VOL. 11 OCTOBER 1950 NO. 4

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 11 Number 4

FIRE CONTROL NOTES

A Quarterly Periodical Devoted to the TECHNIQUE OF FOREST FIRE CONTROL

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

FIRE CONTROL NOTES is issued by the Forest Service of the United States Department of Agriculture, Washington, D. C. The matter contained herein is published by the direction of the Secretary of Agriculture as administrative information required for the proper transaction of the public business. The printing of this publication has been approved by the Director of the Bureau of the Budget (May 17, 1948).

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

Forest Service, Washington, D. C.

UNITED STATES GOVERNMENT PRINTING OFFICE, WASHINGTON : 1950

CONTENTS

"GRASS ROOTS" FIRE PREVENTION

HENRY SIPE

Assistant Supervisor, Cumberland National Forest

The annual fire statistical report indicated the number of forest fires in the United States increased 11 percent in 1949. Census figures for 1950 will likely show the country's population to be growing about 2 million each year. This adds up to an increased fire risk. Although some of the increase is in unprotected areas, debris burning fires on protected areas, for example, increased 48 percent and incendiary fires 33 percent.

Fires can be prevented in two ways: "Shotgun" methods such as the current CFFP campaign posters, news mats, booklets, bookmarks, envelope stickers, etc., or "grass roots on the ground" work by forest officials. There may be those who feel that law enforcement is the final answer to the fire prevention problem; I do not. The following example may illustrate some basic philosophy in fire prevention.

The Sand Hill fire control unit of the Cumberland National Forest in 1946 had an alarming increase in the number of fires. This trend continued in 1947 and 1948, and measures were required to combat the problem. The unit contains 12,400 acres. There are about 110 families scattered fairly well throughout the unit, mostly on submarginal farms. Man-caused fires, excluding railroad fires, that occurred in the unit are as follows:

	Number of fires		
Cause:	*1946*	*1947*	*1948*
Smokers	4	3	3
Campfire	1	0	0
Debris burning	0	1	1
Incendiary	0	1	0
Miscellaneous	5	1	3
Total	10	6	7
Fires per 10,000 acres protected	8. 1	4. 8	5. 6

Since the Cumberland National Forest objective is not more than 0.8 fire per 10,000 acres protected, the occurrence rate was 6 to 10 times too high.

Although only one fire is classed as incendiary, probably more should have been. At least one family was suspected of setting job fires. Another had careless children who might have been causing fires.

In recent years the ranger and his yearlong helpers had not traveled through the area sufficiently to get acquainted with the people. The lookout assigned to the fire tower in the unit was well known, but had a retiring personality and was not in good health.

It was decided to visit as many families and schools as could be reached in 4 days early in 1949. The area had no good roads, so a jeep was used. In February, in company with either the district ranger, a forest guard, or the lookout, I visited 65 families and 4 one-room schools. At the schools we showed colored slides, using the jeep car battery for power. Kodachrome pictures of the pupils were taken. A contact list was made, and keyed by number to a contact map.

On March 18, 1949, a friendly follow-up letter was written to some 70 families in the area and to the school teachers. The letter described why the area was chiefly valuable for timber and gave the growth rate of timber, its financial value, and how the woods could be made to produce good crops of timber. Fire prevention was listed as the first step. The letter closed with a promise of more letters to follow dealing with improvement of the forest.

During the fall of 1949 a similar contact trip was made. A new ranger participated. Fewer family contacts were made, but movies and slides were shown at five of the six schools. At one school, over half the pupils had never seen a movie. Literature was sent to another school, inaccessible even by jeep. A snapshot of pupils at each school was taken. Contact list and map were brought up to date.

On October 6, 1949, a second letter, again friendly and "homey," was written the families, telling about the school contacts, our personnel changes, and expressing appreciation for the lack of fires thus far in 1949. The damage from heavy grazing and the dangers of "lump sum" timber sales by famers to timber operators were described. It was suggested that they plant a few walnuts that fall.

In 1949 only one fire occurred in the area. This was classed as a smoker fire, but was not far from the railroad, and might have been caused by a hobo or railroad employee. This was a very good record, especially since 1949 was much drier than the preceding 2 years.

In February 1950, the district ranger and I visited four schools. A talk was given to the pupils, stressing the damage done by recent floods (10,000 homeless in Kentucky, etc.) and the relation between forests, fires, and floods. The damages done by fire and the ways fire could be prevented were written on the blackboard by the ranger. A mounted photo enlargement (6 by 8 inches) was presented to each school and the negative left with the teacher in case pupils wanted copies. Contact prints were given the teachers individually. Each family represented was supplied literature on forest care, tree planting, and fire prevention. Ten or fifteen residents were contacted enroute. High water prevented travel to the other schools.

On April 6, 1950, a copy of the Forest Newsletter was mailed to each family. This newsletter discussed in an informal way current events over the entire forest. Many of these events were of no special concern to the Sand Hill people, but it served to show that there was a lot of activity on "their" National Forest. Included of course were items such as one about a man they knew paying damages for some fire he had let escape.

The general objective of all this contact work was to get acquainted with the local residents, let them know we had not forgotten them as soon as we were out of sight, learn their problems, and have them learn some of our problems. Fire was not stressed; it was not often mentioned, but it was included in the letters. On the contact sheet

for each family was listed items about children, occupation, health, grudges, reputation, anything unusual. Always we tried to note some point that would be an entree on the next visit, or serve to recall the previous meeting. Before arriving at a given farm the contact sheet was reviewed.

How well this work paid is perhaps best shown by the absence of fires in the spring of 1950. Drier fire weather existed than in any year since records were begun in 1937. On March 27, when the rest of the forest had six fires that burned 760 acres (and others getting ready to pop when a heavy rain fell), the Sand Hill unit had no fires. On this day the danger meters went "over the top." In April there was a run of 20 days without rain. On April 24 meters again went over 100. The only fire in the Sand Hill unit this spring escaped from a railroad section crew burning right-of-way.

It is not planned to continue the intensive contact work done during the last year and a half. We will show movies at one school (which we missed) by fording Rockcastle River at low water, and perhaps visit several other schools once this year. Scattered family contacts and small sales will be made, and free fuel permits issued. A copy of each Forest Newsletter will be sent each family ("getting things in the mail makes us feel important!"). Contact work will be tapered off to fit the needs and our available work time. The results in the Sand Hill unit show that fire prevention is mainly a job of "getting acquainted" with the folks who can be a cause of fires.

[The Cumberland National Forest in Kentucky has had rather outstanding success in fire prevention. The average number of man-caused fires for the 5-year period 1936–40 was 315. In 1949, in spite of a more severe burning season, the number was held to 72.—Ed.]

Preventing Discoloration of Paint in Fire Towers.—Over a period of years on this district painting the interior of the cabs on the fire towers has been necessary every 2 or 3 years. During the summer months the sun rays passing through the windows cause the paint to peel on the window sills and to fade in color on the walls and trim. Any furniture in the direct rays of the sun is affected to the same extent.

In the spring of 1948 the interior of two towers were painted at the same time and with the same type of paint. During the summer season when the towers are closed the windows of one tower were given a heavy coating of Bon-Ami on the inside of the glass while the windows of the other tower were left uncoated. The paint on the tower treated with Bon-Ami after 2 years is as bright as when it was applied, while the tower not treated is due for another painting by the spring of 1951.

Since one of the first duties of a lookout when opening the tower at the beginning of the season is to clean the windows, it is a simple matter for him to wipe the Bon-Ami from the windows in the process of cleaning.—FRED M. WEAVER, *forestry aid, Jefferson National Forest.*

DEBRIS BURNING ON THE OUACHITA

G. H. STRADT

Assistant Forest Supervisor, Ouachita National Forest

Every spring hundreds of brush burning smokes can be observed throughout the Ouachita Forest area, which contains over 2 million acres under protection in Arkansas and Oklahoma. It is the time of the year when fields, brush, and trash are burned in preparation for spring planting, a practice of long standing. Analysis of fire statistics points out that debris burning fires are more apt to escape during the period of February 16 to April 15, depending somewhat on whether spring is early or late, although burning begins soon after January 1, and continues through April. The "escape" period includes that of the highest fire danger created by cured vegetation and strong, switching March winds.

Legislation in both States requires reporting proposed burning in organized fire protection areas, as well as penalties for permitting fire to escape to other ownerships. Law enforcement is one method of approach, but experience over the past 10 years indicates other methods may be better.

Table 1 gives a comparison of total fires classified as lightning and man-caused, and the relation between debris and man-caused fires for calendar years 1940–49.

TABLE 1.—*Lightning and man-caused fires, and relation of debris to man-caused fires, 1940–49*

Year	Total fires	Lightning fires	Man-caused fires	Debris fires	Relation of debris to man-caused fires
	Number	*Number*	*Number*	*Number*	*Percent*
1940	167	47	120	30	25. 0
1941	120	47	73	15	20. 5
1942	130	34	96	13	13. 5
1943	369	114	255	35	13. 7
1944	180	116	64	9	14. 0
1945	67	22	45	5	11. 0
1946	165	36	129	27	20. 9
1947	245	71	174	22	12. 6
1948	191	84	107	16	15. 0
1949	111	23	88	13	14. 8
Average	175	59	116	19	16. 3

The highest number of fires during the 10-year period was recorded in 1943, when five or more occurred every month during the year. In 1945, an unusually wet year, the forest area had an all-time low in number of fires and acres burned during its 40 years of existence under organized protection. The low number of debris fires is attributed to decreased farm activities, due to armed service and defense job movement, together with low hazard conditions. In 1946 the movement was reversed with an accompanying increase in debris fires.

To reduce the number of debris fires, which during 1946 again exceeded 20 percent of the man-caused fires, a forest-wide campaign was developed, to be effective with calendar year 1947 and continue thereafter with other phases of the prevention program. This campaign, which strives principally for on-the-ground contact, contains the following stipulations:

1. Continue thorough investigation of fires, with State or Federal law enforcement.
2. Distribute brush burner cards for reporting proposed authorized burning.
3. Maintain record of all brush burner contacts by name and location, and give brief account of conversation for future reference.
4. Contact all new families and acquaint them with FIRE, as well as all applicable State and Federal forest regulations. Also recontact old families when in their vicinity. Discourage burning by suggesting other means of disposal. If they intend to burn, go over the problem on the ground and encourage burning after 4 p. m., confined to small areas on wet, damp, and low-danger days before February 15, with sufficient control line, manpower, and suitable equipment.
5. Prepare news releases as a reminder of low and high fire danger periods. Supervisor's office to prepare articles as a series and release by scheduled date.

The program has resulted in a substantial reduction in number of debris fires over the past 3 years (a reduction of 18 percent in 1947 as compared with 1946, and 52 percent in 1949). Authorized burners are taking suggested precautions by burning smaller areas and attempting to use natural barriers or previously constructed lines. In addition, an increasing number of brush fires were observed during wet and damp days or late in the afternoon. A good detection and dispatcher system, together with residents reporting proposed burning, has also resulted in fewer false alarm runs.

During the spring of 1950 an additional item of prevention was added to the campaign. In cooperation with Hot Springs National Park and Radio Station KWFC, a trial system of reporting class of fire danger and degree of hazard and risk for guidance of brush burners was initiated. This system is not new, but it had not been used in this area before. This spring the records show continued progress in controlling debris burning. Of 87 man-caused fires, only 11 (13 percent) were from debris burning.

An example of needed contact was noted during the spring of 1948 when a resident living outside the Ouachita National Forest and south of the mountainous terrain, attempted authorized burning, without help or equipment, on some of his land located on a south slope within the forest boundary. He selected a day in March during a class 4 fire danger build-up. The fire quickly escaped and burned over 100 acres before suppression forces could control the spread. This individual was not accustomed to fire behavior in the mountains, even though he had practiced burning on flat and rolling terrain for many years. In this case a previous contact could have prevented a reportable fire and follow-up conviction in court.

The campaign will be continued not only from the standpoint of the debris burning problem, but also on the basis of its favorable effect on the entire fire prevention problem.

MULLIN DOZER TOOTH SHANK AIDS IN SLASH DISPOSAL AND FIRE LINE CONSTRUCTION

H. A. Mullin

Equipment Engineer, Region 3, U. S. Forest Service

Fire lines can now be constructed in rocky formations by using digging points attached to a specially built dozer tooth shank developed

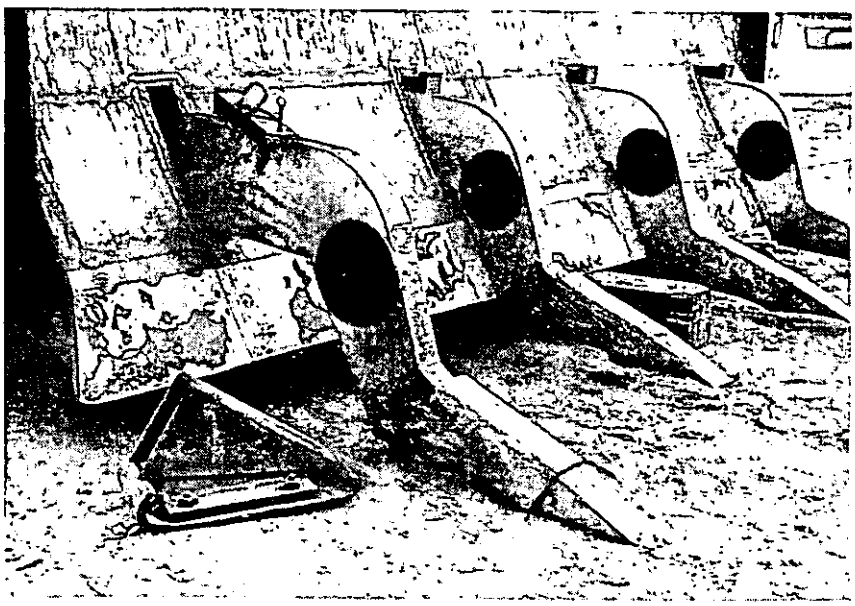


Figure 1.—Tooth shank installation, digging points, brush shoe, and method of installation in a bulldozer.

and tested by the United States Forest Service in the Southwestern Region. A tapered box welded through the cross-section of moldboard of any type dozer receives the tooth shank (fig. 1). The box is designed with a taper to accommodate a wedge that holds the tooth shank tight in the box. Four tooth shanks are considered adequate for most work.

Two styles of digging points were tested. A third type originated by the author has been designed, but not thoroughly tested yet. It is hoped that the new type will contain features the others do not have.

Figure 2 shows the installation of skid shoes used to float the moldboard 4 or 5 inches above the ground surface as an aid in bunching heavy slash after logging. Skid plates are reversible to compensate for

wear. The skid shoe design requires a 1-inch incidence and has a blunt end to avoid penetration into the soil. The weight of the moldboard is carried on the heel of the shoe. This feature offers a means of packing or solidifying the soil while the shoe is skidding over the surface of the ground. The tooth shank protruding out in front of the moldboard reduces the danger of logs skidding on the moldboard when logs are pushed endwise. Large logs can be "floated" ahead of the dozer if the brush shoes are pushed under the log.

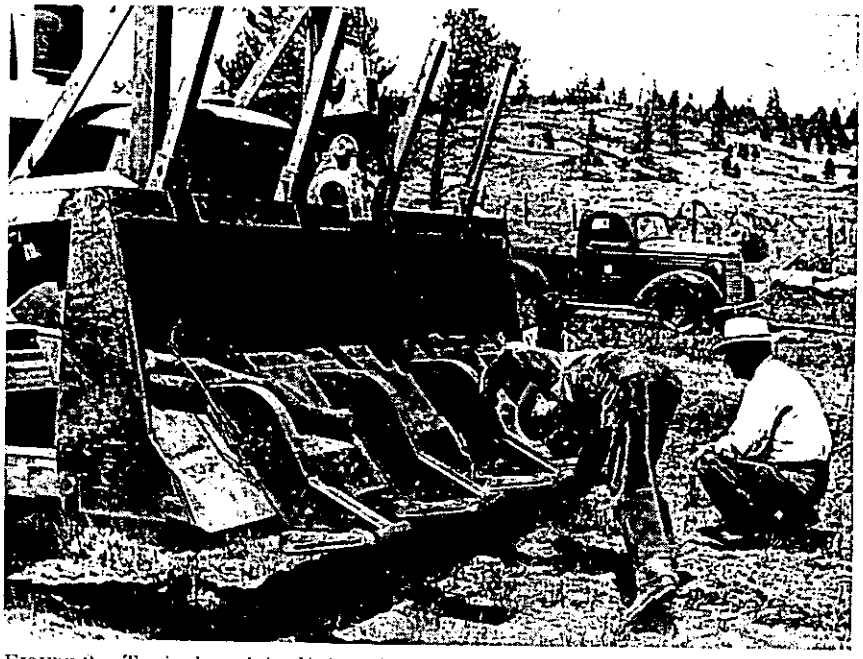


FIGURE 2.—Typical (original) installation of brush shoes on dozer tooth shanks.

Digging points may be installed on the shanks by removing the brush shoes. This requires removing one bolt in each shoe. The same bolt is used to secure the digging point to the tooth shank.

It is estimated that dozer efficiency is increased from 30 to 100 percent depending upon the type of earth formation. Digging ability is made possible by the angle of the digging point. The top of the digging point angle in relation to the ground works on the principle of the wedge, to give mechanical advantage, less friction. The lifting force of the teeth when used as a wedge is three to four times the pushing force. This accounts for the rapid penetration of the moldboard in extremely hard or rocky formations that straight or angle blades would not penetrate.

The tooth shanks and digging points act for the dozer moldboard in the same manner as the teeth on a shovel bucket: the teeth penetrate and break up the soil or loosen the rocks before the moldboard strikes.

Sharp digging points are desirable on all digging tools. If sharp points are maintained penetration into the soil and roots can be done

903091—50——2

with a minimum of power. Working conditions will dictate the best digging point angle. Operators should keep in mind that the greatest mechanical advantage is obtained with the smallest tooth angle.

The tooth shanks can be installed on any dozer. Teeth have been spaced approximately 2½ feet apart on 10-foot moldboards.

It is recommended that for the greatest efficiency installations be made on tiltdozers. This makes it possible to adjust the digging point angle to match working conditions as well as compensate for tooth wear.

Sketches in figure 3 are presented to give the reader a third dimensional view not obtainable with photographs.

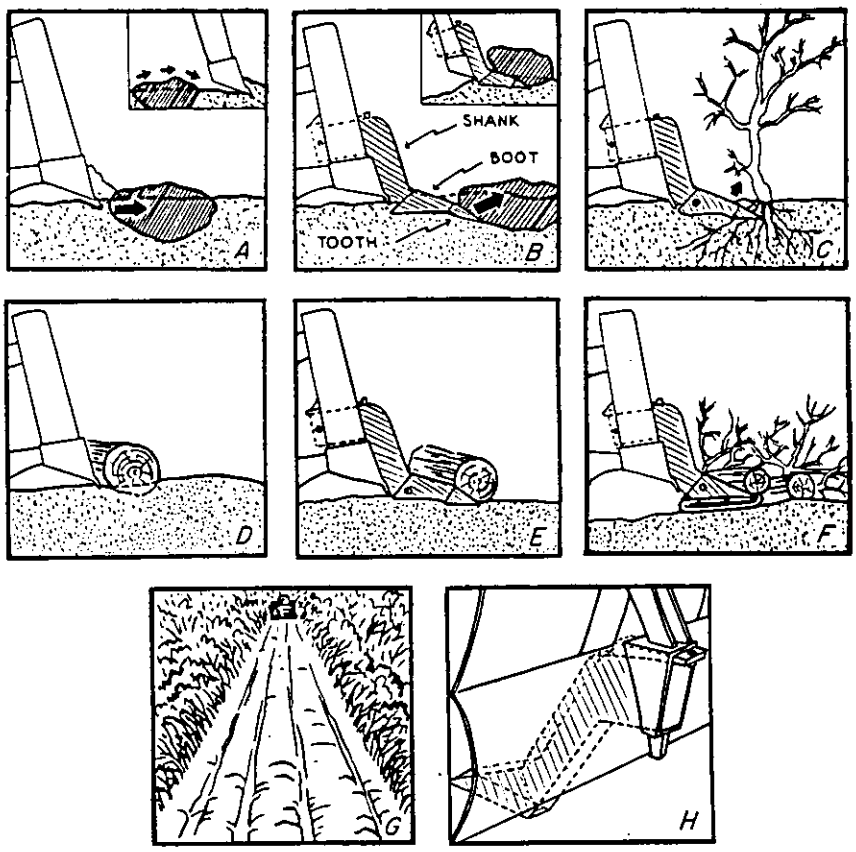


FIGURE 3.—*A*, Action of a conventional dozer moldboard striking a rock; arrow indicates the movement of the rock in the event the cutting edge does not slip over the rock. The conventional moldboard usually travels over the rock. *B*, Digging tooth being forced under the rock and applying lifting action from its power as a wedge. *C*, Action of a dozer tooth digging point directed at the roots of brush or small trees. *D*, Conventional dozer pushing a log partially imbedded in the ground. *E*, Lifting action takes place when log is pushed by dozer equipped with teeth. *F*, Brush shoe floating the dozer blade and picking up heavy fuels. *G*, Fire line construction or road right-of-way clearing in dense brush by dozer with digging teeth. *H*, Installation of a dozer tooth shank as seen from the back of a dozer moldboard.

This tool is not a scarifier. It penetrates like a wedge, lifts rocks and small trees. In hard ground the tooth point pulls the moldboard cutting edge into the ground making it possible to get a full load with a minimum of tractor travel. This means more production in shorter time.

Cost of the installation complete, without digging points, for a D7 will be $450 to $550 depending on the initial cost of the shanks and facilities for welding. The cost of this equipment has been found through experiment and practical usage to be quite nominal in proportion to time saved and production increase, gaged over a short period of time.

Use of Electric Wind Vane by a Coastal Plain Ranger District.—On the Chickasawhay Ranger District of the DeSoto National Forest, the electric wind vane, which can be read down to units of 22½° of direction, has an important place in fire suppression and prescribed burning work. The district is relatively level and there are no mountains to influence the air currents. Fuel has a high rate of spread index.

Information on accurate wind direction and its direction behavior is an essential aid to the dispatcher in determining the number of crews and men to be dispatched to a given fire where advantage can be taken of natural firebreaks, old wild fire burned areas, and prescribed burn areas. This is especially necessary when a number of fires are going at the same time.

The fire crew foreman normally makes some preliminary tactical plans as he travels to a fire. The essential information on wind direction given him by the dispatcher aids him in organizing his preliminary suppression plans, and when on the fire, in carrying out his suppression work. During the life of the fire, wind direction and behavior changes are reported to him on the fire line.

During periods of prescribed burning work, an analysis of weather conditions at work time in the morning will usually indicate the possibilities of carrying on prescribed burning that day. Because of the relatively few days when prescribed burning can be successfully carried on, full advantage must be taken of every such day. The electric wind vane is sensitive enought to indicate the wind direction and something of its behavior for the day to a degree not otherwise interpretable. These early morning interpretations are essential for administrative assignment of the prescribed burning crews to other work if prescribed burning cannot be carried on that day. They also indicate times when special attention may be necessary on those areas prescribed burned the day before, and which were allowed to burn into the night.

Experience has shown that on this district the most desirable and dependable wind for winter prescribed burning is the north wind that follows a good winter rain. It lasts for a period of up to about 4 days, with the final wind shift, usually clockwise, at night.

Occasionally this north wind begins to shift in the middle of the day and as early as the second day after the rain. The first indications are slight shifts not readily interpreted on the ground, but definitely noticeable on the dial of the electric wind vane. When the fire dispatcher interprets the slight shift as an indication of a wind shift, he notifies the prescribed burning crews by radio. The crew foremen can then plan for suppressing the prescribed burning if it should become necessary, and thereby keep burning damage to a minimum.

In late summer and early fall when prescribed burning for seed-bed preparation and control of undesirable species is being conducted, the winds are not nearly as dependable in direction and behavior as the winter winds. Wind direction varies considerably throughout the day and damage to tree growth is more easily inflicted. Therefore, during this period the prescribed burning crews must be accurately informed about the wind direction and its behavior throughout the day.

A satisfactory electric wind vane can be purchased for as little as $25 to $35. It is a good investment for a coastal plain ranger district.—Fred G. Ames, *forester, Division of Fire Control, Region 8, United States Forest Service.*

USE OF AIRCRAFT IN CONTROL OF LIGHTNING FIRES ON BLACK HILLS NATIONAL FOREST

JOHN P. BURKE

Staff Assistant (Fire Control), Black Hills National Forest

A review of the last five fire seasons for the Black Hills National Forest and surrounding protection zone revealed that 74 percent of the fires were lightning caused. Experience has shown that, with sever burning conditions, most lightning fires in the Black Hills will put up at least a small smoke immediately after the strike. The object is to take action on these fires before they grow to critical size or shrink in the rain to become tricky sleepers. Quick action also leads to control of a fire while it is still burning only on the surface of the duff, thereby reducing mop-up time and expense. Unless prompt action is taken on fires after (or during) severe electric storms, their number and growing size can cause the suppression job to snowball to unmanageable proportions. It is in the detection and suppression of these fires that the use of aircraft has become important.

Aerial detection supplements lookout detection on the Black Hills National Forest, but will probably never supplant it. The lookouts report approaching electric storms to the supervisor's office, and maintain a record of the path of the storms and of individual strikes. If the fire danger justifies such action, a plane is sent out in time to follow the storm onto the forest, and it stays on the job as long after the storm has passed as conditions warrant. When forest fuels have had a chance to dry sufficiently to bring out sleepers, the plane is again used. As soon as a flight is scheduled, all lookouts are informed of the course to be flown and are thus alerted to exchange information with the aircraft observer by radio.

When the observer sights a smoke he reports it, immediately if possible, to the nearest lookout, suppression crew, or ranger. Merely being able to see the fire from the air, however, is not enough. The observer must be able to gage the fuel type, slope, size and behavior of the fire, and other important factors, so that he has a basis for determining adequate manpower and equipment. When the fire is in a location not positively identifiable by description, the observer gives instructions to the crew to drive to a known point as near to the fire as possible. While the crew is traveling to this point the plane may continue the patrol, or may be used for picking out a route to the fire. The observer's judgment from the air of the negotiability of roads is very important. Having reached the appointed place, the crew is directed to the fire by instructions over the radio from the aircraft observer.

In rolling country where the hilltops are timbered and no vantage points are available to the suppression crews, much time can be lost in reaching the fire. Frequently a slight breeze will carry the smoke

into the timber or behind a hill, so that the crew can pass very close to the fire without locating it. If the observer can follow the crew from the air, he can stop them at the proper point.

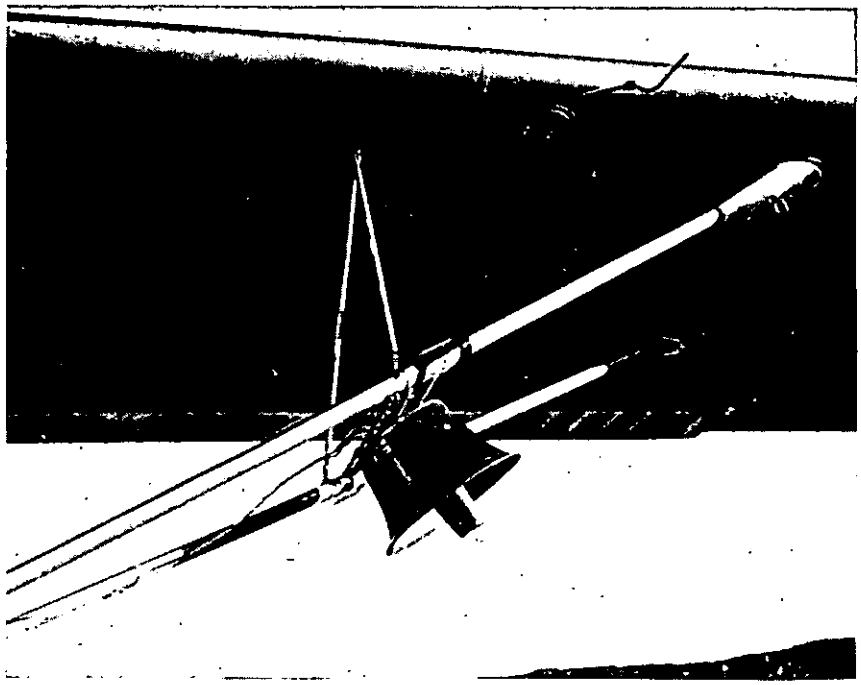
On old, narrow roads through heavy timber it is difficult to locate a pickup truck, and extremely difficult to follow the progress of a man on foot. During daylight hours in clear weather any reflecting surface may be used to reflect a beam of light from the sun to the plane. Signaling mirrors with aiming devices and instructions, salvaged from armed forces rescue kits, are effective for 10 miles or more. The aiming device is especially helpful in hitting a small target such as a plane at a distance.

If the fire is too far from a Forest Service crew for quick first attack, the lookout dispatcher may telephone the nearest cooperator. However, most local residents do not have telephones. The plane, therefore, was equipped with a loud-speaker so that the observer could request the needed assistance from the nearest cooperator, while the plane circled the ranch house or sawmill. The cooperator is informed of the location of the fire, its size, kind of fuel, and the size of crew and kind of tools needed. The plane, by means of instructions through the loud-speaker, leads the cooperator to the fire. Arm signals are used by the man on the ground to answer questions by the observer, who must anticipate the other's message in order to ask the questions. If more help is needed, the observer requests it by radio through the district organization or by loud-speaker from another cooperator. In any event, the cooperator is thanked, and informed that the fire is being reported to the ranger.

A high-wing monoplane with a low engine cowl is in our experience the most suitable type of aircraft. It provides excellent visibility, both to the sides and ahead; it carries ample fuel for 4 hours in the air; and air speed may be varied from 70 to 140 miles per hour. A four-place plane provides ample room for the use of radio, maps and other paraphernalia, while a smaller plane is noticeably crowded and reduces efficiency. A shelf over the baggage compartment of the four-place plane provides mounting space for two 25-watt amplifiers weighing a total of 32 pounds. The left wing struts support a compact speaker, as shown in the photograph.

The walkie-talkie radiophone, type SF, is effective for temporary use in the plane. Fitted with an adapter plug and swivel lug attached to an insulated wire antenna, the set can be turned on and off, as with the original antenna, by screwing the plug in or out. The fine wire antenna is extended out the window, which may be closed on it without damage to the window. The outer end of the antenna is taped to the wing strut about 14 inches below the wing, with the tension sufficient to hold the wire fairly straight and with sufficient length inside the plane to permit manipulation of the set. The SF radiophone should be provided with separate microphone and headphone on cords so that the case containing chassis and batteries need not be held by the operator. A kit providing the necessary parts is being supplied for the 1950 season.

The present technique results in considerable saving particularly in the control of lightning fires. Because of it no great expansion of the present lookout system is contemplated. Consistently quicker detection of lightning fires, more positive first attack and quicker control,



The sturdy, compact speaker mounted on the left wing struts does not noticeably alter the flight characteristics of the plane.

and a smaller mop-up job result in savings which amount to several times the cost of plane hire. The added safety in controlling fires while they are still small is probably the greatest advantage, though it is hard to prove by statistics on the fires that don't get away.

[Aircraft operators must obtain CAA approval on each installation of equipment of the character described in this article. Additional information can be secured from the Forest Supervisor, Black Hills National Forest, Deadwood, S. Dak.]

CARGO PARACHUTE EXPERIMENTS

FIRE CONTROL EQUIPMENT DEVELOPMENT PROJECT

Region 1, U. S. Forest Service

CLUSTER PARACHUTE

The cluster parachute consists of three standard 22-foot rayon cargo chutes attached to a common riser which carries the load (fig. 1). The

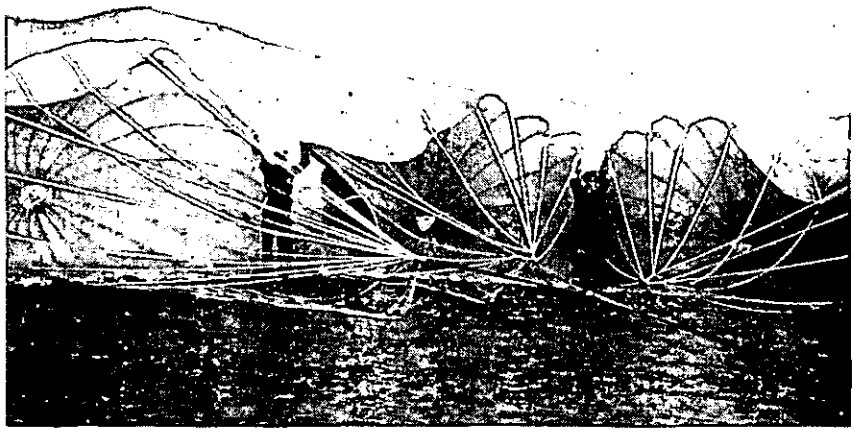


FIGURE 1.—Cluster parachute for loads up to 600 pounds. Note method of attachment to common riser.

distance from perimeter of each parachute to the container or load is 40 feet. Weight of the complete unit, packed in special container, is 66 pounds.

The cluster parachute was devised for carrying heavy loads of water, fuel oil, or equipment. Although total weight (66 pounds) seems considerable, it is less than that of three parachutes packed in separate containers. Advantage of the large parachutes are savings in flying time, less scattering of loads, and means of dropping equipment weighing over 200 pounds. When more than one conventional parachute is attached at the load, the parachutes repel each other, causing a high rate of descent and an increase in the number of malfunctions due to one canopy opening before the other.

Test drops made to date have been successful from a standpoint of damage to cargo but rates of descent are somewhat faster than other special chutes (multiple parachute). There was also a tendency of this parachute to oscillate slightly more than other types tested.

Conclusions were that this parachute arrangement can be improved to obtain a slower rate of descent and perhaps less tendency to oscillate. Because of the tests it is not recommended for general use at this time.

MULTIPLE-UNIT PARACHUTE

This project included development and test of a multiple-unit parachute for use with loads from 400 to 600 pounds. Development of a roller platform for heavy cargo and the increasing demand to drop heavy loads of water, fuel oil, or equipment has created a need for this type of parachute or methods of using standard freight chutes in clusters or pairs. Test drops of equipment, supported by two or more standard chutes attached to the load at a central point, show that the escape of air at the perimeter causes the chutes to repel each other, resulting in a faster rate of descent and contributing toward oscillation in rough air. This was also the case, but to a smaller degree, with the parachutes attached to a common riser.

The multiple-unit chute was constructed of three 22-foot rayon cargo chutes sewn together at the perimeter to form one large triangular canopy. The resulting hole between the parachutes was enclosed by a six-gore, conical chute sewn to the main canopies with zigzag stitching. The length of load lines was varied to allow the canopy to ride flat, and the lines were attached to a single riser of double thickness webbing. The load is attached to this riser.

The weight of this giant parachute is 71 pounds with container. Standard rayon cargo chutes weigh 24 pounds each, complete with containers.

Drop tests of the parachute, with a 526-pound load, indicate very good performance. Rate of descent averaged 23.5 feet per second. There was very little oscillation even in fairly rough air. Opening required 2½ seconds, which is fast enough for low-level dropping for greater accuracy.

Figure 2 shows multiple-unit parachute as packed for use with heavy loads. Single large container is easier to handle in plane than three individual parachutes.

This parachute has a definite place and, of the three different types or kinds tested, gives the best all-round performance on heavy loads. It requires special construction and it is not believed that many of the units should be kept on hand except for special jobs.

BASEBALL PARACHUTE

Baseball parachutes are obtained from Army surplus and available for further orders. The parachute is bias constructed and formed, and has a muslin canopy with braided rayon lines. It differs from the conventional flat type canopy in that it assumes a half-round shape when fully inflated (fig. 3). There is no apex vent. The unit is machine-packed in a square, plastic-impregnated fabric container, the upper half of which is lost when the chute is pulled out. Repacking of the chute in the same type of container is impractical although many of them could be salvaged and repacked into a canvas sock, similar to the present standard cargo chute container but of a larger size.

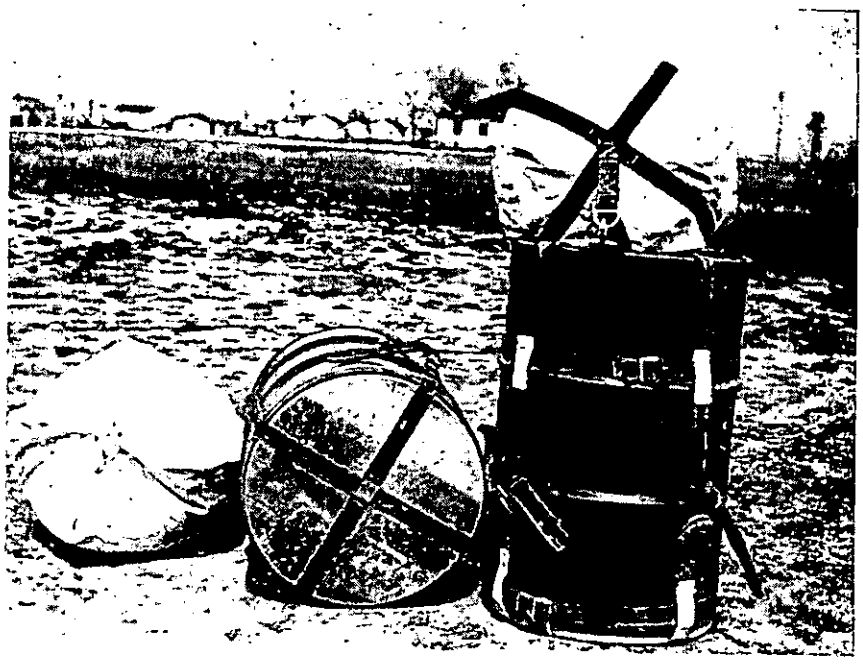


FIGURE 2.—Multiple-unit parachute in container shown with test loads in heavy drums, weighing 526 pounds.

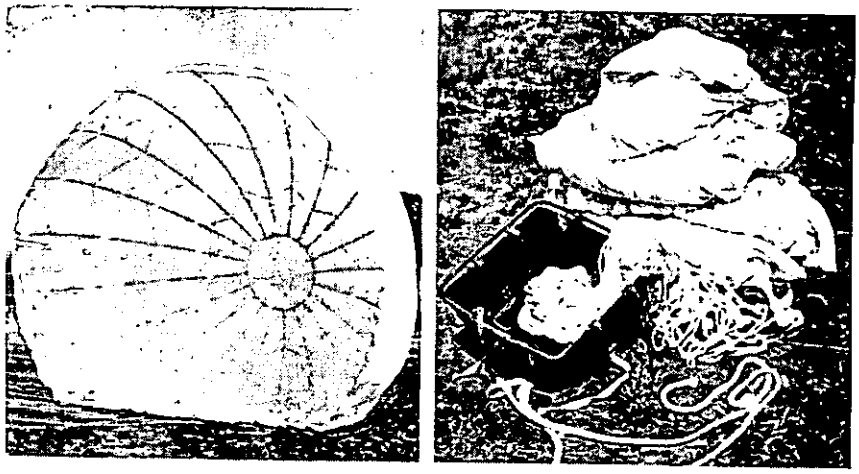


FIGURE 3.—Baseball parachute: *Left*, Extended. Note shape and construction. *Right*, after use. Note bulk of material; half of its container is shown.

The unit, as received and described above, weighs 35 pounds. The diameter of the baseball parachute is given as 20 feet, but because of its formed construction it has a greater surface area than the conventional 24-foot canopy.

903021—50——3

Test drops were very satisfactory. Average opening time was 1½ seconds; average rate of descent, 23½ feet per second with 150-pound load and airspeed of 110 miles per hour. Little or no oscillation and very light landing shock were experienced.

We do not recommend loads over 150 pounds or airspeeds over 110 miles per hour, as opening shock is rather severe (indicated by broken line on one drop). The weight and bulkiness, when repacked into canvas containers, is a disadvantage for smoke jumper use or when several packages must be carried on one trip.

ENLARGED APEX VENT

This project was undertaken to reduce the opening shock of parachutes, used with the long rope attachment, for timber drops. It is believed by reducing the opening shock that a smaller and less expensive long rope may be used. At present one-half-inch rope, preferably nylon, is needed for dropping cargo in heavy timber.

A standard cargo chute was modified to provide a 35-inch-diameter vent in the apex. An 18-inch-diameter bungee ring was installed to close the vent after the opening shock. Modification costs totaled $10.46 for test parachutes. This cost would be reduced considerably if a number of parachutes were modified.

In test drops the parachutes equipped with the apex vent functioned perfectly. Rates of descent were normal. In one drop the long rope (three-eighth-inch nylon) broke in two places but this was an old rope that apparently had lost the elasticity that gives it maximum strength. Also, the cargo was discharged at 110 miles per hour, which is well above the speeds normally used.

We believe it is possible to reduce the labor and material required to modify the standard chute by incorporating the bungee ring directly into the apex of the chute. This is to be tried.

UMBRELLA PARACHUTE

The umbrella parachute is a modification of the standard cargo chute designed to reduce rate of descent and oscillation.

Modification of the standard chute consists of air vents, arranged in a circular pattern, around the upper third of the canopy. The vents are cut across the panels of the parachute and material hemmed on each edge for strength. These vents allow the escape of surplus air which normally is lost around the perimeter and through the apex vent. By "skirting" these vents, additional lift is created over the skirts and the top of the canopy (fig. 4). Skirts are positioned by secondary lines attached to the main lines of the parachute. It is believed that the modification of a number of parachutes may be accomplished when damaged chutes are repaired. The additional material needed for the skirts may be secured from chutes damaged beyond economical repair.

Tests of this chute indicate that further study is needed to perfect the modification, although rates of descent appear to be slower than those of conventional parachutes and there is a noticeable decrease in the oscillation in rough air. Average rate of descent of the umbrella parachute on test drops made to date is 22 feet per second with 150-pound load.

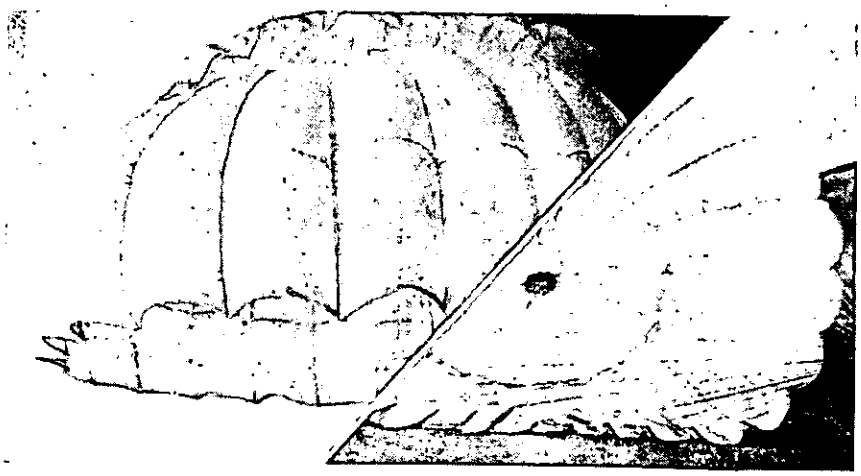


FIGURE 4.—Umbrella parachute: *Left*, skirted lobes arranged in the canopy; *right*, arrangement of vents in upper third of the canopy.

12-FOOT RAYON PARACHUTE

This region recently purchased 200 12-foot orange rayon parachutes (Army surplus) for use with light cargo. Performance tests were made and the record established in case others become available or we receive requests for information concerning this type from other regions.

The parachutes will be repacked in small canvas containers for use in this region. Weight is approximately 1 pound. Initial cost of the parachutes was $2 each.

In general, these small chutes are suitable for loads up to 50 pounds. Fragile loads, or water in 5-gallon cases, should not weigh over 32 pounds. Opening characteristics were superior to the coffin-silk flare chutes used extensively in this region for smoke-jumper packs, light loads of subsistence or water, and other equipment.

ROLLER PLATFORM FOR DISCHARGING AIR CARGO

FIRE CONTROL EQUIPMENT DEVELOPMENT PROJECT
Region 1, U. S. Forest Service

The region has been using two Douglas C–47 airplanes extensively for aerial freight delivery and smoke-jumping activities. Cost per hour is but little more than that of the Fords and Travelairs because of the faster cruising speed. The big planes do require, however, more maneuvering time for dropping cargo in difficult areas. The roller platform was built to enable freight droppers to discharge heavy cargo or multiple bundles quickly and easily at the proper time. The advantages are: (1) Reduction of flying costs; (2) less scattering of bundles on ground; (3) greater dropping accuracy; (4) ease of handling heavy cargo such as a barrel of fuel oil; (5) safety of operation.

The platform frame is constructed of welded, square steel tubing arranged to support ball-bearing rollers made of aluminum tubing. Twelve rollers were used in this model but drawings and specifications are being revised to include two additional rollers. These additional rollers will be installed in the two outside panels in line with the second roller of the center panel. This will provide five rollers on the outside edge instead of the four shown in figure 1.

A sheet of aluminum is riveted to the framework on the upper side and slots cut for the rollers to work in. The rollers extend approximately one-fourth inch above the platform. Pins on the front corners position the platform in the door of the plane.

FIGURE 1.—Bottom view of platform showing construction details. Pin in front corner is for positioning platform in door of plane.

The roller platform has performed successfully in all test drops. We have discharged loads weighing 1,196 pounds with one man only on the lifting bar. With multiple bundles, the practice is to space them as far apart as possible and following each other as they leave the door. Parachutes fouled each other temporarily in opening on one test, but loads were undamaged on landing.

Total cost of the development was $353. Similar roller platforms may be constructed for approximately $200 for labor and materials, with smaller platforms costing correspondingly less.

As a result of tests made on this unit, we plan to construct a roller platform for use in the Ford and Travelair airplanes. Although smaller in capacity, the roller platform in these planes will discharge cargo faster and easier than present methods.

The lifting device consists of tubular handles, with rollers made of ball-bearings, and offset arms slotted to engage a bar in the rear of the framework (fig. 2). Not shown in the picture is a rubber pad which is installed between the floor of the plane and the platform. This rubber pad engages the rollers when the platform is lowered to prevent the rolls turning while the platform is being loaded for a drop, or until the platform is raised to discharge the cargo. This is an important safety precaution and makes it easier to load the platform in flight.

When the platform is raised, the rolls are free to turn, and the incline is sufficient to cause loads to roll by gravity. A sheet of heavy cardboard under odd-shaped or roped bundles will allow them to roll out easily.

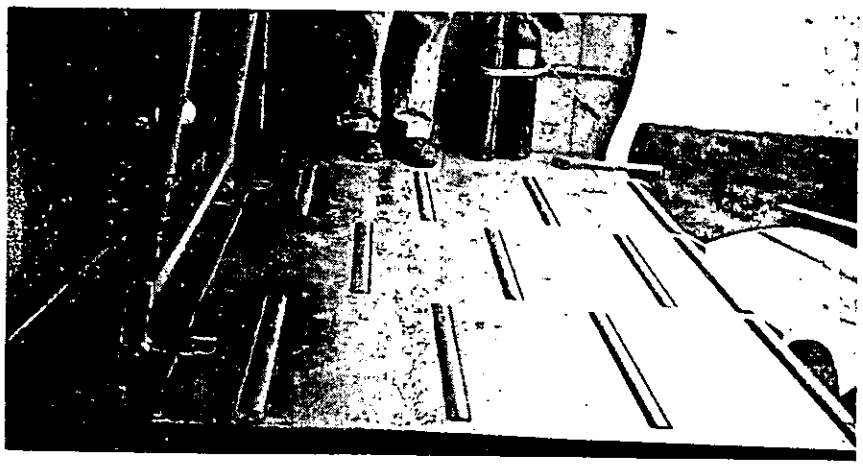


FIGURE 2.—Platform in flat position in door of airplane. Pulling the handle at left to the floor raises platform to unloading position.

CARGO DROPPER'S SAFETY HARNESS

FIRE CONTROL EQUIPMENT DEVELOPMENT PROJECT
Region 1, U. S. Forest Service

The development of a safety harness for use by cargo droppers has been discussed many times. Fire control personnel have been in agreement that it was badly needed but objections to its use were as follows:

1. It hampered or restricted movement of the cargo dropper in discharging bundles of air cargo unless the safety line was long enough to allow free movement inside the airplane.
2. With a restraining line long enough to allow free movement, there was the possibility of cargo droppers falling part way or entirely out of the airplane door.
3. If a parachute was not worn, there was always the possibility that, in an emergency during low-level flight, it could not be attached in time to do any good.
4. If a parachute was worn with the dropper's safety belt, there was a possibility of the parachute being opened accidentally while handling cargo, and the canopy opening outside the airplane. In this event, droppers did not want to be tied to the airplane.

It had been proposed that a bar or strap be hung across the door of the airplane for the dropper to grab in an emergency. This substitute hampered the discharging of cargo and was never considered a satisfactory arrangement.

Discussions brought out several suggestions and possibilities which have been combined in the cargo dropper's safety harness described here.

The safety harness has been designed to use with airplanes equipped with overhead cable running lengthwise of the airplane. This arrangement is satisfactory for use by smoke jumpers or in freight delivery, and requires only that parachute static lines be of the proper length. The safety line is adjusted to allow the dropper free movement in working the cargo at the door, but in the event he should fall, the pull on the safety line swings him back towards the center of the plane to a position directly under the overhead cable. Length is such that the dropper cannot fall out of the door. Movement in the plane is accomplished by sliding the cable snap along the cable as necessary.

The harness is designed to be quickly removable in an emergency. The quick-release fastener releases shoulder and waist straps immediately when struck with the hand. There are no loops in the harness to slide out of. Until the harness is released, the parachute cannot come out of its container even though the rip cord should be accidentally pulled.

Tests of the dropper's safety harness have been satisfactory and the harness is approved by experienced men who tried it.

Cargo dropper's safety harness: Front view showing quick-release box; back view showing arrangement of harness to prevent parachute from being opened accidentally.

Drawings and cable installation instructions are available to those who care to make tests of the harness from the Regional Forester, Federal Building, Missoula, Mont.

[A recent report of a contract cargo dropper's life being saved by parachuting from a crashing plane only 150 to 200 feet above the ground indicates that wearing of parachutes by cargo dropping personnel has more merit than generally believed.—Ed.]

PORTABLE LINEN HOSE WINDER

AUSTIN H. WILKINS
Deputy Forest Commissioner, Maine Forest Service

The Maine Forest Service uses large quantities of 1½-inch linen hose in 100-foot lengths with slotted lug aluminum alloy I. P. T. couplings. In handling this kind of hose, fire wardens have long been interested in some portable type of hose winder. Many have devised home-made models but none which could be declared as suitable for standard equipment.

Double-rolled 100-foot length of linen hose; female end overlaps and protects male coupling threads.

In the winter of 1948 the writer attended a forest fire protection meeting of the Canadian Society of Forest Engineers at Fredericton, New Brunswick. During the meeting a portable hose winder for linen hose was displayed. Through the courtesy of the New Brunswick Forest Service a blueprint of this model was made available to the Maine Forest Service. With some remodeling of the New Brunswick sketch, Maine has made a number of these hose winders, which are now considered standard equipment for each forest fire warden's headquarters.

These hose winders are relatively simple to construct and cost of materials should not exceed 10 dollars. The main office has been securing the hardware and sending it to the warden where the rest of the construction work is completed. There are no patent rights on this winder and anyone interested can easily make his own.

In Maine the wardens are instructed to roll linen hose double with the female end longer so as to overlap the male coupling and form a guard for the threads.

Some wardens have been using this winder satisfactorily for quickly picking up wet and dirty hose off the fire lines to be loaded on to trucks and taken to the storehouse for cleaning and drying. When rolling up clean and dry hose at the storehouse, each roll is tightly wound and ready for service or storage.

This hose winder is not designed for 1½-inch single or double jacket rubber-lined hose. However, it can be used by making the side pieces of the frame above the sockets a little longer.

PUBLISHED MATERIAL OF INTEREST TO FIRE CONTROL MEN

Smoke Jumpers in Action, by J. Morgan Smith. In Disaster, April 1950, published by American Red Cross.

On Fire Prevention, by Clint Davis. In Disaster, April 1950, published by American Red Cross.

Aerial Means of Fire Suppression, by A. Koroleff, Director of Woodlands Research, Pulp and Paper Research Institute of Canada, 3420 University Street, Montreal 2, Canada. Woodlands Research Index 82 (F-3), April 1950.

Forest Fire Control, by P. A. Thompson. Journal of Forestry, April 1950.

Use of Aircraft by the U. S. Forest Service. A mimeographed paper by U. S. Forest Service, Washington, D. C., revised February 1950.

Control Wildfires—Protect Growing Trees, in Does Farm Timber Growing Pay in the South, by Extension Service and Forest Service, U. S. Dept. Agr. Leaflet 277. 1950.

Those Japanese Balloons, by Brig. Gen. W. H. Wilbur, U. S. Army, retired. Readers Digest, August 1950.

Wet Water for Forest Fire Suppression, by Wallace L. Fons. Forest Research Note 71, June 27, 1950. California Forest and Range Expt. Sta., 347 Forestry Building, Univ. Calif., Berkeley 1, Calif.

Prescribed Burning in the Slash Pine Type, in Management of Natural Slash Pine Stands in the Flatwoods of South Georgia and North Florida, by Robert D. McCulley, forester, Southeastern Forest Expt. Sta., Forest Service, Asheville, N. C. U. S. Dept. Agr. Cir. 845. 1950.

Fire Fighter—and More, by Charles A. Wentzel, senior ranger, Department of Forest and Waters, Pennsylvania. Published in the Philadelphia Inquirer Magazine, July 23, 1950.

Smoke Jumpers Fight Forest Fires, in Montana, Shining Mountain Treasureland, by Leo A. Borah, National Geographic Magazine, June 1950.

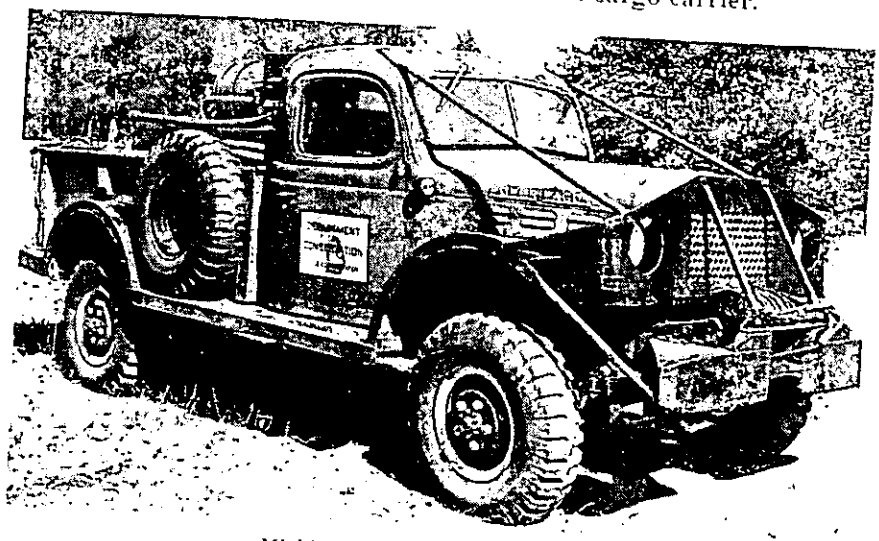
903091—50——4

MICHIGAN POWER WAGON FIRE UNIT

GILBERT I. STEWART

Supervisor, Michigan Forest Fire Experiment Station

The power wagon as used by the Michigan Department of Conservation for forest fire control is a four-wheel-drive truck that equals wheeled tractors in its ability to traverse difficult terrain. The commercial truck requires considerable refinement to adapt it to fire control purposes inasmuch as it is a standard cargo carrier.



Michigan power wagon fire unit.

The basic design was completed at the Michigan Forest Fire Experiment Station. Field experience over the past 3 years has added to the final machine and as the unit is now issued, it is the result of work and suggestion by the entire fire organization. The truck lends itself very well to use as a medium tanker for fire fighting. To fulfill this assignment, the following installations have been added to the commercial truck:

1. Drive shaft leading from the transmission and driven by the commercial attachments for the rear power take-off. Cross members were added to support bearings and the drive shaft, which is actually a jackshaft lying within the chassis frame.
2. Complete armor around the entire body. This includes a radiator grill and protection for the headlights, heavy angle members attached to the fenders and running boards, and a rear bumper and trailer hitch.

3. Slip-on tank unit mounted on a skidlike base. It is removable and may be repositioned exactly by indexing points. The tank unit also includes a high-pressure pumping unit mounted on a steel deck behind the tank. The pump is driven by a multiple V-belt system from the special drive shaft mentioned. A hole in the truck deck permits passage of the belts from the shaft to the pump sheave, and a guard covers the belt system. Capacity is 15 gallons per minute at 600 pounds pressure. Also included in this pumping system is a tank filler operating on the ejector principle. Its purpose is rapid refilling of the tank at supply points.

4. Live reel for hose storage and pumping service.

5. Full radio equipment. This consists of an FM unit operating on a frequency of 46580. The radio instruments are in a steel case mounted on top of the tank. Cables run from the instruments to controls on the dashboard near the driver. They are contained in waterproof and steel casings.

6. Complete tool equipment for pumping service, maintenance, and field upkeep. This includes all pump accessories, nozzle gun, etc. All of these items are contained in a sturdy tool box with recesses for each part. Full operating instructions are mounted in a watertight frame in the lid of the box. For purposes of compactness and utility of space, the tool kit is carried on top of the radio case and below the level of the cab.

This outfit is assigned as initial attack equipment. The tank capacity of 300 gallons permits working time of 1 to 1¾ hours depending on fuel types and skill of operator. Accessory equipment consists of two hand-operated plunger pumps, three shovels, and one ax. Two seats may be mounted at the rear of the body for extra men. The normal crew need not exceed four men.

This model of power wagon and the additional equipment has been under development and production by the Michigan Department of Conservation since 1946. Twenty of these are now in service. Full print specifications have been completed as well as tooling for production. Patterns for all necessary castings are completed. Total cost averages about $3,300, not including radio equipment.

Experimental work to extend its usefulness in fire control is being continued at the Forest Fire Experiment Station. Included in the experiments is the attachment of hydraulically operated plows at the rear of the truck, to be used when possible in line building.

It should be borne in mind that the power wagon does not compete with crawler tractors and plowing units. Its development was intended to provide a relatively fast tanker that would not be road-bound. It actually supplements the crawler tractor and plow. These two units cooperating as a team are capable of effective action, especially at heads of fires where line must be built or where critical sectors must be held while line is being built and at critical points not hitherto possible of attack.

Additional information on this unit may be obtained from State Department of Conservation, Lansing, Mich., or Michigan Forest Fire Experiment Station, Roscommon, Mich.

SOUTH CAROLINA'S TYPE C–150 LIGHT SUPPRESSION PLOW

J. A. McLees

Fire Control Engineer, South Carolina State Commission of Forestry

This plow was designed and developed by the Engineering Section, Branch of Forest Fire Control, South Carolina State Commission of Forestry to fill the need for a light suppression plow that could cope with conditions encountered in the heavy and wet soil types of the coastal plains region. Development was started in January 1950, and the plow was ready for "fire test" during the spring blow-up. Specifications are as follows:

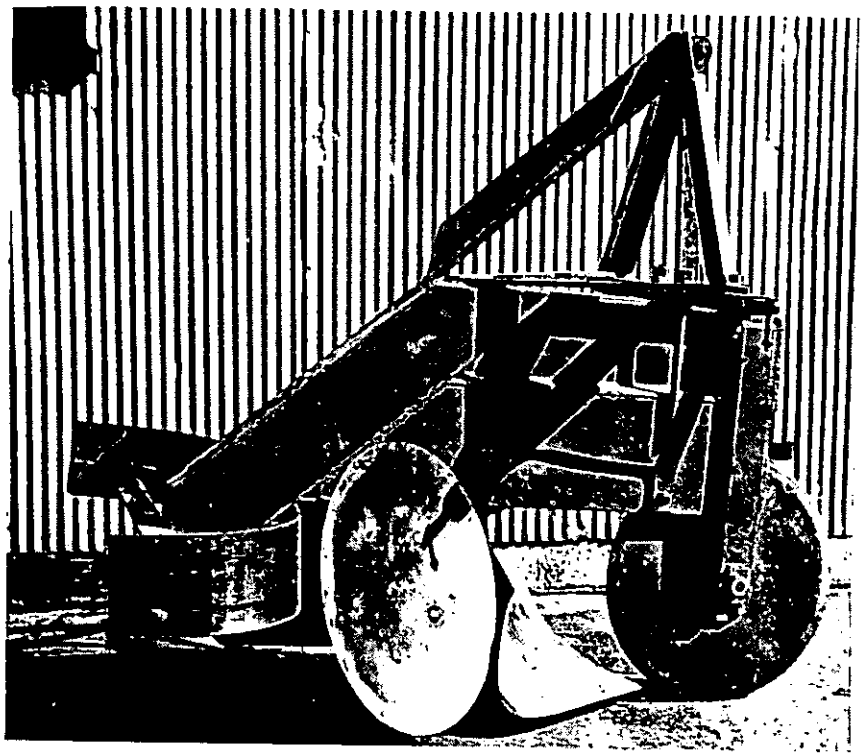
Weight	515 pounds.
Coulter:	
Construction	Cast steel (South Carolina State Commission of Forestry foundry pattern).
Outside diameter	18 inches.
Shape	Cast taper, machine beveled.
Hub	Steel plate, bronze bushing.
Lubrication	Zerk fitting.
Middlebuster point	Cast steel (South Carolina State Commission of Forestry pattern).
Disks	18-inch diameter, farm type.
Main beam	Design; high torque resistant box beam.
Draw bars	Same as Dearborn Cross draw bar.

The middlebuster plow point is not of commercial manufacture, but is of cast steel from a pattern developed by the commission.

Pilot models of this plow carry coulters of machined steel plate. Production models are fitted with a heavy steel coulter, machine beveled, and cast from the commission's aluminum pattern.

The 18-inch disks are carried on heavy duty, dust-sealed hubs, cast from the commission's foundry pattern. The hubs are fitted with Timken bearings. Disks are of commercial manufacture.

The firebreak cut by the unit has an average depth of 4 inches with a cut width of 30 inches. The cut section together with the variable throw provides an effective firebreak of 42 to 60 inches, depending upon the soil condition. The plow constructs an exceptionally clean line and its sturdy construction is an advantage over many other types of light suppression plows tested under South Carolina conditions. It is adequately drawn by Ford or Ford-Ferguson type tractor equipped with bombardier half track system or the H. G. crawler tractor in the 20 horsepower range.



Light suppression plow with specially designed middlebuster plow point and coulter.

Portable Electric Megaphone.—Late in the fall of 1949 a portable electric megaphone was loaned to the Superior National Forest by a commercial company, for testing the feasibility of broadcasting messages from airplanes to ground crews engaged in fire suppression. The short time remaining in the fire season left little opportunity to make exhaustive tests and come to any very definite recommendations. However, some tests were made from each of the three Forest Service planes.

Reception, volume, and clarity was very good from the two-place Piper Cub at elevations near 500 feet. At 1,000 feet reception was fair, while at 1,800 feet it was intermittent, i. e., fair if plane was up wind from the listener, and not audible if the plane was down wind.

A test was afforded from the four-place Stinson during the search for a lost hunter. With the plane flying at an elevation of 500 to 800 feet over an area of about four square miles, the searching party was able to clearly hear the announcement that the lost man had been found. On another occasion, the megaphone operated ground-to-ground points during a stormy night trying to call a lost hunter out of the woods. It was later learned that the hunter heard the voice of the searcher but, it being night, was afraid to leave his fire.

When the megaphone was operated from the Noorduyn-Horseman nine-place plane, reception was poor. This was probably due to the high noise factor from the plane and the elevations required for flying the large-sized craft.

From the few tests made, the Superior Forest believes the megaphone would be very practical in talking to fire crews from small planes such as the Cub and Stinson. It would also be practical in large fire camps for amplifying instructions and announcements.—W. J. Emerson, *forester, Fire Control, Superior National Forest.*

PRELIMINARY REPORT ON THE USE OF A TRACTOR-PLOW IN THE SOUTHERN APPALACHIANS

R. D. Williams

District Ranger, Chattahoochee National Forest

An H. G. crawler tractor with a middlebuster plow has been used in fire suppression on the Armuchee Ranger District since the spring of 1949 with promising results.

The Armuchee is the westernmost district of the Chattahoochee National Forest situated in northwest Georgia. The area is characterized by a series of long linear ridges rising up to 800 feet above the floors of the intervening, wide agricultural valleys. Most of the 146,525 acres protected lie in the ridges where soils are stony and large rock outcrops are frequent. Topography is rough and slopes are steep. About one-fourth of the timbered area is a hardwood type, and the other three-fourths yellow pine-hardwood. Underbrush is heavy and fires in the predominant leaf-needle litter burn with a high rate of spread and medium resistance to control. Slash areas resulting from heavy logging of private lands, and sedge grass and advanced reproduction on numerous abandoned fields interspersed throughout the area, form the most explosive fuels.

During the 5-year period 1944–48 an average of 31 fires burned 784 acres annually. Prior to 1949 suppression was handled entirely with hand tools by the district ranger, 2 seasonal Fire Control Aids, and 7 voluntary fire wardens with trained "pickup" crews. The original force has been retained. The tractor-plow was added to strengthen the organization. Although approximately 10 percent of the protected area is too rough for tractor operation, fires occur infrequently in the rougher sections, and during 1949–50 the unit could have operated on every fire that occurred.

The tractor-plow assigned to the Armuchee District has a total weight of 5,130 pounds, total length with plow lowered of 14 feet, and maximum width of 5 feet. Treads are 10 inches wide. The 4-cylinder motor gives tractor speeds at governed motor speed of 2.02 miles per hour in low gear, 3.19 miles per hour in second, 5.25 miles per hour in high, and 2.35 miles per hour in reverse.

To the commercial tractor were added: Heavy radiator guard; brush guard rising 3 feet above the operator's seat; safety guard over the top of the treads; front bumper reinforcement of 300 pounds of railroad steel to counterbalance the weight of the plow; and a spotlight and rear-mounted headlight (or taillight with clear lens), which were essential for night work. Mounted on the tractor is a back-pack pump, drip torch, three council rakes, short-handled shovel, and Pulaski tool. A standard six-man tool box is mounted on the carrier truck.

The plow weighs 398 pounds and is raised and lowered by a hand winch. It is adjusted for depth of line by changing the pitch of the beam at the clevis. The plow has a 24- by 32-inch moldboard and 36-inch wingspread. In most soils it constructs line 6 inches deep at the center and 54 inches in width, including throwback.

The unit is transported on a 1½-ton stake truck with a 7- by 9-foot flat body and a 5-foot ramp sloped to a 21-percent grade. Portable runplanks complete the ramp to the ground. The truck can travel safely at 45 miles per hour on good roads and the unit can be unloaded and placed in operation by two men in 1 minute (fig. 1).

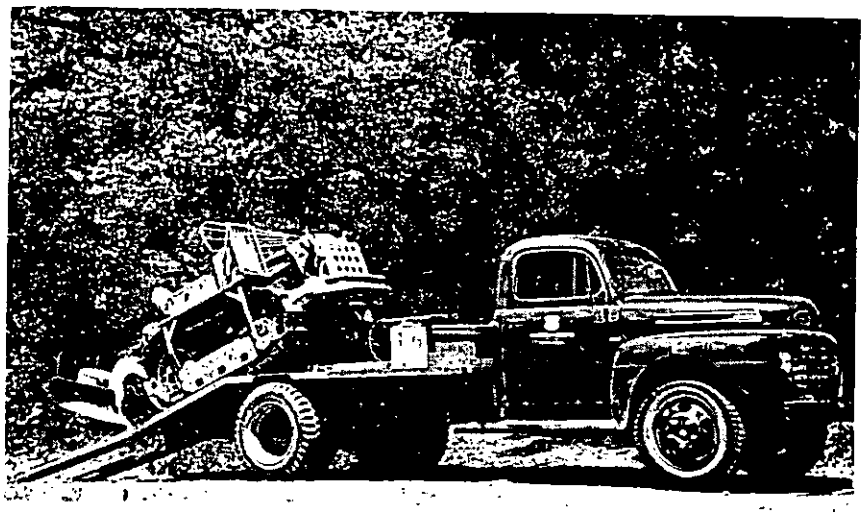


FIGURE 1.—Unloading the H. G. crawler tractor with middlebuster plow. The unit can be unloaded and placed in operation by two men in 1 minute.

The tractor operates efficiently downhill on slopes up to 70 percent, uphill on slopes up to 40 percent, and sidehill on slopes up to 45 percent (fig. 2). Where slopes are too steep for sidehill and uphill operation, the tractor is backed uphill and builds line downward. The outfit performs satisfactorily in rough, rocky terrain and good results have been obtained on night fires.

Organization plans call for immediately dispatching the tractor-plow to every fire in "plowable" area as shown on the control map. When the need is indicated, a warden crew is also dispatched to handle sections of the line too rough for the tractor, and to perform mop-up so as to release the tractor crew for another fire. On class 2 and 3 days, the tractor crew consists of the operator, backfire torchman, and follow-up man with a council rake and back-pack pump. On class 4 and 5 days, two additional men are carried to back up the line. A front scout is necessary if the country is very rough and is always necessary at night. Most fires are controlled by the parallel method as our fires seldom crown. Fusees were found too slow for line firing but drip torches have been used with good results.

From January 1, 1949, to June 30, 1950, 51 fires have occurred on the district. The tractor-plow was dispatched to 36, or 71 percent,

FIGURE 2.—Downhill operation on a 70-percent slope. The tractor performs well in steep, rocky terrain.

of these and operated on 29 fires, or 59 percent. It was not needed on arrival at 7 fires and was not dispatched to others through error in judgment or because it was known that it would not be needed. The unit built 895 chains of line at an average rate of 50.6 chains of held line per tractor-hour and a held line average of 16.9 chains per man-hour on the tractor-built sections. Table 1 shows the results obtained on the 29 fires occurring in 1949–50 and 129 fires controlled entirely by hand during the period 1944–48, inclusive. Class A fires and fires occurring on class 2 days were eliminated from the analysis as these are usually easily handled and offer no test of suppression methods.

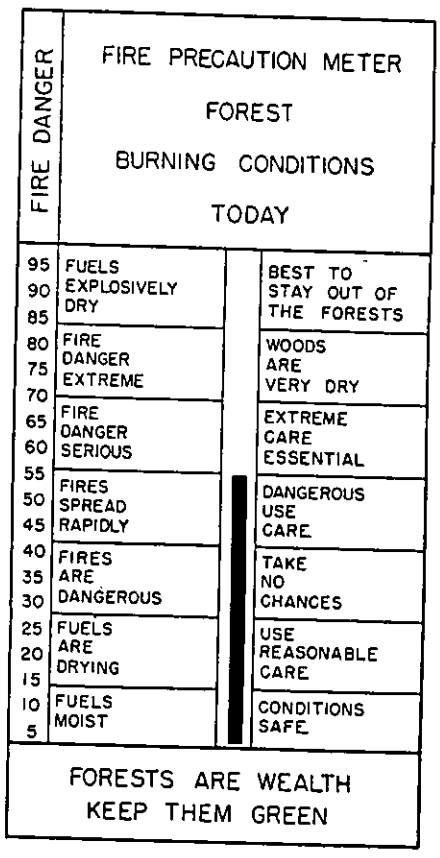
TABLE 1.—*Average size of fire and average time on suppression for hand-tool and plow control on class 3 and 4 fire days*

Fire day and control method	Average size of fires			Average time on suppression		
	Area of attack	Final area	Increase	Line construction	Mop-up	Total
	Acres	*Acres*	*Percent*	*Man-hours*	*Man-hours*	*Man-hours*
Class 3:						
Hand-tool	10. 3	18. 8	83	14. 53	19. 67	34. 20
Plow	8. 8	11. 4	30	5. 74	12. 00	17. 74
Class 4:						
Hand-tool	18. 6	46. 9	152	36. 32	29. 00	65. 32
Plow	8. 6	12. 3	43	5. 98	18. 00	23. 98

Plow-controlled fires are smaller at initial attack because the unit is immediately dispatched, whereas warden crews are more slowly gathered and get-away time is longer. The final average size is considerably smaller and the advantage of plow over hand-tool control increases sharply as fire danger rises.

Operation and depreciation of the tractor and plow was established at $5.25 per hour. Based on wage rates now prevailing in this locality, the average plow-controlled fire was suppressed at a cost of $22 as compared to $36 for the hand-tool controlled fires. Past occurrence of 26 fires annually on class 3 and 4 days, class B and larger, indicates annual savings of $364 in suppression costs. On this basis alone the equipment is a paying investment. However, greatest saving is the reduced acreage burned and reduction in possibility of large disastrous fires. The outfit, too, has a definite prevention value. Job fires which were becoming a problem in one area practically stopped after the tractor was persistently used in place of hand labor.

Fire Precaution Meter.—The more the traveling public and local people become aware of fire danger conditions, the more we can expect caution will be used by people in forested areas during the fire season. For that purpose, a fire precaution meter was devised on the Helena Forest in 1937. Both of the local daily papers, Montana Record Herald and Helena Independent, agreed to carry the meter each day during the fire season. It attracted immediate attention and comment by local readers, and the two papers came back with a request for it in 1938. The first printing was accompanied by a short article explaining the purpose, etc. It was devised as a representation of a thermometer with a line in the center to represent the mercury tube.



Recently revised slightly to fit the present class 100 danger meter, and with some change in wording, it is now being carried in Coeur d'Alene, Idaho, and Spokane, Wash., dailies during the fire season. Similar precaution meters could well be devised for use in daily papers in other regions and parts of the United States where fire conditions and man-caused fires are a problem during varying seasons of the year.

The meter has little value other than in daily papers. It carries a very brief description of each of the seven fire danger levels in the left-hand column. Opposite are briefed measures of precaution which should be observed by people living or traveling in forested areas. A studied attempt was made to carry the message to the readers in language readily understandable to anyone able to read.

It must also be remembered, once such an arrangement is worked out with a newspaper, an obligation exists to decide on what danger rating is to be run and notify the person who is to receive the information in plenty of time to go to press.—V. L. Collins, *district ranger, Colville National Forest.*

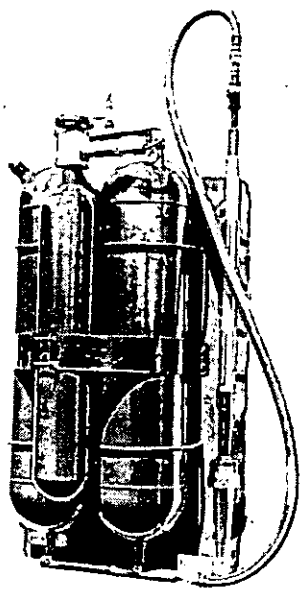
CO_2 BACK-PACK OUTFIT

A. B. EVERTS [1]

Fire Staffman, Snoqualmie National Forest

The subject of pressurized back-pack outfits has come in for considerable discussion by forest protection men. Usually the discussion centers around the use of a CO_2 cartridge for discharging liquid from a pressure cylinder. The disadvantage of the cartridge idea is that the pressure does not remain constant. In order to have sufficient pressure to properly expel the last of the extinguishing agent, it is necessary to overcharge the cylinder at the beginning of the operation. In the dry powder type of extinguishers this problem is provided for by using a heavy cylinder for the powder. This, obviously, increases the weight and would be undesirable in a back-pack outfit.

Test data were obtained on a constant pressure back-pack outfit, constructed mostly from surplus materials. To check pressure data the test outfit was provided with a pressure gage. This gage would be unnecessary for field use. The price a manufacturer would have to get for such a unit, using new materials, would probably be out of reach for most protection agencies. Nevertheless, performance data are interesting.



The CO_2 bottle in the center will expel the two presure tanks better than seven times, maintaining a constant pressure of 100 pounds. Plastic foam nozzle is shown.

Two surplus, stainless steel, shatterproof oxygen tanks with a combined capacity of 4¾ gallons were fastened to a plywood packboard. These tanks were tested to 600 pounds and provided with a safety release set at 200 pounds.

A 10-pound CO_2 bottle (also surplus) containing 3¾ pounds of CO_2 is mounted between the two tanks.

A regulator valve (surplus) set at 100 pounds is screwed into the outlet of the CO_2 bottle. This valve has a soft blow-out disk as is common with such regulators. Thus, there are two safety devices. This valve allows the CO_2 to feed into the pressure tanks through a copper tube, keeping the pressure constant at 100 pounds.

The two tanks are joined at the top and bottom by tubes so that

[1] Recently transferred to the Division of Fire Control, Northwest Region, United States Forest Service, to handle fire control equipment.

only one filler cap is needed. This arrangement also permits equal pressure distribution.

The nozzle is a 2-foot tube which can be provided with straight stream and fog or foam tips of any desired design or capacity. A press button, spring tension valve, operated by the palm, controls the discharge. There is no doubt that this arrangement allows more efficient water application than the hand-operated pump common on back-pack outfits.

The weight of the unit, fully charged with liquid and CO_2, is 65 pounds, or 10 pounds heavier than the conventional units.

With the temperature at 48° F. the 3¾ pounds of CO_2 expelled the two tanks eight times. On the last charge the pressure dropped to 20 pounds.

Using a small plastic foam nozzle and one quart of high expansion mechanical (liquid) foam and the rest water, 35 gallons of foam was measured. Thus, the potential foam capacity of the CO_2 is 280 gallons. The unit operated for 2 minutes, producing foam at the rate of 17.5 gallons per minute.

The unit operated 3¾ minutes with a straight stream tip; 1¾ minutes with fog. These figures mean little, however, as the size of the orifices in the tips determine the length of operation.

The disadvantage of a pressure unit of this kind, besides the cost, is that the CO_2 bottles have to be recharged. In most locations this entails shipping the bottles to a refilling plant. Open top converters, which could be recharged on the ground with dry ice, would be an improvement. Using wet water and the proper fog tips, the unit should be an effective outfit for extinguishing fires in overstuffed furniture and mattresses, a common type of fire for city fire departments. The foam unit should be effective on restaurant range fires, involving burning grease. On the forest fire line, however, it is a little too complicated and too subject to injury. For motor patrolmen, it might have a value.

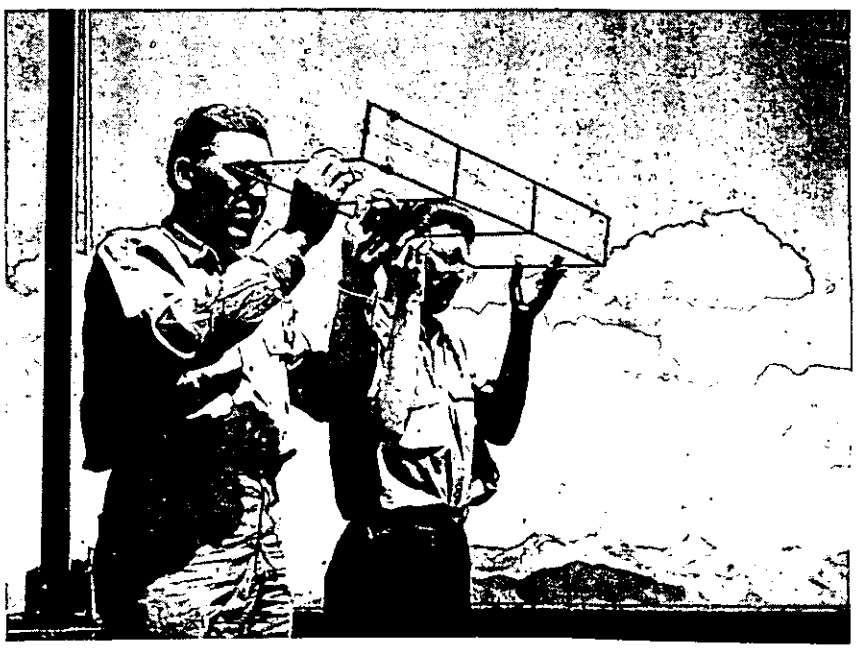
For home use applying 2–4D, DDT, or whitewash with a fog tip, it definitely has possibilities—approximately 32 gallons of liquid easily and effectively applied with 3¾ pounds of CO_2. If the unit had an open top converter, it would cost about 12 cents to recharge the converter with dry ice.

[Additional information may be obtained from the author, in care of Regional Forester, Post Office Building, Portland 8, Oreg.]

A SIMPLE LOOKOUT TRAINING AID

GLENN E. BRADO
District Forest Ranger, Sawtooth National Forest

Each time a new man is placed on a lookout he has to be trained in the various phases of the lookout job. One of his first duties is to "learn the country." This may be done in a number of ways but we have found the training gadget shown in the photograph to be very useful.



Training aid being used; dimensions are 36 by 12 by 4 inches.

The framework of the training aid is ¼-inch iron rod, welded together. The frame may be made any convenient size but should be long enough to enable the trainer and trainee to stand side by side. The cross hairs on one end of the frame are attached to movable sleeves which are locked in place with one-quarter-inch nuts. This provides for adjustment in making the lines of sight parallel. The eye pieces are one-quarter-inch flat washers welded in place; and the cross hairs are made of length of fish line.

To adjust the training aid, simply place the frame on some convenient support with the rigid cross hair centered on some prominent object a mile or so away. Then, *without* moving the frame, adjust

the movable cross hairs until they are centered on the same object. If the eye pieces are 30 inches apart and the lines of sight are parallel, the error will be negligible for lookout training purposes.

The training aid can be used by the training officer in pointing out features of terrain such as creek bottoms, ridges, and prominent landmarks, or by the ranger or other inspecting officer in checking on a lookout's knowledge of the terrain.

In training, the instructor and trainee stand side by side. The instructor should control the movement of the frame and hold his cross hair on the particular topographical feature he is describing. The trainee lightly supports his end of the frame and follows the instructor's movements. With the frame in proper adjustment it is readily apparent that both men look at the same object. By slowly moving the frame, the instructor can trace out creek bottoms, ridges, etc., and the two men can carry on a conversation at the same time.

For checking a lookout's knowledge of the country, the procedure is reversed. As an example, the ranger may ask the lookout to trace out the ridge between Lake Creek and Eagle Creek. The lookout then controls the movement of the frame and the ranger follows his movements.

This training aid is a good supplement to the map and fire finder, and has the following advantages: (1) It can be made in any shop in a very short time, using materials on hand; (2) it is especially useful in pointing out difficult terrain; and (3) it is a time saver.

Air Force Fights Fire on Tonto Forest.—The advantage of airborne attack forces was brought home to the Tonto National Forest on the Lewis Creek fire in June. The fire was discovered under the Tonto Rim about 2 p. m. on a Saturday afternoon, the opening date of the fishing season, a time when it is very difficult to secure local help. Shortly after 3 p. m. it was determined that adequate local help was not available, and a call was made to Williams Field, approximately 130 miles away. Men were assembled, flown to Payson Airport, and hauled 20 miles by truck, all within a period of less than 3 hours.

Twenty-five arrived in the first crew, all in one plane. They were young, husky individuals, willing to work; in fact, anxious to do so. Two of them were assigned to kitchen detail, and were most unhappy because they were prevented from fighting fire. An experienced crew boss was assigned to each five men. The men were held for approximately 24 hours, on the fire line over half the time. Then another crew of 25 was flown in and the first group returned to Williams Field. These men arrived on the fire in less than 3 hours, and after the first call could have been gotten there in less than 2 hours. It would have required at least 12 hours to secure men by truck from any other outside source.

This splendid cooperation resulted from a "memorandum of understanding" which was developed several years ago between the 3525 Pilot Training Wing at Williams Air Force Base and the Tonto National Forest for emergency use. The agreement provides for furnishing from 25 to 200 men by the Air Force, including transportation, suitable clothing, rations, and kitchen and mess equipment, as well as drinking water facilities and medical attention, and goes into some detail as to the procedure of assembling the men. They are recruited on a voluntary basis. We were told by the officers in charge that not the least difficulty was experienced in securing men. They said at least 200 would have volunteered, and they were anxious to come. This was borne out by the attitude of the men on the job, who really seemed to enjoy working on the fire, in spite of the fact that it was difficult and arduous labor. The businesslike and courteous attitude of the men generally was a source of much faborable comment by those who had an opportunity to work with and observe them.

The prompt and efficient action of the Williams Air Force Base undoubtedly averted a serious fire which would have caused great damage to an important recreation area and other national forest resources—PERL CHARLES, *assistant supervisor, Tonto National Forest.*

USE OF LIGHT PUMPERS AND AIRPLANES ON THE SUPERIOR NATIONAL FOREST

WILLIAM J. EMERSON

Superintendent, Ely Service Center, Superior National Forest

For many years fire control in the Superior lake country of Minnesota was exteremely slow and difficult and meant many hours of canoe travel and cross-country packing before the fire was reached. The seaplane, however, together with improved lightweight pumper units and other portable equipment, has revolutionized fire control work in this very extensive area of high recreational values. Water bodies are so numerous, and roads so few, that in many sections all other control methods are considered very difficult or impossible. In fact the seaplane-portable pumper combination has been developed to a point of such efficiency that it is used in initial attack on all fires not readily accessible by motor vehicle, and the portable pumper is a primary tool for mop-up. Even on many fires along roads, it is frequently possible to get quicker action by dispatching a plane pumper outfit from the seaplane base at Ely to a lake near the fire.

Because of existing roadless-area laws and the fact that roads are extremely difficult and costly to build, there will always be many extensive sections where motor vehicles may not be used. Fortunately, this Superior country is blessed with numerous lakes on which seaplanes may land (fig. 1).

The lake shores and islands of the Superior lake country are its areas of greatest fire risk, and the high percentage of fire occurrence in such spots makes the seaplane-pumper combination extremely effective. Every year many shore fires start in the lake country (usually from camp fires), and it is a common experience to suppress such fires with only 100 or 200 feet of hose, quickly landed from a Forest Service plane.

The basic equipment maintained by the Forest Service at the Ely Service Center and Ely Seaplane Base consists of 3 seaplanes and 20 portable pumpers complete with accessories and linen hose. The heavy fire suppression and other transport work is done by the 550-horsepower Noorduyn-Norseman, which can carry as many as five pumper-hose units complete with gasoline and accessories (fig. 2). Or it can transport two or three complete units with pumper operator and hoseman for each unit. Eight fire fighters with personal effects can be carried in the Norseman besides the pilot. The two lighter planes, a 165-horsepower Stinson station wagon and 65-horsepower Piper Cub, are used primarily for detection patrol over the roadless areas and for scouting and mapping work on going fires. All three planes are float-equipped.

Recently the Superior has been experimenting with new smaller and lighter pumpers that can be carried to small fires in the two lighter patrol planes. Of particular interest is the new Pacific Marine light-

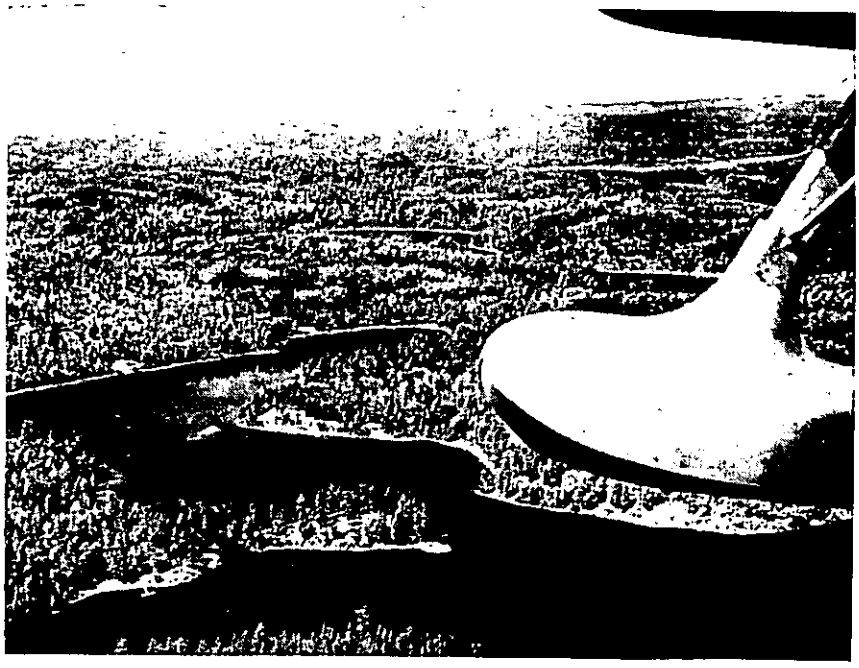


FIGURE 1.—Superior roadless area.

weight "A" pumper which weighs only 36 pounds and is small enough to be carried in the four-place Stinson patrol plane with a two-man pumper crew besides the pilot (fig. 3). A kit, made up to accompany this new pumper, consists of lightweight accessories, 1-inch linen hose in knapsack, small suction hose, and enough mixed gasoline to supply the pumper for the ordinary small shore fire. Small ax, pulaski, and lady shovel complete the kit. The entire pumper unit with hose and accessories weighs only 100 pounds. Use of the smaller plane enables the small initial attack pumper crew to land on many small lakes where the large Norseman plane could not safely land or take off.

The new, lightweight pumper has been in trial use only part of one season and little is yet known about its performance on the Superior, particularly in the many places where the vertical lift from the lake shore to the head of the fire is rather great. On one of the few fires where it was tried during the fall of 1949, the rough, rocky nature of the shore line prevented the seaplane from getting in close. The fire was close to the shore, so the pumper was set up on the float of the plane and the two-man hose crew swam to shore with the light hose. With the seaplane pilot operating the pumper, the crew knocked the fire down with direct water attack before it could get a good start.

Most of the fires which start in this area originate from campfires or lightning and usually require only one pumper unit to be suppressed. However, anywhere from 1 to 10 or even 20 pumper units may be dispatched, depending on information furnished the dispatcher by the patrol plane observer discovering the fire and by subsequent aerial scouting. A short-wave FM radio network, with radios in each plane and tower, portable radios on the ground, and a central control set in

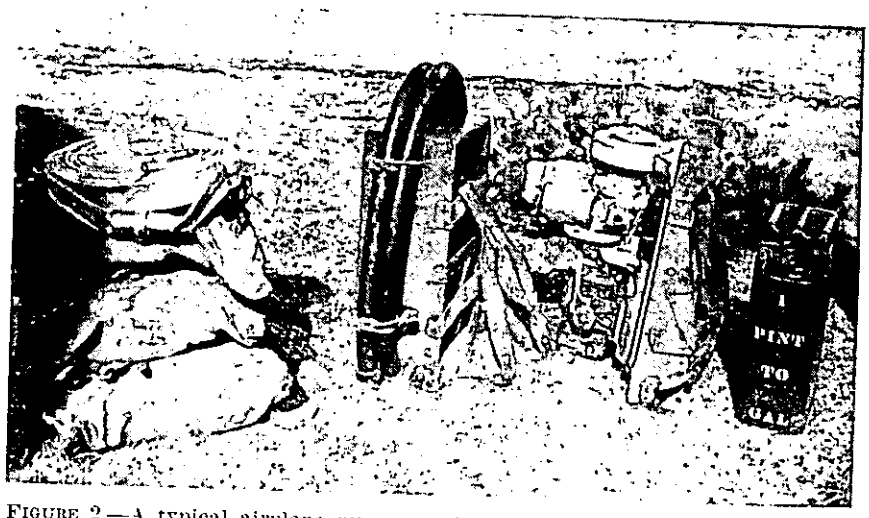


FIGURE 2.—A typical airplane pumper unit on the Superior: Pumper on pack frame, accessory box with intake hose, mixed gasoline, and 1,500 feet of 1½-inch linen hose. This unit is usually transported in the Norseman seaplane with a 4- or 5-man crew for fighting fires in the lake country.

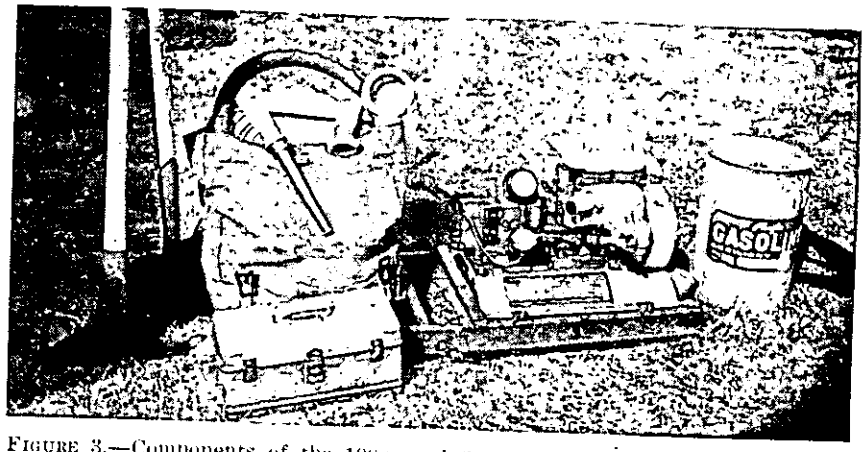


FIGURE 3.—Components of the 100-pound fire kit. Pumper is the new Pacific Marine "A" weighing 36 pounds, mounted on pack frame. This can be operated on shore and island fires in the Superior wilderness country by two men. These two men, the pilot, and the 100-pound kit make up the pay load for the four-place Stinson seaplane.

dispatcher's headquarters, gives excellent communication in this vast forest-lake area. Thus pumper units may be moved from one fire to another without returning to headquarters for instructions.

During peak periods of hazard and risk, small pumper units with two- or three-man crews are sent along on detection patrol flights, so that direct attack may be made on any fire discovered. With this system, fires may be attacked by the small pumper crew only minutes after being discovered by the patrol plane, thereby saving much time and the resultant larger force required by a larger fire.

The new pumpers are also very practicable where the fire suppression equipment must be packed long distances across country. Their compactness and light weight are a vast improvement in this area over the older, heavier portable pumpers, and the small hose and accessories add to the improvement. Two men can pack a complete "A" pumper-hose outfit plus a couple of hand tools apiece for some distance cross country without experiencing severe exhaustion upon arrival at the fire. Here again, Forest Service airplanes frequently make the difference between success and failure on the control job. As soon as a fire is discovered, the dispatcher is able to determine the amount of hose needed by having the plane locate the nearest water chance and estimate its distance from the fire. The direction and distance from the fire and other description of this water chance is provided the pumper foreman so he takes enough hose, but not too much, which would tax unnecessarily the carrying power and speed of the crew going to the fire across country.

On many of these back-country fires, water chances may be available that do not show up on the map. Very small pot holes, wet swamps, intermittent streams, etc., provide enough water hose for fires in many places. During spring and fall, and during wet summers, there have been instances where the only water close to the fire was that lying in a low spot in an old winter logging road. The trained aerial observer is often able to spot such water chances, thereby giving the disptacher and pumper foreman invaluable information shortly after the fire is discovered.

The air observer, by means of FM handy-talkies, is able to direct the pumper crew to the fire or water chance, or both. One member of the crew carries the handy-talkie, while his partner carries a bright orange flag. The air observer cruises overhead, following the course of the crew toward the fire by sighting the orange flag waved periodically by the crewman. Every few minutes, the handy-talkie operator pauses and calls the observer, who gives him new estimated bearing and distance to the fire from his present position. Thus, the fire crew is "talked in" to the fire, sometimes saving them miles of needless wandering en route, and much valuable time.

Many lightning fires on the Superior start in snags or large trees in areas where dirt is practically absent, the soil types being muskeg swamp and solid rock. The small lightweight portable pumper is the best tool for these fires, but the problem lies in finding the burning snag or tree without carrying the portable pumper many needless miles during the search. Here the plane-to-ground radio directions are invaluable, and several times the crew has been "talked in" over long distances to a single burning tree or snag by means of the handy-talkie and bright flag. Similarly the crew may be directed to the best and nearest water chance discernible from the plane. Incidentally, this system is beginning to be used effectively in locating spot fires on large fires.

In addition to the Pacific Marine "A" and "Y" portable pumpers in use on the Superior, another quite satisfactory portable pumper has been made available by remodeling work in the pumper repair shop at the Ely Service Center. A Pacific Marine "N" pumper has been converted to one called the "AN" locally by cutting off two of the four cylinders and shortening the shaft and pumper length several inches. Satisfactory performance for most chances is obtained and the im-

provement in weight and portability is an advantage, especially on back-country fires and fires handled by boat and canoe transportation.

The Superior National Forest is currently experimenting with various lightweight accessories and supplemental equipment to enable portable pumper fire crews to get to fires quicker and easier, and to move their equipment faster and with less difficulty from one point to another on a fire.

One of the recent developments being tested is the new Harodite canvas relay tank or "dike" (fig 4). This is a heavy, treated canvas

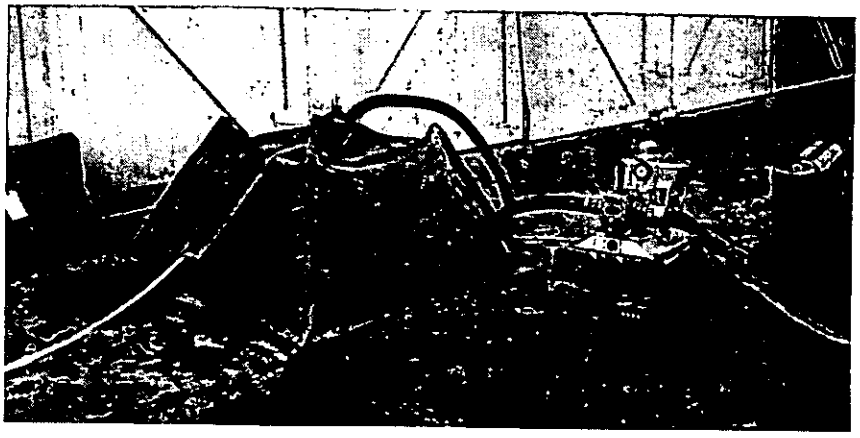


FIGURE 4.—Typical relay set-up: Canvas relay tank, 150-gallon capacity, pumper, and special gas can. Knapsack at extreme left contains a 300-gallon canvas relay tank folded up for transporting to a fire.

tank, pyramid-shaped with intake and output vents in the top. The Superior now has, for trial use, a 150-gallon tank and a 300-gallon tank. In a tank of this shape, the water supports the canvas structure without any additional legs or other supports. These canvas relay tanks are very portable, folding to a flat bundle about 1½ feet square which may be easily carried in a small packsack. Thus the several pumper relay tanks needed in a very long or steep hose lay could be readily carried in packsacks by a couple of men.

Fires in the Superior border-lake country usually occur in midsummer, when the very deep duff dries out and provides a ready avenue of travel for the fire down deep among the rocks. Here resistance to control frequently reaches extreme proportions. A large fire in this area is a very costly, back-breaking operation, extending over a long period of control and mop-up. The portable pumper-seaplane combination seems to be the answer to the question of how to keep most fires small to avoid disastrous and expensive project fires in this extensive area which is otherwise so inaccessible.

USE YOUR WEATHER RECORDS TO INTERPRET FIRE-WEATHER FORECASTS

OWEN P. CRAMER

Meteorologist, Pacific Northwest Forest and Range Experiment Station

"The weather man missed it!" You've probably made that kind of statement about a fire-weather forecast yourself.

What actually happened though, might well be described like this: "The area forecast was not interpreted in terms of the topographic and cover effects at the particular point for which it was used." You can understand why such a description is more accurate by thinking about the nature of fire-weather forecasts and how topography and cover in your district might affect the weather.

The routine fire-weather forecast is an area forecast. Among other things, it describes the general conditions of air flow and the temperature, humidity, and other properties of the air mass the forecaster expects to be present over a large area, say 3,000 to 5,000 square miles. A typical western forecast area has more or less mountainous terrain with cover varying from rocky barrens to old-growth forests. The difference in elevation from the valley floor to the summits may be as much as 5,000 feet—sometimes even more. Within such an area the weather at any one time will be influenced by many local conditions. Heating of air on sunlit south slopes results in up-slope wind currents; the cooling of air on shaded north slopes produces down-slope currents. The air may be funneled through a canyon, or deflected by a ridge lying at right angles to the wind. Friction slows the movement of air over an old-growth forest, and venturi action accelerates wind blowing through a saddle. Eddy currents form in the lea of a mountain.

Suppose then, the forecast tells you that the air will be moving over such an area at 15 to 20 miles per hour from the northwest and that the minimum humidity of that air will be 30 to 35 percent. It would be illogical to expect all weather observations made within the area to be within these narrow limits. Then how can the forecast be used? Your weather station records can provide the means.

For example, take the typical western area mentioned earlier. Undoubtedly forecasters have been predicting northwest winds of 15 to 20 miles per hour for this hypothetical forest from time to time for many years. Each time that the motion of air across the area was described by the northwest 15 to 20 forecast, the topography probably affected air movement in the same way, reproducing a relatively fixed pattern of eddy currents and other changes over the area. At a particular fire-danger station within the area it is likely that local winds will differ from the forecast in the same way each time this general wind condition exists. At a second station within the area, a still

different wind will be observed with the same general flow. Some exposed anemometers in open areas or at stations on high peaks where the flow is little distorted may observe the forecast wind. Now by determining, for selected fire-danger stations within the area, the most likely local wind for any general wind given in the area forecast, you could readily interpret the wind forecasts.

This "most likely" wind may be found by analyzing the fire-weather forecasts made during past years for the area and comparing them with the weather observations made at the selected stations during the same period. For each station make a tally of the winds observed for each general wind forecast (table 1). The tally will show in most cases the station wind that is most likely to be observed for each direction and speed of the wind described in the fire-weather area forecast. Such an aid may be developed for estimating a fire-danger station's wind at the peak of the day's burning conditions from either a morning or the previous evening forecast for the day.

TABLE 1.—*Observed wind speeds for a mountain station in Oregon at time of highest daily fire danger by forecast wind direction [1] and speed class*

Forecast wind direction and speed in miles per hour	Observed wind speed							
	0–3 m.p.h.	4–6 m.p.h.	7–9 m.p.h.	10–12 m.p.h.	13–15 m.p.h.	16–18 m.p.h.	Over 18 m.p.h.	Predominant
	Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*M.p.h.*
S.:								
10–12				3	1	1		10–12
16–18				1				
SW.:								
10–12		3	7	1		2		7–9
13–15			2	4	3	1		10–12
16–18			1				2	
Over 18						2		
W.:								
7–9	1	5	3		3		1	[2] 7–9
10–12		1	9	8	1	1	1	7–9
13–15		5	17	6	3	1		7–9
16–18		4	5			1	1	7–9
NW.:								
7–9	1	3	4	4	2	2		[2] 7–9
10–12	1	4	12		3		1	7–9
13–15	1	6	1	3	2			7–9
16–18		1	2	3	1			[2] 7–9

[1] Because of space limits, only four directions are shown.
[2] The limited number of observations used in this case does not result in a clearly predominant speed; could be 10–12.

You can apply the same method to observed rather than forecast winds. For example, using winds observed in the morning at exposed peak stations, you will find that for each such observed wind a certain wind will occur most frequently at the usual time of greatest fire danger later in the day. This information can be mighty handy when one morning you find that the wind at peak stations has shifted

and increased from the wind of previous days. You wonder: Just what afternoon wind does this morning wind indicate? The station weather records of past seasons can help greatly in making a useful prediction.

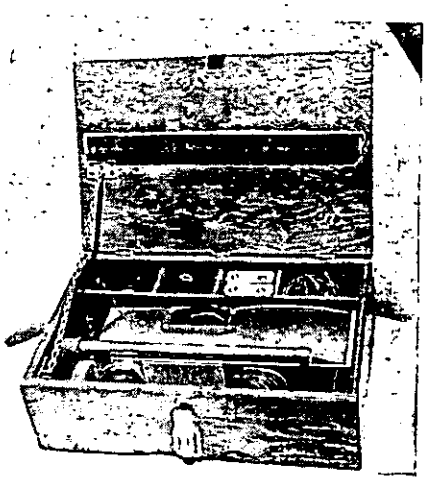
In the Pacific Northwest, we have found that similar methods also apply when interpreting the predicted minimum relative humidity in terms of the fuel-moisture reading to be expected on indicator sticks. Each station is different, however, and to date it appears that, as with the wind, this forecast-interpretation aid must be prepared individually for each station.

Such aids to interpretation of forecasts are of course not perfect. The forecast is only the best available estimate and shouldn't be expected to be exactly correct every time. Some variation in local effects will occur with similar but slightly different general weather patterns. There will also be occasional periods of exceptional weather. You may sometimes be able to identify these periods as expected distinct exceptions to the rule. Lastly, because of differences in station exposure, the reliability of the aids will vary from station to station. Nevertheless, such aids can give considerable help in estimating burning conditions in advance at individual fire-danger stations.

Successful aids of these types have been constructed for many Forest Service fire-danger stations in Region 6. The process of construction itself has added greatly to the understanding of local weather peculiarities. Laboratory test and field use of the aids have consistently resulted in more accurate numerical estimates of expected forest fire danger.

Protective Carrying Case for FM Handie-Talkie Radio.—In 1949 we had some difficulty in carrying our handie-talkie radios in pickups and jeeps without considerable danger of damage. A leather case was constructed, but it was not sufficiently rigid to fully protect the unit. Therefore, a protective plywood carrying case was devised.

The case is made of one-half-inch Douglas-fir plywood with one-quarter-inch plywood partitions enclosing space for two sets of extra batteries and airplane antenna. The radio is held firmly in place and is supported entirely by sponge rubber. The case is finished with one coat of shellac and two coats of spar varnish. The carrying handle was placed on top of the case rather than on the edge to encourage hauling it in a flat position so that it would not tip over. The lid is fastened with an eccentric hasp-type catch so that it may be locked with a padlock. Materials cost just under $5.



Plans of this carrying case may be obtained from the Supervisor's Office, Harney National Forest, Custer, S. Dak., if desired.—HUGH E. MARTIN, *assistant supervisor, Harney National Forest.*

NORTHEASTERN INTERSTATE FOREST FIRE PROTECTION COMPACT

R. M. Evans

Executive Secretary, Northeastern Forest Fire Protection Commission

For nearly everyone who will read this article, the disastrous Maine fires of October 1947 have been effectively dramatized by the short motion picture "Then It Happened." The picture is vivid enough, but to have viewed the conflagration from the air while it was in progress, and later the devastated woodlands and farmsteads and villages, was an experience which the writer will not forget.

Fortunately, some good came from all the damage and destruction. First, Maine enacted long-needed legislation to center in the forest commissioner authority over forest fire fighting activities in organized towns, and, second, the Northeastern Interstate Forest Fire Protection Compact came into being.

The Compact didn't just happen over night. Instead, the idea was hammered out in months of discussions which began in the Conference of New England Governors held shortly after the fires. Chief credit for the result goes to a committee composed of the New England and New York State foresters, to which the late John W. Plaisted, of the Massachusetts Commission on Interstate Cooperation, was advisor; to Frederick L. Zimmerman, research director of the New York Joint Legislative Committee on Interstate Cooperation, who prepared the draft; and to the New York office of the Council of State Governments for its guidance and assistance in presenting the Compact to Congress and the State legislatures. It is worthy of mention that representatives of the United States Forest Service participated in the discussions at all times.

Congress passed enabling legislation and six of the seven States ratified the Compact in 1949, the seventh State ratified early in 1950. As far as is known, this sets a record for speed in adopting an act of this kind.

The Compact is quite a document. It is open-ended territorially; that is, any contiguous state or province of Canada may become party to it. It is hoped that the Provinces of Quebec and New Brunswick will join.

The language of the Compact is broad enough to encompass the whole field of forest fire prevention and suppression in the seven States. For example, article I states:

> The purpose of this compact is to promote effective prevention and control of forest fires in the northeastern region of the United States and adjacent areas in Canada by the development of integrated forest fire plans, by maintenance of adequate forest fire fighting services by the member states, by providing for mutual aid in fighting forest fires among the states of the region and for procedures that will facilitate such aid, and by the establishment of a central agency to coordinate the services of member states and perform such common services as member states may deem desirable.

The Compact creates the Northeastern Forest Fire Protection Commission, composed of three members from each State, one of whom shall be the state forester, one a State legislator designated by the committee on interstate cooperation of that State, and one "shall be a person designated by the governor as the responsible representative of the governor."

The commission was organized at a meeting in Boston on January 19, 1950. Perry H. Merrill, State forester of Vermont, was elected chairman and Arthur S. Hopkins, director of lands and forests, New York, was elected vice chairman. Early in May 1950, the writer was appointed executive secretary. An office has been established in the Forestry Building, Laconia, N. H.

The Compact empowers the commission "to make inquiry and ascertain such methods, practices, circumstances and conditions as may be disclosed for bringing about the prevention and control of forest fires, to coordinate the forest fire plans and the work of the appropriate agencies of the member states, and to facilitate the rendering of aid by the member states to each other in fighting forest fires." The commission has the power to recommend to the signatory States any and all measures, legislative or administrative, that will effectuate the prevention and control of forest fires. An important provision empowers the commission to formulate and revise a regional fire plan for the entire region covered by the Compact, which will serve as a common forest fire plan for that area. Furthermore, the commission may request the United States Forest Service to act as the primary research and coordinating agency and the Forest Service may accept the initial responsibility in presenting to the commission its recommendations with respect to the regional fire plan.

The Compact obligates each State to formulate and put into effect a forest fire plan and to take such measures as may be recommended by the commission to integrate its plan with the regional forest fire plan. In emergencies, each State is obligated to render aid to other member States consistent with the maintenance of protection at home.

The Compact solves the difficult problems connected with powers, immunities, liabilities, and duties of State forces rendering aid to another State. It provides that the employees of an aiding State shall, under the direction of the officers of the aided State "have the same powers (except the power of arrest), duties, rights, privileges and immunities as comparable employees of the state to which they are rendering aid."

As to liability, it is provided that no State or its officers or employees rendering outside aid under the Compact shall be liable on account of any act or ommission on their part, or on account of the maintenance and use of any supplies in connection with their mission; and that all liability which may arise, under the laws of either the requesting or the aiding State, or under those of a third State, or in connection with a request for aid, shall be assumed by the requesting State. The aiding State shall be reimbursed by the receiving State for any loss or damage incurred in the operation of any equipment answering a request for aid and for the cost of all "materials, transportation, wages, salaries and maintenance of employees and equipment incurred in connection with such request." However, the Compact provides that the aiding State *may* assume loss, damage, or expense, and may donate services. It was thought that in the case of limited aid donation would be the

probable practice, but that in the case of major losses and services it was only fair that the requesting State should be liable for the costs. On the other hand, the Compact provides that each member State shall provide for the payment of compensation and death benefits in case its employees sustain injuries or are killed while rendering outside aid pursuant to the Compact in the same manner and on the same terms as if the injury or death were sustained within the State. To avoid questions of liability which might arise with respect to volunteer forces, the Compact provides that "the term employee shall include any volunteer or auxiliary legally included within the forest fire fighting forces of the aiding state under the laws thereof."

Although it is not expected that the costs of maintaining the commission will be great, provision was made by the Compact for standards in the allocation of any appropriations that may be necessary. It directs the commission to allocate the cost among the States affected "with consideration of the amounts of forested lands in those states that will receive protection from the service to be rendered and the extent of the forest fire problem involved in each state." The commission is instructed to submit its recommendations, based on those considerations, to the legislatures of the affected States.

The foregoing are some of the important provisions of the Compact. There are others.

The policies, plans, and work of the commission still are in the formative state. The Compact was conceived as a means of providing mutual aid in the event of disasters such as the Maine fires of 1947. Provision is being made for that through comprehensive State fire plans prepared from a standard outline, and a regional plan in accordance with which the Laconia office will act as collector and distributor of information about the fire situation in the several States, and as dispatcher in case interstate aid is needed.

But it is believed that the commission's greatest usefulness will be in a general leveling up of competence in the forest fire control field among the member States through such things as the sharing of ideas, training, strengthened legislation, standardization of equipment, and public education. Already closure laws are being studied to see if they may be made more flexible and uniform. The possibility of developing a closure index is being investigated. Uniform training outlines for overhead personnel will be developed and training on an area basis will be stepped up. The place of State forest fire organizations in State civil defense set-ups is being looked into.

All in all, it is the feeling that the Compact provides these seven States with the opportunity to develop an example of unified action in a given field that might well become a model for similar action elsewhere.

○

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. Do not submit copyrighted pictures, or photographs from commercial photographers on which a credit line is required.

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.