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FIRE CONTROL NOTES

A PERIODICAL DEVOTED TO THE TECHNIQUE OF FOREST FIRE CONTROL

FOREST SERVICE • U. S. DEPARTMENT OF AGRICULTURE

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

Volume 12 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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HELICOPTER USE FOR FIRE CONTROL ON THE WALLOWA FOREST

GERALD J. TUCKER, *District Ranger,* and JOHN B. SMITH, *Fire Control Staff Officer, Wallowa National Forest*

Helicopters were used at various times during the 1949 and 1950 fire seasons for transporting men and equipment to forest fires on the Wallowa National Forest. Use of this type of aircraft to date has been confined to the very rugged terrain of the Imnaha River canyon and in the spectacular Hells Canyon of the Snake River.

The Imnaha, a tributary of the Snake River, runs parallel to the Snake for 50 miles at distances ranging from 6 to 18 miles. The country between the two rivers is a land of rugged canyons, precipitous slopes, and great rims or bluffs. A road extends along the Imnaha River and connects with a highway to the forest supervisor's headquarters at Enterprise, Oreg. A one-way forest road extends for 24 miles from the Imnaha road to Hat Point lookout, which is located near the center of this area; there are no other roads.

The Wallowa Forest has an airplane landing field located at Memaloose, near the end of the Hat Point road (fig. 1). This landing strip is 60 miles from Enterprise and travel time required is about 3 hours by car, 4 hours by truck, or 20 minutes by airplane. The forest has another airplane landing strip at Lord Flat, 20 miles north of Memaloose, which has no road connections. There are few good trails, and travel by trail or cross country is slow and sometimes dangerous or impossible. It is frequently necessary to travel 5 to 10 miles to reach a point only a mile or two distant. The area is covered with fuels that are generally flashy with high or extreme rate of spread.

Experience indicates that the helicopter is well adapted for use in this roadless area where elevations range from 1,200 to 7,000 feet. Although most of the area has very steep slopes, there are numerous open ridge tops and flat benches which make excellent landing spots for the helicopter.

Commercial helicopters from Yakima, Wash., were used in 1949 and from Missoula, Mont., in 1950. All were two-place Bell machines and were usually able to carry a fireman pack or other equipment up to 50 pounds in weight in addition to the pilot and one passenger, the amount of freight depending upon the weight of the passenger. The machine from Missoula was equipped with a wire basket cargo carrier mounted on the side, which makes a convenient and practical means of hauling cargo and can be used for transporting an injured person.

Base camps from which to operate the helicopters were established at some point along the roads or at the Memaloose landing field, and elevations of these bases ranged from 3,000 feet at the Colvin Ranch to 6,700 feet at Memaloose.

Use of the machines is somewhat marginal at the higher elevations during the middle of the day. However, they were used at all times needed

FIGURE 1.—Typical canyon country of the western Wallowas. Memaloose airstrip upper right; elevation, 6,700 feet.

except for a short time one afternoon during a period of considerable ai turbulence. During this afternoon, while the helicopter was grounded, small fire started. Two firemen with horses were started over the 10½ miles to the fire. Some 30 minutes later the helicopter pilot, after makin

a trial flight, decided that it was safe to carry men, and in 42 minutes he had placed two firemen on a ridge top 300 yards from the fire. One fireman had been taken from the base camp, and the second was picked up at a lookout-fireman station some 10 miles from the base camp. The horseback firemen arrived 3 hours later, after the fire was under control.

On August 3, 1950, Ranger Tucker and two firemen enroute to another fire discovered the Black Butte fire in Hells Canyon. This fire was in a blind area not seen by lookouts, but since it was in flashy fuel and potentially

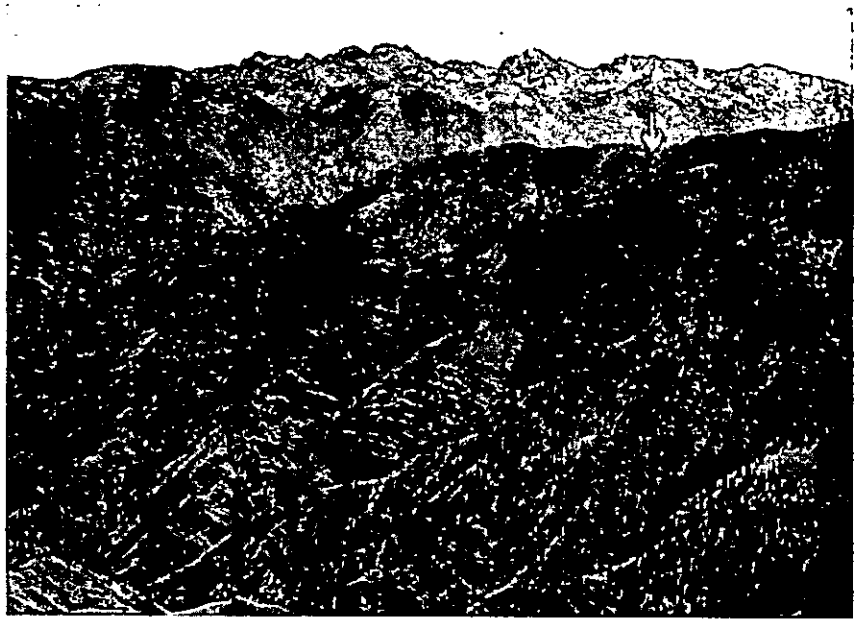

FIGURE 2.—Arrow indicates where helicopter landed fire fighters on the Black Butte fire. Smoke jumpers also landed on this ridge. Fire was still 1½ hours walking time from this point.

most dangerous, they went at once to it. It was soon evident that more help would be needed, and a yellow streamer signal was placed for the patrol plane which had previously been requested to scout the area. A Motorola handi-talkie was dropped to Tucker and he ordered men and equipment.

At 6:00 p.m. seven men left the road near the Memaloose airfield to walk to the fire, about 5 miles airline distance, but 7 miles by trail and 7 miles across country. They stopped enroute from 10:00 p.m. August 3 to 4:00 a.m. August 4 because night travelling was hazardous. They took the wrong ridge in walking down to the fire from Black Butte and came out on a ridge across a deep precipitous ravine from the fire. However, they were within speaking distance, and, following shouted instructions from Ranger Tucker, they were able to make their way through the rims in about an hour to the fire. They arrived tired out at 9:00 a.m. It took them 9 hours walking time to get to the fire.

Fourteen smoke jumpers, six from Region 6 and eight from Region 4, were used on this fire. They jumped near Black Butte on a timbered slope

and walked about 3 miles to the fire. Two arrived at the fire at 9:00 p.m. August 3, and the rest jumped early the next morning.

A helicopter from Missoula operating from Memaloose airfield ferried 14 local men to a flat ridge top near Black Butte, which was about 1½ hours walking time from the fire and near where the jumpers landed (fig 2). Airline distance for the helicopter was about 5 miles, and a round trip, including loading and unloading, required 9 minutes. Six men, who were flown by airplane from Enterprise to Memaloose and by helicopter to Black Butte and took 1½ hours walking time, had only 3 hours travel time from point of hire to arrival at the fire.

The fire crew was supplied by air drop from a local airplane under contract, and William Maxwell, clerk on the Imnaha-Snake Ranger District, did the dropping.

Because of the desirability of quickly returning the smoke jumpers to their base, they were ferried by helicopter from the fire to the Memaloose airfield. Seventeen other men were also ferried to the Memaloose airfield, but three of the local men preferred to take the long walk out. Most men, although hesitant to make the first trip, soon enjoy riding in the helicopter, and there has been no air sickness reported here from air travel in this machine.

We believe the helicopter to be a practical answer for transporting men to fires in the canyon country of the Snake and Imnaha Rivers and that both time and money are saved by the judicious use of this machine. Although we have had two near misses on accidents, we believe that, as the pilots get more mountain-wise and the machines improve, they are destined to play a more important part in fire control work.

Rust Preventive for Water Tanks

An experimental test of a commercial compound to prevent rust was recently conducted at the Michigan Forest Fire Experiment Station, Roscommon, Mich.

The results of the test would appear to have ended a long-time search for a satisfactory and economical rust preventive that could be used in the water carried or stored in fire equipment water tanks. The trade name of the material tested is "Banox."

Four small tanks made of 14-gauge, four-way floor plate (mild steel) were used in the test. One part of each tank was coated with Neutrol or Inertrol. Another part was coated with aluminum paint, and a control part was left untreated. Submerged in each tank was an equal amount of scrap steel, iron, brass, aluminum, galvanized iron, bronze, natural rubber, and Neoprene rubber.

Tank 1 contained plain tap water untreated (control tank); tank 2 contained tap water with 2-percent Drench and Banox; tank 3 contained tap water and 2-percent Drench; and tank 4 contained tap water and Banox (in recommended quantity).

Results of tests after 45 days were as follows: Inertrol coating, no damage in any tank; aluminum paint coating, no damage tanks 2 and 4, tank 1 rusted through tank 3 large spots of rust; untreated iron section, no rust or damage in tanks 2 and 4, tanks 1 and 3 badly rusted. Heavy rusting and metal corrosion occurred in tanks 1 and 3 which had no Banox added to the water. Rusting occurred in tank 3 within the first 24 hours and in tank 1 within 48 hours.

Banox can be used for other purposes such as standby metal water barrels filled with heavy salt water concentrations. It is nontoxic and contains no acids, alkalies or chromate. Two pounds is enough to treat 200 gallons of water. Cost is approximately $12 for one case of 12 2-pound cannisters, f.o.b. Pittsburgh. [From "Give 'N Take," a leaflet published by the Fire Equipment Development Committee for the North Central States.]—E. E. Aamodt, *Engineer, Region 9, U. S. Forest Service*

FIRE LINE FEEDING BY HELICOPTER

CARL C. WILSON

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The increased use of the helicopter on forest fires brought the demand for a small vacuum container to transport hot food to workers on the fire line. Through a local war surplus dealer the Angeles National Forest obtained a U. S. Army Air Force "vacuum vat" which, we believe, solves the problem.

This vacuum vat is actually a large thermos bottle with a wide-mouthed opening. It is all metal and will withstand considerable rough use, thus permitting dropping by helicopter at locations where the ship cannot safely land.

The unit, which has been purchased locally for approximately $15, has the following specifications:

Over-all height	18 inches	Weight, empty	37½ pounds
Outside diameter	16 inches	Weight, with pans	45 pounds
Inside diameter (mouth)	13 inches	Contents, liquid measure	8 gallons

The vat may be obtained with either a stainless steel or enamel lining. The enamel lining, however, permits the transport of citrus fruit juices or other acidic foods without affecting the taste. A set of three tinned pans may be secured with the unit (fig. 1). These are equipped with hold-

FIGURE 1.—Vacuum vat with three tinned pans. F-463453

down clamps and a lid with handle. Each pan has a 2-gallon liquid capacity. Stacked in the vat the pans provide room for three varieties of hot food.

Best results are obtained if the vat is preheated by filling the thermos unit with boiling water and allowing it to set for 20 to 30 minutes. The pans may be used to cook the food. However, these units will probably last longer if ordinary cooking utensils are used. The hot food is then transferred to the oven-warmed pans, and these are inserted into the preheated container.

Field tests conducted on this forest in May 1948 revealed that the heat loss between the time the hot foods are placed in the vacuum container and when they are served to the crews a reasonable time later was almost negligible.

In one case a 20-man road crew was fed the following menu on the job: Spaghetti and meat balls, string beans, hot french rolls, coffee, and lemonade. The temperature of the spaghetti dish was 142°F. when removed from the oven and placed in the vacuum vat at 10:30 a.m. One hour and 40 minutes later the heat loss had amounted to only 4°. Coffee was placed in the thermos vat at 170°F. at 10:30 a.m., and the temperature at 12:10 p.m. was 160°. Heat loss for the other hot foods was consistently low. The lemonade in the enamel-lined vat, of course, remained cool.

A typical meal which can easily be served by means of the vacuum vat is one tray of stew, one tray of cooked vegetable, and a third tray of hot, buttered rolls. Coffee can either be stored in the vacuum vat or in 1- or 5-gallon thermos jugs. The meal is served on moisture resistant paper plates and eaten with paper or plastic disposable utensils.

Most any hot food can be served from this container. However, foods with a high moisture content tend to lose heat in storage. Examples of commonly used menus are:

(1) Weiners and beans
Stewed tomatoes
Hot rolls

(2) Swiss steak and gravy
Scalloped potatoes
Canned peas

(3) Ham and eggs
Buttered toast

(4) Scrambled eggs
Hot cereal
Buttered toast

In addition, this container can also be used to serve cold lunches. Prepared sandwiches, green salad, and a thermos jug of cold milk or fruit juice makes an excellent noon meal for fire fighters.

If two trays are used for hot food and the third for rolls, at least 15 men can be fed from one container. Twenty men can be fed from one unit if all three trays are used for hot food. Several loaves of bread and some butter can be delivered by helicopter to supplement the three tins of hot food in the vacuum vat.

To eliminate premature opening of the vats when several are brought to a large crew, each should be marked with a tag showing its contents. If possible, all of the crew should be fed at the same time so as to reduce the loss of heat caused by opening and reopening the container.

The key points to remember in using these containers are: (1) Preheat the container with boiling water; (2) heat loss occurs every time the lid is removed; (3) heat loss is less from foods with a high moisture content.

Hot food carried in these vacuum containers was first served to workers on the Echo fire line on the Angeles in July 1948. Food was prepared at Arcadia, trucked to the helispot at the road end, 6 miles away, and then flown to the fire line by helicopter, an airline distance of 1 mile and a vertical rise of 1,600 feet. Travel time amounted to 2 minutes as com-

pared to about 1 hour for foot travel from the end of the road. Hot dinners and breakfasts were available to 55 men on the line in less than 22 minutes after the food left the cook stove in the Arcadia barracks.

Hot food readily available by helicopter makes for better morale among the men and increases line production. These modern tools also will tend to decrease the number of elaborate spike camps with the usual primitive, labor-consuming equipment and the temptation to camp at the water holes which may be some distance from the active perimeter of the fire.

The vacuum vat is an effective tool in getting hot food to crews on isolated sections of the fire line. Heat loss from food in the container is almost negligible up to 1½ hours under normal summer conditions which means that surface transport could be used to carry the hot food in some instances. The success of this unit on fires indicates that it can also be used in other fields of forest management, such as road projects and rescue missions.

Published Material of Interest To Fire Control Men

Analytical Studies in the Suppression of Wood Fires, by George J. Tauke and Ray L. Stoker, University of California, Los Angeles 25, Calif. A paper presented at the 1950 Annual Meeting of American Society of Mechanical Engineers. Published November 1950.

Chemical Sprays for Protection Roads, by V. L. Morrison. Journal of Forestry, June 1950.

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Cooperative Fire Prevention Campaigns, by C. Davis. Forest Farmer, June 1950.

Crew and Camp Organization on the Actual Fire Line, by A. A. Boyle. Pulp and Paper Magazine, Canada, May 1950.

Evolution of the Fire Danger Meter, by A. Peffer. American Forests, April 1950.

Fire Protection Law Enforcement Trends in California, by R. O. Reynolds, Journal of Forestry, October 1950.

1949 *Forest Fires and Fire Danger in Massachusetts, Pennsylvania, New Jersey, Rhode Island, New Hampshire, Vermont, Connecticut, New York, Virginia, Maine, Maryland, West Virginia, Kentucky.* By A. W. Lindenmuth, Jr., and J. J. Keetch. Published separately for each state by U. S. Forest Service, Southeastern Forest Experiment Station, Ashville, N. C., October 1950.

Forest Fires and the Danger Index in New Brunswick, by H. W. Beall. Forestry Chronicle, June 1950.

Forest Fire Detection by Airplane Exclusively, by C. H. Lewis, Jr., South. Lumberman, June 1, 1950.

Forest Fire Facts Surveyed. Canadian Forestry Association. Pulp and Paper Magazine, Canada, May 1950.

Forest Fire Insurance, by W. G. Wright. Journal of Forestry, August 1950.

Forest Fire Protection—Manitoba, by D. M. Stephens. Pulp and Paper Magazine, Canada, May 1950.

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Further Discussion Concerning Forest Fire Insurance, by W. G. Wright. Timber, Canada, June 1950.

Game Wardens and Forest Fires, by R. L. Williams. Wyoming Wild Life, April 1950.

Highway Hazard Reduction Guide, lithographed illustrated booklet by California Region, U. S. Forest Service, in collaboration with State of California, Divisions of Forestry and Highways. April 1950.

History of Forest Fires in the South, by F. Heyward, Jr. Forest Farmer, June 1950.

(*Continued on page* 28)

FOREST FIRE SCOREBOARD

JOHN C. BAIRD

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Public interest in fire prevention was stimulated by a scoreboard graph ically portraying forest fire occurrence from day to day, which was pu on public display throughout the fire season by the Rio Grande Nationa Forest.

The scoreboard consisted of a base map upon which each fire was located by a ½-inch bright red circle. Round-headed pins of different colors to indicate the size class of fires fastened a red ribbon at the fire location. This ribbon led to a card at the side of the scoreboard on which was shown the cause of the fire, class of people responsible, and date of fire.

The theme CARELESSNESS was stressed for all man-caused fires, the word being printed in red letters. A block at the bottom of the board recorded the number of fires by carelessness to date.

The scoreboard was originally used during the annual Sky-Hi Stampede at Monte Vista, Colo., when two identical exhibits of the board were placed in well-located store windows. One scoreboard was maintained at the U. S. Post Office in Monte Vista throughout the entire fire season. Ambrose Burkhart, Senior Clerk on the Rio Grande National Forest, was largely responsible for the exhibit and the work connected with it.

The scoreboard has been instrumental in creating considerable local public interest in fire prevention. An estimated 25,000 people saw the scoreboard during the 1950 fire season, and many expressed surprise at the number of fires and the carelessness involved.

[The forest fire scoreboard described here is considered an excellent forest fire prevention aid. It contains the necessary elements to arouse public interest. Units where a majority of fires result from carelessness will find this method of presentation valuable in keeping the public informed on the local forest fire situation.—Ed.]

Identification Marking for Tractors

On large fires where a number of bulldozers are working in the same general vicinity, it is often difficult for the cat boss, aerial observers, and others to identify the various pieces of equipment. This is particularly true when both Forest Service and contract equipment are involved, and the latter is owned by several different concerns.

It seems that better control of machines would be possible if each carried a distinguishing letter or number which would be easily read for a reasonable distance, either on the ground or from the air. When the equipment arrives on the fire, it could be assigned a letter or number, if it is not already adequately marked. Water base paint which could later be washed off, or black scotch tape 1 inch or more in width would be suitable for such marking. A roll of tape could be included in fire kits.—C. D. JACKSON, *Topographic Engineer, Region 5, U. S. Forest Service.*

Study of Portable Wood Chipper

The possible use of a portable wood chipper for fire hazard reduction work was discussed by Ed Ritter in Mechanical Fire Hazard Reducer, FIRE CONTROL NOTES, April 1950. Since that time the Northeastern Forest Experiment Station and the Connecticut State Park and Forest Commission have made a cooperative study of this equipment. The results of the study are published as Station Paper Number 37 entitled "A Pilot Study of a Portable Wood Chipper" by R. H. Fenton and H. A. McKusick. It was found the chipper could be operated (including depreciation) for $4.04 per hour. Production was approximately 195 cubic feet of chips per hour. Costs per 100 cubic feet varied from $1.77 to $2.45 depending upon size of chips produced. The full report can be secured from the Northeastern Forest Experiment Station, Upper Darby, Pa.—M. M. NELSON, *Division of Fire Control, Washington Office, U. S. Forest Service.*

BULLDOZERS FOR FIRE SUPPRESSION IN THE MOUNTAINOUS TERRAIN OF THE NORTHERN ROCKY MOUNTAIN REGION

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A plan of standard operating procedures for bulldozer operation in fir line construction has been developed for use in the Northern Rocky Moun tain Region. The organization, procedures, and equipment set-up wer based primarily on use in timbered and mountainous terrain. The sam principles, however, should apply in most cases where bulldozers are use to construct fire line. The operation, as presented, will not always b possible because necessary equipment and skilled personnel are not alway readily available. In such cases it is necessary, of course, to make the bes use of the available resources and organize accordingly.

The plan presented here is intended to cover only the use of dozers i fire line construction and mop-up. The production figures presented fo bulldozer fire line construction are not considered entirely reliable, bu they are the best available at present.[1] Region 1 is now using a specia form to record additional information on bulldozer fire suppression us and accomplishments.

Following is the plan of standard operating procedure as now used b Region 1 in mountainous terrain:

ADMINISTRATION

PLANNING

The use of dozers for fire line construction should be made an integral part o the over-all fire suppression plan.

SUPERVISION

Dispatching

Know dozer areas.—The best available map should be used as a base for show ing the areas in which dozers can be used.

Know location of available dozers.—This means all dozers within your area tha can be made available for fire use. The following information should be listed fo each dozer and kept up to date:

1. Make, model, and size of tractor.
2. Type of dozer attachment (angle or straight blade).
3. Does it have a heavy-duty winch?
4. Is it equipped with protector cab?
5. Available skilled personnel to operate dozers.
   a. Dozer foreman.
   b. Dozer operators.
   c. Dozer helpers.

Location of trucks for hauling dozers.—Kind and size.

Know road limitations.—1. Transportation map should show types of vehicle each road will handle. 2. Bottlenecks such as poor bridges, sharp curves, narro sections of road, etc., should be clearly marked on transportation map.

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[1] Fire Control men using tractors for fire line construction may be interested i reviewing Equipment Development Report Number 13. "Comparative Performanc of D-6 and D-7 Caterpillar Tractors Equipped with Hydraulic Angle Dozers", b Region 5, Arcadia Equipment Development Center, April 1948, published by U. S Forest Service, Washington 25, D. C.

Flagmen.—Furnish when possible or when State law requires. This should serve the following purposes: 1. Safety factor. 2. Speed up travel time. 3. Lead flagman should serve as guide.

Mechanic.—1. Arrange for as soon as posisble. 2. In addition to regular tools, a portable electric welder is desirable.

Supplemental equipment.—1. Torches for burning out dozer line. 2. Water (may be available at site of fire). 3. Diesel fuel, gasoline, and oil. 4. Standard equipment for fire dozer (see "Equipment").

Know estimated travel time.—The following is a guide to be used for average equipment, operators, and conditions. These figures should be adjusted to fit known conditions.

1. Transports: a. Highways, mountain—20 miles per hour. b. Side roads, single track—8 miles per hour.
2. Roading bulldozer: a. On dirt road—4 miles per hour, including stops for greasing. b. Cross country—1 mile per hour.

Fire line production figures.—The following figures, based upon the estimates by our most experienced men, are for line construction only, according to fuel type resistance to control, and do not include line holding or mop-up.

	Line production (chains)
Low resistance to control:	
100-man crew for 10 daylight hours	[1]300
2 dozers, D-4 or larger, for 10 daylight hours	500
Medium resistance to control:	
100-man crew for 10 daylight hours	[1]150
2 dozers, D-7 or larger, for 10 daylight hours	175
2 dozers, D-6, for 10 daylight hours	125
High resistance to control:	
100-man crew for 10 daylight hours	[1]50
2 dozers, D-8 or larger, for 10 daylight hours	75
Extreme resistance to control:	
100-man crew for 10 daylight hours	[1]20
2 dozers, D-8 or larger, for 10 daylight hours	40

[1] Based on pick-up fire fighters.

General.—Consider the use of dozers when a fire gets beyond the smokechaser stage if it is located in dozer area. However, remember it is just another tool to be used in fire line construction under certain prescribed conditions.

The availability of adequate crews without dozers versus crews with dozers and the time required to get them on the fire must be considered in placing orders.

Do not dispatch large trucks over questionable roads. This can result in blocking all transportation for several hours.

Remember, a dozer is ready to go to work upon arrival on a fire, no matter how long or tough the trip, provided it is properly serviced and fueled and relief operators are available.

When possible, hire dozers with protector cabs, heavy-duty winches, and angle dozers.

Inspection

1. Does the dispatcher have all the essential information to do an intelligent job of dispatching dozers to going fires?
2. Is the dozer and transport record, showing location, availability, etc., kept up currently?
3. Have dozers been dispatched and used on crew-size fires in dozer areas?
   a. If not, what is the reason?
   b. Where used; was such use effective?
   c. Was the Safety Code followed?
4. Was the line burned out and cleaned up as soon as possible?
5. Were adequate fuel and supplies kept on hand?
6. Were relief operators arranged for where needed?

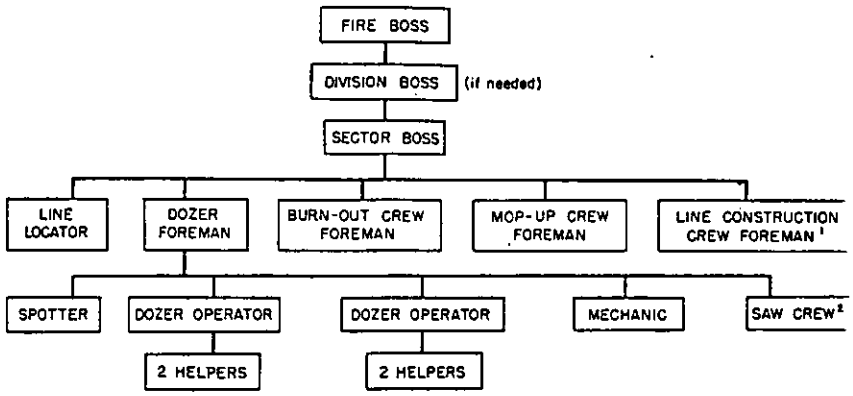
Costs

After calculating manpower and equipment needs to control the fire within allowable time limits, place your order accordingly. Do not duplicate line construction organization by ordering both dozers and crewmen. This has been done all too often in the past. The result is that in some cases the use of equipment has increased the cost of fire suppression without materially improving the performance. Adequate crews for burning out, line holding, and mop-up are, of course, essential for successful use of dozers.

Be reasonably sure that equipment can be used to advantage when it arrives a fire. Release equipment just as soon as it can no longer be used effectively.

Crew Organization

Crew organization is diagrammed in figure 1, and crew line-up on a fire i figure 2.



[1] For constructing hand line if necessary.

[2] Saw crew ahead of dozers if dozers are too small to handle full-length logs.

FIGURE 1.—Crew organization.

Communication

A complete communication network is a must on all large fires. Handie-talki should be furnished the following dozer sector personnel:

a. Sector boss.
b. Line locator.
c. Dozer foreman.
d. Burn-out foreman.
e. Mop-up foreman.

PERSONNEL AND QUALIFICATIONS

Sector Boss

1. Good fireman.
2. Good organizer.
3. General knowledge of dozers.

Line Locator

1. Good knowledge of fire behavior.
2. Good working knowledge of the use of dozers on fire line construction
3. Good woodsman.
4. Good hiker.

Dozer Foreman

1. Good fire foreman.
2. Good knowledge of dozers and the work they can perform; and the ty of terrain they can operate in.
3. Good organizer.
4. Must understand principles of fire behavior.
5. Must have sound judgment.
6. Must be able to make decisions.

Dozer Operators

1. Should be experienced in operating in timber and rough terrain. Expe ence on dozer operations on logging jobs, land clearing operations or pione road work in timbered areas produces good operators.
2. Must be aware of dangers connected with this work.
3. Physically fit, mentally alert. Remember that a dozer is no better than t operator.

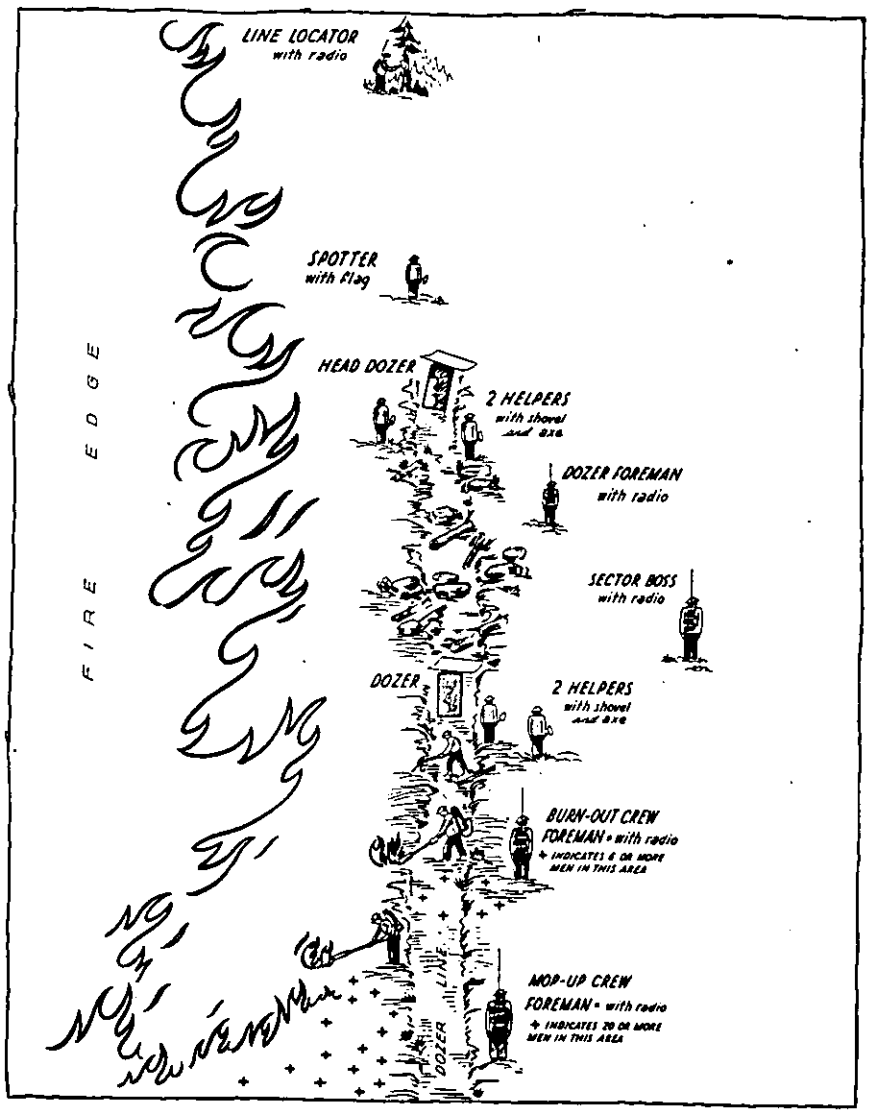


FIGURE 2.—Crew arrangement on fire line.

Spotter

1. Must understand the principles of line location and line construction.
2. Must know intimately where dozers can work without getting into trouble.
3. Must be physically fit, agile, and mentally alert; and should be able to recognize all the hazards of the job.

Extra operators may fill in on this job; but they should have rest periods between the time that they are operating a dozer and the time they take over the spotting job.

It is essential that the operator have complete confidence in the spotter.

Mechanic

1. Should be a tractor specialist.
2. Should be physically fit as it is quite possible that considerable hiking may be involved in a fire assignment.

EQUIPMENT

1. Dozers large enough to build fire line without saw gang in the lead should be used when available and it is possible to transport them to the fire within allowable time limits. Tractor dozer qualifications are given in table 1.
2. They should be lined up in units (two dozers) where possible.
3. Dozers with the following equipment are preferred as listed by priorities.
   a. Protector cab.
   b. Heavy-duty winch.
   c. Angle blade, quick change.
4. Supplemental equipment recommended with each dozer unit.
   a. Protector cab, each dozer.
   b. Heavy-duty winch on at least one dozer.
   c. Two axes.
   d. Two shovels.
   e. Two fire extinguishers.
   f. One each, 100-foot, ¾-inch cable.
   g. One each, 20-foot, ⅞-inch choker.
   h. Two each, single blocks.
   i. Extra control cable and cable cutter with each dozer.
   j. Crank for dozers without starters. Keep in secure place so that it can not be lost.
   k. First-aid kits.
   l. Hard hats for dozer crew.
   m. Wire screen, 3/16-inch mesh, to cover radiator grill to keep debris out thus avoiding heating.
   n. Protection for headlights. Items c to m inclusive can be made up into a dozer kit in advance and placed at a strategic point.
5. Fuel and oil. No amounts have been placed on these items as they will vary with availability and estimated length of the job, but don't run short.
   a. Diesel fuel.
   b. Gasoline (starting motors).
   c. Oil
   d. Grease.
   e. Grease gun, bucket type.
   f. Water.

TECHNIQUES AND PROCEDURES

Transporting Dozers via Truck or Transport

1. If the load is overwidth (as in all the larger dozers), it is desirable to furnish a flagman. This is mandatory in some States. See "Flagman." When available and contacted, the highway patrol will usually act as flagman for emergency trips.
2. When applicable, obtain overwidth permit.
3. Dozers should be chained and blocked against both end and side movement.
4. Transport driver should watch for the following:
   a. Overhead obstructions.
   b. Narrow sections of road and narrow bridges.
   c. Weak bridges—if in doubt unload and bypass where possible.
5. When feasible, include available supplemental equipment and supplies.
6. Place flagmen or flares on the road if it is blocked or partially blocked in loading or unloading operation.

Roading Dozers

1. On roads not suitable for large trucks.
   a. This will not hurt the tractor if the operator will check the lower rollers and front idlers every 20 to 30 minutes for heating.
   b. At the first indication of heating (warm to the hand), the rollers should be greased. If permitted to get hot, it will be hard, if not impossible, to hold grease.
   c. If the tracks are run loose on long trips it will help to avoid heating.
2. Cross country off roads.
   a. This will be mostly in low and second gear.
   b. Choosing the best route.
      (1) Pick a local man (well acquainted with the country) to help in deciding on the exact route to the fire.
      (2) Make use of aerial photographs.
      (3) May be desirable to scout possible route by plane or helicopter.

Sector Boss

1. Coordinate between dozer crew, burn-out crew, line locator, and other crews under his supervision. Be sure the line locator is doing a good job.

TABLE 1.—*Tractor-dozer qualifications*

Tractor make and size	Weight (approximate)			Area track on ground, standard gage	Ground pressure per square inch	
	Tractor	Dozer and control unit	Total		Tractor only	Gross
	Pounds	*Pounds*	*Pounds*	*Square inches*	*Pounds*	*Pounds*
Allis Chalmers HD-19	40,000	[1]15,675	55,675	5,118	7.8	10.9
International TD-24	37,500	[2]12,838	50,338	4,598	8.2	11.0
Caterpillar D-8	35,950	10,365	46,315	4,389	8.2	10.5
Cletrac 120 FDLC	29,760	10,410	40,170	3,840	7.8	10.5
Caterpillar D-7	25,130	8,360	33,490	3,730	6.7	9.0
International TD-18A	22,570	10,650	33,220	3,385	6.9	9.8
Caterpillar D-6	16,725	5,765	22,490	2,740	6.0	8.2

Tractor make and size	Drawbar	Drawbar pull		Travel speeds				Over-all width standard tread	Ground clearance
		Low	High	1st	High	Reverse			
						Low	High		
	Hp.	*Pounds*	*Pounds*	*M.p.h.*	*M.p.h.*	*M.p.h.*	*M.p.h.*	*Inches*	*Inches*
Allis Chalmers HD-19	140	50,100	..	0-3.0	0-7.0	..	0-5.5	109¼	16⅛
International TD-24	148	35,500	[3]4,650	1.6	[3]7.8	1.6	[3]7.7	102	13⅞
Caterpillar D-8	130	28,700	[4]8,600	1.7	[4]4.8	[5]1.7	[6]3.0	103¾	10½
Cletrac 120 FDLC	120	28,600	[7]7,150	1.6	[7]5.0	1.6	2.8	100	19½
Caterpillar D-7	81	21,700	[4]4,270	1.4	[4]6.0	[5]1.6	[7]4.1	97	15½
International TD-18A	89	19,480	[8]4,780	1.7	[8]5.7	1.6	3.5	82¼	14
Caterpillar D-6	66	17,000	[4]3,620	1.4	[4]5.8	[5]2.1	[7]4.6	75¼	12½

[1] Garwood angle dozer.
[2] Isaacson angle dozer.
[3] 8th gear.
[4] 5th gear.
[5] Low reverse gears.
[6] 3rd gear.
[7] 4th gear.
[8] 6th gear.

2. Keep dozer crew to a minimum for two reasons: a. Safety. b. Men will n work effectively in vicinity of dozers, but are inclined to stand around watching t dozers. Keep other crews out of immediate dozer areas for the same reasons.

3. Instruct burn-out crew to burn out and clean up line behind dozers as sc as possible. This is a must. The size of the burn-out crew will vary depending fuels and burning conditions but must be adequate to do a good job.

4. Arrange to build by hand those sections of line not suited to dozer constr tion. Usually this is an early morning job with this crew, switching to line holdi and mop-up later in the day.

5. When there is a choice, be sure to order dozers large enough to build t fire line without the necessity of a saw gang in the lead. If a saw gang should needed, do not overlook power saws. This crew is going to slow down the dozers anything that will speed them up will step up line construction.

6. Communication. Radio communication, handy-talkies, with the following necessary for a smooth-running, efficient organization:

a. Sector boss.
b. Line locator.
c. Dozer foreman.
d. Burn-out foreman.
e. Fire boss.
f. Base camp.

7. Line up dozer foreman and line locator on type of fire line to be construct

Line Locator

This man scouts and blazes line well in advance of the dozers. This is necessa so that desirable line changes can be made before the dozers reach the section question. The general route marked must be negotiable by dozers.

1. Avoid wet or soft ground.
2. Avoid solid rock.
3. Avoid high-hazard or worse fuels because: a. They slow down line co struction. b. Line is harder to hold.
4. Avoid contouring on slopes over 45 percent. Above 45 percent dozers w have to do some excavating to level up, which slows them materially.
5. Dozers cannot climb straight up slopes in excess of 65 percent.
6. Dozers can go down slopes up to 100 percent provided the going is go and the route is clear to the extent that they will not have to back up, such a maneuver is, of course, impossible.
7. It is desirable that the line locator be equipped with an abney level.

Dozer Foreman

1. Decides on type of fire line to be constructed, based on instructions from t sector boss and on conditions on the fire line.
2. Types of line construction:
   a. Direct.
      (1) Generally use in grass and light fuels where heat from the fire w permit working the fire line.
      (2) Use when possible, where timber values in the area are high a loss from the indirect method would be high.
      (3) Above the fire on slopes over 30 percent if the conditions perm The reason is that too much time is lost in working fuels uph against the slope; and where fuels are pushed toward the fire, is usually better to work in the fire where possible.
      (4) When line will not burn out because of poor burning conditio This means that the edge of the fire would have to be work eventually, so the line should be put there in the first place.
      (5) Work inside the fire as much as possible to keep the volume fuels to a minimum.
   b. Indirect.
      (1) Stay away from the fire far enough so that the dozer will not in any danger of carrying any fire to the outside of the line wh clearing the line and piling fuels on the side away from the fi
      (2) Allows the line locator and spotter to straighten the line and choo the easiest going. This speeds up line construction.
      (3) This does require a burn-out crew to clean up the line immediat behind the dozers.
   c. Backfire line.
      (1) Used by specialists only in special cases on large, hot fires.
      (2) Wide line is cleared from which to backfire in advance of ma fire. A dozer unit can do the work of several hundred men wh a wide line is needed to make backfiring safe.
      (3) Advantage is taken of favorable fuels and topography.

(4) Principles of locating line and setting backfire are the same as for a hand line.

d. Ditch line below fire on steep ground to catch rolling debris that might fire across a regular line.

e. General.

(1) Snagging. All snags that may possibly start spot fires or endanger men working on the line and on mop-up should be pushed down.

(2) Hot spots or potential hot spots. Dozers should be used to reduce these and scatter the fuels.

(3) When line conditions permit, in all cases other than direct method of line construction, throw debris away from fire.

3. Must keep the two dozers far enough apart for a safe operation, especially in snag pushing, so that one is always on good, safe ground in a position to help the other in case of trouble.

4. If some manpower is available, it often is good business to skip short sections of line that would materially slow up the dozers provided the dozers can bypass such spots.

5. Be sure tracks are in proper adjustment. They should be fairly tight for side-hill work; this may necessitate adjusting tracks after roading a long distance.

6. Be alert for unsafe work habits—do not tolerate as this is a dangerous operation at best. Be thoroughly familiar with the U. S. Forest Service Safety Code, particularly Sections No. 16, Fire Fighting, No. 39, Tractors, No. 40, Tree Felling, and be sure that the operators are also familiar with these sections.

7. Have plans laid at all times for the safety and escape of crew and tractors in case of a blow-up.

8. Generally instruct lead dozer to break trail and get through in the shortest possible time, not to worry about the kind or amount of work done. Go over top of windfalls. etc., where it is possible to do so safely.

a. Second dozer is to finish line. This does not mean a road; all that is necessary is width enough to get the dozer through and a line the width of a track pad to mineral soil. If some debris falls back in, it is cheaper and faster to have helpers clear by hand rather than to have the dozer back up for it.

b. The distance between the dozers will vary, depending on conditions. If held too close together the lead dozer will often hold up the second one. On the other hand, on hot burning fires it is necessary to keep the dozers close together and build a completed line. One of the most important jobs of the dozer foreman is to watch this and make adjustments currently.

c. Do not separate dozers except on rare occasions such as light fuels and easy slopes. If the dozers are separated instead of worked as a unit, insist on communication with each machine.

9. When working in grand fir or hemlock, caution operators to watch out for sound-looking green trees that are rotten in the center to the extent that they may shear off, causing the tree to fall on the dozer.

10. Inform dozer crew that the operator has a full-time job in looking after himself and his dozer. It is the individual's responsibility to look out for himself and stay in the clear at all times.

11. Arrange for relief operators if the job of line construction will continue for over one shift. Fatigue is a big safety factor on this type of work.

12. Signals must be set up in advance of starting line construction and must be understood by all members of the dozer crew. The following are commonly used. They are given by spotter or foreman.

a. STOP. Wave flag or light back and forth, waist high with swinging motion.

b. COME AHEAD. Up and down in front of spotter from the waist to arm's length above head.

c. TURN. Swing the flag or flashlight on the side to which the operator is to turn.

d. REVERSE or BACK UP. Full circle in front of the spotter.

e. CAUTION. Wave flag or light in a half circle at arm's length above head.

f. CAN'T SEE SPOTTER. Gun motor twice. Given by operator.

g. WANT DOZER HELPER TO COME TO DOZER. Gun motor once. Given by operator.

h. ATTRACT OPERATOR'S ATTENTION. One blast on a police whistle or other suitable substitute to attract attention. Given by helper.

13. Equipment and supplies.

a. Check to see that all necessary items for a successful dozer operation are available or on order. Remember that equipment and supplies can be de-

livered (dropped) by plane on short notice if other means of transpor tion spells delay.
b. Keep mechanic readily available in case of a break-down.

Spotter

1. Works under immediate supervision of dozer foreman. Spare operator often used in this job.
2. Works directly in front of lead dozer, follows the general route blazed the scout, and signals the operator the exact route. Uses a flag in the daytime a. a flashlight at night.
3. Must avoid or warn operator of all hazards that the operator may not able to see.
4. Make detailed location of the type of line indicated by the dozer forem and marked roughly by the line locator.
5. Give the dozer all possible breaks.
   a. Choose the best terrain.
   b. The lightest work.
   c. The shortest route consistent with good fire practice.
6. Spotter must be alert at all times and keep well out of reach of falling timb Remember, this is the most dangerous job of all; be guided accordingly.

Dozer Operators

1. Job is to build a completed fire line.
2. When available two dozers usually work as a team.
3. Do not let both dozers get stuck at the same time.
4. Always be on the alert for dangerous snags or trees.
   a. The practice of "rocking" trees to push them over is generally prohibit Too much danger of the top breaking off.
   b. Always ease into trees and snags. Feel them out before using full power push them over.
5. You are responsible for an expensive piece of equipment, do not take fo hardy chances.
6. Diesel equipment is safer around fire than gasoline; but don't press your lu Keep tractor free of excess oil and grease.
7. Be sure your machine is in good working order and proper adjustment. R port any trouble to the foreman at once.
8. When stopping tractor, always place the shift lever in neutral position a engage master clutch.
9. General:
   a. When the fire line has been completed and the fire controlled, it is usua desirable to keep one or more dozers available for a reasonable period as safety factor.
   b. Dozers can be used advantageously on mop-up, especially in heavy fu and snag areas, if used wisely. Indiscriminate use will increase the mop- costs, hence this phase of the operation will require close supervision.
   c. Often dozers will pay big dividends in man-hours by improving the rou into a fire and the fire line to the extent that 4 by 4 vehicles can be us in placing mop-up crews on the line. This is a dollar-and-cents matter a the cost of improving the line must be weighed against the anticipated ga

OPERATING RULES

1. Know the Safety Code and live up to it.
2. Calked and hobnailed boots are not to be worn on tractors; composition sol are preferred.
3. No one shall ride on a dozer with the operator, except in the seat and und the following conditions:
   a. On business in safe areas.
   b. Roading in open going.
4. Dozers operating in dangerous, timbered country should be protected fro falling tree tops, limbs, etc., by a suitable canopy over the operator.
5. Operators, dozer foreman, spotter, and dozer helpers must wear hard ha when available.
6. The operator shall never leave the dozer seat with the master clutch d engaged except in emergency.
7. No night operation will be permitted in highly dangerous snag areas.
8. Never get on or off a machine while it is in motion.
9. No one should approach a dozer except from a point in full view of t operator and after making sure that the operator has seen him.

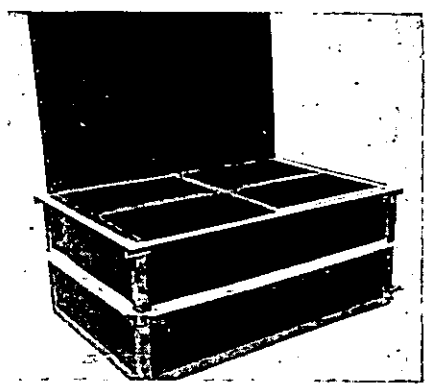
EXPERIMENTAL PLASTIC WATER TANK

ARCADIA EQUIPMENT DEVELOPMENT CENTER

California Region, U.S. Forest Service

In an attempt to construct for fire trucks a water tank that is free from corrosion and long-lived, an experimental tank was designed by a leading manufacturer of rubber and plastic products. It was sent to the Arcadia Equipment Development Center for testing.

The tank, in a steel frame as shown, is fabricated from bakelite. The capacity is 125 gallons.



The tank was tested under conditions which could be expected of any slip-on tanker unit. It was found that after limited testing the tank began to leak around the base seam. Baffle plate also pulled loose. The material in the plates bulged but held up well, the seams alone being deficient.

Conclusions: Water tanks designed like the test unit, and fabricated from the same material, are not adequate for the rough treatment to which fire trucks are subjected.

The plates, from which the tank was fabricated, appeared adequate. However, it is doubtful that the material would withstand constant bending for a long period of time.

A more substantial method of cementing and reinforcing joints would be necessary.

It is not advisable to construct fire tanks of material which will burn readily.

Too much support is necessary in the form of framework, which defeats the purpose of lightweight construction.

Tank was fabricated according to plans for steel construction. Possibly construction of a type more adaptable to the material would have produced a stronger unit.

Still Tying Rolled Hose?

The problem of tying cotton-jacketed, rubber-lined hose in rolls so it can be readily untied was solved for the Cleveland National Forest by Harry Whitney, suppression crew foreman. He cut rubber bands about three-quarters of an inch wide from discarded truck inner-tubes and stretched two of the bands at right angles to each other over the roll. The rolls are securely held in place and can be quickly unrolled by pulling off the bands.—STANLEY STEVENSON, *Fire Control Officer, Cleveland National Forest.*

PLASTIC BALLS ON RADIO ANTENNA RODS FOR SAFETY

GUY V. WOOD, *Communication Engineer,* and ALBERT H. SCHOSS, *Communication Technician, Region 5, U. S. Forest Service*

The exposed and sharp tips on certain types of antenna rods or whips present a serious physical hazard and can be the cause of severe eye and face injuries.

Certain of the standard mobile antenna rods are supplied with either plastic or metal balls on the tips to reduce the physical hazard. Others such as the Motorola Model P-8253 roof-top mount type are not so supplied, possibly because the rods are originally manufactured and stocked in a single maximum length and are cut (at the tip end) to specified frequency lengths just prior to shipment to the user.

On the Motorola Handie-talkie radiophone Models FHTR-1AL and FH2TR-1AL the short-length whips as supplied have a closed loop formed of the tip end which prevents eye or face injuries. The loop is effective until the whip is caught in the brush or on a limb at which time the loop opens up in the form of a fishhook; it is then a constant hazard to the radio user and to fellow workers.

To overcome the above hazards a plastic (Lucite) ball may be heat-sweated on the ends of these, and other type rods and whips not specifically mentioned, by a simple process as follows:

Mounting the ½-inch plastic ball to handie-talkie type antenna whip.—

1. Cut off formed loop on the tip of the whip and file a point so as to provide a tip which will follow a straight course into the plastic.
2. With a knife remove about 1½ inches of the coating on the tip end of the whip.
3. File small notches 1/16, 1/8, and 3/16 inch from the tip end to provide a grip for the plastic ball.
4. Insert the antenna whip in a small vise with the tip extending out about 1½ inches. Heat the protruding tip with a 100-watt electric soldering iron. Do not use an open flame for this heating.
5. By wearing a leather glove it is now possible to slowly force the plastic ball onto the whip while still maintaining contact on the whip with the soldering iron. Avoid touching ball with the iron.
6. Do not make use of a drilled guide hole in the plastic ball, a more secure job results in not using one. It is not difficult to center the ball on the tip.
7. Run the tip of the whip well into the ball but not through it.
8. After cooling, remove the whip from the vise and apply Vinylite or equal plastic cement to the part of whip from which the plastic coating was previously removed. This is to prevent rust and corrosion.

Mounting the 5/8-inch plastic ball to mobile type rods.—

1. Remove, if present, the plastic plug as originally supplied in rod (i.e., in Motorola type hollow-rod).

2. With a knife remove about 1½ inches of the plastic coating from the tip end of the rod.

3. File notches 1/8 and 3/16 inch from the tip end of the rod to provide a grip for the plastic ball.

4. Grind a point-shaped end on the rod tip to reduce the required installing pressure.

5. Complete the operation by following steps 4 through 8 as outlined for the ½-inch plastic ball.

Severe impact and shear tests run on these finished rods and whips have shown no tendencies on the part of the Lucite balls to shatter or break loose.

As an additional feature, by installing these protective tips on the mobile rods the problem of hooking the rod down during periods of nonuse is greatly simplified.

These particular plastic balls, as used, are stock production items and cost only a few cents each. They are possibly available in most localities from plastic hobby or supply stores.

Guiding the Fire Chaser

Recently I had an experience which gave me an idea for improvement. One day when atmospheric conditions blended the ridges so one could not distinguish the exact location, I detected a tiny fire two districts away. The other lookout had been taken down so there was no cross reading. I called Fire Control Assistant Nelson Stone of Camptonville, Tahoe National Forest. He got on a ridge known to me and flashed a mirror, and I directed him from there to the fire. The fire was kept an A size even though it was on the district beyond Camptonville.

Now here's the point: 15 minutes later the sun was gone and we could not have received his flash. If we had a *small powerful light* for this purpose, we could prevent lots of trouble in the future. Sounds logical, doesn't it?

The vertical reading couldn't be taken because of old-fashioned windows with cross bars. [In some regions a gasoline lantern has been used for the purpose described.—Ed.]—Mrs. Mary Gormley, *Lookout, Tahoe National Forest.*

Tape Guards for Edged Tools

Use two thicknesses of masking tape or adhesive tape folded over the cutting edge of axes, pluaskis, etc. The tape stays on and does not need to be removed to use tools; a few blows cut it free when tools are needed. This safety measure does not interfere with carrying axes in the spring clips on pickups and trucks. The white strip shows up well on the cutting edge of tools at night, an important feature for crews in rough country at night.—Carl O. Peterson, *Fire Prevention Aid, San Bernardino National Forest.*

AN EFFICIENT PORTABLE RADIO AIRPLANE ANTENN

ROY L. WEEMAN

Communications Officer, Region 2, U. S. Forest Service

A review of previous antennas for use with portable radios in airplan indicates very poor radiation efficiency. In most instances they have con sisted of end fed wires of random lengths. Such antennas will not properl

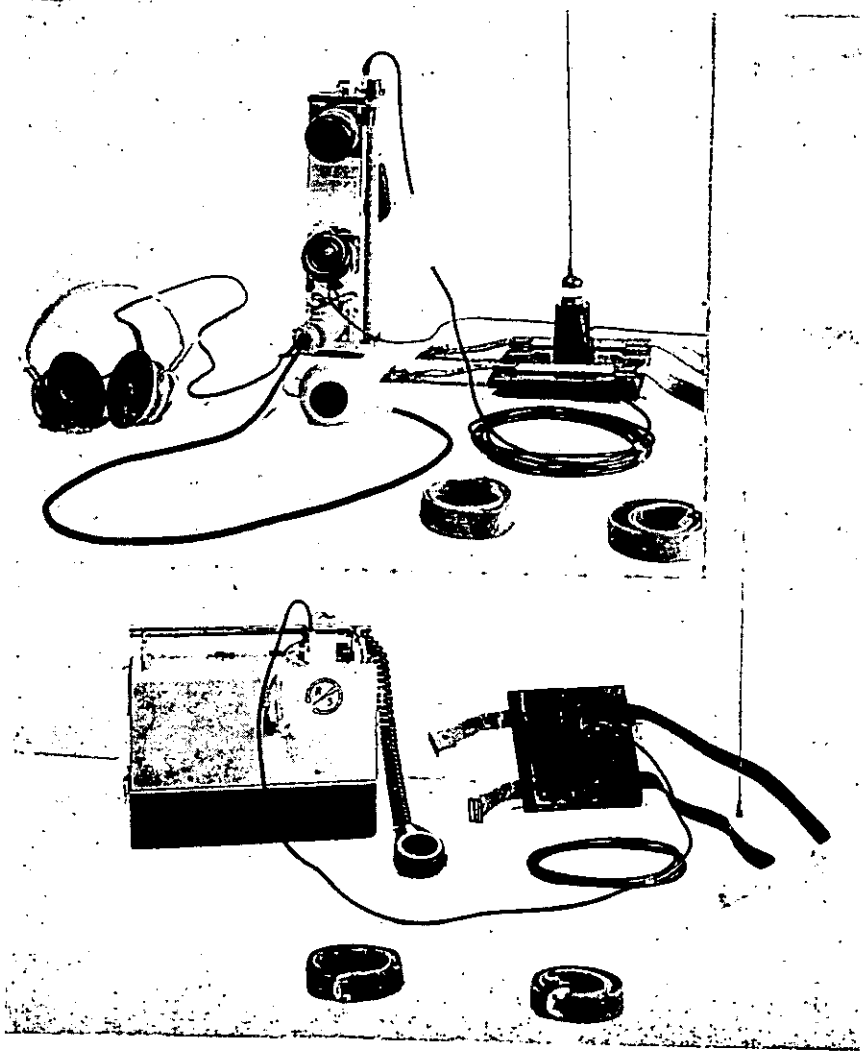


FIGURE 1.—*Top,* plane antenna with SF model "C" handie-talkie attached; *bottom,* underside of antenna base with pack set attached.

match the transmitter terminating impedance and therefore greatly decrease the energy radiated from the antenna.

This antenna consists of a 43-inch whip properly base loaded to satisfactorily match 50- to 100-ohm coaxial cable. In our installations we have used RG58/U 53-ohm cable, but if a more rugged installation is required, heavier coaxial cable such as RG8/U 53-ohm or RG11/U 75-ohm cable may be used. The antenna whip and loading coil may be purchased for approximately $5 from a leading manufacturer of radio equipment. The loading coil is available for frequencies from 25 to 40 megacycles.

The whip and loading coil are mounted in a hardwood block, 2 by 2 by 4 inches, which is secured to a plywood base, 7 by 7 by ½ inches, with 2-inch wood screws. Web straps are passed through keepers mounted on the top of the base to permit attachment to suitable parts of the airplane (fig. 1). Additional web straps are furnished to secure the lead-in between the antenna, which is located as far from the fuselage as practicable, and the cabin of the plane. The lead-in is attached to the loading coil through a hole in the base and can leave the antenna in a collinear or perpendicular direction. Sponge rubber, ½ inch thick, is cemented to the base to prevent damage to the plane. A slot in the rubber permits the lead-in to leave the antenna at right angles. The lead-in can be any suitable length to serve the various airplanes which may be used. An adapter fitting near the end of the coaxial cable permits the antenna to be used with the pack set, SF model "C" handie-talkie, or the Motorola handie-talkie. The unit assembly may also be readily adapted for emergency mobile use in cars, trucks, and pickups to serve the same radiophones.

When the antenna whip is perpendicularly mounted, excellent results are obtained in excess of 20 miles, with practically a total absence of dead spots. Reports from one region indicate satisfactory operation up to 80 miles when the airplane has sufficient elevation to obtain line-of-sight transmissions.

[Aircraft operators must obtain CAA approval on installation of equipment of the character described in this article. Refer to Part 15, Aircraft Equipment, Air Worthiness, Civil Air Regulations.—Ed.]

THE POLAROID CAMERA IN FIRE CONTROL

CARLOCK E. JOHNSON, *Forester, Sequoia and Kings Canyon National Park,*
and LEON R. THOMAS, *Assistant Supervisor, Sequoia National Forest*

The recent development of a new type of camera, the Polaroid land camera, manufactured in Cambridge, Mass., has added many possibilities to the use of photography in forest protection. During the 1950 fire season the authors conducted experiments with this camera to determine its value in fire control.

In making the tests one idea was paramount. That was to record vital fire data and to make it available for ground crews in a matter of minutes. These data would include location, relative size of the fire, topography, fuel type, areas of probable spread, wind direction, logical points of attack, and if possible routes of access to the fire. This can be done by means of aerial photos taken with this camera and dropped to ground crews.

The most significant feature of the Polaroid land camera is the fact that a picture can be taken and developed in this camera, on the spot, within a period of 45 seconds to 3 minutes, depending primarily on the temperature of film at the time of development.

The basic camera with exposure meter costs approximately $100. Additional accessories are not necessary. Black and white film costs approximately $1.70 per roll of eight pictures; the pictures are 2¼ by 3¼ inches. The camera loaded with film weighs 4½ pounds. The exposure meter adds another ¼ pound. The over-all size is 9½ by 5 by 2½ inches. Carrying cases for convenience of handling and protection of the equipment are available.

The camera is built for speed and ease of operation. The aperture and speed of the lens are adjusted in one operation and are calibrated in numbers which correspond to the numbers on the polaroid light meter. This makes for simplicity and eliminates the chance of error. The correction for distance is adjusted separately.

After exposure it is necessary to push a button, pull out the film strip, wait the required developing time, then open the back of the camera and take out the finished picture. As with all cameras, a little experience is necessary before one can consistently take good pictures.

Pictures of a going fire are of greater value to the fire boss if they show the conditions at the time of examination. Aerial pictures can be taken with this camera and dropped to the fire camp in a matter of minutes (fig. 1). Combined with observers notes, written in grease pencil on the picture, or by air to ground radio communication, the fire boss or planning officer can quickly and accurately interpret the information.

Heavily timbered and rough terrain often causes delay in locating small fires. In some instances this has resulted in major fires or expenditure of badly needed man-hours. A picture, dropped from a plane, can make this task much easier for the footsore smokechaser.

Lightning storms ofter cause numerous small fires, requiring simultaneous action by the dispatcher. An observer in a plane can easily photograph each

FIGURE 1.—Eagle Peak fire, Sequoia National Forest. Picture taken at 10:54 a.m. about 2,000 feet above the fire. Within 4 minutes after exposure this picture was dropped to the fire boss.

fire at the time of detection or reconnaissance. Decisions as to priority of strength and attack may be largely influenced by the data recorded in the photograph.

Experienced peace officers are well aware of the need to safeguard "Chain of Custody" in handling evidence for submission to courts. This is particularly true in photographing evidence. This camera enables the investigator to act as sole agent in exposing, developing, and submitting photographic evidence. It also ensures the recording of the actual information desired.

There was one serious weakness in the camera used in the experiment—the low shutter speed. A plane is often subjected to turbulent air which, combined with traveling speed, sometimes prevents clear, detailed pictures. Substitution of a faster lens should eliminate this fault.

Areas containing concentrations of smoke do not lend themselves to detail photography. It is believed that this camera will function as well as any other should this arise. However, it probably could not compete with infra-red type film.

Polaroid film does not furnish a negative. Therefore additional prints can be secured only by a number of exposures or by copying the original print. At present only two types of film, "sepia" and "black and white," are supplied by the manufacturer. The "black and white" type is the only one recommended for use in fire work.

The Polaroid camera is not intended to replace the foot scout or the trained aerial observer. It is not foolproof, nor will it meet all needs that may arise. However, it will give on-the-spot factual data and certainly has a place in fire control.

VOLUNTEER FIRE PREVENTION CLUBS IN OKLAHOMA

WM. MITCHELL

Assistant Forester, In charge of Fire Control, Division of Forestry, Oklahoma Planning and Resources Board

Organized volunteers in Oklahoma are handling fire protection with marked success. Since 1948, an unusual record has been made in the development, use, and response of volunteer help in the prevention and suppression of woods and range fires. This has taken place in the upland hardwood type of northeastern Oklahoma, an area of open range with most of the land in relatively small private holdings.

This idea of organized volunteers came from local people. It goes back to a rural mail carrier, Mallay Douglas, who in 1926-28 conceived the idea that community people should do something about stopping woods fires. He preached and talked this idea as he followed his mail route around Sugar Loaf Mountain in Arkansas and Oklahoma.

This idea was slow to take. Finally, one key person became interested in keeping fires off the Mountain. This spread to two and four, and more, until the majority of the community had joined the volunteer forces. Mr. Douglas later got the Bell Telephone Company to contribute enough salvage wire, as a public service, to reach around the Mountain. Volunteers developed with this wire a telephone network for use in warning of fires and in rounding up suppression help.

Communities in northeast Oklahoma became interested in this idea of the Sugar Loaf volunteers. At the start, progress was slow. Two communities in Cherokee County were organized in the fall of 1943, but only after a summer fire had wiped out 14 sections of woods range. The two communities banded 138 members together to protect 54,000 acres of range and woodland. Assistance in organizing was given by the Oklahoma Division of Forestry and County Agent Back of Cherokee County.

Two more groups were organized in 1944. But from 1944 to 1948, progress was poor. By the end of 1948, however, after State personnel had become available to assist in the organizing work, the groups had increased to 22. By March 1950, the number of groups had jumped to 76, containing nearly 1,300 members. Thus, volunteer interest has mushroomed and is now getting ahead of the number of State personnel available for organizing. These volunteers have become a real value in protection work in northeast Oklahoma.

Volunteer protection is a community undertaking. The people band together to form a "prevention club" that is made up of the majority of residents in a community. The Division of Forestry assists in organizing the club, which elects its own fire chief and assistant fire chiefs. All club members sign a Division of Forestry pledge card to prevent fires and to help in fire suppression. Each member is appointed a State Forest Guard and is given an attractive certificate. A supply of State hand tools is assigned

to the fire chief. When a fire occurs, the fire chief rounds up the members, gets the tools to the fire location, acts as the fire boss, and makes reports covering the fire.

The volunteer groups give protection beyond the area owned by the members. In the State ranger district at Sallisaw, for example, the 818 members in the 51 prevention clubs own 88,448 acres of land. However, these clubs extend protection to nearly 400,000 acres. The area protected by a club is "blocked in" as much as possible to join the boundaries of any adjacent club.

So far, action on fire suppression by the clubs has been good. In calendar year 1949, 45 fires burned nearly 12,000 acres, or 0.8 percent of the whole 1.5 million acres under volunteer influence in northeastern Oklahoma. Suppression assistance by the State is quite limited. Detection now is done by local people, but a State-operated tower system is being installed. Limited State tractor-plow support is given to the clubs when "back up" is needed.

How the suppression action by the organized volunteers will hold up in the future still is a question. Present indications are that the interest will continue. The State intends to rely on the suppression work by the clubs until it is proved that the volunteers are unequal to the task.

The biggest contribution the clubs make is on the prevention of range and woods fires. Carelessness with fires within a club area has become unpopular. In fact, most of the fires handled by the clubs have come from outside club boundaries. People within a club area who desire to burn over their own land are permitted to do so, provided the fire does not escape to the land of neighbors.

It is possible that fire prevention clubs, as now existing in northeast Oklahoma, can be developed in other States. With this thought in mind, essential points on the organizational work in Oklahoma are listed as follows:

1. Key people to provide leadership in support of volunteer community fire protection must be recruited and "sold" on the prevention of range and woods fires, if they are not already so inclined. The key people "work up" interest of other members of the community until a nucleus has been developed. This group then requests State assistance in organizing a prevention club.

2. The "selling" of community leaders in Oklahoma on the need for preventing range and woods fires has been a job done jointly by many men and many agencies. County agents, Extension Service, Soil Conservation Service, vocational agriculture teachers, Oklahoma A&M College, the Oklahoma Division of Forestry, the State Department of Agriculture, and others have joined hands to put this idea across from many viewpoints. Personal contacts, group meetings, demonstrations, contests, radio and newspaper programs have been the major approaches used. Only through the cooperation of the many agencies has this work been successful.

3. After a community group of 10 or more expresses interest in organizing a prevention club, representatives of the Division of Forestry meet with the local people to discuss the idea thoroughly. The community group then decides whether it wants to form a club or not. When the group decides to organize a club, members are signed up, the area of responsibility and the functions of the club are outlined. In this organizing work State personnel who have ability to meet with and get along with rural people are of utmost value.

4. After a prevention club is formed, State personnel assign a gc supply of hand tools and provide a well-designed, weatherproof tool b Monthly visits to each club also are made to discuss problems with fire chief, circulate new ideas, prod or stimulate the program where necessary, give training in fire prevention and suppression, and show inter in community work and activities. Movies and talks are given frequen Much "night work" is necessary. These follow-up visits are of great i portance in keeping the volunteer groups alert and interested.

In conclusion, organized volunteers in Oklahoma will respond to outsi help and interest in community problems. Their effort on prevention a suppression of range and woods fires more than pays for the effort, tin and money involved in the organizing work. Further information on t operation of the Oklahoma prevention clubs can be obtained through St Forester Stauffer at Oklahoma City, Okla.

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(*Continued from page 7*)

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"HOT SHOT" CREWS

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Scouting revealed that the head of the Burma Fire of 1949, Cleveland National Forest, was spreading rapidly uphill through medium to heavy brush and would reach the rim of an adjacent watershed unless checked on a small ridge ¼ mile from the top. One "hot shot" crew under Foreman George McLarty, San Bernardino National Forest, had been working the northern flank from the bottom and would reach the top too late to effect the check. The Cleveland "hot shot" crew Foreman, Leon Ballou, and 4 men were flown via helicopter from the southern flank of the fire to the ridge at the head of the fire. The 5 men hurriedly cut a line in front of the fire, backfired it out and started a direct attack on the fire edge down the south flank to meet the rest of the crew. The crew on the northern flank meanwhile had pushed through and tied to the northern end of the fired out line. Although numerous spots occurred and the crews lost the south flank twice because of whirlwinds, they closed the gap and effected control on a 280-acre fire that would probably have more than tripled its size within 4 hours unless the check had been made and the lines tied together.

Since these crews are trained to subsist on the line with bare essentials, a sustained push taking advantage of lulls in fire intensity is possible. This was demonstrated by the San Bernardino "hot shot" crew on the Agua Tibia Fire of 1950.

Lightning started this fire in very steep to precipitious terrain covered with medium to extremely heavy 80-year-old brush and scrub oak. The east flank of the fire had slopped over the planned control ridge approximately ½ mile from the top of the main divide. Helicopter scouting at 10:30 a. m. revealed that if the slop-over could be controlled the lines being constructed from the top and bottom along the flank would probably control that side of the fire.

Foreman McLarty was flown by helicopter around the slop-over and he then jumped about 6 feet to the ground inside the burn above the slop-over. He subsequently cleared a landing spot and 4 additional men were flown in to begin work on the line. Meanwhile, the rest of the crew were started down the ridge top along an old trail. Helicopter coverage guided the crew to their destination where they split forces and started around the slop-over. Although this action was completed within 1½ hours after the initial scouting, the slop-over had spread to a perimeter of approximately 65 chains on a very steep rocky slope in medium to heavy brush oak type.

McLarty and his whole crew worked until dark. They were sent food, lights, and blankets by helicopter. The crew was fed and rested in relays until a "scratch" line was constructed around the slop-over about 11:00 p. m. Early the following morning, the crew was again serviced by helicopter and the fire line finished and mop-up started.

Stubborn aggressiveness on the part of this crew prevented the fire fr crossing the drainage and establishing a new head on even more p cipitous terrain.

These two examples illustrate the flexibility of "hot shot" crew acti Similar action has been taken many times during the past 4 years. C trol possibilities such as these would have been impractical without w organized, trained, and conditioned crews.

One of the "hot shot" crews has been based during the fire season the Cleveland National Forest. The following notes, although concern primarily with the Cleveland "hot shot" organization and operational p cedures, are representative for "hot shot" crews in the California Region.

The crew is composed of young men whose primary requisites are ph ical fitness and a will to work. Their lack of experience and conditioni are compensated by intensive training in fire line construction and u of hand tools and fire hose lays at the beginning of each season. These m are termed "fire fighters" and receive fire-fighter rates of pay while on fire. When not engaged on fire suppression they are paid laborer wages a used on forest projects.

A subforeman or straw boss works with and has charge of from 5 to fire fighters. The straw boss is an integral part of each crew and takes h days off at the same time as the crew. Two assistant foremen acts as cre bosses and are each assigned one-half the straw boss squads. One of t crew bosses is capable of assuming temporary charge of the whole cre during the absence of the foreman.

The crew is under the direct supervision of an experienced fire fight who can act, as one foreman put it, "from general to father confessor. This foreman must be a skilled leader, fire-wise, and physically fit for ve arduous work. He usually assumes the duties of sector boss on fires.

Crew members are hired only after full understanding and acceptan of the rigid rules set up. Camp routine is fashioned after that of athlet training camps with scheduled hours for meals, work, recreation, an sleep. Although some men quickly drop out of the crew because of t difficulty of the job and the rigid dicipline, three have returned each ye since 1947 and ten others including the foreman have been on the cre for the past 2 seasons.

Conservation, wildlife, general forestry, and training films give the re sons for the "why" and "how" of forest fire protection. The crew is give instruction in the use and care of fire line hand tools, followed by ir tensive work-outs on practice fire lines. Several afternoons during the fir part of the season are spent on illustrative lectures, orientation, fire b havior, safety, and correct fire line construction practices. Action on earl season fires is discussed on the ground with a large part of the constru tive comment coming from the crew members.

After several successful attacks on early season fires, crews begin to de velop an esprit de corps and an eagerness to prove their ability. Severa distinctive arm patches have been designed and worn by crews hailin their identity. The competitive spirit on large fires requiring more tha one crew has provided additional incentive toward better production.

The following summary of work accomplishment, although reflectin considerable more suppression time during the heavier fire season of 195(indicates the advisability of preplanning and budgeting forces primarily fo fire suppression.

	Percent of total man-hours payrolled	
Cleveland crew activities:	1949	1950
Training	12.6	6.6
Project work (nonfire)	10.7	17.1
Fire suppression	48.6	62.6
Headquarters camp maintenance and operation, cooks, and annual leave	28.1	13.7
	100	100

A sample of fire line construction rates by direct attacks on fire perimeters in Southern California vegetative types, computed from the data recorded on the ground by the Cleveland crew foreman and including rest periods, lunch time, and delays due to lost line, is given in table 1. Comparable line construction rates are difficult to evaluate since the "hot shot" crews are generally placed on lines where untrained or unorganized crews would make very little if any progress.

TABLE 1.—*A sample of fire line construction rates by the "hot shot" crew, Cleveland National Forest*

Cover type	Condition of crew	Time	Character of fire edge	Slope	Men	Fire line built	
						Total	Average per man-hour
					Number	*Chains*	*Chains*
Medium to heavy brush	Fresh	Day and night	Hot	Moderate[1]	23	74	0.21
Chamise	do.	Day	do.	Steep	26	135	.86
Medium brush	do.	Night	do.	do.	28	40	.35
Heavy brush	do.	do.	Moderate hot	Moderate[2]	20	23	.23
Chamise	Tired	do.	do.	Steep[3]	12	41	.34
Chamise and brush	Fresh	Day	Hot[4]	do.	38	23	.30
Medium to heavy brush	Very tired	Night	do.	do.	42	65	.25

[1] Scattered scrub oak stems.
[2] Very steep ½ mile hike to line.
[3] Some mop-up, rocks, cliffs.
[4] Line abandoned two times because of flare-ups.

The value of a trained unit of men that can be sent into difficult sections of a fire perimeter with a high degree of certainty that control will be effected, has been demonstrated many times during the past. The ever increasing demand for "hot shots" when the going gets rough is the fire manager's endorsement of the "hot shot" program.

JEEP PLOW

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Recent tests of the jeep and the Newgren-Monroe hydraulically cc trolled fire plow, conducted in cooperation with the State of Michigan Roscommon, demonstrated that performance could be improved if the r quired drawbar pull could be reduced.

Therefore modifications of the plow were made which brought dov the drawbar pull requirements more than 50 percent without greatly r ducing the width or effectiveness of the fire line (fig. 1). Also, a sm change was made in the plow lift lever arms which allows the plow mo freedom to follow rough ground and gives the plow about 6 inches high lift needed for clearance over obstacles and high road centers. The latter especially important when the jeep is equipped with a tank and carri a full load of water.

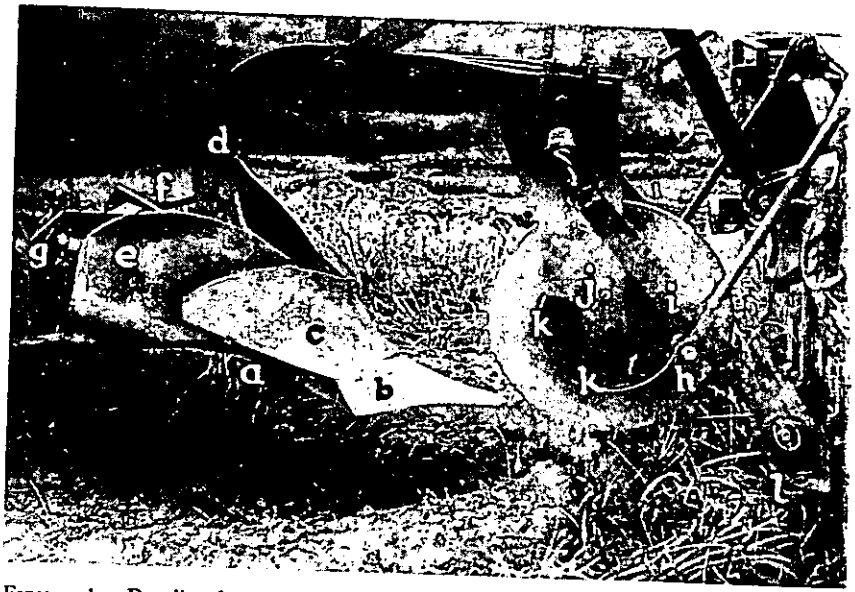

FIGURE 1.—Details of the modified jeep plow: *a*, Turf knives attached to middle-buster share after disks have been removed; *b*, Newgren middlebuster share; *c*, standard moldboard; *d*, plow beam; *e*, moldboard extension, spot welded to *c*, top loading part curved forward to prevent slip-over and bottom part curved to rear, to push and press down the furrow slice; *f*, extended moldboard brace; *g*, part of commercial plow to which disks were attached; *h*, bracket, with a hole, welded on brace bars to allow higher lift; *i*, old hole and mount for lever arm; *j*, second hole drilled to raise coulter in stony country; *k*, depth control flange, on each side of rolling coulter; *l*, implement drawbar, lowest part of rear of jeep.

The turf knives are the most important part of the modification of the jeep plow. They cut the sides of the furrow slice clear of roots and permit it to be moved up and over into the wheel tracks. A clean furrow without fall-back is the result of the use of properly positioned turf knives (fig. 2).

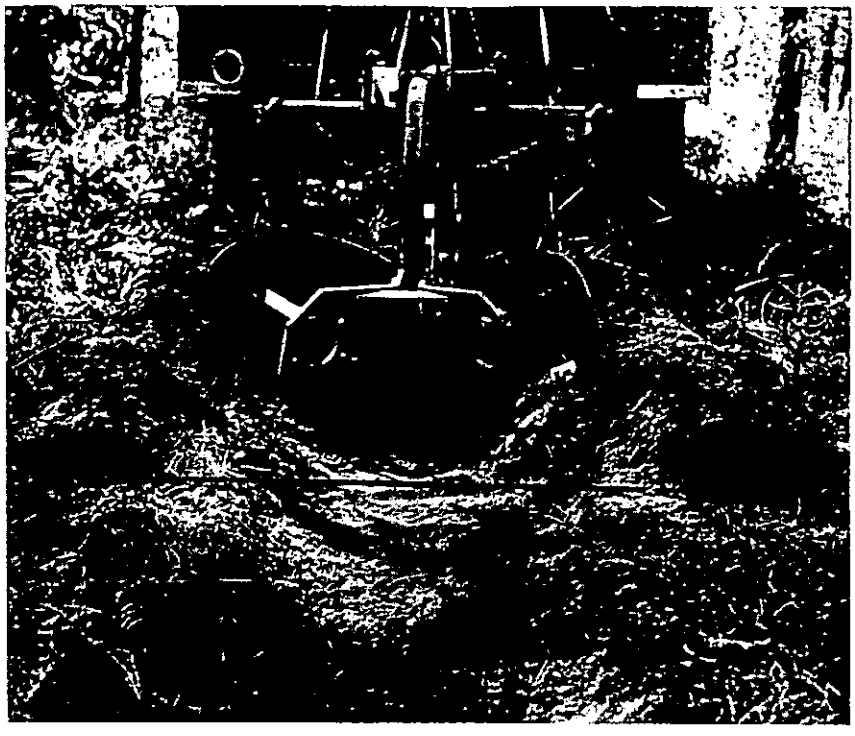

FIGURE 2.—Clean furrow made by the modified jeep plow.

The knives are made up of a single piece of mild steel ¼ by 4 inches. Welded to the knives are two pieces of angle iron 4 by 4 inches having two holes for bolts that are bolted to holes already drilled into the bottom of the plow beam (fig. 3). The knives are heat-treated and hardened with a compound called "Speedit," and are very abrasive resistant.

The modified plow makes a furrow averaging 19 inches wide, with furrow slice of 13 inches on each side, or an over-all line approximately 45 inches wide. This compares with a 27-inch furrow and 54-inch over-all line width made by the Newgren disk plow when a complete line can be made.

The modifications of the Newgren plow are simple to make and the total cost of materials and labor is about $25. The unit parts could be assembled in kit form and the actual installation made in any shop having an electric welding unit.

Tests made in typical jack pine-oak type gave comparative drawbar pull requirement of 1,238 pounds for the plow without modification and only 382 pounds for the modified plow. The traction and power of the jeep

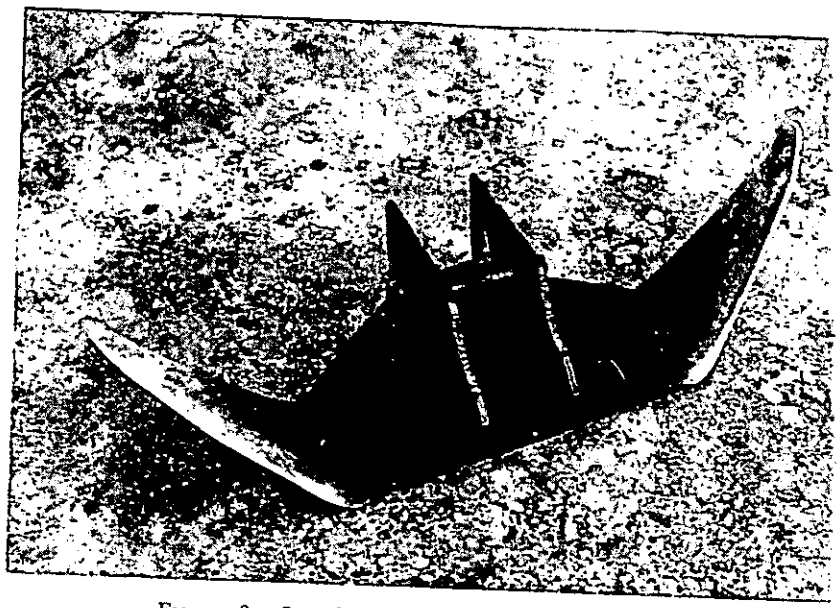

FIGURE 3.—Set of turf knives for modified jeep plow.

were adequate to pull the modified plow in the low, intermediate, an high gear shift range where it was impossible to make a satisfactory lin in low gear with the unmodified plow.

The modified plow extends very materially the use of the universal jee for fire suppression. This plow could be used with any four-wheel-driv vehicle. With increased traction and power, larger moldboards could b used to make wider fire lines.

MANAGEMENT OF FUNCTIONAL LINE MEN ON FIRES

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There must be developed, through thinking and then acting, a fluid type of suppression organization which permits the best qualified attack men to always follow and be on hot fire fronts, has their places on controlled line taken over by men most efficient in holding and mop-up, and develops more supervisory working capacity from the local people for the holding and mop-up phases.

In order to reach these objectives and to become more efficient on each project fire we need to take a fresh look at the procedures used in present-day organizing for suppression. How should our presuppression program be reoriented in order that top management, assisted by plans and service staffs, can direct the suppression forces accordingly.

These thoughts are not new—rather they have been submerged, to a degree, by the rush and complexities involved, particularly on larger fires. Organizational thinking, along these lines, is not pronounced because the biggest job is to select and train men to fill positions in the over-all suppression organization and then to control the fire.

On all large fires there is a tendency to act from thinking in terms of total size and peremeter. More emphasis has been given to total quantities rather than to their component parts. Organizing has been geared to the job of line building without breaking apart the free burning, holding, and cold sections materially and reorganizing accordingly.

As every fire progresses the critical portion of its perimeter becomes less percentage-wise even though the distance around the running front increases. During one or two burning periods this front becomes pretty well stabilized as to length of open line, after which it decreases until control is effected.

We work hard at the job of selecting and training men to fill functional line and plans and service phases for the required organization. Attention is given down to the last details. Now let us consider and point up the two most critical phases of the line suppression task: initial attack, resulting in control; and holding and mop-up, which makes for security.

Selection and training produces men best qualified to fill all of the functional line supervisory positions at different management levels. It should also be used to classify men best suited for initial attack and mop-up, for fires continue to spread because of lack of initiative and aggressiveness in attack and control, and they are also lost as a result of lack of methodical detail in holding, mop-up, and patrol. Thus, the inherent characteristics and capacities of men, along with selection and training, should bracket them to phases of work where their time and energies produce most efficiently.

In all probability we could do a great deal more in developing supervisory working capacity from local cooperators and population if we concentrated

on holding and mop-up training and assignments. It is believed, b large, they could assimilate and become proficient in this phase quicker than in the more complex job of initial attack.

To create a fluid type of organization, keeping in step with cha management objectives—i. e., from initial attack and control to hol mop-up, and patrol—means the manipulation, by shifts, of overhea cording to their qualifications to a much greater degree than is pre done. Top management assisted by the plans section can keep attack control men continually moving to the hot fronts. These men would mally be regular administrative and protection personnel. Their plac controlled line would be taken over by men most qualified to direct l ing, mop-up, and patrol. Through an aggressive program of recruitn training, and regular assignment these positions could well be filled b operators and other local people.

It is believed that, using this approach, the recognizing of so many ch of open, holding, and cold line respectively along with the types of best suited to those kinds of jobs, we will not have to make so many for outside help. At least, wholesale requests for overhead would be t pered to quite a degree, depending on the job estimate, i.e., open, hold and cold length of line.

Each forest should examine its own manpower resources inside and side the Service. Decide what portion of each suppression job should n mally be done locally. Think through the needs over and above that. P for aggressive and intense attacks on open fronts with attenuating methodical strength behind. Phases needing emphasis to gain these obj tives would be:

a. Select and intensively train forest officers in initial attack and mop-up.
b. Select and intensively train local cooperators in holding and mop-up.
c. Develop both groups through assignments to respective operations on ho forests.
d. List qualifications accordingly on dispatch card and memoranda.
e. Forest fire organization.
   1. Break line function down to show—
      (a) Open—initial attack.
      (b) Controlled—mop-up and patrol.
   2. Designate forest officers and cooperators to fill (a) and (b) above.
f. Large fire assignments.
   1. Plans and Records keep inventories of fire line characteristics.
   2. Plans and Records keep list of all men according to qualifications.
   3. Management assign accordingly.

Thus, management of men, by periods and by sectors, can be directe so that a more efficient job is done in fire suppression. It should not ad to the complexity of the existing job because when these essential an smaller elements are broken out then thinking and acting will be done ac cordingly.

INTENSIVE PRE-PLANNING FOR FIRE SUPPRESSION

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During the development of the fire control portion of the Los Angeles River Upstream Flood Control program it was recognized that we should plan, as a fire control objective, to lower the allowable annual burned area from 0.5 to 0.2 of 1 percent of the total area.

After considering all known factors such as elapsed time, rate of spread, speed of attack, and strength of initial and follow-up forces it was decided to intensify the protection already afforded this highly important watershed. This intensification became one of improving upon the speed of attack plus a pre-planning of fire control lines.

The area covered is that 35-mile stretch of "front country" directly adjacent to San Fernando Valley and the City of Los Angeles. This is an area of 277 square miles, or 177,280 acres, most of which is within the Angeles National Forest. The elevation ranges from 1,200 feet in the valley to 5,800 feet at the summit of Mount Wilson.

The cover type is mainly dense impenetrable brush 2 to 15 feet high. This brush area is in a zone with one of the highest rates of fire occurrence in the Angeles Forest. It is also considered the most valuable watershed in areas in Southern California that have damage appraisal figures ranging up to $1,300 per acre.

With this in mind the purpose of the plan became first, to provide an inventory of all known possible control lines now in existence and such items as water sources, camp sites, helicopter landing sites, and tractor and transport routes of travel and loading areas; second, to catalog all the information on time and materials needed to construct fire control lines and appurtenances on all usable major fire line sites; third, to provide an estimate based upon actual construction work of the manpower and equipment needed to make a successful attack on any large fire occurring within the area.

An attempt has been made to show as much as possible of this data on a multilithed 3-color map, thus eliminating long, written data sheets. In some cases it was necessary to prepare briefly written statements to accompany the map. The detail of this information eliminates the time-consuming scouting job necessary to obtain such data before real fire suppression planning on a large fire can begin. The use of this detailed plan should put the fire suppression job at least 4 hours ahead of a normal planning schedule.

HOW THE PLAN WAS MADE

The information needed to prepare this fire plan was obtained in the following manner.

Crews of three men were organized to survey each ridge or canyon bottom which might be usable as a fire control line. Each party was made up of a man considered an expert in fire control, a tractor-trailbuilder operator with fire experience, and a key fire guard. Selection of proposed control lines was based upon a knowledge of the country, use of aerial photos,

and helicopter reconnaissance flights by the local fire control officer. survey was started in the winter of 1949-50. Three parties were in field for a period of 4 months collecting information on 255 miles of posed fire lines.

Each party was instructed to walk every foot of each proposed line obtain the information called for in the following outline.

INSTRUCTIONS FOR PREPARATION OF FIELD NOTES— FIRE PLAN STUDY

1. *Location of fire lane:* Describe location of ridge to be used for fire lane. location into key road, ranch, or some other landmark and note the direction r lays. Key numbers, such as A-1 to A-2, will be assigned when data is placed base map.

2. *If line to be surveyed is an existing break, describe condition:* Describe dition of present cover, that is, grass, light regrowth, etc. If the break is b maintained show the organization doing the work and method used. If this b can be worked entirely by tractor, and is not presently being maintained by ano organization, would there be any distinct advantage in yearly maintenance by Forest Service?

3. *Total length:* Enter the total length of fire lane as determined by act measurement on the ground. Also enter the length of those parts of the line t will be worked by hand crews and by tractors.

4. *Maximum grade:* Determine the maximum grade encountered on the lane. Also enter the maximum grade on parts of the lane that are to be worl by hand crews and by tractors.

5. *Average grade:* Determine average grade by taking not less than four Ab level shots for each mile. The number of readings taken to determine average gra will depend a great deal on the topography being considered.

6. *Minimum width:* Determine the minimum width required for both ha line and tractor line. The following guide lines are for handling construction: Gra 2 feet; grass with scattered sage, 2 feet; light to medium chamise, 2½ feet; bru mixture with sage, 4 feet; medium brush and oak, 5 feet; heavy manzanita, chami or buckbrush, 5 feet; heavy mixed brush, 6 feet.

7. *Time to complete hand line:* Determine man-hours time to construct requir hand line.

8. *Time to complete tractor line:* Determine time needed to complete requir tractor line. In many cases the time for two tractors to complete required line shou be less than half of time for one tractor because of reduced travel time.

9. *Tractor "X" spots:* Describe in detail the bad spots encountered. Give natu of obstruction. Show time required to build around "X" spots. ("X" spots a obstacles that the tractor must work around.)

10. *Transport travel:* Describe in detail the route of travel, from Arcadia, t tractor loading location. Give names of streets, direction of travel, and mileage wher possible.

11. *Tractor loading location:* Describe location, size, turn-around area fo transports, etc.

12. *Helicopter site:* Describe location of proposed or existing helicopter landing site. Estimate time in man-days or tractor work time needed to brush, level, and improve each site. (These sites are called helispots or heliports.)

13. *Escape ways:* Describe locations of trails, adjoining breaks, and other avenues of escape and safety zones that might be used by fire crews working this fire line.

14. *Water sources:* List all water sources on or near lane being considered. If a tank or reservoir, show number of gallons, ownership, including names of owner in case of private tanks, whose lock, and size and type of thread on outlet. For hydrants show size and type thread. On yearlong ditches and streams show best drafting location. Describe all locations by landmarks, etc.

15. *Fire camp sites:* Describe location of nearest fire camp site, water facilities, telephone facilities, including ownership of nearest phone line. Also make a radio test with Arcadia.

16. *Private land:* If the lane crosses private land try to get the name and address of landowner to assist in obtaining rights-of-way.

17. *Remarks:* Recommendations for preconstruction of any parts of tractor or hand line for this fire lane should be placed here with supporting reasons for recommendation. Also place here anything of additional importance to fire control that

you have observed while making the survey of this ridge. Don't be afraid of putting down too much, for every detail may help the fire boss plan his attack at some future date. BE COMPLETE—BE ACCURATE.

The entire area was broken into seven topographic blocks and each block assigned a letter of the alphabet. As each line within the respective block was surveyed its termini were assigned a number prefixed by the block letter, such as A-1, C-12, etc. Each helispot, water source, "X" spot, escape way, etc., was also designated by identifying numbers. These numbers are shown on the map and were later marked on the ground by a metal sign. This identification system enables the plan user to refer quickly from map to written data and it also assures those persons in the field of a positive ground identification system.

All estimates made of manpower needs, tractor and hand line construction time, and necessary widths of control lines were based upon Region 5 Fire Control Notebook data. In every case estimates were slightly pessimistic.

Field data was recorded on mimeographed field note sheets at the time of survey. The proposed fire line and other information was also noted on U.S.G.S. topographic maps enlarged to a scale of 10 inches to the mile for field use.

From this field data it was found that most of the lines workable with tractors were plagued with "X" spots. These "X" spots consisted of such obstacles as rock outcrops, slopes over 65 percent, soil types that do not afford good tractor footing, and man-made hindrances in the form of high tension power line towers, etc. Wherever such an "X" spot existed it was planned at the time of the survey to build a pioneer road or catway around these spots (fig. 1). This work ranged in time of construction from 30 minutes to 2 days per "X" spot.

F-463454

FIGURE 1.—Tractor-trailbuilder constructing catway around an "X" spot in steep, brush-covered area.

In order to make the plan more workable, it was necessary that tl time-consuming construction jobs be eliminated in advance of a poss fire.

Therefore, all such "X" spots were remapped on a work map and a p prepared for their elimination. One D-7 tractor-trailbuilder was assig to this work during the summer of 1950. All "X" spots were elimina except those requiring less than 30 minutes to construct. En route to th "X" spots along ridge tops the tractor built a 9-foot fire lane (fig. 2). Th

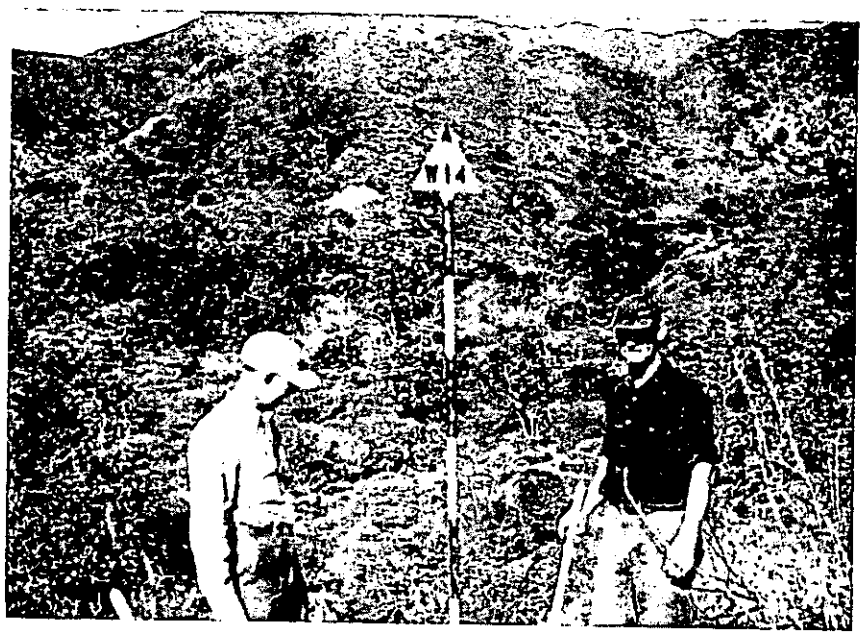
FIGURE 2.—Fire lane constructed through heavy brush. F-46345

fire lanes are usable fire control lines where the cover is not too tall. In cover more than 2 feet high these lanes provide a ready line for tractors to work from if widening is required. They also provide ways through impenetrable brush fields or into the area for men and tractors, plus tractor-drawn flame throwers and pumpers.

After 10 years these lanes will become overgrown if not maintained. However the information on time of construction and possibilities of tractor use will remain the same indefinitely.

While constructing fire lanes and eliminating "X" spots the tractor also constructed all helispots in the vicinity. This construction program required more than 3 months working time.

After all tractor work was completed a crew of two men posted the identifying signs. These signs were made of metal and consist of a 12-inch equilateral triangle riveted to a 1½-inch iron pipe set in 24 inches of soil cement (fig. 3). The triangle is painted orange and the post black and orange. These colors were found to be the most visible in brush areas. These markers or signs eliminate the possibility of fire crews taking the wrong ridge on a proposed line, and they make night identification of ridges positive for line construction crews. Air reconnaissance men can also see the markers from the helicopters.



F-463456

FIGURE 3.—Type of marker to identify key points in plan.

The sign crew also constructed helispots on those ridges where tractor work was impossible. Hand-constructed helispots range in size from 15 feet in diameter (brush clearing) to 25 feet. This size helispot will easily accommodate a Bell or Hiller helicopter. Where a tractor was used to construct a helispot the size averages 60 by 60 feet (fig. 4). These larger helispots will accommodate a Sikorsky or Piasecki helicopter, which it is hoped will be available in the near future for transporting 8 to 10 men at a time to the fire line. These larger helispots can also be used as safety zones for crews during possible blow-up fire conditions.

FIGURE 4.—Helispot constructed by tractor. F-46345

After the field survey was completed it was checked by the local fire control men for possible omissions or errors in judgment.

The field notes were then condensed and as much information as possible was transferred to the field map which was then reduced to a scale of 2½ inches to the mile and multilithed (fig. 5). The multilithed map was then broken down into sheets 8 by 10½ inches and placed with the descriptive data in a loose-leaf binder.

USING THE PLAN

When a fire occurs in the area covered by this plan the following action is taken:

1. Prompt initial attack by men and tankers using direct methods is made while the fire is small.

2. If initial attack forces fail to control the fire while it is small (possible failure of a direct attack is usually determined within 30 minutes after fire is first hit), the fire boss then utilizes the intensive pre-plan data in his copy of the fire plan. On the basis of this data he lays his plan of attack. This information eliminates the need of extensive air and ground scouting *before* over-all plans can be made. In other words, the fire boss has at hand the information needed to make a comprehensive attack plan *now*, not 3 or 4 hours after the fire is known to be a potential large fire, as is the case when ground and air scouting is required.

3. The fire dispatcher, when notified of a fire within the fire plan area, refers to his copy for information on fire needs. If the area is workable by tractor, a tractor transport is dispatched at once to the nearest

tractor unloading spot via a predetermined route of travel. Helicopters are also dispatched to nearest heliports, etc.

Annual revision and maintenance of this plan will be required because of the intensive use of the area. New roads, power lines, and residences will add to or eliminate certain parts of the plan. Each year changes in the plan will be noted by the district ranger and his field men. This information will be turned over to the forest supervisor who will assign personnel to the winter job of keeping the plan up to date.

USE OF PRE-PLANNING ON A SIMULATED FIRE

A fire starting in Schoolhouse Canyon near point A-23 (fig. 5, bottom center) has spread beyond possible control by the initial attack forces. Weather conditions are average bad and the rate of spread upslope in a northwesterly direction is 60 chains per hour. The time is 3:30 p. m. and a wind change from southeast to northeast at 10:00 p. m. is predicted. Rate of spread will decrease to approximately 10 chains per hour after a rise in humidity which was forecast for 6:00 p. m. With this information and the pre-planning data the fire boss is now ready to prepare a comprehensive fire suppression plan for the Schoolhouse Canyon Fire.

He first predicts the rate of spread by 2-hour burning periods. According to his calculations the fire will reach helispot AH-14 on the ridge in about 2½ hours.

Referring to his map (fig. 5) he decides to make a stand on ridges A-17 to A-16; A-16 to A-20; and A-20 to A-26. These ridges were picked as they are the nearest preconstructed fire lanes and he stands a chance to backfire from them.

A fire camp is selected at AFC-6, and the tractor transports are ordered into AT-6 and AT-4, which is not shown on map but is 1 mile west of point AW-5.

A helicopter, which is an initial attack tool on this forest, arrived along with the first crews some 30 minutes before this plan was made.

Using the helicopter to transport some of the initial attack men to helispot AH-16, which is the highest point on the ridge, the fire boss prepares to backfire. Other helicopters are ordered to transport more fire fighters to the fire line.

Initial-attack, 4-wheel drive, 300-gallon tank trucks are dispatched up road to points A-20 and A-25 to aid in holding line to be backfired.

Referring to the fire line data the fire boss determines the following:

A-16 to A-17: Orders 2 tractors to widen fire lane to 40 feet and 40 men to build hand line and hold backfire. (See sample Fire Line Data.)

A-16 to A-20: Orders 2 tractors to widen old firebreak and 60 men to hold backfire.

A-20 to A-26: Orders 2 tractors to complete widening job from A-20 to A-25. Orders 60 men to handle backfire along this line. (A-25 to A-26 is firebreak 40 feet wide and no further work is needed.) Men on upper part of fire line are to be fed and supplied by fire camp located at AFC-5.

Tractors to be provided with fuel and fresh operators by helicopters using those helispots along the line. Some hand crew men are spotted along the line by helicopter to save long walking distances and time.

Fearing a possible blow-up during the next day if northeast winds should continue, the fire boss redistributed his tractors after all lines are widened. Two tractors are sent to A-28 to widen line from that point to A-29 as a safety line.

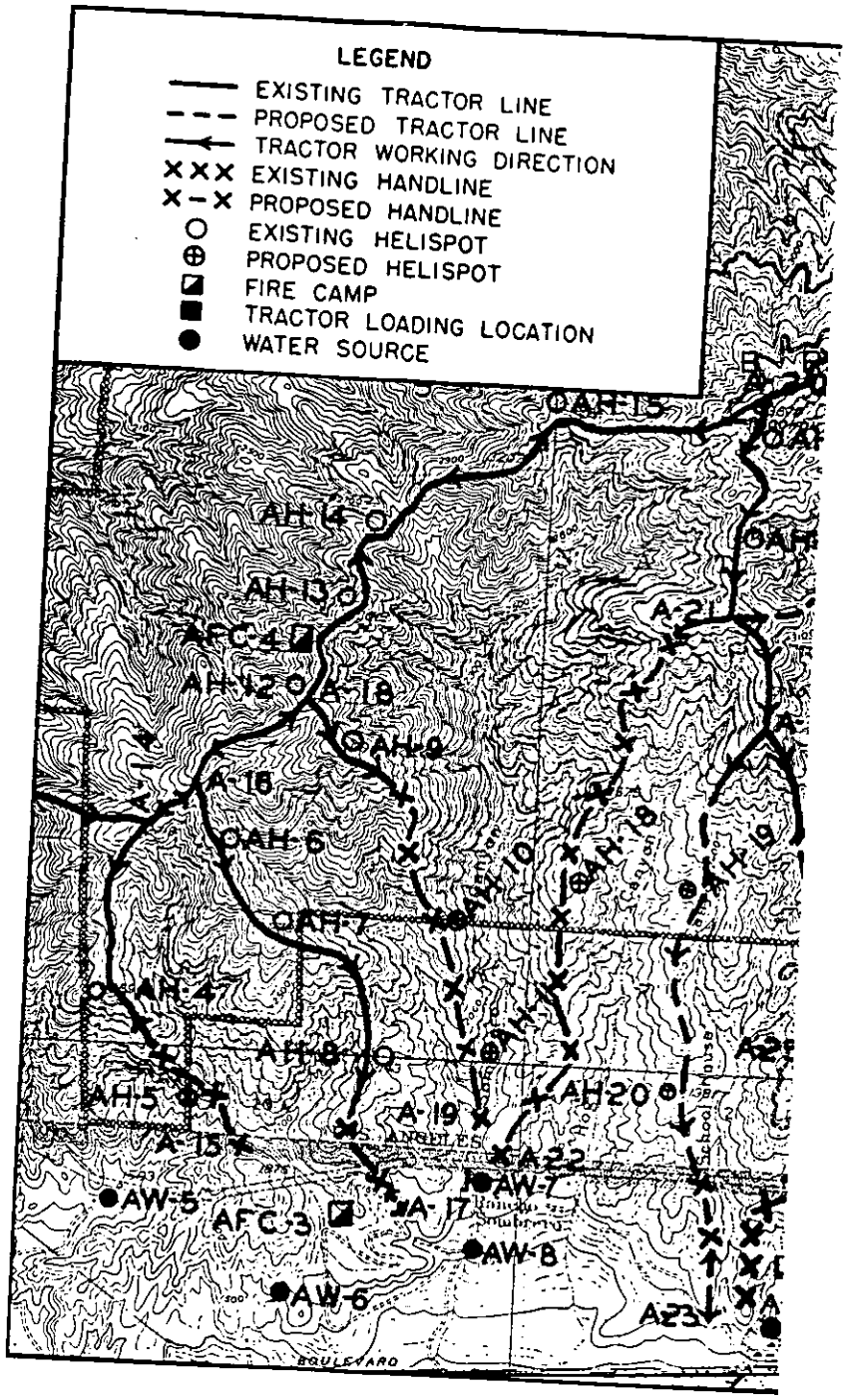


FIGURE 5.—Part of area covered by intensive plan; scale: 2¼ inches equal 1 mile.

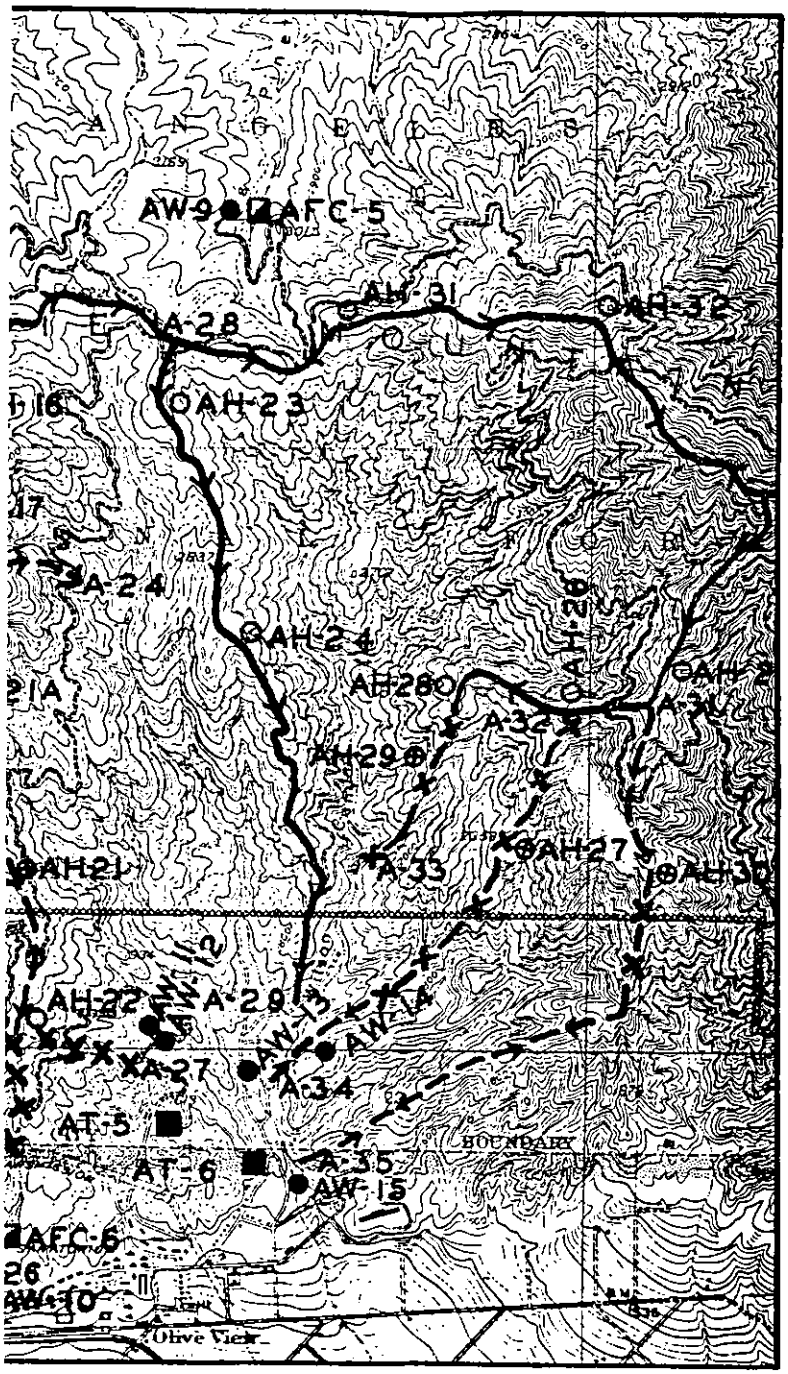


Figure 5 continued.

SAMPLE DATA

The following are examples of the line, fire camp, and transportati data that accompany the maps.

FIRE LINE DATA

East ½ of Block A

A-14 to A-15 *HAND LINE:* 33 ch., 96%, med. brush; steep knife ridge, 15- line required, 160 man-hrs. *TRACTOR LINE:* 33 ch., 37%, heavy bru 40-ft. line required, 1 cat 6 hrs., 2 cats 3 hrs. *TRAVEL:* Tractor from AT via Grapevine T.T., A-13, A-12 to A-14, 1¼ hrs. *HELISPOTS:* AH-4, ¼ l tractor, 4 man-hrs.; AH-5, 2 man-hrs. *WATER:* AW-4, 3,000 gal. Circle Ranch draft; AW-5, 5,000 gal. Symonds Reservoir draft. *FIRE CAMP:* AFC-

FIRE CAMP DATA

East ½ of Block A—AFC-2 to AFC-6

AFC-6 Located at Olive View Park. From Foothill Blvd. at east end of Oliv View Sanatorium, turn north on Colbalt Ave. to Olive View Ave. Turn rig (east) on Olive View Ave. to Sycamore Ave. Turn left (north) on Sycamo Ave. to AFC-6 at Olive View Park. Water from Olive View water syste available at campsite. Telephone available at Olive View on Calif. Water Tel. Line. Radio communications with A-50 at Newhall R. S.

TRACTOR LOADING AND ROUTE OF TRAVEL

Block A

AT-6 Transport tractor via Foothill Blvd. to east end of Olive Sanatorium. Tur right (north) on Colbalt Ave. to Olive View Ave. Turn right (east) on Oliv View Ave. to Sycamore Ave. Turn left (north) on Sycamore Ave. to AT- at Olive View Park near gate on the Armstrong Ranch. 1½ hours transpor travel from Arcadia.

CONCLUSION

This type of intensive fire suppression plan is not a luxury for an area in which flash fuels and high values make fast, well-planned action imperative. Minuteness of detail eliminates the time-consuming scout work which is needed on a going fire to prepare a successful fire suppression plan of action. Because this data was collected by experienced fire men not under the pressure of fire conditions it also eliminates the possibility of unusable information reaching the fire boss.

INFORMATION FOR CONTRIBUTORS

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

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

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

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

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

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