# FIRE CONTROL NOTES

SPRING 1971 • VOL. 32, NO. 2
U.S. DEPARTMENT OF AGRICULTURE • FOREST SERVICE

# FIRE CONTROL NOTES

*An international quarterly periodical devoted to forest fire control*

## CONTENTS

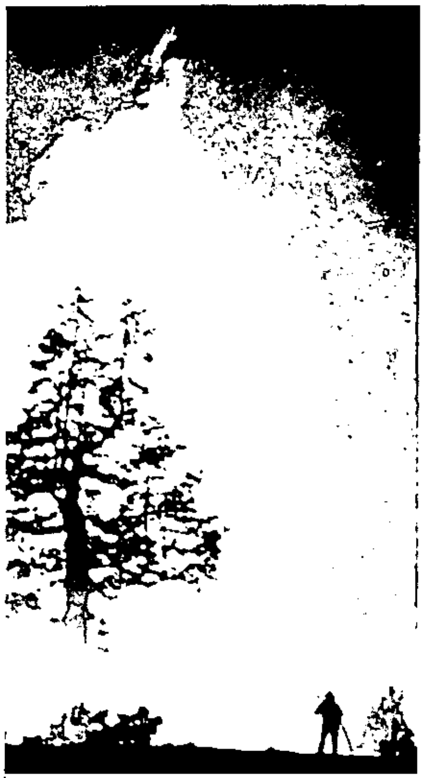


COVER.—The heroism of dedicated men who risked their lives last summer to fight a forest fire in the state of Washington was spotlighted in "Wildfire!," a "GE Monogram Series" on NBC-TV. The MGM documentary graphically depicted the story of 8,550 firefighters who battled one of the worst fire disasters in the history of the Pacific Northwest. GE plans to air "Wildfire!" again on a national network later this year. (Sketch, courtesy MGM Television, doesn't depict FS safety practices.)

(NOTE—The use of trade, firm, or corporation names in this publication is for the information and convenience of the reader. Such does not constitute an official endorsement or approval of any product or service by the U.S. Department of Agriculture to the exclusion of other which may be suitable.)

FIRE CONTROL NOTES is issued by the Forest Service of the United States Department of Agriculture, Washington, D.C. The matter contained herein is published by the direction of the Secretary of Agriculture as administrative information required for the proper transaction of the public business. Use of funds for printing this publication approved by the Director of the Bureau of the Budget (Aug. 19, 1968).

Copies may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402, 20 cents a copy, or by subscription at the rate of 75 cents per year, domestic, or $1.00, foreign. Postage stamps will not be accepted in payment.



# WILDFIRE!

*This story is taken from MGM Television publicity releases about the program Wildfire!, shown on NBC-TV February 5, 1971.*

MGM documentary producer-director Jeff Myrow had been keeping a crack film crew at the ready mark for months, waiting for the Forest Service to alert him when a big blaze appeared in the making. The call finally came on August 24, 1970, from the Portland, Ore., regional office.

Myrow's original plan for "Wildfire!" had been to: "document a single forest fire as thoroughly as we could. Our purpose was to go in depth on individuals —the fire boss, the line boss, and some of the inter-regional fire fighting crews, the men that spend all summer fighting major forest fires."

That was before anyone knew that Myrow's "single" fire would multiply into three major holocausts. Myrow changed his plans:

"The story that we are going to do has gotten larger than a single base camp or a single fire boss," he noted at the time. "This fire has grown so large and become of such historical precedent in terms of size, acreage, numbers of men involved, and money being spent, that we are now keying on the major events each day wherever they take place [see figure]. The story that is happening here is monumental, and we feel an obligation to cover it in its fullest form. . . ."

### 8,550 FIREFIGHTERS

These firefighters were part of the continuing war against forest fires into the middle of which the MGM documentary film crew fell.

Like the firefighters, they slept little and moved fast. They carried their 30- to 50-pound gear up mountainsides, squeezed it into the helicopters carrying firefighters to the lines, and balanced it on the back of four-wheel-drive vehicles bumping down dusty, smoke-covered trails.

They fastened their cameras to the wings and undersides of B-2's, B-17's and other planes "bombing" with chemical fire retardents, and followed every move and action of fire bosses, line bosses, and individual firefighters.

Before the end of their assignment, the 27 cameramen, soundmen, and assistant cameramen had recorded on some 80,000 feet of film an inferno that cost $13 million to suppress and destroyed approximately 12 million trees on 118,000 acres—enough board feet of lumber to build 10,000 homes △

Figure.—MGM producer Jeff Myrow (far right) observes a group of professional firefighters plot strategy during last summer's devastating forest fires.

# Background, Philosophy, Implementation— National Fire Danger Rating System

John E. Deeming
and
James W. Lancaster[1]

*After introduction of a partially-developed National Fire Danger Rating System (NFDR) in 1964 and subsequent analyses, the present research work unit was established at Fort Collins, Colo. in March 1968.*

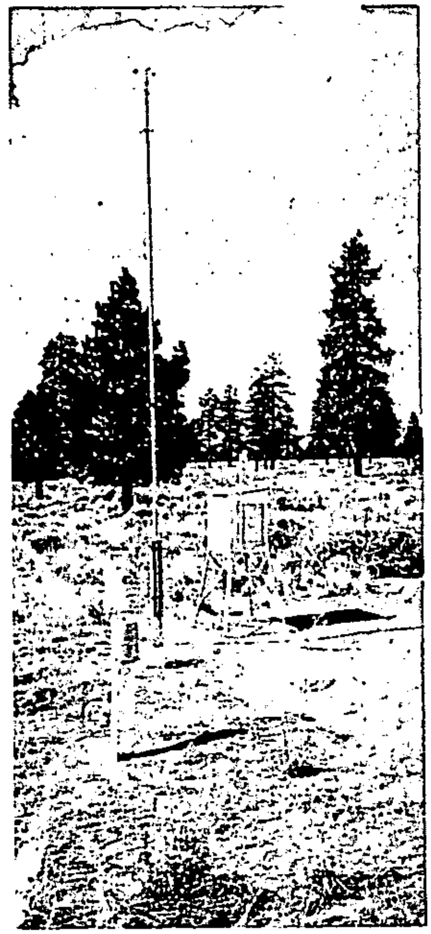
*Full development of the NFDR System could proceed only after a thorough review of the work done as of 1968 and the subsequent establishment of guidelines for the future. These guidelines are now the philosophy of the NFDR. They are presented here, together with an up-to-date status report of the NFDR System which features three indexes for planning (occurrence, burning, and fire load indexes) and three components which rate the basic aspects of fire behavior (ignition, rate of spread, and energy release).*

## NFDR HISTORY

The need for wildfire danger rating on a national basis was recognized as early as 1940 at a fire control conference called by the Forest Service at Ogden, Utah. A committee report made two recommendations: (1) a relative fire danger rating system should be developed incorporating the factors that govern fuel moisture, and (2) the system developed should be applicable nationally.

It was not until 1958 that a joint committee composed of fire research and fire control personnel of the Forest Service started a danger rating development program. In June, 1958, the Washington Office, Division of Fire Research, organized the project, and a year later, full-time work was begun.

By 1961 the basic structure for a four-phase rating system had been outlined, and the first phase was ready for field testing. This was the *spread phase*, with which most readers are probably familiar. It provided two indexes which predicted the relative forward spread of a fire—one for fires burning in a relatively closed environment in timber and the other for fires in the open in fine fuels. A third index, the buildup index, which was incorporated in the spread computations, was a number related to the cumulative drying of the 10-day timelag fuels.[2] The spread phase was field tested in 1962 and 1963. In 1964 the *National Fire Danger Rating System Handbook*, FSH 5109.11, was issued for field use.



***Weather stations like this provide all the information for fire danger ratings.***

***Make accurate weather and fuels observations . . . accurate ratings depend on you!***

Since the remaining phases, ignition, risk, and fuel energy, were not developed, a number of fire control organizations preferred to remain with the rating system being used.

There were at least eight rating systems in use across the country at that time. Early operational use of the spread phase resulted in local modifications, making it obvious that even that phase system was not uniformly applicable. By 1965, however, most fire control organizations in the United States were using

[1] The authors are associate forester and principal forester, respectively, at the Rocky Mountain Forest and Range Exp. Sta., USDA Forest Service, Fort Collins, Colo., maintained in cooperation with Colorado State Univ.

[2] In this instance, the timelag period was related to a cyclic environment in which the *average* equilibrium moisture content was about twice that attained under constant laboratory conditions of 80° F. and 20-percent relative humidity.

the spread phase modified to some degree.

In 1965 a research project headquartered at Seattle was established to provide a fresh look at the needs and requirements for a national system. The Seattle project canvassed most of the fire control agencies across the country, analyzed the requirements, and recommended the development of a National Fire Danger Rating System.

In March, 1968, the present National Fire Danger Rating Research Work Unit was established at Fort Collins. The objective was to have a comprehensive system ready for field trials by the summer of 1970. Because of the wholehearted cooperation of many fire scientists and others in the field, this goal was met. More extensive field trials during 1971 will help to check out and introduce the system. By 1972, the target date, it will be ready for adoption on an operational basis.

## FIRE DANGER RATING PHILOSOPHY

Several major decisions regarding objectives and the direction which the Fort Collins Work Unit would take had to be made before a "philosophy" of fire danger rating could be developed:

1. A target date had to be established for getting a completed system ready for operational field use. It was the consensus of numerous fire researchers that a fire danger rating system superior to any in use at that time could be developed from available "state of the art" information.

2. The basic structure of the system would be designed so that new knowledge, such as better prediction equations and improved fuel inputs, could be incorporated readily. Such refinements would take the form of updated computer programs or new tables supplied to the users; the basic format and definitions would remain unchanged.

3. The system would not be introduced piecemeal but would be offered as a complete, comprehensive package.

4. The complete system would include a subjective evaluation of risk. The development of an objective method would be deferred until the more pressing problems, such as fuel moisture relationships, had been solved sufficiently to meet the needs of the system.

5. Ultimately, the system would be purely analytical, based on the physics of moisture exchange, heat transfer, etc. Some experimentation would be necessary to establish basic relationships, but the system would not be empirically or statistically based.

With the above decisions providing a basic framework within which the project would function, questions had to be answered such as: What size of fire should we deal with? What aspects of the control job should be rated?

After answering these questions, and others the following concepts were adopted as the underlying philosophy of the NFDR System:

1. The system would consider only the "initiating fire," a fire which is usually containable by available initial attack forces (not one which is erratic, with crowning or spotting).

2. The system would provide a measure of the potential job of containment, which in turn would be considered as being linearly related to the length of flames at the fire front. The concept of containment as opposed to extinguishment was basic, since it allowed the research scientists to consider only those fuels which contribute significant amounts of energy during combustion in the immediate flaming front of the fire.

3. The system would evaluate the "average bad" condition by a) measuring danger in the open, b) rating the day with early afternoon measurements, and c) selecting southern or western exposures for measurements. In other words, extrapolating fire danger values for local conditions would usually involve scaling the rating values down, not up.

4. The system would provide ratings which would be physically interpretable in terms of fire occurrence and behavior. Because these components could then be used alone or in combinations, the system would have the flexibility needed to deal with the entire spectrum of fire control planning and dispatch problems.

5. Ratings would be relative, not absolute. This means that the doubling of an index or component would indicate a potential doubling of the rated activity relative to what had previously been observed. Because of the many variables in the computation and our inexact understanding of the interrelationships, we still cannot predict exactly what will happen in a given situation.

## FUEL CONSIDERATIONS

Project scientists have classified the dead fuels into 1-, 10-, and 100-hour timelag classes [3]

[3] Lancaster, James W. 1970. Timelag useful in fire danger rating. USDA Forest Serv., Fire Control Notes 31(3): 6-8, 10 p., illus.

according to how fast the moisture content of the individual fuel particle responds to precipitation and changes in relative humidity. Two classes of living fuels are also considered: grasses and other herbaceous plants, and foliage and twigs of woody plants. One-quarter inch was set as the upper size limit of living plant material which can be dessicated, killed, and consumed in the flaming front of the initiating fire.

In the past, fire danger rating systems considered the variability of fuels only to a very limited extent. The 1964 spread phase recognized only open and timbered types; the California Wildland System recognizes three: timber, brush, and grass. The NFDR System, through the fuel model concept, treats the fuel phase of the fire environment to a degree of exactness never before possible.

## HYPOTHETICAL MODEL

The fuel model is a hypothetical fuel complex representing one or more cover types which have similar fuel properties. As of this writing, eight general models which represent cover types ranging from the tundra of Alaska to the pocosins of North Carolina have been constructed. Fuel models will make it possible to tailor our system to local fuel situations. In this way, danger rating values will be consistent with fire behavior, regardless of differences in fuels.

A mathematical expression for computing the forward rate of spread of a fire was developed at the Northern Forest Fire Laboratory. It is the basis for application of the fuel model concept. The mathematical model considers such fuel bed properties as (1) bulk density, depth, and composition by classes of living and dead fuel particles;

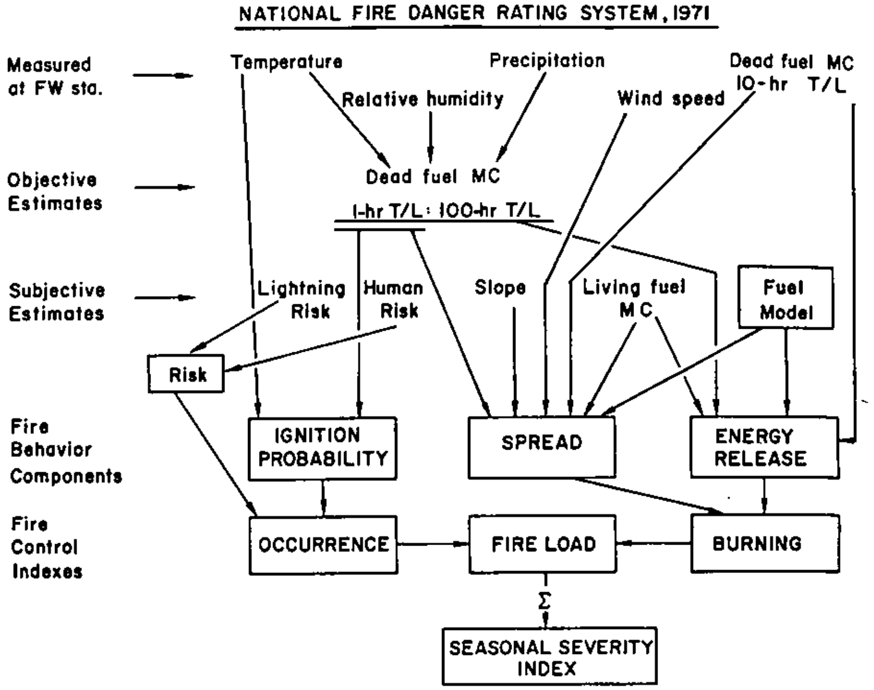



Figure 1.—Structure diagram of the National Fire Danger Rating System for the 1971 field trials.

and (2) fuel particle properties such as density, heat content, moisture content, geometry, and chemistry. With the exception of fuel moisture contents, average values for these fuel descriptors are assigned for cover types included in the fuel model. The moisture contents of the dead fuel components which are governed by local weather conditions are determined objectively by table lookup, computation, or by weighing fuel moisture sticks. The moisture contents of the living components are determined subjectively.

In the construction of fuel models, the NFDR group is working very closely with the fuel scientists who are participating in the Forest Service Fire Planning Task Force, so that the end products will fit together in a coordinated planning system. Terminology and definitions will be consistent.

## STRUCTURE OF THE NFDR SYSTEM

The basic structure of the system (figure) yields three indexes designed for use in fire control planning.[4] Each has a scale of 0 to 100. They are defined as follows:

*Occurrence Index*–a number related to the potential fire incidence on a rating area. This index includes a risk factor which expresses the degree to which an area will be exposed to ignition sources. This index also contains the Ignition Probability Component, which defines the likelihood that fuels will ignite in the presence of an ignition source.

*Burning Index*–a number related to the potential total amount of effort needed to contain an average initiating fire on a rating area. The Spread and Energy Release Components make up the Burning Index. Indications of

[4] The NFDR System deals with fire occurrence, reflected in the O.I., and fire behavior, reflected in the B.I. and F.L.I. Nowhere does it reflect physical factors or production rates of crews and machinery.

how fast a fire is likely to spread and how intense it is likely to burn, when considered together, will give a relative measure of the potential difficulty of the containment job.

*Fire Load Index*–a number related to the potential total amount of effort required to contain all probable fires on a rating for a day. The difficulty of containing a single fire (Burning Index), multiplied by the probable number of fires (Occurrence Index), gives a measure of the potential fire containment job on the area for the day; this is the Fire Load Index.

In addition, the Seasonal Severity Index may be computed by summing the Fire Load Indexes recorded during a given period (see flow chart). The Seasonal Severity Index is useful as an administrative tool to estimate the potential fire control job in an area during a fire season or some other specified period.

The indexes should be particularly useful in daily preparadness planning. For dispatch and as an aid to prescribing action for the individual fire, three components incorporated in the indexes may be used separately because they are indicative of fire behavior: The Ignition Probability Component is an indicator of the potential for short-distance spotting; the Spread Component indicates the forward rate of spread of the head-fire; and the Energy Release Component, a measure of the intensity of the fire front, indicates how hot it will burn and how close it can be worked.

### SYSTEM READY FOR TRIALS

We have now made near-final changes in the system, and it is ready for the 1971 field trials. Tables have been redesigned, and operational instructions have been expanded. We will go into the field in 1971 with eight fuel models. Guidelines for helping field personnel select the proper fuel models for their areas have been written.

We are also working toward an objective system for selecting and delineating fire danger rating areas. For our purpose, a fire danger rating area is defined as a geographic unit where fuel and weather conditions produce reasonably uniform fire danger throughout. Because data from such areas will give a more accurate picture of fire conditions, we will realize a higher return for each dollar spent for fire danger rating.

An intimately related problem is a familiar one: How many fire danger stations are needed, how many can the user afford, and where should they be located to provide the best picture of fire danger. The idea that the most conveniently located station is the most desirable has always been detrimental to an accurate evaluation of fire danger.

We have only started on the evaluation of Risk, a major component of the Occurrence Index. Difficult as they are, the problems involved in the evalution of Lightning Risk appear readily solvable when compared to those posed in the determination of Man-caused Risk. Guidelines for subjectively determining risk inputs to the system will be available for the 1971 season. The far more desirable objective system, however, may not be completed for several years.

### Fuel-moisture ANALOG

Much more promising is progress made in the development of an analog — an artificial fuel moisture stick — made of durable, inorganic, nondegradable materials for direct measurement of fuel moisture values. Tests have been run at the Northern Forest Fire Laboratory on several prototypes. A system which will eliminate weighing, and will instead electronically measure fuel temperature and the 1-, 10-, and 100-hour timelag fuel moistures, appears feasible. Electronic measurement is particularly desirable since it will make the analog adaptable to automatic weather observation systems with radio or land line telemetry. Another advantage is that analogs can accurately and easily evaluate all of the fuel moisture values which are now approximated through use of equations or tables constructed from these equations. The development and adoption of such a device would greatly simplify the work necessary to apply the NFDR System.

### CURRENT KNOWLEDGE LIMITED

Current knowledge of moisture responses in litter and duff fuels is limited. We are temporarily assuming that litter and duff moisture relationships are similar to those for branch and other roundwood, with full knowledge that this is not entirely correct. We are now co-

*NFPA Reports:*

## Deaths Due to Fire Increase in 1970

**Fire** killed approximately 12,200 people in the United States during 1970, according to preliminary estimates by the National Fire Protection Association (NFPA) Fire Record Department. This is an increase of 100 over the previous year, and

see *FIRE 1970, p. 14.*

operating with scientists at the Southern Forest Fire Laboratory to determine these relationships. During the 1971 field trials the scheme for evaluating fuel moisture in the 100-hour timelag class will be based upon work completed for roundwood fuels only. This work demonstrated that, for roundwood, the duration of rainfall, rather than amount, governs moisture gains. Fire control men have long recognized this relationship, but it has not previously been subjected to detailed analysis.

The effectiveness of the new system is already being checked. The Fire Control Methods Project of the North Central Forest Experiment Station has accepted responsibility for this phase of the development. They will check the performance of the system against the records of more than 10,000 fires which occurred in Michigan, Minnesota, Wisconsin, Missouri, and Pennsylvania during the past 10 years. The evaluation will compare the performance of the new NFDR System against that of the 1964 version as a predictor of various measures of fire activity such as numbers of fires per day, man hours to control, final fire size, etc. The sensitivity of the various components and indexes to observed changes in the levels of fire activity from day to day will also be evaluated. △

## INFORMATION FOR CONTRIBUTORS

Please submit contributions through appropriate channels to Director, Division of Fire Control, Forest Service, U.S. Department of Agriculture, Washington, D.C. 20250. Articles should be typed in duplicate and double spaced, 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 organization.

Authors are encouraged to include illustrations with their copy. Illustrations, whether drawings or photographs, should have clear detail and tell a story. Only glossy prints or India ink line drawings are acceptable. Captions for illustrations should be typed in the manuscript immediately following the paragraph in which the illustration is first mentioned, the caption 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 page proportions in mind and letered to permit reduction. In mailing, illustrations should be placed between cardboards held together with rubber bands; don't use paper clips.

Any length article, up to 3,000 words, is welcome. Use any available edittrial assistance; have a friend read your article. We will provide rewrite assistance and final review.

What do we want? Articles about communications, equipment and supplies, chemicals, fuel modification, prevention, suppression, training, and weather △

## Truing A Grindstone

*H. A. Janning*[1]

**If your grindstones received** considerable use both during and after this past forest fire season, than the following method of truing them may be of value to you.

Temporarily affix a piece of 1-x-2-in. or similar slat across the frame of the grindstone as close to the face of the stone as possible without touching it. Fill the reservoir with water and allow the stone to turn for at least half an hour. The longer the stone turns in water the softer it becomes and the easier the truing operation will be.

Obtain a 3-ft. length of thin-walled steel pipe of approximately 1 to 2 in. in diameter and ensure that the end is cut square to its length. Vehicle exhaust pipe will do the job well.

Hold the pipe firmly on the slat with the square end towards the stone. Start at one edge of the stone and slowly revolve the pipe end across the face of the turning stone in a manner similar to using a lathe. At first the high portions of the stone will be shaved off. Repeat the process until the pipe and stone touch evenly all the way across the face for a full revolution. When this is accomplished the stone is true.

Drain the water from the reservoir and let the stone rotate for another half hour until dry. Remember, when a portion of a stone is allowed to sit in water it will soften and, when used, will wear unevenly. This is the most common cause of "out of round" grindstones. △

[1] Ranger supervisor, Prince George Forest District, British Columbia Forest Service.

# No Smoke Needed

*Robert F. Kruckeberg* [1]

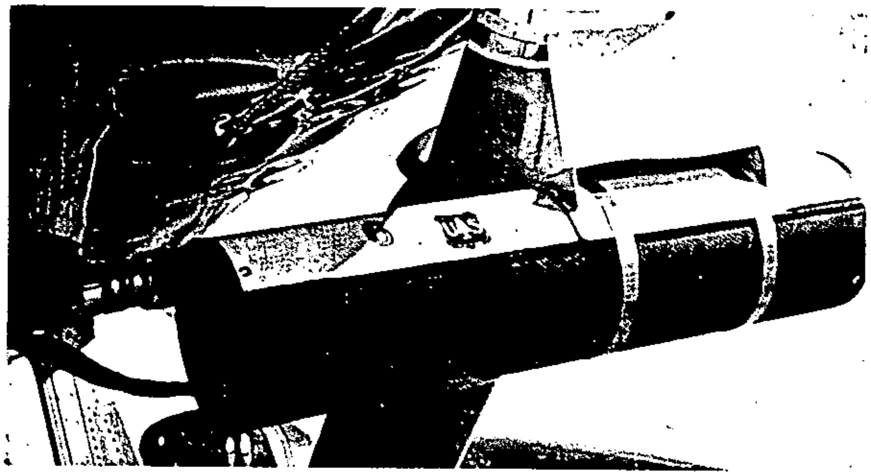
*AT LAST!—a piece of equipment that can "see" fires we can't detect with our eyes.*

*Since most of you haven't seen one of our little "Fire Spotters," you probably are going to relate this statement to something you have read about or seen, such as a hand-held radiometer or one of the more elaborate fire mapper units now on the market. Don't do that—just read on about the simple, inexpensive, lightweight infrared (IR) line scanner that was built to help solve problems you have had for a long time.*

## "WHAT PROBLEMS?" YOU SAY!

You have all spent hours looking for fires that someone reported, either in a specific or general area and then when you got there the smoke was no longer visible and you couldn't find the fire. Maybe a few days or a week later the smoke shows up again and you go out and look but still can't find it. Finally, when conditions are right for burning, the fire takes off and burns a good sized chunk of country before you get it stopped.

Or, you have a big fire going and are worried about spotting out ahead of the fire or outside the fireline that is holding, but heavy smoke prevents you from finding spots until too late.



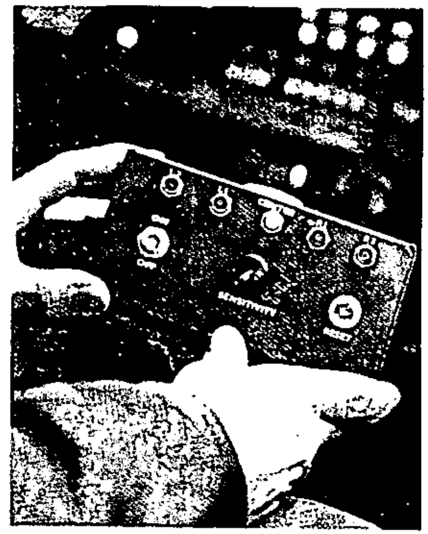


Figure 1.—Above, Spotter mounted on strut of Cessna 185; and below, control box inside aircraft.

Or, the big fire is controlled, but you need to know where to send your mopup crews to do the most good so they won't wander around all day checking areas that are cold while other areas need attention. This is especially true where you have lots of unburned fuel inside the fireline.

These are the old problems—but what really prompted the experts here in Project Fire Scan to get into the "Fire Spotter" business was problem created by the project. Our big, high-flying infrared fire detection system was locating fires so small no one could find them.

### We wanted this . . .

Searching for the device to solve this problem, we set up a list of criteria [2] :

1. The unit had to be able to detect 1-square-foot of hot material from 2,000 feet away. By hot we mean from 1,000° to 1,500°F.

2. It has to be relatively inexpensive—we felt if a unit cost over $2,000 no one would purchase it.

3. It has to be simple so operators could be trained easily.

4. It has to be small enough to mount on a light aircraft or helicopter.

5. It has to be reliable and require little maintenance.

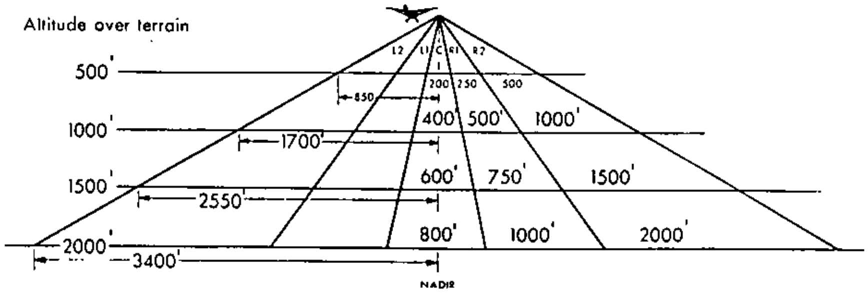
### . . . and we got it

The result was the "Fire Spotter" shown in figures 1*A* and 1*B*—a line scanner complete with revolving mirror, infrared detector, control unit, and necessary electronics.

Here is the way it works:

[1] The author is currently research forester in Project Fire Scan, stationed at the Northern Forest Fire Laboratory, Missoula, Mont. Prior to this assignment he was fire staff officer on the Shoshone National Forest.

[2] If you are interested in more details on this equipment, its design, construction and theory, write for Forrest H. Madden's Research Note, "The Airborne Infrared Fire Spotter" (in preparation for publication), Intermountain Forest and Range Experiment Station, Ogden, Utah 84401.




Total area scanned 120°.
Each light represents 24° scan angle.
Spotter must be horizontal for distances shown to be accurate.

Figure 2.—Area scanned by spotter.

The revolving mirror scans the ground below the aircraft. The five lights on the control box each represent 24° of a 120° scan angle directly below the aircraft (fig. 2). If the R2 light goes on, and you are flying 2,000 feet over the ground, you know you have a hot target to your right, somewhere between ¼ and ½ mile away. At 500 feet over the terrain, that same light indicates that a target is only 350 to 850 feet off to your right.

We built 10 of the units last winter, and put them out for testing under actual field conditions this summer. Results show that we have a tool that works—one that will go a long way toward helping solve the problems mentioned. There may be other uses we haven't discovered yet.

Barnes Engineering Company of Stamford, Conn., is now marketing a unit similar to the ones we built. They have used our experience to produce a scanner that meets the criteria we set up, eliminating some of the maintenance problems but not the reflection and electrical interference problems. These units have been tested in the field, but delivery was too late to provide conclusive data this year. However, results look very good.

## SOME OF ITS USES

We found intermittent smokes that weren't readily visible until pinpointed with the spotter. One logbook entry was typical:

> Lightning strike reported by lookout as smoke seen. Smokechasers did not find the fire. Spotter picked it up after second pass. Then we could see real thin smoke against the sun. Smokechasers put fire out.

We found fires that had no visible smoke at all, but these were usually ones that we already had a good location on. This was not always the case, as indicated by this logbook entry: "Bonneville Power R.O.W. clearing. No visible smoke. Ground crew located dozer pile with coals approximately 1 gallon in size."

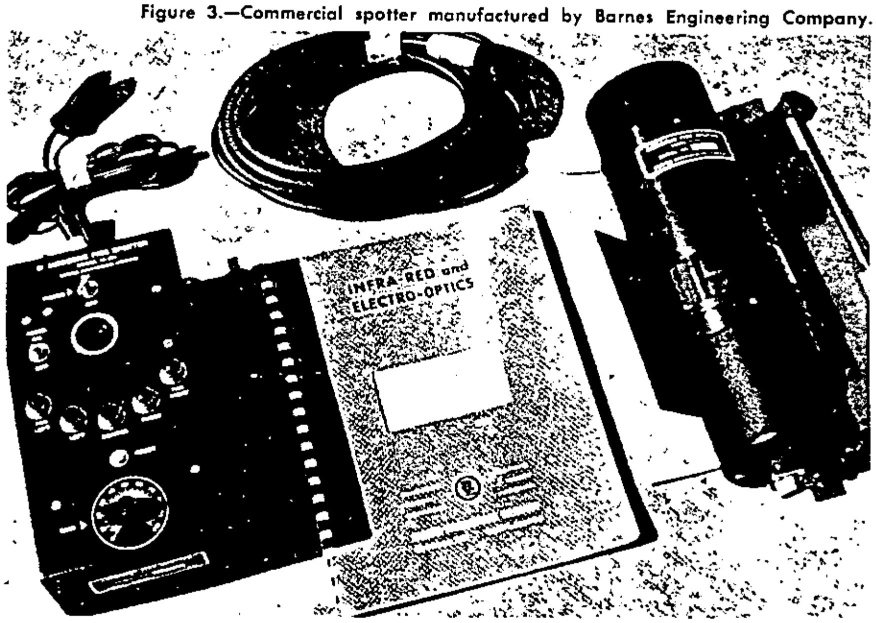
Spot fires outside of firelines were located using a helicopter-mounted "spotter." Hot-spots inside the lines of both wildfires and controlled burns were usually readily visible to the unit mounted on a light plane.

## SOME OF ITS BUGS

This "Fire Spotter" may not be the complete answer to your detection needs, and it may have problems in its application. We *did* have maintenance problems that were partly the result of a design feature. The scanner *can* "see" things that aren't fires but that still trigger the lights—such as sunlight reflections off water, aluminum roofs, and shiny surfaces. Noise from radio transmitters and aircraft electrical circuits *will* trigger the lights. The scanner may *not* "see" all fires—even ones that are putting up smoke.

The maintenance problems we had were somewhat anticipated and the commercial version of our "Fire Spotter" has been designed based upon our experience. The reflection and noise problems are going to be with

Figure 3.—Commercial spotter manufactured by Barnes Engineering Company.



us unless we want to eliminate one of the basic criteria—that of low cost. However, we can train operating personnel so that they understand what the unit can do and what its limitations are. The problem of not "seeing" *all* fires is one they will have to recognize and try to understand. If some object is physically between the heat source and the rotating mirror, such as the bole of a tree or a rock, there will not be any response. Sometimes this can be corrected by flying a different path or at a different altitude, but you may have to wait for a change in the condition of the fire, such as when it burns out from under the log or out the side of a snag.

### PERSISTENCE PAYS

The key to the use of this equipment is persistence, as revealed in a logbook entry made by an observer who used the "Fire Spotter" on three occasions and found three fires in less than 1 hour. During the 20 minutes' scanner operation of one flight, the following was noted in the log: "Lightning strike reported by lookout. Smoke chasers could not find. Made five passes [before locating the] fire. No smoke. Smoke chasers went back and found fire in crotch of tree." This incident shows how a conscientious operator can make this scanner "work" for him.

### BEST USE

Because of the narrow scan width, limited coverage and reflection problems, our experience to date indicates the best use is in confirming and pinpointing reported targets—not in flying a detection patrol.

Our 10 experimental units flew over 420 hours on light aircraft and helicopters. We have records of 26 fires they picked up which would not have been found until later, perhaps much later—and maybe too late. △

# Shaded Fuel-Breaks: Fire Control and Timber Both Benefit

*Ernest V. Andersen, Jr.*[1]

*In keeping with the Multiple Use concept of the Forest Service, shaded fuel-breaks integrate fire control needs with timber management of the forest.*

### FUEL BREAKS IN GENERAL

A fuel-break is defined as "a wide strip or block of land on which the native vegetation has been permanently modified so that fires burning into it can be more readily controlled. There may not be a preconstructed fireline within the fuel-break."[2]

In weighing desirability of constructing fuel-breaks, the land manager must consider Value Classes[3] of the area to be protected as well as the impact on all the resources, including the visual resource within the fuel-break itself. He must also weigh effectiveness and construction and maintenance costs of the planned fuel-break against the cost of fire protection alternatives. Once the decision that a fuel-break is desirable has been made, the manager must determine construction standards.[2]

#### Fuel-Break Frustration

As selective logging of conifer stands in California has progressed, it has become increasingly apparent that fire presuppression activity in that area must include selective fuel manipulation. Due to both the impracticability in some cases of physical disposal of the slash resulting from selective cutting and the costs related to physical disposal, or both, the concept of the shaded fuel-break has been developed.

#### Shaded Fuel-Breaks

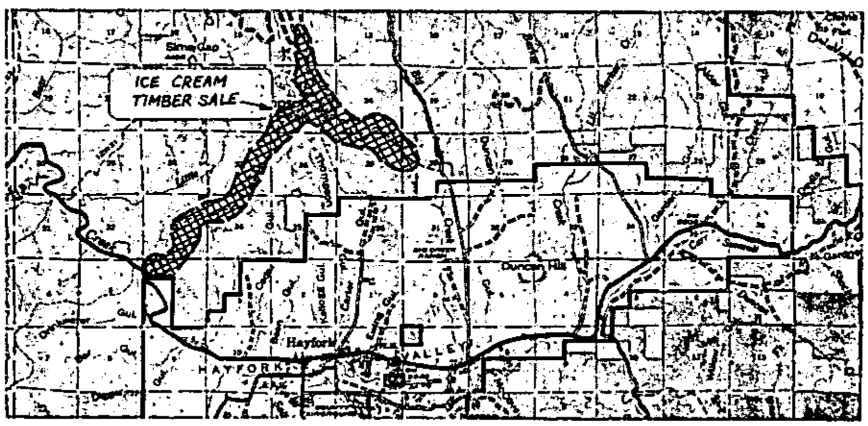
The shaded fuel-break has many advantages in the timbered area of Northern California (and probably elsewhere) than a completely cleared strip or fireline as a presuppression activity. The area of a shaded fuel-break remains in production of timber, frequently increasing both quality and quantity, forage, and browse; visual qualities are maintained or even enhanced; erosion potential is low-

[1] Formerly district timber management officer, Hayfork District, Shasta-Trinity NF; now district ranger, Red River District, Nezperce NF.

[2] Report on the Duckwall Administrative Study, Stanislaus National Forest, Region 5, 1967.

[3] Forest Service Manual 5191.11, Amendment No. 135.

Figure 1.—Map showing Ice Cream Timber Sale location. Note how completed fuel-break will separate high-fire-risk area north of Hayfork from large undeveloped area north of the planned fuel-break.



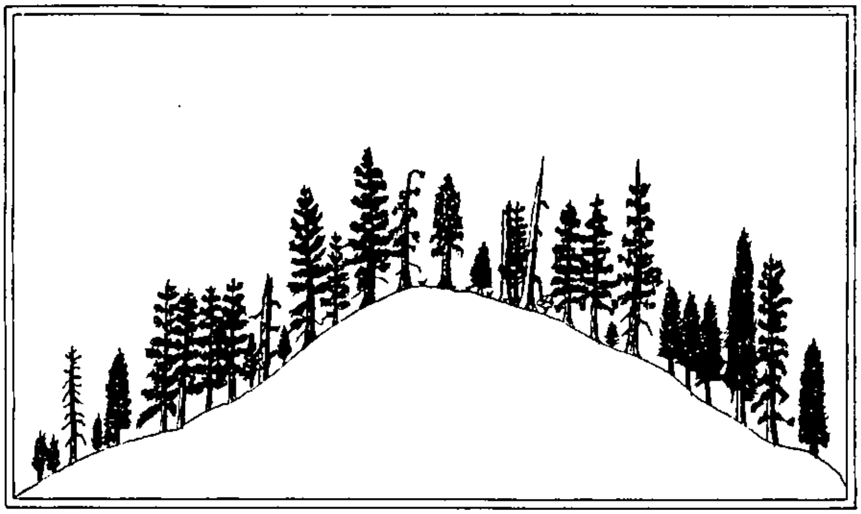
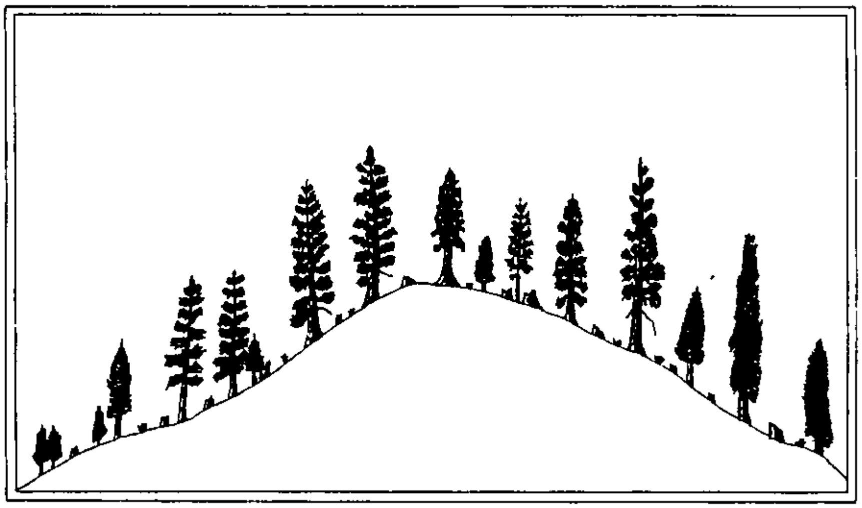


Figure 2.—A. Typical cross-section view of mixed conifer stand before treatment for a shaded fuel-break. B. Same stand after logging and slash treatment.



er, and maintenance costs are low.

## TIMBER SALES

Timber sales can be used to accomplish much of the work needed to establish a shaded fuel-break system. Appropriated money may be needed in areas ineligible for cutting, in non-stocked areas, and in non-commercial areas. Nearly every commercial timber sale offers an opportunity to begin, improve, or maintain the fuel-break system.

### The Ice Cream Sale

A timber sale called the Ice Cream Sale in central Trinity County, Calif., was begun by the Hayfork Ranger District of the Shasta-Trinity National Forest in 1970. The purpose of the sale is to remove selectively timber before creating a shaded fuel-break. The fuel-break in this location is high priority because it separates an area of high- and extreme - probability rates of spread and high resistance to control from an area of high man-caused fire risk (see fig. 1).

The entire sale was pre-marked. The required logging method is to use a mobile yarder on the part of the sale where slopes average 60 percent and slopes of 100 percent or more are common. In order to capitalize fully on this opportunity to develop a fuel-break, a 8 in. D.I.B. top utilization is required.

The stand is cut to separate tree crowns to a degree that crown fires burning into the completed fuel-break will drop to the ground (see fig. 2A. & B.). Yet, enough large trees and/or groups of smaller trees are left to shade the ground and to discourage the establishment and growth of understory vegetation. This balance in stocking is essential to keep maintenance costs at a minimum. It is expected that helitack crews, ground crews, all wheel drive tanker crews and air tankers would be able to control fires burning into the fuel-break.

In a sale like this, special timber sale contract requirements are necessary. Special care to protect the trees planned for leave must be exercised and intense slash clean up and disposal is also necessary. Well-planned cutting and slash disposal result in helispot sites where they are needed to meet hour control standards along the fuel break.

A collection from the purchaser is being made by the Forest Service to dispose of cull logs, tops, limbs, and other logging debris consistent with current policy. Cultural work in pre-commercial sized portions of the stand will require slash disposal measures appropriate to the primary purpose of the sale.

## FLEXIBILITY FOR LAND MANAGERS

In other timber sale areas, the same measures are being taken on those portions of the sale where a fuel-break system is planned. Developing shaded fuel-breaks as an integral part of timber sales provides another option for land managers. To date, a total of 41 miles of shaded fuel-break cutting in the Shasta-Trinity has been included. △

# Unimog Tanker-Plow Unit Cuts a "Wide Swath" In Firefighting

*Richard L. Sassaman*

In the summer of 1967, the Elk State Forest District acquired one of two Unimog 406's purchased by the Department of Forests and Waters for fire suppression. The Unimog was chosen for its capabilities of being both an off-the-road and an on-the-road vehicle (see fig.).

Upon receiving this unit, elaborate steps to insure driver safety as well as vehicle protection for off-the-road travel were taken. A protective frame-work was fabricated out of 6-in. channel iron to surround the cab, including a special grille guard. To protect the windshield, a 2-x-2 in. chain link fence was secured to the frame. This screen can quickly be removed when the vehicle is to be used on the highway for extended periods of time. Special shields were fabricated out of steel plate to protect the radiator as well as the fuel tank, air reservoir, battery, and roof of the vehicle. Two lights are mounted beneath the cab cover to aid in night work. The cab is equipped with 4-inch aircraft safety belts as well as aircraft shoulder harness, to help insure driver safety.

The unit is equipped with a 150-gal. fiberglass tank which has been permanently mounted within a steel plate shell. By means of a rather sophisticated plumbing system, the operator can draft either from an external source to fill the tank, or from the tank in order to use the live reel equipped with 150 ft. of ¾-in. hose. The operation is simple for the operator since all valves are readily accessible.

The Pacific Model "BE" pump is compact enough to permit its being placed partially under the protective shell which covers the tank. The pump can be started by the operator as he stands on the ground at the valve panel. Included with this use is a complement of spare parts and tools required to make minor repairs to the pump when in the field.

## FIRE PLOW MOUNTED

After months of planning, the Unimog was taken to the Michigan Forest Fire Experiment Station in Roscommon, Mich., where it was outfitted with a hydraulically controlled, double-bottom fire plow. This plow has been designed and developed for use with four-wheel-drive trucks by the Michigan Department of Natural Resources, Forest Fire Experimental Station.

In mounting this plow to the Unimog, several modifications had to be made. The frame had to be extended to permit proper mounting of the parallel floating hitch. A complete hydraulic system was also designed and incorporated into the unit to handle the hitch and plow.

The hitch is unique in that it floats parallel to the ground permitting the plow to follow the contour as it trails the Unimog. This feature is quite desirable in that the plowed line is relatively free of "skips", requiring very little, if any, followup handwork.

A 3-in. flange welded to the 18-inch coulter, approximately 4½ in. from the cutting edge, acts as a depth gauge and keeps the plow from cutting deeper than 4½ in.

## UNIT USED

Under ideal conditions the plow can be operated in fourth gear with moderate success;

Figure.—The Unimog 406, fully equipped, with plow in half-raised position.


[1] Forest technician, Pennsylvania Bureau of Forestry, Department of Environmental Resources.

however, second or third gear does a better job. If the unit is operated at too slow a speed, the turf falls back into the furrow since there is not enough speed to roll it away. If the unit is operated too fast, the turf is thrown 4 to 5 feet from the furrow, thereby decreasing the effective width of the fireline. At the proper speed, the turf will roll back and remain at the edge of the furrow, thereby doubling the effective width of the line. The furrow width to mineral soil is approximately 20 in., therefore, with 10 in. of turned up sod on each side of the furrow; the effective width is approximately 40 in.

The plow can be utilized best in areas where there are few, if any, rocks. In dense stands of saplings, where raking a line would be extremely hard, this unit will work effectively; however, line cleanup will be necessary. In areas where it is not possible to plow, the unit has the capability of moving water and tools to remote areas. With a highway speed of 43 m.p.h., it has the advantage of being able to get to a fire quicker than a tractor-plow unit, especially since this unit does not require the use of a low-boy or similar vehicle for transport.

The Unimog 406, with its water and plow capabilities and its complement of hand tools for ground personnel, is an efficient fire-fighting tool. △

**_FIRE 1970, from p. 7._**

a return to the level of 1967. See

Deaths in dwelling fires in 1970 were estimated as approximately 6,500, a decrease of 50 from the previous year.

Property destroyed by fire during the past year totaled $2,710 million, the preliminary NFPA estimates indicate — an increase of $262,400,000 over 1969, and a record high.

Of the property loss total, $2,150 million represents damage to building and contents, and nonbuilding fires—those involving aircraft, ships, motor vehicles, and similar equipment, as well as *forests*—cost about $560 million.

The worst loss-of-life fire in 1970 occurred at the crash of a chartered airliner on November 28 in Anchorage, Alaska, when 46 people were killed. A nursing home fire on January 9 in Marietta, Ohio, killed 31, and a hotel fire on December 20 in Tucson, Ariz., took 28 lives.

The worst property loss fire in 1970 was the destruction of a C5A Galaxy aircraft in Marietta, Ga., at an estimated cost of $30 million; another C5A Galaxy fire, May 25 at Palmdale, Calif., cost $20 million. △

# Resource Locators Made of Canvas Are More Flexible

*Howard R. Koskella*[1]

*Resource locators made of metal and wood proved to cumbersome that a new locator made of canvas was developed.*

The idea of the resource locator is not new.[2] Most early models of the resource locator were intended primarily for dispatching. Some were made of metal card racks set in a wooden frame which served as a carrying case. Bulkiness and weight made them inconvenient for use in a fire camp, and the need for a lighter, more compact model became evident.

## CANVAS MODEL CONCEIVED

BLM and Forest Service personnel at the Boise Interagency Fire Center have developed lightweight canvas models of the resource locator for the plans chief to use. Several Regions of the Forest Service are making similar resource locators. The Boise model is made by stitching a series of canvas pockets on a canvas backing (see figure). Each pocket holds a 5- by 8-in. card. Each locator has pockets for 130 cards; the bottom row of pockets is large enough to hold surplus cards. The overall dimensions of the locator are 36 in. by 54 in., and the top and bottom are fitted with grommets for hanging. It weighs approximately 6 lbs. and may be rolled or folded for transporting or storage.

## THE SET-UP

The following is an example of how a locator can be used by the plans chief or his maps and records officer. Cards are labeled for three functions:

1. *Line.* The "present planned line organization" portion of the locator is divided into night and day shifts using labeled cards, depending on existing organizations. The number of divisions and sectors are shown in each shift. The resource card indicaing a specific crew or piece of equipment can be located under

[1] Fire staff officer, Payette NF. Koskella has used the resource locator system on fires in four western regions.

[2] Fire Control Notes, 29 (1): 7, 1968.

the appropriate shift, division, and sector. If a crew is reassigned, the card is moved to show the new assignment. Reassignments are noted on the lower portion or back of card, providing a record of crew assignments.

2. *Non-line.* This category may be listed in the locator using one card per individual or individuals with similar functions on a card. For example, a single card may list the time officer and several timekeepers.

3. *Additional Resource.* This section of the locator is divided into three subsections labeled *ordered, enroute,* and *available.* These subsections are used to list men and equipment not yet under one of the previous headings. For example, in a strategy meeting the overhead team decides that four more organized crews are needed and the order is placed. The maps and records officer fills in the size and type of crews ordered on four crew cards and puts the cards in the locator under *ordered.* As more information is available, he fills in crew and crew leaders, names, ETA's, etc., and moves the card to a pocket under *enroute.* Once the crew arrives at the fire, their card will be shifted to the *available* section. As soon as the plans chief assigns them to shift, division, and sector, the cards will be moved to the line section of the locator.

A resource locator permits a visible display of all resources assigned to a fire. Fire overhead can review assignments and organization at a glance. Information is easier to use and maintain than that on one-sheet organization charts. The system can be expanded as needed by adding more locators. △

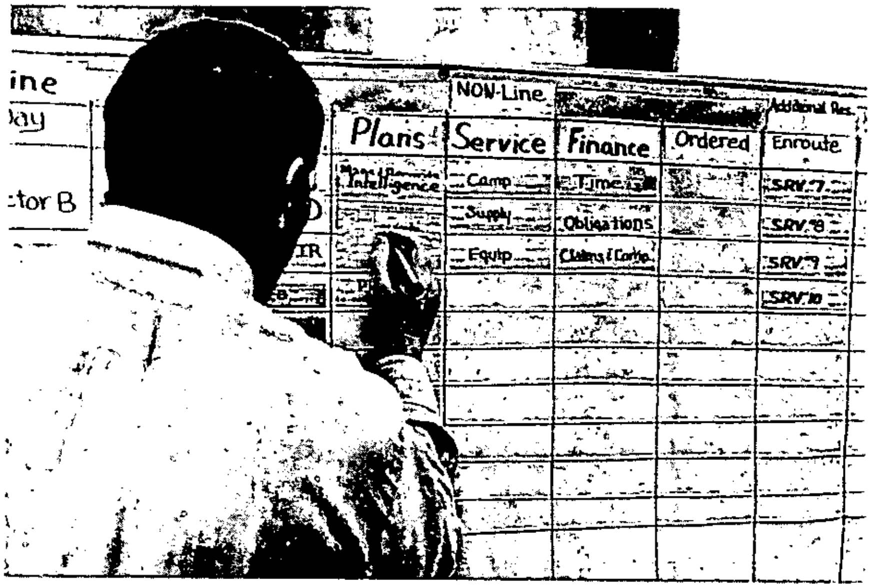



**Figure.—This canvas locator, hung from its grommets, is being updated by the fire staff officer.**

## FAA Reports Fires in Utah

***Region 4***

In Utah, wildland fire agencies rely heavily on public fire detection and reporting. Each year many fires are observed by aircraft pilots and reported to the Federal Aviation Administration. The FAA then reports these fires to the nearest fire control agency. The Utah Cooperative Fire Fighters (UCFF, a group composed of representatives from wildland fire control agencies) recognized the value of this detection/reporting system but wanted more efficiency in reporting interval and accuracy of fire location and in having the FAA forward the report directly to the responsible agency.

Early in 1970, personnel from the Wasatch National Forest, working with the State Forester and the FAA, devised an improved system of fire location and reporting within the State. Using a Utah base map, 5-inch Forest Service transparent compasses were placed over each VOR[1] station and oriented to magnetic north. When the FAA receives a fire report, the location is determined by magnetic heading and distance from one or more VOR stations. This system eliminates the confusion in attenmpting to convert magnetic headings to true North and in locating by township, range, and section in FAA offices. FAA reporting to the proper fire control agency is facilitated by color-coding on the map and a current list of agency contacts attached to the map.

This method is also used for requesting spot weather forecasts from the Fire Weather Forecaster at Salt Lake City.

This is another example of the outstanding work done by the UCFF to resolve fire problems common to all agencies in Utah. △

[1] Very-high frequency — Omni — Range.

345-M

U.S. DEPARTMEN
WASHINGTO

OFFICIAL BUSINESS

E V KOMARFK
TALL TIMBERS RESEARCH INC
ROUTE 1 BOX 110
TALLAHASSEE FLA 32301

POSTAGE & FEES PAID
United States Department of Agriculture

# Connecticut Mounts Pump on Bombardier Tractor

J. Leo Cote[1]

Several years back, Connecticut's Forestry Division began using Bombardier J5 tractors in woods operations. Having used these versatile machines a great deal, Ranger Francis Emigh designed and mounted on them a forest fire pump unit to better extinguish inaccessible portions of fires and "way-back" hiker fires.

## CONSTRUCTION

Two tanks were made from 3/32 in. steel 60 in. long, 19 in. wide, and 12 in. high, welded on the seams with one baffle in the center. The fronts of both tanks sloped in 6 in. and were mounted forward, up to the protective canopy uprights (fig. 1). Filler pipe of 2½-in. pipe coupling was welded in place well forward and outboard for ease of refilling. A 2½-in. filler plug was used, drilled with a small hole for an air breather when pumping. Short lengths of angle iron were welded to the tank and were drilled through the running boards with four hold-down bolts for each tank. The location of section line fitting is different on each tank. For the left tank, ¾-in. coupling was welded in the lower center of the end plate (fig. 2). On the right tank, ¾-in. coupling was welded on the lower rear of the inside side plate. This permits a straight-through line in back of the seat cushion to the pump.

A Pacific Marine Type BE pump was mounted on the running board about 18 in. back of the left tank. Three-quarter-inch piping was installed between the tanks and pump, with sections of plastic tubing to prevent breakage from vibrations. Each tank's suction outlet was fitted with a shut-off to permit use of the lowest tank when working on side hills. The units each carried a maximum of 100 ft. of garden hose and an appropriate nozzle.

## TANKS HAVE LOW PROFILES

The tanks were designed with a low profile for both low center of gravity and operator safety. The tanks do not interfere with entering or leaving the driver's seat. Testing of balance was thoroughly made both sideways and up and down slopes with full and half loads, and operators tell us changes improved working qualities in the woods. Any changes in re-positioning the tanks, however, may change working characteristics considerably.

The total water capacity of 118 gal. with the low-volume pump will last an appreciable length of time on a fire line.

Rangers agree that the use of this equipment can be a one-man operation if necessary.

## UNITS ARE SUCCESSFUL

The two units we have now in operation have been successfully used on more than 17 fires, and we plan to build at least two more. These units are primarily an initial attack tool and should, in seasons of ground fire problems, be used as a delaying and patrol unit on the fire line while the heavier hose lines are advancing. △

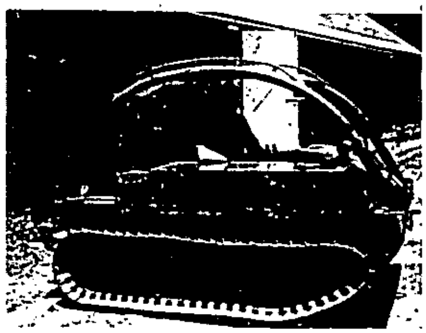
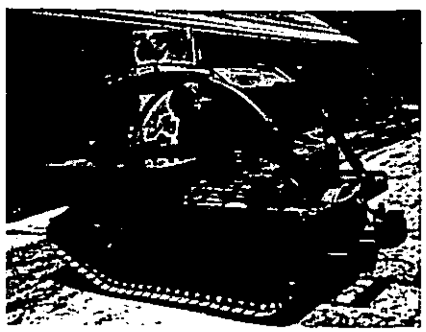


Figure 1.—Modified tractor showing tanks and a portable radio.

Figure 2.—Pumping equipment attached to left tank.



[1] Assistant fire control officer, Connecticut State Park and Forest Commission, Hartford, Conn. 06115.