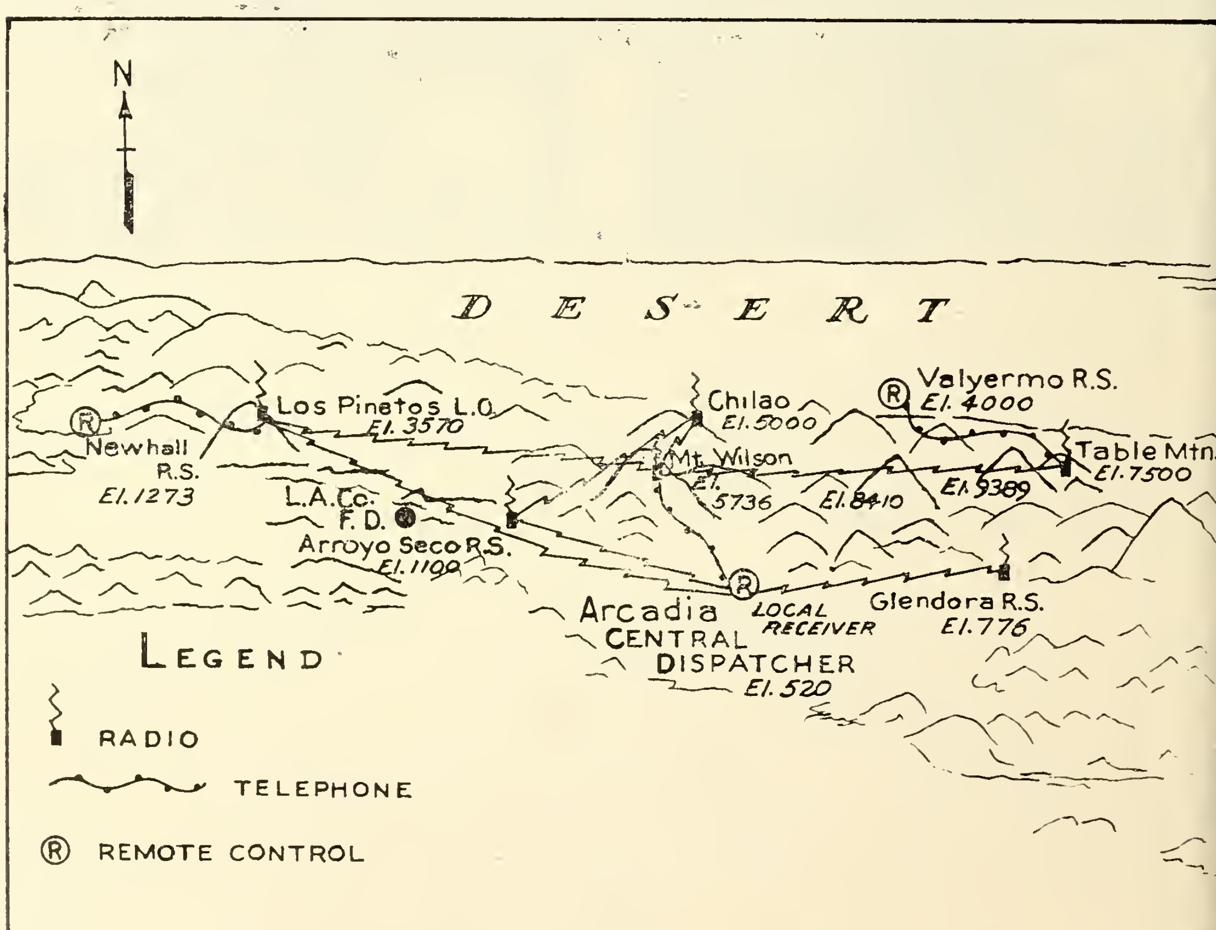

Figure 1.—Diagrammatic sketch of Angeles Forest radio network.

An unattended transmitter and receiver are located atop Mt. Wilson overlooking Arcadia headquarters and remote-controlled to the dispatcher's office over leased lines of the Pacific Telephone & Telegraph Company. Similar installations were made from Valyermo to Table Mountain and Newhall to Los Pinetos, with Forest Service telephone lines providing remote control. These latter two units are at sufficient elevations so that they work directly to Mt. Wilson. A local receiver is installed at Arcadia for use along the base of the mountains, in areas blind to Mt. Wilson, and serves the dispatcher and two front country ranger districts. The Los Pinetos remote-controlled unit works direct to this receiver as well as to Mt. Wilson. With these installations there are very few blind spots on the entire forest.

As a safeguard against commercial power failure, gasoline-driven generators are installed at the remote control sites. In the event of power interruption these generators start automatically and shut off when regular power service resumes. Automatic time clocks are used to start the generators once a week to keep them in working order.

All special equipment illustrated and described in this article was designed and built by A. Donald Galbraith, Angeles National Forest Communications Technician. Everything has been designed for compactness and simplicity of operation, yet there is equipment to cope with most any communication need.

For use in fire camp a remote-control console is installed in a ½-ton panel truck (fig. 2). The cabinet measures 11 by 20 by

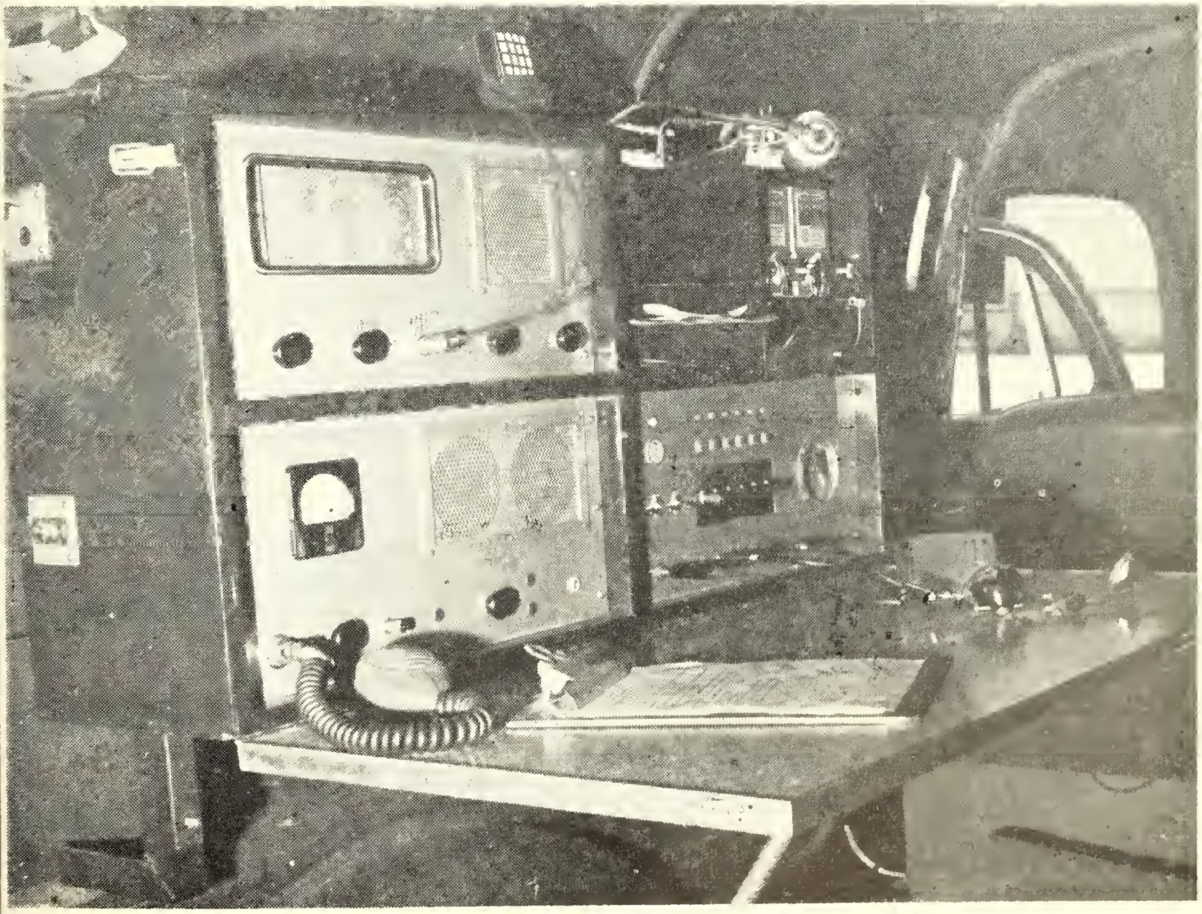

FIGURE 2.—Communication truck with remote-control console.

41 inches. One side is hinged to provide a working desk for two operators. This unit provides control of a single frequency transmitter and receiver which can be any standard mobile installation, or a portable one. The transmitter-receiver can be located several miles distant and connected to the remote-control console by a single pair of wires, either telephone line or emergency wire.

The cabinet is held in place by four wing nuts and may be quickly removed and set up in fire camp on a table when it becomes necessary to use the radio truck elsewhere. Lower left controls are for FM transmitter and receiver; immediately above is a general-coverage radio operating on 550-4500 kc. The microphone on top of the console operates a loud-speaker system. To the right above is storage space for stationery and records. Below this is a telephone switchboard with six trunks. From this control console one operator can handle fire camp radio and telephone traffic most of the time. Occasionally, at peak periods, it is necessary to have two men on duty.

When it is necessary to set up fire camp at low elevation in a location blind to all of the other fixed stations a portable remote (fig. 3) is used. This is a 30-watt, 6-volt DC unit, with gasoline engine charging equipment. It can be located up to 30 miles from fire camp and remote-controlled from the fire camp console via telephone line or emergency wire.

Communication headquarters are usually set up away from the noise of fire camp, and army type field phones are used at the headquarters of the fire boss, transportation officer, timekeeper,

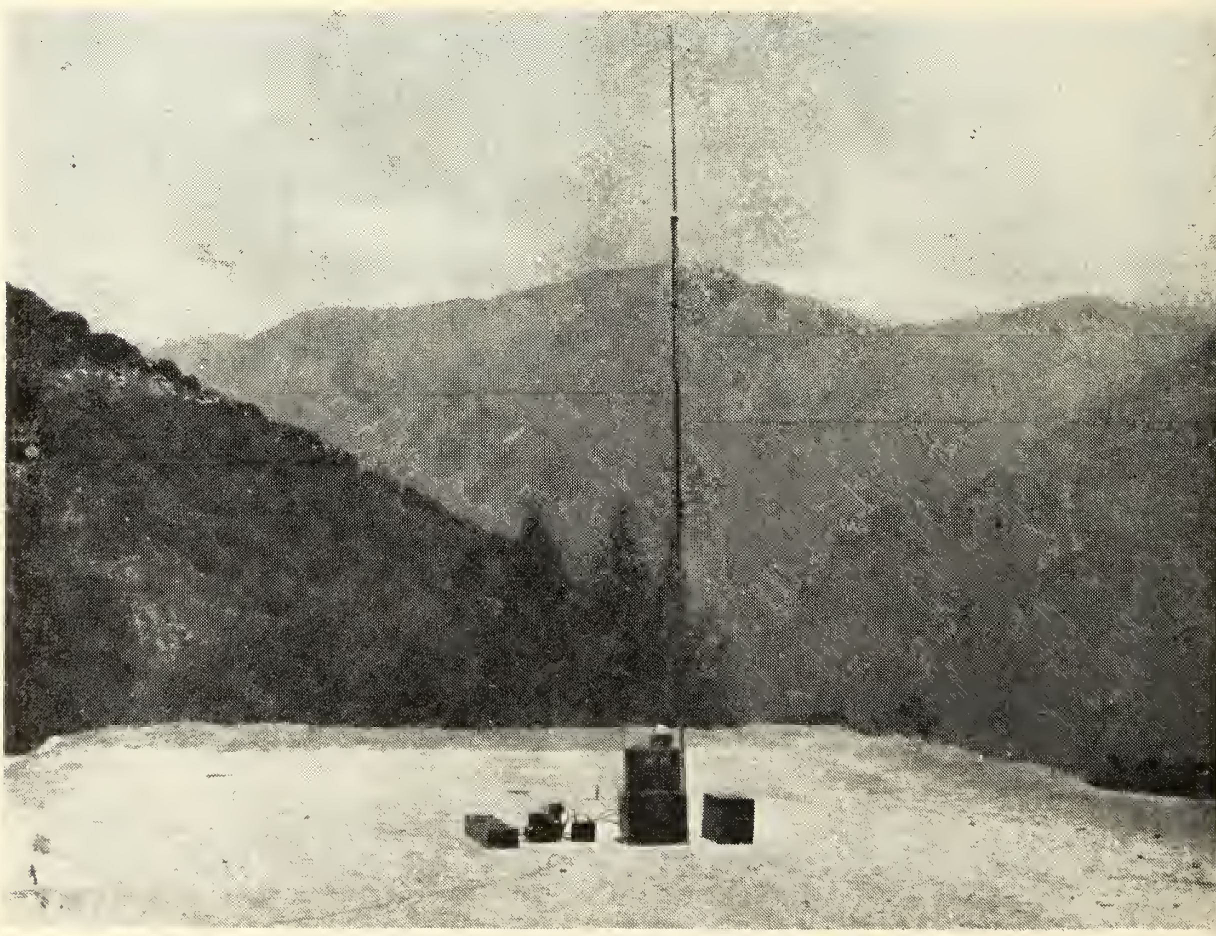

FIGURE 3.—Portable remote unit.

camp boss, etc. Intercommunication between all points in fire camp is then provided by these telephone trunks. Whenever possible a connection with commercial telephone service is made to keep air lanes clear for traffic from the fire line.

Instead of operating radio equipment by power directly from the fire camp AC generator, 6-volt DC power is used. This prevents communication failure should the generator stop. Battery level is maintained either by a separate gas engine charger or an AC charger operated from the fire camp generator.

For further flexibility in fire camp communications a compact, low-drain, dry-battery-operated console (fig. 4) is used as an extension of the main radio, or independently, to perform the same technical functions. This set is used principally by the fire boss and Service and Plans Section at GHQ. It is immediately usable without warm up when turned on.

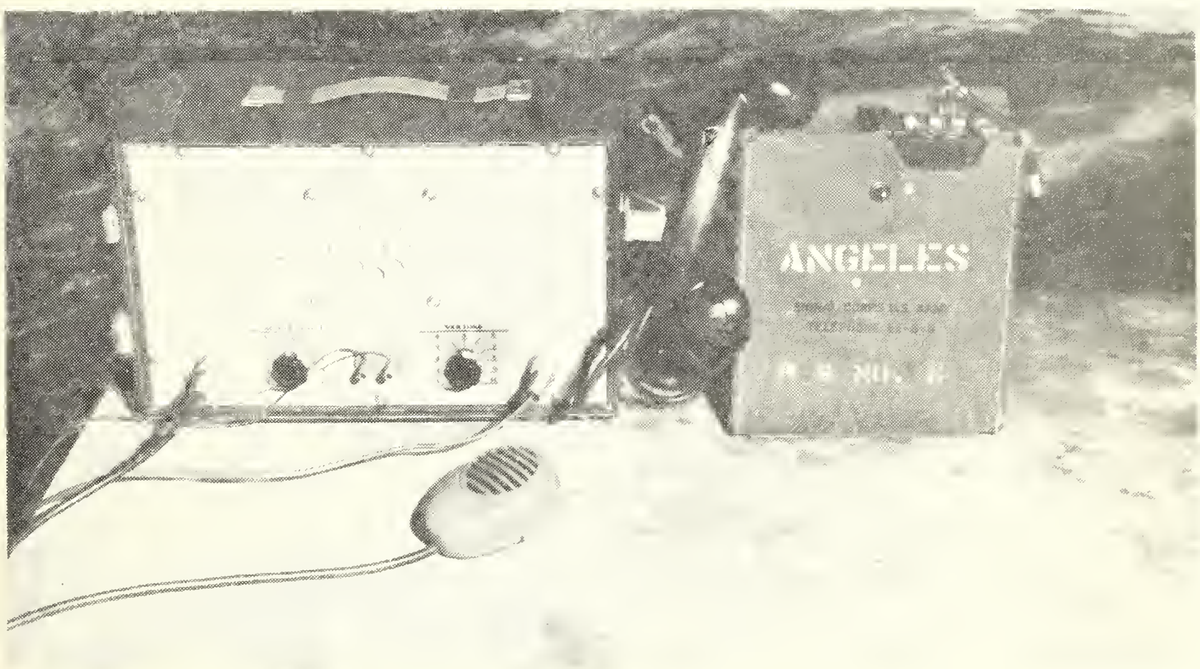

FIGURE 4.—Fire boss console.

Central dispatching is used on this forest and a compact dispatcher console (fig. 5) was designed with controls conveniently located. In addition to the Mt. Wilson set, controls are provided for a local receiver, one frequency of the Los Angeles County Fire Department, an all-wave general-coverage receiver, and eight intercommunication stations connecting the forest warehouses, radio shop, equipment service, equipment development center, and fire crew barracks, all located at Arcadia headquarters.

One battalion headquarters of the Los Angeles County Fire Department, located in the high-value front country area, has a receiver on the Angeles frequency. This enables the two agencies to have communication through cross-band transmissions during joint action fires and for compiling daily weather observations used in determining fire danger indexes.

Radio is used extensively on this forest in fire control work, air and ground rescue operations, flood observations during heavy

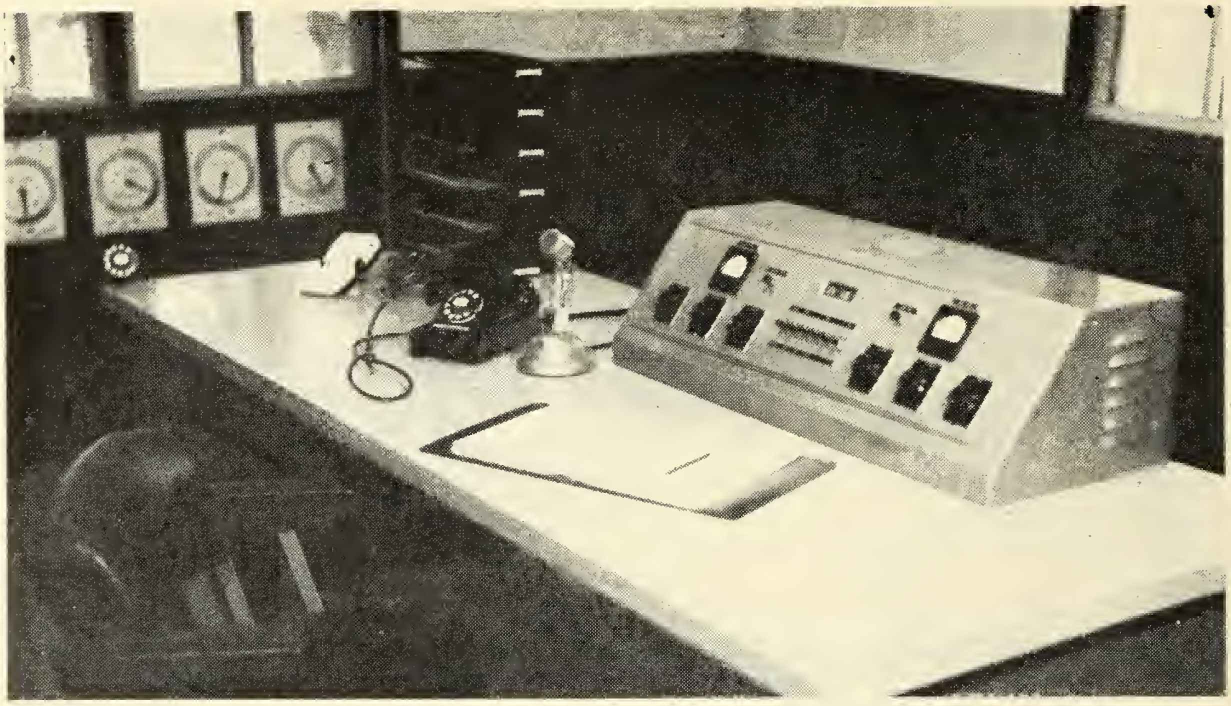

FIGURE 5.—Dispatcher console.

storms, and other emergencies. At present the network consists of 6 fixed stations with 46 mobile units and 30 handie-talkies. The system has been in operation for a sufficient length of time to test it thoroughly under heavy use during major fires and other emergencies and has proved its efficiency with a minimum of service requirements.

Flash Fuel Fire Beater

Specialized hand tools are needed for the manual suppression of cheatgrass and other light flash fuel fires under some conditions. This is particularly the case on rocky sites where a lack of loose soil makes the use of shovels ineffective. Oversized beaters of the fly-swatter type have not been effective because they scatter the fire when an up-and-down beating motion is used.

In an attempt to overcome this effect, a cat-o'-nine-tails type of beater has been devised (fig. 1). When used with a sideways action, this beater knocks out the fire in grass. With a sideways force, burning embers are knocked inside of the fire line.

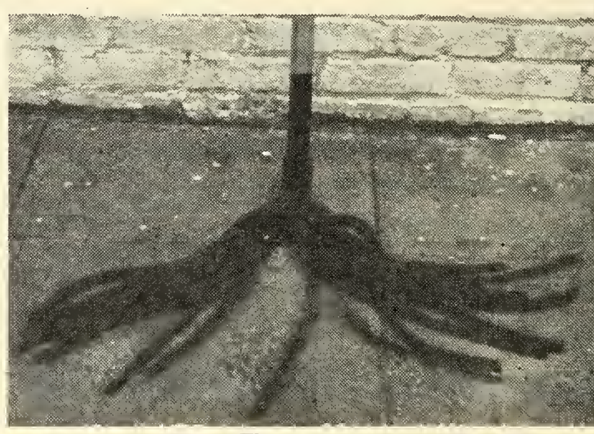

FIGURE 1.

This tool is made from a rake handle cut to a length of from 44 to 48 inches. Twenty-four-inch sections of rubber inner tube, truck tube weight, are used for the tails. These sections are cut in strips ⅝ to ¾ of an inch wide to a length of 21 inches. There should be from 24 to 30 tails. The 3-inch uncut band of rubber at the top of the tails is wrapped around the end of the shovel handle and secured by 3 nails in vertical alignment, reinforced by a dozen wrappings of wire.—PIERRE SARASOLA, *Foreman, Toiyabe National Forest.*

WIND AND DRIFT INDICATOR

W. C. Wood
Foreman, Smokejumper Project, Region 1, U.S. Forest Service

Helicopter pilots in Region 1 use natural heliports that are usually located in remote or back country areas where there are rarely wind socks or wind indicators of any kind. Knowledge of wind currents, their direction and intensity, enables a pilot to land in small spots with less difficulty.

The Aerial Equipment Development Center at Missoula was asked to help find some device that could be carried in the helicopter and thrown out over a proposed landing spot to serve as a wind sock after its contact with the ground. Drift chutes are not satisfactory because of their weight and bulk, and also because they give little or no indication of ground drift after they land.

A streamer-type wind indicator was developed that gives accurate wind direction and indicates, by its degree of movement, wind intensity. This streamer consists of a piece of lightweight orange crepe paper (4 by 84 inches) that is Scotch-taped to a piece of black crepe paper (4 by 18 inches). An 18-inch piece of light thread with a single split shot (oo buck) clinched to its lower end is Scotch-taped to the bottom of the black paper. The streamer is rolled up, thread and shot last, and as many as 12 can be stored under the 'copter's seat cushion without adding appreciable weight or causing discomfort to the pilot.

The pilot, upon approaching the proposed landing site, has only to reach under the seat and with one hand uncoil a few turns of the weighted thread. Immediately above the spot he tosses the streamer out and continues his flight pattern to where he is able to watch the streamer. The weighted string unwraps the streamer automatically during the first stages of the descent. After the shot reaches the ground, the wind blows the lightweight paper away from the anchored shot. The black section serves to identify the weighted end. If wind is absent or negligible the streamer will fall in a heap. If gusts come up the streamer will lay out according to wind intensity.

In the earlier stages of development it was thought that the string could be eliminated. A few models with the shot clinched directly to the black crepe paper were tried. They were satisfactory in all respects except two: On snow courses, high winds would drag the streamer along the snow, and the split shot was more easily torn from the paper, both in handling and after discharge from the 'copter. It is thought that the length of string will allow the streamer more freedom in low brush and grass.

The streamers have been tested on actual helicopter missions on several occasions and pilots report 100-percent success in all tests so far. One pilot enthusiastically reported that even during descent the streamer gave him drift indications according to the attitude in the upper tip of the streamer. The Region 1 contract helicopter is equipped with a dozen streamers for further testing and application.

MAINE FORESTERS PUT FIRE PROTECTION ON STAGE

Arthur G. Randall
Assistant Professor of Forestry, University of Maine

Forest fire protection was dramatized effectively for some 3,000 people attending the 14th Eastern Maine Sportsmen's Show at the Bangor Auditorium, April 21-26. The theme of the show, sponsored by the Penobscot County Conservation Association, was Keep Maine Green. The Maine Forest Service exhibited a fire danger station, forest products, and forest tree leaves and fruits.

A group of forestry students from the University of Maine, known as the "Hot-Shot Fire Crew" appeared each evening and Saturday afternoon as one of six acts on the stage. Over 60 students took part altogether, with 28 appearing in each show. They wore red hats, levis, heavy shoes or boots, and shirts or jackets bearing a distinctive "Maine forester" shoulder patch.

The stage was permanently decorated with a background of evergreen saplings. It was set for the Hot-Shot performance by laying planks, extending for 60 feet parallel to the audience. Saplings were inserted in holes drilled 2 feet apart and the planks covered with pine needles. Since the stage lacked regular footlights, they were improvised by placing red lights in a notched board. Four wash basins were filled with warm water. A canvas relay tank was set up and a few inches of water poured in from buckets. A student narrator explained the action over the loudspeaker.

A hunter armed with a shotgun sneaked through the artificial forest, fired two blanks, and was rewarded with a small roll of canvas tossed out by the property man. Excited by his good fortune, he carelessly leaned the shotgun muzzle against his belly, while he stoked his pipe. He ostentatiously tossed his match away to the pious ejaculations of the narrator and stalked off stage. The property man plugged in the red lights and dropped dry ice in the basins of warm water.

Smoke was a problem, as the dry ice vapor would not rise but hugged the floor. The solution was a bee smoker, which emitted dense clouds of white smoke. Burning pine needles in it gave a genuine forest fire flavor.

A siren sounded the signal that the fire had been discovered and the suppression crew was on the way. The crew tooled up from a red box on the stage. The organization was a one-lick system under a foreman. A line-clearing squad of strawboss with double-bit ax and three men using pulaski tools felled the trees standing in the planks. A line-building squad of strawboss and five men used adz-hoes and mower-teeth rakes. A line-holding squad of strawboss and five men using paired backpack pumps and lady's shovels maintained continuous patrol. These men wore headset flashlights donned before going on stage.

Although, as the narrator pointed out, the size of the stage did not permit use of bulldozer or tank truck, a 1½-inch hose was brought in and water pumped into the canvas tank from a pumper operating just outside the rear door. A second canvas tank was the source of water. If a second hose line was attached to the siamese and both open, the pressure on stage was not great enough to splash the audience.

Overhead lights were turned out and headsets on to show night patrol and the red lights extinguished one by one as mopping up proceeded. As the lights came on again to tumultuous applause, the rest of the crew came back on, prodding the firebug ahead of them.

The Sportsmen's Show was just one project of the Hot-Shot Crew, which stands ready to go to real fires and has two other demonstrations scheduled this spring.

Stainless Steel Water Tanks

The Illinois Division of Forestry has six 1-ton trucks equipped with 16-gage stainless steel water tanks. These tanks, each with a capacity of approximately 110 gallons, have been in service for almost a year and have proved to be very satisfactory. Water taken from them is clear and free from any corrosion particles. It is believed that pump repairs will be reduced because of the clearness of the water.

The tanks were constructed by a local welder at a cost of $142.85 per tank. Each one is 78 by 18 by 18 inches with two baffle plates running crosswise of the tank. A 2-inch filler plug is placed 2½ feet from one end of the tank on top. A 1-inch outlet is placed in the bottom, 6 inches from the end of the tank.—RICHARD THOM, *Staff Forester, Illinois Division of Forestry.*

Rubber Tanks to Help Keep Oregon Green

As an additional weapon against forest fires, an Oregon lumber firm this year is installing about a dozen huge ex-Army rubber tanks at its woods operations.

Each landing is to have one of the 3,000-gallon tanks to give it an extra and sure water supply at all times.

The Williamette Valley Lumber Company and affiliated firms, one of which is the Williamette National Lumber Company, are installing the collapsible tanks to augment a fleet of tanker trucks, bulldozers, portable pumps, and various other equipment items and tools held in readiness in the event of fire.

The tanks are made of heavy neoprene rubber and were manufactured for use in Army filtration plants overseas. They can be set up anywhere and are readily filled, emptied, and moved. The substantial capacity is counted on to give each logging operation a water supply large enough to provide "that extra safety factor."—ALBERT H. WEISENDANGER, *Secretary, Keep Oregon Green, Association.*

SLIP-ON PUMPER UNITS FOR FOREST FIRE SUPPRESSION IN THE DOUGLAS-FIR REGION

L. T. WEBSTER, *Deputy State Forester,* and DON LEE FRASER, *Assistant State Forester, Division of Forestry, Washington*

In considering the optimum type of mobile pumper to put in operation for forest fire suppression, at least two factors should be considered. These are what fuel types are involved in the areas covered, and what is the length of season during which the mobile pumper will be used each year?

If the equipment is to be used in heavy fuel type, such as areas with sizable concentrations of unburned slashing, it is desirable to have tanks and pumpers of larger capacities than would normally be required in areas of average fuel, where volume can be sacrificed in favor of speed and mobility.

In areas where the fire season extends throughout most of the year, it may be advisable to build the tank and pumper equipment as an integral part of the unit. In areas where the fire season runs 6 months or less and where the truck may be effectively used for other purposes during the off season, it is advisable to use a slip-on type unit complete with power pumper.

The fire season in the State of Washington normally occurs within a period of 6 months or less each year. Except for a few large-volume units, the most efficient mobile pumpers have been determined to consist of slip-on units placed on conventional trucks of varying capacities. On this basis, the Washington State Division of Forestry during 1951 and 1952 has developed, with a view toward standardization, four types of slip-on units as follows:

155-Gallon rectangular slip-on unit to be used on 1-ton Willys, four-wheel-drive pickup.—Tank dimensions and fixtures: Width 47 inches, length 49 inches, height 16 inches, with bolt-on cover, baffled into four compartments, with two bolt-down brackets on each end, two sling loops on each side of top, 4-inch filler cap, and 1½-inch drain plug (fig. 1).

240-Gallon rectangular slip-on unit to be used on Dodge power wagon.—Tank dimensions and fixtures: Width 48 inches, length 49 inches, height 24 inches, with bolt-on cover, two bolt-down brackets on each end, two sling loops on each side of top, 4-inch filler cap, and 1½-inch drain plug (fig. 2).

210-Gallon rectangular slip-on unit to be used with ¾-ton Ford or 1-ton Chevrolet standard pickup truck.—Tank dimensions and fixtures: Width 48 inches, length 84 inches, height 12 inches, with welded cover, baffled into six compartments, with two bolt-on brackets on each end, two sling loops on each side of top, 6-inch vented, watertight filler cap, and 1½-inch drain plug (fig. 3).

Each of these three units has a WA-7 pump, manufactured by a Seattle company, mounted in a cradle on top of the tank with

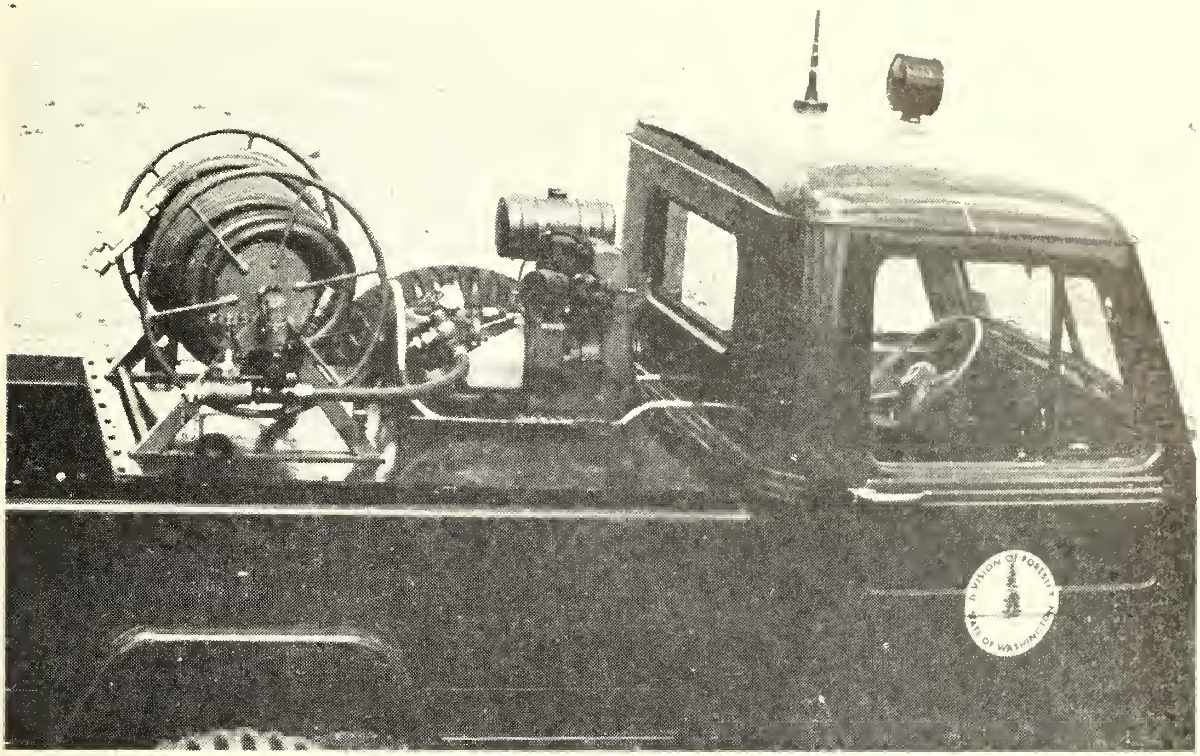

FIGURE 1.—155-gallon slip-on unit.

quick-detachment fittings. A live hose reel carrying a minimum of 200 feet of ¾-inch, semihard rubber hose is mounted on top of the tank adjacent to the pumper. Hose is equipped with a suitable 1-inch combination shut-off nozzle readily adjustable to fog or straight stream. Size of stream may be varied by changing nozzle tip.

These units are designed to operate at pump pressures up to 250 pounds per square inch and volumes up to 25 gallons per minute depending on nozzle orifice and other variable factors.

500-Gallon rectangular slip-on unit to be used on conventional Ford, Chevrolet, or Dodge 1½-ton stake-side, dump, or flat-bed trucks.—Tank dimensions and fixtures: Width 70 inches, length 90 inches, height 18 inches, with cover welded on, baffled into six

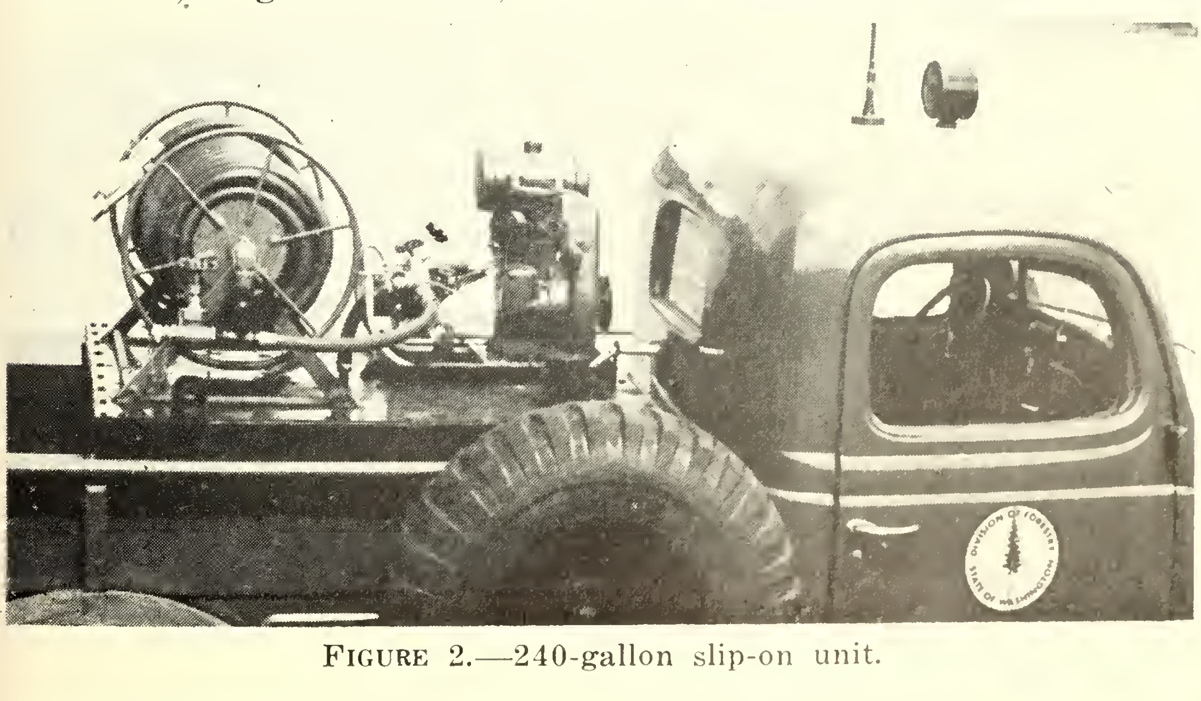

FIGURE 2.—240-gallon slip-on unit.

compartments, with two bolt-down brackets on each end, two sling loops on each side of top, 6-inch vented, watertight filler cap, and 1½-inch drain plug (fig. 4). A WX-10 pumper, manufactured by a Seattle company, is mounted in a cradle on top of tank with quick-detachment fittings. A live hose reel carrying a minimum of 300 feet of ¾-inch, semihard rubber hose is mounted on top of the tank adjacent to the pumper. Hose is equipped with a suitable 1-inch combination nozzle readily adjustable to fog or straight stream. Size of stream may be varied by changing nozzle tip. A 1½-inch tee with valve is placed between pumper and hose reel to permit laying a 1-inch or 1½-inch hose line direct from truck. This unit is designed to operate at pressures up to 250 pounds per square inch and volumes up to 40 gallons per minute depending on nozzle orifice and other variable factors.

All tank shells are preferably constructed from 12-gage Mayari steel with baffles of 14-gage Mayari steel. Baffles are all plug-welded.

A 1½-inch suction strainer with cylinder 8 inches in diameter by 8 inches in length, and capped on each end, is used in all units. The shell on the strainer cylinder is constructed from 1/16-inch tinned steel perforated with ⅜-inch holes on ⅝-inch centers, and wrapped with 40-mesh Monel wire cloth. A 1½-inch galvanized pipe passing through and welded to the center of one end cap extends to within 1 inch of the other end cap. This strainer is used in a vertical position in either forward corner of the tank. The suction strainer extends through a manhole with bolt-on cover to permit free passage of the strainer to and from the tank for inspection or repair. This suction strainer is especially important when rotary gear pumps are used. Suction line from tank to pumper is flexible, hard hose with slotted screw-type couplings. Discharge line from pressure relief valve to live hose reel is flexible semihard rubber hose. On all of the units under 500 gallons, a 1-inch tee with valve is installed between pumper and live hose reel to permit laying 1-inch hose line direct from pumper when desired.

A properly designed bypass valve adjustable within the pressure limits to be used is installed on the discharge side and adjacent to the pumper. Bypass water is carried through separate ¾-inch garden hose into the tank. The bypass or pressure relief valve is very important as it functions automatically as the shut-off nozzle is opened or closed. This eliminates excessive strains on equipment and saves materially in hose breakage and replacement.

All units have plywood tool boxes designed to carry hand tools for five to ten men, depending on local requirements. In addition to this, tool boxes carry gasoline and oil, pumper tools, and 500 feet of 1-inch cotton rubber-lined hose.

A properly designed slip-on unit has the following advantages:

(1) If the portable pumper is properly mounted it may be quickly detached and moved to a source of water supply for filling the tanker, far beyond the normal suction lift of a pumper which

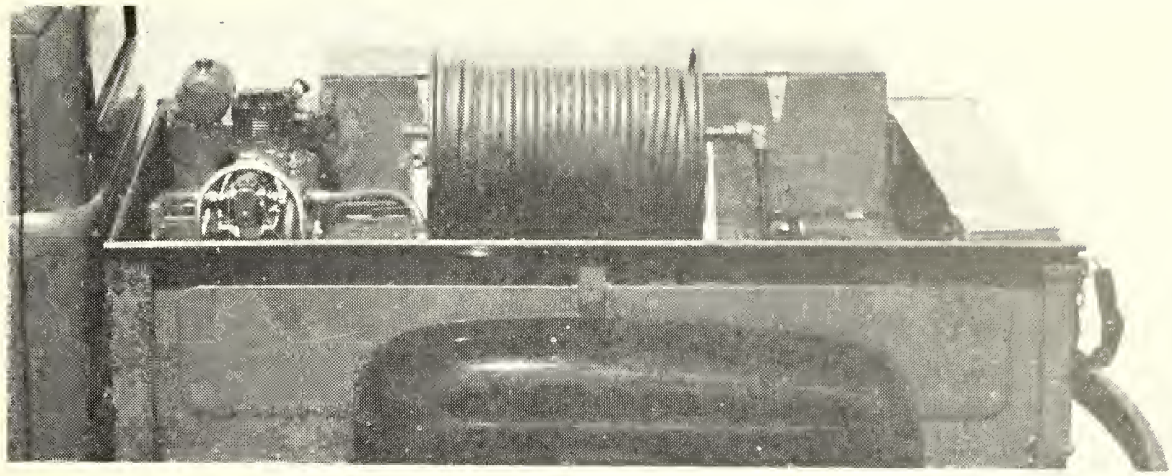

FIGURE 3.—210-gallon slip-on unit.

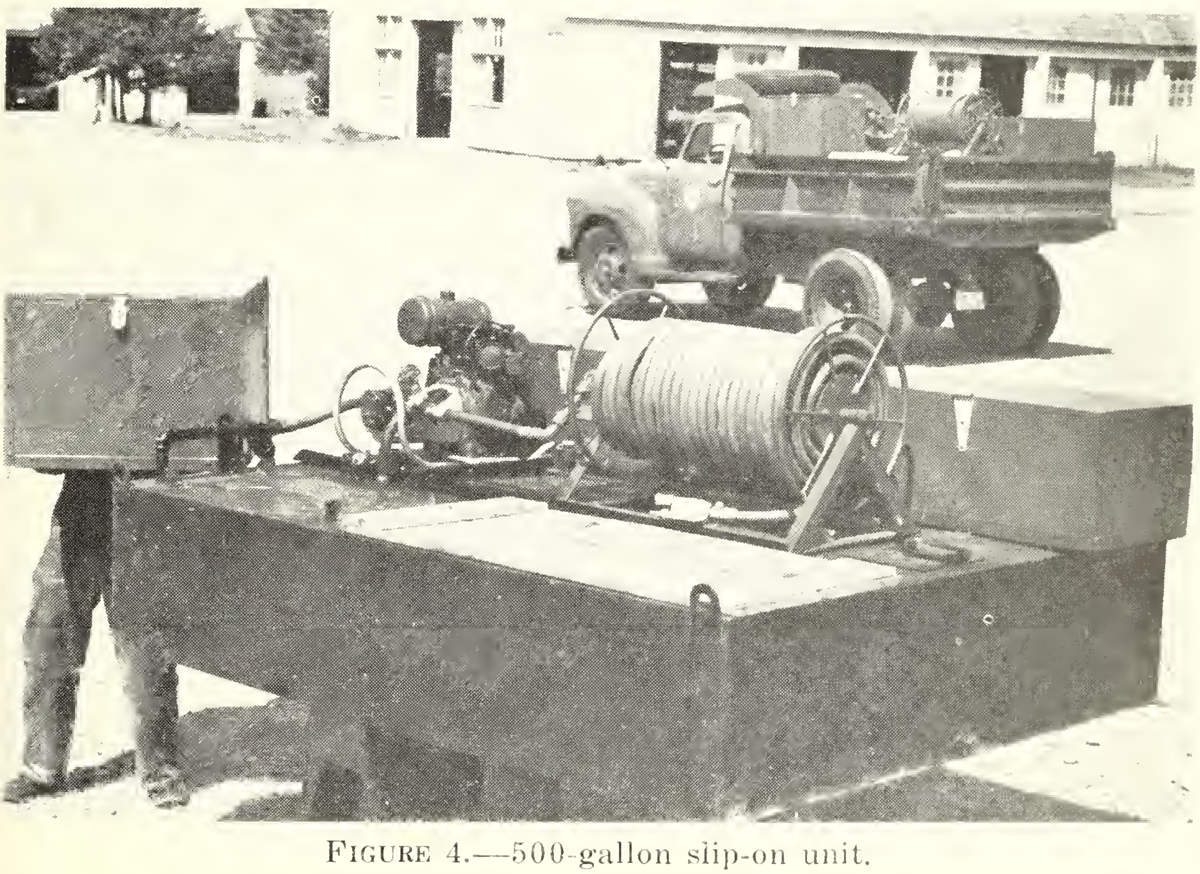

FIGURE 4.—500-gallon slip-on unit.

cannot be detached from the truck. It may also be removed from the truck and used as a separate pumper unit to pump direct from water supply onto fire in many locations where a truck could not get to the water supply.

(2) A slip-on unit does not tie up an expensive truck so that it cannot be used for any purpose other than a tank truck. It is a simple matter to load or unload as needed.

(3) It is a simple matter to transfer a slip-on unit from one vehicle to another in case of truck failure or when a new truck replaces the old one.

(4) A slip-on unit incorporates all of the pumping equipment and tools to make it a self-sufficient fire fighting unit. It is ready to go instantly without the delay involved in assembling various items which may be needed.

TANKER SPRINKLER BAR

Arcadia Equipment Development Center
California Region, U.S. Forest Service

In order to alleviate dusty conditions at forest stations, recreation areas, campgrounds, and fire camps, fire trucks are frequently used for sprinkling purposes. Naturally, it is a slow and inefficient process to settle the dust by means of hand sprinkling with a hose. This explains the request by the California Region for a portable sprinkling system which could readily be attached to a tanker.

Such a sprinkling system, which attaches onto either the front or rear bumper of a truck, has been built at the Arcadia Equipment Development Center.

It consists of two pieces of 1¼-inch pipe, each 3 feet long, coupled in the middle by a swivel joint (fig. 1). This allows disjointing for carrying in one of the tool boxes. Any size pipe from 1-inch up would serve the purpose. Four holes, equally spaced on the pipe, serve as orifices for expelling water which is sprayed out in fan-shaped patterns by deflectors.

The width of the four sprays, where they hit the ground, can be regulated by rotating the pipe so that a uniform sprinkling job results. As shown in figure 2, the over-all width of the sprinkled strip is 8 feet. Should a wider strip be desired, additional sections of pipe could be added, or longer pipes used which would still fit in the tool box.

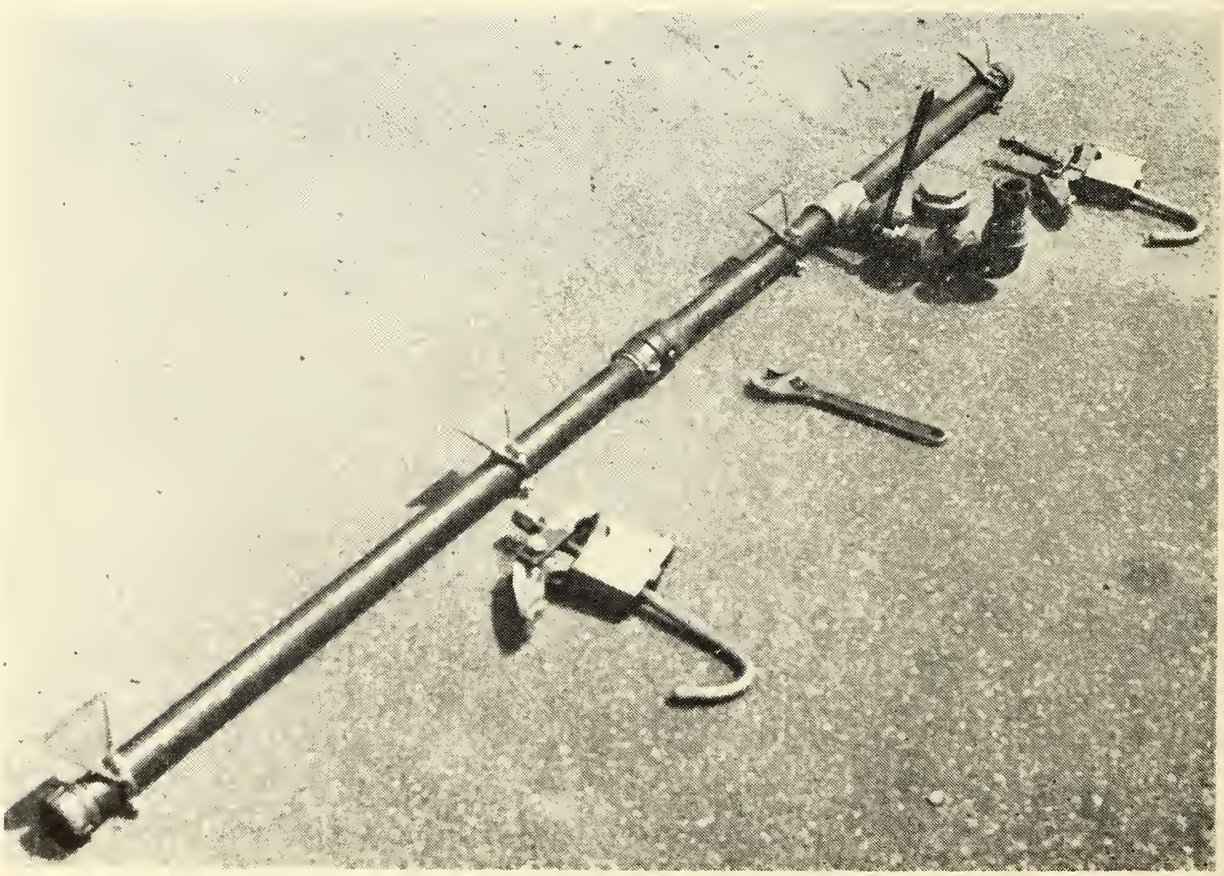

Figure 1.—Sprinkler bar and clamps.

FIGURE 2.—Sprinkling at a nozzle pressure of 125 pounds per square inch.

Two adjustable clamps hold the pipe in place and attach firmly onto any bumper. The clamps on the pilot model are well machined and, therefore, cost more than is absolutely necessary. However, the design proved very effective for holding the unit in place. The J-bolts are made sufficiently long to fit a bumper 8 inches wide. For narrow bumpers, washers cut from 3/4-inch pipe are used to take up the slack. If preferred, a simple arrangement of "C" clamps could be used as a substitute for the design shown.

The four holes are drilled 5/32-inch in diameter, which allows a combined flow of approximately 18 gallons per minute when pumping at a pressure of 100 pounds per square inch. The deflectors used are a commercial item which can be purchased for approximately $1.50 each.

A 1-inch swivel inlet provides ready attachment of the 1-inch hose line from the live hose reel. The pilot model is equipped with a quick-throw valve which can be rigged with pulleys and rope for control from the cab. This, however, is optional and may be omitted for the sake of economy. The hose reel shut-off valve could be used as a substitute control.

Drawings or information regarding this item can be obtained from the Arcadia Equipment Development Center, 701 N. Santa Anita Ave., P. O. Box 586, Arcadia, Calif.

PARA-CARGO NETS

W. C. Wood
Foreman, Smokejumper Project, Region 1, U.S. Forest Service

Until recent years, para-cargo in Region 1 was man-tied and roped for dropping, much in the same manner as for mule transport. Small bundles required extra time and labor when they were to be dropped in one unit.

A canvas cargo sling was developed for handling these small packages as one load. This sling consisted of a 6-foot-diameter piece of 22-ounce canvas with C-10 webbing straps sewn at right angles to each other across the canvas and with buckles attached to straps. The perimeter of the canvas was hemmed and fitted with grommets through which a drawstring of ¼-inch rope was laced. Loading of this net is simple and fast. The canvas may be spread out on the floor and several small bundles placed in the center according to fragility or size. The canvas is drawn up to cover the sides and secured tightly with the drawstring. The webbing straps and buckles are fastened to form a loop for attaching the parachute.

The canvas sling is entirely satisfactory in all respects except cost. The sling requires 4 yards of canvas at a cost of $4.22. Salvaged or condemned parachute webbing was formerly used on the straps but is no longer available. Seven yards of C-8 webbing are required at a cost of $1.40. Hardware costs $1.25 and labor approximately $5.00. The total cost is $11.87. These slings are frequently not returned from the fires and a cheaper sling is desirable.

Two types of fish netting were used as substitutes for canvas in two experimental models (fig. 1) to reduce cost in materials. The netting is 1-inch square mesh. The white netting is new nontreated fish netting which costs 90¢ a yard. The dark green netting used is condemned fish netting which costs about 7¢ a yard.

It was hoped that the green used netting could serve as a substitute for canvas, but strength tests show it to be too far deteriorated to withstand most parachute openings. Box corners or projections can shear the cord even in loading and handling.

The white netting is much stronger and makes a more satisfactory para-net.

Two nets were constructed from the pattern of the canvas para-cargo sling. An unusual number of fabricating problems were encountered in constructing these models. Netting does not "lay-out" like canvas and other solid fabrics; hence there is difficulty in cutting to measurements. Netting does not lend itself to easy and fast sewing machine work. The cords and knots of the net become entangled in the foot and feed mechanism of the sewing machine. It was found that the netting had to be "sandwiched" between two strips of webbing to insure smoother feeding action through the machine, so an additional webbing piece was required. The small hard knots of the netting deflected and broke machine needles. Folds and hems were difficult to hold in alignment during

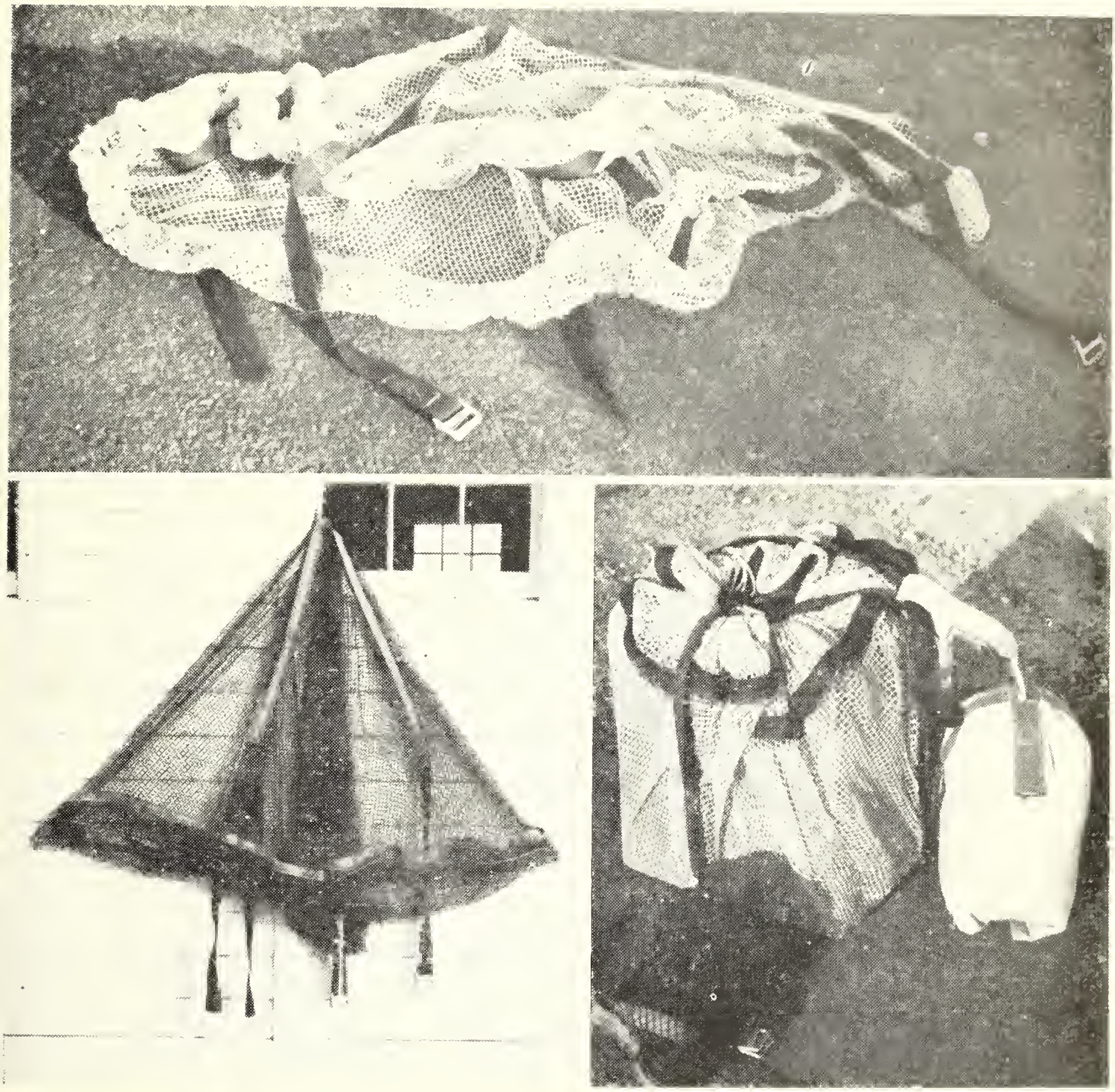

FIGURE 1.—Experimental cargo nets: new, white fish netting; inexpensive, used fish netting (dark green); white netting containing cargo and with chute attached.

sewing and resulted in sloppy work. Labor cost of the net sling was $20 on each of these models or about three times that of a canvas net.

Three test drops at an airspeed of 90 miles per hour were made on the net models with the following results:

Drop	*Description*	*Weight (pounds)*	*Results*
1	White netting with SPF radio box and sandbag.	65	Radio box shifted sideways inside net, but overall performance satisfactory.
2	Green netting with SPF radio box and sandbags.	65	Twelve-inch tear developed at corner of box. Webbing saved box from going out of net. (Damage on the first drop eliminated this sling from a second test.)
3	White net with small boxes, canned goods dumped in at random.	150	Entirely satisfactory, no tears or holes.

From the two drops with the white net sling it appears that the white net is strong enough to serve as a substitute for canvas; however, cost of construction on this model would rule it out.

A simpler design has been devised which reduces labor on a new model to about $1. The new model consists of an 8-foot square of netting with its sides turned 2 inches and rolled inward to four complete turns. A 30-foot piece of parachute suspension line is threaded through the folded mesh of the rolled hem at 6-inch intervals in the same manner as though the hem contained grommets or eyelets (fig. 2). Cargo packages may be confined by placing

FIGURE 2.—Experimental cargo net which, because of low cost, may be considered disposable.

them in the center of the net and drawing the parachute line up from the corners and sides until the hem is constricted to approximately 6 inches. The cargo chute is attached to multiple loops formed by the parachute line drawstring. Operational tests on this model are forthcoming. These nets have considerable promise for confining light packages and because of the low cost may be considered disposable where return transportation is expensive. We believe, however, that permanent net-slings should have some webbing reinforcement for added strength when 150- to 200-pound loads are contemplated.

One objectionable feature of netting is its tendency to snag and hang up on the slightest projection. Even small screw heads not properly countersunk into the floor of the aircraft will catch on the net. Extra precaution should be taken when dropping netted packages. A flat piece of cardboard may be attached to the bottom of net cargo slings to alleviate this hindrance, but this adds another step to impede the predischarge maneuvering.

MAINSTAYS OF FOREST FIRE PROTECTION[1]

A. A. Brown
Chief, Division of Forest Fire Research, U. S. Forest Service

Fire is an old friend, and an old enemy of man, depending on how well it is used and controlled. As a friend, it serves everyone, but as an enemy it threatens us all, too. But the responsibility for keeping it under control falls generally to a small group. The acceptance of such a responsibility is a common characteristic of all fire men and is something that all of us here have in common. A good part of the task ahead is to get more people to accept that responsibility toward fire.

I happen to represent men who take on that responsibility in woods and wild lands—the forest fire fighters. They have a common purpose with all other fire fighters but they work in a very different environment so the job differs, too, in many respects. The forest fire fighter is a long way from city hydrants and he is lucky if he can get to his fire on wheels.

We in the forest fire fighting services have been busy mechanizing wherever we can in the last 10 years, and we have much to show in the way of equipment development. In 1950 a total of 1,500 miles of fire control line was worked by the aid of machines of various kinds on or in the defense of the national forests alone. Even so, 83 percent of the forest fires attacked by the national-forest organization are still controlled by men on foot using hand tools and woodsman's methods.

In the U.S.A. forest fire fighting is a big job every year and a costly one. On the national forests there are usually over 10,000 fires controlled each year and on areas protected by State and private agencies there are about 80,000 additional fires. The total number of forest, brush, and grass fires reported each year amounts to close to 200,000.

Much of the threat from forest, brush, and grass fires is to improved property of all kinds. Consequently, what happens in forest fire fighting has a considerable impact on the success of the protection of improved property. In every bad forest fire year, there is a noticeable jump in losses to insured property. There are several reasons that should interest all fire chiefs.

In the United States only about 7 percent of our land area is included within city limits or other units in which organized fire departments operate. The other 93 percent of the land area is in rural country and wild lands. This, too, creates an important distinction in the fire fighting job. Forest fire protection is widely scattered while municipal and industrial protection can be highly concentrated.

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[1] Paper presented at the May 3-5, 1951, sessions of the Dominion Fire Prevention Association, Windsor, Canada.

Organized forest fire fighting is much younger than structural fire fighting and most of its development has occurred in the last 40 years. Progress in that development can be described in various ways. It is most usual to do so historically or statistically to show progressive reduction in losses or improvement in performance. I shall attempt instead to discuss what seems to me to be the essential elements in such progress in order to take a little sharper look at the main supports on which a successful system of forest protection must depend. I think you will agree that most of these are important to all systems of protection though they may not have the same relative force.

The main supports which I would like to examine with you might be placed under the following four headings: Public education and legislation, cooperation at all levels, systematic planning, and research and development.

Public Education and Legislation

Perhaps a better term would be "public policy" since legislation bearing on fire is essentially a statement of public policy whether it be local or national in scope. Public policy is expressed and made effective only to the degree that people recognize and understand a problem and resolve to do something about it. This is the necessary background to the development of a conservation program and to the support and financing of the protection of wild land resources. In the United States people became interested in forest fires and in the damage done at the beginning of the century. Conservationists called attention to the significance of such fires and newspapers gave them considerable publicity. This created a favorable background for national legislation which set up the national forests and charged the administrators with the responsibility of protecting them from forest fires.

Our great leader in conservation, and the first chief of the Forest Service, Gifford Pinchot, was the first man to impress the need of conservation of national resources on our public consciousness. Several of our presidents have carried on that sponsorship by promoting and helping to give further legislative expression to national policy. In our conservation movement, protection of forests and other wild lands from deterioration from fire has always been a key feature.

In recent years, public education in the prevention of fires has been greatly advanced by the participation of the National Advertising Council in formulating national advertising programs. These programs featuring "smokey bear" and appealing to the general public, were begun during the last war as a free contribution to wartime public service. They have been so popular and so successful that the National Advertising Council has continued its sponsorship to the present. The objective is simple, but the stake is big. It is a full realization by the general public of the need to keep our national resources productive, and of their own personal stake in forest fire losses.

Cooperation at All Levels

Fires outdoors are no respecter of land ownership boundaries or of jurisdictions. This becomes impressed on every experienced forest fire fighter and has become one of the controlling principles of successful protection throughout the U.S.A. It was first applied by timberland owners who found that their own efforts to protect their holdings were not effective unless their neighbors took similar action. This led to the banding together of timberland owners into timber protective associations. This cooperative principle has continued in the development of forest protection. In time, since there was always some difficulty in getting uniform compliance with agreements to pool funds and efforts, four of our western States have enacted laws which provide for protection assessments against timberlands in order to facilitate the operation of both State and association protection systems. But to an increasing degree the State and Federal governments have come in as partners.

The principle of public participation in financing protection was first recognized by our Weeks law in 1911. In 1924 our Clarke-McNary law was enacted to provide Federal support of State-wide protection under State authorities. Through the operation of this law the Federal stake in forest protection was recognized and protection systems under State Foresters have developed rapidly until they are now active in 43 of our 48 States.

In spite of the accomplishments that have already resulted from recognizing that cooperation between owners and agencies is essential to any form of systematic protection, there are still a good many gaps in the scheme. This is recognized in recent efforts to strengthen wild land protection on a national basis as a part of the provisions now being set up for improving the national defense. Under it there is increased effort to provide for emergency action across State lines and to increase the cooperation between structural fire fighting groups and forest protection agencies.

The need of improved jurisdictional arrangements becomes apparent whenever a major disaster occurs. This was highlighted by the difficulties experienced at the time of the great fires in Maine in 1947. It led to the so-called New England compact by which resources of a group of our New England States are available to meet emergencies in any one of them. The provisions of the compact left the door open for adjoining States to enter into the arrangement and I understand it is hoped that the adjoining Canadian provinces may find it desirable to enter into these compacts in some way along the international boundary.

From first-hand experience in the Northwest I know that wholehearted cooperation across the international boundary has been a long established custom in fire fighting and so few jurisdictional problems have arisen that so far no one has taken the trouble to codify the legal aspects.

Cooperation, of course, extends much further than cooperative arrangements between jurisdictional units. In a large sector of our western country the active cooperation of local residents in preventing fires, reporting them, and participating in their control, has long been the backbone of a protection system by which forest fire losses are kept to a minimum at a very low protection cost. This again represents cooperation on the ground, which is, after all, the essence of any cooperative arrangement. Much of the value of forest fire prevention publicity is in the degree to which it stimulates cooperation on the part of the general public in the effort to prevent fires or to control them before they become dangerous.

Systematic Planning

All fire fighting has a special emergency character that makes it different from most civilian activities. This is because fires start and spread at unpredictable times and places and it is impossible to schedule the need of any fire fighting activity to the degree that can be done in most forestry activities and on construction jobs. Consequently, the only way that systematic protection can be carried out successfully is through careful planning. Such planning has to address itself to the question of determining the places and times of year when effort will be needed to control fires and to the relative amount of effort that will be required in order that the fire organization may be maintained in reasonable relation to the job that will need to be done.

Planning has to concern itself with providing protection to large areas of land and to getting effective action on fires wherever they may occur. There are many phases to it and I shall not dwell on the different kinds of planning that are involved. I think it is sufficient to say that effective control of fires, regardless of the lands or the effort involved, is impossible unless a great deal of planning has been done to provide fire fighting forces at the right time and at the right place to control all fires that start.

Research and Development

From the very beginning the development of successful forest protection has depended on factual information. It is necessary to know a great deal about the occurrence of fires in every locality, the times of year when they become dangerous, and the damage they do before the requirements of the fire fighting job can be fully appreciated. Fire statistics play a big part in supplying such information but they always require analysis and interpretation before the question of what to do can be resolved.

The need of factual information for every area protected applies not only to the planning and maintaining of the organization but to its day to day operations as well. Study of the relation of weather to forest fires has enabled the development of so-called fire danger ratings which provide a daily guide to the fire control administrator in managing his organization. Fire danger ratings in the U.S.A. are imperfect in many respects and vary a great deal in their significance but have proved so valuable to the administraor that they are in use in all of our national-forest regions and y a majority of the State organizations.

Research in forest fire behavior has also provided the essential ase for training fire fighters and in developing the judgment of ıen in the planning and managing of large fire fighting operaions. There is still a long way to go before we can predict just hat a fire will do in all circumstances and we particularly need ome new research in the behavior of big fires.

The most important thing of all in the research activity is the reation of an attitude of mind where new ideas and new answers o old problems are constantly being sought. The existing fire reearch group of the Forest Service is very small and their indeendent efforts might have little significance except as they are acked by strong demands by some of our research-minded forest dministrators who are constantly looking for better methods and ho are carrying on administrative studies to find out as many hings as possible for themselves. Some of the most important reearch is not academic in nature but consists of the ability to reak way from the conventional in order to arrive at a better olution.

Much ingenuity has been directed toward the problem of bringıg machine methods to bear on forest fire fighting. Such developıent has been closely coupled with other forms of research and, in he Forest Service, was under the leadership of Mr. David Godwin or many years. He was responsible for establishing a definite connuing program of equipment development and application under ne difficult situations usually encountered in forest fire fighting ı rough inaccessible terrain. The benefits of giving special attenon to the adaptation of equipment to the job to be done have xtended from the improvement and invention of hand tools to ackpack hand pumps, tank trucks, plows, tractors, radio equipent, and transportation equipment. Work in the field of equipıent is dynamic, and it is never completed. One reason is that here is no ideal answer for all needs in any one piece of equipent. All of it has certain limitations. So careful testing on the round and careful analysis of performance is necessary to find ıt where and when a particular piece of equipment will pay its ay. We still need a great deal of this kind of work.

In recent years the most important factors that are finding ıeir place in systematic forest protection are the best use of airaft, including helicopters, the development of light fire trenchers, ıe standardization of fire tank trucks, the place of chemicals in re fighting. The feasibility of attacking fires directly from the air also a most attractive future promise.

onclusions

This brief summary of the mainstays of successful forest fire otection is in outline only. Each is a story in itself. When all come well established and activity in each is maintained in step with the dynamic nature of the job, forest protection becomes a highly successful and progressive enterprise.

But on a State- or Dominion-wide basis there may still be a serious lack in the over-all defense against fire, that is, if only city and wild land protection are well developed, and each is on an independent basis.

In the U.S.A. there are great sections of the farm and range country where no means of concerted action has been organized. In some sections volunteer fire fighters extend their protection on the city pattern into the countryside. In others, the wild land protection agencies extend their services also. But well coordinated protection coverage for city, country, and forest is still rare. This lack of coordination also shows up in equipment, training, and methods. If you have seen city firemen out battling a grass fire with ladders and chemical extinguishers or a forest crew trying to protect a structure without a pumper, you know what I mean.

Current national defense plans provide a fine opportunity to advance fire protection on all fronts. If they are properly drawn to meet large-scale fire emergencies, all protection forces will find themselves partners. Such a partnership could be highly profitable if it results in a new unity in a common purpose, more complete coverage in protecting our national wealth, more pooling of the effort in research and development, and more exchange of the "know how" that means better performance down the line.

Do Diesel Locomotives Set Fires?

There is definite evidence that Diesel locomotives do set fires. During the period April 7 to July 11, 1951, Diesel locomotives set 33 fires along the Great Northern Railroad right-of-way, according to information from the Snoqualmie National Forest, Seattle, Wash. In addition, a comparable number of fires were set on the State protective area.

Investigation of these fires, and contact with railroad officials established the following facts:

1. More than one locomotive was involved—two, at least, and possibly four.

2. All fires were started on the east-bound run while the locomotives were laboring on an up-grade.

3. The railroad officials accepted without question the theory that the fires started from sparks.

4. In previous seasons, these same locomotives had not been known to have set fires.

What was wrong? The railroad company was concerned. The one thing they knew about was that a different type of lubricating oil—highly detergent—was being used. A mechanical engineer and an oil company expert were called in for consultation. The fire-setting locomotives were given a complete overhaul, and a different type of lubricating oil was used. The locomotives went back into service. No fires have been reported since.

The explanation in this case would seem to be that the detergent oil was doing exactly what it was intended to do—loosen carbon. When the locomotives encountered a steep grade, pieces of carbon broke loose and were emitted from the stacks.—Division of Fire Control, *Region* 6, *U.S. Forest Service.*

/olume 14 Number 1

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

FIRE PREVENTION

C. A. GUSTAFSON

Chief, Division of Fire Control, U. S. Forest Service

The 165,000 forest fires occurring annually on the forest lands of the United States emphasize the tremendous fire prevention job confronting fire control managers. Unless more rapid progress is made in preventing such fires this nation stands to lose billions of dollars worth of important and valuable natural resources in the next 50 years.

The forest lands of the United States total approximately 640 million acres, and all but 63,290,000 are under organized protection. On these protected lands the ratio of man-caused to lightning fires is 14 to 1 (table 1). Available figures indicate also that the unprotected lands are exposed to 5 times as many fires per unit of area as are the wild lands under organized protection, and with an even higher ratio of man-caused to lightning fires.

The most successful fire control job that can be accomplished is the prevention of fires. Fires such as those started by lightning and by air crashes, vehicle accidents, and enemy action in time of war cannot be prevented. However, the vast majority of man-caused fires are susceptible to prevention efforts.

The purpose of this article is to outline what procedures to establish and the methods to follow to assist in the prevention of fires. A brief background of the major uses of wild lands and their general relationship to fire occurrence will point up the value of fire prevention and will aid in the preparation of a specific plan for a given unit.

TABLE 1.—*Number of forest fires on protected areas in the United States by causes and groups of States, 1951*

Groups of States	Lightning	Railroads	Campers	Smokers	Debris burning	Incendiary	Lumbering	Miscellaneous	Total
Pacific	2,248	386	442	1,931	841	362	547	1,491	8,248
Rocky Mountain	3,787	85	247	434	201	52	54	345	5,205
North Central	39	490	130	1,054	2,351	1,619	60	526	6,269
Southern	904	1,470	1,908	11,255	13,469	36,259	2,023	8,271	75,559
Eastern	51	819	674	3,716	2,728	1,104	87	1,408	10,587
United States	7,029	3,250	3,401	18,390	19,590	39,396	2,771	12,041	105,868

1 Taken from Forest Fire Statistics, 1951, by Forest Service, Division of Cooperative Forest Protection, U. S. Dept. of Agr. 16 pp. [Processed.]

Uses of Wild Land and Their General Relationship to Fire Occurrence

At the turn of the century logging and lumbering were limited mainly to the area east of the Great Plains. Mechanization of woods operations had not taken place to any marked extent. Fires in the logging woods were caused by lunch and warming fires, promiscuous slash and debris burning, and smoking. These same causes prevail today but added to them are fires resulting from the operation of tractors, power saws, high and ground lead systems, logging railroads, trucks, and other machinery common to the logging industry of today. In addition the number and size of woods operations have increased manyfold. They have moved westward into areas characterized by long periods of low relative humidities, heavy fuels, and rough terrain.

Hydroelectric power development was almost unknown in much of the United States, particularly in the far West, at the close of the nineteenth century. Today thousands of miles of transmission lines traverse millions of acres of hazardous fire areas. Thousands of miles of railroads and many more thousands of miles of highways pass through the wild land areas. Cities and villages have increased in numbers and in population and the uses of the wild land areas have expanded correspondingly.

Increased use has usually meant increased risk, or chance of fires starting.

Consumption of pulpwood has increased tremendously from 4.5 million cords in 1921 to more than 26 million cords in 1951. This increase has meant more men and machines in the woods and a greater number of families living in and near the wooded areas. Hence the wild land areas are being subjected to a higher degree of risk.

Lumber production in the United States has been steadily increasing since the low point reached in 1932 (fig. 1). A proportionately much higher increase of lumber production has occurred on national-forest lands. It follows that the risk brought about by expanded production has increased proportionately much more rapidly in recent years on national-forest lands than on privately owned lands and will continue to increase until the full sustained-yield capacity of these lands is reached.

The use of wild lands for recreation purposes has increased to a point where the numbers of people, whether picnickers, campers, hunters, or fishermen, have created a serious risk situation. This risk will increase as the population increases and the time and means available for recreation become greater. To offset the mounting impact of increased use on the number of fires that start on wild lands each year, the fire control manager must resort to fire prevention.

If a composite index of total use is plotted against the index of number of man-caused fires the two curves should be almost parallel. This would be true if no effort had been made to prevent fires. Figures for the national forests in the eleven western

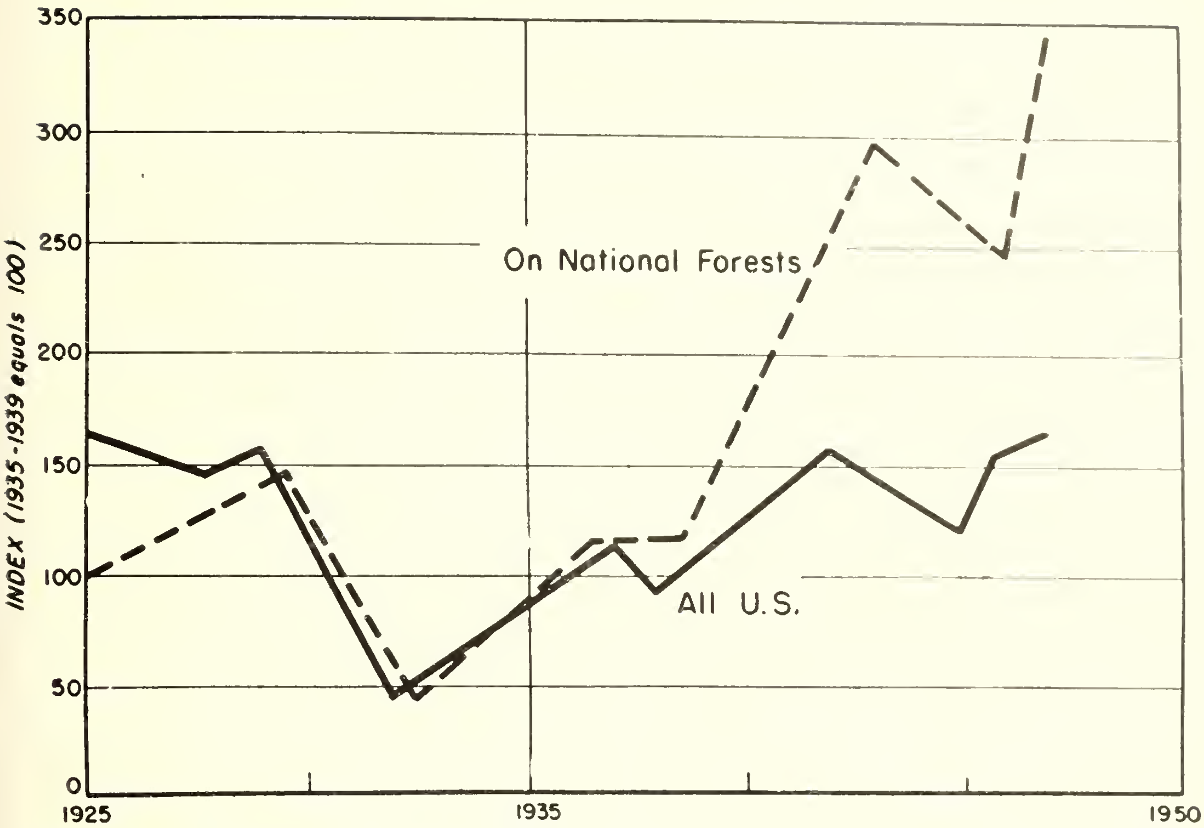

FIGURE 1.—Index of lumber cut in the United States and on national forests.

States, developed a few years ago by G. D. Fox, produced a composite index of use and an index of the number of man-caused fires. These show conclusively that in spite of large population increases and increases in industrial production, the number of man-caused fires has not paralleled increase in use (fig. 2). The fire expectance curve shows what would have been experienced after 1931 if the same relationship between numbers of fires and total use had remained at the ratio which prevailed during the period 1927-31. The large index difference between actual and expected fires indicates very strongly that increased prevention effort did result in a large reduction in man-caused fires in the face of vastly increased use of the national forests.

If the total number of fires prevented from occurring is assumed to be the result of increased prevention effort compared to the period 1927-31, and the cost for suppressing the average size fire that occurred during the 1927-31 period and the value of losses in resources that would otherwise have resulted are known, the savings resulting from this prevention effort, according to Mr. Fox, may be determined.

The annual savings in suppression costs during the period 1942-47 was calculated to be $3,000,000; stumpage value of the timber that did not burn but would have without this increased prevention effort, even with very aggressive suppression action, was estimated at $1,900,000; reforestation costs that would otherwise have been necessary and the growth increment that was saved were valued at approximately $4,400,000. The increased prevention effort that was made to offset the impact of the increased use of the national forests in the eleven western

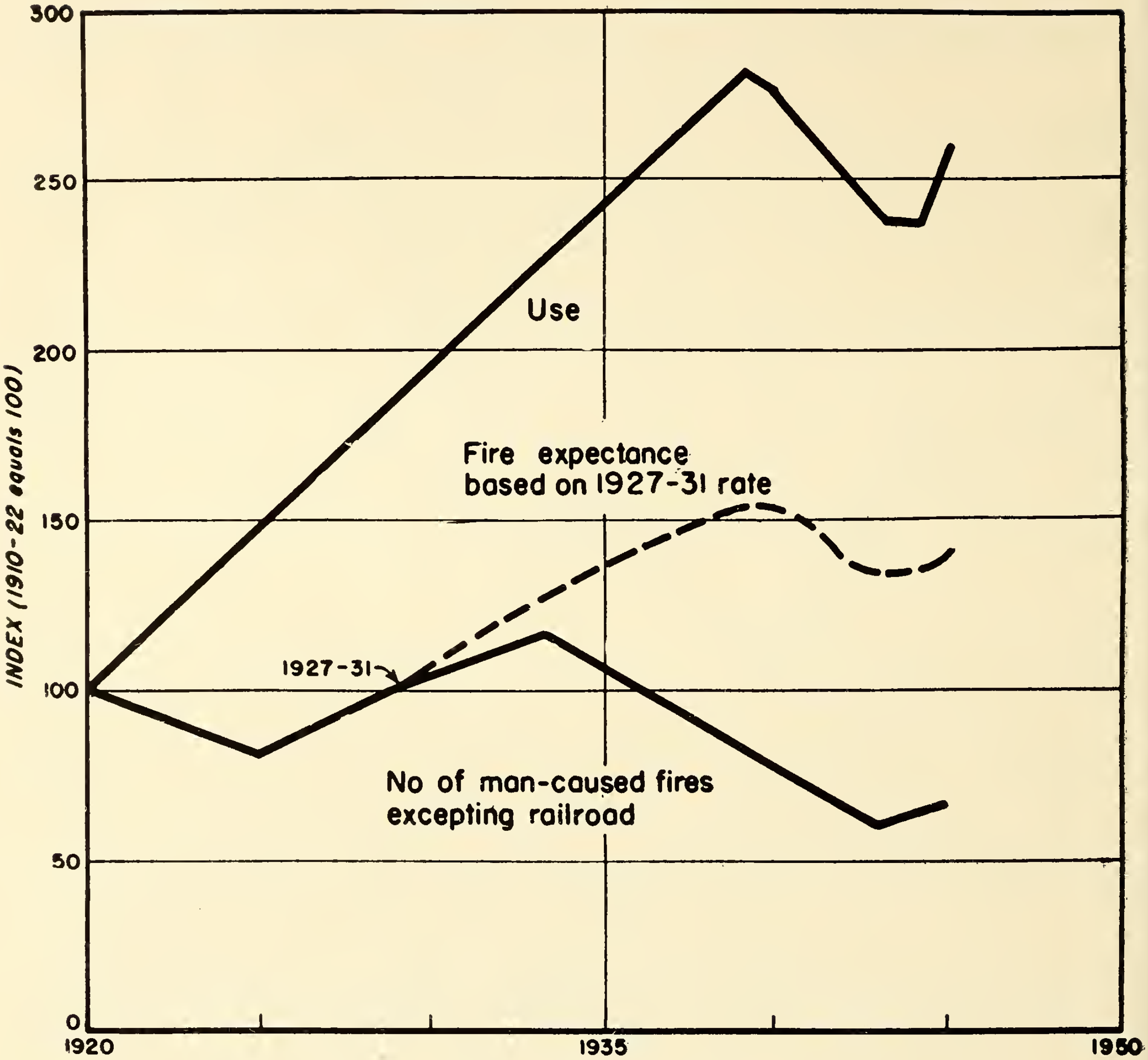

FIGURE 2.—Index of use and index of number of man-caused fires on the national forests of eleven western States (15-year average plotted at middle year; fire expectance based on 1927-31 rate).

States showed a grand total annual saving of about $9,300,000 during the 1942-47 period, exclusive of the value of intangibles.

The foregoing discussion emphasizes that prevention of fires does pay large dividends in suppression funds saved and damages prevented. Although the prevention of fires in the national forests of the eleven western States has more than kept pace with the increased use of those forests, a great deal remains that must be done before the prevention of fires has reached the point of diminishing returns. This is true not only on the national forests but on most all other wild land areas in the United States and Alaska.

This brings up the question of fire prevention plans. Such plans are basic to the intelligent application of effort directed at the problem of man-caused fires in the United States.

Fire Prevention Planning

Primary elements in developing a fire prevention plan for a unit are an analysis of the fire business of the unit and an understanding of the media of prevention.

Analysis of the Fire Business of the Unit

The following information must be available on general and specific causes of fires: Who starts fires; why are fires started; when do fires occur; where are fires being started; what fires are resulting in the excessive damage to resources and high suppression costs.

General and specific causes.—The general causes, other than lightning, usually recognized by most fire protection agencies are:

Railroad—fires resulting from maintenance of rights-of-way or construction or operation of common carrier railroads.

Lumbering—fires, except those caused by smokers, resulting from lumbering operations. (Lumbering operations include all activities connected with the harvesting or processing of wood for use or sale. Lumbering fires include those caused by logging railroads which are not common carriers.)

Campfire—fires resulting from fires started for the purpose of cooking, warming, or providing light by persons camping or traveling on or near wild land, except those started by railroads or lumbering employees in connection with their duties.

Debris Burning—fires resulting from any fires originally set for clearing land for any purpose, or for rubbish, garbage, range, stubble, or meadow burning without intent on the part of the burner to have such fires spread to lands not intended to be burned. (Does not include lumbering fires or hazard reduction on rights-of-way of common carrier railroads.)

Incendiary—fires that in the judgment of the reporting office are deliberately set by anyone with the intention of burning over land or damaging property not owned or controlled by him.

Smoker—fires caused by smokers' matches, or by burning tobacco in any form.

Miscellaneous—fires that cannot be properly classified under any six standard causes listed—does not include fires caused by lightning.

To provide sufficient detail on which to base fire prevention plans each general cause must be further analyzed as to specific cause. The specific causes usually recognized are:

Airplane
Berry-land burning
Blasting
Branding
Burning building
Burning vehicle
Cooking fire
Exhaust
Fireworks
Fuel sparks
Fusee
Glass
Grudge fire
Hot ashes
House or stove flue sparks
Insect or snake control
Job fire
Land clearing
Logging line
Meadow burning
Moonshine
Oil-gas well
Playing with matches
Power line
Pyromania
Range burning
Refuse burning
Repel predatory animals
Right-of-way clearing
Rubbish disposal
Safety strip burn
Slash disposal
Smoking
Smoking bees or game
Spontaneous combustion
Tie disposal
Warming fire

Identification of fires by general cause and appropriate specific cause provides the first inkling of what can be done to prevent fires in the area. For example, if railroad fires are a problem the area of trouble is a narrow strip on each side of the tracks. Specific causes may be fusees, fuel sparks, hot ashes, hot brakeshoes, etc. If most of the fires are started by fusees, what must be done to eliminate such fires can be definitely outlined. The fire prevention measures may involve reduction of hazards along the tracks, installation of an electric block system eliminating in large measure the need for fusees, education of the men in more careful use of fusees, or the development of a new kind of fusee with fewer fire starting characteristics.

Who starts fires.—The class or classes of people responsible for fires can usually be obtained from a study of reports on fires that have started in the area. Classes generally recognized in such analyses are:

Camper	Construction worker	Hunter
Fisherman	Miner	Stockman
Picnicker	Timberman	Farmer
Traveler	Rancher	Other

The fire control manager will then know the people toward whom prevention efforts must be directed. For instance, if deer hunters are starting fires during the period September 16-October 15, the manager, to minimize the chances of fires being started, may initiate such prevention measures as: Registration of all hunters; establishing special prevention patrols in areas frequented by hunters; closing high hazard areas to public use if such authority exists; closing the entire area to public use; delaying the hunting season until weather conditions become more favorable; installation of camping facilities if they are lacking and if such a lack contributes to start of hunter fires.

Why are fires started.—There are three primary reasons why fires are started: Carelessness in the use of fire; poorly designed or poorly maintained equipment, for example, a power saw may cut timber efficiently but the muffler may start fires because of faulty design, or an adequate spark arrester for tractors may be properly designed but the operator may not have replaced it when it has burned out; and intentionally for various reasons such as land clearing, ridding the country of snakes, or paying off a grudge. The more information that is available on the reasons why fires are started the easier it will be to devise methods and programs to prevent fires.

When do fires occur.—The timing of prevention work is important. Records of fires that have started in previous years should be studied to determine when they occurred. This time factor should be correlated with the general and specific causes, the class of people responsible, and the reasons why the fires are starting. For example, if it is known that fires occur along a certain river during May and fishermen are responsible, the fire control manager can arrive at a specific plan of action geared to that time of the year to prevent such fires.

Where are fires being started.—Knowledge of the specific location of the starting points for all fires is essential in fire prevention planning; particularly in relation to areas of special risks. The specific details are used in preparing a fire business map. A planometric map with a scale of ½ inch equals 1 mile is satisfactory as a base. Spotted on this map are the starting points of all man-caused fires that have occurred in the past 5 years. Appropriate symbols can be used to identify those started by lumbering, railroads, campers, debris burning, and the other general causes. As would be expected, fires usually occur with a relatively high frequency in areas of concentrated use and become more widely dispersed as use becomes lighter. The areas of concentration are delineated and numbered and a detailed study of each area is made.

A simple fire business map developed for demonstration purposes is shown in figure 3. Six special risk areas or zones are indicated. The fires in each area are identified as to general and specific causes, who starts them, why they are started, when they are started, and whether damage is great and suppression costly. The analysis is assumed to reveal the following details.

Special Risk Area 1 is along the railroad. All fires are fusee fires caused by rear brakemen throwing the fusees from the rear of moving trains which are slowing down as they approach the town. The brakemen are careless in placement of fusees, and flammable fuels are along the railroad tracks. The fires occur between June 1 and September 30; they are very costly to control and damage has been great.

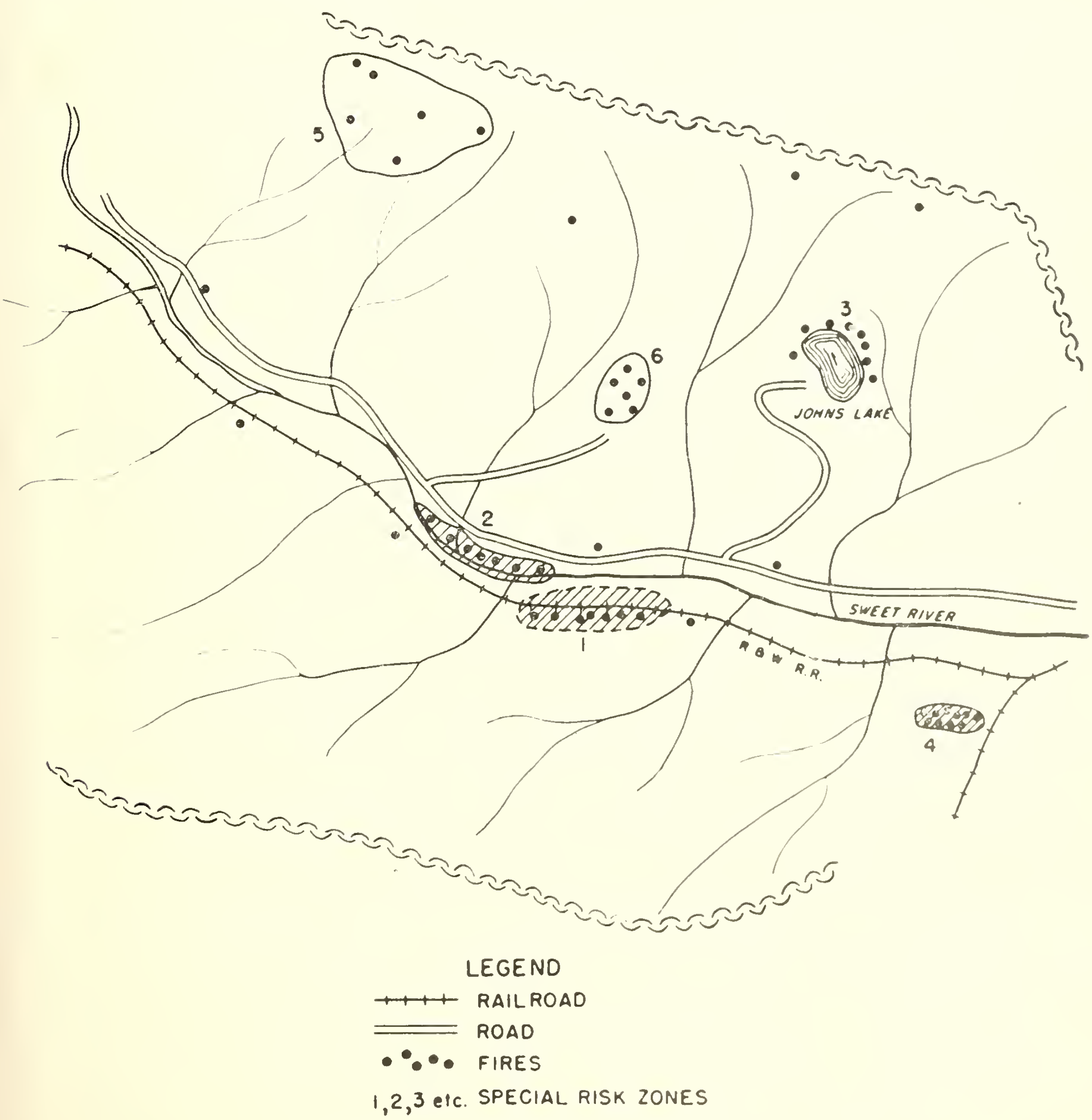

FIGURE 3.—Fire business map.

Special Risk Area 2 is along the river and the normal assumption would be that they are fishermen fires. This cannot be taken for granted; more study is required. The study would show that these fires are not caused by fishermen but by people using the swimming holes in the vicinity. The fires then are warming or cooking fires started by campers from the nearby town. No camping facilities such as stoves or tables are available, and the users are careless. The fires occur during August and up to September 15, and have not been costly to control or damaging.

Special Risk Area 3 is at Johns Lake where 50 percent of the fires are caused by smokers and the other 50 percent by campers smoking fish. No "Smoke Here" signs or other fire prevention material is posted in the area; no spots are designated or facilities provided where fish could be smoked; and the users, people from one of the valley farming areas, are careless. The fires occur from August 1 to September 15, and damage and cost of suppression are heavy.

Special Risk Area 4 is close to town. Ninety percent of the fires are from debris or rubbish burning and the remaining ten percent are miscellaneous, specifically caused by children playing with matches. Neither the town nor the county has an ordinance regulating refuse burning; the people are not watching their debris fires after starting them, and they burn during periods when winds are high and relative humidity low, and children have not been taught the danger of playing with matches. The people starting the fires live in or on the outskirts of the town. Most debris fires occur in May, the rest through the spring, summer, and fall season; the children could set fires any time of the year. Damages and suppression costs are high.

Special Risk Area 5 is high on the mountain and does not involve many fires. All fires are camp fires for cooking and keeping warm, started by careless hunters, usually during the first 10 days of the hunting season (September 16-25). Hunters may camp where they choose as there are no posted hunter camps. Since the fires are in a relatively inaccessible area where values are high and heavy fuels predominate, damage is heavy and suppression costs high.

Special Risk Area 6 is a continuing logging area. Fires are started by loggers operating power saws. Operator carelessness predominates but some fires are started by hot power-saw mufflers coming in contact with moss and other light fuels. Fires occur during July, August, and September, and suppression costs and damage are high.

The fire business map shows about 10 other widely dispersed fires. These should also be analyzed and the information recorded for consideration when final prevention plans are made.

Where are man-caused fires resulting in excessive damages to resources and high suppression costs.—It is extremely important to prevent fires in high hazard areas such as those with heavy logging slash or in other areas where fires usually become difficult and costly to control. Similarly it is very important to prevent fires from starting in or adjacent to areas where values are high. These areas involving high suppression costs and supporting high values must be identified for special consideration in the development of prevention plans. This is usually done by delineating such areas on the maps to be used.

Media of Prevention

After completion of the analysis all the prevention devices and tools that are available and may be applied to the problem should be listed and examined. Special attention should be given to the prevention media or tools that assure the best results in reducing the number of man-caused fires in relation to the amount of energy applied. Prevention media will include the following:

Laws, ordinances, regulations.—A review of applicable laws, ordinances, regulations, or other legal means regulating use and care with fire should be made to explore the probable need for additional legal authority.

Contracts, permits, easements.—All existing contracts, permits, easements, and similar documents regulating operations should be reviewed to determine if they are adequate or additional stipulations are required.

Fire prevention signs.—The public is entitled to know where it may camp, under what conditions smoking is permitted, whether or not fireworks are permitted, and those other laws, ordinances, and regulations regarding the use of and care with fire that can be briefed on signs and posted. Also fire prevention signs are one means of conditioning the public to the dangers inherent in the use of fire. A study of available sign material and additional material required is essential.

Education.—Overcoming carelessness, and ignorance, is the most difficult problem facing control managers since it involves changing the habits of people. It involves such things as getting people to break their matches; use the ash trays of their cars; build camp fires in safe places and put them out before leaving them; burn debris at the right time and with proper preparation; shoot off fireworks away from high hazard areas; clean up flammable debris in and around buildings; etc.

Methods used to overcome carelessness are mass education, group contact, individual contact, and special letters. Mass education may be accomplished through radio programs, television, theaters, press releases, feature articles, displays, posters, and general publicity. The Cooperative Forest Fire Prevention Campaign and the Keep Green programs are excellent examples.

Group contact permits local level contact with many individuals, saves time, and is less costly. It is particularly useful in reaching schools, civic organizations, labor unions, etc.

Individual contact, friendly, planned, and skillfully directed, has proved to be much stronger than the mass education or group contact approach in reaching the miner, local settler, logger, cattleman or herder, construction foreman, resort operator, and other individuals who may be somewhat isolated.

Special letters provide another medium of planned friendly contact in educating people in the need for care in their "use of fire." By such letters the fire control manager can reach the hunter immediately before hunting season, and miners, lumbermen, stockmen, and other users of wild lands at appropriate times.

General and special prevention patrol.—This prevention tool is used extensively in many areas to check on compliance with prevention laws, rules, and regulations. It is ideally suited to fire prevention inspections of summer houses and local residences, woods operations and logging equipment, camp grounds, debris burning, hazard reduction, fishing and hunting areas, group out-of-door celebrations, power lines, construction work, etc.

Law enforcement.—All forest fire laws—Federal, State, county, municipal—must be strictly and impartially enforced. Every man-caused fire should be thoroughly investigated to determine whether or not the fire was the result of any given set of facts or circumstances constituting a trespass against the applicable laws, ordinances, and regulations. Whenever evidence that is deemed acceptable in court identifies the offender, the case should be recommended for prosecution.

Civil liability of trespasser.—The States and the Federal Government have legal rights equal to those of the citizen to recover losses occasioned by injury to its property or enforced expenditures of its funds. Prosecution to recover enforced expenditures and losses to its property where the trespasser is held responsible by the courts is one means of impressing on the public its responsibility for extreme care in the use of fire. Civil liability can be a strong prevention tool.

Closures and restrictions.—Closures and restrictions, where legally authorized, are used extensively to reduce the number of man-caused fires. Such measures involve restrictions as to entry or use. Restrictions as to entry include closure of areas to all forms of public use; closure to entry except under registration or permit; and entry conditioned on the user being equipped with fire fighting tools. Restrictions as to use may prohibit the setting of or use of fire; building a camp fire in an unsafe place; using steam boiler or internal combustion engines unless equipped with approved spark arresters or combination exhaust muffler and spark arrester; disposing of burning material in any place where it may start a fire or discharging of fireworks except in designated areas; possession or use of tracer ammunition.

Application of closures and restrictions involve certain principles. Problems must be identified, necessary measures analyzed, and the most feasible course of action selected. Public support is enlisted by providing full information and publicity—some time in advance if practicable—on why such action is necessary. Careful adjustment of closures and restrictions to both the areas and periods for which they are needed must be made and plans and personnel adequate for effective enforcement provided. Prompt removal of restrictions and closures as soon as changes in burning conditions make it possible is necessary. The public must be notified when closures and restrictions are initiated and when they terminate.

Hazard reduction.—It is recognized that it is impossible to prevent all man-caused fires or to eliminate all the risk. To minimize risk requires the removal of critical hazards (flammable fuels) from the vicinity of the risk. Removal or reduction of fuels in which fires may start is particularly adaptable along railroad and highway rights-of-way; around sawmills and other industrial operations in the forest, towns, summer home tracts, military encampments, camp grounds and picnic areas, and isolated homes in wild land areas; on logging areas through slash disposal and snag felling; and in connection with power lines.

The Fire Prevention Plan

Analysis of the fire business of a unit and a full understanding of the media of prevention set the stage for the preparation of a Fire Prevention Plan. This plan must be specific, not general. It must use the "rifle," not the "shotgun," approach to each specific prevention problem. Specifically it must answer the questions: *What?*—the specific fire prevention job requiring action; *where?*—its location; *how?*—what fire prevention media will be used; *when?*—time prevention work will be done; *who?*—what individual has the primary responsibility for the assigned prevention task; *completion*—some means to indicate the job has been completed and when; and *inspection for compliance.*

The Fire Prevention Plan would involve two principal phases: education of the users of an area to obtain their support for the fire prevention program and to be careful in their use of fire, and specific steps certain individuals, firms, and the agency responsible for fire protection must take to prevent fires from occurring in the area.

Education of the Users of an Area

Education of the users calls for a specific action plan for general fire prevention work that requires definite answers to the seven points listed above as applied to the fire prevention sign plan, radio, television, press, and individual and group contacts.

Preparation of a fire prevention sign plan would involve determining steps to be taken and assigning specific responsibilities for each phase of the work. Necessary steps could include mapping location of signs, selecting type of sign for each location, ordering signs, constructing and establishing sign posts and backboards, setting time standards such as dates for putting signs up and taking them down, and inspecting work.

A similar procedure is followed for radio, press, and television answering the questions what will be done, when will it be done, who will do it, where, how, etc.

Individual contacts are a very important part of any fire prevention plan. Since not all individuals, especially in areas of heavy population, can be contacted personally, careful selection is necessary. These contacts involve: Name of each individual, his chief interest, reason for contact, what will he be contacted about, who shall do it, when should it be done, his reactions, recommendations for future contacts.

The basic principles and the methods of procedure involved in individual contacts can also be applied to group contacts.

Specific Action Plans for Special Risk Areas

The special risk areas determined from analysis of the available information and the fire business map require specific action programs covering the seven points what, where, how, when, who, completion, and inspection. For the section included in the sample fire business map work involved in the special risk areas may be: Area 1.—Hazard reduction by the railroad company along its right-of-way with particular emphasis on this area, and meeting with labor unions, brakemen, and company officials to obtain more care in placement of fusees. Area 2.—Development of camping and picnicking facilities near the swimming holes. Area 3.—Provide facilities for smoking fish, post spots where smoking may be done safely. Area 4.—Special rubbish clean-up campaigns in and around town; and meetings with civic groups to get the townspeople to impress on their children the danger coming from playing with matches. Area 5.—Arranging delay of 10 days in the hunting season to allow for the fall rains that usually occur at that time, limiting camping by hunters to specific camps, and posting areas cautioning hunters to be careful with their camp and warming fires. Area 6.—Examining the timber sale contract to determine if authority is provided to regulate conditions under which power saws may be used; preparing operating rules for power saws; working with the manufacturer toward the design of a muffler that will not start fires.

One system that may be used in briefing the planned prevention work is as follows for two of the special risk areas:

Special Risk Area 1.
- What—Elimination of fusee-caused fires.
- Where—Along railroad right-of-way with specific emphasis on risk area.
- When—By summer of 1953.
- How—Examine stipulations in right-of-way agreement to determine responsibility of railroad company in prevention of fires occurring on right-of-way.
  - When—January 1953.
  - Who—Fire control manager and legal advisor.
- Meet with railroad officials to discuss their responsibility in preventing fusee fires and formulate plans for prevention of such fires.
  - When—January 1953.
  - Who—Fire control manager and legal advisor.
- Meet with union officials and brakemen to obtain their cooperation in preventing fusee fires.
  - When—January 1953.
  - Who—Fire control manager.
- Hazard reduction along right-of-way with particular emphasis on risk area.
  - When—March and April 1953.
  - Who—By and at the expense of railroad company. Technical assistance and inspection by fire control assistant or fire control manager.

Completion—Report of progress and date of completion of hazard reduction work.

Inspection for compliance—Patrolman will check rear brakemen for fusee placement to determine if more care is being followed in the use of fusees. Time: June 10 and 20, July 10 and 20, August 10 and 20, September 10. (Inspection for compliance with stipulations in agreements, permits, etc., is essential.)

Special Risk Area 2.

What—Elimination of camping and cooking fires as causes for fires.

Where—Swimming hole on Sweet River.

How—Survey area to determine what camping facilities are needed.

When—January 1953.

Who—District ranger.

Make plans and schedule construction of facilities.

When—March 1953.

Who—Forest engineer.

Attend town meeting and inform townspeople of improvements to be constructed and why. Also impress upon them the need for their cooperation.

When—April 1953.

Who—Fire control manager.

Press and radio releases.

When—June 15, 1953, and every two weeks thereafter.

Who—Fire control manager.

Post fire prevention signs, in accordance with sign plan, along highway prohibiting camp fires at any other location along river.

When—June 1953.

Who—Patrolman.

Completion—Report on construction of camping facilities on Sweet River.

When—June 1953.

Who—Forest engineer.

Inspection for compliance—Patrolman will inspect area each weekend from July 1 to September 5.

Device for Filing a Double-Bitted Ax in the Field

A safe, simple, and efficient device for filing a double-bitted ax was designed by Harold E. White, Webb Lookout, Olympic National Forest.

This device consists of a 10-inch length of 2 by 4 and a 12-inch piece of wood ¾ by 2 inches. One edge of the 2 by 4 is cut concave to fit the bit of the ax.

The piece of 2 by 4 is nailed to a stump or other flat surface with the concave side down. The ¾-inch piece is placed under the bit to be filed and should project slightly beyond the cutting edge (fig. 1). A nail at each end, approximately 1 foot from the two pieces, will hold the ax in place.

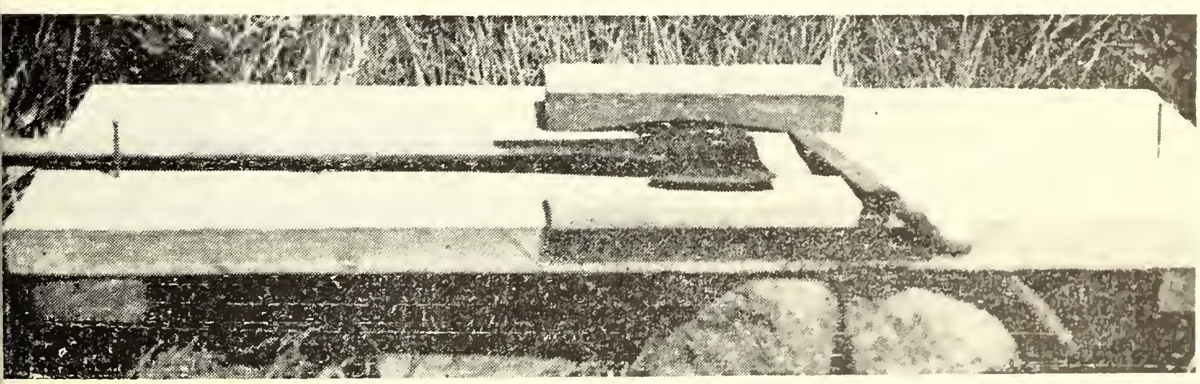

FIGURE 1.—The double-bitted ax in place and ready for filing.

The 2 by 4 prevents the file from going too far and cutting operator's hand. The ¾-inch piece prevents hand from touching ax.

This is a handy device at guard and lookout stations and for field crews where double-bitted axes are used.—W. E. WHEELER, *Fire Staff Assistant, Olympic National Forest.*

FIRE PREVENTION EFFORTS PAY OFF IN THE NORTHEAST [1]

A. W. LINDENMUTH, JR., *Forester, Division of Fire Research, Southeastern Forest Experiment Station,* and J. J. KEETCH, *Forester, Region 7*

The frequency of forest fires in the 13 northeastern States dropped about one-half from 1943 to 1950, exclusive of the effects due to weather. The analysis includes all fires, practically all man-caused, that burned on State and private lands (about 99 percent of the total number of fires in the region) on days when fire danger measurements were made.

The average downward trend and the annual observations from which the trend is determined are shown graphically in figure 1. Each dot represents the annual ratio (called fire frequency) of fire occurrence to fire expectance.

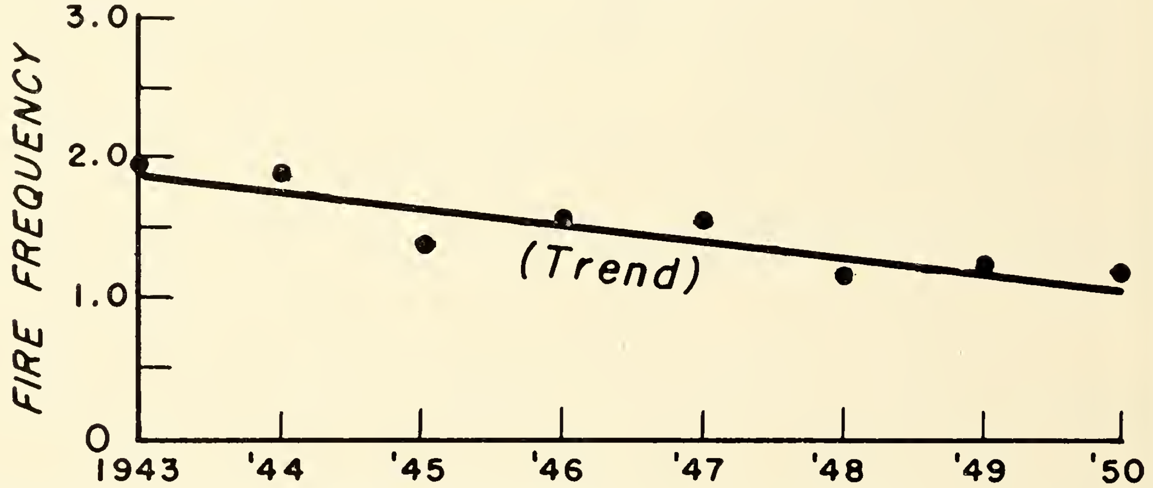

FIGURE 1.—On an average, fire frequency (the ratio of fire occurrence to fire expectance) declined in 13 northeastern States from 1.9 in 1943 to 1.1 in 1950.

Fire occurrence and fire expectance are shown in figure 2. Fire occurrence is the actual number of fires that burn. Fire expectance is a computed number proportional to measured fire danger. The computation is easy in the East where the burning indexes read from the meters are directly proportional to the average number of fires that burn. Burning index is multiplied by a constant (number of fires that burn per unit of burning index) to get fire expectance. Trial constants (number of fires divided by units of burning index) are calculated by seasons for each year during a five-year base period. The data are sorted by seasons, sometimes by months, when seasons and months are closely associated, because the number of hunters, picnickers, and

[1] Also published as Southeastern Forest Experiment Station Research Note No. 12.

other visitors to the forests varies by seasons. The three lowest trial constants out of the five calculated for each season are averaged. This average is the constant used in calculating fire expectance. By calculating the constant in this manner, fire expectance becomes a fire prevention goal. The objective is to reduce fire occurrence to or below the level of fire expectance and to hold it there; that is, to attain and hold a fire frequency of 1.0 or less.

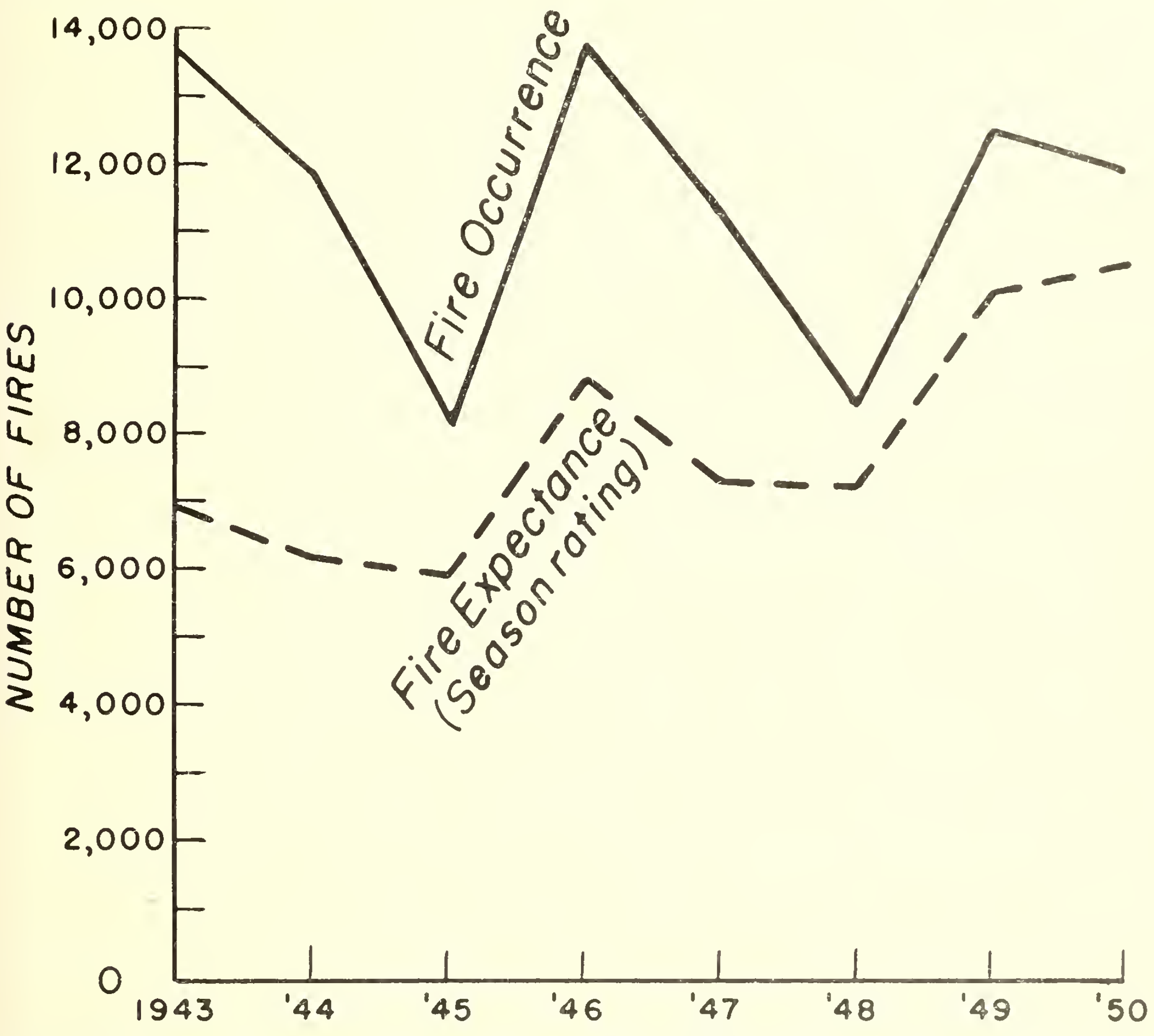

FIGURE 2.—Fire occurrence (the actual number of fires that burn) and fire expectance (a computed number proportional to measured fire danger) vary widely because of influences of weather. This variation can largely be eliminated by transforming these data to fire frequency.

By transforming fire occurrence and fire expectance to fire frequency, the effects of weather are largely eliminated from comparisons between years on the same area, and the error owing to differences in population, fuel types, land use, and other factors in comparisons between areas also is greatly reduced.

The decline in frequency of forest fires is common to most of the 13 northeastern States, particularly during the last 5 years of the period. During the postwar years there was a downward trend in 11 States, very little change in 1, and a moderate increase in another. The decline was sharpest in Kentucky, Pennsylvania, Virginia, Connecticut, and West Virginia, in the order listed.

While the degree of change varies by States, there is no indication that the location of a State affects the trend. There are differences between States because each State places a different amount of emphasis on fire prevention, employs different methods and techniques in preventing fires, and faces different fire prevention problems. However, variations are not extreme, so the data may be pooled to make up a regional picture, as has been done in the figures.

The regional observations form a relatively orderly pattern around the average trend line with small deviations predominating. Hence, it may be inferred with some confidence that the downward trend is a caused effect rather than a happenstance. The most rational explanation in view of no significant population change, particularly no decrease, is that money spent for organized and sustained fire prevention programs is buying a significant reduction in the frequency of forest fires.

What the trend in fire frequency is by causes cannot be inferred with confidence, however. The analysis was not designed to get this information; to get it, each cause would have to be analyzed separately. But some indication of what the answer may be can be obtained by tabulating the percentage of fires attributed to each cause by years and examining the tabulation for trends. From such a tabulation it appears that the frequency of fires decreased in all categories, somewhat sharper than average in the smoker and railroad categories and not so rapidly as the average in the debris burner and camper categories. This suggests that the fire prevention program is eliminating fires from all causes, but it might be profitable to fortify fire prevention efforts directed specifically toward the elimination of debris burner and camper fires.

Chaos by Choice?

"Some of the principles which we are about to discuss call for action which seems to be contrary to human nature. As a whole these principles call for conscious, continuous, and well-organized management and supervisory processes. It is not human nature to be orderly and well organized. Human instincts have to be curbed, human attitudes changed, and human beings inspired in order to bring about orderly and systematic activities on the part of human beings. Furthermore, it is not particularly dramatic to live in a well-organized and orderly fashion. It seems that human beings by nature would rather find themselves in emergencies and then rise to the challenge of those emergencies than carry on their activities in such a way that the possibility of emergencies is reduced. There is much more drama in becoming the hero of an emergency than there is in carrying on our activities in such an orderly fashion that there is no emergency." Excerpt from a talk on Basic Administrative Practice, by Lawrence A. Appley, now president of the American Management Association.

FIRE TOOL BOX MOUNTED ON EQUIPMENT TRAILER

R. N. McCullough

District Ranger, Snoqualmie National Forest

The White River Branch of the Weyerhaeuser Timber Company has developed a heavy trailor unit to carry the necessary fuel and equipment for each tractor side. On top of the tank of this trailer are brackets to which a fire tool box can be bolted during the fire season and where it is not apt to be damaged. In this way

the fire tools are always near at hand and never forgotten at the last landing.

This has proved to be a much more satisfactory way of maintaining good fire tools than handling the box as a separate unit.

FIRE WEATHER FORECASTS

FRED M. FITE

Regional Fire Dispatcher, Region 1, U. S. Forest Service

Special fire weather forecasts can be of great help to the fire boss, and also a money saver, if the fire weather forecaster has the proper information on which to base a forecast, and the officer in charge of the fire will have enough confidence in the forecast to take advantage of that information.

On at least two occasions, to my personal knowledge, while Ralph S. Space was assistant chief in the Region 1 Division of Fire Control, he prepared to backfire in the face of apparently adverse weather conditions. He did this on the strength of special forecasts received, and was very successful. Had he waited until the weather actually changed, it would have been too late to take advantage of the temporary change.

The following is quoted from his report: "Most of the man-power (some 900 men) was concentrated in preparing a close-up flanking attack . . . special weather forecast indicated . . . a southeast wind. Forces were shifted and tactics changed to back-fire preparations . . . the wind changes, lines held, thousands of dollars saved . . ."

All of the fire weather men are just as anxious to give a helping hand with special forecasts as the fire control men should be to receive them. That these two desires do not always dovetail to result in maximum use of the aid meteorologists can give is due to a number of things. Some of these can and should be remedied.

The fire control man should not hesitate to get in touch with the fire weather meteorologist whenever he needs help with respect to weather information. In some areas communications are still very poor, but the forecasts can certainly be worth the price of a few phone calls.

Forecasts are based on a tremendous amount of observational material (radio soundings, pilot balloon observations, and many surface observations) which the meteorologist has at all times. While it is true that sharp localization cannot be made without knowing the exact location of the fire, still there is much information the meteorologist can give to aid fire control management in estimating needs even before the complete details are known. I believe that special forecasts should be asked for as soon as there is knowledge that a fire exists, with the understanding that the meteorologist will give what information he can and that more exact forecasts will be forthcoming as soon as other information can be forwarded to the weather office.

In order for the forecaster to make an accurate special forecast for a given fire, he should have certain information from the area of the fire. Following are some suggestions:

The forecaster should have a thorough understanding of the location, elevation, aspect and steepness of the area. He should also know the approximate size of the fire or area to be burned. If possible, the forecaster should visit the area for any large operation such as broadcast burning, helicopter spraying, etc., before operations begin.

When it is possible to supply the information, weather factors should be measured at a station representative of the area to be covered by special forecast. Use an established fire danger station as a sampling station, if one is available. Otherwise, set up a temporary station and be sure the forecaster is informed of its exact location.

Here in Region 1, whenever it is available, our forecaster would like to receive at 1 p. m. on the day preceding that covered by the forecast, the maximum and minimum temperatures and relative humidity during the preceding 24 hours; the current wet and dry bulb temperatures; wind velocity and direction recorded at noon; plus the current observations of wind directions in the canyon bottoms and across ridges.

The field man should not gain the impression that if weather information is not taken at a specific time that it is of no value to the meteorologist. On the other hand, when an observation is taken, then it is of the utmost importance that the forecaster know when and where it was taken.

Many times a forest officer will go to a fire with only a pocket sling psychometer. If he can take a careful reading of the wet and dry bulb values, and estimate the wind velocity and observe the direction, that information, together with the time and place of observation, should be forwarded to the forecaster, along with the initial request for a fire weather forecast.

If the fire remains uncontrolled and becomes a large project operation, it would be well to set up a weather station on the fire, if there is none nearby located representatively, and proceed to report weather as follows:

At 8 a.m., maximum and minimum temperature preceding 24 hours.

Current dry and wet bulb temperatures.

Sky conditions, together with any change in sky conditions during past 12 hours.

Wind direction and velocity, and location of station. Wind direction and velocity over ridges if that is available, either from a nearby lookout or by estimation.

Maximum humidity during night and minimum humidity yesterday afternoon, if a hygrothermograph is available.

At 4 p.m., current wet and dry bulb temperatures, sky conditions (indicate change, if any, since 8 a.m.), wind direction and velocity at station and across ridges.

For well-defined, small areas, forecasts should hit temperatures with an accuracy of plus or minus 5 degrees, and relative humidities with a plus or minus 5 percent.

Wind is the hardest factor to forecast since it is affected by local conditions. However, the forecaster should be able to predict winds definitely favorable or unfavorable to the planned activity.

Finally, but of great importance, keep the fire weather forecaster informed of how the burn or going fire is progressing and also how his forecasts are meeting the above accuracies. This may seem of little importance to the fire control man, who is working on the fire, but it is of great importance from the forecaster's point of view.

When it is not possible to have the Weather Bureau mobile unit on the fire or project, then it is best to arrange direct communications between the project and the forecaster. Make communications a part of the operation plan to avoid confusion and encourage systematic exchange of information.

Handy Woodpacker

This simple yet convenient device for carrying wood was designed by Harold E. White, Webb Lookout, Olympic National Forest.

To construct the woodpacker mortise a piece of wood 1 by 4 by 23 inches into the middle of the edge of a piece 2 by 6 by 12 inches. A length of chain with about 56 inches of ¼-inch rope is stapled to the 2 by 6 on the edge opposite the mortise. Place the 1 by 4 piece between the front and back canvas of an Alaska type packboard so that the 2 by 6 forms a shelf at the base of the pack board. To prevent the device from coming out between the canvas, a ¼- or ⅜-inch bolt 14 inches long is placed on the under side of the 2 by 6 and through the rings at the bottom of the packboard.

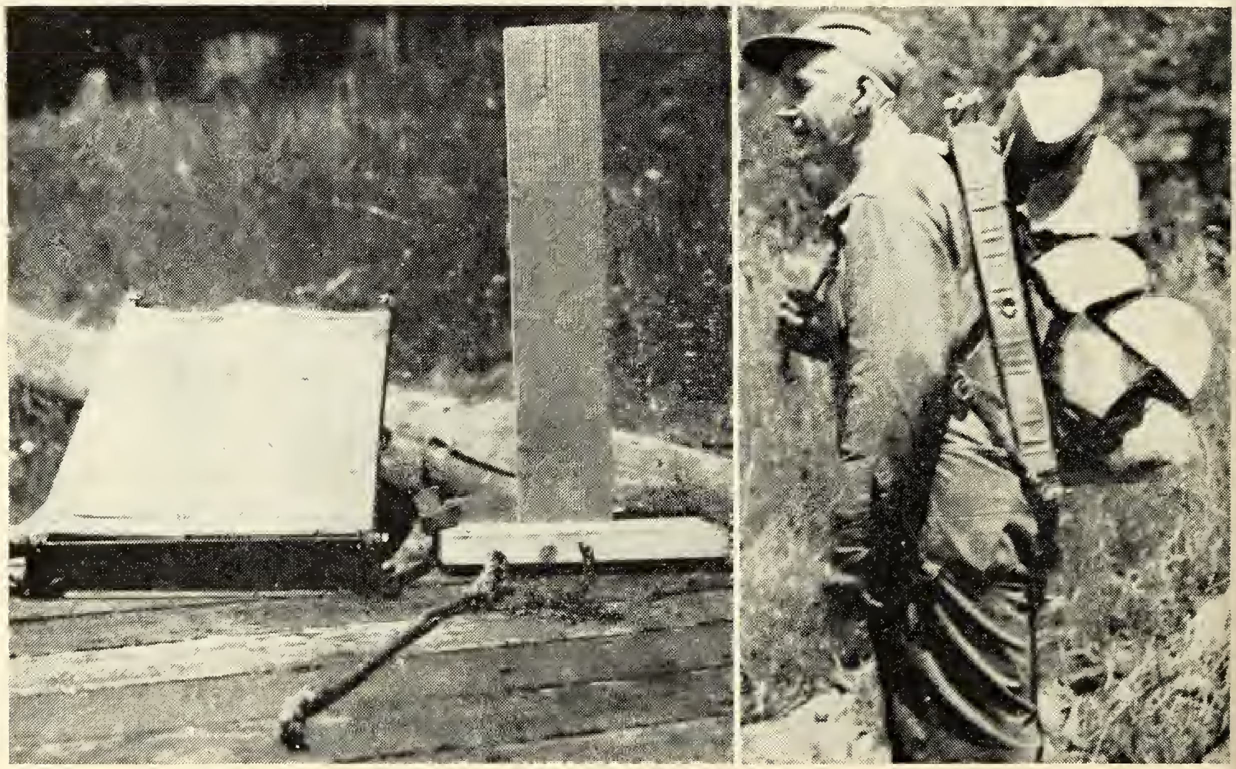

FIGURE 1.—Alaska type packboard showing 14-inch bolt in place; mortised piece with chain and rope; and woodpacker in use.

To load the woodpacker, place it on a stump or log and pile wood on the 2 by 6 shelf with the chain in the clear. When wood reaches the top of the packer, pull chain and rope up over the wood and hold tight while you slip your arms into the packboard straps.

A heavy load of wood can be conveniently packed in this manner. Release the rope to unload and the wood will fall off in the clear.—W. E. WHEELER, *Fire Staff Assistant, Olympic National Forest.*

CHOOSING SUITABLE TIMES FOR PRESCRIBED BURNING IN SOUTHERN NEW JERSEY [1]

S. LITTLE and H. A. SOMES,[2] *Northeastern Forest Experiment Station, U. S. Forest Service,* and J. P. ALLEN, *New Jersey Department of Conservation and Economic Development*

INTRODUCTION

Prescribed burning is useful in managing pine-oak forests in the Pine Region of southern New Jersey. It favors reproduction of pine by preparing suitable seedbeds; it checks the development of hardwood reproduction; and it protects against wild fires by reducing the amount of fuel on the forest floor (*3, 5, 6*).[3]

Prescribed burns are now being used on both State and private lands in southern New Jersey. Foresters select the areas to be treated, map the operations, and suggest other silvicultural practices and improvements (such as roads and firebreaks) to be used in conjunction with the burning treatments. The actual burning is done by trained crews whose wages are paid by the owner. The State Department of Conservation recommends qualified crews, and all burning is done under permits issued by this Department.

The ideal fires for these periodic burning treatments are light (*3*). Usually the flames are so low on upland sites that a man can readily walk through them; the flames generally rise not more than a foot or two above the ground. Such fires do not consume all the fuel, but they lessen the depth of it greatly.

This type of fire should be obtained, if possible, when burning with the wind. Although fires set against the wind have given satisfactory results, they spread more slowly, and are much more costly, than fires set with the wind (*4*). And since upwind fires require drier fuel, they may cause excessive damage if the wind shifts.

Using fire this way as a silvicultural tool is still more an art than a science. Experience and skill are necessary to obtain fires of the desired intensity. The biggest problem of all in using prescribed fires is to choose the suitable time for burning.

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[1] Also published as Station Paper 51 by the Northeastern Forest Experiment Station.

[2] Stationed at the Lebanon Experimental Forest, New Lisbon, N. J., which is maintained by the Northeastern Forest Experiment Station in cooperation with the New Jersey Department of Conservation and Economic Development, Bureau of Forestry, Parks, and Historic Sites.

[3] Italic numbers in parentheses refer to Literature Cited.

Choosing the Proper Time

Choosing the proper time is highly important in getting a satisfactory fire. When fuels are too dry or the wind is too strong, the fire may cause excessive damage. At the other extreme, when fuels are too wet, much time may be wasted. Attempts to burn on unsuitable days have increased the cost of treating certain tracts by as much as 400 percent.

Winter Months are Best

The winter months have been found the best for prescribed burning in southern New Jersey. Suitable conditions are usually found between Christmas and March 1—although in some years they have been found as early as December 1 and as late as March 20.

During this period changes in fuel moisture are relatively slow; so there is less chance that fires will increase greatly in intensity during the burning of a tract. There is also less danger of heat injury to trees during this period. The chance of killing the foliage of young pines is much less when air temperatures are below 50° F. than on warmer days.

However, the number of days suitable for prescribed burning during a winter is limited. During the winter of 1946-47 there were 38 suitable days; the winters of 1947-48 and 1949-50 offered only 20 days each.

Choosing the Right Day

In choosing the right day for making a prescribed-burning treatment, the fire-danger-rating system developed by the U. S. Forest Service for use in the eastern United States (*1*) can be used as a guide.

A word of caution is needed here. One must bear in mind that the fire-danger-rating system was not designed for this purpose. It was designed primarily to help forest-protection workers predict when accidental forest fires are likely to occur during fire seasons.

In prescribed burning, the fire-danger ratings can serve only as rough guides to fire behavior and intensity. They cannot be expected to provide exact measures of burning conditions. Their main usefulness in prescribed burning is in setting the upper and lower limits of probable burning conditions.

In 4 years' experience with prescribed burning in southern New Jersey, successful burns have been made when the danger rating was as low as 3; and safe burns have been made when the danger rating was as high as 30.[4] However, when ratings approach 30, conditions are likely to be too dangerous for burning. The greatest proportion of satisfactory burning days (75 percent) occurred when the danger ratings were between 10 and

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[4] Fuel moisture, wind velocity, condition of the vegetation, and season of the year are the factors used in predicting fire danger. These are integrated on a fire-danger meter, which indicates the danger rating on a 100-point scale.

15. Of all the days that had ratings between 5 and 25, 63 percent were favorable for burning.

Within this range of fire-danger ratings, however, one must rely on judgment and experience to determine local burning conditions. Flammability varies greatly according to many factors, including topography, kind of stand, fuel type, amount of fuel, and past and present weather conditions.

For example, in winters of below-normal precipitation most of the burning has been done at low (5-10) danger ratings, and in winters of above-normal precipitation at higher (10-25) danger ratings.

Effect of weather conditions.—Suitable times for burning when the fire-danger rating is relatively high (20-30) are usually in periods when past precipitation has had a greater effect on natural fuels than the fire-danger measurement indicates. For example, cool moist weather between storms has sometimes caused a difference between fire-danger rating and actual flammability.

Suitable times for burning when the danger rating is very low usually follow periods of higher danger. Then the duff may be dry enough for satisfactory burns, although the measured danger rating is very low because of (1) little wind and (2) the effect of a heavy frost, dew, or light rain or snow.

Effect of fuel type.—Burning conditions in southern New Jersey vary appreciably with the local fuel or forest type. On upland sites, the actual flammability may be lower in pure pine stands than in pure oak stands during the dormant season. This is partly because the pines provide more shade, partly because the pine needles form a more compact and slower-drying litter than oak leaves. Consequently, prescribed fires in several upland tracts have died out, or lessened greatly in intensity, under clumps of pine. Also, on some days when actual flammability was too high for burning oak-pine stands, stands of nearly pure pine could be treated.

Although the open canopies in pine-scrub oak stands permit higher wind velocities and more rapid drying of fuels (2), the actual flammability may sometimes be lower than in oak-pine stands. This is because scrub oak leaves are smaller, form a more compact litter, and provide less duff than black, white, and chestnut oaks. (In these respects scrub oaks are more like southern red and pin oaks.) As a result, some prescribed fires have not burned in spots where 20-year-old scrub oaks formed dense thickets, even though they spread through the arborescent oak areas. And stands of pitch pine and scrub oaks have been successfully treated at times when the flammability was too high for burning oak-pine stands.

Pine swamps have moister soils, usually more open overstories, and more fuel in shrubs and duff. Thus, pine swamps have sometimes been too wet to prescribe-burn, or at other times would burn too hard, when at the same time oak-pine stands have been treated successfully.

Effect of amount of fuel.—In all fuel types, suitable times for prescribed burning vary with the amount of fuel. In areas being treated for the first time the fuel is usually more abundant and more continuous than in previously prescribe-burned areas. Consequently, if the first prescribed fire is to be light, a time must be chosen when much of the lower fuel is too wet to ignite. In contrast, the more frequently and more recently the area has been treated, the less fuel is usually available; then a burn can be made at the higher fire-danger ratings and still produce a light fire.

However, there are some days that provide suitable conditions for both initial burns and reburns. On these days the litter may be dry, underlying duff wet, air temperatures relatively low, and the wind light.

Time of Day

Time of day is important too. Usually burning conditions build up to a peak of severity in the early afternoon. Hence more care has to be taken in firing tracts in the morning than in afternoon or evening, because there is a much greater chance that morning fires may later increase in intensity.

Recommendations

Use of Fire-Danger Ratings

Subject to the cautions that have been pointed out, fire-danger ratings can be used as a rough guide in determining suitable times for prescribed burning as follows:

In oak-pine stands.—Satisfactory burns can probably be made at fire-danger ratings of 10 to 15, sometimes at ratings of 5 to 10 or 15 to 20.

In upland pine stands.—The range of danger ratings on days suitable for burning upland pine stands is similar to the range for oak-pine stands—but more flexible. Sometimes upland pine stands have been burned when fuels in oak-pine stands were too dry for safe burning. Sometimes they have been burned at low danger ratings. Usually these times—as in oak-pine stands—were during or just after a light precipitation that followed a dry period.

In pine-swamp stands.—Danger ratings have been less useful in predicting burning conditions for pine swamps. Satisfactory burns of pine swamps have been made at ratings of 5 to 20. Unsuccessful attempts have been made, because of too-dry fuels, at ratings of 3 and up; and, because of too-wet fuels, at ratings of 25 and less. Only 35 percent of the attempts to burn pine swamps with light prescribed fires have been successful.

Use of Test Fires

A test fire may be used to check actual burning conditions against the fire-danger rating and local fuel conditions.

Usually a small patch of litter in the woods is used. If a carefully placed lighted match will start a fire of slightly less than the desired intensity, then an attempt to burn tracts having similar fuel can be made.

If there is any question about how a fire will behave, the usual procedure is to try first a "backing" fire, changing to a "quartering" fire, and then to a headfire if the behavior of the fire indicates that the change will be satisfactory. Because all of the perimeter of a tract is usually fired anyway, that procedure does not greatly increase the cost of burning. Under proper conditions, the use of both headfire and backfire in a tract does not cause a damaging flare-up when they meet.

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METHODS OF REINFORCING STANDARD 5-GALLON GASOLINE CANS FOR DROPPING

AERIAL EQUIPMENT DEVELOPMENT CENTER

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The Aerial Equipment Development Center at Missoula has completed tests of various methods of reinforcing the standard 5-gallon gasoline can to withstand greater impact without rupture. These cans are used to a large extent for delivery of water to fire fighters by parachute because of their light weight, availability, and reasonable cost. Re-use or return from the fire is not contemplated and therefore any method of reinforcement must be inexpensive and at the same time reduce materially the percentage of loss.

Five-gallon gasoline cans were filled with water and dropped from various heights onto a plank platform to establish the height of the "gallows" from which succeeding drops would be made. This was established at 10 feet, which we believe will provide a sufficient safety margin for free-fall drops from helicopters (requested by the California Region) and reduce materially the failure of cans dropped by parachute. At this height the standard cans suffered almost 100 percent loss when dropped in an upright position. The release mechanism used a quick-release safety-belt buckle with release line attached in order to give uniformity of drop position.

Test drops were conducted in series. Cans were full except in two series of five cans each in which a 1½-inch airspace was left. One can out of five in each of the first six series of tests was dropped on gravel and turf for comparison, but the results showed no significant difference. For information, two drops were made with cans landing on the side, and one drop with friction and adhesive tape to determine if tape with less tensile strength than the filament tape would be satisfactory.

Results of the drops were as follows (figs. 1-3):

Type of protection or reinforcement	*Cans in test (number)*	*Landing position*	*Results*
None	5	Flat	Four cans split at seam 4 to 12 inches; fifth can developed slight leak.
None	5	Corner	Corner crushed in 4 to 6 inches; no leaks.
None [1]	5	Flat	Both seams of four cans and 1 seam of the fifth split 6 inches.
None [1]	5	Corner	Corner crushed in 4 inches; no leaks in three, pinhole leaks in two.
Board pallet (¾-inch) on bottom.	4	Flat	One or both seams ripped 3 to 10 inches; board broken on one can.
Board pallet (¾-inch) on bottom.	1	Corner	Board not broken; no leaks.

Type of protection or reinforcement	Cans in test (number)	Landing position	Results
Boards banded on 4 sides and projecting 3 inches below can bottom.	2	Flat	2 boards broken on each; 1-inch hole in top of one, 4-inch split in seam of other.
Boards banded on 4 sides and projecting 3 inches below can bottom.	3	Corner ..	1 or 2 boards broken; no leaks except small rock puncture in bottom of can dropped on turf.
C-8 (2,900-pound) webbing.	2	Corner ..	No leaks.
C-8 (2,900-pound) webbing.	3	Flat	No leaks in two, hairline leak in seam between webbing in third.
Corded or filament scotch tape, 4 strips 2 inches apart.	3	Flat	No leaks in two; pinhole leak in bottom seam of third.
Corded or filament scotch tape, 6-inch strips ½ inch apart.	3	Flat	No leaks in two; pinhole leak in seam between strips on third.
Corded or filament scotch tape, seams taped solid.	4	Flat	No leaks in three; pinhole leak in bottom seam of fourth.
Seams heavily taped with adhesive.	1	Flat	Both seams split 6 inches.
None	2	Side	1-inch tear, top and bottom corners.
Boarded on 4 sides.	2	Corner ..	Small rock punctures in bottoms, landing on turf.

[1] Cans had 1½-inch airspace, all other cans were full.

From these tests it is apparent that the cans reinforced with the corded scotch tape are the most durable. This method of reinforcement is also the most economical of the various methods tried. Using the ¾-inch tape available the cost per can is approximately 20 cents. No doubt the tape can be secured in 6- or 8-inch widths, and a single square patch with the reinforcing cords placed across the seam of the can will provide still greater protection. The cost of the tape should be materially reduced with purchase of several rolls.

Another factor which affects the distribution of impact forces is the attitude or angle of the can at the instant of impact. Nearly all of the cans which were dropped on one corner withstood the impact without rupturing the seams. Occasionally the crimp in the bottom of the can would develop pinhole leaks. A couple of the cans with smashed corners had microscopic leaks which were not apparent until some time later when the cans were again inspected for loss of water. These pinhole leaks are not considered serious because of the time required for any appreciable amount of water to escape. However, any can dropped should be inspected immediately and placed in position to retain the water, should any leaks have developed.

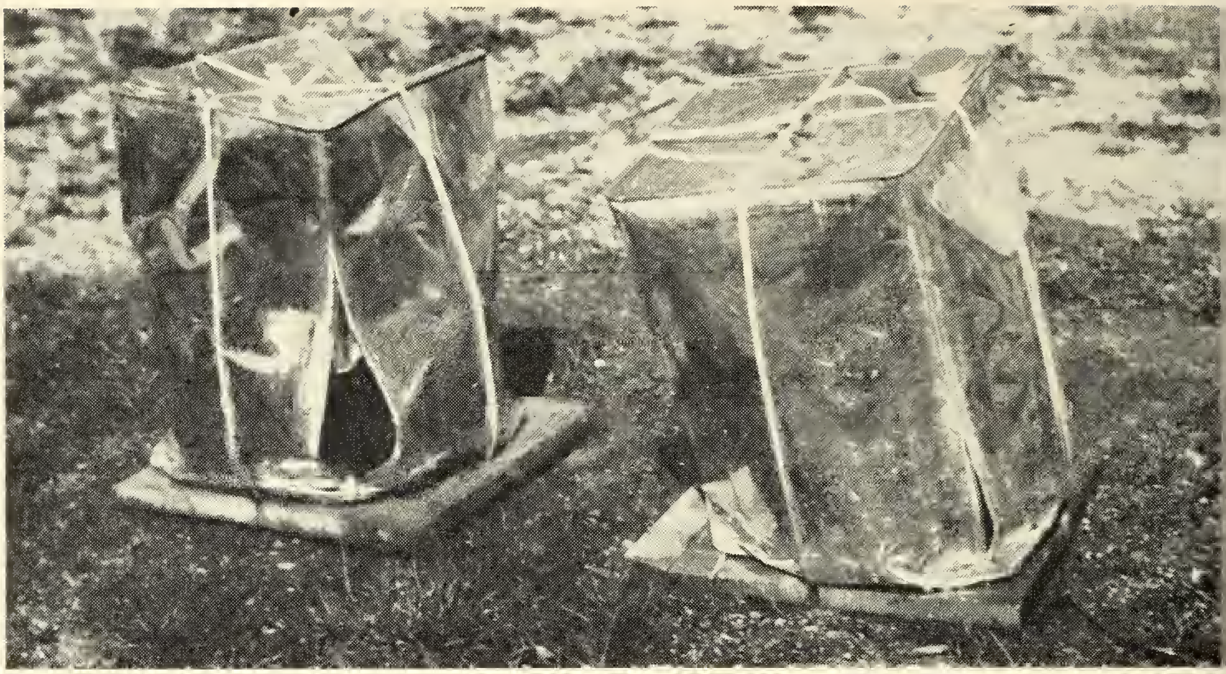

FIGURE 1.—Cans protected by ¾-inch board pallets, dropped flat.

It was reported earlier in the tests that full cans withstood impact better than those with an airspace left at the top. Completed tests do not bear this out since there apparently is little or no difference.

Field tests using four small cargo chutes (rated at 25 pounds maximum load) loaded with full cans, total weight 42 pounds, proved the effectiveness of corded tape reinforcement. The two unprotected cans were a total loss; the two protected cans had no loss of water. However, the use of light parachutes (25-pound capacity) should be given further study under actual operational conditions before final recommendations.

In another test a tape-reinforced can was dropped in a winged cargo box. Water cans dropped previously in this type of container suffered 100 percent loss. On this drop the winged cargo

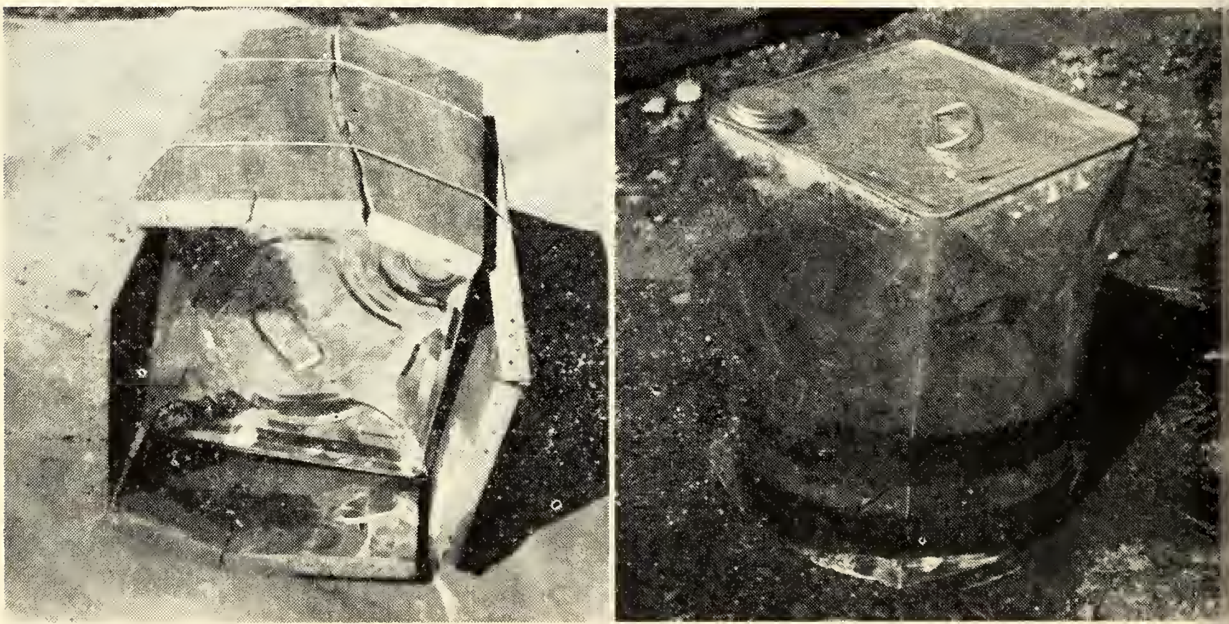

FIGURE 2.—Left, Can protected by ¾-inch boards banded on 4 sides and projecting 3 inches below. Right, Can reinforced with C-8 webbing.

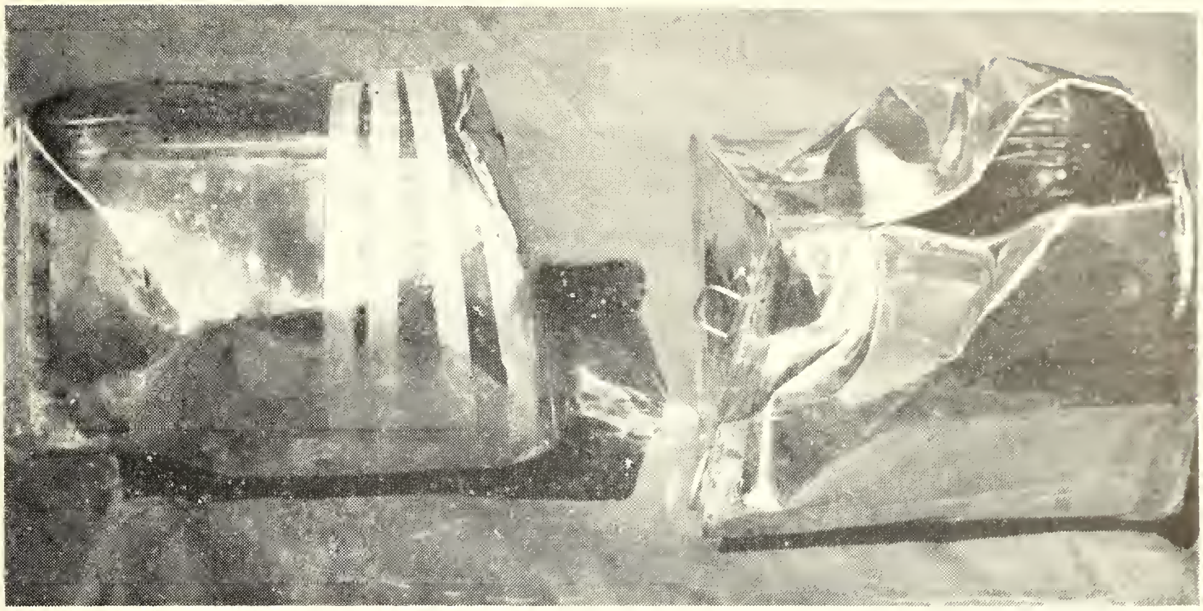

FIGURE 3.—Both cans dropped under identical conditions. Results illustrate strength of filament or corded tape reinforcement.

container functioned well but hit the ground with considerable impact. The water can in the winged container was bulged almost round and a hairline crack was discovered in the seam under the tape. A very slow leak developed, but it is believed a solid sheet of tape would have prevented any loss of water and might even have prevented the hairline crack.

We believe the use of tape for reinforcing the standard 5-gallon gasoline can is sound and economical. The reinforced cans should also serve for free-fall low-elevation (up to 10 feet) dropping from helicopters.

PLANES VS. MULES

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Airplanes over forest fires are becoming a common sight, especially over large fires or fires in inaccessible places. The airplane is, in many instances, replacing the horse for scouting fires and transporting smokechasers, and the mule for supplying isolated fire camps. The question of whether or not cargo dropping can replace the mule in supplying isolated fires is one of the most controversial in fire control circles.

Experience on the Gila Forest in 1951 proved that the airplane is capable of delivering supplies for fire fighters in remote areas and can do the job better than mules. This article will attempt to point out some of the problems involved and will give comparative cost data on one Class D fire. Each method of supply has its advantages—and naturally, disadvantages.

A string of mules can travel day or night, during all kinds of weather, in smoke or clear areas. They can deliver supplies on ridges or in the bottoms of steep winding canyons. However, they must be rested, fed, and watered; their rate of travel is relatively so slow that the camp may be without supplies and suppression action delayed. Also, the pay load per mule is limited.

An airplane can make cargo drop flights only during daylight hours. Strong winds, low clouds or heavy smoke often hamper the drops. The location of the drop area is very important. The ideal drop area is an open space located on a ridge or in a saddle with an approach and take-off course free from surrounding mountains. The plane needs only to be serviced with gas and oil and it is ready for the next trip. The pay load of the plane is governed by its capacity, the altitude and weather conditions, but in nearly all cases is much larger than that for the mule.

The time element, so vital in fire suppression work, is definitely in favor of the airplane. Rush emergency items can be delivered within minutes by plane but by mules delivery would be "too late." The problem of assembling enough pack stock and packers to supply large fires is becoming more difficult each year. This problem increases rapidly with the increase in size of the fire to be supplied. By contrast, cargo planes are available almost overnight for any size fire.

Data from an actual 1952 Class D fire are used here to show relative delivery costs of supplies. The fire started May 31 in a rough, inaccessible area within the Gila Wilderness Area. The route of supply from the supervisor's headquarters (also the source of supply) is 45 miles by road and 12 miles by trail. By plane, it is 80 air miles from the airbase (also a source of supply) to the fire. The first reinforcement of fire fighters arrived at the fire early June 1; the second crew arrived during the day, making a total of 57 men on the fire.

This fire was supplied entirely by air. Food, tools, beds and camp equipment were dropped at the camp the first morning. The plane made three flights to deliver 3,300 pounds of cargo. Total flight time was 6 hours and plane rental was $240 plus pilot and cargo dropper's salaries of $28.08. Disposable mess outfits and one-way cargo chutes were used. Blankets and tools were the only items packed out from the fire. This cost is the same by either method.

If the supplies had been packed in to the fire with mules, the estimated cost is as follows:

Truck mileage (base to end of road) 90 miles @ 25¢ per mile	$ 22.50
Forage cost, 28 head pack and saddle stock:	
Grain, 7 lbs. per animal per day—392 lbs. @ $6/100	23.52
Hay, 20 lbs. per animal per day—1,120 lbs @ $50/ton	28.00
Stock hire, 28 head @ $2.50 per day, 2 days	140.00
Hire of 4 packers, 18 hrs. each @ $1.35 per hr.	97.20
Total [1]	$311.22

[1] Based on four 6-mule strings carrying an average mule load of 168 lbs., 2 days per round trip, and packing forage for two feedings.

The above costs for packing are representative of costs in the Southwest. No estimate is made for either the packers' helpers or the airplane cargo packager, since these costs would be about the same. A comparison of the two costs—by air drop $268.08 and by mule $311.22—shows a definite advantage for the plane. The time of delivery by plane is of course much shorter than by mule, but this time element was not calculated in dollar values.

Experience on the Gila Forest during 1950, 1951, and 1952 has proved that in the future the airplane will in a large measure replace pack mules in suppression of forest fires.

Keeping Ax Handles Tight

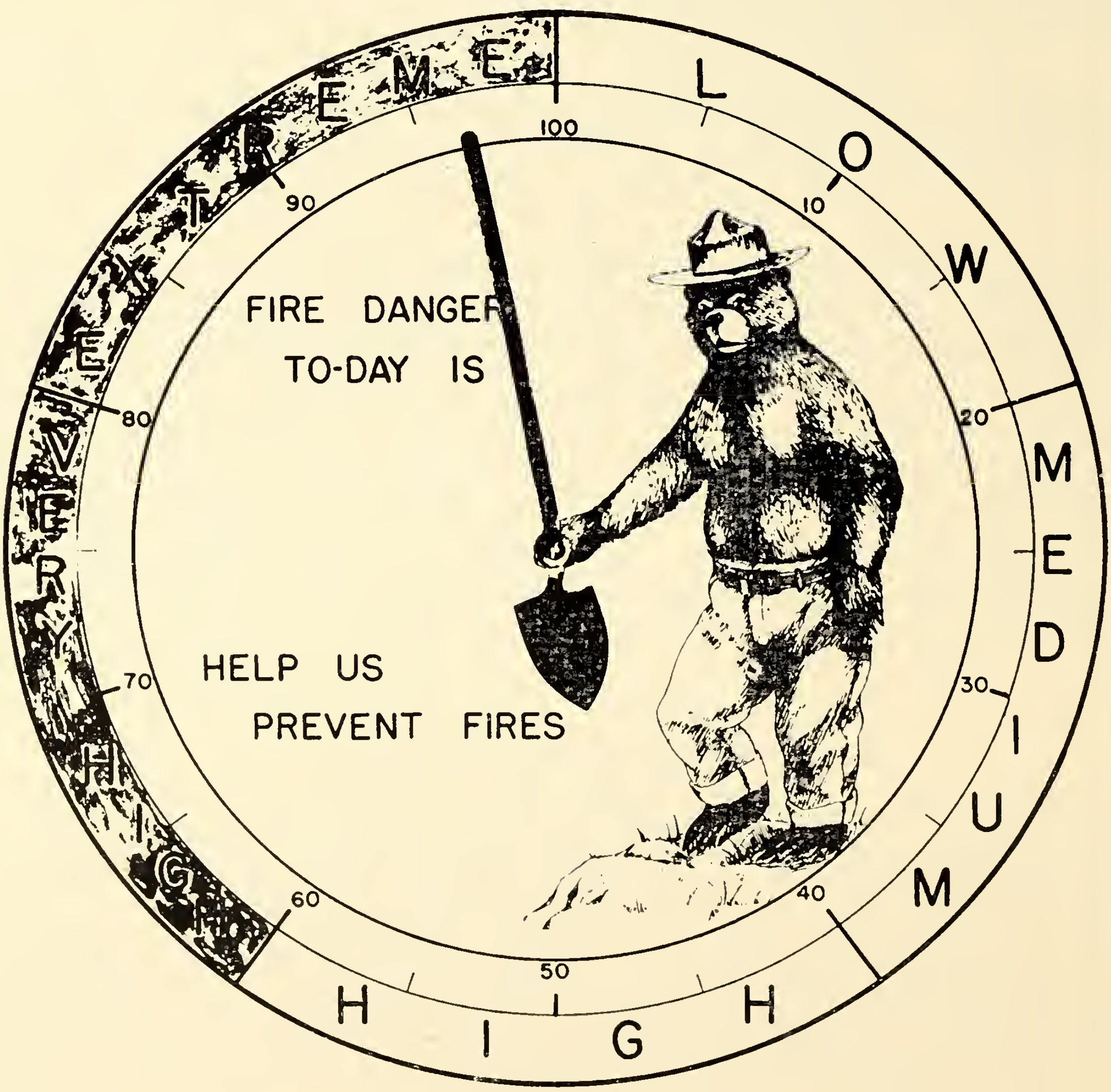
The July 1952 issue of Fire Control Notes contains an article on how to keep ax handles tight (Keep Your Ax Handle Tight, by H. H. Smith and S. P. Burke). When Fire Control Notes was first published, there were two short articles on the same subject (The Loose Axe-Handle Bogey, by F. W. Funke, p. 290, August 1937, and No More Loose Handles, by D. J. Kirkpatrick, p. 24, October 1938). It is recommended that after the handle has been fitted, the head end be dipped in paint, the thicker the better, and the handle then be driven in and wedged. I have used this method in Arizona's hot, dry climate and handles will stay tight in caches. For that matter, so will the woodpile ax, which is subject to all climatic conditions.—I. J. Turney, *District Ranger, Tonto National Forest.*

SMOKEY BEAR FIRE DANGER RATING METER

T. A. PETTIGREW

Central Dispatcher, Trinity National Forest

The Region 5 fire danger rating system is based on rating areas with values running from 0 to 100. The fire danger rating is given in five brackets: low, medium, high, very high, and extreme. In most cases each ranger district is in a different rating area from its neighbor and in some instances there are two rating areas within a ranger district. For example, on the Big Bar Ranger District the extreme fire danger starts at the numeral rating of 65, while the adjoining Hayfork District enters the extreme bracket at 33. This system has always been confusing to our own personnel, especially those going to another district or forest where they had no idea what bracket the fire danger was in when given the numeral rating.



In order to overcome this situation the Trinity National Forest has made a fire danger meter with five brackets each representing 20 points on the numeral rating. On this meter the area average is 40, the division point between medium and high fire dangers; the area base index is 70, the center of very high fire danger. A conversion table was made to convert the standard Region 5 numeral fire danger rating to this new scale. The meter was made twice as large as the regular Region 5 meter for use in public places like post offices, lumber camps, and sawmills. This is a means of keeping the public in general and the lumbering industry in particular informed of the current fire danger.

In order to make the meter attract attention and give it more eye appeal, Billy Lunsford, one of our junior foresters, drew Smokey for us. Smokey's right hand is in the center of the meter so it appears that he is holding the pointer. The shovel pointers are made of acetate or plastic of a suitable thickness. These were cut out on a jigsaw; however, it would be better to have a hobby shop stamp them out. The shovel is 7½ inches in length over-all, the blade and ferrule are covered with copper colored lacquer and the handle is painted red with fingernail polish. It is necessary to buff the clear acetate or plastic before painting it.

An India ink tracing of the poster was drawn; then black and white prints were made. Smokey's pants are colored blue, the hat brown, and the rocks grey or tan. The five brackets of fire danger are also colored. The poster is secured to a piece of ¼-inch plywood. The shovel pointer is fastened in place with a screw through the ferrule and into the plywood back. This screw, when tightened correctly, holds the pointer in any position.

DISPATCHER'S RECORD ON CONCENTRATION OF LIGHTNING FIRES

T. A. PETTIGREW

Central Dispatcher, Trinity National Forest

During widespread thunderstorms, dispatchers have a problem in spotting fires on a map and recording information in some form so all information for any fire can be quickly found. In dispatching for lightning concentrations, especially when the storm causes more than a dozen fires, the standard dispatcher's log book is impractical for recording reported fires and action taken. When it is used, the dispatcher wastes much valuable time trying to determine locations of fires and checking to see what, if any, action has been taken on a given fire. Several years ago the form illustrated here was put in use on the Trinity Forest and it has proved to be satisfactory for recording information for as many as 90 fires from one storm. Brief but complete information is recorded for each fire and can be referred back to in a few seconds.

DATE	NO	NAME	DIST.	DIST. NO.	TIME	REPORTING STA. AND BEARING	SECOND REPORT	THIRD REPORT	LOCATION	ACTION TAKEN	MEN FROM	FOLLOW-UP	LUNCHES OR FOOD SENT	EQUIPMENT NEEDED	TIME CONT.	TIME OUT	REMARKS, RADIO NO., ETC.

When the first lightning fire is reported, the dispatcher at once completes the first seven columns on this form, plus the column headed "Location." This is entered by legal subdivision. As other reports are made on the fire, they are recorded in the proper column, as is the action taken. A pin map is started using push pins with numbers in their tops corresponding with the numbers in the second column of the form. If a fire proves to be a false alarm, the pin is removed and that line on the form crossed out. By a look at the form it can be determined what fires have not been acted on, the ones which are controlled or out, and those which need supplies and follow-up.

The Trinity Forest personnel do not contend that this is the best method of recording action on a concentration of fires, but it is a workable one. It is merely offered with the thought that it might be better than some being used at present.

THE NORTHEASTERN FOREST FIRE PROTECTION COMMISSION

ARTHUR S. HOPKINS, *Executive Secretary*

Notwithstanding the fact that the Northeastern Forest Fire Protection Commission has been operating somewhat less than 3 years, it has already made substantial contributions to forest fire prevention in the seven northeastern States from New York to Maine.

This body was organized under an Interstate Forest Fire Protection Compact approved by Congress on June 25th, 1949, and confirmed by the legislatures of the several States in the region. The present officers are Chairman A. D. Nutting, Forest Commissioner of Maine, and Vice-Chairman W. F. Schreeder, State Forester of Connecticut. The Commission is made up of three members from each State; the State Forester, a member of the Joint Legislative Committee on Interstate Cooperation, and a personal representative of the Governor. The full Commission meets once each year. The planning and training phases are carried on by the Technical Committee which consists of all of the State Foresters. Its purpose, as defined in the Compact, is to promote effective prevention and control of forest fires in the northeastern region of the United States and adjacent areas in Canada by the development of integrated forest fire plans, by the maintenance of adequate forest fire fighting services by the member States, by providing for mutual aid in fighting forest fires, and for procedures that will facilitate such aid, and by the establishment of a central egency to coordinate the services of member States and perform such common services as may seem desirable.

The Compact also specifically mandates each member State to formulate a forest fire protection plan and to integrate such plan with a regional plan to be prepared by the Commission. These State plans are now substantially completed and work is actively in progress in connection with the preparation of the regional plan.

Inasmuch as the forest fire compact idea had its inception shortly after the disastrous Bar Harbor fire of 1947, the mutual aid provisions of the Compact received the greatest emphasis in the beginning. It was most obvious that if the interchange of any personnel was to be made with the most efficiency, a standard overhead organization for use in connection with large or "campaign" fires would be necessary. Such an organization has been set up and a number of training sessions have been held. The training material is worked up by a selected team of personnel from four or five States who act as instructors at an annual training meeting in the winter. At these meetings, key personnel from the several States are given instruction which fits them to act as trainers in their own States. From two to ten men from each State have attended the several training meetings which have been called to date. It is the considered opinion of all the States concerned that this standard training alone has justified the Compact because of its effect on the morale and efficiency of the rank and file of the various forest fire fighting services.

The Commission, in its office, maintains inventories of the trained personnel in the various States as well as the kind and amount of forest fire equipment available for use in a foreign State at times of emergency.

The critical drought of last July and August furnished an example of how the Commission can act in an emergency. For the first time, the mutual aid provisions of the Compact were called into action. On the basis of information received from Maine that several large fires were burning and that no rain had fallen subsequent to the first of July, on the 26th of that month all of the Compact States were alerted and informed that very possibly Maine might require some assistance. Weekly reports were requested from each State as to the accumulated burning index and the number of fires. Contact was maintained with Maine. On August 3rd, Maine reported that there was a possiblity that, because of a high northeasterly wind, several of their large fires might be out of control within 24 hours.

The reports which had been received up to that date indicated that the woods were closed in Maine, the eight eastern counties of Massachusetts, Rhode Island, and the northerly part of New Hampshire, leaving only New York, Vermont, and Connecticut available for assistance. In addition, New Hampshire had a stubborn fire in the northerly part of the State which also presented a possibility of the need for help. The contacts with Maine indicated that, if aid was necessary, it would require only portable pumps and hose. Upon receipt of this information, Connecticut and New York were contacted to determine the quantities of such equipment available for immediate dispatch to Maine.

Early on the morning of August 4th, New Hampshire requested aid, asking for pump operators. This request was referred to Vermont which contacted New Hampshire and made arrangements to furnish such personnel, when necessary, and to stand by New Hampshire. At noon of the same day, Maine formally requested aid. Previous contacts with Connecticut had indicated that it would take them 24 hours to assemble any substantial number of pumps or quantities of hose. New York, however, had a supply available at its Saranac Inn Depot. At 1:15 P. M., Maine was notified that the New York plane was loading five portable pumps and 16,000 feet of hose and would take off from Saranac Inn about 2:30 P. M., arriving at the Old Town Airport in Maine about 4:30 P. M. This schedule was carried out and the equipment requested delivered in approximately 4½ hours. As has been previously stated, this was the first call for assistance made to the Commission. It involved equipment only but had there been the need, trained teams of overhead personnel or individuals could also have been dispatched to Maine's assistance.

The Commission has already prepared and distributed a pocket manual covering the use of radio in the field. It is also at work on the preparation of a forest fire protection manual.

Although the Compact provides that each State shall render aid to the United States Forest Service or to other agencies of the Federal Government in combating, controlling, or preventing forest fires in areas under their jurisdiction located within the boundaries of a signatory State, the Forest Service itself is not a member of the Commission. The Compact does provide, however, that the Commission may request the Forest Service to act as primary research and coordinating agency and that the Service may accept the initial responsibilities in preparing its recommendations for a regional fire plan and also that representatives of the Forest Service may attend meetings of the Commission.

All of the States feel that the provisions, providing for the cooperation of the U. S. Forest Service, are most fortunate. They have already resulted in a much closer working relationship between the several States and the regional Forest Service officers who have given most unstintingly of their time and knowledge. Much of the progress which the Commission has made up to this point is the result of the direct contributions made by the staff of Region 7, particularly Roy W. Olson and Robert F. Collins.

Press-Radio Men Given Fire Coverage Cards

At the suggestion of newspaper and radio men who have become powerful backers of Keep Green, an identification card was evolved this year by Keep Oregon Green to help the newsmen "cover" fire emergencies. The card, signed by state forester and regional forester, asks district wardens and district forest rangers to "see that the bearer is given every courtesy when visiting your fire lines for news coverage."

The card was issued to solve what had been somewhat of a problem, according to the newsmen. They said they had often found it difficult to report fire news because of access restrictions and difficulty in locating someone able to speak with authority on what was going on. The card gets authorized press and radio men through the lines to the men in command.

TEAMWORK ON A FIRE [1]

HORACE B. ROWLAND, *Chief, Division of Protection*
Pennsylvania Department of Forests and Waters

I believe that all of us here will agree that teamwork as we understand it is one of the most indispensable ingredients of good fire control work. We all know what it is. Details may vary a little, but the fundamental idea is that each person involved plays his part for the benefit of the over-all group or job. Personal prominence is set aside.

Perhaps we who are involved in forest fire control have more need for teamwork because so few of us have at our command an organization of our own people who can be directed at our will. Our fire control forces are usually made up of many diverse but cooperating groups. In our State, as in most, we have Federal agencies, the Forest Service and the Park Service. We also have State agencies which in turn depend upon individual fire wardens, fire companies, fire fighters, landowners, and industries.

It is the job of many of us in the supervising agencies to plan for teamwork throughout the year so that when the emergency of a fire does arise we can depend upon the many groups to work together. This teamwork is hard to get on the spur of the moment if we are unfortunate enough to find it lacking on a fire operation.

Teamwork is essential if we are to have any sort of worthwhile organizational planning. This is especially important on any large fire. To staff such a fire we call in those in our organization who might most nearly fill the position in question. This might result in crossing administrative unit lines. We may call in help from adjoining ranger or forest units or cross district lines. We even discuss the possibility of calling help from other States or from the U. S. Forest Service to help State agencies. These things are within the realm of possible action for all of us and might involve the use of men not known to us personally. To make such arrangements work we must all keep teamwork high in our minds whether we are on the receiving end or the giving end.

Back home we plan for teamwork with our fire wardens. These are all independent individuals, who often do not know each other personally. We have training meetings, fire warden schools, winter and preseasonal meetings, picnics for fire wardens and crew members. Regardless of the actual training material one of the primary objectives of all such sessions is that these men get to know one another so that they may work better together if called upon.

We have had occasions where lack of teamwork has resulted in one fire warden undoing the work of another simply because he wanted to go it alone; he was loath to work with another. This man felt he was just as good as the other fellow, and had as much experience. Why should he step aside, and why should he turn over his equipment?

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[1] Taken from a paper presented at the Interagency Fire School, Douthat State Park, Clifton Forge, Va., Sept. 17-18, 1952.

We have cases where landowners or industrial operators have set backfires to protect their own interests rather than to team up with the State agencies in an over-all plan to control a fire. These incidents indicate a lack of teamwork. It has been the job of most fire control agencies to meet these situations and to promote the required teamwork. Fortunately most of this sort of thing is past but it still crops up once in a while much to our embarrassment.

You and I have all seen the evidence of poor teamwork in our own groups, such as reluctance to accept help from other than our organization on its own working territory. We have instances where the hardest decision a warden, inspector, ranger, or even a forester has to make is that he needs help. Many still think that a call for help, even when it is desperately needed, is an admission of weakness or inadequacy on their part. It seems to me the opposite is true. The strong man is not the one who tries to carry through alone because he hates to ask for help but rather the one who sizes up his situation, plans his needs, and asks for the equipment, transportation, or additional manpower that he doesn't possess.

I believe that with all our training in the technique of handling fire, in the strategy of fire control, in the organization of supervisory overhead, we have to continually train our people in the willingness and ability to give and to accept teamwork on the fire line or in the organization. We have to plan our training sessions and conferences and other activities to bring about as much mutual acquaintance and understanding as is possible. This meeting itself is helping prepare the ground for future wholehearted teamwork.

It is true that very few of us have to deal with any wide open cases of failure but I think we all see or have experienced those incidents that represent lack of wholehearted teamwork: The occasional dragging of feet when it comes to helping the other fellow or when called upon to do something out of routine. The hesitancy in leaving our own work to go help with the other job. The quickness with which we take refuge in the urgency of our own work when the suggestion may be in the offing that we go into action for the other fellow. The lack of enthusiasm in taking over part of the other fellow's job. The reluctance in asking for help when such a request might be considered a failure on our part or when the help may come from our neighbor or associate. The alarm at seeing some of our pet equipment being sent to the other fellow. The sudden need to have all our own resources available only for our own possible emergency. The ungracious way in which we accept help sent to us. The attitude that such help is a token of inadequacy. The impression given that we would have gotten along just as well without the help.

These are all samples of the lack of teamwork. Webster says, "Work done by a number of associates, all subordinating personal prominence to the efficiency of the whole,"—is teamwork. We all need it; we can all give it; we all need to cultivate and foster it—it makes for good fire control.

FIRE CONTROL TRAINING IN EASY YEARS

A. R. Cochran
Chief, Fire Control, Region 7, U. S. Forest Service

Severe fuel moisture conditions, high temperature, heavy south wind pressure of turbulent air set the stage for the fire of the decade. Some time during the noon hour while the sawmill crew was off to lunch, the Iron Mountain fire started, presumably caused by undetected fuel sparks from the steam rig. Starting on the south side of Iron Mountain, several miles south of the Holston District of the Jefferson National Forest this fire ripped through State protected territory, and before it was controlled some twenty hours later had burned a swath several miles in length completely killing everything in its path and in many places consuming whole areas of timber. The never-to-be-forgotten date was May 6, 1941. A county survey party working about a half mile above the sawmill site escaped being burned by crawling into the bed of a creek, on which fortunately they were working, until the fire had passed over. An axeman said of Wylie, another axeman in this party, "Wylie were a prayin' and he weren't foolin' either."

The subsequent board of review showed that the ranger and his organization assisted by the State had done an outstanding job in controlling this fire and holding the burned area at a minimum under the conditions which prevailed. This included dispatching manpower, overhead, and equipment to the fire and the organization and servicing on the fire.

The size of the fire, its behavior, and the suppression action by the ranger furnished a good training subject in the annual group training school held the winter following. While a large amount of manpower was used and the cost relatively high, there was little evidence of waste and no one was willing to concede that the job could be done with less manpower unless there was to be a heavy sacrifice in burned area.

Ten years have passed bringing great changes in the availability of manpower and overhead. Gone are the days when trained and experience seasoned CCC and "relief" work crews were to be had for the calling. The decade's end was characterized by excessive costs of labor and supplies for fire fighting—another serious problem for the fire control head. Eight of the ten years have been easy, or relatively easy fire years. Naturally many changes have come in the fire control organization. How would the Iron Mountain fire problem be met today?

This is a practical question to ask, but how could it be made a training opportunity? In the past few years much advance has been made in the field of organizing overhead for fire suppression. Modern radio communication has come into use since 1941—a subject in which training is badly needed. Even the oldtimers need o reflect on tough fire behavior, for the easy years have a lulling effect. The easy years make it difficult to produce real training experience, especially for the younger members of the organization.

The Forest turned once more to the Iron Mountain fire as the most realistic training subject available for the 1952 season.

The Iron Mountain fire offered a good training situation in fire behavior for here is a case of severe fire weather combining with onditions of atmospheric turbulence; the latter being recognized s almost certain to occur each season and in some seasons several imes to produce difficult fire suppression problems.

This fire offered a realistic problem in manning, organizing, nd servicing. For what has happened will certainly happen again. The training problem was to present this excellent training situtation in a realistic manner. One of the obstacles to adequate training is the cost of preparation, for competition with other urgent work is keen. This is a price that must be paid for there are no worth-while bargains or short cuts to adequate preparation. Ranger Ockers of the Holston District provided for the use of hree basic training methods in conducting this school; namely, emonstration, dramatization, and group discussion.

For the demonstration he built a relief model of the area of the ron Mountain fire on a scale of approximately 2 feet to the mile. The model was given a plaster Paris surface treatment so that the uccessive stages of the fire could be painted on and the progress f line construction shown by appropriate painted lines. Time control was maintained by the use of a large dial clock. The relief model was of sufficient size to lend reality to the problem.

A script was prepared for the dramatization of the action that would be taken by the district to suppress the Iron Mountain fire, ssuming conditions and situations of manpower and overhead hat prevail as of today. The pitfall in script writing is to fail to onnect it with reality. The best technical thought and skill must o into this as a dispatching and organization problem, otherwise t becomes a stumbling block to training and may do actual harm. The various stages in the fire's progress are subject to analysis nd group discussion, and it is possible to inject problem solving t any desired stage for the purpose of elaborating on or emphasizing any aspect of the over-all suppression problem. This is ubject to a reality check because the log and review of the riginal fire is available for a reference base any time it is needed.

The ranger having completed adequate and technically competent advance plans for training had laid a good foundation for he next step, that is, to stage the program. For this the use of furniture mart display room was secured which furnished mple well-lighted space for the trainees and the training props. The relief model was placed in the front center of room space. eats were placed in front of the relief model for the fire boss and is staff. Back of the staff seats was placed a large blackboard and asel board facing the trainees. Seats for the trainees were placed in a semicircle facing the ranger and his staff, with the relie model between.

The day preceding the opening of the training session th ranger and his staff ran a rehearsal of the proposed action. It wa also necessary to rehearse the time control and the showing o the progress of the fire and suppression action on the relief mode so that the training props would have maximum value.

The final stage found the ranger and his staff consisting of line boss, a plans chief, and a service chief in their seats with th district dispatcher at a desk some distance removed to simulat action in the ranger's office. The trainees occupied their semi circular seating arrangement. The overhead organization foun its decisions subject to challenge from the trainees, for a technica committee had been appointed from this group with the responsi bility and authority to question decisions made by the overhea organization.

The arrangements had enough connection with reality to com mand the respect and interest of the trainees. The overhead staf was placed in a defensive position and thus was forced to mak the soundest, best-considered decisions possible. At each stag the trainees had an opportunity to enter into a discussion con cerning organization, service, and fire control strategy.

No claim of uniqueness is made for this training setup. It i one answer to one year's fire control training problem. The result were such that it is felt that the problem could be repeated afte an interval of 2 or 3 years if no difficult fire suppression job ha come up in the meanwhile.

Fire Sirens

Here is a suggestion that may be helpful to fire truck driver-operator who must take their trucks over busy highways or other roads where it' necessary to use their sirens extensively. On most fire trucks the sire switch is floor-board mounted, and consists of an ordinary push-to-operat starter switch. Trucks so equipped cause the driver to do a left-footed danc between the clutch pedal and the siren switch at times when the siren i needed most. Some trucks have a dashboard-mounted switch, or a horn button switch. This, however, leaves the driver with only one hand holdin the wheel, which isn't good.

There is a simple, inexpensive solution to this problem. It is a commo headlight dimmer switch mounted in the truck's floor board simply by usin the old starter-type switch mounting holes. No additional wiring is re quired. The switch will easily carry 6-volt loads up to and including 3 amperes. If the siren draws more than that, it's a good idea to install relay.

The wiring for one of these units is simple. There are three binding post on the switch, the center one is usually for the "hot" wire. The other tw are ordinarily for high- and low-beam circuits, and the wire from th switch to siren can be attached to either one of these.

The beauty of this unit is that you can push the switch once, take awa your foot, and the siren will sound off until you touch the switch again. Also, you can keep both hands on the wheel, and you can use the clutc when shifting gears without letting the siren die. This is advantageous, o course, rounding corners, going through intersections, and up and dow hills. It is especially valuable if the truck isn't equipped with a long-roll o coaster-type siren.—CORP. ED PARK, *Dispatcher, Rycom Fire Department, APO* 331, *San Francisco, Calif.*

POWER-SAW OPERATION FIRES

DAN D. ROBINSON

Associate Professor, School of Forestry, Oregon State College

Forest protection personnel have been concerned over the increasing incidence of fires from power chain saw operations.[1] The logging industry in western United States has also recognized the problem but information has been lacking on the specific conditions which cause such fires to start.

Early in 1952 Booth-Kelly Lumber Company of Springfield, Oregon, made a grant to the School of Forestry at Oregon State College to study the problem in the Pacific Coast States and develop recommendations for reducing fire losses from power-saw operations. Results of the study appear in the 1952 issue of The Logger's Handbook published by The Pacific Logging Congress and are summarized here.

Data on fires occurring from operation of power saws during 1950-52 were compiled from all available sources in British Columbia, Washington, Oregon, and California. The specific causes of power-saw fires during felling and bucking operations were as follows:

	Felling fires (number)	*Bucking fires (number)*	*Total*	
			Number	*Percent*
Specific cause:				
Spark or carbon discharge	12	15	27	16
Leaking fuel	6	10	16	10
Spilled fuel	6	10	16	10
Forest fuel contacting hot muffler	35	22	57	33
Hot exhaust	3	16	19	11
Backfiring of motor	1	15	16	10
Loose wiring	0	2	2	1
Miscellaneous	3	11	14	9
Total	66	101	167	100

Total number of fires occurring during the felling operation is disproportionately high because 25 of the 35 fires starting from forest fuel contacting the hot muffler were due to one hazard on one particular make of saw. Where additional information was available the kind of fuel in which fire started can be broken down as follows:

	Fires	
	Number	*Percent*
Kind of fuel:		
Moss	13	11
Sawdust	24	21
Rotten wood	8	7
Duff	27	24
Needles and fine slash	11	9
Pitch	4	3
Bark	7	6
Confined to saw	22	19
Total	116	100

[1] L. L. Colvill and A. B. Everts, Region 6, U. S. Forest Service, studied the problem on national-forest timber sales and reported their findings in An Informal Study of Power-Saw Fires, Fire Control Notes, January 1952.

On the basis of the case histories of the reported fires and ex tensive field observations on numerous logging operations th following precautions are suggested as means of reducing th number of fires from power-saw operations:

1. Use proper mixture of gas and oil as recommended by manufacturer
2. Permit hot saw to cool 2 to 3 minutes before refueling.
3. Refuel saw on a spot cleared to bare ground.
4. Use funnel, or a gas can with flexible metal hose or small screw-o hand pump when refueling saw. Inexpensive hand pumps with flexible neo prene hose are available for this purpose. The pump screws onto the top of standard 2½-gallon gas can and need not be detached until the can is refillec
5. If gas is accidentally spilled on saw, wipe it off with a cloth or allov spilled fuel to evaporate before starting motor.
6. Move saw at least 10 feet from spot of refueling before starting motor
7. Keep outside surfaces of saw clean of oil and fine sawdust. A smal fine wire brush helps to clean cylinder head cooling fins and other inaccessibl surfaces.
8. Clean the carbon from muffler and cylinder ports at least once eac week.
9. Keep muffler on the saw and check frequently for cracks. Vibratio tends to loosen muffler bolts and this causes muffler to crack or break off.
10. Check insulation on spark plug wire and keep connections tight.
11. Check fuel lines and connections frequently for gas leaks. Vibratio tends to loosen fuel line connections and gas tank caps.
12. Avoid running the carburetor on a lean mix. A lean adjustmen causes the motor to overheat rapidly.
13. Do not attempt to operate a saw that is backfiring, missing, or other wise not running properly.
14. Clear flammable material away from saw cut insofar as practicable.
15. Set hot saw on log, stump, or bare ground rather than in dry litte or slash.
16. Check sawdust pile for smouldering embers before moving to next cu
17. Use chisel bit or planer type chain where possible.
18. Keep a filled fire extinguished and a shovel with the power saw. Th extinguisher should be carried on the operator's belt or in his hip pocket. *I should not be strapped on the saw.*
19. Check carbon spark discharge by running saw under full load afte dark or in a dark, well-ventilated room. Carbon spark discharge may b checked on the operation during daylight hours by holding a piece o white blotting paper in the exhaust stream near the muffler port. Ho carbon will burn small black spots on the surface of the blotting paper.

All models and makes of power saws used on western Unite States logging operations were studied and tested in an effort t determine what features were a fire hazard. Tests were conducte under conditions simulating actual woods operation while saw were operating under full load.

The most dangerous fire hazards on the machines are ho mufflers, hot exhaust streams and, to a lesser degree, hot carbo particles discharged in the exhaust stream. Direction of exhaus discharge, location of muffler, and baffling inside the muffler ar factors which may cause accidental fires.

Muffler and exhaust temperatures at muffler port were meas ured on all models of saws while the machines were operating i bucking and felling position. With one exception muffler tempera tures were above 550° F., the approximate ignition point of fores fuel. Maximum muffler surface temperatures on some model reached 1,100° F. Exhaust temperatures at muffler port generall approximated muffler temperatures or were somewhat lower.

A number of starts were obtained by holding dry moss, duff, and fine branches against mufflers while the saws were operating. Several starts were also obtained by setting the machine in dry forest debris after completing a cut. There is a momentary increase in muffler surface temperature immediately after the motor is shut off which increases danger of ignition if the hot saw contacts dry forest fuels.

The field tests definitely established the fact that all makes and models of saws can be a fire hazard. On the basis of these observations a saw should contain the following features to be reasonably safe during summer operation.

1. The muffler should be located at the highest practical position towards the rear end of the saw.
2. The exhaust should discharge to the side and outward parallel with the ground or at a slight upturned angle.
3. The exhaust stream should be broken up by baffle plates or by bouncing the exhaust off the inner walls of the muffler.
4. Mufflers should be double-walled with an air space between walls or should consist of a perforated pipe enclosed by a protective metal shell.
5. An air stream should be forced across the muffler to aid in cooling the surface.
6. Muffler ports should be screened or contain a series of small outlets to break up carbon particles.
7. Surface temperature of mufflers should not be greater than 500° F. under full load.

None of the present models of power saws meet all of these features. Certain engineering problems may prohibit the incorporation of all suggestions on some saws. In the final analysis, certain combinations of the foregoing features on the machines usually determine the degree of hazard.

Carbon sparks are reported as the cause of 16 percent of the reported fires listed in the tabulation. Sixteen of the 27 fires reported from this cause involved mufflers without adequate interior baffling. Three models of saws tested discharged carbon sparks which remained alive after hitting the ground. In each instance the saw had a muffler without baffle plate or screen. Carbon sparks are sometimes blamed for fires which actually start from a hot exhaust stream.

The feasibility of spark arresters was considered. However, weight and space are limiting factors in a practical spark arrester for power saws. The outside surface of the arrester overheats thereby creating a hazard comparable to that of a hot muffler. Carbon spark discharge is negligible from an adequately baffled muffler if the engine is clean and the correct gas and oil mixture is used. It appears to be more practical to use a muffler with adequate baffling and keep the engine clean than to employ spark arresters to reduce carbon discharge.

Fuel leaks and loose wiring in the ignition system have been responsible for some fires. Vibration tends to loosen fuel line connections and spark plug wires. Heavier fuel lines and additional packing material at the connections should reduce leakage. Fuel tanks should be vented to permit control of fuel leaks when saws are operating in vertical or inverted positions. Rubber hoods over spark plugs would reduce danger of sparks from shorts at this point.

The survey and tests conducted on power-saw operation fire hazards indicate that careless operation practices and certain features of the saws are responsible for fires. An intensive education program by public agencies and responsible industry officials is warranted, and modification of certain hazards on the saws should be undertaken.

Keep Oregon Green Pays Off

In 1941 Governor Sprague called public and industrial leaders of Oregon together and declared that if the heavy mantle of smoke which hung over much of western Oregon each summer, caused by destructive forest fires, was to be stopped a public education program to Keep Oregon Green was necessary. This necessity, he said, stemmed from the fact that more and more persons were using our great outdoors for work and play, and that they were more or less ignorant of the cautions that should be observed in the use of fire. As a result of this meeting, the Keep Oregon Green Association was formed for the purpose of making Oregon's citizens aware of their vital stake in their forests and range lands and hence of their responsibility.

Keep Oregon Green is supported entirely by contributions from the logging, lumbering, pulp and paper industries, county courts, associations, business firms, civic clubs, banks, railroads, the State Board of Forestry, and individuals who are interested in helping to reduce the number of man-caused fires in Oregon. Activities are carried on by an executive secretary, a board of trustees of whom Governor Douglas McKay is president, and voluntary workers who make up the 36 county committees.

Headquarters of the association is in Salem, on State Street, in one of the State Forestry Buildings, which is contributed by the Oregon State Board of Forestry. From here material is furnished to county committees, district wardens, forest rangers, civic organizations, schools, and to many others who can make good use of it. This material consists of forest fire prevention posters; decals; place cards; exhibit material for use at fairs, parades, and in window displays; cuts for newspaper advertising; spot radio announcements; calendars; colored slides and films; ash trays; and forest fire prevention plates for use on automobiles and trucks.

The generosity of Oregon's 122 daily and weekly newspapers and 46 radio stations in contributing space to news and editorials on forest fire prevention and thousands of radio spot fire prevention announcements is doing much to reduce the number of man-caused fires. During the season of 1951 there were 1,168 forest fires from the following causes: smokers, 339; logging, 205; slash and debris burning, 164; campers, 127; incendiary, 55; railroads, 33; miscellaneous, 245. If during the month of September no major fires take place and fall rains set in, Oregon will show an amazing reduction of man-caused fires this year despite the relatively dry summer throughout the State. There must be something to account for this. The experts say it is public education with much credit going to the Keep Oregon Green campaign.

One of the most effective jobs done by the association has been the organization of the youth of our State into the Oregon Green Guard. More than 40,000 boys and girls, ages 8 to 16, are members and have taken a pledge to do their utmost to help Keep Oregon Green.

The thinking of the people of Oregon has changed since 1941 and they have acquired a consciousness of fire danger and fire costs. Now a precaution has become something of a crusade, with a crusader spirit that has spread to other timber-growing States.

THINK PROTECTION, TALK PROTECTION, PRACTICE PROTECTION, should be the creed of every citizen.—ALBERT WIESENDANGER, *Executive Secretary, Keep Oregon Green Association, Inc.*

Volume 14 Number 2

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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Forest Service, Washington, D. C.

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STATISTICAL FIRE OCCURRENCE PREDICTION AS A PSYCHOLOGICAL TOOL IN FIRE PREVENTION

F. F. Cameron

Statistician, California Division of Forestry

In 1948, using official census figures and semiofficial intercensus year figures for the State of California as the independent variable, and the numbers of forest and watershed fires on lands protected by the California Division of Forestry for the same years (1933 to 1947, inclusive) as the dependent variable, a linear correlation equation was computed and a high coefficient of positive correlation discovered.

Correlation, in the statistical sense, is a mathematically expressible relationship between two or more numerically definable facts, preferably but not necessarily within the same period in time, which seem to move in like or opposite directions in an organized, and therefore, a predictable manner. The correlation is said to be positive if the components of the series move in like directions, and negative if in opposite directions. The coefficient of correlation is an index moving within the arbitrary limits of plus and minus one, which marks the mathematical degree of the relationship. Plus one indicates perfect positive relationship; minus one, perfect negative relationship; and zero, the absence of any relationship.

The discovery of a high coefficient of positive correlation between the number of forest fires and population suggests that people cause fires. With correlation expressed as a mathematical equation, it may be used to calibrate precise relationships between persons and fires, and, what is more important, to determine, within predefined limits, future relationships between the components of the correlation so that, given a population estimate in the not-too-distant future, the number of forest fires might be computed.

The statistical term for the application of an equation outside the observed limits of the data, i. e., into the future, is extrapolation. Extrapolation is a risky business, and a number of statisticians will have nothing to do with it, preferring to devote their efforts to descriptive statistics. Some statisticians argue, however, that a record of the past is of mighty little value if it cannot be used to determine futurities, and they will fortify their argument by pointing out that even if a few of the conservative statistical principles are violated by extrapolation, a great many sound psychological values accrue in the process; and weighing the loss of one value against the gain of others, they will take what they term the "calculated risk."

Another statistical technique that conservative statisticians avoid is the one known as interpolation. Webster defines interpolation, in the mathematical sense, as "the calculation of intermediate values of a function from observed values according to some assumed law of change in value." The inherent weakness of interpolation as indicated by the definition is, of course, in the word "assumed." That which one statistician will gladly assume in the interests of getting along with his problem, the other statistician will solemnly denounce as unwarranted, unsound, and unwise.

Notwithstanding these warnings a table of 1949 forest fire probabilities was prepared for areas under the protection of the California Division of Forestry, embracing: (1) an extrapolation derived from the equation expressing the average relationship between population and numbers of fires for the prior 15 years as the summation expected; and (2) interpolations on the basis of 6 major administrative units, called districts, for each of the 12 months of the year.

Since it was unnecessary as well as reckless to inform the field of the course that applied statistics was taking in the Fire Control Office, the predictions were not released prior to the fire season. However, as soon as the official figures were compiled, the estimates were compared with them and a remarkable degree of conformity noted.

The over-all prediction, for instance, anticipated 2,453 forest fires during the year. Actually, there were 2,608 such fires during the year, or 155 more than anticipated. However, the over-all figure, or the extrapolation, was not the important figure from a psychological viewpoint. From this point of view, it was the interpolations, or the month by month, district by district figures that were valuable. Since there were 72 such figures, 1 for each of the 12 months for each of the 6 districts, it is impracticable to report the record in detail. However, on the average, each predicted fire-incidence figure missed its actual occurrence counterpart by 12.0 fires.

This isn't too bad from the practical standpoint. In view of the further fact that, on the average, each of the six administrative units for which predictions were prepared is broken into five smaller administrative units, i. e., ranger units, it would be possible to argue that the average "miss" might likewise be broken down to 2.4 fires per ranger unit. From a technical point of view this argument is invalid besides being incapable of proof; but it is cited as an interesting coincidence of that which in point of fact subsequently happened.

The following year a like set of prediction figures was prepared and held in the Fire Control Office for checking against the Ten Day Fire Record when it became available. Again the over-all fire-incidence figure was not too greatly out of line with expectancies, for the record indicated that 2,400 fires broke out as compared with 2,564 anticipated by the chart. The difference, 164 fires, being 6.4 percent of the predicted figure was very like the 6.3-percent differential of the previous year, although in the opposite direction.

Again the primary interest did not center around the over-all differential between the predicted and actual fire-incidence figure but rather around the 72 component differentials that marked the practicability of the interpolations. Here also, however, the table held up rather well—improved in accuracy as a matter of fact—as the average differential was determined to be 9.8 forest fires per district per month.

It was decided in the Fire Control Office that since the trial runs had proved reasonably successful, the fire-prediction program was ready to come out in the open. It was further decided that greater psychological values would develop in a program geared to the smallest selfsustaining administrative unit; i. e., the ranger unit, and the request was made that the prediction figures for 1951 be computed on this basis.

This request raised the number of interpolations from 72 to 360 (30 ranger units x 12 months), but did not, of course, affect the over-all extrapolation. The statistical expectancy in preparing this more detailed table was that percentagewise the differentials would be greater than formerly, but that numerically they would be less. It wasn't seriously expected that the average numerical deviation would approach the postseasonal deviation of 2.4 developed by the unsound techniques previously described, but it was hoped that it wouldn't be too far afield.

In accordance with instructions, the table of 360 predictions was prepared and released by segments to the interested parties in the field. At the time of release a letter was prepared asking the rangers to match their fire records month by month against the segment of the table covering their ranger units, and at the end of the year indicate in letters to the Fire Control Office their personal and organizational reactions to the program.

Before these letters could be received—indeed before they could be written, i. e., in August of 1951—the State Board of Forestry, having been informed of the program, asked for a report on its status as of July 31st. A report was prepared showing that the table of predictions had anticipated 1,168 fires to the end of July and that there had actually been 1,028. It showed also that the average deviation of the 210 interpolations which to that time had been put to the test was 2.2 fires, and that 36 percent of the predictions or 76 of the 210 were "on the nose," that 184 had missed by 5 or fewer fires, and that only 1 had missed the mark by more than 20 fires.

By the end of the year the extrapolated expectancy was 409 fires above the actual record or 15.9 percent. This was largely due to a drastic change in the definition of "forest fire" when we revised our fire report form; approximately 400 refuse and improvement fires, formerly classified as forest fires, were listed separately. However, as before, the major interest centered around the 360 interpolations, the month to month, ranger unit by ranger unit predictions. A tabulation of deviations, signs ignored, appears below. The reader may note that 304 or 84.4 percent of the predictions were within 5 fires of the actual number subsequently to be suppressed by Division of Forestry crews; that 99 percent came within 20 of the expected number; or that 30 percent of the predictions were "on the nose."

Numerical deviation between expected and actual number of Zones 1-2 forest fires, 1951

Numerical deviation	Number of deviations	Numerical deviation	Number of deviations	Numerical deviation	Number of deviations
0	110	9	3	20	2
1	74	10	5	24	2
2	56	11	1	27	1
3	26	12	1	49	1
4	23	15	1	70	1
5	15	16	1		
6	15	17	3	Total	360
7	14	18	1		
8	2	19	2	Average	3.1

It may likewise be noted that there were 2 cases in which the prediction missed the actual number of fires by a wider numerical margin than seems desirable, i. e., 49 and 70; and that these two cases raised the potential average from 2.8 to the 3.1 that is shown. These, to be sure, appear to be serious miscalculations, the more serious since both of the predictions erred on the side of conservatism. In short, twice during the year a ranger's monthly work load was heavier by 49 or 70 fires than he had been led to anticipate, which is just the sort of apparent miscalculation to undermine confidence in statistical prognosis as a practical psychological tool.

The explanation is rather a simple one. The two underestimates fell in the same month—August—in almost contiguous ranger units that suffered an unprecedented number of lightning fires during a protracted storm. It is coincidence, of course, but in the ranger unit in which the predicted number of fires was 49 less than the actual number for that month, there were 45 forest fires started by lightning, whereas in the ranger unit where the underestimate was 70 fires. the actual number of fires started by lightning strikes was also 70.

This experience, however, drew attention to the fact that no system of statistical prediction can anticipate where or when or how many times lightning may strike and start forest fires. Recognizing this, the State Forester recommended that future estimates include only man-caused fires. For this reason, we are now in the happy position to be able to state that to the end of September 1952 not one of the 270 predictions has missed the actual number of fires by more than 18, and that the average miss for the first 9 months of the year stands at 2.5 fires.

Aside from technical arguments as to the soundness of extrapolation and interpolation as statistical tools, the writer maintains that the psychological value of providing a "par" for fire prevention personnel to shoot at is terrific. For in business, as in sports, the American male asks only for a target to shoot at, a par against which to compare his efforts, a challenge to be met. A prediction of the number of fires that an old-time ranger may expect to have in his administrative area, prepared by a white-collar worker in the main office who has never even seen a forest fire, is more than a challenge; it's like waving a red flag in front of a bull. Any ranger worth his salt is going to make a liar out of that statistician if he has to stomp out every fire in his ranger unit personally. And this same statistician submits that even if the red flag is shaky statistics, it is pretty fair country style psychology, harnessed and working like a draft mule for the conservation of our natural resource.

To support this contention, it might be pertinent to quote at random from the flood of letters received in the Fire Control Office in response to the request for comments and criticism of the 1951 fire-prediction program. Among these are the following:

The forecast was considered excellent with respect to forest fires. Considerable interest was aroused and a comparison noted month by month.

As an aid to fire prevention work I would suggest a forecast be made of number of fires by causes.

It is felt that any index which can be perfected and which will assist our unit in fire prevention and fire control strategy is definitely a tremendous asset to our over-all problem. We expressly desire to have an expectancy chart prepared for 1952.

We feel it would be of some value to have this prediction continued as it was found to be quite accurate.

As to the value of these prognostications, I feel compelled to state that while they were interesting I see no real practical value to them.

According to the prediction we were to have 48 forest fires; actually we had 63. . . . In view of these inaccuracies it does not seem worthwhile to make these predictions.

This prediction was very helpful to us and would provide us with a rule of thumb for guidance in planning.

Unless we have a more accurate "guesstimate" than in past seasons the information is not usable.

We believe the prediction chart is useful and of value, especially for an over-all State fire expectancy. However the prediction may vary in various localities due to variations of conditions such as winter rainfall, weather during the summer period, etc., which should be evaluated by the persons responsible in each area and allowances made for these conditions.

And then there was the comment and editorial appearing below which seemed to this writer to catch and utilize the spirit of the whole matter.

The prediction given us for our county was used to very good advantage in fire prevention work. While the prediction and the actual fires did not match up very well, it accomplished the purpose. When we first received the 1951 predictions we gave them to the newspapers. The Sentinel gave us a good writeup on them and offered the people of the county a challenge to cut down the fires from the predicted total. Two or three times during the summer this same paper ran articles of comparison on the actual fires and the predictions. At the end of the year when we gave them the totals we received a very nice writeup as well as an editorial on the entire subject complimenting the public and Forestry for a job well done.

The Sentinel editorial follows:

Congratulations folks, you did it!

You made a liar of the statistician, and if we know the fellow he's right happy about it.

The fellow sat there last year at his office in the State Division of Forestry, looked over the records from this County and predicted 63 forest fires for 1951.

Today he can look at some more figures and find out that he reckoned without the fire prevention work of our rural firemen and the residents of the rural areas. Net results were 33 forest fires; and while this is still 33 too many, it sure knocks the predictions into a cocked hat.

How come? Well the Ranger for the Division of Forestry says that residents and visitors in the rural areas have become more conscious of fire prevention. They gave a little more thought to their cigarette butts, they paid more attention to camp fires and warning signs, they were better organized to combat anything that might turn into a fire, and they did enough housecleaning and firebreak building to reduce the danger. . . .

And that is one of the practical and enduring results of a foray into the field of applied statistics. It may have been launched on shaky statistical grounds, but the psychological weapon was a two-edged sword!

Forest Fire Fighting Training Films

[All film 16 mm. color unless otherwise specified. Information on purchase or loan can be obtained from U. S. Forest Service, Washington 25, D. C.]

Name of film	*Length (minutes)*	*Subject matter*
CARGOING & LOADING (Released 1950.)	20	Packaging and loading techniques for airplane dropping of fire supplies and equipment.
CARGO DROPPING (Released 1950.)	20	How cargo is dropped by parachute from Ford Trimotor and DC-3 airplanes to forest fire crews.
CARGO RETRIEVING (Released 1950.)	21	How to retrieve fire supplies, cargo and parachutes from trees.
SMOKEJUMPERS (Released 1947.)	60	Indoctrination, ground training, and jump training of parachute fire fighters.
THE SAWYERS (Released 1949.)	26	Safety training film on correct and safe use and care of the crosscut saw.
THE AXE MAN (Released 1949.)	21	Safety training film on correct and safe use and care of the double-bitted ax.
TRACTORS AND FIRES (Released 1950.)	20	Use of tractors on fire suppression, emphasizing how they speed up work and save manpower. Utah and Idaho.
FOREST SMOKECHASER (Released 1948.)	25	Follows a smokechaser from the time of sighting a timber smoke until he suppresses it. Fundamentals of suppression tactics, scouting, hot-spotting, line building, and mop-up. Locale of film, ponderosa pine belt in Idaho.
SHOVELS, PULASKIS AND MEN. (Released 1948.)	24	Designed to instruct fire wardens, rangers, and others who are responsible for small fire-crew organization in the "how" of training for fighting small forest and brush fires with hand tools. Utah and Idaho.
FIGHTING LARGE FIRES IN BRUSH & GRASS. (Released 1947.)	26	Shows how a fire boss on a large, fast-moving range fire gathers information, analyzes it, plans his action, and executes the plan. Utah and Idaho.
GRASS AND BRUSH FIRE FIGHTING. (Released 1945.)	26	Shows how volunteer crews are organized and the tools and tactics used in fighting grass and brush fires. Utah and Idaho.
A CAMPAIGN FIRE (Black & White; released 1951.)	35	A film on big fire organization—planning the attack, setting up camps, utilizing overhead, and handling crews. California.

(Continued on p. 19.)

REGION 4's FLASH FUEL BURNING INDEX

J. WAYLAND MATTSSON

Forester, Region 4, U. S. Forest Service

With the large increase of flash fuels in the West after the thirties, particularly of cheatgrass brome, there developed a need for a simple, inexpensive device that would help evaluate fire danger in such fuels. A fairly reliable meter was desired for laymen, which would integrate temperature, humidity, and wind, into a burning index. These three factors could be obtained from local weather bureau stations without the need for establishing additional Forest Service fire-weather stations. Any such meter would serve as a guide only, since its success would depend largely on personal judgment.

During the spring of 1946, A. A. Brown, who was working on special fire control projects, was assigned to Region 4 to go over our fire-danger measurement systems and devise a flash fuel burning index. Again it was emphasized that there was need for a "grass" meter that could be readily used by the southern forests and possibly by all forests where an understory of flash fuels was the main problem.

Since obviously it would be desirable to use only one meter and its ratings throughout the region, Brown first tried to adapt the Region 1 burning index meter, which this region was already using in measuring fuel factors in the Idaho pine belt. The R-1 meter failed to reflect fully the degree of fire danger in grass and brush areas and had a further draw-back in that it required daily readings of fuel moisture by the use of fuel-moisture sticks. Brown found that there was very little data available on which to base danger ratings for cheatgrass and similar fuels but that there was a definite relation between humidity, temperature, conditions of annual vegetation, and wind when the larger brush and grass fires started. He devised a scheme taking into account only these four factors. Experience with cheatgrass and other flash fuels in open country shows that high temperatures play a very important part in producing blow-up conditions and that the effect of wind is more decisive than in timber types. For this reason, wind and temperature were given increased emphasis in the rating.

The steps in obtaining a "grass" danger rating are broken into two parts. The first step uses only humidity and temperature to measure weather factors that affect the dryness of fuel (table 1). The maximum rating for these two factors is 50. This part of the rating is separate from the remainder in order to enable a good-size-up of the potential fire danger independent of wind. Wind is the most variable of all factors and can change drastically in a short time. The best basis then for presuppression arrangements is that of the potentialities represented by the condition of fuels and their moisture content. A strong wind can add an additional 50 points if conditions are otherwise dangerous.

Table 2 shows the additional points for the wind velocity prevailing at any given time. As humidity and fuel moisture increase, wind effect decreases. An illustration of a reading from the tables 1 and 2 follows:

A humidity of 18 with a temperature of 80 will give a fuel rating of 39 from table 1. Referring to table 2, a 5-mile wind will add 18 to make a BI (burning index) of 57; a 10-mile wind gives 71; a 20-mile wind will build it up to 87, a blow-up condition.

TABLE 1.—*Rating for humidity and temperature only, for dry grass in grass, brush, and ponderosa pine types*

Relative humidity	Temperature (° F.)							
	Over 98	91-97	84-90	77-83	70-76	63-69	56-62	Under 56
0-10	50	48	46	43	41	39	37	35
11-15	48	46	44	41	39	37	35	33
16-20	46	43	41	39	37	35	33	31
21-25	43	41	39	36	34	32	30	28
26-30	40	38	36	33	31	29	27	25
31-35	37	35	33	30	28	26	24	22
36-40	33	31	29	26	24	22	20	18
41-50	29	27	25	22	20	18	16	14
51-60	23	21	19	16	14	12	10	8
61 up	15	13	11	8	6	4	2	0

TABLE 2.—*Wind rating values to add to table 1, for dry grass in grass, brush, and ponderosa pine types*

Wind (m.p.h.)	Rating value for a relative humidity of							
	0-20[1]	21-25	26-30	31-35	36-40	41-50	51-60	61 up
0- 2.5	8	7	6	5	5	3	2	1
3- 4	12	11	10	8	7	5	2	1
5- 6	18	16	14	13	11	7	4	2
7- 8	25	23	20	17	13	10	5	3
9-10	32	29	26	22	19	13	6	3
11-12	38	34	30	27	23	15	8	4
13-14	42	38	34	29	25	17	8	4
15-17	46	41	37	32	28	18	9	5
18-20	48	43	38	34	29	19	10	5
21-24	49	44	39	34	29	20	10	5
25 plus	50	45	40	35	30	20	10	5

[1] 100 percent allowance for wind effects for humidities under 20.

To the burning index, obtained above, a judgment factor based on volume, density, and flammability of grass and other fuels must be applied for any particular area. The following series of reminder situations are used as part of the instructions for applying the ratings from the meter. They represent the judgment factor.

1. *Cheatgrass completely cured.*
   a. Dense and continuous enough to carry fire alone. (Full grass BI rating applies.)
   b. Heavy but too broken by less flammable fuels to support continuous spread. (Very flashy, reduced grass BI.)
   c. Too sparse to carry fire alone. (Reduce grass BI to condition of associated fuels.)

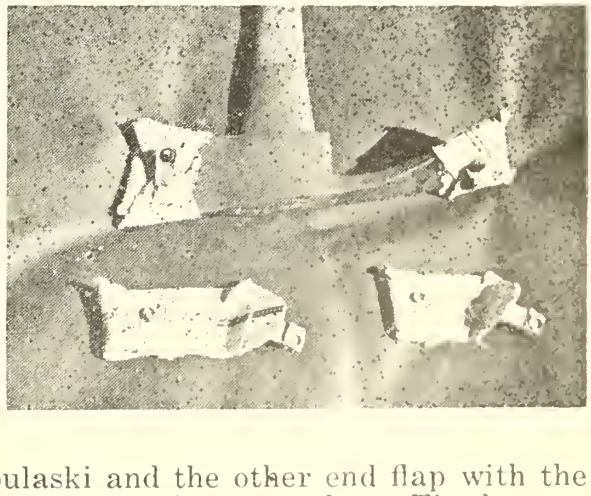
2. *Cheatgrass curing.*
   a. Cured and flammable only on exposed slopes. (Grass BI applies to restricted areas.)
   b. Not cured enough to carry fire alone. (Reduce grass BI to condition of associated fuels.)
3. *Cheatgrass green.*
   (Rate only on basis of other fuels.)

A daily record of the grass burning index is valuable in keeping the personnel of our regional office currently informed of general fire-weather conditions throughout the region. Eleven weather stations broadly representative of the region were selected out of many that report daily to the Hill Air Force Base, Ogden, Utah. This base weather station notifies the regional clerk daily by telephone of humidity, temperature, and wind readings for these selected stations. The information is recorded and the data converted to a general grass BI reading. A glance at the record shows personnel the danger areas, since all BI's over 75 are recorded in red.

After using this grass BI for 5 years, we have found it a good general indicator of serious emergency conditions, a sound fire control planning device, and a reasonably accurate measure of flash fuel danger. The State Foresters of Utah and Nevada are also using this meter and they find that it keeps their people aware of danger trends and helps them evaluate the local fire-weather conditions. In Utah, county sheriffs, who are charged with the fire protection of S&P lands, use it as a guide in issuing burning permits. The Utah State Forester has provided all wardens with a pocket-size card based upon the meter for their use during the fire season.

Snap-On Pulaski Sheath

We in this area, and I am sure others, have had trouble keeping pulaskis properly sheathed. Tom Coski of the Payette National Forest has developed a simple and inexpensive sheath, made of old fire hose, which we feel is the answer to the problem.



The complete pulaski sheath can be constructed from a 17-inch length of 2½-inch unlined fire hose, plus 6½ inches of ¾-inch bungee tape and two snap buttons. Actually there are two individual sheaths, one for the ax and another for the hoe. Both sheaths are made in the same manner except for dimensions.

A length of hose is split along one side and cut to the proper pattern. The middle flap is folded down. The larger end flap with the male part of the snap fastener attached is then folded over and sewed to the middle flap. The sheath is then placed on the pulaski and the other end flap with the bungee and female part of the fastener attached is snapped on. The bungee assures a proper fit and makes the sheath self-adjusting.

When not on a pulaski the two sheaths can be snapped together and placed in a shirt or pants pocket, where they are out of the way and not as likely to be lost as the heavier and more expensive commercial sheaths.

These sheaths are being manufactured at the Smokejumper Parachute Loft, Payette National Forest, McCall, Idaho, and are available for purchase through Procurement and Supply, U. S. Forest Service, Region 4, Ogden, Utah.—REID JACKSON, *Forester, Payette National Forest.*

THE ROLE OF BURNING INDEX IN FIRE-DANGER ESTIMATION

JOHN S. CROSBY

Forester, Central States Forest Experiment Station

The factors that are used to make up a burning index meter rating and the locations at which these factors are measured determine to a large extent how the rating should be used. Meter ratings used in the eastern part of the United States are based on fuel moisture, wind velocity, and condition of vegetation. These factors, which affect the burning of fuels, are integrated to provide a single index number or rating, a burning index. The location of stations and exposure of instruments used in connection with any one meter are standardized to make ratings comparable between stations. Burning index alone is not a complete measure of fire danger. However, if adequately supported, burning index is a good tool for use in estimating total fire danger.

Fire danger is more than burning index. Fire danger may vary from place to place and from season to season even at the same burning index rating because of (1) differences in the general level of fire occurrence; (2) differences in fuel, cover, soils, elevation, topography, and aspect that cause variation in the behavior of fires and difficulty in controlling fires; and (3) differences in the damage that may be done to the resources protected. Daily presuppression organization and planning at the district level must be related to the total fire danger to be most efficient. Although burning index is a good starting point, it must be supplemented by local consideration of these other factors in order to properly rate the fire danger.

Many of these modifying factors can be quantitatively correlated with burning index. This permits more reliable estimates of current fire danger and thereby makes the burning index meter a more valuable tool. For example, an analysis of Lake States data showed that there is a consistent relation between fire occurrence and burning index as rated by the Lake States Burning Index Meter. A preliminary analysis of Missouri data indicates that there is also a correlation of fire occurrence with the ratings of the Central States Meter. An increase in burning index is accompanied by a corresponding increase in the rate of fire occurrence. It can be assumed, then, that an area having generally high fire occurrence will have more fires at any level of burning index than an area where fire occurrence is generally low. This means that at any level of burning index the fire danger is greater on a district that has high fire occurrence than on a district that has generally low fire occurrence. Presuppression activities may have to be organized at a lower burning index on the high occurrence district than on the low occurrence district.

The influence of fuel and cover on fire behavior will affect the danger and must also be estimated. Fire behavior becomes more dynamic as burning index increases, but different fuels, or similar fuels modified by different forest cover, will exhibit different characteristic fire behavior with the same burning index rating. The difference in fire behavior may be explained in two ways. One, the burning index is taken at a standard location which gives a rating that may be higher or lower than the rating obtained under different conditions of cover and position; and, two, there is a real difference in fire behavior resulting from the burning of different kinds, sizes, shapes, and positions of fuels or aggregations of fuels. To illustrate, a study in the Lake States showed that at a given burning index and given wind velocity, rate of spread of fire was greater in open country and open stands than in dense forests, and that light loose fuels permitted higher rates of spread of fire than did heavy fuels. Fire danger may, therefore, differ significantly between districts or parts of the same district, because of different prevailing cover and fuels.

Difficulty of controlling fires and probable damage are also factors of fire danger. In any locality the difficulty of suppressing a fire increases with burning index. In the Northeast,[1] fire damage has been related to burning index. The burning index points the way but does not specifically rate the amount of damage or the difficulty of control. The quantitative relations must be worked out locally in order to use them in the equation of fire danger.

Burning index by itself is an isolated statistic. When it is given meaning in terms of fire occurrence, fire behavior, difficulty of controlling fires, and possible damage, it is a sound basis for estimating fire danger and provides more precise information on which to plan and organize fire control activities.

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[1] FOREST FIRE DAMAGE APPRAISAL PROCEDURES AND TABLES FOR THE NORTHEAST. A. W. LINDENMUTH, JR., J. J. KEETCH, AND RALPH M. NELSON. Sta. Paper 11. Southeast Forest Exp. Sta., Asheville, N. C. 1951.

Combination Wheel Chock and Jack Block

Have you ever attempted to use a truck jack whose lifting height was insufficient and there was nothing at hand to shim under it? A wheel chock, recommended as safety equipment on all tank trucks, can serve a dual purpose and compensate for this deficiency.

Rear axles of many vehicles are of such a height that the provided jack will not raise the wheel sufficiently to allow for a tire change. The chock not only eliminates this problem but offers greater stability when elevating a vehicle on loose earth or gravel, and better leverage for operating the handle. The chock is of simple design. It is a 6- by 8-inch block of wood, 12 inches long, and sawed at a 45° angle. Metal stripping around the edges precludes splintering, and an attached pull rope makes for ease of handling.—D. C. BIEDEBACH, *Fire Crew Foreman, Angeles National Forest.*

MECHANICAL TRAIL TRANSPORTATION

Lawrence A. Waggener, Jr.

Equipment Inspector, Division of Engineering, Region 6, U. S. Forest Service

With the completion of several "mechanized" trails, that is, trails specifically designed for use by mechanical trail equipment, mechanical trail transportation is being used to advantage in several locations in Region 6. However, builders of these trails have unintentionally been responsible for the defeat, in part, of the program they were endeavoring to exploit. Limited attention was given to advance location. In many cases no emphasis was placed on this very important part of trail planning and construction.

What are the results? The most common are steep grades often occurring in unfavorable soil conditions, unnecessary adverse grades, switch-backs that are costly to construct, and poor drainage.

Much has been said about tractors and other machinery used in the construction of these trails. In the past, efforts have been directed toward design and construction of this equipment while transportation units such as the trail "mule" and the scooter have not received sufficient attention.

The primary purpose of a "mechanized" trail is to provide fast, efficient transportation of men and equipment to remote areas for the suppression of fires. We are learning rapidly that this transportation can be used effectively and economically in many other activities, such as engineering and timber management.

It was known that some transportation vehicle was needed, and experiments were made with several special trail trucks of varying design. While these carried desirable loads, handled well, and furnished good traction, their lack of maneuverability on switchbacks, etc., made them unsuitable. This brought about the trail "mule." Its design enables it to negotiate extremely short radius turns with little difficulty (fig. 1).

The trail "mule" is somewhat intricate in design but simple to operate. It does have limitations. It requires reasonable footing—a relatively compact and smooth tread of dirt or gravel—and moderate gradients. These should be held to sustained grades averaging 10 percent with occasional short pitches of 15 percent. The latter should be allowed only where advance location determines such practice necessary. Under these conditions the "mule" will average satisfactorily 8 to 10 m. p. h. with a near-capacity load.

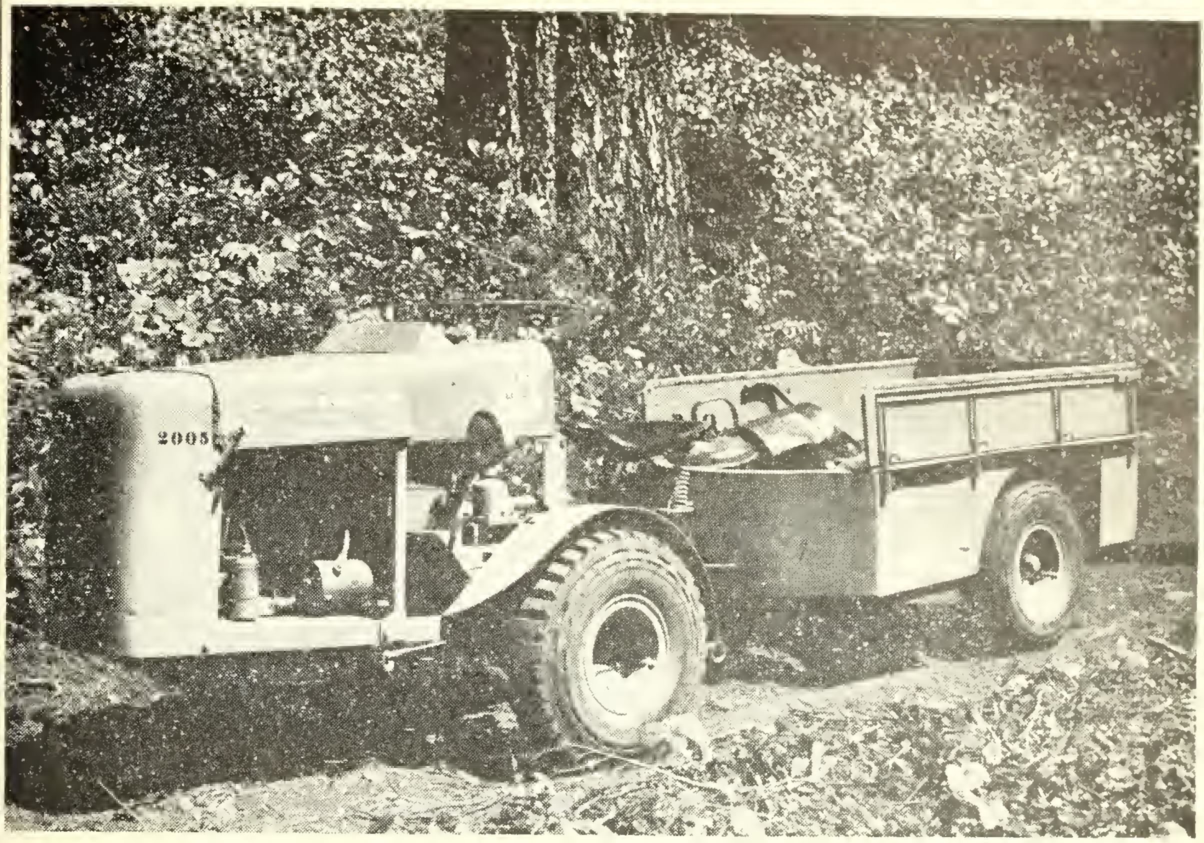


FIGURE 1.—The trail "mule" can climb grades of up to 10 percent, short pitches up to 15 percent, at speeds of 8 to 10 miles per hour. Four or five men can ride in the trailer.

The scooter (fig. 2) requires similar trail conditions. It provides speedy transportation for one rider and miscellaneous gear. For both vehicles highway travel between headquarters and trail ends is practical where distances are reasonable.

Originally, an attempt was made to smooth the tread of a trail by back-blading with a tractor-trailbuilder. The results were not satisfactory. Drags and a drawbar type grader were employed next. With the advent of the trail patrol grader (fig. 3) in 1949 the problem of properly conditioning the trail for vehicle travel was accomplished more satisfactorily. It enables the operator to install ditches and dips, turnpike fill sections, and provide a smooth tread. This use has improved greatly the performance of the trail "mule." Higher speed, smoother ride, less operator fatigue, and reduced mechanical breakdown are the results. In addition, proper use of the grader has conditioned trails to withstand the elements of weather, erosion, etc., reducing maintenance problems and costs significantly.

Some Forest Service officials have argued that value received from a "mechanized" trail system will not offset its higher construction cost. Like a truck trail, it must be engineered if it is to be adequate. However, field personnel that use these trails have learned that lookouts can be serviced faster and at less cost than by using pack stock. Foot travel over them requires less effort, and if fire crews must travel afoot, they are less tired and more ready to go to work upon arrival.

FIGURE 2.—The trail scooter provides rapid one-man transportation when trails are constructed on reasonable gradients.

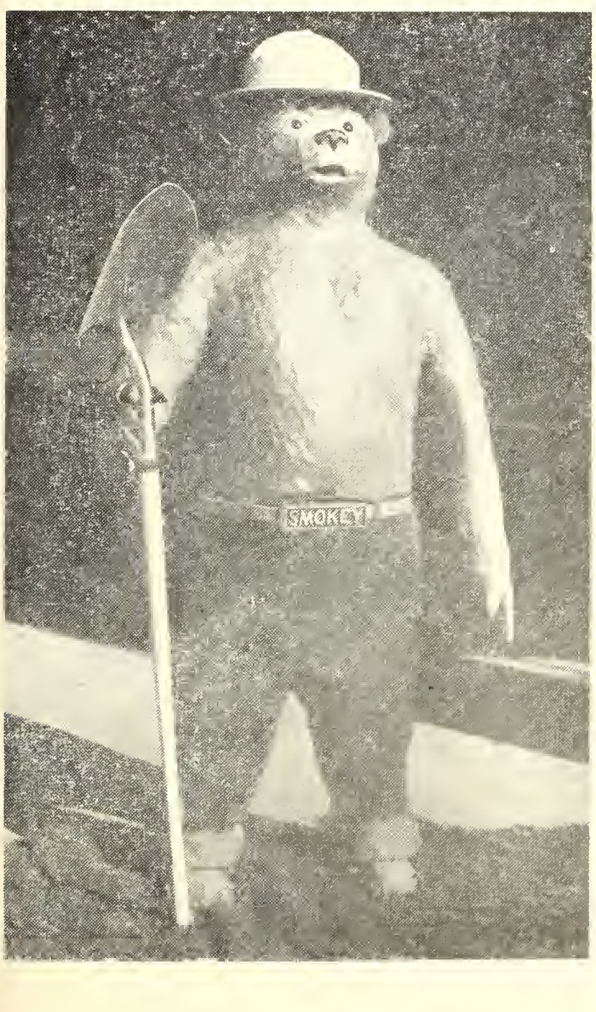
FIGURE 3.—The secret to mechanized trail maintenance is the trail patrol grader.

Administrators have learned that these trails have other uses. While their primary purpose is in fire suppression, one supervisor forecasts that the trails will more than pay for themselves while timber cruising, road location, and sale activities are underway. Use of the trail and equipment for transporting crews will eliminate costly camps and much slow foot travel which would mean, in this heavily timbered and rugged terrain, saving a considerable sum. He further prophesies that a future road to replace the trail will frequently follow the trail location, thereby reducing clearing and burning costs appreciably.

"Mechanized" trails as an avenue of rapid access to remote areas are a reality. Their potential has yet to be appreciated. Because of higher costs of construction, however, they should be built only where speed and long-term economy offer a decided advantage to the Government. Administrators should be encouraged to consider these trails rather than shy away from them when determining means of access to back country areas. This is especially true where travel is essential but major improvements or roads will be slow in development.

Life-Size Paper Smokey Bear

A cheap, effective Smokey Bear was made by forest personnel on the Mendocino and used during the past season on floats in parades and at County Fairs. Smokey is especially effective in drawing the attention of children. The Smokey Bear pictured here is about 5 feet 6 inches high, has a 56-inch waist, and weighs about 45 pounds. He cost about $12 and the material used was as follows:



Base framework.—2 1- by 4-inch uprights passing through body from feet to shoulders; they pass through 2 ¾-inch plywood boards at waist and chest, cut to shape body.

Feet.—2 by 4's, 14 inches long.

Shoulders.—A 1 by 4-inch.

Arms.—2 by 4's.

Head.—¾-inch plywood outline nailed to shoulder frame.

Hat brim.—¼-inch plywood; crown shaped from plywood and wire.

Covering for framework.—¼-inch mesh chicken wire, crimped and shaped.

Covering from waist up.—Newspapers soaked in paste made from ½ cup paperhanger's glue and 3 gallons of water.

Eyes.—Glass.

Finishing.—Spanish brown water paint with some black enamel brushed on lightly to give impression of hair. Nose, black enamel and white paint.

Hands.—Cotton gloves.

Overalls.—56-inch stock.

J. N. EWING, *Forest Engineer, Mendocino National Forest.*

TIME CLOCKS ON LOOKOUT RADIO EQUIPMENT

JOHN W. MCKEEHAN

Communications Technician, Stanislaus National Forest

Until 1946 a telephone system installed in the early 1930's was the main source of communication between the lookouts and the fire dispatcher of the Stanislaus National Forest. Since then a radio network has been developed which provides communication with mobile units in the field as well as with the fixed ranger stations and fire dispatcher. Of eleven manned lookouts nine are provided with dry battery-operated radio equipment; the other two use telephone. It has been forest policy to have the lookout operator keep the radio on during his normal working time of 8 to 10 hours each day. Should he detect a fire at night he can always turn on the radio and report it, but should the dispatcher receive a report of a fire it has been impossible for him to reach the lookout by radio.

The radio network has become the primary source of communication and yet it has been necessary to maintain the telephone system in order to reach the lookouts when their receivers are not operating. It was felt that the additional expense of operating the radio 24 hours a day was not justified in the occasional need for calling a lookout.

The age of the telephone system has necessitated higher costs of maintenance, and much of the line is due for reconstruction. Because of the primary use of the radio network, large expenditures for telephone maintenance and reconstruction are more difficult to justify.

It was felt that if some means could be devised to communicate with the lookout at night without the heavy battery drain caused by having the receiver on all night, it would be possible to eliminate some of the telephone line. It was decided to incorporate in the lookout radio system a time clock which provided for automatically turning on the radio receiver each hour for 5 minutes, then turning it off. In this way anyone desiring to communicate with the lookout at night could do so during the 5 minutes when his receiver was energized. Once called the lookout could switch over to continuous operation for any period.

After considerable search a time clock was located which could be modified to accomplish the desired operation. The clock will run for 30 days on one winding, is accurate to 5 minutes per month, and while designed to control an electrical circuit once a day, could be modified for hourly operation.

Using this method it may be necessary to wait as long as 55 minutes to reach the lookout but this must be weighed against the additional battery expense of 24-hour operation. With the time clock the increase in battery consumption is approximately 18 percent more than that of the normal 8-hour day as compared with some 200 percent if the receiver is left on continuously.

It was determined that substantial savings could be effected if five of the eleven lookouts were equipped with the clocks. The others had telephone lines which could be easily maintained or were not equipped with radio. Two of the five lookouts had separate sleeping quarters on the ground and required the installation of remote controls from the radio equipment in the towers. The other three had the sleeping quarters in the towers.

Five clocks were modified and each equipped with a switch to select either periodic or continuous operation. Adapting cables and wiring were designed so that a clock could be inserted in the radio wiring system without modifying the basic equipment (Type T model D). A pilot light installed on the clock gave the lookout a visual indication of when the clock operated the system. This is so the operator can have his radio turned on and still report to the dispatcher the time of the hour that the clock would operate.

These clocks were installed during May and June 1952 and have been in use all season. The dispatcher makes a weekly check of the "clock time" from each lookout and this record serves the dual purpose of furnishing him with the exact time he should call a particular lookout at night and giving the radio technician a record of clock performance. The fire control assistants of each district were made responsible for winding and setting the clocks. This year all clocks were set to operate on the hour, but next year a plan of setting clocks by areas or districts is to be tried. The thought is that then only one area or district can be called without awakening all lookouts.

The operation for the first year has been very successful and each time a lookout was wanted he was reached without difficulty. Next year it is planned to install additional clocks in lookouts and to extend their use to mobile units at guard stations by placing an extension speaker in the sleeping quarters and having the clock turn on the mobile receiver.

Fire-Weather Division Activated in Shreveport

A full-time Fire-Weather Division was activated by the Shreveport office of the U. S. Weather Bureau on March 1, according to State Forester James E. Mixon of Louisiana. The division will interpret hourly weather information into fire-weather forecasts for the benefit of forestry agencies in Louisiana, Texas, Oklahoma, Arkansas, and Mississippi.

Mixon said that this service has been furnished Texas since 1948 and has proved valuable to State foresters in planning fire operations. Daily fire-weather forecasts by the Shreveport office were initiated in Louisiana during the October emergency and have been continued. Personnel who have had experience in this type of reporting will be transferred to Shreveport from stations in the North and West.

The State Forester praised the action taken by the bureau as "another example of cooperation between government agencies" to solve a difficult problem. He said that the information, which is phoned twice daily to the commission office in Baton Rouge, is transmitted by radio to every tower in the State.—Ed. Kerr, *Press Representative, Louisiana Forestry Commission.*

BATTERY BOXES FOR TF AND MOTOROLA REPEATERS

FRANCIS W. WOODS

Communications Officer, Region 4, U. S. Forest Service

Two years ago it became apparent that something should be done to simplify the battery replacement problem on dry battery-operated repeaters. Equipment was being damaged when batteries were replaced, and too much of the radio technician's time was taken each spring to make the reinstallations.

It was decided to build a heavy duty battery box and to use No. 6 cells for both A and B supply on the receivers. The new box was to have a spring arrangement in the lid wired so that the lookout or anyone could simply open the box and place the proper number of No. 6 cells. Then when the lid was closed the batteries would be properly wired and would not have to be oriented.

The first battery box designed was similar to the old SPF kit box, but it wasn't satisfactory because the lid was so wide that it bowed up slightly, causing loose connections. John Barkdull, Boise technician, redesigned the battery box, using 3/4-inch plywood for all but the top spacer which is $\frac{3}{8}$-inch plywood (fig. 1). A spring had been designed earlier for two outside contacts, and a die made to punch the spring. Barkdull, in redesigning, made two inside contacts by cutting one on the outside. The die, which cost approximately $250, is the property of the Forest Service and is available for use anywhere in the Service.

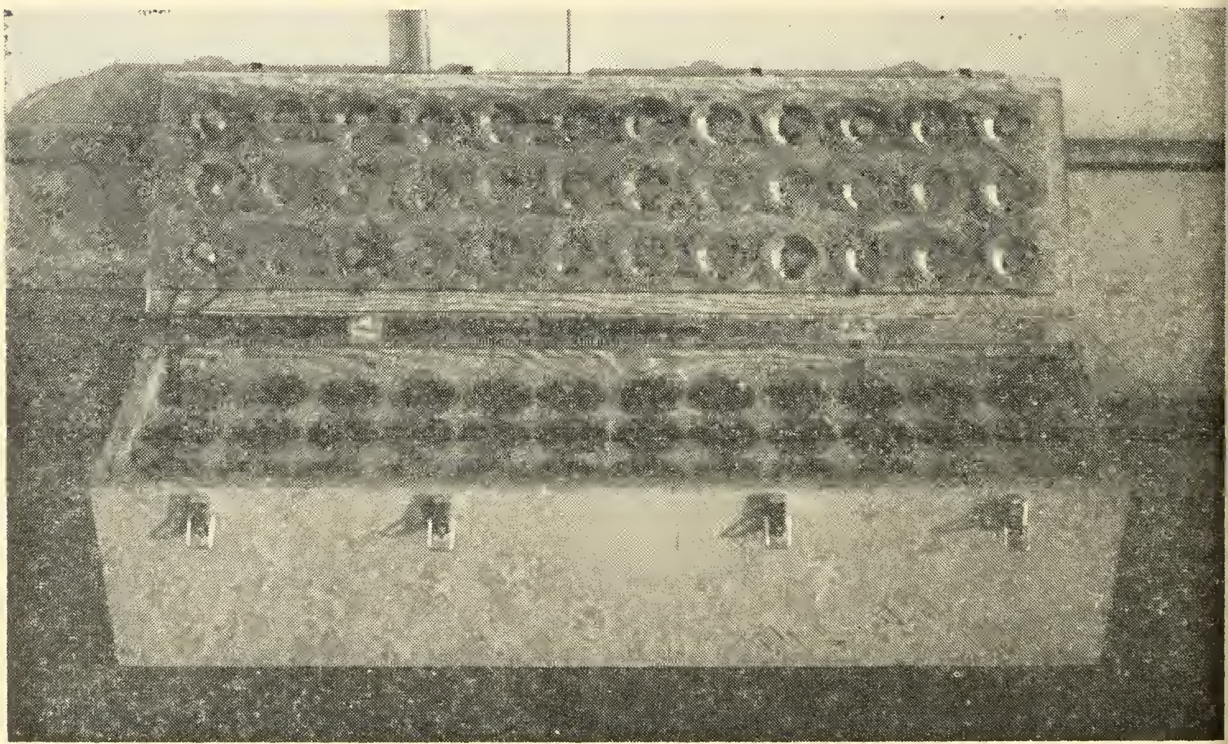


FIGURE 1.—Interior arrangement of battery box.

One box completely assembled with the springs, battery cable, and plugs costs about $17, and one man can assemble and wire two boxes a day. On the Boise National Forest 13 repeaters were used last summer without failure (fig. 2). One set was in service from July 1 to November 3—4 months of continuous 24-hour stand-by service. Receiver A battery on this unit dropped 0.25 volt and B battery 6 volts. Motorola repeater units used with these boxes lasted comparable periods.

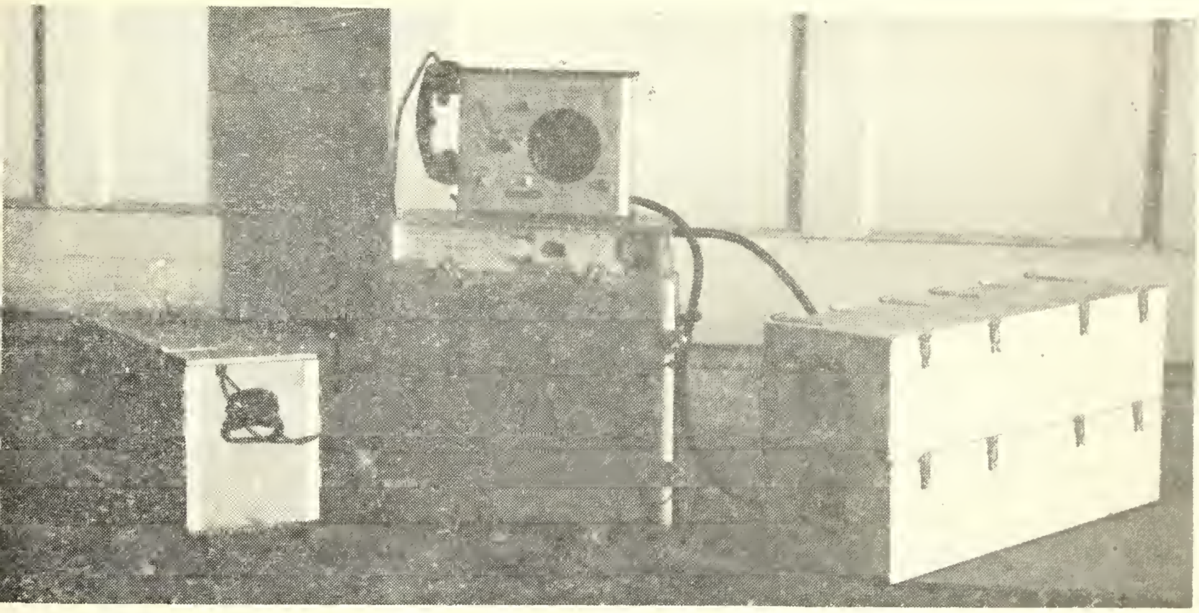


FIGURE 2.—TF relay, showing battery boxes and cable.

Forest Fire Fighting Training Films—Continued

Name of film	*Length (minutes)*	*Subject matter*
HELICOPTERS & FOREST FIRES. (Released 1950.)	20	Operation and use of helicopters in fighting forest fires; emphasizes proper techniques and safety for personnel flown to inaccessible areas. California.
FOREST FIRE AND WATER.... (Released 1952.)	10	Shows application of water on fire and desirable methods of water application. California.
ONLY A BUNCH OF TOOLS.... (Released 1949.)	26	Deals with recruiting and training of volunteer crews in fighting forest fires in the Northeast. Illustrates the complete organization for fire fighting agencies in these States.
FIRE IN THE FOREST.............. (Released 1951.)	26	Shows conditions that cause small fires to become large, disastrous ones. Locale Northeastern States.
BUILDING THE FIRE LINE (Released 1951.)	20-25	Depicts a warden organization handling a fire suppression job from beginning to end in Northeastern States.
WATER ON THE FIRE.............. (Released 1952.)	30	Filmed in Connecticut. Deals with efficient use of water and water equipment in fire suppression.
FOREST FIRE FIGHTING IN THE SOUTH. (Released 1945.)	39	Demonstration of types and proper use of hand tools used in fighting fires in the South.

THE ALEUT PACK STRAP

REID JACKSON

Forester, Payette National Forest

The problem of packing and carrying smokejumper gear after a practice or fire jump has been lessened by the use of the Aleut pack strap. The strap is of simple construction, very light weight, and it can be adapted to almost any type of man load (fig. 1). The design for the pack strap was introduced to the Region 4 smokejumpers by civilian instructors of the U. S. Air Force Survival School, McCall, Idaho. Fifty of these straps were manufactured and tested by Region 4 smokejumpers with the following findings:

1. The strap is best adapted to large, loosely packed loads. This type of load when covered with a thin manta tends to form itself to a man's back and makes an ideal pack (fig. 2).
2. Hard, tightly packed loads tend to shift and are uncomfortable against the back.
3. The shoulder bind, age-old curse of the man pack, is eliminated to a large extent. The weight of the load is distributed across the chest instead of the shoulders and enables a man to carry a heavier load with more comfort.
4. A safety factor is also involved. When packing in steep country there is less danger of rolling with a pack when this type of strap is used. The parachute cord holding the load in place can be attached to the grommets with a slip knot, and the whole load can be instantly dumped if an emergency arises.
5. When not in use the pack strap can be rolled up into a compact unit about the size of a softball.

The pack strap is attached to the pack in the following manner: The packer first places the parachute cord around the pack with the chest strap on top and facing the side of the pack that is to rest against his back. He then sits down with his back against the pack and places the chest strap over his head and down to his chest. The shoulder straps are now in the proper position. The cord running around and under the pack is brought up and tied through the grommets on either side of the chest strap. He then stands and adjusts the pack elevation by taking up or feeding out cord through the grommets. The cord is then tied to the chest strap.

These pack straps, constructed of C-8 webbing, are manufactured at the Smokejumper Parachute Loft, Payette National Forest, McCall, Idaho, and can be purchased through Procurement and Supply, U. S. Forest Service, Region 4, Ogden, Utah.

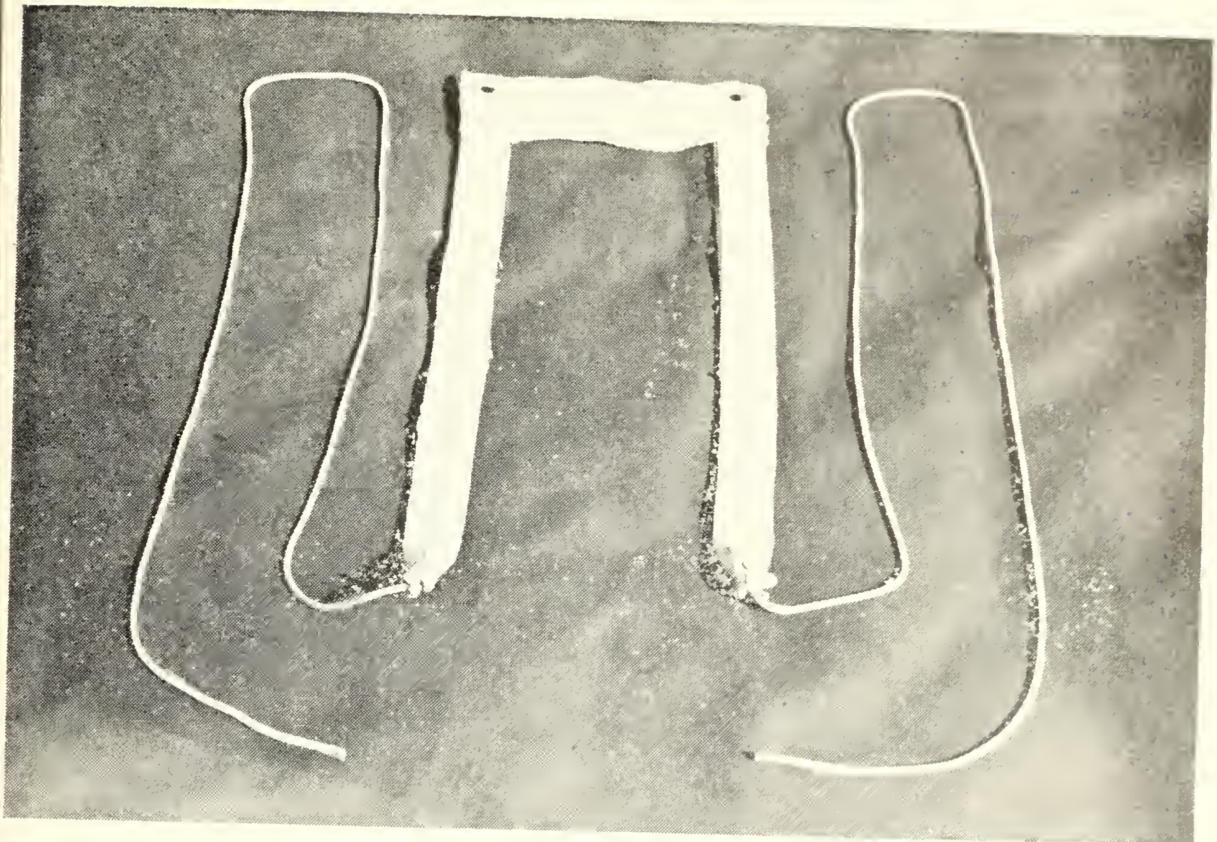


FIGURE 1.—The Aleut pack strap.

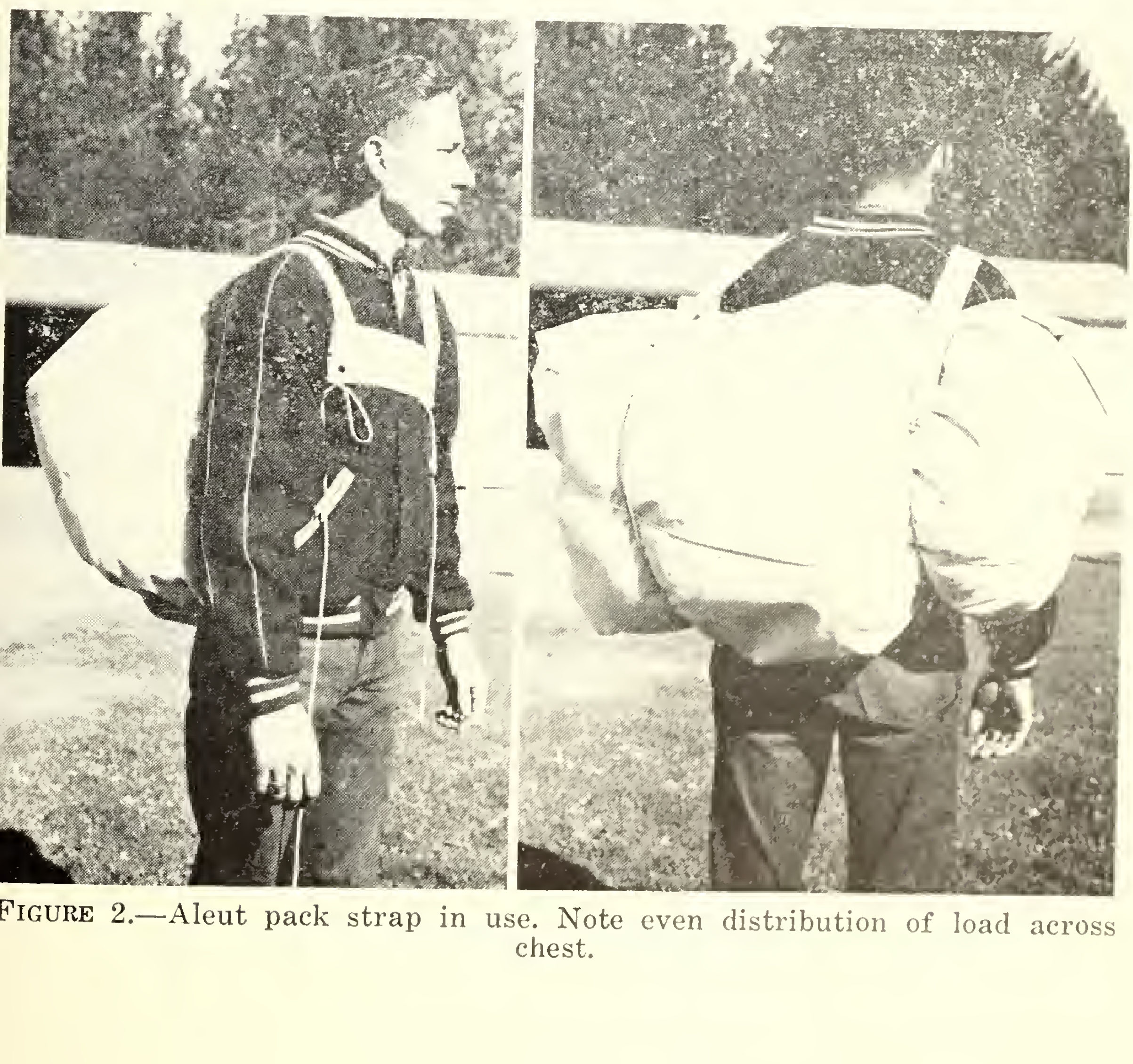


FIGURE 2.—Aleut pack strap in use. Note even distribution of load across chest.

A SAFE, CHEAP, AND EFFECTIVE FOREST FIRE GRENADE

R. L. FENNER

Range Conservationist, California Forest and Range Experiment Station [1]

A general purpose forest fire grenade has been developed that is safe to use, and it can be produced at low cost. Though not suitable for use in vegetation where there is no ground fuel, the grenade provides a fast, sure way to ignite grass, pine needles, and hardwood-leaf fuels from a distance of 200 feet. With this grenade, ignition patterns can be used to build up the volume of fire or to regulate drafts inside the fire line.

Drawbacks to the use of grenades in numbers sufficient to accomplish their purposes have been the high cost of the grenades and the dangers involved in handling and igniting them. This grenade has had sufficient trial to point out how it meets the fire fighters' and users' requirements of safety, effectiveness, and low cost.

The grenade consists of four essential parts: incendiary charge, fuse-primer, skin, and striking tip (fig. 1). Although the design is simple, considerable care and experience are needed to assemble sure-fire grenades.

Incendiary charge.—The charge consists of a 1-inch section of standard fusee with a 9/32-inch hole bored through the center of the section. The hole must be this large to prevent smothering of the reaction when the primer ignites the incendiary charge.

Fuse-primer.—The fuse and primer are made from a single piece of spitter cord 10 inches long. A 3-inch segment of the cord is folded back on itself and then refolded to form a 1½ inch primer consisting of four thicknesses of cord. This leaves a fuse 4½ inches long. Use of this simple primer is the most important factor in constructing a cheap, safe grenade. The primer is inserted into the hole in the charge, and is held in place by crimping the ends on each side of the charge. Care must be used in this operation so that the air space through the grenade is not blocked.

Skin.—The skin of the grenade consists of a 7/8-inch cardboard tube 1/16-inch thick and an over-all covering material. The purpose of the skin is twofold: (1) A directional shape is given to the flame (fig. 2) by the slow-burning cardboard tube; and (2) after the grenade is assembled, the crumbly portion exposed by cutting and drilling the fusee is held in place by the over-all covering material. Masking tape is a satisfactory cover, but for quantity production the assembled grenade is dipped into highly flammable plastic.

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[1] Maintained by the Forest Service, U. S. Department of Agriculture, in cooperation with the University of California at Berkeley, Calif.

Striking tip.—Paper safety matches are fastened to the fuse tip so that it can be ignited by pulling between two surfaces covered with the striking compound used on safety match box covers.

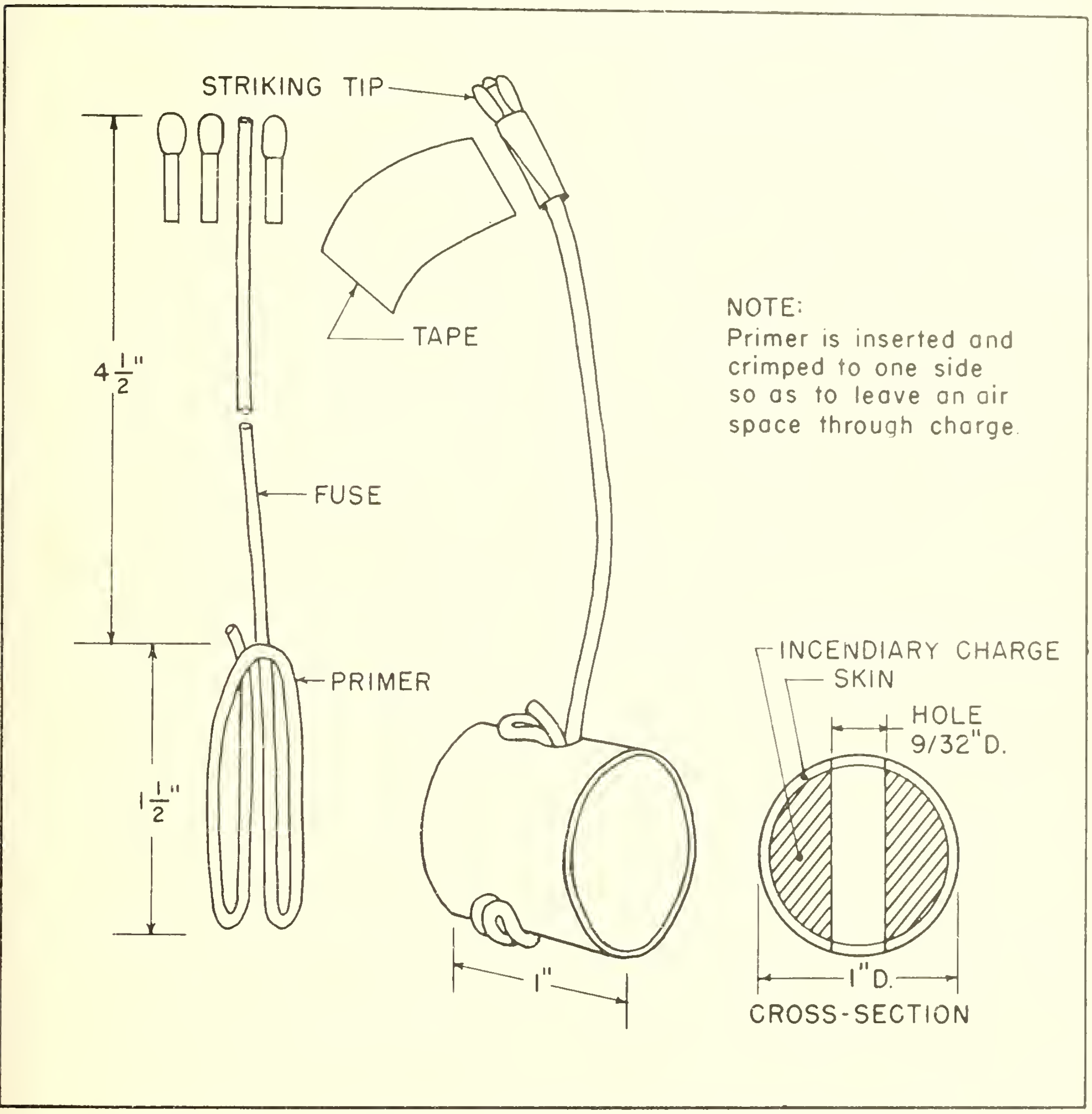


FIGURE 1.—Construction details of Fenner fire grenade.

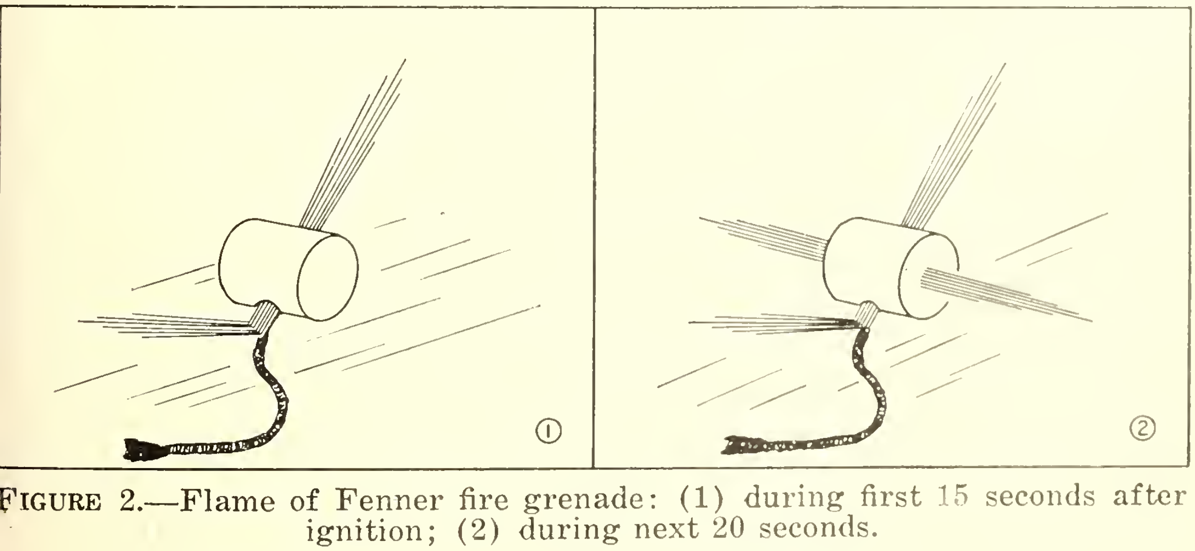


FIGURE 2.—Flame of Fenner fire grenade: (1) during first 15 seconds after ignition; (2) during next 20 seconds.

Experience with the grenade has given the following information on how well it meets the requirements of safety, low cost, and effectiveness.

Safety.—The grenade does not contain explosive or poisonous compounds. The charge is stable and contains no flammable liquid, and the primer does not contain an explosive cap.

The grenades are not easily ignited by accident and can be handled and stored with relative safety. Greater caution is needed, however, than is ordinarily required for handling and storing fusees because of the matches and exposed black powder on the tip of the fuse. The grenades should always be stored in containers that keep out sparks or flames. The grenades should never be carried in pockets or in containers that cannot be readily jettisoned in case of accidental ignition. The incendiary charge can be extinguished with water.

Elementary precautions should be taken in lighting the fuse. It should be ignited only at the tip and with the tip pointing away from the body and from other grenades. Also, it should be ignited only after selecting the spot into which the grenade is to be thrown. Once ignited, the fuse burns 8 seconds.

Cost.—The grenade is relatively inexpensive. Since only common materials and no cap igniting primer are needed, raw materials for a grenade cost about 5 cents. An experienced worker using hand tools can fabricate about 20 grenades an hour.

Effectiveness.—Large numbers of grenades can be carried because of their small size and light weight—about 35 fit in a 1-pound coffee can. They can be thrown by hand up to 100 feet. With an ordinary sling shot, they can be projected up to 200 feet. Accuracy depends on practice.

With proper striking tips, grenades can be ignited and thrown at the rate of 20 per minute. Without a tip they can be ignited with a match, cigarette, punk, or fusee.

The 8-second fuse allows time for throwing or projecting from a sling shot and allows the grenade to reach the ground before the incendiary charge ignites.

Once the fuse is lit a properly constructed grenade will always fire. Misfires have always been traced back to improper construction. In one test, a group of grenades fired consistently after being submerged in water for 3 minutes.

The flame is two-pointed for about 15 seconds and then forms a four-pointed star for 20 seconds as it reaches maximum intensity (fig. 2). Because of this shape some fire is always directed along the ground surface regardless of how the grenade falls. The flame covers an area about 6 inches in diameter and reaches a height of 1 foot with no wind. The flames are intense enough to ignite fuels 1 inch in diameter next to the grenade, and will ignite fine fuels up to 6 inches away.

The grenade is being produced and used only in experimental quantities at present. Additional information covering the device will be available through the California Forest and Range Experiment Station.

SIRENS ON AIRPLANES SUMMON WOODS WORKERS FOR FIRE FIGHTING

WILLIAM J. EMERSON

Superintendent, Ely Service Center, Superior National Forest

Woods workers are the handiest and best source of labor for fire fighting on the Superior National Forest in Minnesota. These men are present in sizeable numbers on logging operations, but during the day when they are needed for fire, they are scattered far and wide through large areas of woods, engaged in cutting and skidding timber. With the present trend toward scattered "shacker" groups and away from the large logging camps, many of these workers also eat and sleep in remote, isolated groups of portable shacks close to their work. Thus the problem of getting large numbers of these scattered woods workers on fires during the early stages is a difficult and critical one. In the past, they were summoned by means of messenger, usually on foot, after the request for fire fighters had been sent by car or called via telephone to the logging headquarters. This was a very slow process and sometimes the resulting lag in attack on the fire was very costly. The problem was how to quickly reach any needed number of these groups of men in the woods to summon them out for fire fighting.

Trials were made with certain types of ground signals, such as smoke bombs, and explosive bombs launched from the ground to explode in the air with a loud report. Such signals proved rather ineffective and sometimes unsafe to use.

With the large numbers of power saws and tractors operating among these woods workers, it seemed that we needed a signal which would be both seen and heard by practically the entire group of scattered timber workers. The use of airplanes looked like part of the answer. But how to signal large numbers of men from the air with a positive and easily understood message, without tying up the airplane for an excessive time in the act?

First, an electric megaphone was tried from an airplane. This was quite effective from a light plane when a message was to be delivered to someone in one spot. But its use to call a message to scores of men scattered over hundreds of acres in the woods was found to be ineffective and usually confusing. Some groups of men would not hear the megaphone unless it was directed straight toward them at a relatively close distance. Some men would misunderstand and place their own interpretation on the words they heard, or thought they heard, from the megaphone. So it was decided to confine use of the electric megaphone to calling specific messages to individuals or to small local spots on fires.

Next a siren was tried on the airplane to determine its effectiveness in calling out the large groups. It was found that a light airplane flying a few times back and forth over a large area, blowing a siren, was very effective in summoning the scattered workers, after their foremen had told them that the airplane siren was the signal to immediately leave the woods and report to their camp for specific instructions. There seems to be little chance for misunderstanding, confusion, and delay, after the logging supervisors have instructed their workers to respond to the siren. The airplane can then drop a message to the camp or headquarters where the men will report, giving the location of the fire and any other necessary instructions.

All timber operators having sizable numbers of loggers in the woods during the fire season are being contacted and requested to advise their men of the meaning of the airplane siren signal. Permission will be secured from the operator before his men are summoned in this manner.

In order to have the airplane sirens always available and ready to use, the Superior National Forest installed sirens permanently on each of its three seaplanes. Thus, by radio through the central dispatcher, the planes can be dispatched from their existing positions to fly over any given logging area to sound the siren and thus start mobilization of the woods workers for the fire. The dispatcher and pilots have in their possession maps showing current principal logging areas with the approximate number of men working in each one. These maps, which will be brought up to date annually by the district rangers, will furnish a ready reference when a plane is dispatched to fly over specific areas to summon men out by means of the siren.

There is a big advantage, of course, in being able to install sirens permanently on the planes so there will be no delay incurred in installing the siren each time it is needed. Forest protection agencies not owning airplanes should be able to arrange for installation of a siren on their charter plane where contract or agreement exists for use of one or more specific airplanes during the fire season. Ordinarily, before installing and using a siren, or any other accessory or addition, on an airplane, a CAA Form 337, Repair and Alteration Form, should be made and approved by CAA.

The following description of siren installations on the Superior National Forest's airplanes will serve to illustrate types of sirens that may be used and ways of powering them:

1. Piper Cub two-place seaplane. Wind-driven siren mounted on lift strut, left side, close to fusilage (fig. 1, left). Siren is activated by its own 10-inch propeller, which is released and stopped by a control connected through a flexible cable with the instrument panel.

2. Stinson Station Wagon four-place seaplane. Electric automobile-type 6-volt siren mounted on small step, left side, just ahead of lift struts, alongside fusilage (fig. 1, right). Power is 6 volts taken off the plane's 12-volt battery on a separate circuit fused close to the battery. Control is by a switch on the instrument panel.

3. Noorduyn-Norseman nine-place seaplane. Electric automobile-type 6-volt siren, same type as used on fire trucks, mounted on right side on bracket attached to top of rear float strut. Power is

6 volts taken off the plane's 24-volt battery on separate circuit fused close to battery. Control is by switch on instrument panel.

The Cub and Stinson sirens are very effective and quite easily heard on the ground from elevations up to 1,000 feet. The engine noise of the larger Norseman plane tends to drown out about 30 to 50 percent of the siren signal, and since the Norseman is not flown at low elevations if this can be avoided, the siren is not as effective as those on the light planes. However, it is sufficiently loud to be heard by men in the woods.

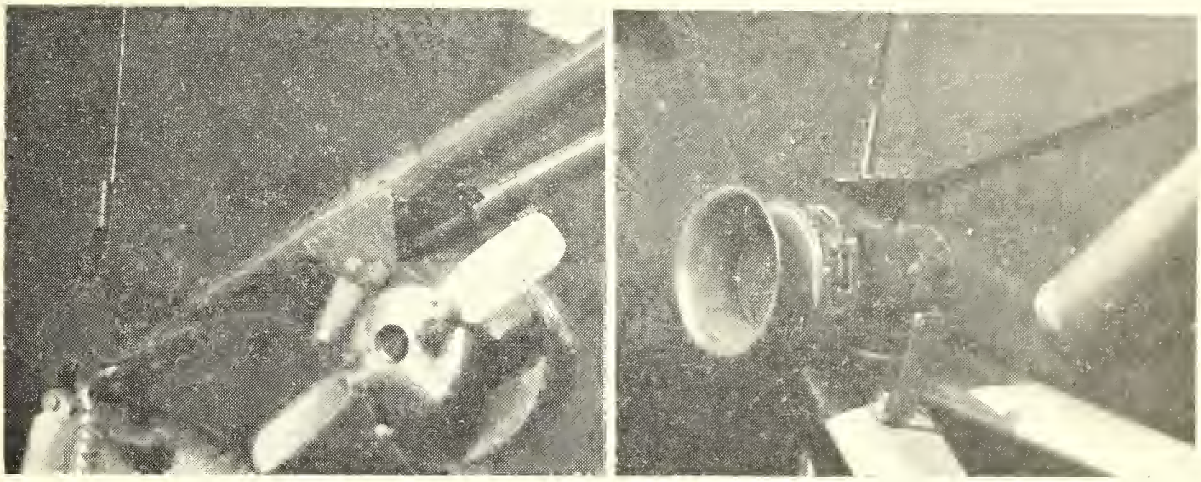


FIGURE 1.—*Left*, Wind-driven siren on Piper Cub seaplane; *right*, electric siren on Stinson seaplane.

Besides the use described above, airplane sirens can serve other purposes, through prearranged instructions. For example, men in danger of being trapped on a fire may be warned to get out by a blast, or series of blasts, of an aerial siren. Ground messages to the airplane can be acknowledged by means of the siren. Sirens can be helpful in contacting lost persons, persons to whom you are dropping emergency messages, field parties you are trying to contact or locate in the woods. On the Superior, we have found the combination of siren and message-dropper very effective in communicating with ground parties who do not have radio. Another use of aerial sirens which has paid off has been to alert ground parties on fires and other projects to go to the nearest field radio to receive a specific message. Spot fires have been found quickly by ground crews searching for them after the airplane siren was sounded directly over the spot fire to point out its location.

Costs of sirens will vary greatly according to the type and size used. Electric sirens cost from $25 to $50 and may be purchased from most fire equipment suppliers. However, most fire control agencies have one or more usable truck sirens lying around or can divert one from one of their trucks. Wind-driven sirens are quite hard to locate these days, despite the fact that they were required equipment on seaplanes not too many years ago to warn water craft the seaplane was approaching to land. We finally secured one for $6. However, indications are that there are a few on the used equipment market which can be found by advertising in trade publications.

CRAWLER TRACTOR PULL-OUT CHAINS

Stuart B. McCoy

Ranger, Wisconsin Conservation Department

Forest fire tractors pulling plows must go where the fire is burning. Mud holes, small creeks, peat bogs, and rock and stump straddling all present situations where tractors get hung up for lack of firm footing. Being stuck while a running fire is spreading is most aggravating, and often seriously time-consuming.

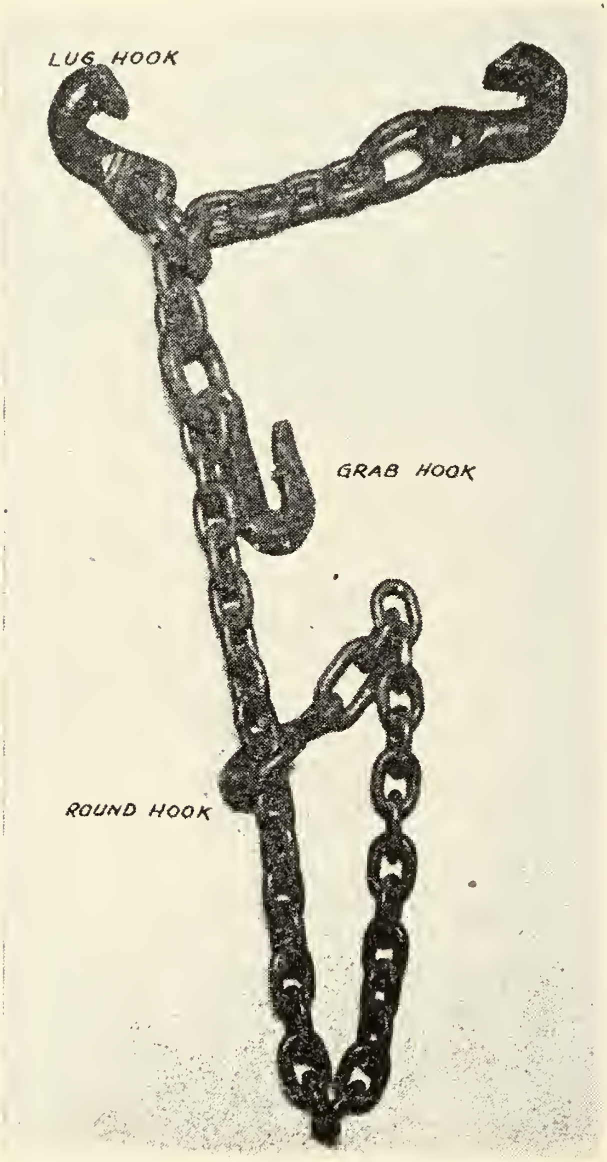


Figure 1.—The pull-out chain.

Wisconsin solved this problem by the use of home-made pull-out chains that are now standard equipment on 70 tractors. They are simple to build and have paid for themselves many times over.

Essentially, the pull-out chain is nothing more nor less than a 5-foot chain with the round hook retained on one end. The grab hook is removed and replaced with a heavy-duty forged hook shaped to fit the edge of the track plate. In order to catch the other side of the track plate, a second identical forged hook with a loose ring is provided to slide on the 5-foot chain. By sliding on the chain the two hooks will fit any width plate, and when pull is exerted on the end of the chain, they tighten to hold securely. Each track needs a chain.

Usually all that is necessary to extricate a hung-up or stuck tractor is to give it something solid underneath upon which it can exert its temporarily useless strength. The round hook end of the chain is now fastened around a cut pole, old log, loose stump, or any available material that will provide a solid footing when pulled under the track. In soft mud, several poles cut to a length a little greater than the total width of the tractor and pulled underneath as a bundle will cause almost immediate traction.

The grab hook hanging on the ring connecting the short and long pieces of chain is an auxiliary feature. It provides a quick method of attaching any log chain to the pull-out chain in case the round hook is damaged or lost. Where sufficient additional chain is available, the pull-out chain may be fastened directly to a more distant live tree or solid stump for anchorage.

The pull-out chains may be fastened on the tracks either in front or rear. When power is applied to the tracks, care must be taken to see that the movement of the tracks will pull the chain underneath. The lug hooks are easily released as solid footing under the tracks releases tension on the chain.

Figure 1 shows a pull-out chain used with 7,500-pound tractors having 13- and 14-inch treads. The specifications shown below have been found satisfactory for this weight tractor. For other tractors, specifications can be changed accordingly.

Lug hooks forged from 1¼-inch axle steel. Lug-hook rings made from ⅝-inch round, 2½-inch inside diameter. Grab-hook ring made from ¾-inch round, 3-inch inside diameter. Chain is ½-inch electric welded, about 5 feet long. Grab and round hooks standard ¾-inch hooks. Short chain about 12 inches; longer chain about 48 inches. Ring on grab hook prevents loose lug hook from working too far down chain toward round hook.

Handling Fingerprint Records

Under the present conditions of an unfavorable labor market, very likely both private and public protection agencies are experiencing difficulty in handling the paper work involved in hiring temporary seasonal workers. This problem is complicated by the necessary loyalty checks for all Federal and many State and private protection jobs.

The fingerprinting of applicants for work on this forest used to be one of the major chores involved in the processing. Several members of our permanent force were trained to take fingerprints, but time spent at this job was badly needed elsewhere. Time was also taken up when many of the fingerprint records were returned as unsatisfactory and had to be done over. Since men whose jobs were to last less than 180 days were not fingerprinted, we had no check on them except their own statements.

We now have a very satisfactory cooperative arrangement with El Dorado County Sheriff Rowland Morris. Many of our candidates are not the highest type of individuals, and the sheriff's office is as happy to get a check on them as local forest officers are to get help on the checking. Eldorado keeps the sheriff supplied with fingerprint forms, and the deputy or undersheriff makes two fingerprint records for every applicant. One set of prints is used for the loyalty check and goes through the Forest Service with other forms if the employment lasts 180 days. The other set of prints is checked with law-enforcement agencies cooperating with the sheriff's office, and a complete report on the individual, so far as state-wide criminal activity or tendencies are concerned, is returned to the forest supervisor usually within 2 weeks.

Last season several men were spotted by this check who were either wanted or were serious risks. We always send an applicant for fingerprints before he makes out an application blank, and many have failed to report to the sheriff's office when confronted with the necessity for a fingerprint record. Early elimination of such applicants saves much time. Under our old system, some shady characters who were aware of the time lag involved in running down records would deliberately falsify their applications and work through a season before the checkup caught them. Our cooperative system has eliminated this time lag in processing, and has helped the Eldorado select the best men available for employees. It has also made possible a worth-while saving in time and money.—E. H. ELLISON, *Administrative Services Officer, Eldorado National Forest.*

A PORTABLE LIGHT FOR FIRE FIGHTING TRACTORS

Division of Forestry, State of Washington Department of Conservation and Development

In the control of forest fires much valuable time can often be gained by operating bulldozers at night. Usually on large or difficult fires in the State of Washington, private operator's tractors are employed. These machines normally do not have night

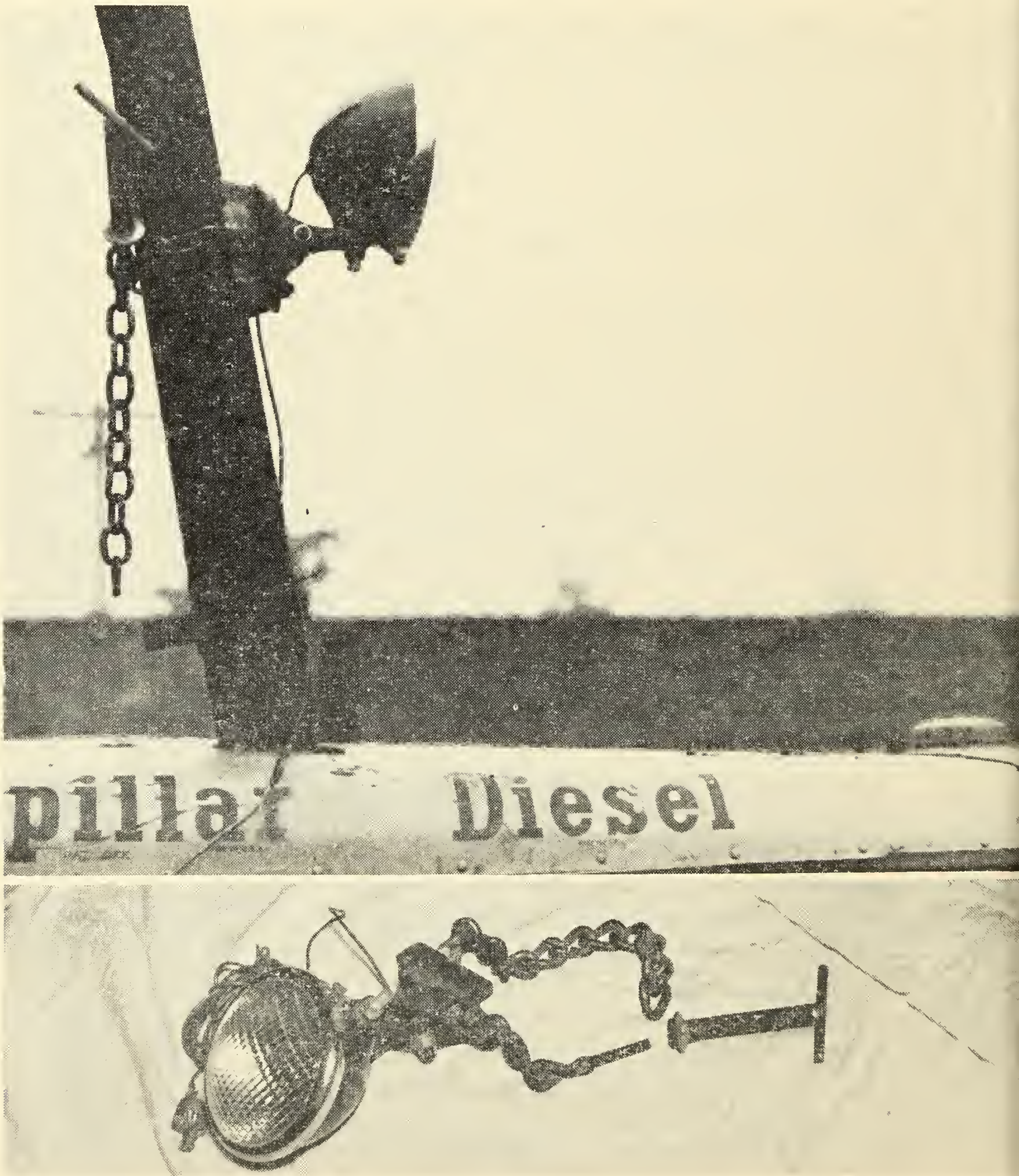


FIGURE 1.—This portable light saves many hours of daylight operation on fires by enabling tractors to get into position during the night.

lights. At night tractors operating without lights often find it impossible to (1) get to the fire when it is not adjacent to well-established roads and (2) to build fire trails once they are there, because rough terrain makes the light from the fire inadequate for safe operation.

Both of these problems have been partially solved by a portable tractor light that was developed by Tom Almont at our State Forestry Automotive Shop. This light was designed for quick installation on any type of tractor having either a 6- or 12-volt battery (fig. 1). Ease of installation is, we believe, one of its principal attractions over other lighting systems that we are acquainted with. The combination chain-bolt clamp allows the light to be fastened to any size pipe, angle iron, or screen. In some instances the light has been attached to the exhaust pipe.

The wiring for this light is very simple. During the 1952 season all of our lights were equipped with 6-volt, seal-beam elements. The clamp holding the light in place serves as the ground. A single wire leading from the light is fastened to the battery or generator by means of an alligator clip. On a 6-volt battery, the clip is fastened across the whole battery or to the generator terminal, and on a 12-volt battery it is fastened one-half way across. Since some battery connections are too hard to get at because of the battery cover, we now plan to carry both 6-and 12-volt, seal-beam units at all times. Thus, it will always be possible to make a connection directly with the generator as needed.

These portable lights are built from automobile headlights and scrap material that would ordinarily be waste around the shop. One costs approximately $6. Field supervisors' and fire control assistants' cars carried these lights throughout the 1952 fire season, ready for use whenever the need arose; district wardens' pickups will also carry them in the future.

Inexpensive Message Tubes for Air Use

For quite a few years the Shasta National Forest has used an inexpensive message tube for dropping to ground crews from patrol and cargo planes. These tubes are made from condemned 1½-inch CJRL hose, and have an over-all length of 13 inches. An 8-foot strip of cheap yellow flagging material is riveted to one end of the tube, and a 3-inch beveled tab is cut in the opposite end. This tab, tucked in, closes the tube. Yellow is used for the streamer because of its high visibility.

This tube and streamer is also used by ground crews to signal their needs for water or food to a plane by making a W or F. The plane then requests information on the amounts needed, and the ground crew responds by showing a single bar mark for one 5-gallon can of water, two bars for two, etc. If the crew has enough tubes, they can signal with a numeral. The same applies to food except that the bar or numeral indicates the man-days of food needed.—MERVIN O. ADAMS, *Forest Dispatcher, Shasta National Forest.*

A "DR. PEPPER" FIRE REPORTING SYSTEM

Ed. Kerr

Press Representative, Louisiana Forestry Commission

Through what he calls a Dr. Pepper fire reporting system, State Forester James E. Mixon of the Louisiana Forestry Commission knows exactly how many fires are raging, what size they are, and how many units are fighting them at any hour of the day. The system gets its name from the fact that fire reports are received in the central office at 10, 2, and 4 o'clock each day.

The 10 o'clock report covers fires occurring the night before and the other two are devoted to fires occurring that day. Status of the fires is also included, so the State Forester can keep abreast of how many fires are still going and how many have been contained. In other words, the State Forester in Baton Rouge knows at all times the fire activities in the remotest corner of the State.

A huge area in the front room of the central office accomodates a map of Louisiana (fig. 1). Each tower is represented by a small bulb that is lit when the tower is manned, turned off when the towerman leaves his post. All lights are actuated by a control board facing the receptionist, who is radio and telephone operator.

Figure 1.—The "Dr. Pepper" map.

When the radio operator receives a report, she immediately proceeds to record the information on the floor map. This is done by means of plastic "gimmicks" that have a hole in their centers, and are of different sizes, shapes, and colors. When they are slipped onto a wooden stake and placed on the map in the approximate location of the fire, they tell the complete story of that fire's existence.

Take for example a fire occurring in Sabine Parish. It is reported to be 500 acres in size and is being fought by two commission units and one unit sent by a forest industry. It is reported on the 2 o'clock signal as the second fire that day in Sabine and has not been contained.

The operator puts a red ring on the stake first to represent the hour reported, then a pink cube representing a 500-acre fire, then two pink hexagons symbolizing commission fire-fighting units, and one pink triangle for the forest industry unit. If the fire had been reported "dead out," a black cylinder would have been placed on top of the other symbols. A number two tag is then placed on top of the stake, showing that this was the second fire reported in that parish that day. All numbers start over again at the beginning of a new day.

The map, which presents a striking assortment of variegated colors toward the end of a day in fire season, has been responsible for opening the eyes of many a citizen to the forest fire danger in Louisiana. Such is its appeal that the commission office is the only State department chosen by a local sightseeing service to show its tourist customers.

All-Purpose Dispatch Map

The Georgetown Ranger District of the Eldorado National Forest, Calif., has been fortunate enough to have most of its area covered by the 7½-minute quadrangles of the U. S. Geological Survey, having 40-foot contour intervals. These topog quads and, for the extreme eastern part of the district, a Forest Service planimetric map enlarged to the same scale fitted together provide a composite district map, the most up-to-date available. The map, approximately 6 by 9 feet, almost covers one wall in the office.

It makes a very effective and accurate dispatch map when 12-inch azimuth circles are added for each lookout. The scale is large enough to put in all roads, trails, isolated uses, and other information important for fire control purposes. The map attracts attention of most office visitors, and its use for general information is superior to smaller scale maps. Found section corners, road log distances, and mining claims have been added, and it is believed that as more information is added the map will give a better basis for land use planning.

Time has not permitted the development of "single reading" fire location from one lookout through use of the vertical angle to the extent that it is believed possible, although preliminary checking has indicated that we can expect considerable accuracy.—GEORGE I. RAMSTAD, *District Ranger, Eldorado National Forest.*

MEETING THE HUNTER PROBLEM DURING SERIOUS FIRE WEATHER

JACK I. GROOM

Fire Staff Assistant, Fremont National Forest

Each fall the Fremont National Forest is host to some 25,000 hunters. The hunting season varies, but is usually from about October 1 to 18. This forest is located in south central Oregon close to a high desert area where very light fall rains are often slow in coming. Past records show that the forest has had a number of large fires caused by hunters' carelessness. There are two possible ways of preventing such fires: close the forest to all entry or carry on an effective fire prevention campaign with the hunters. After having tried both this forest feels that hunter contact is the better method.

One way of making sure that every hunter group is contacted is to require campfire permits and then keep ranger stations open so that hunters can get permits without too much delay. When the permits are issued, time is taken to inform the hunter of fire danger and to gain assurance that he will do his part in the prevention of forest fires. Maps and other information are available at these stations, and an effort is made to be as helpful as possible to these people so that they will feel that they are the guests of the Fremont National Forest. Fire permits are issued for spots which so far as possible are at springs or creeks where safe fires can be built. Several times each year emergency calls come through for hunters, and because of the permit record it is usually possible to find them in a short time. In 1952 we issued approximately 5,000 campfire permits.

Patrolmen are taught to be helpful and cooperative in their contacts with hunters. They are, of course, constantly on the lookout for fire situations that need correcting. When a campfire is found in a danger spot, the hunter is told in a polite manner why it is dangerous and is helped to make it safe. The objective is to educate people to be better forest citizens. Sometimes when a State fire law is violated, it is necessary to take the case to the local court. One of the main purposes of patrol is to catch and correct such a situation before a violation occurs.

As a result of the above process, campfires are generally not much of a problem. The biggest fire problem results from warming fires that hunters build, usually early in the morning, when they are away from their camps. Warming fires are more of a problem in seasons when light rain falls than they are during very dry seasons. Light rains change the fire danger for only a short time, but some hunters think that the fire season is over and neglect to put out their warming fires before they move on. Likewise, smokers get careless while hunting and start fires by throwing away burning matches and tobacco.

In both of these cases, the fire patrol is not able to check the fire because it occurs away from main routes of travel. The only way to attack this problem is to impress each hunter, both at the ranger station and in the field, that there must be *no warming fires* and that they should stop traveling when they wish to smoke and then make sure their smoking material is dead out when they leave. Here again the proper approach is through reason, which takes a little more time but gets much better results than just telling the hunter that what he is doing is against the law.

Although much can be done by patrolmen and issuers of campfire permits to persuade hunters to leave a clean camp, dirty camps are a constant problem during hunting season. There is something about getting out in the open woods that causes people to abandon their usual orderliness. They just come to relax. The patrols work constantly on this matter and most people cooperate willingly, but when you entertain 25,000 people there are a great many who don't seem to get the point.

In all hunter contacts, the idea is put forth that if forest fires result from their activities, they should naturally help to suppress them. This line of reasoning is accepted and applied, and usually a hunter will have a small fire under control before a fireman gets to it. Hunters are proud of the fact when they have helped stop a forest fire, so every opportunity is taken to commend them. The reduction in acreage burned as a result of hunter fires is a testimony to the success of our hunter-contact program.

	Hunter forest fires	
Year:	*Number*	*Acres*
1946	19	1,408
1947	12	1
1948	9	10
1949	32	70
1950	25	6
1951	10	([1])
1952	5	([1])

[1]Less than 1 acre.

In trying to eliminate the forest hunter problems of unsafe campfires, warming fires, smoker fires, and dirty camps, it is necessary for every hunter to accept the idea that he has a responsibility while he is in the woods. This acceptance can best be gained if he understands what that responsibility is, and is given the feeling that he is welcome on the forest. It is essential that as many hunters as possible be contacted personally. This means that an office at rangers' headquarters must be kept open as many hours and week ends as necessary to serve the people, and that enough employees must be on hand to issue permits and help with hunter information so that no one is unduly delayed. To effectively contact hunters in the woods, a careful job of planning must be done before the hunting season starts. All camps should be visited at least every other day and more often if possible. Every employee needs to be as helpful as he can because the hunters' good will and understanding can help lick the problems involved. Then too, a national forest belongs to the people of this Nation, and it should, if possible, be available for their use and enjoyment.

XZIT—ITS EFFECT ON THE RAILROAD FIRE PROBLEM

RALPH C. BANGSBERG

Fire Control Officer, Shasta National Forest

For many years the Shasta National Forest has been struggling with the knotty problem of how to reduce the number of fires caused by railroad operations. Running through the forest is 116 miles of main-line Southern Pacific right-of-way, 46 miles of McCloud railroad, and 15 miles of Great Northern track, a total of 177 miles of main and secondary line.

The most difficult problem has been concerned with the 116 miles of Southern Pacific's main line. For at least 20 years railroad officials and forest officers have been holding conferences, inspecting right-of-way, laying out work plans, advising, and trying to figure out how to prevent these operation fires.

Following the route of the Southern Pacific Railroad north from its entrance to the Shasta Forest, it first enters the steep Sacramento Canyon. This is a timbered area varying from precipitous shale slides and cliffs to steep, heavily wooded slopes. Timber is largely ponderosa pine, Douglas-fir, white fir, and cedar, with occasional black oak and manzanita thickets. Climbing out of the canyon north of Dunsmuir the railroad winds over arid plains and mountains that support large areas of flash fuels, cheatgrass, bunchgrass, extensive fields of dense manzanita, sagebrush, old slash and cut-over timber stands. For the most part this is an area of little rainfall with only moderate snowfall at the highest elevations (about 5,000 feet) on the right-of-way.

In 1942 an extensive program of hazard reduction was started with co-op money from the railroad. This burning of right-of-way action materially reduced the number of starts, but we were still averaging 25 to 30 fires a year.

From figure 1 you can readily determine fire incidence for the years from 1932 through 1952. As a matter of interest, acreage burned follows the peaks of the curve. The dramatic increase in number of fires in certain years can be attributed to increases in volume of traffic, severe fire danger, type of engines used, war traffic, etc. Most noticeable is the low of three fires in 1933 at the height of the depression when there was almost no traffic over the line, in contrast to the low of three fires in 1952 when there was more traffic than in any other year except in 1941 and 1942 at the start of World War II.

In 1952 the tonnage was heavy and fire dangers varied from medium to extreme. There were no summer rains to lower these fire dangers. A tie-up of Western Pacific lines, because of a burning tunnel, shoved additional freight over this line along with freight that was detoured because of damaging earthquakes in the Tehachapies. New trainmen, engineers, and crews were working over the line. There had been no increased hazard-reduction effort. In the light of previous experience everything favored an increase of right-of-way fires.

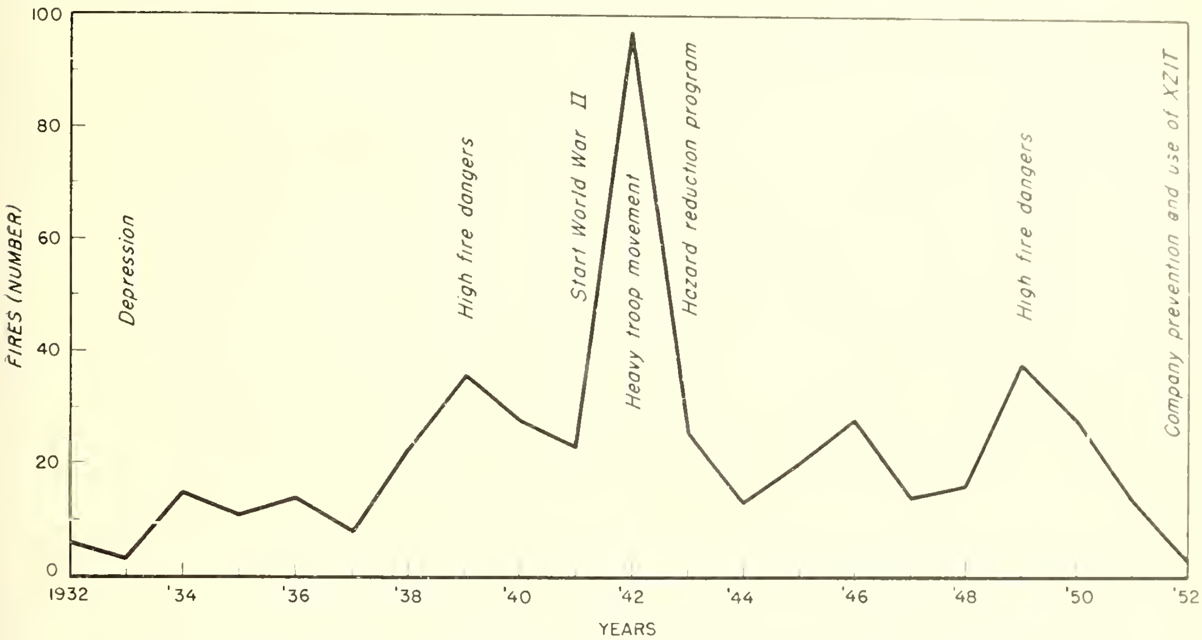


FIGURE 1.—Railroad operation fires, Shasta National Forest, 1932-52.

Several factors contributed to the greatly reduced fire incidence in 1952: (1) The Southern Pacific doubled its prevention effort with its employees. (2) Diesels, which have a dynamic braking system, were used in considerable numbers, lowering brakeshoe fires. The Diesel operates much like an automobile coming down grade in low gear, working against compression. (3) Better mechanical maintenance and inspection of stacks, screens, and other fire-causing mechanisms. (4) Last, but not least, the adding to fuel oil of a carbon-reducing agent called XZIT. XZIT, through its chemical action, cleans oil tanks, fuel lines, removes soot and carbon from fire boxes, flues, and stacks, thus eliminating the exhaust of hot sparks when an engine pulls grades.

What has XZIT done to help solve the railroad fire problem? The answer is given best by the following record of fuel spark fires.

Year	Fires (number)	Area burned (acres)	Damage (dollars)	Cost (dollars)
1941	4	10	.....	100
1942	29	3,439	7,581	155,000
1943	4	(1)	.....	61
1944	5	183	176	18,300
1945	9	45	38	4,500
1946	11	141	412	14,100
1947	5	(1)	.....	60
1948	2	(1)	.....	80
1949	10	6	.....	987
1950	14	132	145	13,900
1951	11	26	.....	1,440
Total	104	3,983	8,352	208,528
1952	0	0	0	0

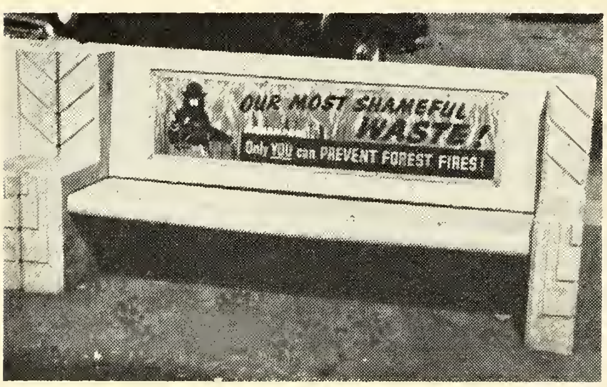
[1]Less than 1 acre.

Since there were 317 railroad fires from all causes for the period 1941-51, 33 percent of them were caused by fuel sparks, according to the above record. Thus, for the year 1952 it is reasonable to conclude that the use of XZIT accounted for at least a 33 percent reduction in railroad fires.

From the standpoint of the Southern Pacific, the use of XZIT has saved money for them through lowered operation costs and a reduction in fire claims cases. The company has decided to use this additive throughout the year regardless of fire season. The Forest Service has profited through the reduction of fuel spark fires and the consequent release of crews for other work, including the prevention of other man-caused fires. However, it is yet a little soon to draw any final conclusions. We will need more than one fire season to judge the long-run effects of the use of XZIT. The use of this additive plus an active interest in fire prevention on the part of all concerned may yet eliminate the long-standing problem of railroad fires.

Smokey the Bear Works for the Cleveland National Forest

Through the fine cooperation of the San Diego Seat Advertising Company, large metal Smokey Bear posters have been placed on twenty seats at bus stops in the most heavily populated sections of the City of San Diego. The signs, painted on a metal base, will remain in place until the close of the fire season and again be used starting about July 1. It is estimated that these signs will be viewed by upwards of a hundred thousand people each year.



Radio Station KFSD has purchased a record of the Smokey Bear song, and this is used as a theme on the weekly radio program conducted by the Cleveland National Forest. A separate verse is used each week for 4 weeks and on the fifth week the first verse is repeated. This catchy tune has brought forth many very favorable comments.

Through the assistance of the San Diego County Citizens Study Group on Forest and Brush Fire and Conservation Problems and in cooperation with the State Division of Forestry, some twenty papers in San Diego County are running weekly columns carrying a reproduction of Smokey and starting "Smokey Bear Says." In the news items that follow the entire fire situation, both State and Federal, is covered, including the number of fires that have occurred during the past week, weather, and fire conditions. A great deal of interest has developed throughout the area.

Several hundred members of the Smokey Bear Junior Forest Ranger Club have been appointed and, since the cards are issued only to those who have made contributions to conservation, membership is very much coveted by youngsters.—ROY H. BLOOD, *Administrative Assistant, Cleveland National Forest.*

"LITTLE LULU"—MECHANICAL FIRE LINE RAKER

JOSEPH JAEGER, JR.

District Forester, Missouri Conservation Commission

A recent equipment development of interest to men who construct fire lines by hand-tool methods in the central hardwood region is an adaptation of a commercially made power mower to a mechanical fire line raker (fig. 1). The raker has been given the name of Little Lulu by men using it. Experienced fire fighters who have seen this tool in operation were favorably impressed and expressed confidence in its ultimate success (fig. 2).

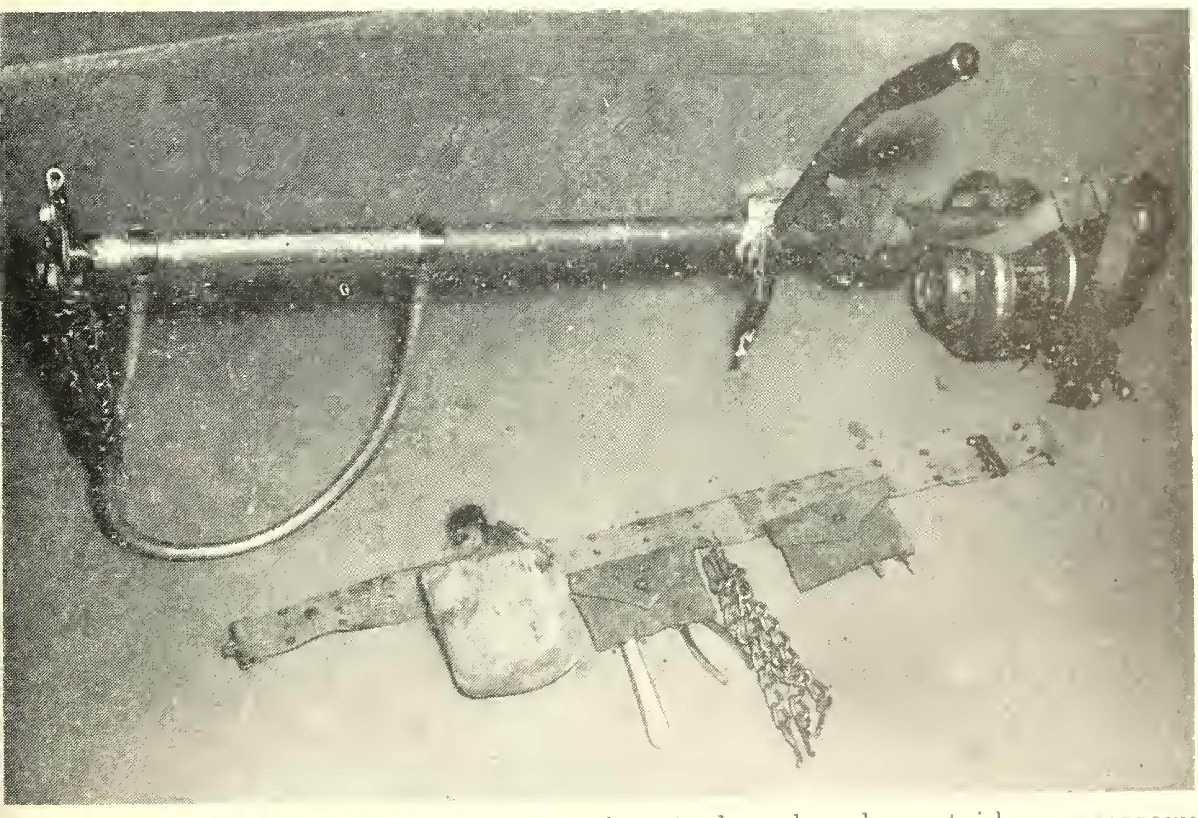


FIGURE 1.—The converted fire line raker tool and web cartridge accessory belt.

In 1950 a southern subcommittee of the Region 9 Fire Equipment Development Committee discussed the possibility of using a commercially made power mower as a tool in fire fighting. William E. Towell, Assistant State Forester of Missouri, Missouri Conservation Commission, offered to buy a mower and investigate its utility as a mechanical fire raker. The offer was accepted, and a mower was purchased and turned over to the Lake Ozarks Fire Protection District.

FIGURE 2.—Little Lulu in operation.

The mower received for development was a sickle-bar type with a 20-inch blade, power being furnished by a 1¼-h.p., single cylinder, 2-cycle engine. The over-all length of the mower was 54 inches, and it weighed approximately 24 pounds. The torque tube that transmitted the power from the engine to the head operated on an eccentric. The first step in development, therefore, was the conversion of the torque tube to operate on a complete revolution basis (360°). This was done by removing the eccentric gear from the transmission and replacing it with a specially tooled helical gear.

The next step in the development concerned the raking head that would perform the actual leaf and grass raking on the fire line. After thorough investigation and various experiments, a small steel plate with six steel spring tines attached was added to the end of the torque tube. However, when actual field tests were made, the tines broke too easily. Further experiments resulted in attaching three chains to the plate, and thus far they have proved satisfactory in field tests. A piece of ⅜-inch galvanized pipe bent in the shape of a U was attached to the lower end of the torque tube to serve as a guide in regulating the depth of the fire line as well as a safety guard to prevent the operator from placing his foot in the whirling chains. It is of interest to note that Little Lulu makes fire line while going either forward or backward.

So far the results of Little Lulu on actual fires have been very encouraging. It makes a fire line about 12 inches wide, and if a wider fire line is desired, that too is possible. The rate of fire line construction varies from 1½ minutes per chain in open forest to 3 minutes per chain in thick broomsedge mixed with hickory and sassafras reproduction. Although a three-man crew is preferred, two men can operate this piece of equipment. The lead man locates fire line and with his brush hook chops out any material that might interfere with the operation of Little Lulu. The lead man carries a web cartridge belt to which is attached a 1-quart canteen filled with extra fuel, three extra chains for the line raker, and two small pouches containing two screw drivers, an 8-inch crescent wrench, a pair of pliers, an extra spark plug, an extra starter rope, and five cotter pins. The second man operates Little Lulu and does the actual line building. When a third man is available, he checks fire line and backfires the line when necessary.

Several shortcomings have been noted on Little Lulu—a small tank for fuel, no automatic way of stopping the engine, no clutch for throwing line raking head out of gear while the engine is still operating, and inconvenient location of the throttle.

Since the development of Little Lulu, the manufacturer of the original power mower unit has brought out a new one. We are developing it as a mechanical fire line raker, and call it Big Lulu. The added features of Big Lulu are a 1-quart gas tank, assuring 1-hour operation at full throttle; a friction clutch that gives easier starting and better maneuverability; a larger engine, rating 2 h.p. at 4,000 r. p. m.; a well-located throttle control; direct drive from the engine, eliminating the transmission gear box; and an automatic short button for stopping the engine. Weight of the larger model is 26 pounds.

From the development viewpoint there will be only one Little Lulu. The pioneer efforts on this piece of equipment produced good results, and they are being used in the development of Big Lulu. It is anticipated that Big Lulu will be in operation by the first of the year.

Sign Posting With a Staple Machine

For the past 3 years the Angeles Forest has tested various types of staple machines as a substitute for tacking paper fire posters. A stapler, costing approximately $8 and using ¼-inch staples, has been found to be the best all-around tacking tool. All sizes of paper poster signs can be quickly and efficiently mounted on wooden backboards, trees, telephone posts, bulletin boards, or any other wooden surface. The ¼-inch staples when applied 6 to 8 inches apart do a better job of holding paper signs in place than the regular poster tack.

Our field men have found this tool to be faster and more efficient than the tack hammer with its elusive tacks. They have also used it for tacking tar paper in building construction and for temporary repairs to torn tents and fire fighters' jeans. The uses for this handy tool are unlimited. Further information may be obtained by writing to the Forest Supervisor, Angeles National Forest, 1443 Federal Bldg., Los Angeles 12, Calif.—Harry D. Grace, *Fire Control Officer, Angeles National Forest.*

FIRE CACHE WAREHOUSING DURING A HEAVY FIRE LOAD

W. F. Clarke and A. B. Everts

Region 6, U. S. Forest Service

Region 6 maintains five fire caches. Those at Pendleton, Bend, and Grants Pass, Oreg., are 500-man caches and are on first call for equipment for the forests nearest them. The 600-man cache at North Bend, Wash., supplies all the Washington forests except the Gifford Pinchot. The 5,000-man regional cache is located at Portland, Oreg. It is on first call for the Gifford Pinchot, Mt. Hood, Siuslaw, and Willamette Forests. In addition, it backs up all the outlying caches on replacements.

Generally, when one of the smaller caches has sent out tools and equipment for from 200 to 300 men, replacements are made. This is not a hard and fast rule but is determined by consultation with the regional fire dispatcher, who bases his decision on the over-all regional fire situation at the time.

When several project fires are in progress at the same time, it is not uncommon for tools and equipment from one of the smaller caches and the regional cache to be dispatched to the same fire.

Figure 1.—Dirty hose in from the fires to be washed, tested, dried, rolled, and stored away. If rains persist, the hose must be dried inside. During the latter part of the 1952 fire season, 80,000 feet of hose and 52 pumpers were shipped from the Portland fire cache.

The regional cache is much better equipped than the smaller caches for reconditioning used equipment. For this reason, nearly all of the equipment coming off a fire comes into Portland. The outlying caches are then "spiked" up to their plan with "ready-to-go" equipment from the Portland cache.

It frequently happens that considerable fire equipment is out on late fall fires. Then come the rains, welcome to all, even though they are hard on equipment. Then the trucks start moving back into the Portland cache wet flies and tents, thousands of feet of dirty hose, musty and damp sleeping bags, rusty mess gear and tools, smelly ranges (figs. 1 and 2). In the field it's all over. The boys go back on their regular jobs, try to wrangle a few days' leave to hunt or to just plain "relax." In the fire caches it's just starting.

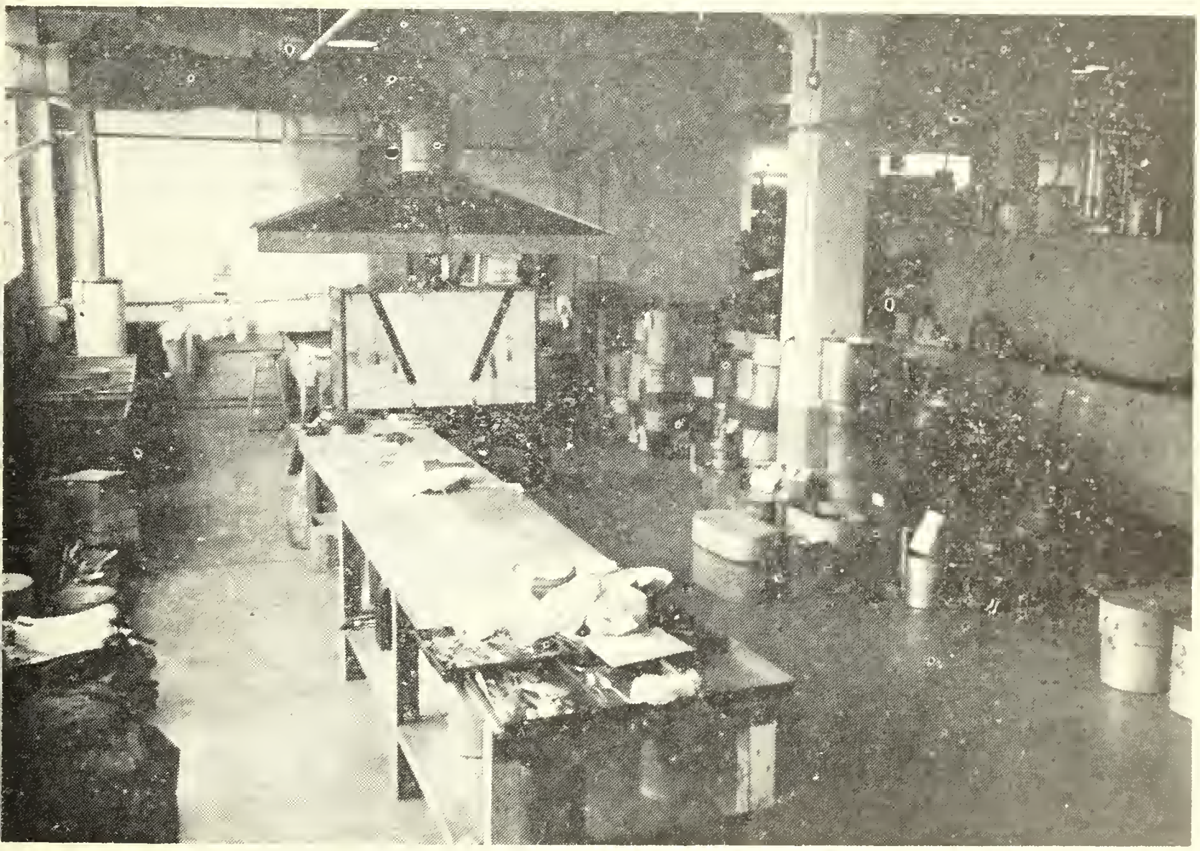


FIGURE 2.—A corner of the cache where mess equipment is reconditioned. Magnus No. 1-DX cleaner is used in vats to loosen rust. All liquid gas ranges and griddles are also soaked in this solution and then "steel wooled." Ranges are cleaned of all paint and then paint sprayed again.

In the spring months, when everything is shipshape and ready to go, a visiting fireman, looking over our regional cache is apt to remark: "What in the world do you do with all this equipment?"

If, during the past 2 years. this same fireman had seen our cache in the late fall, he would most certainly qualify his spring remark: "What are you going to do if you get another fire bust?"

Indeed, the April and October appearances of the cache bear no similarity; for, while we still have sufficient stock of some items, we most certainly are scratching the bottom on others. In the fall of 1951, it was necessary to fly in scarce items from the Region 1 warehouse at Spokane. This back-up by Region 1 made it unnecessary to make emergency purchases on the open market to the extent that otherwise would have been necessary.

In 1951, 258,625 pounds of fire equipment were handled by commercial carrier. It is estimated that an additional 10 percent was moved in our own trucks. It is difficult to get an accurate figure on the savings made in using commercial carriers because so many factors enter into the computations, the most important being to what extent we are willing to overload our trucks. Generally, we can make out cases for savings of from 17 to 50 percent by using commercial carriers.

Constantly we work toward ways of improving our packaging, cleaning, storing and shipping. A few items may be of interest:

Mess equipment.—There are 271 items in a 25-man mess outfit, not counting the lunch sacks and bags and paper towels. It takes 4 of these to make up a 100-man outfit, or 1,084 individual items. For several years the region has been using paper plates, cups, and bowls, and plastic knives, forks, and spoons. Last fall and spring we removed all the tin plates, cups, and bowls, and all the knives, forks, and spoons from these mess units—all small items, but time consuming to clean after a fire—and replaced them with paper and plastic dishes and mess utensils. This one move, alone,

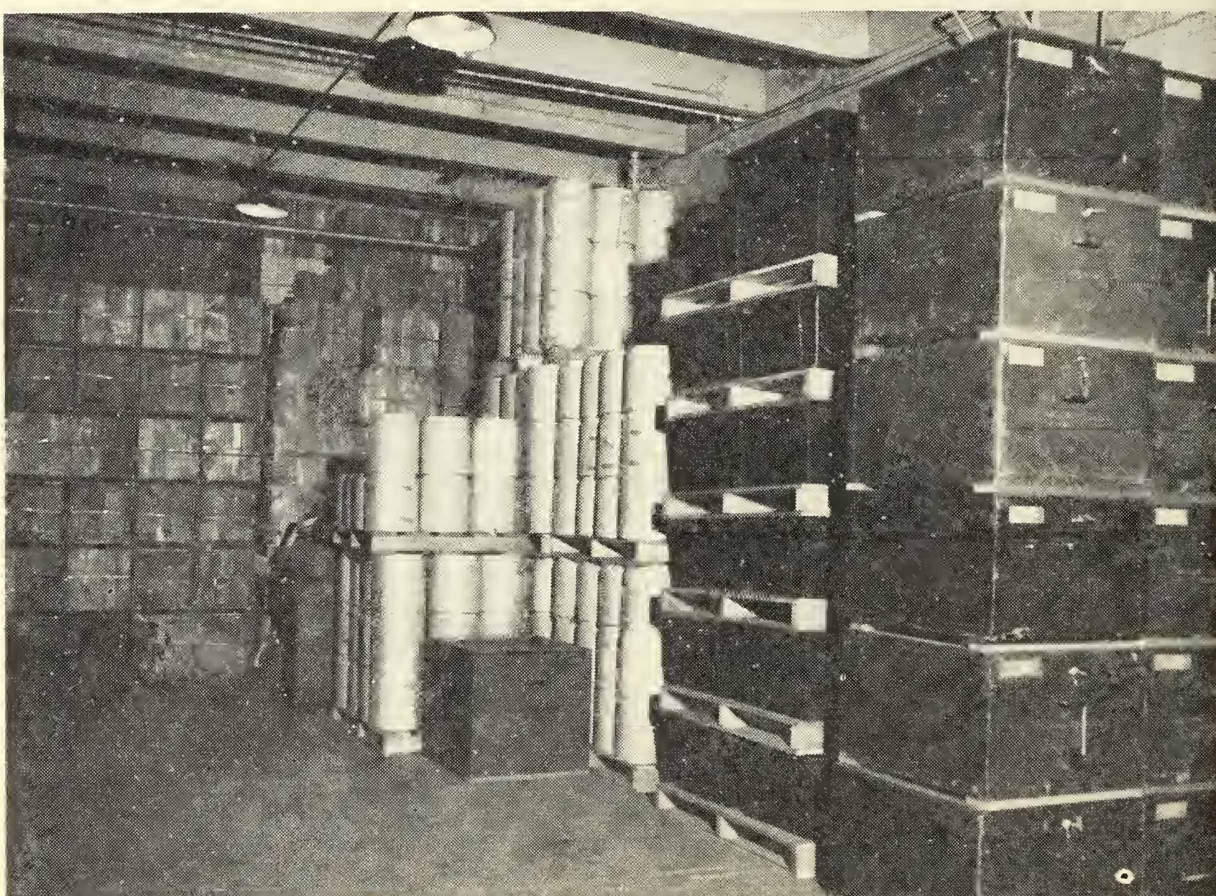


FIGURE 3.—The shipping boxes on the right contain 5-burner liquid gas ranges and accessories. The slats between the boxes enable the tines of the lift fork to pick up a single range. Kimmel stoves and dropping cans for hot foods are handled on pallets.

Figure 4.—Lift truck handling four 25-man mess outfits on a single pallet.

eliminated 686 items needing reconditioning in a 100-man outfit, and the field is well satisfied. Extra paper and plastic gear go out on all fire orders. Obviously use of this gear on a fire is much more sanitary as well as saves the labor of dishwashers in the fire camp.

Sleeping bags.—Cleaning and fumigating kapok sleeping bags, especially when they are wet, is a real "headache." This year, for the first time, we tried out paper sleeping bags (one-trippers). Field acceptance was good for early fires. For late fall fires we may need to add a blanket for extra warmth. This paper sleeping bag idea needs to be aggressively followed up. Elimination, to the greatest extent possible, of the kapoks will most certainly decrease the warehousing problem and, with it, costs.

Storage.—Storage and loading in the fire cache are greatly facilitated by use of a lift truck (figs. 3 and 4). Many fire shipments are made at night; with a lift truck, one man can handle all items. Warehouse space is also saved because equipment can be stacked higher than by hand labor. The ease of handling and safety are also important.

The first order for equipment on a fire usually is placed by asking for a certain number of 100-man outfits (camp and line) (fig. 5). Subsequent orders usually are by items—so many pulaskis, adz hoes, back-pack cans, pumps, hose, torches, etc. This region has discarded the boxing of hand tools. All axes, pulaskis, hoes, shovels, etc., are now bundled, six to a bundle, in burlap, ready for air dropping, mule or truck transportation. No longer is it necessary to keep a supply of different sized boxes on hand. There is no great loss if the burlap does not come back from a fire.

FIGURE 5.—A 100-man camp and line outfit (except for full complement of sleeping bags) on pallets ready for loading. Note the burlap packaged hand tools. The tank in the background is a Siskiyou hot-water heater. Efforts toward better palletizing of the 100-man outfit will be worked out this winter.

Only a few of the many problems involved in the behind-the-line back-up of the men on the fire line have been mentioned in this article. The opportunities for improvement are never ending.

'olume 14 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

ACTUARIAL FIRE PLANNING IN THE NORTHERN REGION

Ralph L. Hand

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Fire control planning differs from many types of planning because the immeasurable and unpredictable features greatly outnumber the stable. For this reason it becomes necessary to anticipate the results that may be expected from a combination of separate elements, many of which cannot be accurately weighed by themselves. This places the fire control planner in almost an identical position with the insurance actuary, hence the term "actuarial fire planning."

The problem is to calculate the mathematical probabilities that certain conditions will exist as a result of certain combinations of stable factors and imponderables, according to the specific time of year and locality; to interpret the results of these calculations in terms of men, machines, and other facilities needed to meet each situation; and finally, to identify these various "levels of preparedness" according to the impact of weather conditions on each major fuel type.

There are many combinations of circumstances which may result in the need for a certain number of men and machines at a given place and at a given time. If we are caught short, it makes little difference what the reason was. Any one combination of circumstances is not likely to be repeated in the same manner within the span of a reasonable planning cycle. In attempting to use individual factors which in various combinations go to make up the fire load, we complicate the problem by introducing a series of elements about which we can do little more than speculate. It is proper, of course, to continue the study of these elements with the idea of developing better forecasting results for our day-to-day action; but for the advance organization and placement of men and other facilities, we need to simplify our methods. That is the reason for actuarial planning, which analyzes and measures the results of the past and converts them into terms of future probabilities.

Basic Material

In order to develop a complete series of actuarial tables, it is first necessary to conduct an individual fire analysis, a transportation analysis, and a number of additional, separate studies regarding certain phases of fire control activity. Emphasis should be placed on the importance of getting the best available information in all cases. There should be no hesitancy in utilizing data that has been worked up for other purposes or in other regions, provided it is applicable and the best that can be obtained. On the other hand, the entire planning project need not be delayed simply to wait for the completion of a long-range research study. Use the best data that exists, but if nothing else is available within reasonable time limits or realistic financial limitations, individual judgment may have to be resorted to in certain instances. Only by this means can the plan be carried to its "payoff" conclusion. If we slow up the whole job in order to substitute measurements for estimates in a few isolated cases, we may find that the good reliable data has become obsolete before it can be put to use.

Allowing for the normal losses in pioneering a work of this kind, the Northern Region spent approximately 2½ man-years annually, plus 6 weeks per year per forest, contributed by regular personnel, for a total period of 5 years, to complete the job of analyzing basic material.

Following are brief descriptions of the important analyses and special studies that are basic to the plan.

The Analysis of Individual Fires

The Northern Region suppression plan is based on a searching analysis of approximately 27,000 fires that occurred during the 20-year period 1931 through 1950. It is planned to analyze the succeeding 5-year period at the expiration of the 1955 fire season, and to continue this procedure at half-decade intervals.

Punchcard tabulations cannot be used for this type of analysis. Each fire is regarded by itself and very often the facts of greatest importance cannot be coded on the individual fire report. Furthermore, it is almost always necessary to consider the accumulated effect of a number of separate factors together, in order to catalog a fire in one of the special categories or make the proper manpower and time adjustments.

Considerable emphasis should be placed on the importance of uniform methods in making the analyses and the requirement that fully qualified men be used for the work. Adequate coordination can be assured only by the participation of a planning specialist through most of the operation on every forest. Throughout the entire job, those making the decisions should be cautioned first against accepting recorded action, especially on the less recent fires, without judging it in the light of modern conditions; and secondly, to be realistic in recognizing the kind of errors that cannot be wholly eliminated. In this way, it is possible to get a reasonably accurate picture of what would be expected in the way of action under present-day conditions, assuming an adequate supply of men and all necessary facilities.

Detailed instructions for making the individual fire analysis have been prepared and are available for use.

The Transportation Analysis

This analysis is designed for the purpose of determining the best answers to the following problems:

1. Proper location of manpower, machines, and other equipment.
2. Need for transport equipment, including trucks, airplanes, and pack mules; also the proper balance between ground and air facilities.
3. Degree of centralization required to promote the greatest efficiency in purchasing, warehousing, and distributing.
4. Need for extensions and adjustments (including establishment of standards and priorities) in the road, trail, and landing field systems.

The transportation analysis includes a number of separate studies, the most important being:

1. The transportation zone map. A map of each forest on which is shown the present road system and the usable airports. Details of this map cover the following:
   a. Classification of roads as to speed and load capacity; i.e., will it accommodate heavy transports, long-wheelbase buses, etc. (three classifications each for speed and capacity).
   b. Location of all barriers or bottlenecks (weak bridges, steep grades, poor alinement, etc.) that prevent through traffic of special equipment. Each barrier indicated by a number that corresponds to a descriptive tabulation.
   c. Time calculations recorded at each road intersection, figured from all important distribution centers (existing and prospective).
   d. Zone delineation from one or more major supply centers, indicating the end of road transportation according to hour-control standards for heavy reinforcements.
   e. Delineation of air-delivery zones or areas that cannot be reached by truck haul within allowable time limits. Within these zones the time is shown by air transport from one or more airbases (existing and prospective).
2. The travel-rate study; broken down into two phases, road and trail. Air travel, being direct, and involving such readily measurable elements as airline distances and cruising speed of different types of airplanes, does not usually require a special analysis. This study results in a series of travel standards for each recognized type of facility.
3. The trail study. Confined mainly to the back-country areas that are in the air-delivery zones. This analysis deals with the logical rearrangement of trail systems to fit in more closely with smokejumper use in such areas. It establishes travel-time standards to be used principally for evaluating the comparative efficiency of back-pack, pack-stock and various types of mechanical trail transport in the return of smokejumper or other air-delivery equipment.

4. The study of volume in ton-miles hauled (includes breakdown by air and ground transport according to supply base).
5. Expansion and adjustment of the transportation system (affects all air facilities, roads and trails, and includes project priorities).

Special Analyses

1. *Bulldozer Analysis.* A special study of bulldozer use, including a map delineating those areas or zones, ordinarily accessible to dozers, and where such equipment is usually effective. Included also in a comprehensive study of all identifiable dozer fires from which rates of progress in line construction and percent of total perimeter that is operable by dozers can be determined for each zone. The maps and other data are by individual forests.

2. *Tanker Analysis.* A special study of the tanker fire problem by individual forests, covering such fields as:

a. Occurrence rate and trend in man-caused fires.
b. Slash or other rapid-spread fuel areas in relation to road accessibility.
c. Nonroad tanker use; study of areas where lighting as well as man-caused fires may be accessible to 4-wheel drive equipment.
d. Study of existing and prospective tanker bases and need for water-source developments.

3. *Smokejumper Analysis.* This study covers the entire field of smokejumping, including transportation. It is used to determine the number of jumpers required on an expectancy basis; the relative value of different operating bases and the degree of centralization needed to insure efficiency. It also covers the subjects of pack-stock and mechanical equipment for the return of gear.

4. *Minor Power Equipment.* As other types of power equipment (i.e., chain saws, fireline trenchers, etc.) come into practical use, separate studies are conducted along the lines of the bulldozer and tanker studies and for similar purposes.

The Method

The actuarial system of fire suppression planning can best be described by use of a triangle, similar to the familiar fuel-heat-oxygen combination used in explaining flammability. In this case, however, we use fuel, weather, and fire-starting agencies as the three points of the triangle. Under previous planning systems, mobilization has been based on something like this:

Fuels rate X and weather is such that we are approaching a Burning Index of Y; therefore, since it is midsummer, with the likelihood of severe lightning storms, and since the woods are full of huckleberry pickers, we must be prepared to "give 'er the works." Just what that means in terms of men, methods and machines, as applied to that particular fuel rating at that particular B. I., at that time of the year and in that area, is left mainly to judgment. This may mean the pessimistic reflection of some oldtimer on the tough seasons of 1929, 1931, and 1934, or it may mean the vague optimism of a newcomer who has never seen a bad fire season.

In the new system, we attempt to calculate the precise mathematical betting odds in all cases where measurements are impossible and forecasts good only on a short-range basis. In application it works thus: With an X fuel rating and a Y Burning Index, at this particular time of year and in this unit, the betting odds are 2 to 1 that we will need K men, L units of certain specified types of power equipment, F trucks, G head of pack-stock, etc., etc. The "even" or 50-50 odds may double the manpower requirement and boost the need for trucks, but not change the special equipment—or it may do otherwise. If we want to play a safe game, with the odds, say at 1 to 19 in our favor, the requirements may approach the high levels of the oldtimer's memories of 1931; and it might be utterly foolish to prepare for such an eventuality. As conditions become more critical, specific-requirement and locality calculations can be made daily and pinpointed to a finer degree.

The arrangement of the planning material is such that data on individual factors can be segregated and localized to almost any degree of refinement desired.

I should like to repeat here that the individual fire analysis from which the expectancy tables are compiled is not just a mass of statistical data. What may be regarded as the equivalent of a careful post mortem was conducted for each fire. Only the geographic location, time of year and time of day, are recorded with historic exactitude. All other facts regarding behavior and action are recast in terms of present-day conditions, transportation facilities, and methods. Certain man-caused fires were thrown out because they would not have occurred under the present situation. Many fires were adjusted downward as to manpower and length of control-line requirements, in order to compensate for the faster transportation or better techniques that are available now. In other instances, the manpower (or machine power) was boosted appreciably to comply with present-day practices—the result being less burned area and less final cost at the expense of heavier initial attack.

As is logical in a system based on expectancy tables, averages are not used except in a few instances where a quick figure is needed for purposes of comparison. In the calculation of such factors, for example, as number of suppression men required, the average figure is almost invariably much too high. This is due to the tremendously overweighted effect of one or two bad seasons against a normally light load.

To avoid the obvious dangers of a "strength-of-force" plan based on average figures, the present system employs a means of determining various "plan levels" that can be tied in with the characteristics and peculiarities of the various fire seasons. These are explained as follows:

Plan Level 1 (*the ranger district level*).—In order to provide a businesslike margin of safety, the normal (or 50-50) level has been adjusted slightly upward—usually to provide coverage for 11 or 12 out of a 20-year total. In defense of this, it may be stated that no insurance agency that expects to remain solvent will make contracts that give the policyholders an even break with the company; this is just commonsense logic. Plan level 1 may, therefore, be defined as representing the maximum requirements of a normal season, with a small safety margin added. The "normal" season in this case is not measured by average fire dangers, duration of dry weather, and total fire occurrence. It is measured in terms of the impact that these and other elements have on manpower, machines, other equipment, transportation, and communication facilities, overhead, special services, and everything else that goes to make up the total fire load.

Plan level 1 is also referred to as the ranger district level, because it is the level at which every ranger district should attempt to become self-sufficient. This does not mean that every district ranger who has need for bulldozers, chain saws, or similar items of power equipment at plan level 1, should have such equipment tied down for his exclusive use. It does mean that he must know where he can get it on short notice and that he must provide the necessary contracts and other arrangements well in advance of the time of need.

Plan Level 2 (*the forest level*).—Rarely if ever does it happen that all ranger districts on a given forest are hit by a combination of circumstances that involve all three points of the triangle (fuels, dry weather, and fire starts) at the same time. Thus, when every ranger district has gone as far as possible toward becoming self-sufficient at plan level 1, it generally results in a strengthened forest organization that can meet a somewhat higher level (usually 13 to 16 years out of 20). This level is attained by prearranged plans for rapid interdistrict movement of men and facilities, plus the use of project crews and equipment that are centralized at the forest level. Plan level 2 is recognized as a definite step above the normal, but it still lacks many of the earmarks of a critical season. After all available facilities are exhausted, if the requirements cannot be met, the forest should seek help from other units through a designated dispatcher. Sometimes the problem is relatively simple because a neighboring forest is in control of certain facilities that are in excess of its own plan level 2 needs. At other times it will require special efforts and arrangements which may be a regional as well as a forest responsibility.

Plan Level 3 (*the group level*).—We now come to the season that is definitely in the critical category. This does not necessarily mean critical on a regional basis, we must remember to keep our sights properly alined and recognize that one tough spot in the region can place us in a situation that may require desperate measures. If properly organized in advance, it may often happen that an individual forest that is barely able to meet its own level

2 obligations can pull one ranger district through a level 3 ordeal without outside help. Generally, however, when we speak of plan level 3, we think of a situation in which at least one forest is definitely beyond its depth through having more than one—perhaps several—ranger districts in a critical situation. Such situations immediately become a regional problem but should be confined at the group or zone level insofar as reasonable and practical. It is often difficult and sometimes virtually impossible to line up the volume of manpower, machines, overhead, and transport facilities within one group of forests to meet a simultaneous outbreak in, say, three forests in the northern Idaho zone or two in western Montana, but we can still do our best. A plan level 3 organization within one zone should take care of from 17 to 19 years out of 20 within the group area.

Plan Level 4 (*the regional level*).—This is the top level represented by the so-called bust season. Within the 20-year period covered by the analysis, the Northern Region has had three such years that affected the entire region. These were 1931, 1934, and 1940; the first two were occasioned mainly by critical burning conditions, the other by worse-than-normal burning conditions coupled with extreme concentrations of lightning fires. As with the other levels, it must be recognized that a single ranger district or even an entire forest can reach level 4 without necessarily loading the region to that level. However, it is almost certain that a level 4 on a single ranger district with a high potential, will not only greatly overload the forest but may place the entire group in a level 3 situation—even though all other districts are at normal or below. The planning of facilities and manpower for level 4 on a regional or even a zonal basis becomes immediately a regional problem and invariably requires aid from other regions or from military sources, or perhaps both. While the entire region has not experienced level 4 conditions since 1940, certain individual forests were very closely approaching that condition in 1944, 1945, and 1949.

Uses of the Plan

In conclusion, I should like to emphasize the fact that the Northern Region's actuarial fire suppression plan is neither a substitute for, nor an adjunct to the well-known "Hornby Presuppression Plan" that has been used (with increasing modifications) in this region for the past 20 years. By the very nature of its construction, the new plan cannot differentiate between certain presuppression and suppression features. Hence, it does overlap the Hornby Plan to a limited extent in the field of preparedness and initial action on the small (smokechaser) fire. It does not enter the phases of prevention or detection, but it does cover all action subsequent to the initial discovery, from the single mission of a lone smokechaser to the heaviest reinforcements required on large project fires.

Once the analyses are completed and the data properly arranged, modernization of the plan at 5-year intervals, or even oftener if desired, is not an exceptionally difficult nor time-consuming job. It is assumed, of course, that transportation maps, maps and records of slash and other high-hazard areas, and such similar data will be kept currently up to date with a reasonable degree of regularity. This, of course, would be necessary under any kind of planning system. Assuming that this is done, the actual analysis of a recent 5-year period, and consolidation of the data into a set of revised tables, can be accomplished in from 4 to 6 man-weeks per forest. New innovations in travel speeds or fireline producing equipment will, of course, require additional study and analysis, but again, this would be needed under any consideration.

Probably the greatest present value of this type of plan is its adaptability in providing the answers to almost any kind of special problem. To date, it has played a major part in such matters as the determination of pack-stock needs, evaluation of the Remount and Winter Range, decentralization of warehousing, various problems concerning the smokejumpers and other aerial services, the Spokane Warehouse, the new aerial development center, and others. It has been the basis of priorities in the assignment of tanker units and is used currently in establishing levels and approving placement of handtools at the ranger-district, forest, and subregional levels. It also determines the levels for our centralized fire caches at Missoula and Spokane. It is used as a check in approving or disapproving revisions and adjustments in the seasonal forces of the various forests and in the distribution of fire training funds.

The most recent use made of the tables was to determine the impact of peak loads on present and probable future radio channels. From the expectancy tables it was possible to graph the information needed in a matter of hours; otherwise it would have taken weeks of study and compilation.

Another and perhaps greater use is dependent on progress in developing simplified methods in fuel-map revision and our ability to teach rangers and district dispatchers to use the suppression plan guides. A few are well acquainted with this system of planning, having taken a part in its early development, but many more are unfamiliar with the data itself, as well as with the means of application to a ranger district.

The satisfactory completion of a zoning project, which would divide the region into suppression zones and attack units, is the No. 1 need if we are to get maximum use out of the vast amount of information that has been compiled. Next, and perhaps equally important, is the need for continued efforts to indoctrinate rangers and their fire control assistants in the application of the actuarial principle, particularly to the organization and mobilization of suppression forces. These are the only real stumbling blocks that prevent the suppression plan from reaching its final goal—the completion of a workable action plan on every ranger district.

EXPLORING THE POSSIBLE USE OF FIRELINE PLOWS IN THE WEST

Fred G. Ames

Forester, Region 8, U. S. Forest Service

In the southeastern United States, fireline plows have long been used as a tool in fire suppression. The past decade has seen remarkable progress in the development of effective fireline plow units. The use of these plow units has expanded until practically all organized forest fire control agencies and many industrial timberland owners depend upon such equipment for fire control work. (More than 1,500 mechanized plow units are working in the South.)

For the past two years Region 8 of the United States Forest Service has been conducting extensive tests of fire plows to determine the capabilities of proved units, by types and size classes, under many different conditions. The results of these tests will be available to fire control agencies wherever plow units have possible use as an effective fire control tool.

In September 1952, a reconnaissance trip through several areas in the West was made to determine the possible use of fireline plows. The examination was based on a comparison of conditions existing on these areas with the various conditions encountered during test work in Region 8. Many similar conditions were found.

The first area examined was the Bessey Division of the Nebraska National Forest. This area had many characteristics common to the sand pine "scrub" of the Ocala National Forest, where the disk-type fireline plow has been the principal fire tool for more than 10 years. The forest areas on the Bessey Division consist of ponderosa, jack, Austrian, and Scotch pine and eastern redcedar plantations up to 40 years old.

Soils on the two areas are similar, a deep porous dune sand, free of rock. The sod is light, and while the Ocala "scrub" has scattered clumps of woody shrubs, the forest floor of the older Bessey Division plantations are practically free of anything other than a thin low grass. The only obstacles to plowing are the occasional short steep slopes and these can be successfully overcome.

Comparing forest and soil conditions on this Division with the testing areas in Region 8, a light disk plow pulled by a crawler tractor of about 20 drawbar horsepower should be effective in the younger plantations and the open areas, building 150 to 200 chains of plow line per hour. In older plantations where stand density will be a factor, a medium or heavy disk plow pulled by a crawler tractor of about 38 drawbar horsepower should produce between 125 and 170 chains of line per hour.

The other seven selected areas examined during this reconnaissance trip were on the Harney National Forest in South Dakota, the Boise Forest and the Bureau of Land Management lands in Idaho, the Modoc and Lassen Forests and a portion of the Sacramento front country in California, and the Coconino plateau in Arizona.

Topography on these areas varies from rolling to steep and rugged, yet on all of them sufficient plowable topography exists to justify the use of fire-plow units. Many of the forest conditions and much of the terrain in the ponderosa pine type, occurring on most of the areas examined, resembled conditions found on the testing areas in the Ouachita Forest of western Arkansas, where a light plow pulled by a light crawler tractor is successfully used.

Dense stands of ponderosa pine reproduction, similar stands of lodgepole pine, and some brush areas will be definite physical obstacles in plow line production. Similar conditions of density existed on one or more of the testing areas in South Carolina and Florida. These physical obstacles can be overcome by use of a suitable size crawler tractor. Most of the juniper-sagebrush type is definitely plowable. as are considerable areas found in the lodgepole pine, alpine fir, and white fir types.

Down timber (heavy logging slash, down snags, blowdown, and bug-killed timber) is one physical obstacle to plowing that will cause difficulty to the plow unit on areas otherwise suitable. On areas where down timber is heavy, it will be necessary to clear a way for the plow.

The plow type suggested for use on these seven areas is the Talladega mountain-type middlebuster. This plow is simple in construction, has no moving parts, and is designed for use in rocky soils. It makes a V-shaped furrow, moves a minimum of dirt, and distributes the berm evenly. The plow point is designed to work between rocks and to free itself of most of the solid rock and tree roots encountered. This type of plow unit is compact, as is necessary for operation in mountain country.

This type of plow was tested in the mountains of northern Georgia and western Arkansas. During these tests a light crawler tractor with a rating of 18 drawbar horsepower was successfully used to construct plow line on downhill slopes of up to 66 percent, side slopes up to 45 percent, and uphill slopes up to 30 percent. Line production on these tests averaged 91 chains per hour for 31½ miles under simulated fire suppression conditions.

The successful use of a fireline plow in the areas examined is dependent upon a well-balanced unit which is properly armored, adjusted, and outfitted for the job, operated by a well-qualified and experienced man familiar with the unit's capabilities and working with a trained and well-organized support crew. Under such conditions fireline plows could be highly effective fire suppression tools.

A COMPACT MAP CABINET FOR FIRE DISPATCHER'S USE

FRANCIS L. COYLE

Forestry Aid, Chippewa National Forest

This map rack was designed to hold all maps, forms, and information required by the dispatcher, in an easily accessible manner but in only a minimum amount of wall space. Overall dimensions are 33 by 31 by 7 inches. In addition to the space on the back of the doors, the rack contains four panels mounted on a movable base bolted to a frame. This frame is fastened to the inside center of the cabinet and can be pulled out so that all four panels can be consulted merely by turning the panels as pages in a book (fig. 1).

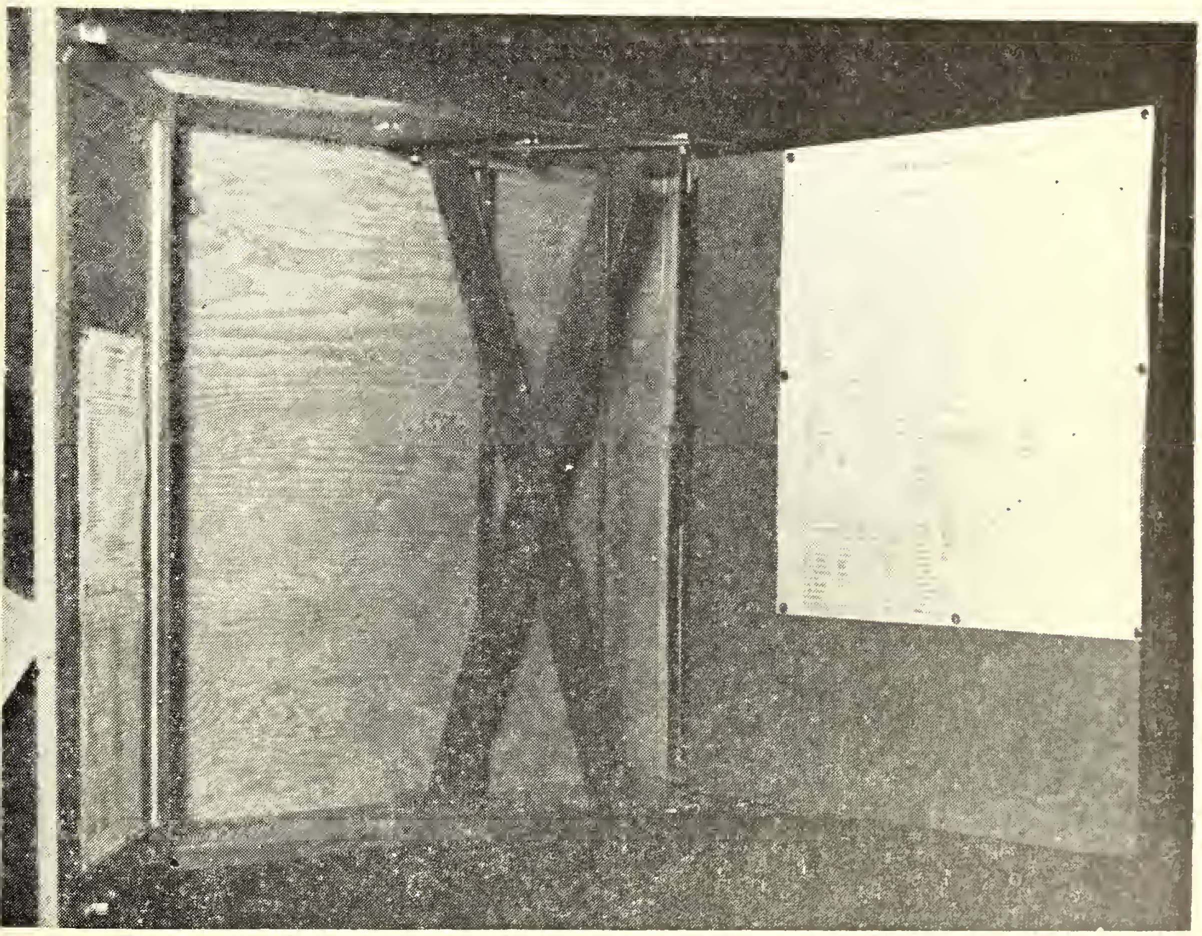

FIGURE 1.—Frame pulled out and panels ready to be turned.

The cabinet contains the following material: Travel-time maps, a lookout manning guide, firefighter wage rates, names and telephone numbers of five firefighter squads, the Cass Lake District presuppression plan, a fire danger record form 274 R-9, Forest Supervisor's presuppression plan, the current fire record form F-5 R-9, a current fire record map, a district map showing areas requiring special attention in fire protection, an organization map, a services of supply map, the Unit action plan, a manpower placement map, a fire organization chart, and an atlas of district fuel type maps.

FIRE PLOTTING RULE

John L. Kerzisnik

Forester, Superior National Forest

The transmission of accurate fire data from an air scout to the forest fire officer on the ground is always of paramount importance. In the interests of efficiency, the data must be both brief and complete. This becomes increasingly more important during periods of high fire danger when traffic on radio channels is apt to be heavy.

A simple rule to facilitate the work of the air scout is shown in figure 1. The device consists of a plastic azimuth circle equipped with a graduated indicator arm of the same material. A brass rivet acts as the pivot around which the arm rotates. The azimuth circle is a Forest Service issue item used in plotting fires. The indicator arm was constructed of plastic 1/16 inch thick.

On a map, preferably timber type, the air scout picks a suitable orienting point near the map information he wishes to plot. The orienting point may be a section corner, point of a lake or stream, or any other easily identifiable map feature. The center of the azimuth circle is placed on this point. In figure 1 the orienting point is the one-quarter corner between section 13 and 18.

Readings of angles and distances to relevant data such as water chances, spot fires, ridges, and swamps, are transmitted to the receiving party by means of radio. They are plotted by means of a similar device similarly oriented on a map of the same type and scale. Figure 1 shows the location of some pertinent points on a going fire.

When map data gets outside the range of the graduated arm, the orienting point can be shifted to some other map feature and plotting continued from the new point.

Should other facilities be lacking, the size and shape of a fire can be reasonably shown by plotting and joining tangents to all curves on the perimeter of a fire.

When photographs are used instead of maps, a holder is suggested. A simple holder, made from a square of plastic and fitted at the corners with photo holding slots held in place by plastic cement, will carry a 9- by 9-inch photo. The photo fits on the reverse side of the plastic holder. The azimuth circle and indicator arm are fixed in the center by plastic cement. When the photo is in place, the principal point will fall directly underneath the pivot. Readings are taken as before, transmitted by radio and plotted at the receiving station on a similar photo. The use of photos is limited to where two sets of similar prints are available.

From brief experience, the indications were that the method could best be utilized by having the observer-scout as a passenger together with the forest officer in charge of directing the opera-

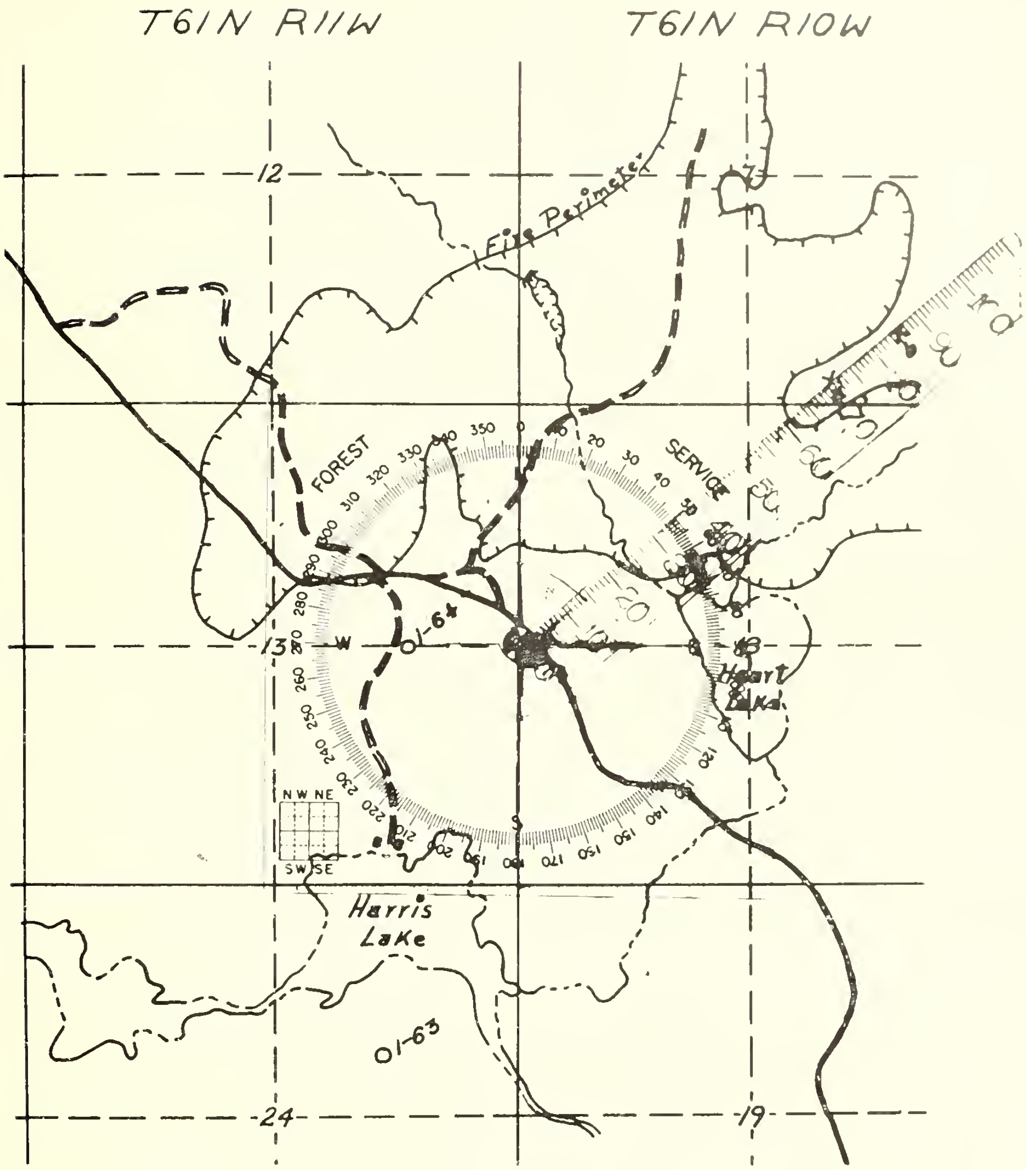

FIGURE 1.—Plastic azimuth and scale in use. Readings are to spot fire *a*, 49° distance 71; spot fire *b*, 50° distance 86; and beaver flowage, 1° distance 64.

tion from the air. This allows the scout to do his plotting in conjunction with current actions. It also allows the scout to divorce himself from other radio traffic and treat the mapping job as a separate project.

Photo interpreters with a background of air checking photographs can readily adapt themselves to mapping and plotting fire data, gaging distances, and identifying types.

This method of transmitting fire data is very simple to apply. Each orienting point in effect simulates a fire tower giving angle and distance readings to any point within the range of the indicator arm.

KENTUCKY FIRE FINDER

RALPH A. NELSON, *District Forester*, and L. B. DUNN, *Ranger, District Western, Kentucky Division of Forestry*

The Kentucky fire finder is not exactly a new idea, but rather a new combination of several old ideas. Its construction is relatively simple; materials are easy to obtain and cost only about $5 per finder (fig. 1).

The sights and the various disks were cut out on a small band saw. A zinc linecut of a standard 8-inch Forest Service protractor was made at the local newspaper office and used in a job press to print the protractor directly on the ½-inch plywood disk. This provides a cheap, accurate and durable protractor.

A solid top with a small window and cross hair for observing the protractor makes it possible to eliminate errors in reading. This is considered important with the inexperienced lookouts so often used these days.

The finder's three small disks provide a simple yet accurate method of shifting the finder to clear obstructions. This idea was taken from the Minnesota finder described by Roger Williams in the January 1951 issue of Fire Control Notes.

Materials needed are as follows: 1- by 3-inch seasoned yellow-poplar for sights *A* & *B* (fig. 1); 3/8-inch fir plywood for top disk *C;* ½-inch fir plywood for disk *G;* 1/4-inch fir plywood for the three small disks *H;* 3/4-inch fir plywood for bottom disk *J;* 1/8-inch hard board for washer *E;* a zinc linecut of an 8-inch protractor from which impression *F* was obtained on disk *G;* seven 1/8-inch flat-headed bolts to assemble the various parts (notice that the three bolts *L* project 1/4 inch beyond their nuts and fit into holes *K* in disks *H*); two horsehairs for sight *A* and opening *D* in disk *C*. The horsehairs were the most difficult material to obtain.

Sights *A* and *B*, 4½ inches high, are brought to a slight point at the top center, to help "rough in" the sight on a fire. Disk *C* is 16 inches in diameter. Window *D* has a radius of 3½ inches for inner cut and 4 3/8 inches for outer cut; an angle of 40° from center determines other two sides of window.

Washer *E* has a 6-inch diameter with ½-inch center hole. Disk *G* is 17 inches in diameter. Stock for this disk was cut 18 inches square, and the protractor *F* was printed roughly in its center. After the ink had dried the 17-inch circle was inscribed about the center of the protractor.

Disks *H* are 7½ inches in diameter. Holes *K* 6 inches from center take bolts *L* (straps could have been used in place of these disks as in the Minnesota finder, but it was felt that the disks would provide a steadier base). Disk *J* is 17 inches in diameter.

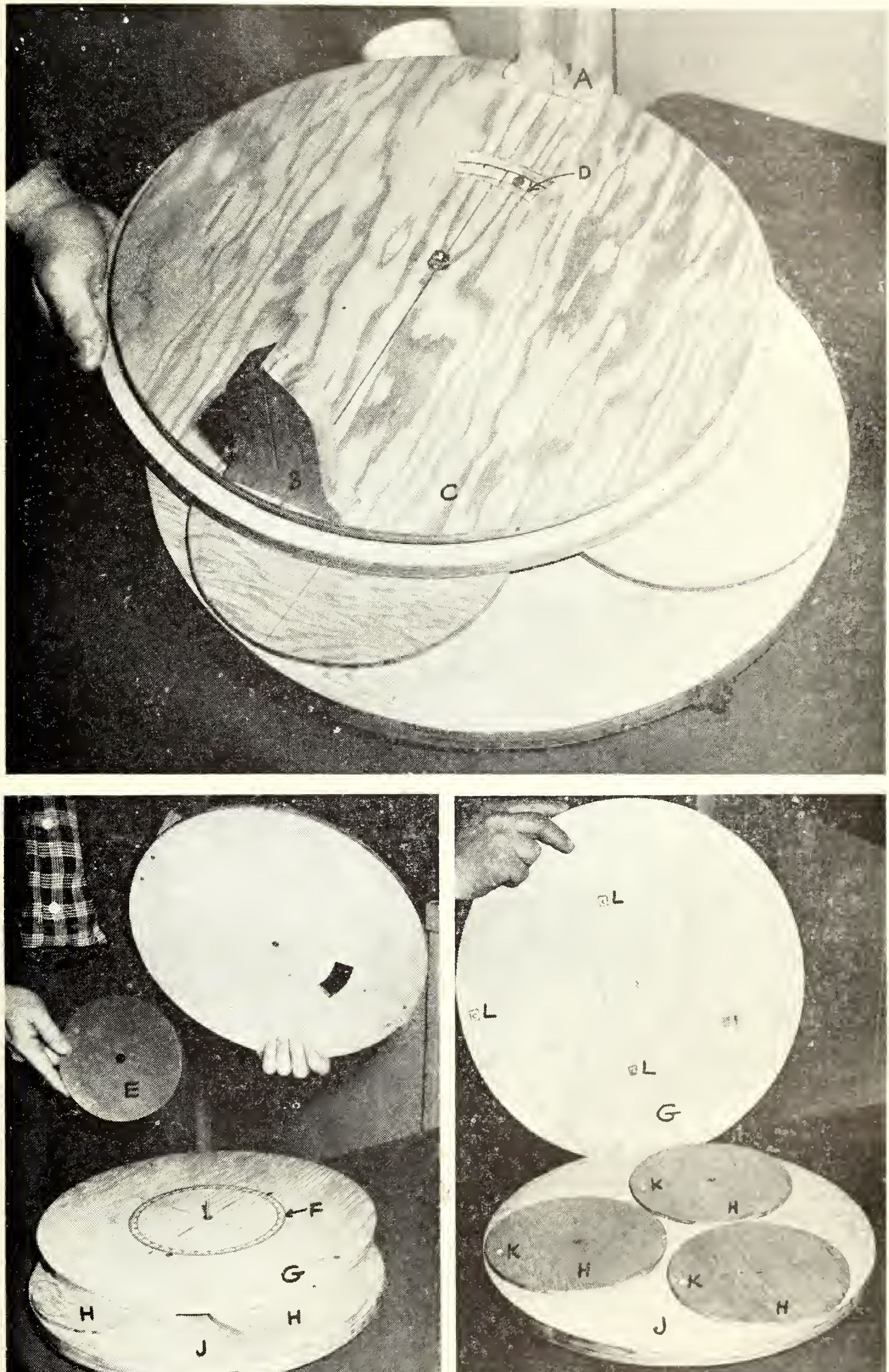

FIGURE 1.—Three views showing component parts of the Kentucky fire finder.

WASATCH FIRE TOOL CACHE BOX

FRANK STONE

Fire Dispatcher, Wasatch National Forest

We have recently designed a fire tool cache box that we believe is an improvement over the old-style caches we have used. Other forests and regions may be interested. The box is designed for a 10-man outfit. The equipment is placed in the box as follows (fig. 1): 1st long compartment at back of box, 4 pulaskis and safety sheathes; 2d long compartment in center, 8 baby shovels; 3d long compartment in front, 10 knapsacks with supplies and 2 files, 1 whetstone, 4 small first-aid kits, 1 5½-foot crosscut saw and 2 handles; 4th compartment at left end, 1 5-gallon waterbag and 5 1-gallon canteens. Because the box partitions are removable it can be used for almost any combination of tools.

A sheet-metal covering adds to the life of the box and gives it protection against the weather. Two- by four-inch cleats are attached to the bottom to prevent rotting when the box rests on the ground.

The box can be transported easily by pickup. This facilitates both spring delivery to cooperator, per diem guard, or other location, and pickup when the season is over so that the contents can be checked and reconditioned at the central warehouse.

Drawings of the box can be obtained by writing to the Regional Forester, U. S. Forest Service, Ogden, Utah.

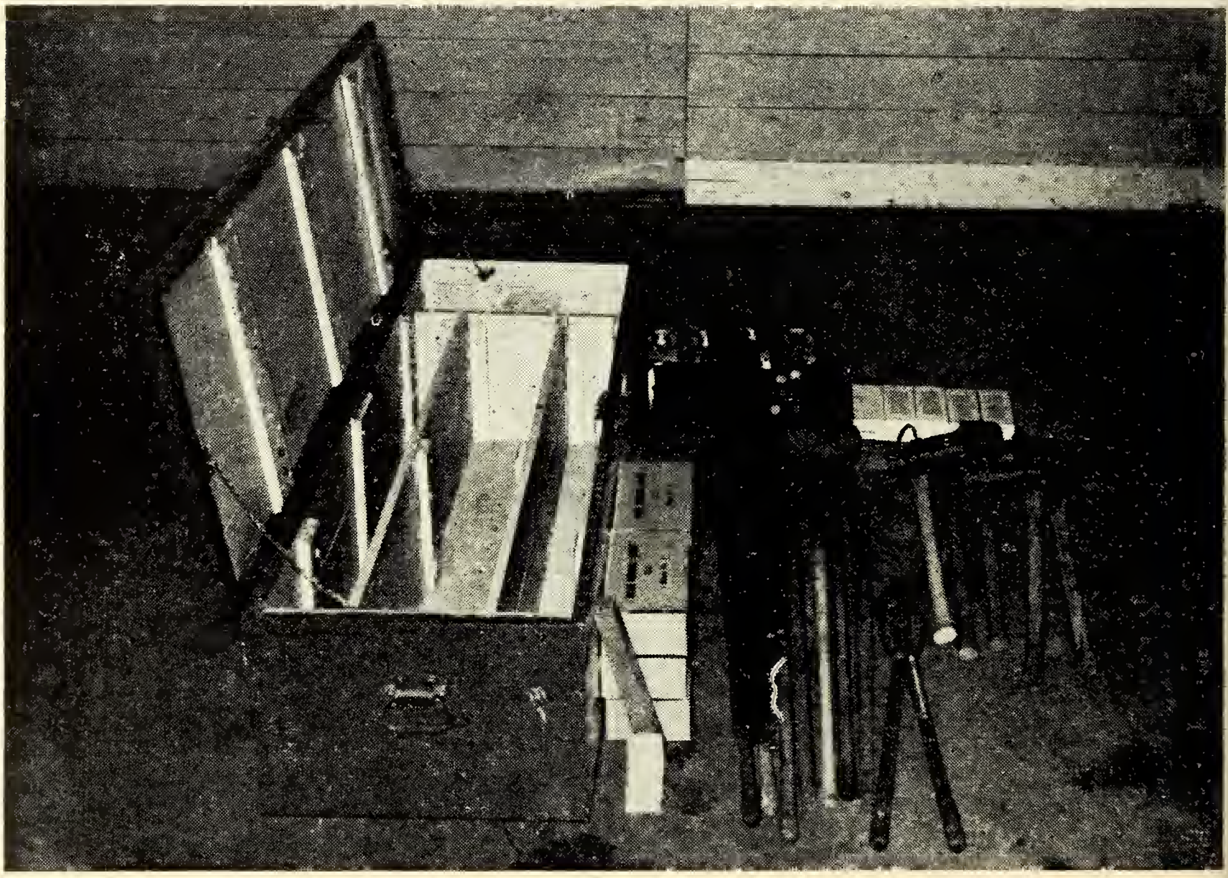

FIGURE 1.

PICKUP TOOL RACK AND RADIO BOX

VERNON LEWIS

Fire Control Assistant, Klamath National Forest

A pickup tool rack and radio box has been designed and put in use on the Salmon River District. The rack provides a safe and handy place for tools and does not interfere when pickup is used for hauling. The rack sits next to the cab and is fastened to the bed by two 1/4-inch bolts at each end. The radio transmitter and receiver boxes are mounted on sliding shelves so they are easily available for servicing. (fig. 1).

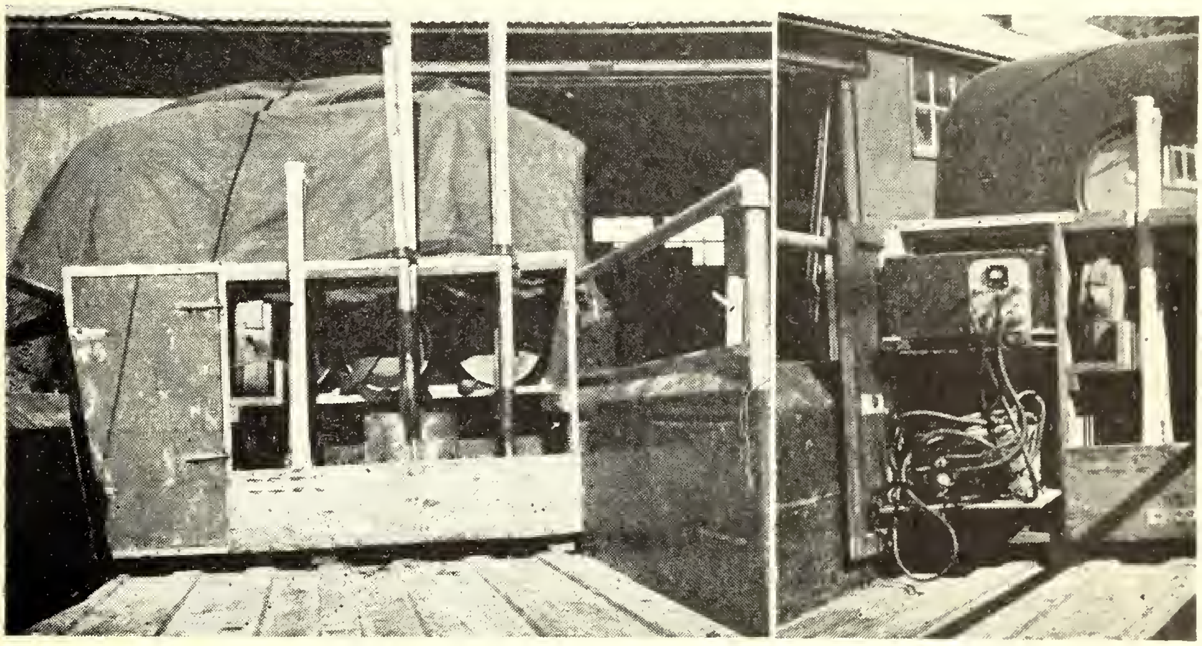

FIGURE 1.—Tool rack from rear of pickup; radio box door closed and open, showing transmitter and receiver units on sliding shelves.

A canteen rack mounted behind the tool handles consists of a 1- by 4-inch base with a 1- by 2-inch back. Canteens are held in place by a cord and light spring. The cord is fastened to the rack at one end and a screen door hook is used on the other end.

Scrap lumber was used to make these racks but 3/4-inch plyboard would be better and would simplify construction. Light aluminum was used to cover the radio box. Small blocks of 2- by 4-inch lumber, shaped or notched to hold tool heads, were nailed to the bottom. Rubber straps with spring snaps hold handles in slots.

An accessory box may be placed in front of the rack and securely locked in place by fastening 1½- by 4-inch pieces to the bottom of the box and extending them beneath the tool rack to the front of the pickup bed. Removable pins through the bottom of the rack into these pieces lock the box in place. When needed the box may be removed by pulling the lock pins and sliding box out.

STATISTICAL FIRE NARRATIVE REPORT

RICHARD F. JOHNSON

Assistant Fire Dispatcher, Angeles National Forest

Immediate analysis of fire suppression action is conceded to be one of the best methods of recognizing and remedying weak spots in a fire organization. Prior to 1940 the U. S. Forest Service Statistical Fire Report required an analysis of such items as Discovery Time, Report Time, Get-Away Time, and Travel Time, all important factors in fire suppression. Revisions of the Statistical Fire Report Form 929 in recent years have eliminated this analysis section leaving the fire planner with an excellent set of statistics but in many cases without the reasons as to why the action occurred.

STATISTICAL FIRE NARRATIVE REPORT

(Complete form in pencil for each Statistical Fire-Include only information not covered in Form 929 follow forest service-action that leads to first constructive work on the fire)

NAME OF FIRE DRAW-BACK SIZE CLASS B DATE 7/10/52

DISCOVERY TIME: 25 (Min.) Hrs. If Discovery time exceeds Regional Standard of 15 minutes check reason. (1) Lookout man failure____ (2) Lookout not occupied X (3) Fire at night____ (4) Smoke or haze____ (5) If in "Blind Area" state time since last detection patrol____ (6) Patrolman away from patrol area X (7) Other____

REPORT TIME TO FOREST SERVICE OFFICER: 10 (Min.) Hrs. If Report Time exceeds Regional Standard of 5 or 8 minutes (whichever is applicable-Ref: Page 97, Fire Control Handbook Part I, check reason. (1) Uncertain of existence or location of fire ____. (2) Dispatcher seeking confirmation of location____ (3) No one available to receive or transmit report____ (4) Telephone failure____ (5) Radio failure____ (6) Failure to use nearest communication facilities____ (7) Failure to report directly to responsible agency X (8) State the route report followed in #7 L.A. CITY FIRE DEPT. TO L.A. COUNTY FIRE DEPT. TO ANGELES DISPATCHER (9) Other____

GET AWAY TIME: 2 (Min.) Hrs. If elapsed Get-away time exceeds Regional Standard of 2 minutes check reason. (1) Seeking confirmation____ (2) Gathering men____ (3) Not prepared to go____ Why____ (4) Stopping to eat____ (5) Mechanical failure____ (6) Handling this fire as one of series____ (7) Other____

TRAVEL TIME: 30 (Min.) Hrs. If elapsed Travel Time exceeds standard on Hour Control Map, check reason: (1) Got lost____ (2) Took wrong route____ (3) Stopped to pick up men or equipment enroute____ (4) Location of fire erroneous X (5) Hunting for fire____ (6) Work on other fire enroute____ (7) Congested traffic conditions____ (8) Fire not chased by nearest man____ (9) Other____

INITIAL ATTACK FORCE: Were initial attack forces adequate, considering fuels, topography, weather conditions etc? NO (yes - no) If inadequate, state why SUFFICIENT PUMPERS WERE DISPATCHED BUT HANDTOOL CREWS SHOULD HAVE BEEN MOVED IN EARLIER

FIGURE 1.

Boards of Fire Review held in Region 5 at the close of the 1951 season pointed out the need of some method of supplementing the statistics with a narrative report that would explain the reasons involved in failure to meet elapsed time and performance standards. The Statistical Fire Narrative Report (figs. 1 and 2) was designed by the Angeles National Forest and has been in use during 1952.

The report is submitted in pencil for each statistical fire that occurs. It is intended to follow Forest Service action regardless of the cooperative assistance received in the suppression action. Entries are confined to information that does not appear on the Statistical Fire Report to avoid duplication. These reports are reviewed currently by the district ranger, fire control officer, and fire dispatcher. A summary review of each district's fires is made at the end of the year to point out additional training needs and corrective measures.

INITIAL ATTACK ACTION: State briefly the size-up and action taken in initial attack.

ORIGINAL DISPATCH OF FOUR PUMPERS SENT TO GOLD CANYON IN BIG TUJUNGA DRAINAGE AND WERE TURNED AROUND AT 1430. INITIAL ATTACK DELAYED APPROX. 20 MINUTES. ACTION ON FIRE, AFTER LOCATION CONFIRMED, WAS SATISFACTORY.

Did the first man on the fire immediately report conditions upon arrival? YES If not, why.
Yes - No

DIRECT BY RADIO. ALSO CONFIRMED EXACT LOCATION OF FIRE

REMARKS: State any additional pertinent information that will clarify action

NEAREST LOOKOUT ON DAY OFF DUE TO MEDIUM INDEX. PATROLMAN AWAY FROM STATION FOR THREE DAYS ON NORTHERN CALIF. FIRE. FIRE DISCOVERED BY PASSING MOTORIST FROM LITTLE TUJUNGA CYN. ROAD. REPORTED AS BEING IN GOLD CYN WHICH IS IN BIG TUJUNGA DRAINAGE. FIRE ACTUALLY LOCATED IN GOLD CREEK OFF OF LITTLE TUJUNGA DRAINAGE

In your opinion what corrective measure should be taken?

PROVISIONS SHOULD BE MADE TO LOOKOUT ON DUTY OR PROVIDE A RELIEF PATROLMAN FOR THIS AREA WHEN REGULAR MAN IS ABSENT FOR EXTEND PERIOD. WORK WITH OTHER AGENCIES AND COOPERATORS TO GET REPORTS ROUTED DIRECTLY TO AGENCY RESPONSIBLE.

Name Date

FIGURE 2.

A DISPATCHER'S FIRE LOG

A. VIRGIL SHOEMAKER

Central and Zone Dispatcher, Angeles National Forest

To be complete, a fire log should include an orderly arrangement of the day's events as they happen, including times, orders, action, and significant statements or decisions influencing the dispatcher's action. It should contain the bare facts and nothing more. The official log appears on every dispatcher's desk, along with the radio and telephone, all within easy reach.

The record may be jotted down in a very informal way, the log may be typed, or it may consist of a mechanical recording. In any event, the facts are preserved in the record for the assistance and protection of the dispatcher and the agency.

The Angeles dispatcher is responsible for initial action in the Los Angeles River Drainage, for Forest-level dispatching for the balance of the Forest, and as a zone dispatcher for Federal lands in southern California. The type of action required varies widely, and assistance may come from many different sources. For our particular problem, the commonly used bound log, or 3-ring binder, does not meet our needs as well as the following three forms maintained in pencil:

First report of fire.—This letter-size form, punched for a 3-ring binder, contains spaces for all "Lookout Flashes" and "First Reports" from other sources. In the case of a "Lookout Flash," the observer classifies and identifies his report, and the dispatcher makes the appropriate entries on the form. A check is used in the "Type of Flash" column when the observer is uncertain, that is object may be smoke, dust, cloud, ground fog, dense haze, etc.; S (for Smoke Flash) when certain of smoke, but may be incinerator, railroad, or legitimate burning; F (Fire Flash) when certain that a fire is seen, flames or other visible evidence; and O (Other) for such as burning airplane in flight.

If the "First Report" originates from other than a lookout, as much detail as possible is obtained on what is burning, location of fire, what is on or enroute to fire, its size, wind, rate of spread, cover, and pertinent remarks, as well as the name of the person calling, his location, and how to reach for further information. Sources other than lookouts account for 90 percent of the first reports on this Forest. Subsequent remarks and facts are entered on the back of this form, and extension sheets used when needed.

Dispatch record.—Overhead, labor, and all vehicular or special equipment sent to or requested by the fire is entered on an 8- by 15-inch dispatch record sheet. On large fires, labor may be entered on one sheet, equipment on another. Items sent by the dispatcher are entered in columns 4 to 10 which show (4) position on fire,

(5) name-unit sent, (6) number sent, (7) source, (8) equipment used, (9) time ordered, and (10) time left station. Orders received from the fire are set up on columns 2 (day, hour, number), 3 (order by), and 4, and a check entered in column 1 when order is filled and columns 5 to 10 completed. Places for "releases," "at headquarters," and "remarks" are provided. This procedure permits the dispatcher, in one glance, to see what has been sent and what orders are pending. No need to thumb through the pages of a log and hunt for buried remarks. A carbon copy is sent to the fire at the end of the first hour or two, to assist the fire boss and records officer.

Fire order.—Whenever another office or function is involved, as in the case of a tractor and transport ordered by the fire and furnished out of a Division of Engineering equipment depot pool, a written "fire order" in drawn up and, if at all possible, actually delivered to the office involved. This eliminates the hazard of duplicate orders or new orders being interpreted as a confirmation. It also furnishes a written route of travel, and indicates the proper fire charge, time of order, and other pertinent information. The dispatcher is advised when the order goes and the "order sent" columns are completed and the information posted on the Dispatch Records. Unfilled orders are held in a "pending" bin.

Inasmuch as the Supervisor's (administrative) officers are in another city, carbon copies of all orders involving payment are sent in. This covers orders for rental buses, U-Drive trucks, organized crews, and similar items where payment is required. This establishes a fire obligation, avoids overlooking payments and similar orders contracted for during emergency conditions.

"First Report of Fire" form, "Dispatch Records," and "Fire Orders" for a particular fire are held and maintained together in 5- or 6-bin desk trays.

Substantial advances in dispatching service will come from new methods and improved working tools and we have found the above system to be of help in our particular job.

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States Forest Fire Law Enforcement Record, 1952

During the calendar year 1952 the States initiated 7,193 prosecutions for violations of their forest fire laws. This exceeded 1951 prosecutions by 954 cases. The 1952 prosecutions resulted in 6,557 convictions or 91 percent. At least 22 cases were still pending at the time of this report.

Of the 7,193 cases prosecuted 1,927 were for technical violations such as illegal brush and debris burning, failure to extinguish camp fires, collection of fire fighting costs, etc. Prosecutions for escaped fires amounted to 5,266.

Virginia again led all other States in the greatest number of prosecutions with a high of 1,145 cases of which 99 percent resulted in convictions. North Carolina was again second high with 976 prosecutions resulting in 97 percent convictions.

The States' records of convictions secured on the number of prosecutions is very good but it should be remembered that the total number of prosecutions is relatively small considering the fact that more than 100,000 man-caused fires were reported on State and private lands last year.

CARD SYSTEM FOR RANGER DISTRICT FIRE DISPATCHING

Keith K. Knutson

District Ranger, Pike National Forest

On ranger districts with no organized Forest Service suppression crews, manpower is often hard to obtain with the speed required for effective first attack. This is probably the situation on a majority of the ranger districts, and it is certainly the case outside of the so-called "fire regions."

It was forcibly brought to my attention when I transferred from the Arroyo Seco District of the Angeles National Forest, with headquarters at Pasadena, Calif., to the South Platte District of the Pike National Forest, with headquarters at Buffalo Creek, Colo. Buffalo Creek is a hamlet consisting principally of a general store, a filling station, and a considerable number of summer residences, and it is about 50 miles from Denver, the nearest city. I believe it is safe to say that on the Arroyo Seco District I had more men in my summer fire organization than there are permanent residents on my present district.

The South Platte District embraces more than 200,000 acres and is typical of those on the eastern slope of the Rockies in Colorado. It has rough topography, not too many roads, and fuel ranging from sparse to heavy, and from flashy to slow burning. Closely restricted grazing in the past few years has built up the grass cover and the lower slopes support a cover of oak brush and mountain-mahogany with some cheatgrass in places. Because of its accessibility to Denver and the very heavy tourist trade in Colorado, the recreation use is extremely heavy. "A tourist behind every bush" is a stock expression here during July and August. In addition, there is a "lightning belt" centered on the district.

In spite of the potentialities, the actual fire occurrence is not high. The normal fire load for the past few years has been 15 starts per year, with 3 of them man-caused, but it has varied widely in different seasons. Although this normally low load is an advantage, it also presents a problem in giving the local people, upon whom we must depend for help, enough actual fire experience so that they are properly trained and in the mood to either respond quickly to a fire call or to take independent action when necessary.

The district is staffed in summer with one ranger, one assistant ranger, one lookout with an alternate (the only lookout on the Pike Forest), and one patrolman whose time is largely taken up cleaning campgrounds after tourists. For all other first-attack and first reinforcement forces we are dependent on local ranchers, woods workers, resort owners, miners, and miscellaneous persons.

The general principles of cooperation by local people and the preparation of district fire plans have, of course, been in successful operation on this and other forests for many years. The present discussion deals only with a workable method of putting that cooperation into effect with the least delay.

To get the speediest initial attack with this type of labor, we felt that the first requirement was a central dispatcher. The lookout is currently manned by a married couple who have been there at intervals for several years. The wife is the regular lookout, and the husband serves as alternate and also takes care of nearby trail improvement and maintenance when not on lookout duty. Since the lookout crew is the first discovery source for 75 percent of South Platte District fires, and on duty at all times, it was decided to give them this second responsibility. This has not in any way lowered their efficiency in performing their primary duty of detection, and occasionally it gives an opportunity to demonstrate to visitors, of whom there are some 5,000 or more during the summer season, what actually takes place when a fire is discovered by the lookout.

The preliminary work in setting up this kind of system is done mainly by contacting prospective wardens. They are the key individuals in the organization and without their full accord the system could not be a success. They should be men who have taken an active interest in conservation and fire control, easily reached by phone, and available a large part of the time.

At the same time cooperators are also contacted. They too must have an active interest and be willing to go to fires, but their latitude of operation on initial attack is not so great as that of the wardens. A third member of the team is a manpower coordinator. This man is used to gather manpower for reinforcements when necessary. He should be an old-timer in the area who knows the best sources and availability of manpower. His age and physical condition are not an important consideration.

After the preliminary contact work is completed, the district is divided into warden zones and cooperator units. Each zone contains one or more units. All wardens agree to go to all fires within their zones if necessary. The cooperators act as initial attack forces only within their units, unless there is a previous mutual agreement that they will go into an adjoining unit when the need arises.

A great deal of thought must be used in making these divisions. Among the points that should be kept in mind are (1) physical location of cooperator within the unit; (2) method of transportation and availability of roads and trails; (3) agreed territory in which the cooperator will operate—this may have to depend on his work and his responsibilities; and (4) topography. On the South Platte District there are 10 warden zones and 33 cooperator units, and there are 1 to 7 units per zone. The outlines of the zones on our maps are in red, those of the units in green. This color code is used throughout the system. The cards used are made up so that all information needed for dispatching in one zone or unit is on one card.

Zone cards show the following information, with all phone numbers:

1. Warden.
2. Complete list of cooperators and their units.
3. Manpower coordinator.
4. Adjoining wardens.
5. Where additional manpower can be obtained.
6. Special dispatching instructions, if any, in high-hazard and high-rate-of-spread areas.

The following information, plus all phone numbers, is shown on cooperator unit cards:

1. All cards have "For fires in this area call in the following order until dispatch is made."
2. Order in which calls are made: cooperator first, supervisor's office last. In all cases the ranger is to be notified. This is also noted on all cards.
3. The nearest place where tools can be obtained.
4. Where water equipment is located, if available.
5. Where to order food.
6. If power line-building equipment is available, this is noted.

In all cases the telephone number, if any, is given. This may appear to be repetition, but it is essential to speed and accuracy. These 4- by 6-inch cards are filed under the zone headings, which are in alphabetical order. The unit cards are immediately back of the zone card in the order in which they appear on the zone card. On the box is shown "Instruction for Use," as follows:

1. Locate fire in proper zone and unit.
2. Pull unit card and call manpower as shown on card until dispatch is made.
3. If unable to contact anyone on the dispatching card, call the supervisor's office for assistance.
4. When a call is made from the fire for additional manpower, food, tools, water equipment, etc., call as indicated on the unit card.

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Tanker Fitting Color Code

The tanker fitting color code was developed primarily to alleviate the difficulties experienced in hooking together fittings with various types of threads, such as hose, tankers, hydrants, etc., where various agencies are co-operating in the suppression of fires. The California Region and the Los Angeles County Fire Department use five colors that are most distinguishable during both night and day operations to identify the various threads as follows: black, Parallel Iron Pipe; yellow, National Standard; green, Pacific Coast; blue, Chemical; and aluminum, Garden Hose.

A quick-drying enamel is used to paint the identifying colors on the fittings. Since the various types of threads are nearly impossible to distinguish from a visual standpoint, the color code has been most beneficial to personnel in selecting the correct fitting. It is only a matter of matching colors rather than threads.

The Region has adopted the color code and had printed in color enough plastic cards, which are 4 by 4 inches with a hole in each corner, so one could be attached to each tanker.—V. E. WHITE, *Fire Control Assistant, Angeles National Forest.*

TOP PACK POWER-SAW CARRIER

Charles A. Yates

District Ranger, Six Rivers National Forest

On the Orleans District of the Six Rivers National Forest we have devised a power-saw carrier for use in our back country work (fig. 1).

The carrier is mounted on a top pack and bolted securely. The box, 3/4-inch plywood put together with wood screws, is made to fit tightly around a power chain saw with a 30-inch blade. Guides and slots inside keep the saw from shaking around. A small tool kit box is built in above the rear handle of the saw. This kit box holds tools, grease, equipment handbook, and files. A cloth wrapped around the tools keeps them from rattling. When the door is fastened down the tools cannot come out of their compartment. The saw chain is covered with a piece of discarded 1½-inch fire hose split down one side.

The saw can be taken out of the box without untying lash ropes or unloading the animal. It can be quickly loaded or unloaded, expediting trail maintenance work.

Figure 1.—Carrier opened, ready for power saw to be unloaded.

ELDORADO MAP CASE

E. L. CORPE

Central Dispatcher, Eldorado National Forest

A number of maps of various sizes—protection boundary, judicial district, grazing allotment, improvement, etc.—are stored and intermittently used by the Fire Staff Officer of the Eldorado. The need for a case to prevent undue wear and tear, and to have the maps readily available for reference, had long been felt. This became more acute when the Supervisor's office was moved to new quarters with smaller individual offices.

Bert Young, Fire Control and Grazing Officer, worked up the original design, and after one or two refinements by other personnel, Forest Carpenter Clarence Hume constructed the first map case. The idea of mounting the maps on light plywood, so they can be easily moved and displayed for small groups, was especially liked, and six additional cases have been built for staff officers.

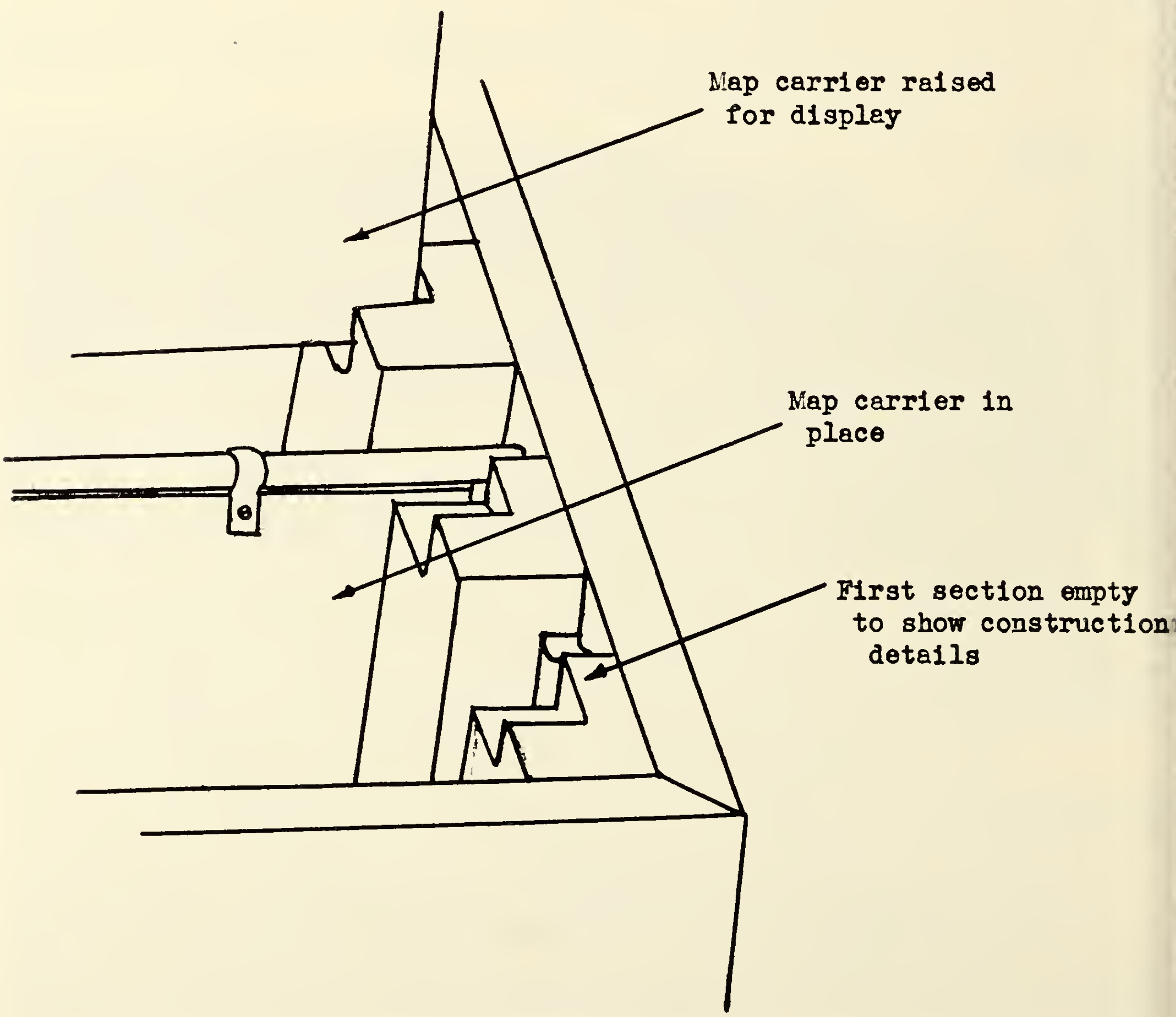

FIGURE 1.—Detail of inside corner of map case.

The case is constructed of 1/2-inch plywood, reenforced at joints and top and bottom. Inside dimensions are 46 by 37 by 8 inches, which gives space for seven sheets of 1/4-inch plywood, 34 by 44 inches. Maps are taped or stapled to both faces of the plywood sheets, thus providing storage of 14 full size maps, or a larger number of smaller ones.

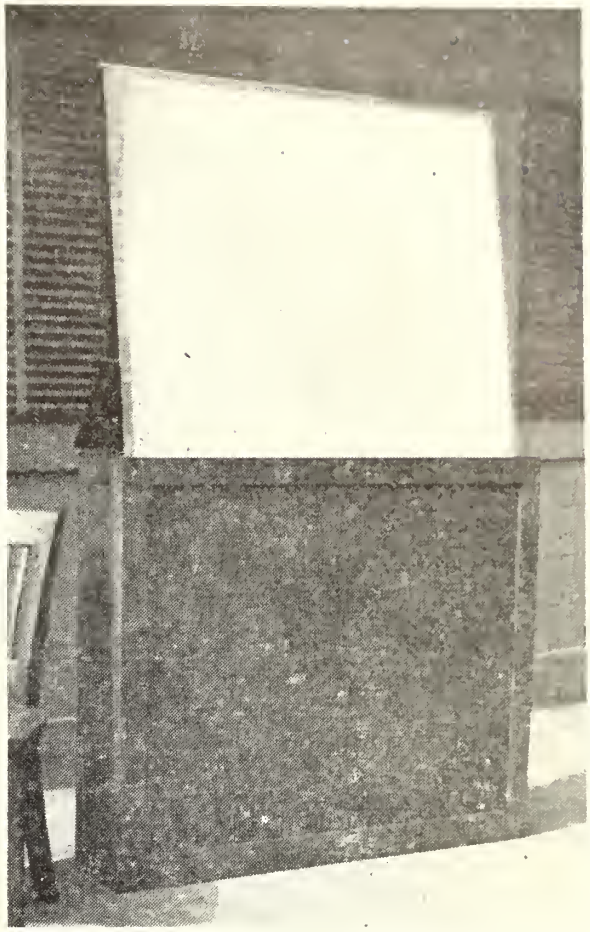

FIGURE 2.—Map case with carrier sheet raised for display.

The plywood sheets or map "carriers" are loosely fitted into grooves at the sides of the case (a tight fit will bind the sheet in the case). A 1/4-inch round dowel 45 inches in length is fastened to each sheet; the half inch projections of the dowel at each edge of the carrier serve as stops to hold each piece of plywood at the desired depth and distance apart inside the case.

Two 44-inch pieces of 1-inch by 8-inch soft stock are routed at the top, grooved full length to receive the carriers, and secured inside the case at either end.

A tight lid to keep dust out, and a stain or varnish finish complete the construction.

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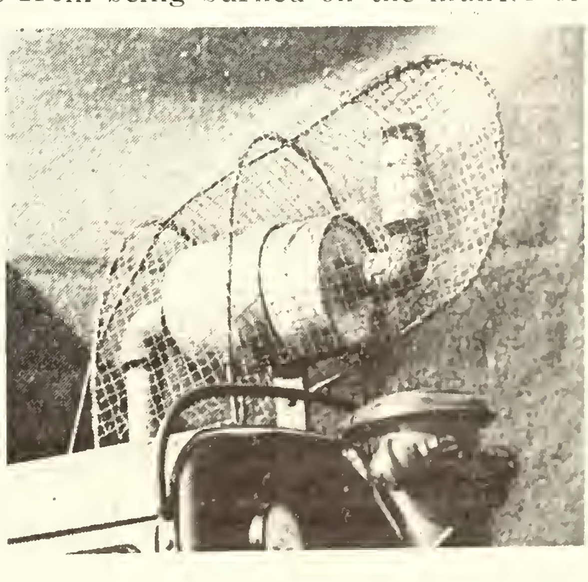
Exhaust Safety "Stinger"

The device which we call the exhaust safety "stinger" is a protective guard to prevent the operator and his helpers from being burned on the muffler or exhaust pipe on the top of a Wisconsin Model 4F-4-1 air-cooled engine. This particular engine and the pump it drives are mounted on the chassis of a 1 1/2-ton pumper.



This "stinger" is very easily and economically constructed. The framework consists of 5/16-inch rods shaped to fit over the muffler and tail pipe. They are bolted to the top part of the hood on the Wisconsin engine. The protective covering over the frame is ordinary hardware cloth secured by overlapping the ends around the rods and twisting. This is not a mechanically perfected device, but may serve as a base for improvement.—GEORGE W. VALLEY, *Fire Control Assistant, Sequoia National Forest.*

A GRAVITY SYSTEM FOR FIRE FIGHTING

ROSCOE T. FILES

Forester, Snoqualmie National Forest

This summer two visiting forest officers on a training assignment from another region saw a gravity system in operation for the first time. The use of available water by gravity is an old story to fire fighters of the Pacific Northwest, but an effective fire fighting tool in any area where water occurs in an adequate supply at an elevation of 50 or more feet above the point of use. Where it is possible to obtain a head of 100 feet or more, a gravity system will produce an effective stream. Once installed the gravity system runs continually with only an occasional check of the intake system to remove small sticks and debris.

There are several ways of installing a gravity system, the simplest being by use of a gravity sock. This is a cone-shaped piece of canvas having a 1/4-inch wire hoop approximately 10 inches in diameter sewn in the large end and a 1 1/2-inch pipe nipple, about 6 inches long, fastened to the small end of the canvas cone. Cone length may be 3 to 6 feet, the longer the more efficient.

An improvised gravity sock can easily be made by tying a piece of canvas, tin, or cloth around the end of the hose to funnel the water into the hose. Other successful versions are an old bucket, a canvas mail sack, and the end of a piece of 1 1/2-inch hose. The gravity sock is placed in the stream where a dam can be built around the intake sock, or tied securely in place under a small falls. As soon as the water flows from the hose connection, the hose is strung out, and a new section is connected when the water starts to flow through the last connected section. When several sections of dry hose are connected and then attached to the hose line, an air lock will often occur. In this event the line will have to be opened to release the air.

Additional hose is attached by kinking the hose to stop the flow of water while a connection is made. When the pressure becomes too great for the hose to be kinked, a Siamese connection can be placed in the line to bleed off excess pressure. Additions can be made to the system until the pressure approaches the tested pressure of the hose. When the danger point is reached, a Siamese valve can be installed and an extra hose line used. Another method to reduce pressure is to run the first gravity line into a second gravity sock and connect the fire hose as explained above.

As a safety factor in nearly all gravity systems, every foot in height should be figured at one-half pound pressure to the square inch. For example, a 100-foot drop from the source of water to the nozzle will give 50 pounds nozzle pressure. This same figure may be used to determine the amount of elevation drop allowable before reaching the breaking point of the hose line.

Other suggestions of interest to users of a gravity system are the following:

By placing a 1-inch hose or 3/4-inch garden hose on the end of the 1 1/2-inch gravity system, a small amount of water can be used as an effective mopup tool.

In locations where several small streams occur on the lower part of a fire, and each stream is too small to supply a pump, the combined flow of the streams can be directed into a sump. Then, by using several short gravity systems, the sump will be capable of supplying a pump.

Where back-pack transportation is involved on a fire, linen hose is recommended for use in the gravity system because of the light weight of the hose and ease in handling.

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The Zipper Binder—A Forest Tool

The zipper 3-ring binder, first tried on the Caldor District, Eldorado Forest, seems to be the answer to a problem, and its use is spreading.

The forest guard, scaler, patrolman, foreman, or project worker no longer depends upon a pocket notebook for all of his written material. Having job instructions, job lists, safety plans, prevention plans, fire plans, training plans, instructions on closing stations, on operating radios, accident report forms, station inventories, current inspections, etc., he is faced with where to keep them, how to keep them, has he got them, is it written—the ring zipper binder takes care of them.

In the winter, the binders are brought up to date. In the spring or summer they are given out. In the fall they are collected, information (i. e. camper use, inventories, etc.) taken out. In between times they can be inspected.

They are inexpensive, dust proof, not bulky, convenient, and practical.—George I. Ramstad, *District Ranger, Eldorado National Forest.*

KEEP IDAHO GREEN

R. A. TRZUSKOWSKI

State Fire Prevention Director, Idaho

Our youth make a strong force in Idaho's campaign of fire prevention; and Governor Len Jordan's Keep Idaho Green committee is doing everything possible to sustain their active interest in the preservation of our State's greatest natural resource, the forests. Through the means of a statewide educational program, more than 15,000 members of youth organizations have taken up the never-ending fight to reduce the occurrence of man-caused fires. The principal contributing groups are the Boy Scouts of America, Campfire Girls, 4-H Clubs, and the Girl Scouts of America.

The Idaho State Junior Chamber of Commerce in 1946 was the stimulating factor that created the Keep Idaho Green movement, and has since maintained an active interest, offering its membership as leaders and organizers of fire prevention work. The Keep Idaho Green committee, created in 1946, is composed of public-spirited citizens representing State, Federal, and private interests. The principal objective of the educational program sponsored is a coordinated effort to reduce the occurrence of man-caused fires. The program operates on a budget of $8,000, half of which comes from donations from private sources; the other half from State and Federal funds. To coordinate the activities of the Keep Idaho Green program, a full-time director is hired by the State Forestry Department.

The vast educational program has resulted in the distribution throughout the State of more than 500,000 individual pieces of literature, including posters, stickers, postal cards, bookmarks, blotters, pamphlets, decals, and animated displays. A visual part of the program, including the showing of film strips and motion pictures, has proved most effective. The commercial theaters of Idaho contributed by showing trailers of Smokey, symbol of forest fire prevention. Idaho's radio stations sponsored fire prevention programs and spot announcements reminding the public to be careful with fire. The newspapers deserve special mention for the part they played in keeping the public informed of current news of fires and fire dangers.

On some 3,000 miles of Idaho highways, 300 road surface signs 8 feet wide and 4 feet high, were painted (fig. 1). With these important messages in strategic locations, it is almost impossible for the traveler to go any distance in Idaho without seeing one.

In 1950, a new fire prevention character, called the "Guberif" and defined as any person who starts fires through carelessness was introduced into the Keep Idaho Green program. The term

FIGURE 1.—One of 300 road surface signs on Idaho highways.

was derived from the word "firebug" spelled backward. The sight of the word has created a challenge to people being "exposed" to it for the first time. Psychologically, it has created a point of interest whereby the origin and meaning of the word are discussed, eventually leading to an active debate on fire prevention. The public-spirited citizens of Idaho are determined to stop the spread of "Guberifism." A constant effort by Idaho's youth to exterminate the Guberif will improve Idaho's fire prevention record (fig. 2).

The combination of our friend Smokey the Bear and the good-for-nothing Guberif has created a wholesome interest in our educational program. The Keep Idaho Green committee hopes to produce a series of short movies depicting the Guberif in various phases of everyday life as a media to remind the public that any person can become a Guberif through carelessness.

Idaho's fire prevention program is no different from any other. However, through continuous contact and recognition of achievement in activities, we have been successful in attaining the wholesome, active interest of many thousands of our young people. Each year more than $2,000 is awarded to youth organizations for Keep Idaho Green work. To be eligible for an award, each youth group is required to submit a report summarizing the work accomplished during that particular year. These summaries help the committee review the work being done by the various organizations. Many reports are arranged with elaborate displays and made into attractive scrapbooks.

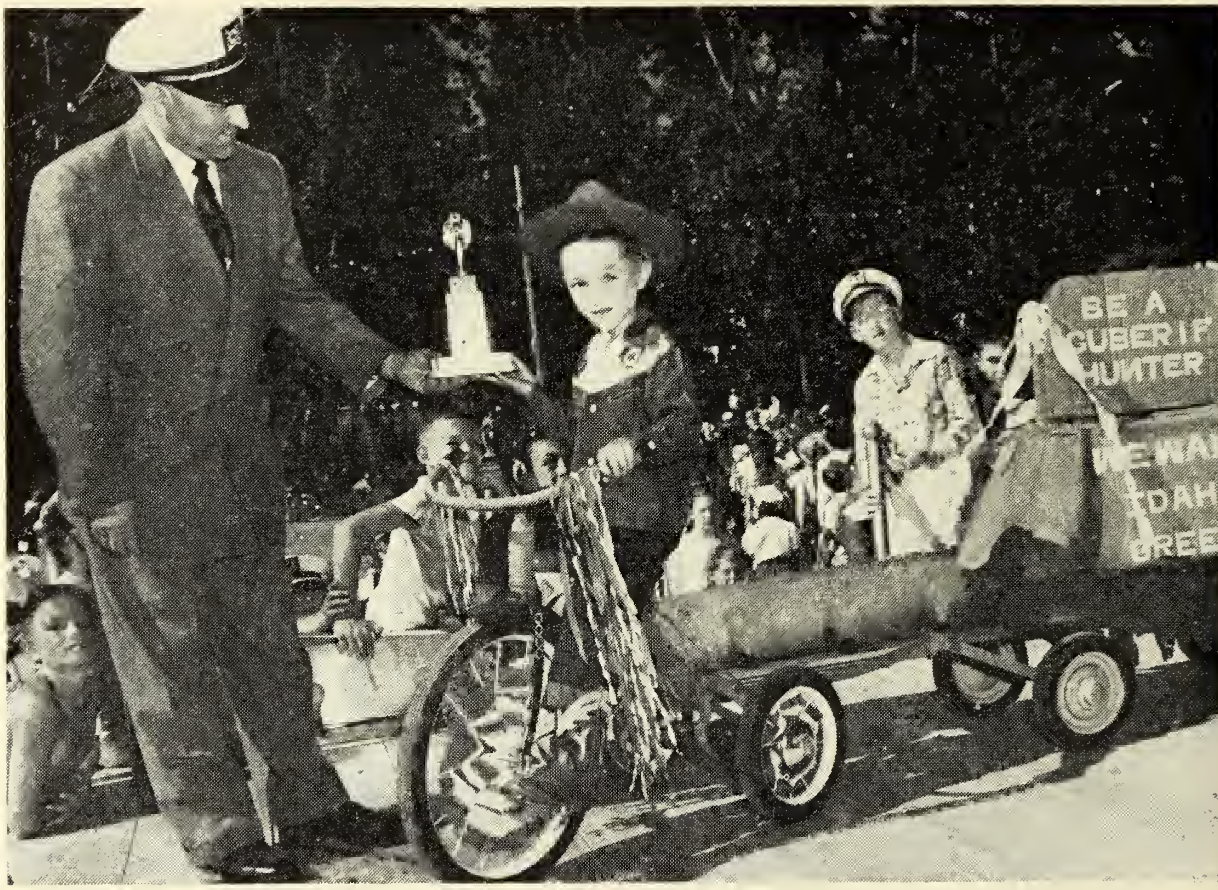

FIGURE 2.—Children's parade winner.

The never-ending battle to reduce the occurrence of forest and range fires is one that we in Idaho do not minimize. Each year, still, careless, indifferent individuals cause many fires that bring destruction to thousands of acres of Idaho's timber and grassland. This huge annual loss is needless. The responsibility for fire prevention rests on us—the people!

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Region 4's Approach To Training

We are all familiar with the old four-step method of instruction: Prepare the worker, present the lesson, try out performance, and let the trainees try out alone. Two other factors are so important in training that they have now been added: Advance preparation by the trainer and a critique or summarization. These are the six tested steps:

1. *Preparation by the trainer.*—Prepare a sound training outline, based upon definite objectives, coupled with a good job analysis in which the trainer puts all of his experience and thought; then practice until presentation will be adept and proficient.
2. *Explanation.*—Interest the trainees in the job to the extent they want to know all about it. Prepare the worker. Arouse interest and stimulate participation.
3. *Demonstration.*—Show and tell the trainees how to do the job.
4. *Application.*—Try out performance, allow the trainees to practice under close supervision.
5. *Test.*—Test to see how the trainees proceed without help.
6. *Critique or summarization.*—Review the whole procedure or job to correct weaknesses and tie the whole training program together.

If these six separate and distinct steps of instruction are adequately and expertly handled success in training is assured; they always work. Training requires such an organized approach.—*Region 4, U. S. Forest Service.*

HUMAN RELATIONS ON THE FIRELINE

FRANK F. KOWSKI, *Training Officer,* and GEORGE A. WALKER, *Chief, Fire Training Branch, National Park Service*

We have not been dragging our feet with respect to training our personnel for fire control work. For the most part the training has consisted of thorough instruction in the use of equipment and control techniques, or in the technical duties and responsibilities of fire overhead positions. But, how far have we come in improving our understanding and handling of the fire fighter as an individual? Supervisors from fire boss to straw boss, either directly or indirectly, guide and control the performance of the fire fighter, whether he is digging a fireline, operating a pump, or working in a mopup operation. Therefore, it is of the utmost importance that fireline supervisors know and understand how to work with these men most effectively.

We have all seen cases where a crew just didn't "put out" for the foreman. Probably on the opposite side of the same fire there was a crew performing work just as arduous and dangerous, yet which came into the fire camp at night with morale high and a good day's work accomplished. Sometimes people try to rationalize such situations by saying that one crew spent the day in a more difficult fuel type or that one crew was composed of a poorer caliber of workers. Granted that such conditions must be regarded as real obstacles, how much of the lack of accomplishment and low morale should be blamed on inadequate supervision and leadership on the part of the crew foreman and his straw bosses? Maybe it's time that we do some *real thinking* about how we can improve our understanding of human nature and get it to work for us instead of against us. The statements presented here are aimed at doing just that—to start us thinking again.

The subject of supervision is far too extensive to deal with in its entirety. However, there are a few guiding principles with which we might well refresh our memories. Let's start with the principle of understanding and knowing the job thoroughly. While this is of prime importance in any job, it is particularly so where any delay or hesitancy due to not knowing or understanding the job may mean the difference between successful control and the fire that got away. Nothing is more frustrating to a crew than to have a supervisor who doesn't know his job. Fortunately, the bulk of our fire control training (fire behavior, control techniques, organization) is aimed at this phase of supervision and it doesn't pose the problem that other shortcomings might.

Let's take a look at the principle of leadership. We all know the benefits of "leading" over "bossing" but all too often we hear of a fire emergency used as an excuse for extensive and uncalled-for bossing. The qualities of leadership are just as apparent in a critical fire situation as they are at any other time or place. The ability to lead is a desirable trait in all supervisory positions, but particularly where the going is rough and there is an important suppression job to do.

What do we mean by leadership on the fireline? We usually think of an individual who understands the job to be done, who thinks clearly and acts quickly, who is willing to show the way, and who has the ability to create and hold crew interest. Most of these qualities are developed through routine training, but the ability to create and hold crew interest has been neglected. When an individual understands how and why certain things are done, he becomes more interested, and when he is interested he usually produces more and better work. Therefore, the supervisor should always explain to his crew how to do the job, the objectives, and why the particular job is important or necessary. Occasionally time doesn't permit this, but if it is customarily done, crew members will accept orders on those occasions when it can't be, confident that the supervisor knows what he is about.

Maybe we should brush up on the technique of giving instructions clearly and in a friendly fashion. Sometimes, there is a certain amount of confusion in fire suppression operations, and a supervisor scarcely helps the situation when he issues instructions that are not clear. Since most employees are reluctant to say that they do not understand, it is vital that the fireline supervisor give his orders and instructions in a readily understood language and manner. He should encourage his crew to ask questions concerning the instructions and stress the importance of their being understood.

The manner in which instructions are given is often overlooked or disregarded by some supervisors. They do not intend to arouse resentment, but their attitude or tone of voice may do just that. Friendliness in giving orders should prevail, especially if the job or task has undesirable features, and there are many of these in fire fighting. It is not too much to ask that we treat people with the same friendliness we would expect if the situation were reversed.

The current trend in fire control training gives ample emphasis to the importance of work planning, but how much is given to work delegation? It is not sufficient to know and understand the work to be done. The supervisor must also know how to organize and delegate work to the crew—and to do it wisely. Work should be assigned fairly and with consideration for those best suited to the specific job. Responsibility and authority go hand-in-hand in work delegation, and an employee must have a commensurate amount of both in order to get the job done efficiently even though final responsibility rests in the supervisor. When a supervisor has demonstrated his know-how in delegating work, he can be reasonably assured that the men will have respect and confidence in his ability to get the job done.

Frequently, bad and good work are accomplished on the fireline. The bad work is corrected and eliminated. As a rule, the good work is recognized, but how often is it acknowledged? While it is extremely important to call attention to poor work in fire control, it is equally important to acknowledge honest effort on the part of employees. One sure method of increasing or maintaining the morale of individuals or groups is a word of appreciation for their work accomplishment. Fire fighting is hard and dirty work, often performed under difficult circumstances, and certainly a pat on the back now and then for a job well done will pay dividends.

Don't we all remember occasions when discipline on the fireline was administered on the spur of the moment when someone was tired? The average individual doesn't object to discipline if it is administered judiciously and on a fair and consistent basis. When it is necessary to take disciplinary action, it should be done immediately because delay may create additional complications—but not so quickly that all facts are not properly investigated. If it is necessary to reprimand an individual, it should be done as impersonally as possible and away from others. The supervisor can usually keep disciplinary action at a minimum if he takes the time to explain conditions and governing procedures, and why things must be done in a certain way.

Fireline safety should be mentioned here even though we emphasize the importance of safety in all of our fire training programs. We must never forget that the prime responsibility of the fireline supervisor is the safety of his men, both on and off the fireline. No opportunity should be overlooked to call attention to unsafe practices, but it is a poor policy to point out an employee as a horrible example. Supervisors must remember never to place an employee in a position where he may feel ridiculous. It is much better to correct the individual or the group in a lesson for all and avoid casting personal reflection on the offender. The men will soon be aware of the supervisor's interest in their safety, and consequently it is reasonable to assume that they will become more safety conscious themselves.

Some fire control techniques have become more or less standardized through the years, but this does not necessarily mean that they are the best. Therefore, the supervisor should be open-minded and welcome suggestions of different methods. We recall one experienced crew foreman who understood the law of gravity as well as anyone else, but he was so "pump conscious" that he overlooked the possibility of a gravity hose system until it was suggested by one of his crew members. Even if a suggestion proves to be impractical, the employee has had the satisfaction of expressing his thoughts. In addition, the supervisor has demonstrated his willingness to discuss and try out possible improvements in work methods. It is unlikely that pickup labor will come up with many innovations in fire control, but how about permanent and seasonal employees?

The morale and respect of a crew are largely determined by the supervisor's interest in its welfare. There is always a certain amount of casual interest on the part of the supervisor, but it should be more than that—it should be sincere. If someone takes a personal interest in your well-being, it is only natural that you will try just a little harder to make your work acceptable to that person. The supervisor should maintain a close and friendly contact with his men so that he will know their wants and needs. He will improve his stature with his crew if he anticipates its needs rather than waits for a request. Willingness on the part of the supervisor to listen to complaints or grievances, both real and imaginary, and his honest effort to settle them indicates to his subordinates that he is sincerely interested in their welfare. Some of these complaints or gripes may seem trivial to the supervisor, but they are important to the individual making them. In all cases an attempt should be made to settle them as satisfactorily as possible.

How long has it been since we last programmed activities through which we could better train our supervisors? Everyone *wants* to be a good supervisor! The inclusion of human relations principles in training discussions and conferences for supervisors will go a long way in meeting this objective.

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Tire Innertubes For Line-Firing

During the 1952 fall fire season extremely hazardous burning conditions necessarily increased the use and value of line-firing in fire suppression. Discarded tire innertubes proved to be very satisfactory as line-firing torches, and the users rate them superior to the fusee torch.

Although ruggedness of terrain will determine to a degree the amount of line that can be fired, two additional factors seem important. First, innertubes vary as to type and amount of material of which they are composed. The composition very definitely determines the amount of line-firing that can be accomplished with any single tube. Second, there are techniques in handling the innertube as a torch which must be learned before maximum service will be realized. With some experience the torch handler will be able to control the burning of the innertube in such a way as to obtain the utmost service. The handler could tie a wire or stick to the tube for a handle and thereby lessen the chance of coming in contact with burning rubber.

How does an innertube work as a torch? After the innertube is cut, one end is grasped and the other is ignited at the fireline, by carbide lamp or other means. Once the innertube starts to burn freely a steady stream of burning rubber droplets will be produced. The torch handler then walks the fireline dragging the tube while the burning droplets set a continuous string of fire. It is estimated that an average of three-quarters of a mile of line can be fired in 25-30 minutes with one automobile tire innertube.

Advantages and benefits to be derived from this type of line-firing are as follows:

1. The innertubes cost nothing since most service stations are glad to get rid of them.
2. Since one man is capable of doing a job that normally would require two or more men, some manpower is released for other work.
3. Time required to burn out fireline is reduced, thereby lessening the chances of fire crossing the line and also releasing manpower for other work.
4. Line-firing at night can be accomplished practically as easily and effectively as during the day, though burning conditions are usually less suitable.
5. Unlike a fusee, an innertube after being ignited can be extinguished for additional use at another time.—ROBERT H. KING, *District Forester, Green River District, Kentucky Division of Forestry.*

LOGAN CITY-CACHE COUNTY FIRE ORGANIZATION

JOEL L. FRYKMAN

Forest Supervisor, Cache National Forest

Cache County in northeastern Utah has a countywide fire protection organization that is believed to be unique. This organization, centered around the Fire Department in the county seat at Logan, handles all city and county fires as well as grass and woodland fires on private land in the county. Logan is a city of 16,832 residents.

In 1924 the Cache County Commissioners entered into a cooperative agreement with the Logan-Cache Fire Department to suppress all uncontrolled fires on private and State lands not given protection by a Federal agency within the county, including those fires in towns and villages. The county commissioners delegated the powers of the county sheriff to the fire chief who was made responsible to the commissioners for issuance of burning permits and suppression of uncontrolled fires within his zone of responsibility.

Some of the non-Federal lands protected by the Fire Department lie inside the boundary of the Cache National Forest. The National Forest lands also lie close to the Cache Valley farmlands. By agreement between the two organizations, the first to receive a fire report located on adjacent lands will take the initial action, turning over the fire to the responsible party as quickly as possible.

All requests for burning permits on county-protected lands are cleared with the Fire Department. Examinations are made on the ground by a member of the Fire Department before permits are issued. Where these fires might also threaten National Forest land the district ranger makes an examination with the Fire Department, particularly if there is any question about issuance of the permit.

Area Protected

Within Cache County there are 752,000 acres. Of this acreage 263,622 acres are under organized protection by the Cache National Forest. The remainder, or 488,378 acres, is now being protected by the Logan-Cache Fire Department.

Outside of Logan there are 21 towns and villages to which the above organization is responsible for fire protection. In addition to Smithfield there are 5 towns with a population of from 1,000 to 1,760, 3 towns of from 500 to 1,000, and 12 towns and villages of from 10 to 500. The valley, lying on the bed of old Lake Bonneville, is intensely farmed. The major area protected is 35 miles long and averages about 10 miles in width. There are comparatively few timber fires, as the foothills are grass or sagebrush covered with some maple and mountain-mahogany in patches. Fires in this type burn rapidly so that action must be fast. These foothills border steep mountain slopes having very high watershed values.

Equipment

The Fire Department has 5 pumper and 1 ladder trucks. The ladder and 4 of the pumper trucks are located in a modern fire station in the center of Logan. Two of the pumper trucks are owned by the county. The fifth pumper truck is located at Smithfield, a town of 2,400 residents, 11 miles north of Logan. The town of Clarkston has a small pumper truck equipped with 1,000 feet of hose. There is a county-owned pumper truck in the northern end of the county and 3 small towns each have a trailer with hose, all manned by volunteer crews.

Only the fire chief's car and one pumper unit are radio equipped. Contacts with the fire station by radio must be made through the Police Department radio. Ninety-eight percent of all fires reported are reported by telephone. The Fire Department also has an ambulance and furnishes this service countywide, there being no other ambulance in the county.

The towns having fire equipment can and do call on the Logan-Cache Fire Department to suppress fires on which they have taken first action.

Personnel and Training

The Fire Department at Logan has 23 firemen under the direction of Chief Borg. These men maintain 24-hour service. The Smithfield pumper is manned by 10 volunteer firemen. Lewiston, where the county pumper is located, has 20 volunteers. The trailer units have about 3 volunteers each but the crew may pick up others. They call the Fire Department which responds.

Cooperative fire schools are held each spring for the purpose of training men in fighting wild-land fires. Personnel from the Logan-Cache Fire Department, Cache County, Logan City, State Forester's Office, and the United States Forest Service participate as trainers. These sessions are attended by personnel from the Fire Department and their cooperator crews, city and county crews, Cache National Forest per diem fireguards and others who are interested.

Costs

The operating budget for the Fire Department in 1952 was $83,182. Of this amount the city of Logan paid $59,182 and Cache County $24,000. The county received $615 from Clarke-McNary funds in 1952.

Results

While the Fire Department suppresses uncontrolled wild-land fires in the valley and has been responsible for all property fires in the valley for 28 years, only in the past 2 years has it been responsible for wild-land fires on unprotected private and State lands inside the forest boundary. The full effectiveness of the organization in dealing with wild-land fires cannot be judged as yet, but even so, the record has been impressive. The fire prevention done through careful examination of burning-permit applications and quick action on fires has had a worthwhile effect on residents of the valley. They have become more fire conscious as a result of their participation in fire suppression work.

A thorough check of burning permits has caused the landowners to realize their own responsibilities for fire and to use greater care. The record of permits issued since 1950 has been as follows: 1950, 39; 1951, 76; 1952, 86.

During 1951 Fire Chief Borg, with the assistance of the county attorney, obtained two convictions for burning without a permit. In 1952 there were three such convictions accompanied by fines. A fourth case in 1952 for a similar offense resulted in a 60-day jail sentence for negligence in setting a fire.

Since the summer of 1951 was rather moist and the 1952 season had 61 days in September to November without measurable precipitation—a near record—the three years, including 1950, were not similar. A record of fires, kept separately by city and county origin, was as follows:

Year:	*City grass and rubbish fires (number)*	*County grass and brush fires (number)*
1950	23	19
1951	31	24
1952	17	16

While a greater number of permits was issued, the care exercised in checking those areas for which issued evidently was rewarded by fewer fires in 1952.

In 1952 the Fire Department handled its first mountain fire on private land in some rugged terrain. Prior to that year its experience in suppression of wild-land fires had been limited largely to grass and brush fires on the foothills. This was quite a change for men used to fighting fire largely in towns or near roads or in good terrain, but they came through successfully.

The cooperation between the city, county, State, and the United States Forest Service in this fire protection effort has developed a teamwork that we feel will pay large dividends in the future in reducing the number of fires, protection costs, and damages.

QUICK ATTACK PAYS OFF

W. B. WARD

Ranger, Jefferson National Forest

The fire history of the Clinch Ranger District has been the subject of much discussion locally. Invariably the argument arises between those who favor quick attack with a few men and those who want to delay initial attack to gather up a larger crew. This discussion of past fires always includes the years 1941 and 1942 in which 50.0 and 56.1 percent, respectively, of the fires were under 10 acres. In 1952 78.2 percent of the fires were under 10 acres. A check of the records revealed that in 1941-46 41.6 percent of the fires were over 10 acres while in 1947-52 only 24.6 percent were in this group.

From this it appears that progress has been made in fire fighting, so we studied the records to try to find the answer. The 12-year period 1941-52, inclusive, was used so that the two halves of the period would have comparable "bad" fire years.

Since none of the older men on the district recalled a large fire due to a long lapse of time between origin and discovery, this was ignored, and the elapsed time from discovery to first attack and average number of men in the first attack were selected for study. These two factors seemed to be the best answer to the gradual reduction in the size of fires.

In reviewing the records of individual fires it was not immediately apparent that either the size of the first attack crew or the elapsed time before attack had much to do with the ultimate size of the fire. For instance, in 1946 three men were fighting on a fire just 6 minutes after discovery but it still ran to Class D, while in 1950 one man did not arrive on a Class A fire until 1 hour and 10 minutes had elapsed. In 1942 on 19 Class C fires the average initial attack crew contained 11 men and arrived on the fire 1 hour and 18 minutes after discovery. In the same year on 5 Class D fires the initial attack crews averaged 20 men but were not at work until 2 hours and 55 minutes had elapsed! This one year seemed to prove our point, but 1943 spoiled everything. That year on 9 Class C fires the crews averaged 6 men and arrived 1 hour and 18 minutes after discovery; but 10 men attacked the only Class D fire in 59 minutes.

Obviously burning index (especially time of day) and point of origin have much to do with the final size of any fire, yet weighted averages indicate a trend to quicker attack and smaller crews as shown in the following tabulation:

	Average elapsed time, discovery to attack		*Average size of initial attack crew*	
Fire size class:	*1941-46 (minutes)*	*1947-52 (minutes)*	*1941-46 (number)*	*1947-52 (number)*
A (0.25 acre or less)	46	23	5	4
B (0.26-9.99 acres)	68	66	8	6
C (10.0-99.99 acres)	94	81	12	7
D (100.0-299.99 acres)	118	90	16	25
E (300.0 acres or more)	69	105	10	5

Before attempting to draw any conclusions there are several general points which should be mentioned. The topography of the district ranges from 1,100 to 4,100 feet above sea level and is generally sharp, giving most of the fires a hot run to the first natural break. There are only a few broad areas without some natural line locations but during the 12-year period none of the large fires occurred in such areas. Most of the Class C fires are held at the first good natural break in topography. The Class D and E fires have generally been those which started in relatively inaccessible places when the burning index was high. Although the district is small, travel is difficult and much of the protected area requires 2 to 3 hours' travel time after the crew is mobilized.

Occurrence has followed no unusual pattern. Railroad fires dropped after rights-of-way were cleared and two lines converted to diesel. Incendiarism fluctuates, both in number of fires and location, reaching a new high in the fall of 1952 with 9 fires.

Virginia has a brush burning law which prohibits burning except between 4 p. m. and midnight from March 1 to May 15. This has been in effect since 1940 and has been very effective. Fewer fires get out of control and those which do escape are easier to control when the burning index drops late in the day.

The number of fires per year has ranged from a high of 60 in 1941 through a low of 8 in 1947 and back to 46 in 1952. The average number per year for the first 6-year period was 31.7, the second 6-year period 21.0, and the 12 years 26.3. This is fairly typical of the trend for this section of the country with low occurrence during the war years and a gradual reduction throughout the period.

In the first 6 years we had the advantage of paid standby crews which influenced the number of men on first attack. During the second 6 years we relied entirely on volunteer crews but action was immeasurably speeded up by a network of FM radio in the last 3 years. Regular personnel were able to participate in initial attack in many cases when a mobile radio or scheduled check by portable radio received the report which initiated control action. The district has had a ranger and three yearlong forestry aides throughout the 12 years.

The usual tool outfit contains Council tools, ax, brushhook, hazel hoe, crosscut saw, and backpack spray pumps. No power line-building equipment has ever been used. Power pumps are available but have only been used occasionally on mopup. Water from a slip-on tanker unit was used on initial attack only one time out of 316 fires in the 12 years. This leaves the work squarely on the oldtime handtool crew. Most emphasis has been placed on proper line location and the use of water to control the backfire in initial attack.

With all the facts at hand we conclude that it is very much to our advantage every time we are able to dispatch one, three, or five men immediately and follow up with additional manpower as needed. In the last few years these first men have repeatedly said, "We got here just in time to catch it!"

THE HALFTRACK AS A FIRE FIGHTING UNIT

Arthur A. Lusher

Forester, Jicarilla Indian Agency

Since World War II, halftrack units acquired as surplus property have been available for civilian uses. The halftrack is a heavy, powerful machine, designed and built to withstand very rugged use conditions, and to propel itself over a wide variety of types of terrain. It can travel over improved roads at speeds of 40 to 50 miles per hour or negotiate rough areas to about the same extent as a crawler type tractor. High speeds are not recommended, however, because of excessive wear to the tracks and bogey wheels. Such a halftrack was acquired by the Jicarilla Indian Agency, Dulce, N. Mex., for use in protecting an area of approximately nine townships of rolling terrain of ponderosa pine timber type containing a variety of fuel types (fig. 1).

In adapting the halftrack to the fire control needs of the reservation, modifications had to be relatively inexpensive. Since the halftrack could travel fairly easily over most of the area the propelling and traction mechanism required no modification.

A Ranger Pal Junior fire plow was mounted on the rear of the halftrack by means of a solid pin hitch. The plow is placed in operating position by manually lowering it, and the hitch holds it at the desired plowing depth. The plow point is protected by a vertical rolling cutter and obstructions are avoided. It is possible to plow a fire strip 5 feet wide including fold-out.

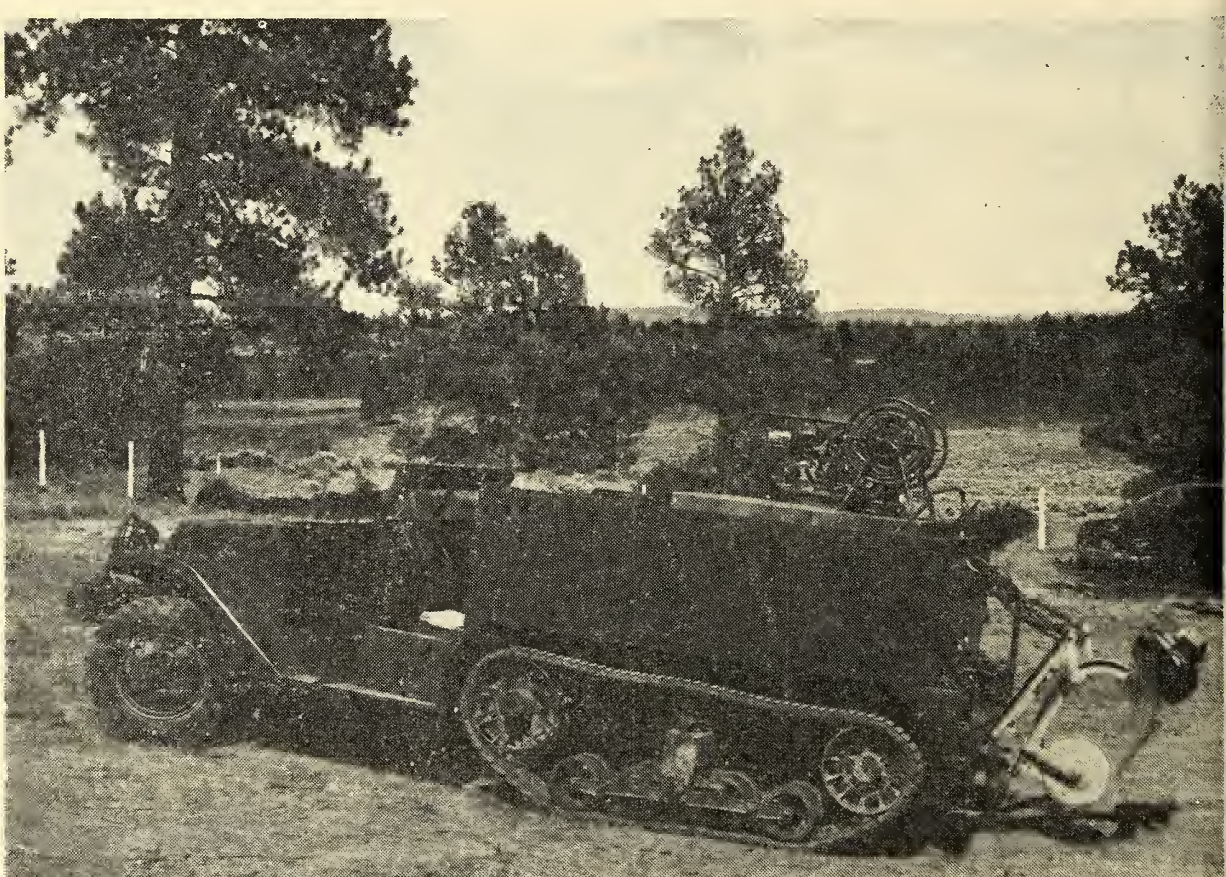

Figure 1.—Army halftrack converted to tanker-pumper.

Fire fighting efficiency of the unit was extended by removing the original gasoline tanks and installing a 400-gallon water tank equipped with a 101-F Bean portable pump and suitable hose and nozzle connections. Under average conditions the 400 gallons of water will last 2 hours. A 65-gallon gasoline tank was installed directly behind the driver's seat. Other modifications include installation of a high-frequency radio unit and space for rations and handtools.

The halftrack thus equipped has proved a reliable and efficient fire suppression unit. Its use has measurably reduced the travel time and manpower requirements of the protection area. The unit is versatile in that it is equally suitable for direct attack or for backfiring or burn-out methods.

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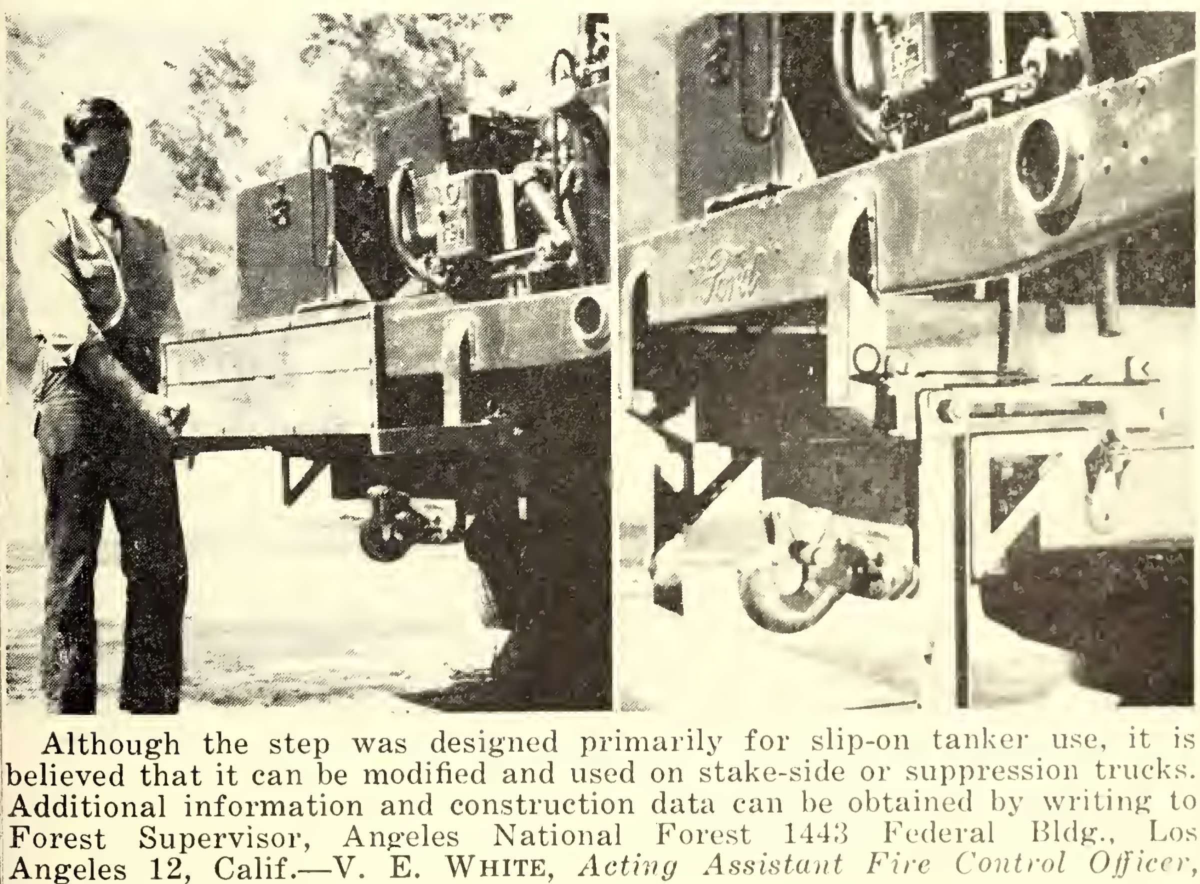
Folding Step For Slip-On Tanker

With the advent of the slip-on type of tanker the need for a folding step, which would make the unit easily accessible to the operator for operation and maintenance, was immediately apparent. The step described here is for a slip-on pumper-tanker mounted on a 1/2-ton, four-wheel-drive, flatbed truck. Since this type of truck is used on the roughest terrain, it was extremely important that the step fold away in a manner to allow complete freedom for the rear tow hook from any angle and also give maximum protection to the step in case the truck was backed into a bank or mountainside.

The step, when not in use, is held in a folded position flush against the back of the truck bed by a spring-tensioned keeper mounted on each side. The overall dimensions of the step are 37-1/4 inches by 10-3/8 inches by 1 inch. The estimated cost per unit is $30 to $40, depending on the number of steps desired.



Although the step was designed primarily for slip-on tanker use, it is believed that it can be modified and used on stake-side or suppression trucks. Additional information and construction data can be obtained by writing to Forest Supervisor, Angeles National Forest 1443 Federal Bldg., Los Angeles 12, Calif.—V. E. WHITE, *Acting Assistant Fire Control Officer, Angeles National Forest.*

MANAGING PRISON INMATES IN ORGANIZED FIRE CREWS

HURSTON S. BUCK II

Hot Shot Crew Foreman, Stanislaus National Forest

Each year the Forest Service and the California Department of Corrections draw up an operating agreement for the use of prison inmates in fire camps that will be in operation in Region 5. These men come from the four State Prisons, Folsom, San Quentin, Soledad, and Chino, and only those who have from 1 to 4 years left to serve may volunteer for camp service. None are drafted. All volunteers are given a complete checkup in the prison hospital and dentist office before being cleared for camp. Their physical condition and age are a large factor in their final selection. The past record of each man is reviewed to determine his suitability for fireline work. Upon arrival at camp and after, if the Hot Shot Crew Foreman finds a man in the group that is unable to carry out the duties of a fire fighter, he may have the man returned to the prison without hurting the inmate's record.

While in camp, inmates are restricted to areas posted with "camp limit" signs. An inmate may move around the grounds inside the limits at his own will, but to go beyond he must be accompanied either by a Department of Corrections officer or a forest officer connected with the camp. The camp is handled exclusively by 1 lieutenant and 5 officers from the prison, and at least one of these men is on duty during a 24-hour period. When crews are needed on a fire, they are counted and checked out to a forest officer. A count of the men is made while they are in camp at least every 2 hours. When out of camp it is the forest officer's duty to make the count.

The prison furnishes the food and runs the kitchen. The commissary is managed by the prison officials, and no one else is permitted to trade, give, loan, or sell any article to an inmate. Cigarettes are the articles that have to be watched most closely, because they are the same as money to an inmate; he can use them as a medium of exchange.

California Department of Corrections officers or forest officers connected with the camp are the only persons allowed to talk to an inmate whether in or out of camp. It is a violation of the law for the inmate and free persons alike if they converse.

Naturally, it is desirable to condition the inmates for fireline work insofar as strong legs and wind are concerned. These men come from prison with little recreational exercise. They are very soft, and a lot of them have never lived in the mountains. When a camp is established before the fire season starts, project work such as tree planting and blister rust is provided to help accomplish conditioning. If a camp is established after the season starts, the men are conditioned on project work between fires.

Some of the inmates have never handled a shovel or an ax, but they are willing to learn. It is necessary to start with the most elementary instructions on handtools and fireline setup. While line of command is always important, it is a must with this type of crew. The working of the fireline from the fire boss down, and the complete fire camp setup, is explained to the men.

Hard hats, canteens, and tools are issued to the men. The writer has observed that different nationalities handle the various fire tools with varying degrees of efficiency. We do not issue brush hooks because it takes too long to properly train the men in the use of that tool. After the tools are distributed, safe carrying practices are demonstrated; emphasis is placed on safety in carrying tools while hiking to or from a fire. The men are also taught two methods of fireline construction: the "one lick" and the "bump-up." They construct practice firelines by both methods for 2 days in different cover and terrain, and they are also trained in dry and wet mopup.

When there is a call to a fire, the Department of Corrections officer in camp is notified at once. He in turn alerts the crew. We have two trucks and a pickup. The men have all been briefed in loading. Bedrolls all go in the pickup and the tools go in the truck boxes. The forestry inmate clerk has a kit already packed with the necessary forms to be used, and it is also loaded onto the pickup. The men get on the trucks and are counted by the Department of Corrections officer who is to accompany the crew. While in travel, the crew is not permitted to cross the California line because its men are wards of the State, and once out of State they are free until extradition papers can be cleared. Upon arrival at the fire the men are counted again and checked to the forest officer. These men are very willing workers on a going fire, and they are also thorough on mopup.

This unit is set up as a sector, with sector and crew bosses so that the efficiency of the trained crew will not be impaired, and the inmates will be prevented from mixing with pickup labor. In a crew of this kind there is a radio operator, clerk-timekeeper, and men trained in felling with handsaws or chain saws.

At the end of a shift the foreman counts the men and brings them back to the fire camp where they are again counted by the Department of Corrections officer and turned over to him. The officer takes the inmates into a sleeping area away from the fire camp area in general. This area is posted with camp limit signs, and the men must stay within the limits except when the officer brings them out to meals. The Department of Corrections officer is notified of the hour that the men will be needed in the morning, and it is his responsibility to have them up and fed so that they are ready to be checked out at the proper time.

The possibility of the escape of any of the inmates is of paramount importance to the Department of Corrections. This is the reason for all of the counting that is done and for the restrictions as to conversation between inmates and free personnel. If an inmate were permitted to run at will around the fire and fire camp, he would be in a position to make a contact for transportation and possibly an escape. The sheriff's office nearest the camp where the men are housed for the summer is given a picture of each man. The forestry foreman is also supplied with pictures of each man he takes on every fire. The Department of Corrections officer has a picture of each one too. Counted often, the men know that if they were to leave it would be but a short time before they were missed, and that it would be almost impossible for any distance to be gained. If inmates are on the fireline and one is missed and cannot be located the officer in the fire camp is notified at once. The Department of Corrections as a rule does not ask the Forest Service to chase a fugitive, but when requested full cooperation is given. If an inmate is off the line without permission, it is the same as escape and is a punishable offense.

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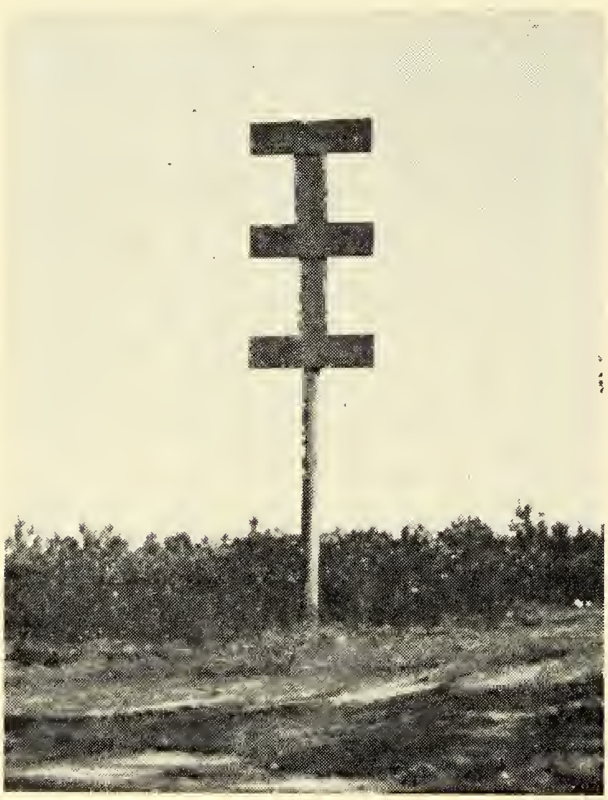
Location Marker For Lookout Reference

One of the forest fire detection problems on the Myles Standish State Forest, near Plymouth, Mass., is the prompt and accurate location of fires which are visible from only one lookout. Terrain is level to rolling without easily identified natural features. Cover is a dense growth of scrub oak and pitch pine which tends to obscure natural landmarks such as roads and ponds. Parts of this area have been cut over, and the patches of slash, in which fire travels rapidly, make accurate location for suppression crews of prime importance.



The solution to this problem is a system of markers, similar to the one illustrated, which we mounted on the top of trees and poles high enough to place them above surrounding vegetation and in locations where they are under direct visibility from the lookout. Each marker is painted a bright yellow, which seems to glow in the sun and renders the marker readily visible. Markers are located near road junctions, fishing ponds, scout camps, picnic grounds, and similar hazard areas. Exact location of each marker is recorded on the lookout map.

This system of markers provides a network of artificial landmarks within the area of responsibility of the Myles Standish Lookout that facilitates rapid and accurate determination of fire location without the aid of cross shots from other lookouts. In addition the markers provide a visible "yardstick" for estimating distance. This aid is of considerable value in training a new observer and to one not familiar with that particular area.

The usefulness of the markers was established shortly after they were put up. A fire occurred in a slash area about 500 yards from a marker. The observer was able to report the exact fire location without the aid of a cross shot. The markers have proved so useful that we plan to extend the system.—HAROLD L. BALLARD, *District Fire Warden, Massachusetts Forest Fire Service.*

Volume 14 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.

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Forest Service, Washington, D. C.

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CONTENTS

HALF-INCH FUEL-MOISTURE STICKS—HOW THEY ARE MADE

C. E. Hardy

Forester, Northern Rocky Mountain Forest and Range Experiment Station

Nearly 30 years ago the idea of using sticks of known dry weight as a criterion of the moisture content of forest fuels was conceived. The purpose of indicator sticks is to evaluate the relative dryness of fuels as one essential step in fire-danger rating. Richard E. McArdle, now Chief of the United States Forest Service, developed the idea of 1/2-inch square sticks and doweling 3 sticks together. The late Harry T. Gisborne, in Region 1, tested natural branches, 2-inch dowels, 1-inch dowels, and the square ones during the process of arriving at the present type of fuel-moisture indicator sticks. Prior to 1942 sets of sticks were not trimmed to any particular oven-dry weight. Either a special scale had to be used or a conversion table prepared for each set. Starting in 1942, all sets were trimmed to exactly 100.0 grams, oven-dry weight. This reduced computation work tremendously and minimized errors. It also meant that a set of fuel-moisture sticks could be used anywhere without having its little conversion chart tagging along.

After the sticks were generally accepted throughout the Western States, the California Forest and Range Experiment Station assumed the manufacturing task and started development of a mass-production method. In 1948 the manufacturing responsibility was assigned to the Northern Rocky Mountain Forest and Range Experiment Station. Development of efficient mass-production methods continued at the Priest River Experimental Forest in northern Idaho. Finally, in the fall of 1951, a manufacturing center to produce fuel-moisture sticks for the entire Western United States was established at the Forest Service Warehouse in Spokane, Wash. The Division of Procurement and Supply has an ingenious group of fellows at the Spokane Warehouse—they love to find easier and cheaper ways of doing things. This article will tell how they are doing the job.

A set of Forest Service standard fuel-moisture indicator sticks consists of four 1/2-inch ponderosa pine sapwood dowels spaced 1/4 inch apart on two 3/16-inch-diameter hardwood pins. The dowels are held in place on the pins by wire brads at each intersection. The resultant set of indicator sticks is 2-3/4 inches wide, approximately 20 inches long, and has an oven-dry weight of 100.0 grams.

The manufacturing process is a continuous one. When production is fully underway, material is in all stages of completion. Six or seven weeks' production by a 2-man team is sufficient to supply the normal annual demand for 1,800 sets. The sticks are made during the winter months when warehouse work schedules can best be adjusted for the purpose.

The Division of Fire Research furnishes technical supervision to the project. The forester in charge of Fire Danger Rating research assists in instruction and inspection at the lumber mill when the dowel stock is purchased, training of new personnel at the place of manufacture, setting standards and tolerances, and inspecting the product through all stages of manufacture.

Procurement of good quality dowel stock makes the whole job easier. Specifications are strict: the dowels are cut from well-manufactured, sound ponderosa pine lumber, air-dried or kiln-dried to a uniform moisture content of not more than 15 percent. All dowels are round and accurately cut to a uniform diameter of 1/2 inch, tolerance of ± 1/64 inch, and to a length of 23 1/2 inches, tolerance of ± 1/8 inch. They are smoothly and accurately machined except for occasional minor imperfections that can be corrected by light sanding. The grade or quality of the dowels is such that at least a 20-inch section of the length is free of the following defects: heartwood, knots, pitch pockets, pitch streaks, excessive number of resin canals, splits, checks, shake, stain, decay in any stage, cross or diagonal grain in excess of 1/2 inch per foot, coarse grain or grain having noticeable percentage of summerwood, sweep in 2 planes, sweep in 1 plane in excess of 1/8 inch per 23 1/2-inch dowel. Specifications for the 3/16-inch connecting pins are similar except that these are maple or birch.

The primary pieces of equipment needed for the manufacturing job are: 2 electric ovens made so the inside rack turns continuously, drill press, drilling and assembly jigs, 4-inch power saw, 3 sets of balances (knife-edge types for the sorting table and the initial check-out at the oven, and a high quality torsion balance for final trim and final check), a tacking machine and tacks, GI brush, rubber stamp, and other incidental tools.

Fuel-moisture research shows that of the unsatisfactory indicator sticks, 80 percent are made from dowel stock either too light or too heavy to meet the length requirements. Dense wood containing excessive resin in the cells and wood that is very light in weight produce sticks that have erratic moisture absorption and drying characteristics. It is important that such woods do not find their way into a set of fuel-moisture sticks. However, the elimination of these types of wood is not easy because experience shows that such defects cannot be readily detected by observation.

One of the project men, an ardent disciple of Rube Goldberg, developed an ingenuous device to overcome the trouble. He wasn't sure that his idea of an automatic sorter would prove successful; so instead of making the contraption on official time, he performed the development work on holidays and weekends. The result of his work is a very successful sorting device that automatically detects woods of various densities. Figure 1 shows the sorter and its inventor, Arthur Mast. It consists of a series of No. 14 wires and counterbalances, with the fulcrums held in a wooden framework. The sorter is adjusted so that a dowel rolling along the top of the frame will drop into a pocket when the weight of the dowel trips the counterbalance. There are 6 pockets—1 for the extremely heavy dowels, 1 for the extremely light dowels, and the other 4 for the usable dowels in order of their weights.

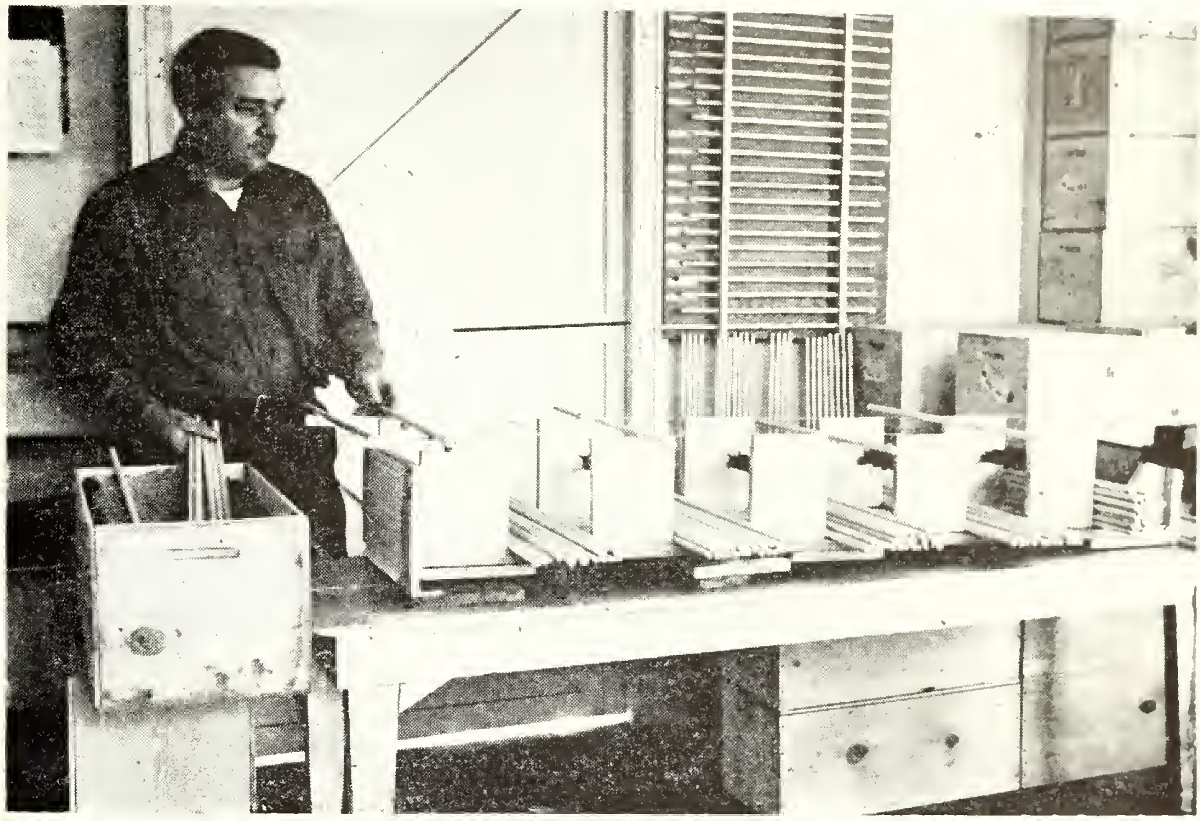

FIGURE 1.—The sorting machine.

After dowels are sorted by weight the next step is inspection to eliminate pieces with such defects as pitch streaks, heartwood, and other items listed in the specifications. A defect rack containing samples of every type of unsatisfactory wood has been assembled as a training aid and guide for the inspector. The culling process takes place in front of a large window, because experience has shown that defects are most readily detected under natural light conditions (fig. 2). Dowels passing inspection are placed according to weight in one of four bins.

Up to this stage in the sorting and inspection process each dowel has been treated as an individual. The next step is to select four matched dowels for assembly into a set of fuel-moisture indicator sticks. One dowel is selected from each of the four weight sorting bins so that no one set of sticks will contain a preponderance of the heaviest or lightest acceptable woods. The four dowels are weighed to determine whether or not the resultant set will meet final weight/length requirements. Proper allowance is made for the moisture content.

The hardwood connecting pins that hold the 4 ponderosa pine dowels together are cut by a power saw to a length of 2 1/2 inches. A special jig permits cutting 90 hardwood pins at a time. Less than one man-hour of labor will produce enough hardwood pins to assemble 1,800 sets of fuel-moisture sticks.

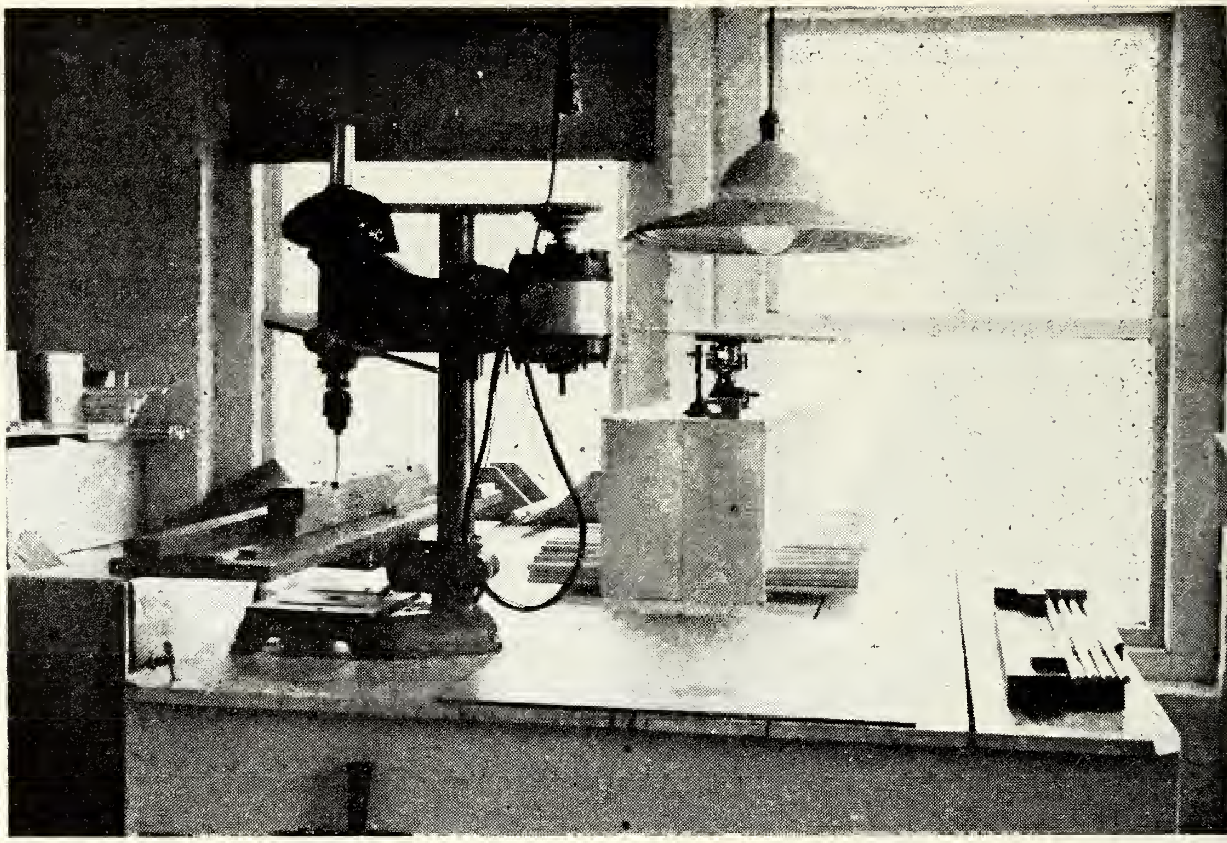

FIGURE 2.—Drilling and assembling layout.

Prior to the actual assembly operation a drill press bores two holes in each ponderosa pine stick for insertion of the hardwood connecting dowels. A special jig holding four ponderosa pine sticks is used in this operation. The two outside sticks are bored only to a depth of 3/8 inch so that the connecting pins will not protrude. This reduces the need for excessive sanding and finishing of the completed set. Holes for the connecting pins are bored through on the two inside sticks. The pins are put through the inside dowels, and the outside dowels are placed over the ends of the pins. The set of sticks is now ready for final assembly.

During final assembly, still another special jig is used to obtain proper spacing of 1/4 inch between each dowel, and to facilitate tacking of the hardwood pins (fig. 2). Tacking is performed with a hammer that automatically feeds the tacks into position. After tacking, little splinters around the holes are removed with a GI brush. Dirt and rough spots are removed with 1/0 sandpaper. Insertion of a screwhook in the end of one of the middle dowels completes the assembly job.

The next manufacturing step is oven-drying of the assembled sets of sticks. Each oven contains a constantly rotating rack that holds 56 sets of sticks in a vertical position. A clutch stops the racks for loading and unloading (fig. 3). Heated air passes uniformly around each set of sticks. The moisture-laden air is ejected through a port in the side of the oven.

Mass production techniques for a 2-man team have been developed for both the assembly and oven-drying operations during a 40-hour work week. New charges of fuel-moisture sticks are put in the ovens every week day except Friday. On Monday after the ovens are charged, the entire day is available for sorting, drilling, and assembling. On other week days the work schedule is divided between these operations and the oven-drying procedures.

FIGURE 3.—Loading an oven.

After 18 to 20 hours of drying, four sets selected at random from each oven are marked, weighed on a sensitive balance, and the weight recorded. This procedure is repeated hourly until no further weight loss occurs. It is extremely important that all sets of sticks be absolutely dry before removal from the ovens. Any residual moisture will cause an error in all remaining work. When bone dry, the sets are ready for trimming to exactly 100.0 grams.

The two men—call them the initial weigher and the trimmer—must acquire a proficiency in the trimming step, because after a set of sticks is out of the oven for more than 2 minutes, it begins to absorb moisture and pick up weight. The initial weigher removes a set from the oven, weighs it, records the weight, and lays it on the small shelf just beside the trimmer (fig. 4). The trimmer picks up the set, glances at its weight on the chart, and saws it off just slightly longer than called for by a special trimming guide attached to the saw table. The trimming guide is a series of lines parallel to the saw blade, from 18 to 23 inches out from the saw. The guide lines are marked in grams and tenths of grams of initial weight. Guide-line positions are derived from the formula:

$$\frac{\text{Initial weight}}{\text{Initial length}} \quad \frac{100.0}{X}$$

Thus, a set of sticks with an oven-dry weight of 110 grams wil be much longer when trimmed to 100.0 grams than one which ha an oven-dry weight of 120 grams. After the first cut the trimme weighs the set on a torsion balance to determine how mucl material remains in excess of 100.0 grams. The balance is ad justed so that each mark on the scale above the pointer means one tenth gram. He saws off about the right amount and reweighs This is done until the set weighs exactly 100.0 grams. After a very short time the trimmer is able to make the final trimming in one or two passes through the saw.

FIGURE 4.—Initia weighing and trim ming.

After trimming, sticks are hung in a rack holding 20 sets A full day's run, usually consisting of five racks, is placed in the conditioning cabinet, part of which is shown in fig. 5.

The conditioning cabinet is a ventilated closetlike structure where sets may hang until they come into balance with the sur rounding atmosphere. It has been found that a week is long enough for a day's run to stay in the conditioning cabinet. At the end of that time any set that is erratic in its moisture absorption and retention capabilities can be spotted and either corrected or destroyed.

A simple procedure has been developed for testing sets of fuel-moisture sticks after their removal from the conditioning cabinet. Each set of the oldest day's run is weighed to the nearest 10th gram on a torsion balance. This weight is recorded on a chart that has a number for each set. The sets are then hung on the final check rack (fig. 6) in consecutive order so the hook number of a set corresponds to the number on the chart. The weights of the day's run of sets (100-110) are added together and

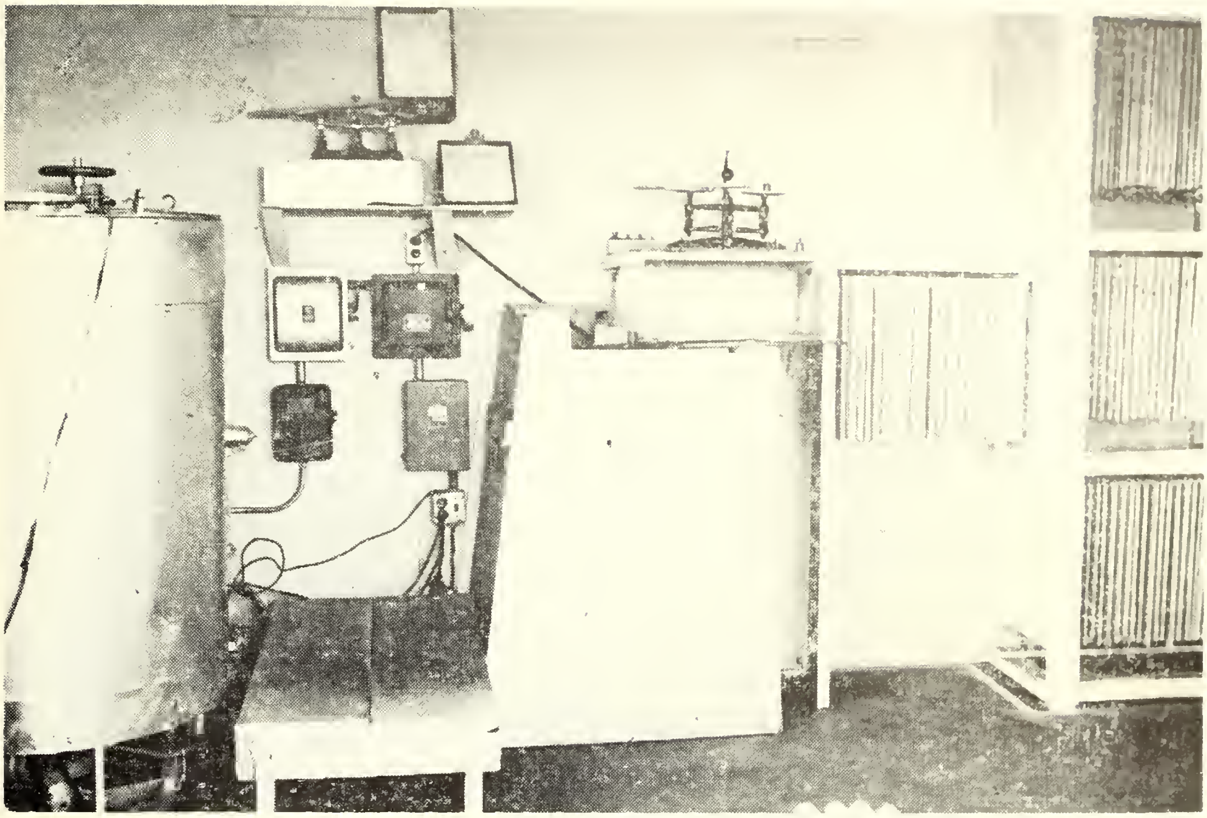

FIGURE 5.—Drying, trimming, and conditioning layout.

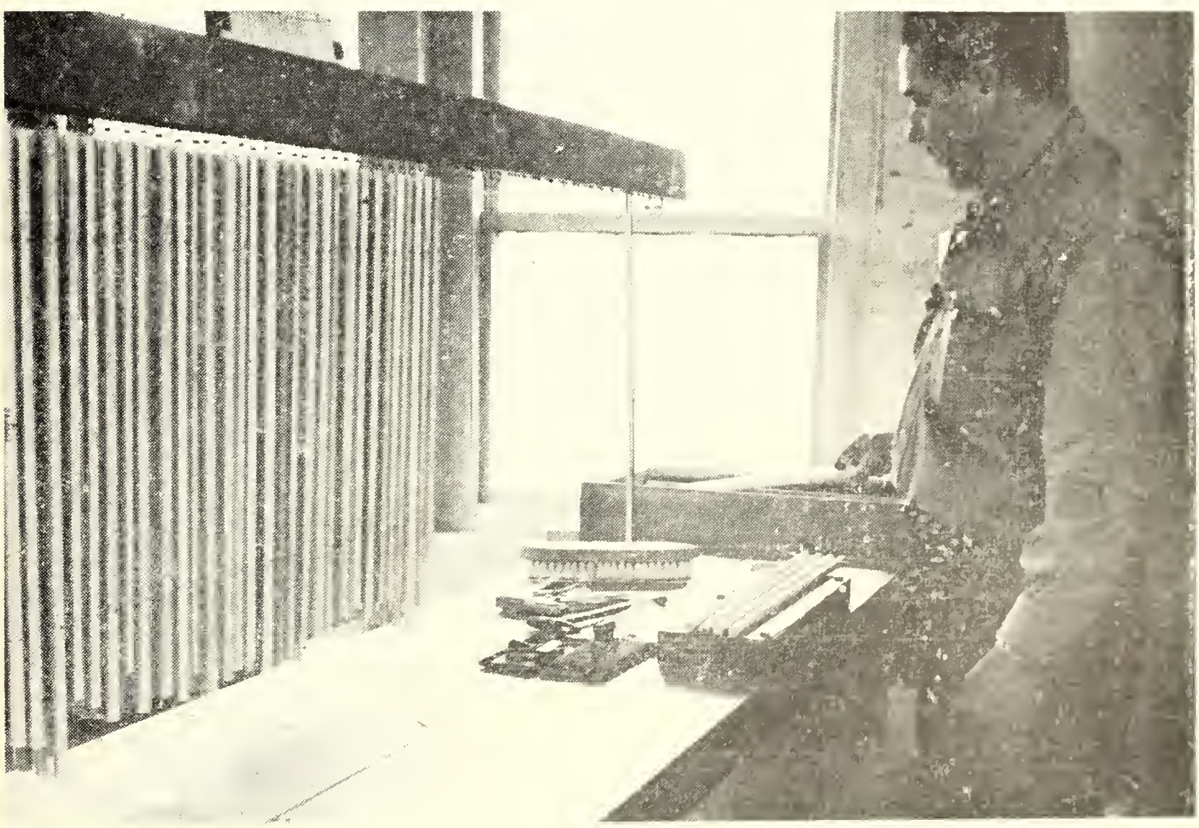

FIGURE 6.—Final check rack.

averaged. Any set whose weight deviates 0.5 to 1.0 gram from the average is corrected. If slightly overweight (0.5—1.0 gram), a set is trimmed down on the saw to the average weight. If slightly underweight (0.5—1.0 gram), brads are driven into one end to bring the weight up to average. If a set varies more than 1.0 gram from the average, it is discarded. Manufacturing experience shows that only 2 or 3 percent of the sets need adjustment; rarely is it necessary to discard one. All of the previous sorting and culling has diminished the possibility of losing the manufacturing investment long before fuel-moisture sticks reach this point.

After the final weight check, each set of sticks is again examined for fingermarks, loose dowels, splinters, or other defects not previously noted. The set is stamped in red indelible ink on the screweye end: THIS END NORTH, and, THIS SIDE UP. It is slipped into an individual paper envelope, put into a tight box, and stored away under uniform temperature and moisture conditions until spring. Then, orders from New Mexico to Alaska begin pouring in for these indicators of that ever-so-important factor in rating fire danger—fuel moisture.

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Map Mounting

There have been a number of articles on methods of mounting maps for various fire control and administrative uses, but I have found the following method the easiest and most satisfactory for mounting maps on plywood or sheet metal. The materials used are regular clear nitrate dope; nitrate dope thinner; 1½- or 2-inch paint brush (spray equipment can be used); ruler or large drawing triangle or spueegee; map mount of plywood or sheet metal; map.

The nitrate dope is the same unpigmented finish used on airplane fabric. It gives a waterproof, wear-resistant surface that will take a lot of rough use in the field or on the fire finder and dispatching map. One quart of dope will cover about 150 square feet of paper or wood with one coat. The dope can be used without the thinner, but thinning makes the dope easier to handle. Two people can do a better job of mounting large maps than one person, because the dope dries rapidly and the alinement of the map on the mounting base must be completed quickly.

First apply about three coats of dope to each side of the map and to the side of the mount on which the map is to be placed. Each application of dope should be allowed to dry before the next coat is put on. This drying takes but a few minutes. Next apply another layer of dope about the width of the brush along one side of the mounting base and immediately aline the edge of the map on this fresh application before it dries, holding the opposite side of the map off of the base. Progressively apply dope to the mounting base and smooth the map onto the base with a straightedge or squeegee. Do not press the map onto the base any harder than is necessary to push out all of the air between the map and the base. A little extra dope for this operation will give more time to adjust the position of the map and remove the air bubbles.

After the map is positioned and stuck to the base, apply five or more additional coats of dope on the surface, allowing drying time between coats.

Printed, paper azimuth circles, or another map can be applied to the surface of the first mounted map by simply placing the circle or map on top of a fresh application of dope, allow time to dry, then put more dope on top of the new additions. Nitrate dope cannot be used on top of the Visitype azimuth circle because it will dissolve the printing.—BROOKE R. DAVIS, *Ranger, Chattahoochee National Forest.*

WE'RE PUTTING EVERYONE ON THE TEAM

Don M. Drummond

Assistant State Firewarden, Nevada

Everything seems to be going up, including the number of man-caused fires on the wild-land areas along the eastern slope of the Sierra Nevadas, where the important communities of Reno, Carson City, Minden, Gardnerville, and Lake Tahoe are located. Sometimes it seems that not only the number of these fires, but quite sizeable parts of the most important watershed, recreation, and potential residential areas are going up too—*in smoke.* Theoretically, man-caused fires can be prevented. There are 8 agencies charged with fire prevention responsibilities in the 20-mile wide, 70-mile long area along the east slope of the Sierras: the State board of fire control, 3 counties, a rural fire district, the Bureau of Land Management, the U. S. Forest Service, and the Indian Service. These agencies have come to the conclusion they must exert even more effort at putting the theory of fire prevention into practice.

Factors that make our work of fire prevention a little more difficult each year, and which are perhaps typical of the situations existing around many communities in the Western States, are as follows:

1. As a result of past misuse and past fires, cheatgrass (*Bromus tectorum*) has taken over and is constantly invading new areas of wild land in the foothills, especially along the highways and access roads. Cheatgrass, so flammable that we are nearly correct in listing it as both a hazard and a risk, is probably the greatest single contributing cause to the increased number of fires and their size.

2. Automobile travel is growing at an astounding rate. More tourists, more commuters, and more travel by local people is shown by actual counts made by the State highway department. In other words, more people are traveling through our high-hazard areas each summer on both transcontinental and local highways.

3. Local residents are adding to the risk each year as they move out into newly developed suburban areas and subdivisions with their homes and stringer construction of motels, night clubs, and other business.

4. The reactivation of military bases is bringing into our area thousands of people who fail to realize the fire hazards existing in the semiarid country around them.

5. Literally hundreds of people commute 10 to 65 miles daily through areas that are so much a part of their daily routine they become oblivious to the fire hazards around them.

6. And the children, who constantly present new problems, apparently act by impulse and must learn by costly experience.

For the past several years the cooperating agencies have been meeting in March to map out the prevention plans for the coming fire season. And, although the prevention program is undoubtedly felt by the public, our fire occurrence records for the past few years make us believe that we are not getting ahead of the increasing risks and hazards, and the growing number of fires, as we should.

This spring when we realized that we should be doing better with our fire prevention job, we went to our interagency meeting determined to find out "why" as nearly as possible. Past fires were analyzed for cause, location, damage, and cost; classes of people responsible for fires were determined; possible new sources of man-caused fires for the coming year were examined. With this information we determined ways and means to reach the various classes of people who have been or may be responsible for starting fires.

It may be interesting to note that we divided the population into 50 classes, and then listed 50 different ways to reach them—a total of 2,500 general prevention jobs—with 3 methods devised specifically to reach each class. We find every class of people to be a problem at times, but children with matches and oil barrel incinerator users cause the greatest annoyance.

Having finished this initiatory work, we outlined in detail on a chart the total fire prevention campaign and made assignments to each agency and to each individual within the agency. Sometimes we feel that as the job of wild-land fire prevention comes closer and closer to its climax, more and more of it is left up to temporary summer employees, amateurs, and others not sincerely interested. The "regulars" are going to pitch a little harder and a little longer this season.

Smokey Bear, now a national forest-fire prevention symbol, has provided the way for public-spirited citizens to help. They can use Smokey to promote their fire prevention campaigns without feeling they are providing free advertising for public agencies. Our newspapers and radio stations support our fire prevention campaign thoroughly. Our merchants and theatres use our fire prevention material generously. Our highways and recreation areas are well signed and posted.

We have used the following ideas, in addition to the Cooperative Forest Fire Prevention material, with success: a fire prevention message on a large advertising balloon over Reno's largest gambling club; a street banner, carrying a fire prevention message, across the busiest street in town; fire prevention posters on the doors and endgates of all cooperating agency vehicles; small cartoon posters in such places as on the backs of cash registers, where everyone looks; special flier-type material for automobiles parked on city streets; judicious use of a mobile public-address system on weekend patrol of recreation areas; billboard-type signs on roadside fire scars, pointing out cause and resulting damage; cartoon form letters and fire prevention inspection guides; telephone fire prevention tags, listing telephone numbers of nearest firewarden; Smokey Bear "Thank You" cards for use at end of season.

We are planning to add the following ideas for the coming summer: More personal contact, inspection, and follow-through on areas of new construction and in areas where home incinerators are used; more personal contact with children during the summer through their organizations and through the theatres which sponsor Saturday morning "kid matinees"; Smokey Bear and his fire prevention message on the back of State Highway Patrol safety inspection stickers, to be placed on every Nevada motorist's windshield; large Smokey Bear fire-hazard signs along the highways; special fire prevention calendars for hotels and motels; timely contact of cummuting military and civilian personnel, with fire prevention message.

Even now we feel we haven't found all of the answers to fire prevention, but by next spring we hope to have the area of "where to look" narrowed down considerably.

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Nonglare Shield For Lookout Cab Windows

An annual maintenance problem of repainting the upper tier of glass panes in lookout cab windows has been eliminated on the Cassville District of the Mark Twain National Forest. In the past, the window panes had been painted green to reduce the glare from above. The paint chipped and peeled with a change in temperature, and each repainting thickened the paint coat, thus inducing more chipping and peeling. On the basis of a successful 12-month trial, a green plastic called Visionade is the answer to our maintenance problem. This material was originally designed to stop rear-window glare in automobiles. Temperature extremes inside the lookout cab have in no way affected the adhesive properties of Visionade. The life of this material is expected to be indefinite, since some motorists who applied it to their automobiles claim that it is still satisfactory after 3 years' service.

Visionade is transparent, thus permitting vision through the upper tier of panes without glare and sunrays blinding the observer. If for any reason the shield must be removed, it can be peeled off carefully and remounted as many times as is necessary. The largest sheet available to us is 11 by 36 inches and has been purchased locally from auto-supply stores for about $1.—K. F. Karow, *District Ranger, Mark Twain National Forest.*

HOSE WASHER

John Bourque

Inspector, Quebec Forest Protection Service

District No. 2, Forest Protection Service, has developed a washing device that has proved most effective for cleaning fire hose before drying (fig. 1). It was designed for use with a regular fire pump.

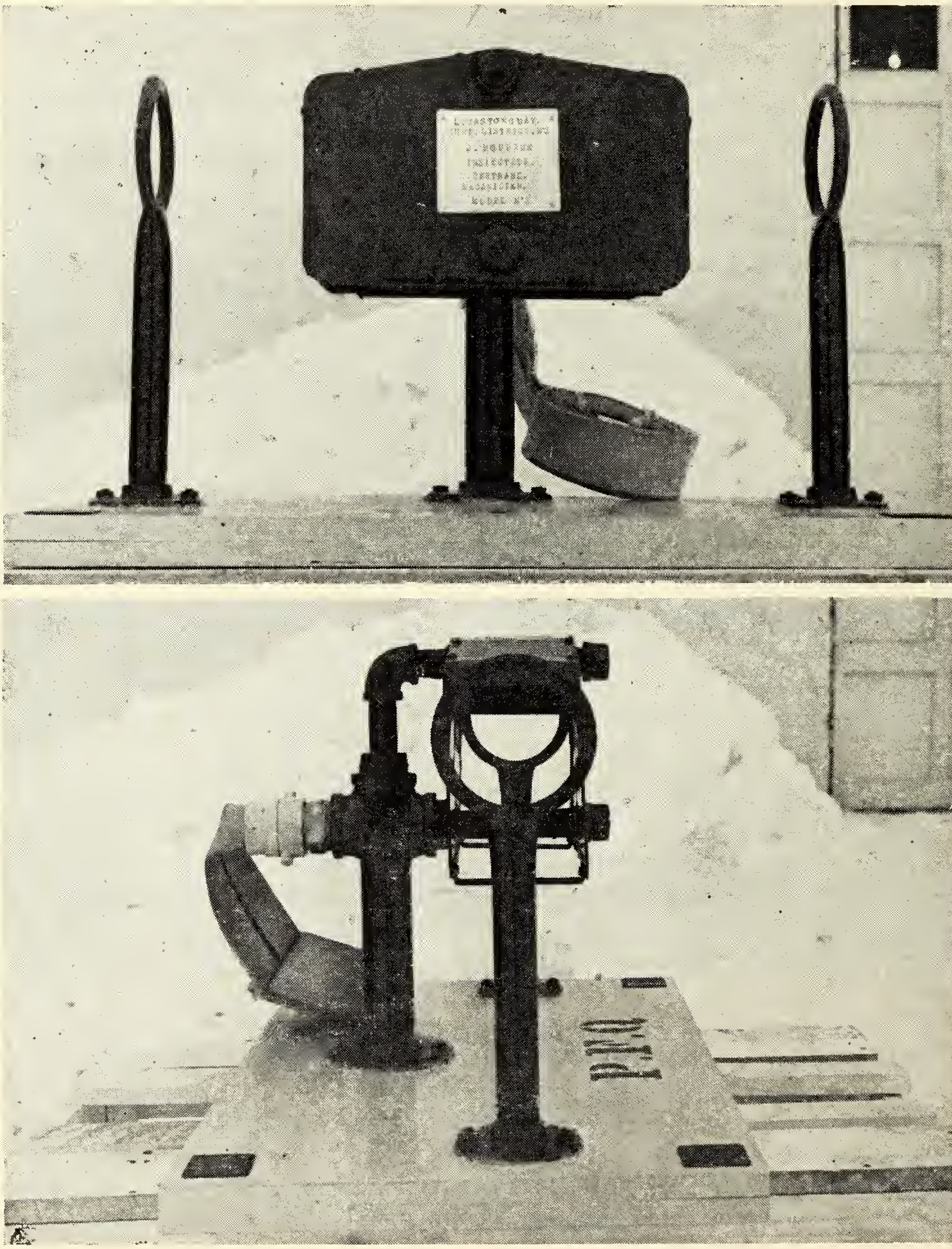

Figure 1.—Hose washer from side and end.

The overall dimensions of the machine are 17 1/2 by 18 by 30 inches. It is mounted on a wooden base of 18 by 30 inches and its essential components are 2 lateral guides, each 4 inches in diameter, and a central water-flowing apparatus. This water ejector, which is connected to the pumping unit through a 12-foot length of 1 1/2-inch fire hose, is composed of 2 horizontal pieces of 3/4-inch galvanized pipe about 5 inches long, between which the hose is drawn. Small perforations 1/8 inch in diameter are made at the lower side of the upper pipe and at the upper side of the lower pipe, through which streams of water under fairly high pressure are directed at the hose from above and below, thus washing the dirt and ashes off. The ejector is covered on 3 sides with a fender of galvanized sheet iron.

Dirty hose is pulled slowly through one guide to the water-ejecting device, from which it is drawn thoroughly cleaned through the other guide and out to the drying rack or tower. An advantage of this washer is that it can be made locally with ordinary pipe fittings, sheet iron, and steel rods.

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Glareproofing Tower Window Panes

The Division of Forestry of Oklahoma has experimented for the past 25 years with glareproofing tower window panes. We have tried colored panes as well as special paints that were either sprayed or brushed on the inside and outside of the tower windows. The colored panes were fine, but when broken, replacement was a factor in their utility. Painted panes were also satisfactory, but it was necessary to repaint about every 14 months because the paint would lose its effectiveness as a glare resister, and fade and peel.

In the past 2 years our best results have been obtained with a new material called Plyotron, which is manufactured in New York. It is the same material used on car windshields as an inside visor. Plyotron has proved itself as a glare resister, a haze filter, and a labor saver. After 2 years on a tower, it has not shown any signs of deterioration, and crystalization or buckling have not resulted from humidity or temperature changes. It also acts as an adhesive on broken glass. Glareproofing our towers with paint costs about $8.20 per job for travel, paint, and labor, and the towers must be repainted every 14 months. The Plyotron material costs 32 cents for a 13- by 12-inch pane, or approximately $12 for a standard aeromotor 100-foot lookout tower. Roughly, it costs $18 per tower, including travel, labor, and materials. One application of Plyotron has lasted 2 years without repairs, and from inspection it seems safe to state will last another 2 years. From every standpoint, we believe that Plyotron is the answer for relieving eyestrain and furnishing a built-in haze filter on Oklahoma's towers.—W. H. MITCHELL, *Chief of Fire Control, Oklahoma.*

SCALE-MODEL TOWER FOR CONSTRUCTION TRAINING

EARL M. BRADEN

District Forester, Tennessee Division of Forestry

A scale-model tower and footing layout proved very successful in demonstrating and discussing fire tower construction at a recent training session for our fire control personnel. This setup enabled us to study tower construction procedures from the layout of the footings to the final assembly of the steelwork. The model made the subject more easily discussed and also helped hold the attention of the trainees as various procedures were actually demonstrated.

Construction of the model was fairly simple and very inexpensive. The "ground" section was cut from the bottom of a 14-inch square corrugated cardboard box with 4 inches of the sides left on to give the depth (fig. 1). The footing holes were cut out and boxed in with other pieces of cardboard. To give added realism the top and inside of the holes were coated with water putty and then painted to resemble the ground around a tower site. The model forms for pouring the concrete footings were made to scale out of 1/16-inch gum veneer. Anchor rods were made out of No. 12 telephone wire and scale 2 by 4's were used to suspend the forms in the holes. To give more detail two forms were completely assembled and the other two were left in different stages of assembly. The forms could be placed in the holes, moved about, or taken out for examination. With this part of the model we could demonstrate the layout of the footing holes, the construction of the forms, the setting of the anchor rods and the final setting and alining of the forms for pouring the concrete.

The rest of the model consisted of the assembled first 20-foot section of a 60-foot tower and a few loose pieces of the next section. This was sufficient to cover all construction procedures in the erection of a full 60-foot tower. The base for this part of the model was also made from the bottom of a cardboard box, and footings were made from light cardboard and painted white to resemble concrete. All of the steel angle pieces were made from cardboard file folders. These pieces were cut to scale from a blueprint, then crimped to make the angle iron and painted with aluminum paint to give added stiffness and realism. After all of the pieces were ready, the section was assembled in the same manner as an actual tower, using airplane cement to hold the pieces in place. Later bolts were imitated with dots of black india ink. Scaffolding was made of 1/16-inch gum veneer cut to represent planks. A gin pole was represented by a piece of dowel, a carved balsa pulley, and twine for rigging. With this part of the model we could demonstrate the actual erection of the steelwork, the placing and use of scaffolding and most important of all the raising of the heavy leg pieces by use of the gin pole.

The entire model was built to a scale of 1 inch to 2 feet, and all materials used can usually be found around any office. It was well worth the time spent on building because it made the discussion more interesting, brought out more questions, and it is always easier to "show how" than to "tell how."

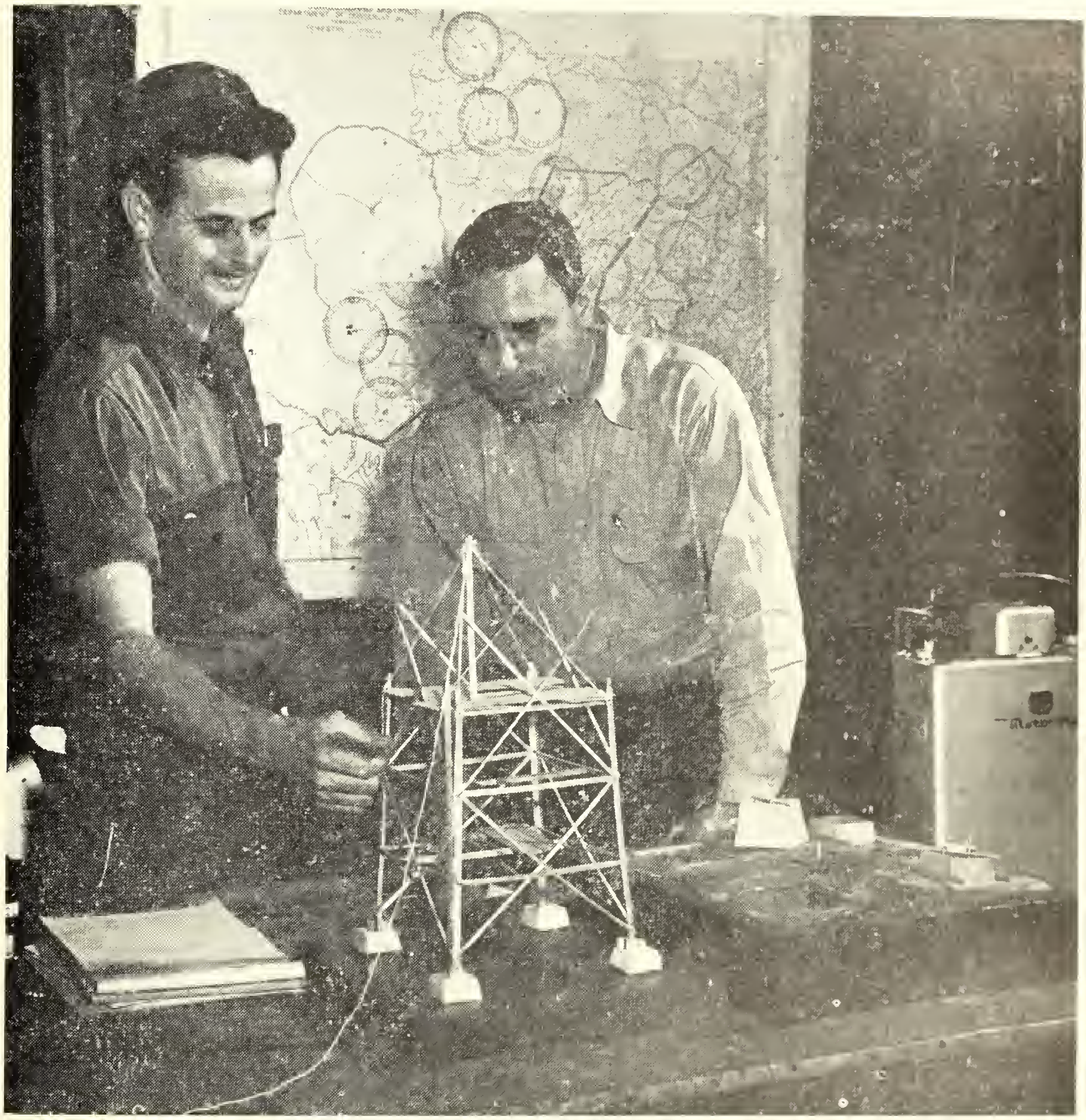


FIGURE 1.—*Right*, "ground section" showing holes and footing forms; *left*, 20-foot section of model tower under construction.

A "USE OF WATER" OUTLINE FOR TRAINING PERSONNEL AT GUARD SCHOOLS

Richard H. Woodcock

Timber Sale Officer, Olympic National Forest

For a national forest that is noted for its rain, the Olympic has had more than its share of fire fighting during the past two fire seasons. Out of the disastrous Forks fire of 1951, one of several needs was found to be a more thorough training course in the use of water in combating forest fires. In an area where the concentration of fuel is as heavy as it is on the Olympic and streams are abundant, the use of water is usually the best way to combat fire and sometimes the only way. Therefore, a course was conducted at spring Guard School (1952) on use of water. From limited material available the following outline was made up to be used as a guide in instruction as well as for later reference. Although it is presented here for what it is worth, some may not agree on all of the points included. We will welcome constructive criticism.

Part I. Theory and Technique of Fire Streams and Hose Lays

Time: June 18, 1:00 p.m. to 5:00 p.m. (Station 1)
Equipment: 1½-inch CJRL hose; 1½-inch linen hose; 1-inch CJRL hose; ¾-inch garden hose; assorted nozzles; tanker or pumper with accessories.

Introduction.—Water is Nature's most effective force in combating fire, and it is especially effective in the Pacific Northwest where it is plentiful and the fuel cover is heavy. Speed counts, and *water must be applied correctly.*

The first and most important requisite for effective use of water is a skilled nozzle man. Second, a reliable, foolproof pump or pumper. Third, a good pump operator. Fourth, a correctly designed nozzle with various size openings. Fifth, a quantity of good hose. Sixth, accessories to control water in the hose line, making the entire unit as flexible as possible.

I. The nozzle man

The most vital factor. A poor nozzle man can waste 60 to 80 percent of the water. He must be able to determine: (1) method of attack, i.e., once over or twice over; (2) type and size of nozzle to use; (3) direction of crew for highest effectiveness and speed of work.

II. The portable pumper

Its effectiveness depends on its portability, dependability, and volume of water that it can deliver at effective working pressures through various lengths of hose, and to various elevations above the pump settings. *The amount of fire that can be put out in any given period of time depends on the amount of water delivered.*

III. The pumper operator

Should be mechanically minded, reliable, and attentive. Not a job for catching up on the reading.

IV. Nozzles and tips

No one kind of nozzle or tip will perform with equal efficiency on all types of fires. To obtain largest effective stream, either nozzles of different size or nozzles with interchangeable tips should be used, the latter preferred. The tip or nozzle that will give the greatest number of gallons per minute at a given pressure should be used. The tip is cut down only to secure an effective stream for the work to be done. Small nozzles increase pressure but cut down volume and delivery. A small stream under high pressure breaks up and will not carry as far as a larger stream under lower pressure.

Nozzle pressures in excess of 60 pounds will break a stream and reduce both its vertical and horizontal range. Nozzles of 1/8-inch to 1/2-inch bore do not require more than 45 pounds nozzle pressure to produce efficient streams.

At specified nozzle pressures, the water delivery from various size nozzle tips is as follows:

Orifice size (inch)	*Nozzle pressure*				
	40 pounds (g. p. m.)	45 pounds (g. p. m.)	50 pounds (g. p. m.)	55 pounds (g. p. m.)	60 pounds (g. p. m.)
1/8	2.96	3.13	3.30	3.46	3.62
3/16 (garden hose)	6.64	7.03	7.41	7.77	8.12
1/4	11.8	12.5	13.2	13.8	14.5
5/16 (rounded)	18.0	19.0	20.0	21.0	22.0
3/8	26.6	28.2	29.7	31.1	32.5
1/2	47.3	50.1	52.8	55.3	57.8

Fog nozzles

Cold-water fog extinguishes fire by quickly absorbing heat and cooling the burning material below its ignition point and also by blanketing the fire to exclude oxygen. A given quantity of water, in vapor form, will absorb many hundred times more heat units than will be absorbed by an equal volume in the form of a solid stream. The small water particles are rapidly converted to steam, which blankets the area.

The basic principle of creating cold-water fog is the impingement of 2 equal streams of water at a 90-degree or sharper angle. A number of such impinging streams are grouped to produce the fog pattern desired. Low-velocity fog for flammable liquid fires is created in a circular pattern nearby the applicator nozzle head. High-velocity fog for general service is projected to a greater distance. Both types require approximately 100 pounds nozzle pressure to produce efficient operation.

Fog offers the quickest and most efficient method of wetting down outside of fireline prior to backfiring or on inside of fireline to prevent blowing of sparks until more complete mopup can be made. A fog tip on an applicator is efficient as a mopup tool.

V. Hose

A. *Types and characteristics.* The two general types are rubber-lined cotton (CJRL) and linen. The following is a comparison of the 2 in the practical 1 1/2-inch size, adopted by most protective agencies as standard.

CJRL hose.

1. Weighs approximately 27 pounds per 100 feet.
2. Has no seepage factor.
3. Must be dried after using and stored in a cool place where there is plenty of dry, fresh air.
4. Can be cleaned by scrubbing machines.
5. Will stand more abrasive wear than linen hose.
6. Will deteriorate under the sun's heat.

Linen hose.

1. Weighs approximately 13 pounds per 100 feet—one half the weight of CJRL.
2. Can be used in the packsack lapping-in method of laying hose.
3. Generally treated against mildew and much longer lasting than CJRL hose.
4. Has a seepage factor of 0.3 ounce per lineal foot at 150 pounds which amounts to approximately 2 gallons per 1,000 feet of line.
5. Cannot be burned with a blowtorch while water is running through it.
6. Has 10 percent greater friction loss than CJRL hose.
7. Can be stored wet without deterioration.
8. Should not be washed in scrubbing machines.

B. *Handling hose.* Should use special packboards and sacks for carrying hose. With board, 1 man can carry 200 feet of CJRL hose or 400 feet of linen hose. Lapped-in method quickest for linen hose and also protects hose. (Demonstrate.) Can be layed as fast as man can walk. Roll CJRL hose from center with male end approximately 4 feet short. Protects male end and enables hose to be pulled out easily, free from bends and twists. (Demonstrate.) Avoid dragging all hose on exposed sand, gravel, or rocks. Always use good gaskets so hose can be tightened by hand without use of spanner wrench. Never drive vehicles over hose. Demonstrate half-hitch method of rolling booster hose when live-reel is not available.

C. *Water friction in hose.* Friction in a given hose will increase as pressure is increased or as the volume of discharge is increased by using larger nozzle or tips. One-inch hose can be used for short lays and relatively small water deliveries (under 15 gallons per minute). Over 15 gallons per minute (free flow) the friction loss is 7.2 times greater in the 1-inch hose than it is in 1 1/2-inch hose. Use tables for realistic examples. (Demonstrate.)

D. *Hose threads.* Brief explanation on diversity of threads. Comparison of maximum external distance of male thread for various standards, which follow:

Standard	¾-inch hose Outside diameter	¾-inch hose Threads per inch	1-inch hose Outside diameter	1-inch hose Threads per inch	1½-inch hose Outside diameter	1½-inch hose Threads per inch
USFS Nat. Std.	1.2951	11½	1.2951	11½	1.8788	11½
U.S. parallel pipe	1.0353	14	1.2951	11½	1.8788	11½
American Nat. Std.	1.375	8	1.375	8	1.990	9
Chemical and booster	1.375	8	1.375	8	...	
U.S. Navy Nat. Std.	1.2951	11½	1.2951	11½	1.8788	11½
American Nat. Std., water and garden hose	1.0625 (½" & ⅝" same)	11½	1.2951	11½	1.8788	11½
American Nat. Std., air-oil-steam	1.0353	14	1.2951	11½	1.8788	11½

VI. Accessories for controlling and diverting streams—a *must* for a versatile and complete fire fighting unit

A. *Unit siamese valve.* Uses: (1) Y main line; (2) pumping in relay; (3) pumping against head; (4) assist in coupling or uncoupling of hose line.

B. *Bleeder valve.* Provides a means for drawing water from hose lines without disconnecting the hose or shutting down the pumper. No projections. Will work under any pressure.

C. *Pressure relief check valve.* Enables pump to be started against head. Prevents water from flowing back through pump when pump goes down. Provided with bypass that can be opened while pump is being started.

D. *Siamese connection.* Simple Y coupling with no valves.

E. *Pressure relief valve.* Automatically bypasses discharge from pump when nozzle is shut off or pressure in hose line becomes excessive. Usually set at a pressure of approximately 200 pounds.

F. *Hose tee.* Provides means for taking off from 1 1/2-inch line with a 1-inch or 3/4-inch line.

VII. Hose lays

A. *Simple hose lay.* (Demonstrate and practice.) Use of siamese forward and in reverse. Teamwork—practice coupling and uncoupling hose. Method of carrying folded hose forward. Lay hose straight, untwist hose.

B. *Progressive hose lay.* (Demonstrate and practice.) Use of tees or several siamese valves.

Part II. Pumps and Water Relay

Time: June 19, 8:00 a.m. to 12:00 Noon (Station 3)
Equipment: Type Y pumper, Edwards Model 40 pumper, 500 feet 1½-inch CJRL hose, pulaski, shovel, canvas sump, gas, oil, and accessories including nozzles, tools, check valves, take-offs, suction hose, siamese valves.

Introduction.—The best all-purpose pump for work on forest fires is the portable pumper, a self-contained unit whose principal qualifications are simplicity, dependability, pressures developed, and volume of water thrown.

I. Fire pumps generally fall into two categories, centrifugal and positive displacement pumps

A. *Centrifugal pumps.* Will handle large capacity, high pressure, or both. No close clearances. Will handle a moderate amount of abrasive material and have a long service life. Pressure relief valves are not required except for large capacity pumps. Maintenance and repair costs are low and they provide more dependable performance than positive displacement types, are slightly larger, have a higher initial cost, and are not self-priming.

B. *Positive displacement pumps.* Rotary gear, cam, and piston pumps are examples. Compared to centrifugal they are cheaper, self-priming, smaller, and more compact. They are quickly damaged by sand and other material in the water, require more power to do a given job, and need relief valves to handle surge pressures and overload. They also cost more to repair and maintain. Pump pressures are generally limited to the burst point of 2-year-old hose, which is approximately 200 pounds. Theoretical lift for 200 pounds pressure is 460 feet (200 ÷ 0.433) at sea level. Hose friction and elevations above sea level cut this theoretical lift to a maximum of about 400 feet.

II. Instruction and maintenance on two sample pumps

A. *Pacific Type Y.*

Motor.—2-cycle, 2-cylinder, 2-port type with alternate instead of simultaneous firing. 9.8 horsepower at 4,000 r. p. m. 3,500 to 4,000 r. p. m. under normal working conditions. Water-cooled. 0.025 is correct setting for breaker points and spark plugs. Spark plugs should be Champion No. 13 plugs or any 18 MM plug of equal quality.

Fuel mixture.—1 pint SAE 30 oil to 1 gallon of gasoline, unleaded preferred.

Pump.—Positive displacement, self-priming, rotary-gear type. Performance data:

Pressure (pounds)	100	125	150	175	200	225
G. p. m.	63	59	53	46	40	20

Pump lubrication.—Good grade SAE 30 oil in gear case. Lightweight grease every 10 hours on pump bearings. Waterproof grease every 4 hours on pump packing. Always squirt lube oil over impellers through discharge side before starting pump.

Starting hints.—Place timing lever in vertical position. Open carburetor needle valve two full turns. Move carburetor lever to choke position. Flood carburetor and pull starting cord. When engine starts, raise carburetor to fast position. Adjust needle valve, closing it about one turn. Move timing lever against engine rotation to speed pumper up and with engine rotation to slow down. Special instructions for flooding warm engine.

Total weight of unit, 70 pounds.

At 51 gallons per minute, 1 gallon of gasoline will last 42 minutes.

B. *Edwards Model* 40.

Engine.—4-cycle, 1-cylinder, L-head, all-aluminum, 1.1 hp., 1,400 to 2,600 r. p. m. Mechanical type governor; crankcase oil capacity, 3 pints; weight, 72 pounds.

Pump.—Positive displacement, self-priming, rotary-gear type.

Performance data.—Up to 50 g. p. m. and pressure up to 250 pounds.

Total weight of unit, 112 pounds.

III. Proper pump setup

Problem. Find all errors in sample setup.

1. Placement of suction hose.
2. Air leaks.
3. Placement of pump. Theoretical suction lift is 33.95 feet at sea level with 26 to 28 feet common practice. If machine is used to draw water to its maximum ability, it will not be able to push water to its maximum ability. (Every added foot of suction lift will decrease the possible discharge as much as 10 percent.)
4. Lack of fittings and miscellaneous.

IV. Hand signals, used for communicating with the pump operator or other crew members

DELIVER WATER AT NOZZLE

INCREASE PRESSURE

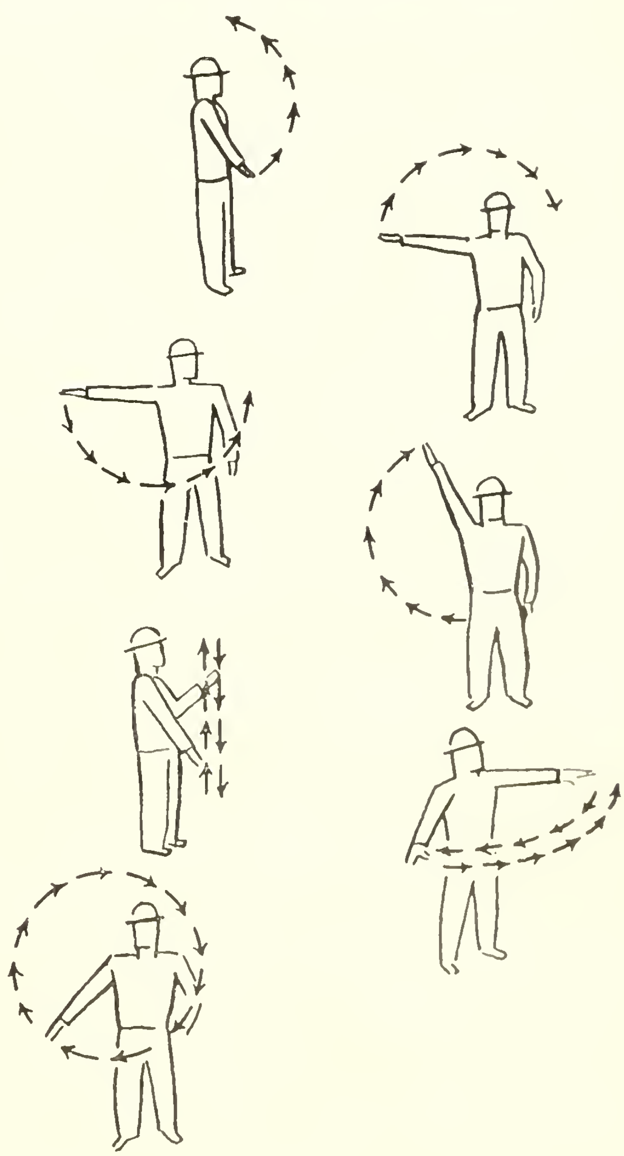
DECREASE PRESSURE

MORE HOSE

BROKEN HOSE

SHUT DOWN

ROLL UP HOSE



V. Pump relays

Pump relays are necessary at times to overcome excessive "head." The term "head" means back-pressure created by gravity where water is pumped to a higher elevation. It amounts to 4.33 pounds for each 10 feet of rise. Generally 2 feet of elevation is equivalent to 1 p. s. i. of pressure when using 1 1/2-inch hose. There are 2 methods of lifting water higher than can be reached with 1 pump.

A. *Relay system* (for raising water as high as 1,500 feet above its source).

1. With relay tanks. Canvas tanks; optimum spacing of pumps, 240 feet, 260 feet, 280 feet, 300 feet. Rough method for measuring these distances—five or more pumpers may be used in a series—simplest, easiest, and best method.
2. Without relay tanks. (Demonstrate.) Same spacing. Use of siamese connections and unit siamese valves. Calls for attentive pump operators.

B. *Tandem or booster setup* (for raising water a maximum of approximately 700 feet). (Demonstrate.) For use at bottom of steep mountain or cliff, 2 pumps in a series; limited to 2 because pump casings not built to withstand additional pressures. This method will produce approximately 350 to 400 pounds. Both machines should be started in unison.

Part III. Control and Mopup of Forest Fires With Water

Time: June 19, 1:00 p.m. to 5:00 p.m. (Station 3)
Equipment: F.S. White slip-on unit with Model 120 Edwards pump and accessories. Shovel, pulaski, adz hoe.

Introduction.—Water is the natural element for combating and extinguishing fire. A good stream of water is infinitely more effective than any other method for knocking down and extinguishing rapidly advancing fires, doing mopup work, extinguishing spot fires, etc., when applied correctly. With modern equipment, water can be delivered through hose lines a mile or more and lifted in relays to an elevation of a thousand feet or more.

I. Three stages of control with water include checking the advance, making a water trench, and following up

A. *Checking the advance.* Requires knocking down hot spots on the ground and in stumps and snags. Use the greatest amount of water with the largest nozzle opening possible. Hold water to an advancing front, generally on a strip 2 to 3 feet wide and never more than 10. Fundamental idea is to stop the spread until fire can be confined by means of a water trench. Back-pack pumps and take-off connections are used as follow up before trenching.

B. *Making a water trench.* Mainly a sluicing action around the fire edge. Width depends on conditions. Never more than 5 feet wide. Use large nozzle openings, dropping down only to increase pressure. Nozzle to be 1 foot or less from ground. In duff a twice-over procedure advisable. Assistant should point out smokes skipped, cut logs, dig out pockets, etc. Use of patrolman between once-overs advisable.

C. *Follow up.* Immediate mopup or allow interior material to burn out. Concentrate water on smoldering edge; takes approximately 2 inches of water to extinguish a fire. (At 20 gallons per minute, it takes 47 minutes to extinguish a 2-foot strip 375 feet long while only 50 feet can be covered in the same time if a 15-foot strip is attempted.) Don't spray everything the stream will reach. Straight stream close to ground or a fog applicator nozzle.

II. Use of water with conventional trench methods

A. *Blanket method.* After the trench is completed and the hose is strung, a 10- to 15-foot strip outside trench is thoroughly wet down (2 inches). Interior then burned out from trench inward. (Fog most efficient and quickest.)

B. *Mopup method.* Start from trench and work inward in 15- to 25-foot strip. Mopup in continuous strips.

III. New developments—wet water, foam, fog, etc.

IV. Explanation of Forest Service White slip-on tankers with Edwards 120 pump

Engine.—2-cylinder opposed, L-head, 4-cycle, air-cooled, internal-combustion, high-compression type. Governor speed control and heavy-duty magneto ignition. Uses standard gasoline and 2 quarts detergent SAE 30 motor oil. Spark plug gap of 0.020 inch.

Pump.—Positive displacement, self-priming, rotary-gear type. Performance data (Size B Rotor, 2,600 r. p. m.):

Pressure (pounds)	100	150	200	[1]250	300
G. p. m.	50	45	42	40	30

[1]Recommended maximum.

V. Recommended nozzle accessories

Small-capacity tankers normally use small amounts of water, usually 5 to 15 gallons per minute. However, in some situations such volumes will not do the job. Nothing is gained by wasting water while the fire gains headway. In the Navy Fire-Fighting School, the toughest fire is either put out or lost in a minute's time with 52 gallons of fog.

A. One-inch combination straight-stream, fog, and shut-off nozzle with 3/16-inch straight stream and either 6 or 8 gallons per minute fog head (for use on fires not requiring large volumes of water).

B. One 1 1/2-inch nozzle with lug for spare tips (1/4-, 5/16-, and 3/8-inch tips). All tips and lugs to be 3/4-inch garden hose thread. 3/8-inch tip (37.6 g. p. m.) gives the farthest reach with these slip-on units.

C. One 4-foot by 3/4-inch aluminum applicator with 3/4-inch garden hose female swivel coupling on nozzle end and 3/4-inch male garden hose thread on tip end.

D. One 30-g. p. m. fog tip for use on applicator when mopping up, on 1 1/2-inch straight stream for wetting down, or for a building fire. (Fog when used on an enclosed fire where it is converted to steam expands 1,700 times.)

E. One 15-g. p. m. fog tip for brush fires or fires of heavy intensity.

THE DIESEL LOCOMOTIVE FIRE CONTROL PROBLEM IN MICHIGAN

DELL F. WEIR

Supervisor, Railway Fire Prevention, Michigan Department of Conservation

The introduction of diesel locomotives to Michigan was made several years ago, and their use was confined to switching service in railroad yards of our larger cities, or to the operation on short-line railroads for hauling light-tonnage trains. A rapid change to diesel locomotive power for freight and passenger service, however, has taken place in more recent years. Michigan's railroad locomotive power today is about 50 percent diesel. Individual railroad company diesel power varies from 5 to 100 percent.

In Michigan, reported diesel locomotive-caused forest fires increased from 8 in 1950 to 28 in 1952. These fires were 37 percent of the total railroad-caused forest fires reported for that year. During this 3-year period we cooperated with some of our railroad companies in experimenting with devices for arresting sparks from the stacks of diesels. While we have not yet determined which type of spark-arresting device is the most efficient, we can see the possibility of eliminating the worst offenders.

After the close of the 1952 forest fire season we felt that a conference should be held for all those concerned with control. It was believed that a careful and complete analysis of the problem should develop some constructive recommendations for the control of these fires. Accordingly, a conference was held at Milford, Mich., March 5 and 6, 1953. It was attended by representatives from the American Locomotive Co., the Electro-Motive Division of General Motors Corp., and Fairbanks, Morse and Co.; officials from the operating, engineering, and mechanical department of nine railroad companies operating diesel locomotives in Michigan; representatives from the forest fire agencies of the United States Forest Service, the Wisconsin Conservation Department, and the Michigan Conservation Department.

The discussion of the many ramifications of the diesel locomotive as a cause of forest fires was sincere and frank. Every representative attending the conference was eager to contribute to the solution of the problem. The following general conclusions were reached.

1. That diesel locomotives cause fewer forest fires than do steam locomotives.

2. That ignited carbon deposits ejected from the diesel locomotive exhaust stacks are a major cause of right-of-way fires.

3. That carbon deposits formed in the diesel locomotive exhaust chamber are a residue of fuel oil combustion; when ignited, loosened, and ejected from the exhaust stack such deposits, if large enough to hold a high temperature until they land, set fires when forest fuels on the right-of-way are conducive to quick ignition.

4. That detergents or other additives in lubricating oil used in diesel locomotive powerplants are not a serious contributor to the fire problem. Carbon deposits formed by these additives are small in size and of a flaky texture. When they are ignited, loosened, and ejected from an exhaust stack they are incapable of holding high temperatures for any length of time. The sparks called floaters, and easily observed at night, are no doubt part of these ignited carbon deposits.

5. That, as far as has been determined, ignited carbon ejected from the diesel locomotive exhaust stack is formed by: improper setting or adjustment of the fuel-oil jet, which causes improper combustion; the locomotive being operated for long periods with the motor throttle at or near idle, which causes a buildup of combustion residue in the exhaust chamber; the residue from lubricating oil.

6. That certain types of railroad services are more conducive to the formation of carbon deposits than other types of services.

7. That the cause of carbon deposits being ignited, loosened, and ejected from the diesel locomotive exhaust stack are high temperatures in the exhaust chamber; high velocity of combustion gases ejected from the exhaust chamber; moisture in the exhaust chamber, which tends to loosen the carbon deposits.

8. The methods used for arresting ignited carbon deposits are (a) deflector or baffle plates placed at various positions and angles in the exhaust chamber; a supercharger that breaks up by centrifugal force, ignited carbon deposits before they are ejected from the exhaust stack; (c) screened hoods placed over the exhaust stack.

9. Diesel locomotive spark-arresting devices have limitations: (a) The arrangement of deflecting or baffle plates in an exhaust chamber must not materially reduce the ratio between the area of opening of the motor exhaust ports and that of the exhaust stack or the motor will become overheated. (b) The height of any spark-arresting hood over an exhaust stack is limited because of the clearance necessary for the locomotive to move through tunnels, and under bridges, buildings, etc.

10. Train crews need fire prevention education. Representatives of the Wisconsin and Michigan Conservation Departments agreed that a properly worded forest fire prevention sign and ashtrays placed in the locomotive cabs and cabooses would be a good fire prevention measure. They also agreed to intensify efforts to educate train crews.

Owing to the fact that the diesel locomotive fire control problem in Michigan is new, our data is not adequate for determining what make or type of diesel locomotive is the offender. Nor have we yet been able to be positive about the results of the spark-arresting devices we have experimented with. However, with forest fire agencies, railroad companies, and builders cooperating in the correlation, analysis, and utilization of the statistical information compiled, there is certain to be a reduction in the number of diesel-caused forest fires.

FIRE PROTECTION IN THE BRADFORD OIL FIELDS

L. E. STOTZ

District Ranger, Allegheny National Forest

A part of the Bradford Oil Field, the second largest, and one of the oldest and most valuable oil fields in the United States, is located on the Northern District of the Allegheny National Forest near the city of Bradford, Pa. This intensely developed oil field lies in a heavily forested area of the northern hardwood type, and the danger of forest fires damaging or destroying oil-well equipment is always present during the spring and fall fire seasons. Not satisfied with enriching the subsurface with Pennsylvania-grade oil, Nature was lavish in clothing the hills above this famous oil pool with a forest which, following clear cutting, has a preponderance of second-growth black cherry, one of America's finest cabinet woods.

Perhaps no other forested area in the United States has so much capitalized value per acre as the Bradford Oil Field where, in the secondary recovery of oil through water-flooding of the oil sand, an average of 210 oil wells and 220 water wells per square mile exist. In addition to the many producing wells in the Bradford Field, heavy investments have been made in the miles of surface and underground pipelines, electric powerlines to service the wells, and countless pumphouses, water-treatment plants, and storage tanks. Allegheny National Forest is "pockmarked" with oil well openings, lease roads, and many other installations necessary for the secondary recovery of oil. The average investment per acre in this field for the recovery of oil and gas is between $5,000 and $6,000, not including the investments in mineral rights which are extremely variable. Naturally, such heavy on-the-ground investments for the recovery of highly flammable products make the participants in this venture extremely fire conscious.

In the days of the wooden derricks, lumbering operations in the field created heavy slash through the liquidation of the old-growth timber stands, and many large fires occurred that often destroyed the wooden derricks, causing the oil-well tubing to drop into the well. Now the derricks are no longer a feature of the landscape, and selective-cutting methods on national-forest land create a minimum of logging slash, widely scattered. However, some of the private land within the Bradford Field is still being clear cut for chemical wood or pulpwood, and the heavy slash presents a high fire hazard until it rots down.

Present-day wells are pumped by electrically driven pump jacks, and the grass is kept mowed around the well openings. Any accumulation of waste oil around the well is burned during times of low fire hazard. Today, greatest danger to the oil field from forest fires is the shutting down of the wells if a fire burns down electric-line poles supplying current to the motors on the pumps.

For the protection of the surface of their underground holdings, from the ground line to the tree tops, the oil companies are dependent upon their own field men working on the oil leases, the Pennsylvania Department of Forests and Waters, and the United States Forest Service. Where a fire occurs on private land the Department of Forests and Waters is responsible for its suppression, and the cost of suppressing it. Where it occurs on national-forest land, on which the oil companies own the subsurface rights, the suppression and cost of suppressing the fire becomes the responsibility of the Allegheny National Forest.

Fire wardens in this area are appointed by the Department of Forests and Waters as State Fire Wardens, and are subject to call by either agency for suppression of fires on both private and national-forest land. It is significant that many of the most active and valuable fire wardens are supervisory field employees of oil companies in the Bradford Oil Field. These men, and the roustabouts, truck and tractor drivers who work under them, are strategically dispersed throughout the woods on their regular round of duties and make excellent organized fire crews.

Ten- and twenty-five-man fire tool boxes, equipped and maintained by the Forest Service, are located throughout the oil field in company buildings near a telephone. There is also a heavy concentration of bulldozers, jeeps, heavy trucks, and other valuable equipment in the oil field, which belongs to the oil companies and is available for fire fighting at any time.

The heavy network of highways, secondary roads, and lease roads makes the forested area within the Bradford Field one of the most accessible timbered areas in the United States. These roads, in addition to making it possible to reach a fire in record time, also are of considerable potential value for backfiring purposes should the need ever arise.

In the intensively developed part of the Bradford Field, individual workers are so fire conscious as they go about their daily work that any occasional fire is usually so quickly controlled that State and Federal agencies have only to take whatever followup action is necessary for statistical purposes. With water wells 300 feet apart, and equipped with an extra T and valve, a hose connection for fire fighting can usually be made within 2 to 5 minutes. Two lookout towers, 1 State and 1 Federal, look directly into the heart of the Allegheny National Forest part of the Bradford Oil Field. Any fires not immediately observed from the ground by the oil workers are picked up from these towers, and crews are quickly dispatched.

Thus, all of the factors for successful fire protection are at hand in the Bradford Oil Field on the Allegheny National Forest, and if adverse weather conditions should create an emergency fire situation, the oil industry can be counted upon to throw its trained manpower and heavy equipment into the fight along with the Federal and State agencies that are charged with protecting the surface of this oil empire.

SOME OBSERVATIONS ON SLASH BURNING

JACK HEINTZELMAN and CLARENCE EDGINGTON

Olympic National Forest

In broadcast burning of slash during the past season on the Quinault District of the Olympic National Forest we were concerned with the difference in burning conditions on north and south slopes, particularly when both were located in the same unit under the block system of cutting.

Most of our slash burning was done in the dry-up period, and the south exposures were the first to get in shape for burning. Several times we ended up with a good clean burn on the south side of the hill and a large number of small fires scattered through the slash on the north side. Ordinarily this situation wasn't critical, because the north side was fired in the days that followed until a good burn was obtained. However, with this procedure it was always possible that something would interrupt the usual routine, or that high-cast winds might arise, and the north slope would burn out under unfavorable conditions and cause damage.

To improve this procedure, we have decided to vary our method of using fuel-moisture sticks. In the past, we have placed our fuel-moisture sticks only on the south slope, the place most likely to dry out first, and in the green timber. We found that we could obtain a satisfactory burn when the sticks in the slash reached 13. Ordinarily the sticks in the green timber at this time would be 20 or higher. It is our assumption that sticks on the north slope at the same time would be 16 or higher. We now plan to use fuel sticks on north as well as south exposures, and to burn each exposure when its fuel-moisture condition becomes right. This procedure will, we believe, help considerably in keeping the control of burning in man's hands rather than having the fire in control.

Another procedure that we have followed in the past has been the building of bulldozer firelines around the staggered settings in advance of burning. In heavy slash, this results in a large windrow adjacent to the timber, though separated by a cat line. Under adverse burning conditions the windrow gets extremely hot and holds the heat, and we have had trouble trying to keep fire from spotting to the timber. This system has been varied by burning the slash first and then building the cat line. The fuel-moisture condition in the timber is ordinarily such that the timber is relatively safe at the time of the burn, and the cat line is easier to construct after burning and acts as a better control line in the subsequent dry up. While this procedure has worked well in some cases, it cannot be recommended in all cases.

A third observation we wish to make is that for lighting slash we prefer the fusee to the pneumatic flamethrower, drip torch, etc. It is lighter, more convenient to carry, and will light the slash quite satisfactorily when the slash is *right* for burning. However, for those who contend that the pneumatic flamethrower is better for lighting slash when the slash isn't *quite right* for burning, we would answer that the slash shouldn't be burned until it will burn readily enough for the fire to spread over the logged area.

These points are made in order to present some of our preliminary thoughts on broadcast burning, and to elicit a rebuttal.

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Railroad Bulldozes Firebreak

For many years forest fires have originated on the right-of-way of the Louisville and Nashville Railroad along a 4-mile stretch between Livingston and Hazelpatch, Ky. The railroad is located at the foot of a western slope that averages 20 to 30 percent. It was necessary for fire fighters to wade or boat across Rockcastle River, paralleling and west of the tracks, to reach the fires, or to walk in from either end of the 4-mile section. In any case it was impossible to control fires before many of them had reached the top of the ridges to the east. The chief litter was Appalachian hardwood leaves. Most of the area above the tracks is national-forest land.

Two railroad sections meet in this area, making it necessary to deal with two foremen. In spite of frequent contacts with foremen and track supervisor, the right-of-way was seldom fully fireproofed, as required by State law, before fire season rolled around. The section crews used a roughly raked line at the edge of the right-of-way from which to backfire. As a result these fires sometimes escaped the crews' control. Although the L & N usually paid damages to the United States, collection was often a slow and expensive process. To make matters worse, an incendiary was suspected of starting fires to throw suspicion on the L & N, and perhaps to allow private owners to collect high damages.

Ranger S. W. Campbell of London suggested that the L & N construct a firebreak with a bulldozer at a safe distance back from the tracks, and his suggestion was passed on to the company. John T. Metcalf, an attorney for the L & N, recommended company cooperation. The company then accepted a special-use permit to build and maintain the proposed firebreak on national-forest land, because the railroad right-of-way was too narrow for safety.

The firebreak was constructed in October and November 1952. It is 10 to 15 feet wide, including the cast-over ridge of earth, and varies in distance from the track from 40 to 250 feet, averaging about 100 feet. It is not suitable for a jeep road without additional work. The job required 176 hours and the cost was approximately as follows: bulldozer at $6 an hour, $1,056; operator at $1.73, $304; helper at $1.20, $211; total, $1,571, or $393 per mile.

This firebreak should pay for itself in several years by reducing damage claims from the Government and private parties, making a safe line from which section crews can backfire, and allowing productive timber growth on slopes badly ravaged by repeated fires. It is likely that if fires start on the right-of-way not fireproofed, the firebreak would stop or delay the fire from spreading and allow fire fighters to reduce the area burned. It may be necessary to redoze the break every 4 or 5 years.—HENRY SIPE, *Assistant Forest Supervisor, Cumberland National Forest.*

METHOD FOR FINDING THE PERCENTAGE BURNED ON UNPROTECTED FOREST LAND

J. EDWIN MOORE

Florida Forest Service

Estimating the amount of unprotected forest land burned has always been a problem. Figures to compare the percentage of protected land burned with percentage of unprotected land burned are always desirable, particularly in Florida where approximately half the unprotected forest land burns each year while 2 to 4 percent of the protected land burns. During the past year 1.7 percent of the protected land burned.

Adequate records can easily be kept by fire fighting personnel to show whatever information is desired for fires on protected land, but obviously this cannot be done on unprotected land. Until recently it was guessed at, but one person's guess was as good as another's. Several years ago, in order to obtain a more accurate figure, a statistical method for counting sample plots from an airplane was devised. The Southeastern Forest Experiment Station greatly assisted in planning this procedure by providing the statistical background for a satisfactory technique.

First, a random course of approximately 1,650 miles was sketched on a map. Thirty-six segments, each 20 miles long, on which sample plots were to be tallied, were indicated on the course. The course was located in such a manner as to fly over unprotected land as much of the time as possible, but no attempt was made to avoid towns, lakes, or other nonforest land.

Next the course was altered slightly so as to locate each of the 20-mile segments between 2 points that could be recognized easily from the air. Most frequently used recognition points were railroads, lakes, and small towns. County lines were not taken into consideration except insofar as it was necessary to keep the 20-mile segments outside of the protected counties. Black tape was pasted in a 2 1/2-inch square on the side window of the plane. This was located beside the observer approximately 14 inches from his eyes and in such a position that the observer could sit comfortably and look through the square at the ground.

It was necessary to have some sort of timing device that would notify the observer to tally a plot at regular intervals of approximately 15 seconds. A little experimenting showed that a satisfactory timer could be made from a clock that had a sweep second hand. The glass was removed and 4 small, flexible wires were evenly spaced around the edge of the face. These wires were insulated from the clock and bent in such a way as to make contact with the sweep second hand as it came around. Leads from the wires were fastened together. Another wire was fastened to the metal frame of the clock. The clock then served as a switch in a buzzer and dry-cell circuit. This mechanism was placed in a small box that the operator could hold in his lap. On top of the box was attached a tallying device for tabulating 3 sets of figures.

Once in the air and on the plotted course, the pilot held the air speed at 100 m. p. h. When the plane was over the starting point of a segment on which plots were to be tallied, the pilot advised the operator who turned on his timer. Whenever the buzzer sounded he looked through the 2-inch square on the window. What he saw was tallied in one of three categories: burned forest land, unburned forest land, or nonforest land.

The results of the 1953 survey showed 364 unburned plots, 500 burned plots, and 796 nonforest plots, or a total of 1,660 plots. Considering that 500 out of 864 forest plots were in burned woods, 58 percent of the unprotected woodland burned. While this seems high, and it is higher than the 47-percent burn found by a similar survey last year, it is undoubtedly correct within reasonable limits. A check can be obtained by referring to the forest survey of 1948-49 in Florida which indicates that 56 percent of the land in the unprotected counties included in our aerial survey is forest land. According to the sample plots tallied in the aerial survey, 52 percent of the area is forested.

This survey required a total of approximately 12 hours of flying over and between the segments on which sample plots were tallied, plus a few hours travel between the airport and the chartered course. While flying the chartered course, sample plots were being tallied two-thirds of the time. During the other one-third, the plane was flying from one segment to another and this gave the pilot and the operator an opportunity to relax and prepare for the next 20-mile segment.

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ILLINOIS FIRE DAMAGE APPRAISAL SYSTEM

RICHARD THOM, *Staff Assistant*, and MARTIN ANDERSON,
District Forester, Illinois Department of Conservation

Fire damage in Illinois is based on the following factors, each of which affects the final damage figure: (1) Average annual growth per acre of the timber type; (2) average stumpage value, by types, per 1,000 board feet; (3) site types, based in part on the timber types as outlined by the Illinois Technical Foresters' Association; (4) years fire has set back growth; (5) stocking; (6) fire history of the stand; (7) damage other than that to timber.

These factors are all considered when making an appraisal, and are used on merchantable stands where breast-high tree diameters range from 10 inches upward. One can readily see that each of the first 6 factors, which can be varied from 3 to 5 different degrees, provide numerous possible combinations for arriving at a damage figure for a specific stand of timber.

The site types considered are described below:

Upland Mixed Hardwoods. Includes Illinois Technical Foresters' Association site types Cove Mixed Hardwoods, Lower Slope Mixed Hardwoods, and Mixed Oaks. Species common to the Upland Mixed Hardwoods type are red, white, and black oaks, beech, hard maple, ash, sweetgum, tulip poplar, and hickory.

Oak-Hickory. Includes black, white, scarlet, southern red, and post oaks, and hickory.

Blackjack and Post Oak.

Bottom-land Softwoods. Includes soft maple, ash, elm, sycamore, sweetgum, cottonwood, boxelder, hackberry, swamp white, cherrybark, and water oaks.

Bottom-land Hardwoods. Includes water, white, and red oaks, hickories, ash, sweetgum, soft maple, elm.

The average growth per acre for the above site types, and average stumpage value, is designated by the service forester. Because Illinois is a very long State, variations in growth rates and stumpage values are pronounced.

The number of years that fire has set back growth is dependent on the severity of the burn. Fire intensity varies with the nature of the fuel, time of day, humidity, wind velocity, and other factors. For purposes of fire damage appraisal, fires are described as follows:

Creeping fire. Burns only the top layer of leaves and duff. Growth set back 3 years.

Hotter fire. Consumes twigs and small slash (up to 2 inches). Growth set back 7 years.

Very hot fire. Burns all slash, scorching tree trunks and destroying pole and sapling size timber. Growth set back 15 years.

The stocking of the woodland stand will affect the appraisal figure, since a poorly stocked stand does not have as many stems to be damaged by the fire as does a well-stocked stand. Stocking classes are described as follows, with the assigned factor for each:

Good. Area well stocked, stand practically complete, little or no waste growing space. (Factor 1 1/2.)

Medium. Area fairly well stocked but not completely; trees wider spaced than in good-stocking class, or bunched so that considerable growing space is not utilized. (Factor 1.)

Poor. Area poorly stocked; trees widely spaced, or large openings numerous. Less than 50 percent of the growing space utilizing. (Factor 1/2.)

A woodland that is repeatedly burned year after year cannot be damaged as much as one burned infrequently. Therefore, the fire history is described as follows, and a factor assigned to each condition.

Little evidence of past burning. Accidental; few scars allowed on edge trees. (Factor 1 1/2.)

Evidence of fire in the past. Few scarred trees. Some healed larger trees. No young trees (under 10 inches) scarred. (Factor 1.)

Evidence of periodic fires in the past. Many large trees scarred. Young trees (under 10 inches) scarred. (Factor 1/2.)

Evidence of repeated annual fires. Abundance of scarred trees in young and old classes. Leaf litter, duff, and seedlings very scarce or absent. (Factor 1/10.)

The formula for computing the estimated damage per acre is

$$S \times Y \times D A F + K$$

A=average annual growth per acre.
S=average stumpage value per M board feet.
Y=years fire has set back growth.
D=stocking factor.
F=fire history factor.
K=other damage per acre.

As an example, let us consider the following fire: A 10-acre stand of poorly stocked blackjack oak-post oak timber, with an average growth of 50 board feet per acre per year and stumpage valued at $5 per M board feet, is burned over by a fire described as very hot. This stand of timber has been burned yearly. Forty dollars worth of cut mine props are also destroyed.

Growth × stumpage = 0.25
0.25 × 15 (very hot fire) = 3.75
3.75 × ½ (poorly stocked stand) = 1.87
1.87 × 1/10 (fire history factor) = 0.19
0.19 per acre × 10 = $1.90
$1.90 + $40 = $41.90 total damages.

Training is very essential for this appraisal method, since most of Illinois' appraisals are made by the district fire wardens, who are not trained foresters. Field trips are arranged to acquaint the wardens with the various timber types and to familiarize them with the terms described. In a surprisingly short time most men can accurately identify the timber types, stocking, fire history, and intensity of burns.

The district fire warden is given a damage appraisal card that does most of the computation (fig. 1). The card is set on the intensity of burn. The figure that appears to the right of the correct fire-history classification, beneath the proper timber type, is multiplied by the stocking factor. This result is the damage per acre, to which other damages are added. Each item necessary to the appraisal is recorded on a fire report form. Thus, the completed form gives a description of the fire and timber in great detail to the forester in charge.

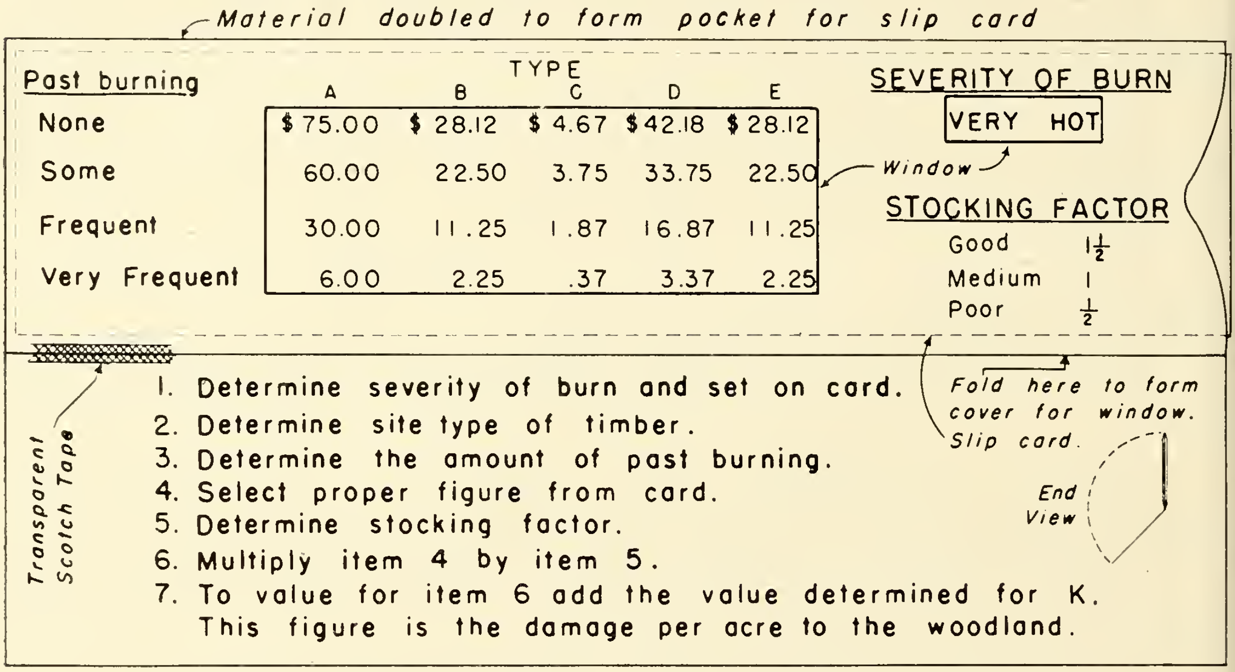

FIGURE 1.—Sample damage appraisal card, before folding.

This method of appraisal is simple to teach and use, and provides uniformity among field personnel. It considers the lack of uniformity of fires and woodlands, and makes greater accuracy possible because it is used on the fire and not in a distant office. As men become more proficient, the degree of accuracy can be increased by closer definition of timber types.

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A Lighted Clip-Board

If you've ever had to keep records in a fire camp at night, then perhaps you'll agree that a clip-board with a built-in light would be a mighty handy item. There is such a clip-board equipped with a reflector, unit, bulb, and battery case, all neatly and permanently attached for convenience. It is operated by a switch on the clip, and two standard flashlight cells and a bulb provide an ample amount of light for the entire board.

Several boards hung at a single location could provide an illuminated bulletin board for display of fire maps, camp layouts, etc. For persons engaged in maintaining records on vehicles, personnel, supplies, and other items in fire camps during the hours of darkness, a lighted clip-board can be a help. This board is manufactured in various sizes and it costs approximately $3. Possibly this cost would be less for large quantities. For further information contact the Arcadia Equipment Development Center, U. S. Forest Service, 701 N. Santa Anita Ave., Arcadia, Calif.

PLANNING FOR THE USE OF FIRELINE PLOWS

FRED G. AMES

Forester, Region 8, U. S. Forest Service

INTRODUCTION

Early in the spring of 1944 the dreams and hopes of southern foresters and landowners started toward reality. At that time the development of the various types and size classes of plow units common in use today began.

At the present time, the various State forest protective agencies and many of the large private landowners, as well as the United States Forest Service, are largely dependent on the use of fireline plows for fireline construction in the Coastal Plains. These plows are now playing another important role in southern forestry, because they are an essential tool in the extensive prescribed-burning program carried on in this section of the country. Through their use, fire is safely and economically employed as a silvicultural tool in forest management. Without the use of fireline plows, progress would be far less or much more expensive, the resulting fire damage would be higher, and adverse conditions occurring during burning could not be quickly handled.

The Forest Service, State protective agencies, and large private landowners have proved that the use of fireline plows in fire suppression pays big dividends both in savings of acreage that might otherwise be lost and in savings in the cost of suppression. Fire suppression by the use of handtools is now seldom practiced in the low and upland sections of the Coastal Plains.

PLANNING

Planning for the use of fireline plows on new areas is as essential as planning for any other new procedure. It is desirable that the planners have a knowledge of forest conditions and organizational angles that contribute to the success or failure of fireline plows in line-construction work. In addition, the capabilities and limitations of the various types of plows and plow-unit size classes must be understood. This understanding is most easily reached through the demonstration or trial of proved plows operated by experienced operators. It should be realized that proved plows may be only the beginning in the development of fireline plows.

In the past decade, forest fire suppression men have learned a lot that can benefit those planning for the use of fireline plows on new areas. The important elements that should be considered in such planning are discussed here briefly.

ANALYSIS OF FOREST CONDITIONS

It is important that an analysis be made of plowing conditions on the area. This should cover forest type, stand classification and density, rough types, soil and sod conditions, topography, physical obstacles, and seasonal factors.

Forest type, stand classification, and density.—Designation of an area by forest type actually means little, but stand classification and density are often the deciding factors for determining plow-unit size-class limitations. A simple cruise should be made of several miles of typical forest stands on the area. The cruise line should be located on the same basis that a fireline location is made for a handtool line-construction crew. Two items should come out of the cruise—average number of stems and average basal area per acre. Ordinarily, only stem sizes between "over 5 feet high" to 10 inches d. b. h. need be considered in this cruise, because stems within these sizes are usually the only ones affecting the plow unit. We used 1/20-acre plots at 2-chain intervals in our analysis.

Rough.—This term is used to describe the accumulated mass of living and dead plant materials that occur on or close to the ground. Insofar as the use of fireline plows is concerned, the density of this rough and its allied root system sometimes limits the plow-unit size class. For example, the tough root systems of the palmetto and swamp brush in the open stands of the lower Coastal Plains prevent successful use of the light- and medium-size class of plow units.

Soils.—First and foremost in an analysis of the soils is the presence or absence of rock. Disk-type plows will successfully handle small pockets or small quantities of fine gravel, but they are not satisfactory in the more rocky soils. Soil textures have some effect on the plow, but the greatest factor is the reaction of the soil to extreme weather conditions. Does the soil become very hard in periods of drought? Does it retain excessive moisture long after heavy rains?

Topography.—Our observations have been that rolling land with short slopes not exceeding 40 percent can easily be plowed with the conventional type of wheel plow—a plow carried on wheels. However, where slopes are greater and are long and frequent, a tractor-mounted plow is desirable. It has the advantage of being able to back up slopes that are too steep to move up in a forward position.

Physical obstacles.—Physical obstacles, such as roots, holes, down timber, wet physiographic features, topography, soils, rough, timber stand, and rock should be analyzed for quantity, prevalence, and type. After all, the ability of a plow unit to do a satisfactory job of fireline construction is its ability to overcome, with a reasonable amount of good operation, the resistance offered by the physical obstacles.

Seasonal factors.—We have found from our long fire season in the South that the seasons of the year have some bearing on plow-unit capabilities. Hard dry soils and the excessive moisture retained by the soil following heavy rains have already been mentioned. The hard dry soils usually occur in periods of drought during July and August. The excessively moist soils occur on areas having impervious subsoils and in the swampy areas of the lower Coastal Plains.

In some areas the hardwood reproduction is so dense that during the summer abundant leaves materially affect fire-plow production because the plow-unit operator has difficulty in seeing forward. The plow-unit leadman is a help, but on mountainous terrain he, too, may have difficulty in seeing ahead.

Fire Occurrence Locations

An analysis should be made of the patterns of fire occurrence on the areas under study. Definite fire patterns will reflect where the plow-unit should be located, and the intensity of occurrence within these patterns will reflect the number of plow units needed.

On some of our areas, the pattern and periods of occurrence of fires varies with the seasons of the year, and so require a shift in plow-unit headquarters as the centers of fire occurrence move.

Mapping Plowable Areas

From the economic angle of planning alone, it is essential that at least the proportion of plowable area be sufficient, or that portions of the area covered by the active fire patterns be sufficiently large, to justify the expenditure for equipment.

Later, when fireline plows are available for use on the area, a detailed plowable-area map should be available for the dispatcher and all fire planners as an aid in day-to-day planning and for use by the dispatcher and fire bosses in their plans of attack on a going fire.

Economics

Today the State protective agencies, many large private landowners, and the Forest Service are using approximately 1,500 plow units in the Southeast. They are almost wholly dependent on these machines for fire suppression in the lower and the upper Coastal Plains section of the country. Fireline plows are now being effectively used in the mountains of Arkansas, Georgia, and Tennessee. These plows can construct high-grade fireline at production rates up to 3 miles per hour in reasonably dense timber in the flatwoods and rolling uplands of the Coastal Plains, and up to 1 1/2 miles per hour on mountainous terrain.

Through the use of fireline plows, both the acreage burned and the cost of suppression have been materially reduced. From time to time analyses have been made comparing the results of the use of fire plows in fire suppression with the results of fire suppression by the Civilian Conservation Corps handtool crews. One comparison showed three significant figures: (a) A reduction of 82.5 percent in average size of fire; (b) a reduction of 22.6 percent in the number of fires reaching Class D and E size; (c) a reduction of 48.1 percent in average cost per fire. These figures proved to us that an organization with any appreciable "plow country" to protect cannot afford to be without fire-plow equipment. This thought is also borne out by the increase in the extent State fire protective agencies and private landowners have increased the number of their fire-plow units in the past 6 years.

The question of just how far one should go in an investment in fireline plow equipment is difficult to answer. The logical approach to the answer seems to be that depending on the local rate of fire spread, there needs to be an outfit to attack the fire before the fire gets to be of critical size. The critical size would be determined by the values at stake where the fire is burning and by the values at stake in the direction in which the fire is traveling.

In assessing the question of how far one should go in an investment in fireline plow equipment, it must not be overlooked that pressure is on the protective agency. Never before has standing timber had the monetary value it has today, and even with a recession in business it would probably continue to have higher values than was ever thought of in the past. The general public and wood-using industries are placing high values on the remaining stands of timber, and protective agencies are behooved to do a better and more effective job.

Equipment

At the beginning of the past decade there was a change in ideas concerning the necessary weights and size classes of fireline plows. One of the new thoughts was to work from the light-size plow unit up to the heavy-size plow unit only as necessary. On an area suited to light-sized plows, the light plows will outplow and outmaneuver many of the heavier plows on the same area. Some of the considerations that follow will be helpful in choosing and adapting the type of plow unit to be used. They cover the plow unit as a whole, or the tractor or plow separately.

An organization about to enter the field of fire-plow use needs a clear-cut specification for a satisfactory fireline, and particularly for width. There is no justifiable reason to construct a fireline wider than is actually required. In spots where a wide line is needed, double firelines can be plowed—a common practice in the Southeast. Reduction in fireline width means a reduction in plow pull, the use of smaller and faster tractors, and faster fireline production.

Actual tests indicate that the average pull of a plow should not consume more than 40 percent of the drawbar pull of its tractor in the gear in which the tractor is operating. For example, when using an OC-3 Oliver tractor operating in 2nd gear, the average plow pull should not be more than 1,000 pounds (40 percent of 2,512 pounds, the rated pull of the tractor operating in 2nd gear). A heavier pulling plow results in a sluggish plow unit that fails quickly in the inevitable tough-plowing spots found on any fireline.

Consideration should be given the type of line constructed by the plow. Plows constructing flat-bottomed furrows are best adapted to use in soils without rocks. Plows constructing V-shaped furrows work better than flat-bottom plows in rocky soils; they also move less dirt and construct a higher quality line. The question of line quality is of importance here. During our test work, all test lines were graded for quality. Satisfactory fireline was found to have an average grade as low as 82 percent perfect.

Checks of 835 chains of fireline constructed for actual fire suppression confirmed this.

The plow depth adjustment must be simple, fast, and easy to operate; only one adjustment should be necessary. There should be sufficient range in adjustment so that the most shallow plow line possible can be constructed.

Plow units that have a maximum of flexibility both vertically and horizontally are most effective. Vertical flexibility ensures that the plow remain in contact with the ground as the tractor moves over rough ground, across rock and tree branches. Horizontal flexibility ensures short quick turns of the unit with the plow in the ground, reduces side bind on turns, and results in a lower average plow pull. Ideal horizontal flexibility is reached when the plow beam is free to turn 90° to the right or left of the center line of the tractor.

The pros and cons of hydraulically operated versus gravity-fed plows can be argued at length. The decision is one that must be made by administrators. Hydraulic plows when operating under *down pressure* invariably have greater average pulls than gravity-fed plows. All obstructions in the soil, such as roots and rocks, reflect greater stresses than if the plow was allowed free movement. A properly designed plow should ordinarily take the ground without down pressure. If hydraulically operated plows are used, there must be no sacrifice in flexibility of the plow unit.

In an effective plow unit, the tractor and plow must be properly outfitted for fireline construction use: (1) The tractor must be provided with brush guards to protect the operator. (2) When a plow unit is to be used on steep slopes, the tractor should be equipped with an electric fuel pump and provision made to prevent fuel from spilling from the air vent in the tank cover. (3) The tractor should be properly armored with belly pan, radiator grill shield, and track guards for protection of the operator. (4) The tractor bumper should set close to the tractor frame and the ends curve toward the track to prevent saplings and small poles slipping in between tracks and bumper. The absence of this feature can cause considerable trouble in dense stands and in mountain plowing. (5) The tractor should be properly and adequately lighted, front and rear, for night fireline construction. The tractor should also be equipped with a swinging spotlight.

The tractor should be as narrow as practical. Tractor width is a vital factor in timber-stand resistance to the plow unit.

Special attention must be given tractor-mounted plows. When in a raised position for deadheading, the plow must fold back as closely as possible to the tractor and be securely fastened. Very little if any movement of the plow should be allowed. This is not only a desirable feature for deadheading but it is an extremely important safety feature.

The plow unit should be equipped to carry a few of the more common mechanic's tools, a shovel, an ax, a chain, a first-aid kit, and lights for use by the crew on night work. Also, a hard-boiled hat and goggles.

The plow-unit transport must be sufficiently adapted to the use as a plow-unit transport so that loading and unloading is easy, simple, and safe, and the plow unit can be quickly and securely fastened to the transport bed.

Plow-Unit Distribution

Plow-unit distribution during the fire season is of great importance. Even though transportation of the plow unit and the line construction is fast, the plow unit needs to arrive on the fire in a hurry. In the Southeast, ranger districts with high rates of fire spread have as an integral part of their fire plan definite plow-unit locations. Project work is planned within these areas to occupy the plow-unit crews when not on fire duty. Under this plan the plow unit is always close by its crew. Usually, the equipment remains in the area, only going to headquarters for shop repair. Most of the trucks are equipped with mobile radio; otherwise portable radio is available for crew use.

Organization

Basically, a fireline plow unit is a fireline building tool, and its crew might be considered under conventional fire organizations as fireline builders. On this basis, the crew will be small. For effective fireline construction each man must fit into the team as an integral part. Each man must be a qualified fire fighter and in addition qualified in the task he is to perform as a member of the plow-unit crew. Each member of the crew, like the Army tank crew, must be a specialist.

Briefly, for fireline building only a 3-man crew is essential. This crew consists of the following: (a) The plow-unit leadman, whose duties are to walk ahead of the tractor picking the route of travel for the plow unit, for fastest line construction consistent with the location outlined or marked by the fire boss; (b) the plow-unit operator, whose prime duty is to construct a satisfactory plow line with care to prevent getting stalled or mired in soft ground; (c) the follow-up man, working just behind the plow unit, whose duties are to clean spots of the low-quality line and to assist the plow-unit operator when difficulties are encountered.

Overall forest conditions will allow variations in organization. For example, a good plow-unit organization used in the Southeast, where the plow-unit crew is expected to handle all phases of fire suppression, consists of (a) crew foreman, to plan attack, to serve as a leadman if a leadman is necessary, and to serve as a backfire man immediately behind the plow when not serving as a leadman; (b) plow-unit operator; (c) two fire fighters who serve as safety men along the fireline, one of whom serves as backfire man when the foreman has to scout the fire or serve as leadman.

The forest administrator should work out the best plow-crew organization for his forest and overall fire organizational system. He should also not fail to work out details for fitting the plow unit and its crew into large fire organizations.

Training

Training each member of the plow crew individually as well as a team is absolutely necessary. It is as important here as in any phase of fire control work, and administrators should work out detailed training plans. Individual members of the crew must know how to execute their jobs efficiently, and the plow-unit operators and leadman must definitely know the plow-unit capabilities and limits. Training and practice is the only answer. Essentially as important as original training is refresher training. Use charts and training aids.

Operation Instructions

The key members of the plow-unit crew should be provided with written instructions pertaining to the proper use and care of the plow unit as a whole, the forest policies covering the use of the plow unit, proper plow depth adjustments, accessories to accompany the plow unit, the place of the plow unit in the fire organization, and the safety angles to fire-plow operation.

Plow-Unit Maintenance Standards

There should be written plow-unit maintenance standards prepared for the field personnel. These maintenance standards should cover all phases of preventive maintenance, allowable wear tolerances, and care of both the tractor and the plow.

These elements may seem elementary, but every one of them is an essential part of fireline plow-use planning. Every element is a necessary part of the plan to put fireline plow units to effective use on a new area in the least possible time.

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Fire-Pump Engine Storage Damage

[This is based on a USDA Employee Management Improvement Suggestion made by Arden E. Robinson of the Sellwood Shop, Portland, Oreg. The suggestion was accepted and adopted throughout Region 6. In approving Mr. Robinson's suggestion, the Regional Equipment Engineer noted: "I concur wholeheartedly in Mr. Robinson's proposal. . . . The cost of a crankshaft alone is in the neighborhood of $40. Replacement of bearings is very costly to say nothing of damage to cylinder walls and other working parts. Failure of many pumps on fires can be traced to damage by acid action and rust while in storage.—Ed.]

Fire-pump engines were being packed and stored with other pump equipment in the Region 6 warehouse at Sellwood for long periods of time. Consequently, the engines sat in the same position for the whole storage period. During this time, the lubrication drained away from the upper surfaces, and condensation formed in the engines because of temperature changes. The lack of lubrication on the surfaces, and acids formed by moisture in the lubricant, caused rust pitting and etching of the cylinders and bearings. Etching is especially noticeable at the contact points of steel and iron when these metals rest in the same position for long periods.

The pump units are now stored on racks where they can be rotated at least once a month or oftener. This changes the point of contact of the bearings and other parts, and redistributes the lubricant over the surfaces again. This film of lubricant and change of contact point retards rusting and etching.

DUAL SERVICE COMMUNICATION—SIX RIVERS NATIONAL FOREST

C. E. BELL

Radio Technician, Six Rivers National Forest

In addition to the more or less standard FM radio system that interconnects the Supervisor's office with various field stations and mobile sets through the use of a single repeater station, the Six Rivers Forest has for the past 2 years operated a supplemental radio-telephone service in conjunction with the Pacific Telephone and Telegraph Company office in Eureka. Basically, this tie-in provides for connecting commercial telephone lines directly to our radio network through the local P.T. & T. switchboard. The primary reason for this hookup is to provide reliable communication between the field and Eureka on a 24-hour day, 7-day week basis. By using the services of established commercial operators, the need for standby Forest Service operators is eliminated.

The telephone company switchboard marine operator has no radio equipment of her own, but she uses the Supervisor's office transmitter through a connecting wire circuit between the two offices. She also has a speaker connected by means of a wire circuit to our receiver in the Supervisor's office and can monitor all forest network traffic. Through her own switchboard and the local switchboard, she can connect any telephone in Eureka directly to the radio circuit. It is also possible for her to connect the radio channel to any telephone in the United States by going through the long-distance switchboard.

The marine operator calls the ranger stations by means of a dialing system that activates a bell or buzzer at the respective ranger station. She does not call by voice, and does not use the station's call letters. In return, a ranger station calls the marine operator by means of a tone, *not* voice. The system is designed primarily for use outside regular office hours (nights, weekends, and holidays) but can be used any time. This connection with the telephone company switchboard does not interfere with the normal operation of our radio network. Calls between the field stations and the Supervisor's office made during regular office hours, or at other times when the sets are manned, are made by voice and with the regular station call letters.

To serve as a radio-telephone, it has been necessary to incorporate into the system several units not usually found in Forest Service radio networks. The transmitting frequency at the Supervisor's office was changed to a third frequency to provide duplex operation to the repeater station (fig. 1). Added units consist of a Quik-Call (Motorola) receiver with a small audio amplifier, a relay panel with relay for changing control automatically, a speech amplifier for boosting the telephone speech to the transmitter, and a Western Electric termination panel for the telephone circuits (figs. 2 and 3). Four telephone circuits are required from the Supervisor's office to the telephone office—one for receiving, one for transmitting, one for transmitter control, and one for signaling the operator. The last two circuits are phantom. These lines terminate in a G-2 panel with hybrid filters located at the telephone office.

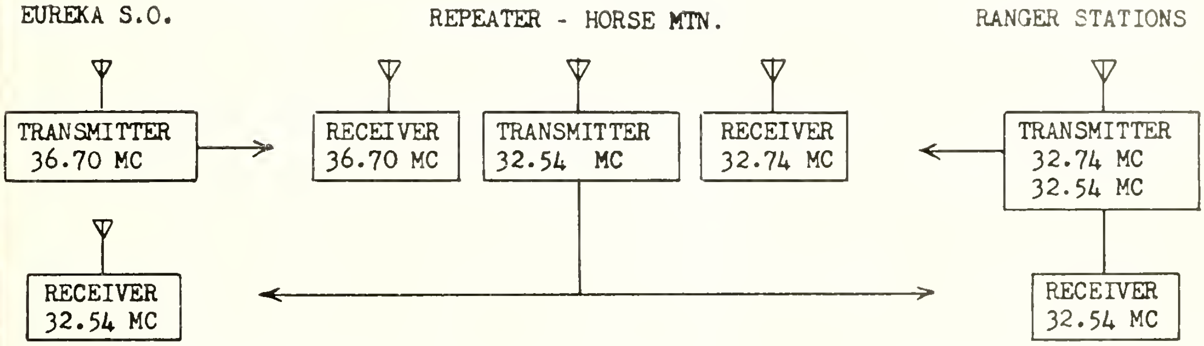

FIGURE 1.—Transmitter and receiver frequencies and locations.

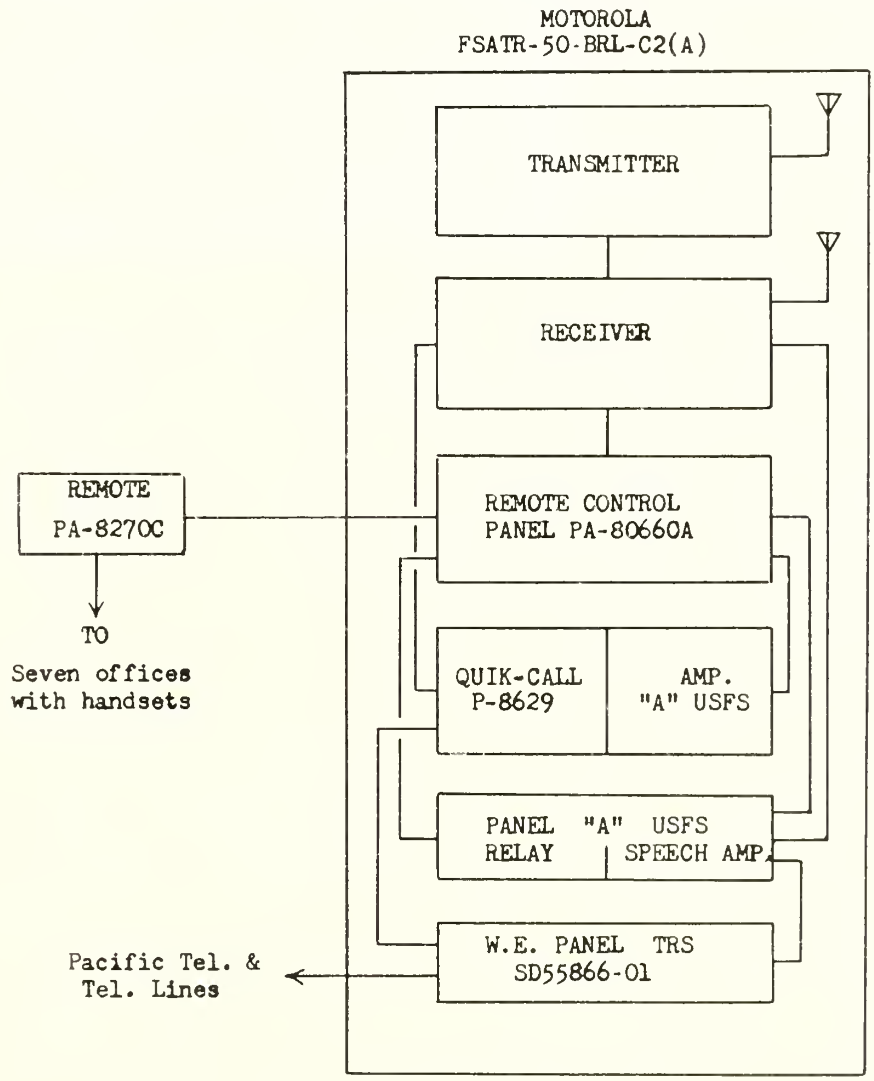

FIGURE 2.—Basic radio setup and added units, Supervisor's office, Eureka, Calif.

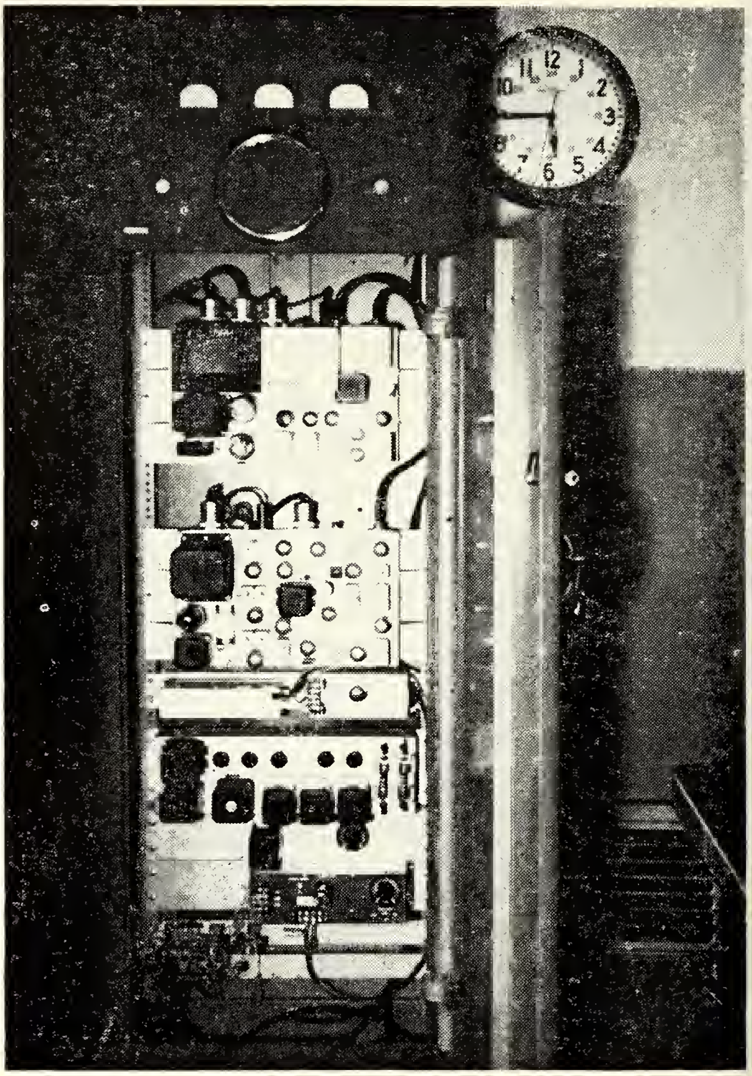

FIGURE 3.—Radio-telephone panel, Supervisor's office, Eureka, Calif.

Two receivers are used at the repeater station. The second receiver is necessary for duplex operation required for connection with standard telephone circuits. Both receivers control and feed equal audio to the transmitter and may be used simultaneously.

Added equipment at the ranger stations include Motorola Quik-Call sender, Western Electric selector unit, termination panel with audio control and signaling booster for the selector (fig. 4). One or more residences are wired for remote control, signal buzzer, and call button for signaling the telephone operator.

When the telephone operator plugs into our circuit through the G-2 control panel at the telephone office our control relay is energized, turning the transmitter on and holding the receiver on. Normally the receiver shuts off during transmission. The operator is now able to talk and receive at the same time (duplex). With a key, the operator connects to our transmit line a dial tone system having 2 tones—600 cycles and 1500 cycles. Dialing causes a shift from one tone to the other, each change acting as one impulse on the selector units at the ranger stations. Each selector has a stepper relay with a code wheel that has 5 hold pins preset to correspond to the station's number. Each pulse moves the code wheel one step, so if the number of pulses dialed moves the code wheel to a hold pin, the second number dialed will be added

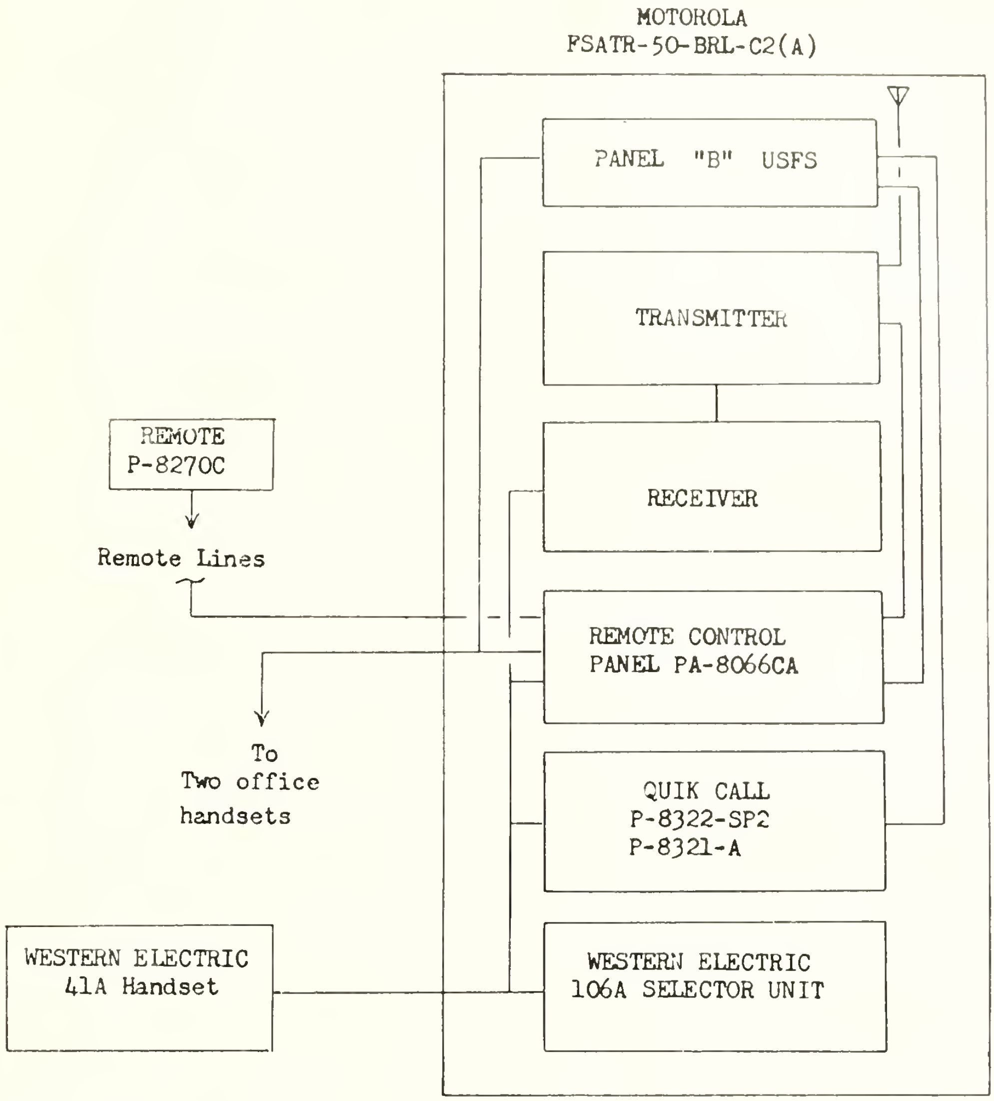

FIGURE 4.—Ranger Stations. Remote lines, 3 pair run from equipment in office to 3 residences, 1 pair for remote unit, 1 for selector signal buzzer, and 1 for control key of Quik-Call.

to the first and so on through the 5 numbers of the call. The total must be 23 to make the signal bell ring. If a number misses a hold pin, the code wheel returns to zero.

All dialing numbers for the stations have been assigned by the telephone company and are unlisted. After dialing, the operator releases the dialing key, and when the station answers it is informed of the phone call and the phone is plugged into our system. When the phone party hangs up, the operator disconnects the line, releasing control for normal operation. Because of losses in the hybrid filters and telephone cable of incoming speech, a small speech amplifier is added at the transmitter input to raise the volume.

A district making a phone call turns the transmitter on in the normal manner, pushes the call button for 3 seconds, then releases both. Two tone pulses are transmitted, which actuate the signal at the telephone office switchboard. These tone pulses are from the Quik-Call sender unit that has four tone generators called Vibrasenders, a timer chassis, and power supply. Pushing the call button closes a relay on the timer, releasing 2 tone pulses of

1 second each. Two tones are transmitted on each pulse, their frequency being the same as the four Vibrasponders in the Quik-Call receiver at the Supervisor's office. Only by these four pulsed tones is it possible to energize the signal relay in the receiver.

Throughout its 2 years of operation, this system has worked very well. It has proved to be a very satisfactory solution to the problem of providing 24-hour service between the Six Rivers ranger stations and their Eureka Supervisor's headquarters. It was particularly adaptable to the telephone company exchange at Eureka, where a coastal ship-to-shore radio telephone marine operator is available.

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Repellents For The Protection Of Fabric In Fire Hose

From time to time inquiries are received by the Fish and Wildlife Service for information concerning repellent materials applicable to fabric as protection against rodent depredations. Frequently, these inquiries have had to do with damage to the covering on fire hose that is stored.

In an effort to find the answer, studies were carried out with fire hose, the outer fabric of which was impregnated with candidate repellent compounds.

For the tests, 8-inch sections of 2-inch fire hose were used. The treated sections, along with untreated hose, were exposed to wild Norway rats held under simulated warehouse and field conditions. Food and water were supplied the animals during the tests but no nesting material was provided. The animals had access to sawdust, however, which was spread on the floor for sanitary purposes. Exposure of the hose was made by suspending test lengths between 1- by 4-inch boards so that each section was equally available to the animals for 7 months, October to May.

Of the six deterrent compounds tested, Z.A.C. (zinc dimethyl-dithiocarbamate-cyclohexylamine complex), sodium pentachlorophenate (Dowicide G), copper napthanate, ammonium sulfate, Teramine, and creosote, only the first two showed marked repellent properties. During the course of the tests, hose treated with these two compounds were only slightly damaged by the rats, while the average percent of fabric removed in all other tests was from 12½ to 87½ percent.

Hose treated with Z.A.C. were sprayed with a 10-percent solution in which P.e.p.s., a synthetic rubberlike adhesive, was used as a sticker, with Dreft added as a wetting agent. Hose treated with sodium pentachlorophenate were impregnated with a 10-percent solution in water, with Dreft added.

The results of these tests should not be interpreted as being applicable to the protection of foodstuffs kept in burlap and cloth bags. Repellency in barrier control deals with factors quite different.—JACK F. WELCH, *Biologist, Fish and Wildlife Service.*