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FIRE CONTROL NOTES

A PERIODICAL DEVOTED
TO THE TECHNIQUE OF
FOREST FIRE CONTROL

FOREST SERVICE • U. S. DEPARTMENT OF AGRICULTURE

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Volume 19 **Number 1**

FIRE CONTROL NOTES

A Quarterly Periodical Devoted to the

TECHNIQUE OF FOREST FIRE CONTROL

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

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Forest Service, Washington, D. C.

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CONTENTS

MAKE IT POSITIVE . . . Some Opportunities in Fire Control Training

JACK C. KERN,
Chief, Branch of Training, U. S. Forest Service

The field of fire management has many opportunities for advancement. One of the greatest challenges, as Show[1] pointed out in an earlier issue of this periodical, is the intensive and specialized development of fire control personnel. But their effective management cannot be passive or taken for granted. Good personnel management requires aggressive and positive direction.

People, the priceless resource of any organization, require understanding, guidance, encouragement, and the chance for full expression of thought and action. Most of us need skilled job leadership and a planned schedule of off-the-job experiences to gain perspective and widen our knowledge.

It has been stated that at least 90 percent of a man's training and development is gained by the man himself under capable job leadership. The remaining 10 percent is gained through formalized group sessions and planned study under skilled instructors. In this whole process of learning by doing and of learning by contact with expert instructors and group thinking, there is practically unlimited opportunity for improvement. However, such opportunity has to be created, recognized as a positive aid to individual and team progress, and worked upon vigorously.

Some possibilities for personnel development follow:

1. The opportunity for positive results by simply taking more "time out for people" is essential. Take time to know people as individuals, and to see how their specific responsibilities fit into the organization. Find out what each of them needs and wants in order to do a good job. Our most successful fire leaders are those who recognize that men need individual recognition and job satisfaction. These leaders seek positive ways to help their men help themselves. They assign the full job, following the principle that people grow when given responsibility. A recent study in five large industries shows that supervisors who continually think about the *people* in their organization actually obtain better results than those who think only of job production.

2. Another important way of learning to know people in the fire organization is to analyze individual training needs. Such an analysis can help prepare the man for top performance on his present job and for future assignments. An individual training plan or personal progress record will make this process of growing on the job more systematic and positive. A simple, written plan prepared by the man and his boss together, enables them to set training goals and to understand their separate responsibil-

[1] SHOW, S. B. *Primary Bases and Ideas for Fire Control Planning on California National Forests.* U. S. Forest Serv. Fire Control Notes 16(1): 1-8. 1955.

ities. Both the employee and supervisor can learn through this process. This plan sets down the man's own ideas of what he thinks he needs to become a better fireman or a better fire leader. The boss may add to these needs, based on his ideas or the suggestions of others who have observed the employee's work. A mutually agreed upon schedule can tell what is needed, and when, where, and by whom training can best be accomplished. Some of this training can probably be done most effectively in a group with a skilled instructor. Good study habits are the responsibility of the individual; but the will-to-do and can-do-it attitudes are often set by the boss.

3. The professional services offered by schools and universities give another chance to improve our training in fire-attack methods and fire leadership. The University of Maryland's College of Engineering, for example, conducts Fire Service Extension Institutes for volunteer fire departments. Three courses of 22 weeks each, involving latest attack methods, are given. They include basic, advanced, and special classes. More and more schools are offering professional help with specialized short courses or workshops. Local fire departments have also developed skill courses for local talent. Such courses are an encouraging contribution to America's growing field of adult education.

4. Fire training committees in mutual-aid organizations, such as those established in the Fire Compacts of the Eastern States, can determine the size and nature of the training job ahead. They bring about a more uniform understanding of fire problems, and of fire organization and control actions. Adding a professional educator or a training specialist to these committees, in an advisory capacity, will help to bring up-to-date teaching techniques to bear upon tough problems of instruction.

5. The assignment of fire training leaders to accompany groups of trainees to going fires has real promise. These group leaders can see that the men are assigned to capable trainers, and that they "learn under fire." Later each man's experiences can be evaluated by the leader and a chart made for future training based on individual need.

In summary, most of us have the capacity to do our jobs better, safer, easier, and cheaper. Most of us have the potential to take on increased responsibilities. Taking time out to analyze ways for self-improvement and the improvement of team efforts can pay dividends. There are opportunities for positive results by the fire man and his fire leader looking at this situation together. The preparation of simple, individual training plans can make both individual and fire-team development more positive and thus more effective. Cooperative action from schools, universities, local educators, and mutual-aid training committees can apply the latest instruction techniques. The assignment of trainees to actual fire situations under skilled leadership can be made more systematic. Fire training is a vital element of good supervision and direction. Its end product is efficient fire service.

SAFE PRACTICES UNDER BLOWUP CONDITIONS—A TRAINING OUTLINE FOR THE FIRE CREW BOSS[1]

The purpose of this large fire overhead training outline for the crew boss is to help him know more about blowup conditions and safe practices to use.

Blowup fires and safe practices to follow have always plagued the crew boss. The importance of the problem has again been pointed out by fire accidents during the past several years. There is need for practical, clear, concise instructions to the crew boss on this subject. As a start, the best available information has been listed and recorded in this outline.

A blowup condition is defined as an explosive, violent fire behavior that is difficult to identify before it occurs.

The training outline is organized in three main parts:

I. Instruction steps and key points to stress in fire behavior fundamentals.

II. Instruction steps and key points for indicators of dangerous fire behavior (blowups).

III. Instruction steps and key points for the crew boss to follow for safe practices.

It is extremely important that the instructor use all experiences that can be brought to the attention of the crew boss to point out the key points and principles outlined in this training plan.

It is recommended that a minimum of four hours be given each year to fire crew bosses on the subject of blowup conditions and safe practices.

FIRE BEHAVIOR FUNDAMENTALS

Example of introduction.—Successful fire fighting is based upon the knowledge of why a fire burns and what makes it spread. Fire is simply a rapid chemical combination of fuel, heat, and air. The basic principle of fire suppression is to remove one or more of these elements in the quickest and most effective manner. In order to do this, however, there must be some knowledge of the causes and reasons for fires acting as they do. The primary factors that influence the spread of forest or range fires are fuel, weather, and topography.

[1]For the full text of this training guide see *Safe Practices Under Blowup Conditions for the Fire Crew Boss*, by Forest Service, U. S. Department of Agriculture. 19 pp. 1957. [Processed.]

Fuels.—Fuels are commonly divided into two main groups: (1) Flash fuels such as dry grass, dead leaves, tree needles, brush, and small bushy trees; and (2) slow burning fuels such as logs, stumps, deep duff.

Weather.—Weather factors with which you as a fire crew boss will be concerned are wind, moisture, and to a lesser degree, temperature.

Slope or topography.—Slope greatly affects the spread of fire in two major ways: (1) Preheating and (2) draft.

Judgment is the major factor in determining the relative importance of all the elements which determine fire behavior. For example, continuity and arrangement of fuels are sometimes more important than volume. Given a certain volume of fuel, features of arrangement or position will influence spread as well as difficulty of control. If fuels are patchy, broken up by areas of thinner fuel, rocky or barren spots, the spread may be uneven and slow (blackboard illustration recommended). If these same fuels are partly on the ground and partly in the air—standing snags—spread may be by spotting, and with severe winds, this may cause a most difficult fire. *It pays to look carefully at all conditions in sizing up a fire.*

The fire crew boss must take advantage of known methods of sizing up a fire at a given time and predicting what will happen as the fire advances or as changes of weather occur.

INDICATORS OF POSSIBLE UNUSUAL FIRE BEHAVIOR

Occasionally a forest fire burns with an intensity that seems far out of proportion to apparent burning conditions. Each blow-up fire raises the question: What can we do to recognize conditions causing extreme fire behavior? How can we predict these conditions in advance? The following on-the-ground indicators should be watched for as they may mark extreme burning conditions that will follow:

A. Fast burning fuels.
1. Unusually dry fuels.
2. Large amounts of fine fuel (grass, needles, moss, etc.) particularly where continuous and on steep slopes.
3. Crown foliage dried by surface fire over large area.
4. Brush and conifer tree foliage after prolonged drought.
5. Concentration of snags.

B. Weather factors.
1. Strong winds blowing.
2. Unexpected calm. May result in winds shifting.
3. High clouds moving fast may result in unusual winds on ground.
4. Unusually high temperatures early in morning.
5. Dust devils and whirlwinds.

6. Thunderheads above or in close proximity to fire usually lead to dangerous downdraft winds. If thunderhead is upwind of the prevailing wind, the danger is greatest.
7. When slope becomes shaded, look out for downdrafts.
8. If a fire is burning near a mountain or glacier (such as Mt. Hood), greater downslope wind velocities will normally occur.
9. Keep an eye on smoke column. Winds may be blowing from different directions above fire. This could result in spot fires outside.
10. Watch smoke column for an increase in wind speeds aloft. This leads to spotting, and gusty wind conditions may also result.
11. Sudden changes in direction and/or velocity of wind when weather fronts move in.

C. Fire behavior (which could lead to a blowup).

1. Spotting ahead of fire or downslope below line being worked.
2. Intense burning inside fireline.
3. Smoldering fires over a large area.
4. Many simultaneous fires starting.
5. Whirlwinds inside fire causing spots and creating intense, erratic burning.
6. Broadcast crown fires in brush or timber.

SAFE PRACTICES FOR CREW BOSS TO KNOW AND USE

The crew boss has two main responsibilities: (a) To obtain an effective, fair day's work from his crew, and (b) to look after the safety and welfare of his crew 24 hours a day to the best of his ability.

After instructing in how to recognize conditions leading to blowup fires, the training leader guides the group into sharing experiences in what safe practices to know and use to prevent injuries or loss of life during blowup conditions. As he puts across the following instruction steps and key points (which are numbered) he should (a) review with group and stress key points, (b) encourage crew bosses to relate actual experiences they have had on a fire to stress key points, (c) relate experiences he has had to illustrate points, and (d) use case histories of disasters or near misses.

A. *STAY ALERT.* Be prepared for safe emergency action. Keep Your Head.

1. Heads up: Look up, look down, look around.
2. See what you look at.
3. Know where the fire is and how it is behaving at all times. If necessary, use scouts or post lookout with proper communication.
4. Know what danger signs to look for, including fatigue. Use your fire behavior know how.

5. Think before acting. Pause, think, then act.
6. Fire fighting is dangerous. Crew boss has a key job. Men are looking to the crew boss.
7. Keep an up-to-the-minute plan of get-away action in mind.
8. Act with decision and promptly when escape action is needed.
9. Remember—a fireline is not usually safe until it is burned out.
10. The spectacular fire may not be the most dangerous. The quiet-looking fire may be the most hazardous.
11. Get weather forecast in morning.

B. *WORK* and *ACT* as a *TEAM*.

1. Gain confidence of crewmen.
2. Keep crew together. Need to do this for clear, safe actions.
3. Use action words: "Come here," "Follow me," "Keep together." The crew boss is the leader.
4. Don't assume anything. Crew bosses have said, "Let's go" and men have gone different directions.
5. Know where all your men are.
6. Men must follow all verbal orders and stick together when orders are given to move out.
7. Have men keep handtools as they may be of value in providing protection.
8. Assign most experienced, mature men for scouting and for lookout when in especially hazardous situations. Arrange for prompt communication.
9. Manage and control your men.

C. PLAN GET-AWAY, including escape routes.

1. Crew boss must always have in mind a clear-cut plan of action for fire blowups. Know in advance where you will lead your crew. If necessary, prepare and mark escape route in advance.
2. Let your crew members know you are responsible for their safety.
3. In the event of a blowup, pause a moment and size up the situation. Then think clearly, speak decisively, and act in a calm and deliberate manner.
4. Remember danger potential of timber, brush, and grass fire fighting.
5. Keep crew informed.
6. Keep in mind open places such as rock slides, streams, burned-over places, meadows, alder patches, and gravel bars.
7. One of the safest spots is burned-over area. If needed, dig in.

8. When not possible to get into burned area, remember, men can travel faster downhill or along contour.
   Warning—Remember, winds usually blow downslope at night and fires can run rapidly downhill.
9. If necessary to jump through burning edge of fire, have men place hat or coat over face.
10. Caution men: if clothes catch on fire, roll on ground in dirt to put out fire.
11. Do not travel ahead of fires in direction of spread unless you are positive that a safe place ahead can be reached by crew.
12. When not possible to get within burn, pick most open ground available and avoid dense brush, where men can become separated and go astray.
13. After reaching escape spot, check to be sure it is safe from falling trees, snags, rolling logs, or rocks. Try to find a safe vantage point and post lookout.
14. In any brush fire fighting, when working in advance of fire with dozer, build safety strip for retreat.
15. In timber types, sharp ridgetops are good bet to get to if possible.
16. Watch for safer topography, benches in steep country.
17. As last resort, burn out and dig in.
18. When at safe spot, remember suffocation has killed. Have men keep damp clothes over their noses and get next to ground.
19. Where heliports exist, keep their location in mind.

FOREST FIRE SOUND LOCATOR MISSILE

AUSTIN H. WILKINS
Deputy Forest Commissioner, Maine Forest Service

In Maine, forest fire fighting ground crews have had many exasperating experiences trying to locate lightning strikes in dense woods in remote areas. Often they were close, yet valuable time was lost before the actual tree or small smoldering ground spot was discovered. Many times, when near enough, crew members were able to locate the fire only by a good sense of smell, or spotted the tree while circling through the area. In other instances they were directed by means of plane to ground radio communication, loud speaker from plane, dropped sketch maps, smoke signals, compass bearings, or some other helpful method. Sometimes crews were fortunate enough to travel right to the spot without too much delay, but this did not occur too often[1]. No doubt fire fighters in other States have had similar experiences.

A former Maine Forest Service fire warden, Maurice Clark, had a number of these experiences while working as patrolman in the Katahdin District. For some time he had been thinking on how to perfect a mechanical device that could be released from a plane and that would give off an audible sound of sufficient volume to be heard within a range of 500 yards on the ground and thus narrow down the search area. This idea began to take physical shape after many experiments in his home workshop. Satisfied that his rough homemade model had merit, he then decided that an electronic engineer should be consulted and specialized equipment was necessary to meet desired requirements. He also had to find a concern to manufacture and market the item at a reasonable price.

Electronic Technician William Tiffany of Auburn, Me., provided both financial and technical assistance in developing the device. Thus was born the "Forest Fire Sound Locator Missile" from Maurice Clark's original idea. Patent rights have been approved and production started on a limited scale. The total cost is approximately $265 per unit, complete with parachute.

In general, this missile is an electronic device, with dry batteries and amplifier, encased in a galvanized iron cylinder. It emits a rising and flowing high pitch signal audible up to one mile in densely wooded areas. It is most effective within one-half mile radius and under favorable terrain and woods conditions can be heard beyond a mile.

Specifically, the component parts and features of this unit are as follows (fig. 1): Removable blunt nose section of 16-gage galvanized iron with battery holder for two power pack batteries in a rubber shock mount; a watertight cylinder housing of 18-gage galvanized iron containing an amplifier unit of a sealed transistorized amplifier in an inner shock case; a reentrant sound projector (signal device); a sound dispensary cone of 360°.

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[1]As a safety factor the department has a firm policy of always sending out fire fighters in pairs to look for lightning fires.

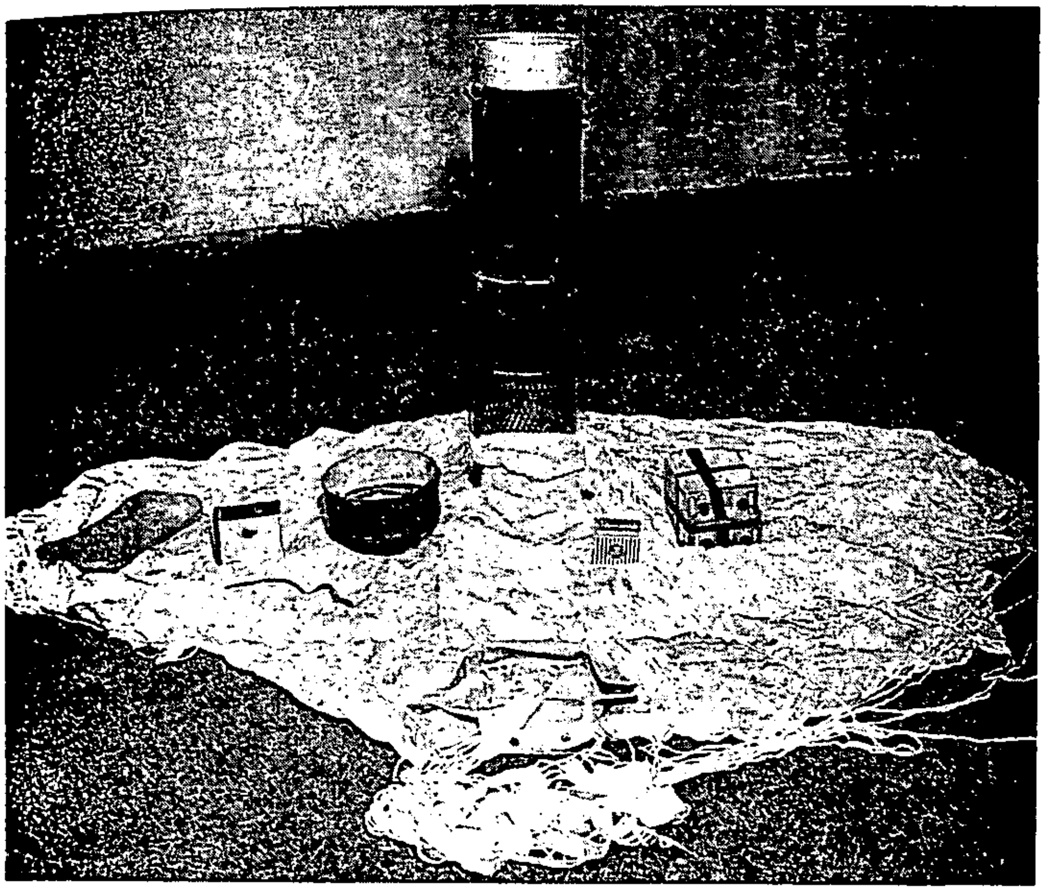

FIGURE 1.—Dismantled missile showing component parts of power pack batteries, transistorized amplifier, relation oscillator, and removable nose section.

The mechanism is positively triggered by jack-type switch either manually or by plane release mechanism. The overall weight is approximately 36 pounds, diameter 8½ inches, and height 38 inches, painted either cab yellow or Chinese red. There are two hooks on the outside for attaching the parachute, two hooks for provision of a slide bar to simultaneously release the missile from a specially designed carrying rack and trigger the mechanism, and two clamps to hold the nose section of the missile to the main body of the missile housing. By turning a set screw it is possible to adjust the sound pitch from low to medium to high.

One significant feature is that with oscillation there is little drain on the battery. In both laboratory and field tests the first few manufactured missiles gave a strong oscillating signal for 8 hours without a stop. In another unusual instance, in the spring of 1957, three of these missiles gave an oscillated sound for 21 hours without a stop while being used to coordinate three separate ground search crews that were looking for a lost fisherman. Tests also determined that cold winter storage had no ill effect on the dry batteries.

The missile is waterproof, and will withstand the shock of hitting rocks, ledges, and other hard objects and still emit a strong signal. Experiments are now being made to devise a hard rubber nose for the removable nose section to help break the shock of hitting hard objects.

The missile can be manually thrown from a plane "free fall" or with a parachute. Tests indicate it is best to use the parachute because there is no guarantee on "free fall" (fig. 2). The Maine Forest Service has devised for each of its two float planes a single V-shaped trough 10 feet long of aluminum tubing attached to the pontoon (fig. 3). The trough is of a size to permit carrying one or more missiles. Highly successful test drops have been made with this type of rack. Plans are underway to equip each plane with two racks to go on each pontoon. These racks can be easily attached or detached.

The present missile has an outside plug that has to be pulled or released in some manner to trigger the sound mechanism. When the missile is dropped by parachute the pulled plug stays with the static line in the plane. To the parachute case is attached an extra plug with which the person finding the missile can stop the sound signal. Otherwise, it would be necessary to remove the nose section and disconnect the battery wires.

With no actual lightning fires to make drops on, several experiments were made under typical woods conditions in Maine, New Hampshire, and the Provinces of Ontario and New Brunswick during the 1957 fire season. One test drop was made from the Maine Forest Service Cessna 170 float plane with very satisfactory results. By prearrangement a crew of ten was placed in an area with a ½-mile radius in a dense, second-growth hardwood type near a heavy white pine cutting. The missile, with sound signal working, was dropped from the plane at 2:05 p. m. at an altitude of 300 feet. At 2:25 p. m. the unit was discovered hanging about 5 feet above the ground with the 17-foot orange parachute caught on a branch of a hardwood tree (fig. 4).

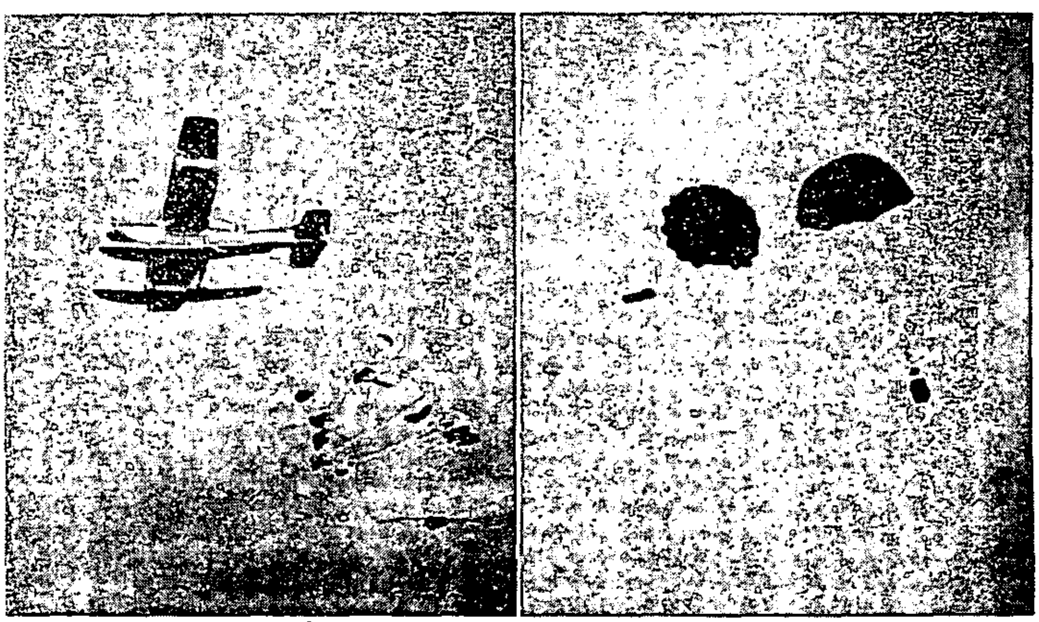

FIGURE 2.—*Left*, Multiple chute release from plane of fire tools and locator missile. *Right*, Locator missile and pack of hose in descent.

FIGURE 3.—Sound locator missile in position in aluminum carrying rack attached to pontoon for air drops.

The following advantages brought out by experimental drops to date indicate that this sound locator missile has a practical and valuable use in forest fire control work:

1. The audible sound signal is effective at half mile distances and can be heard a mile away under favorable terrain and forest growth conditions.
2. The search area is greatly narrowed down.
3. The device permits quicker discovery of the fire at a saving of valuable time and cost.
4. The device permits early initial suppression action to prevent possible spread of fire.
5. Missile can be recovered and used repeatedly.
6. It is lightweight and can be easily transported.
7. It is compact, with a removable nose section to permit servicing.
8. Strong sound signals will emit continuously for at least 8 hours.
9. It can withstand the shock of hitting hard objects such as rocks, ledges, or trees, and still emit good sound signals.

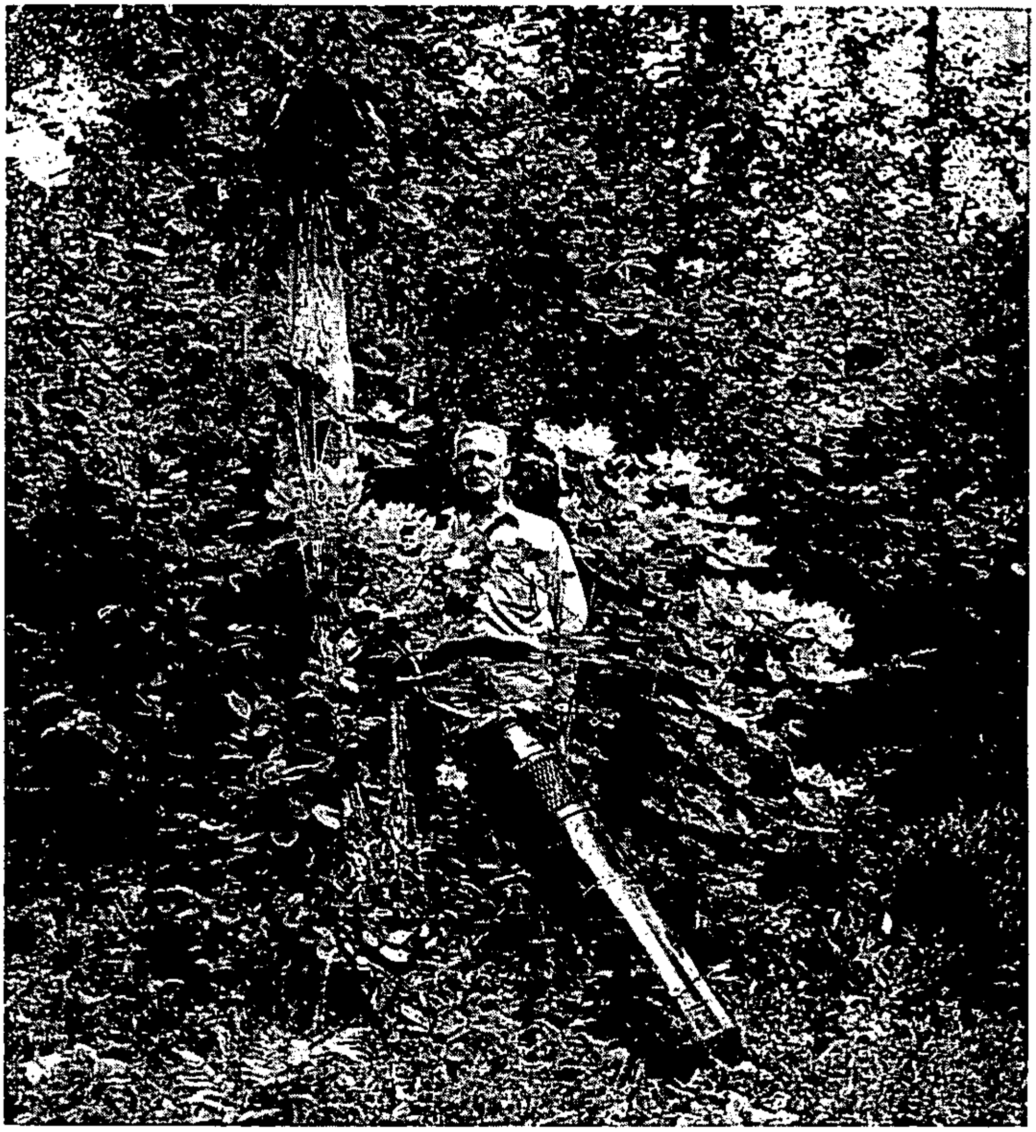

FIGURE 4.—Parachute and missile found just as they landed in second-growth hardwood.

10. It is waterproof.

11. Missile can be released from the plane either manually or electrically "free fall" or by parachute.

12. Ground crews find the sound signal helpful while the missile is in descent, especially when coming down by parachute.

13. In open forest types the bright red missile and orange parachute can be easily seen, as well as the sound signal being heard.

14. Missile may have practical value for guiding rescue crews to lost persons and other uses not yet determined.

The Maine Forest Service has purchased six of these missiles and distributed two to a division. Several orders have been placed by protective agencies, while others have expressed an interest. Prints and further information may be obtained by writing to Maine Forest Service, State Office Building, Augusta, Me., attention Austin H. Wilkins.

BUILDING FIRELINE WITH A SELF-PROPELLED TRAIL GRADER

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In recent years, a self-propelled, two-man trail grader has been undergoing test in Region 6. This versatile machine is used not only to build new trails and improve old ones but to build fireline as well. Forty of these machines are in use in the region.

As with any new machine, improvements are continually being made. Three models are now in use. The original grader has a single 14-inch driving wheel; the second model has three wheels on one axle for additional traction; the third model has a crawler track 32½ inches long and 5 inches wide (fig. 1).

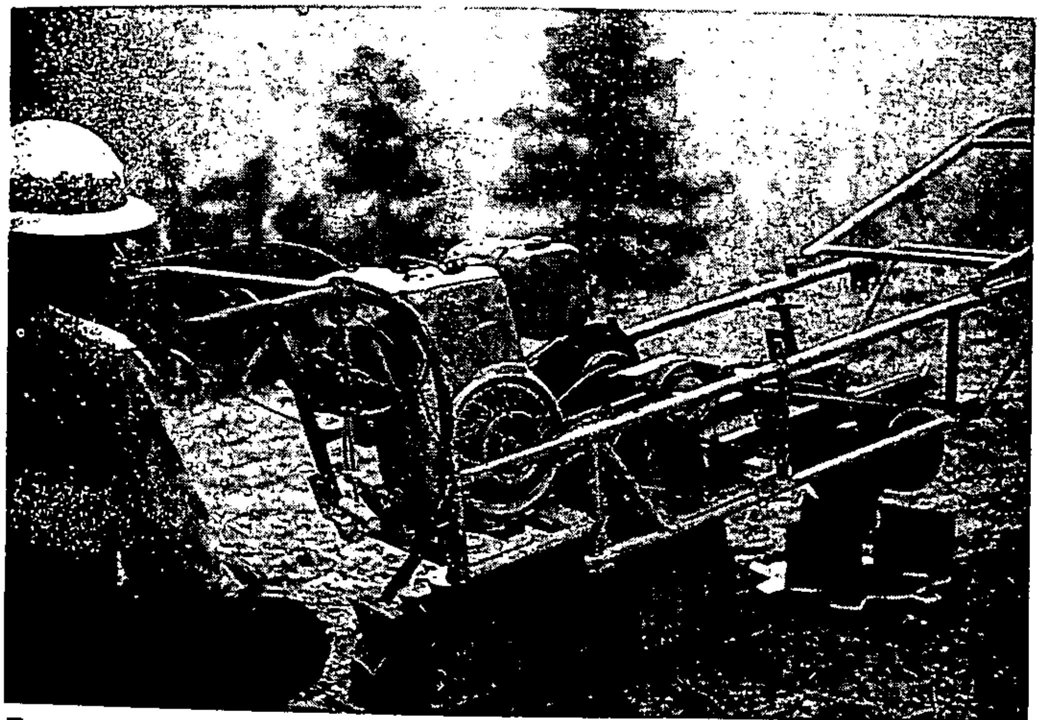

FIGURE 1.—The crawler-type trail grader. This model is best for fireline construction.

In order to obtain maximum performance of the grader in building fireline, the operators must be well trained. The machine is not a particularly easy one to operate, and there should be frequent reliefs, at least at half-hour intervals. Since the grader is a digging machine only, clearing must be done in advance. For these reasons the grader should be considered a crew machine.

FIRELINE-CONSTRUCTION TESTS

Test runs of single and three-wheel models were organized and reported by District Assistant W. M. Starkovich of the Ellensburg District of the Wenatchee National Forest. Organization of the 13-man crew was as follows: Crew foreman; 1 assistant foreman to locate line; 5 pulaski men to clear and chop; 1 power-saw operator to cut logs and large poles; 2 machine operators for trail grader; 1 man to carry extra gasoline and accessories and assist machine operators; 1 pulaski man to take out roots and decayed logs; 1 shovel man to finish line.

The following rates of line construction were recorded:

Moderate resistance to control type.—Mixed species of large Douglas-fir and western larch with dense stand of white fir understory. Medium amount of down logs with sizes up to 3 feet, and other litter and duff up to 6 inches in depth. Slope, 0 to 35 percent; rate of line construction, 36 chains per hour.

Low resistance to control type.—Pine with understory of pole-size Douglas-fir thickets, sodded pine grass, with light litter on the ground. Duff 2 to 3 inches deep. Slope, 0 to 40 percent; rate of line construction 43 chains per hour.

Large open ponderosa stand with very little litter on ground. Fairly heavy sodded pine grass. Slope, 0 to 45 percent; rate of line construction, 49 chains per hour.

In sidehill operation, the three-wheel machine tends to kick sideways and is difficult to hold in position. The one-wheel machine performs satisfactorily, but there is a noticeable lack of traction and a tendency for the driving wheel to dig in. The traction problem has been solved by using a crawler track instead of wheels. With this improvement, the machine has dug fireline up and down and on contour on a 70-percent slope. Twelve of the Region 6 machines have been converted to the track type.

PERFORMANCE ON FIRES

Opportunity to use the grader on fires has been limited. However, three track-type graders were used on a fire on the Wenatchee Forest in July. The fire started from a railroad on a steep, dry slope at midday. It had all the prospects of a project fire. Actually, credit for control at 60 acres goes to aerial tankers that knocked the fire out of the crowns of reproduction and fireproofed a wide area on the running front, thus giving railroad workers a chance to move in with a handline.

The line built by the first two graders on the fire, which arrived before experienced fire overhead, was not properly located to be most effective. The third machine went all the way around the fire with a new line, some of which became the final line. In evaluating use of the machines, Ranger McNeil made it clear that he was not depreciating the machines in any way. The fact that there were 75 railroad workers on the fire with handtools made the machines less of a necessity than would otherwise have been true.

FIGURE 2.—Line constructed by the track-type grader on a side slope.

The grader builds an excellent fireline (fig. 2). Since the cutter disk is reversible, the dirt can be cast to either side. On cross-slope operation the dirt is cast downhill; otherwise, it is cast to the side away from the fire where it helps to insulate the fuel next to the line. The cutter disk will kick out rocks as large as coconuts, and is sturdy enough to withstand contact with larger rocks without damage. Brush-type roots are easily severed.

In summing up, the following points are made:

1. For trail construction, there is a difference of opinion as to the need for the crawler track. For fireline construction, there is no difference of opinion; the track is the answer.

2. This is definitely a crew machine. The size of the crew will vary with the fuel type. In areas where clearing is unnecessary, four men may be sufficient. Training in machine operation is required.

3. The machine can be transported in a pickup. The Wenatchee Forest carries its machine in a horse trailer.

4. The machine does not have a reverse, which is certainly desirable. The manufacturer is presently working on this problem.

5. Fire trenchers, at least in the Western States, should have a means of winching the machines through or across otherwise impassable areas such as sharp canyons and talus slides, or over ground where traction is difficult. A simple spool-type arrangement and 100 feet of nylon line should solve this problem.

6. It is much easier to work the machine down slope than it is up slope, and this fact is worthy of consideration in planning fireline construction.

SPECIFICATIONS FOR THE LATEST MODEL

Engine.—Nine hp., 4 cycles.

Transmission.—Transmission case, idler shaft, wheel shaft, and belt-tension adjustment idlers have sealed ball bearings—keywayed sprockets.

Clutching.—One master clutch from engine to jack shaft, controlled from lever on handle bars. Two secondary clutches that allow forward motion independent of rotation of cutter disk. Low speed (or work speed) allows travel up to 1¼ m. p. h. Secondary clutch lever allows for higher speeds up to 5 m. p. h. "Double clutch" arms and levers permit change of speed without stopping to change belts.

Gear box.—Shift on gear box for clockwise and counterclockwise rotation of cutter disk. Removable disk, 16-, 18-, and 20-inch. Gear box adjustable to operate at four angles in relation to ground surface.

Brake.—Mechanical brake controlled by lever on right rear handle bar.

Front handles.—Adjustable up and down. Fold back for easier transport of machine.

Dimensions:

Height, 37 inches to handle bars, 24 inches to top of bed.

Length, 109 inches overall, front handles extended; 78 inches at top of bed, front handles folded; 50 inches at bottom of bed.

Width, 29 inches at handle bars, 17 inches at bottom of bed, 21 inches at bed top.

Weights, 1-wheel grader, 390 pounds; 3-wheel grader, 420 pounds; grader with track, 480 pounds.

GLARE-REDUCING GLASS FOR LOOKOUT STRUCTURES

DIVISION OF FIRE CONTROL
Region 7, U. S. Forest Service

Lookout personnel in modern towers are exposed to intense glare of light, and frequently to heat. As a result they experience eye discomfort that can be assumed to impair efficiency in searching for and locating smokes. Sunlight fades furniture, interior paint, and exposed maps, thus creating some maintenance problems.

The problem of glare from ordinary clear window glass has been worked on unsuccessfully. At one time towers were equipped with wooden shutters hinged at the top of the window to form a canopy over the window. This was abandoned in many localities because storms would tear them from the hinges and create a severe safety hazard. The use of sunglasses by towermen will help but sunglasses become tiresome and are often laid aside.

In 1955 the Region entered into a cooperative agreement with a firm which manufactures a glare-reducing glass. According to the manufacturer the glass gives an even transmission through the visible range of the spectrum. Colors are rendered without distortion but are greyed or toned in brilliance. The glass transmits but 65 percent of the heat energy in comparison with 86 percent by clear glass. According to the company the glass also transmits a large percent of the near ultraviolet light which is beneficial. This type of glass is used in modern schoolhouse construction.

This glass was installed by the company on the 14 x 14 cab of a 60-foot tower, located on top of the Alleghany Mountains, elevation 4,300 feet, on the George Washington National Forest. The comments made on its effectiveness are based on three fire seasons of use.

The color of objects is retained in true relationship although darkened. Glare is reduced to an extent that it is no longer evident. The glass acts as a haze cutter to improve visibility to a marked degree. Heat is reduced materially. The interior of the tower is protected from fading by the effects of bright sunlight. The critical test of any glass reducing light transmission is its effect on discovering night fires. It was determined that visibility was reduced to a minor degree only and that this reduction was not an important factor overall.

On a cloudy day more heat is required to keep the tower at a comfortable temperature than with clear glass as might be expected because of low heat transmission characteristics of the glass. The glass must be cleaned frequently because dust lowers visibility perceptibly, much more than with clear glass. From the exterior this glass looks opaque with practically no "see in" properties.

As a result of the demonstrated advantages of this glass the forest is making a second installation. Its cost is about double that of clear glass, or approximately $150.

A second lookout in the Region is equipped with a rose-tinted glass on the south and west sides. This has proved to be an aid in reducing glare and has haze-cutting properties. Its cost is also about double that of clear glass.

As a result of the tests conducted in the Region with glare-reducing, haze-cutting glass it can be stated that the advantages are material and the disadvantages small. The small investment is justified when compared with the added comfort and efficiency afforded the lookout.

☆ ☆ ☆

Outdoor Fire Statistic Sign

The Arcadia Dispatcher's Office of the Angeles National Forest felt a need for some means of informing the public of the current fire situation. To meet this need a routed redwood sign with slots for removable figures was placed where both the general public and the nonfire personnel at the Arcadia Depot would notice it. The sign shows the fire danger for the day, total number of statistical fires to date, and acreage burned. It measures 24 by 50 inches, with 2- and 3-inch letters sprinkled with glass beads for night illumination.

This sign reaches many more people than an inside fire danger clock. Local comment has been very favorable, and some of the district rangers have expressed interest in using a similar sign at their headquarters.—CHARLES G. COLVER, *Assistant Dispatcher, Angeles National Forest.*

HOUSE TRAILERS FOR DETECTION OF FOREST FIRES

E. C. DeGraaf
Formerly Assistant Forest Supervisor, Olympic National Forest

In the Pacific Northwest an important forest fire control problem, not solved by the conventional lookout system, is the need for additional intensive detection over areas and drainages recently logged. Everyone is familiar with the fixed lookout stations used by the U. S. Forest Service and other forest protective agencies. Location, coverage, and intervening distance standards for these fixed lookouts were largely adapted to the protection of undeveloped areas. Detection standards were used that provided for coverage of large unbroken blocks of standing timber. The hazards and risks common to this condition were recognized, and protection was planned accordingly.

The situation in parts of the Northwest has changed appreciably. Logging roads are now opening up many timbered areas. Logging operations are expanding in all directions, and many unbroken timbered areas have now become a checkerboard of cutovers and logging slash. Logging no longer is limited to lower elevations, since heavy construction equipment, powerful logging trucks, and cable-type logging have pushed operations to whatever elevations contain stands of merchantable timber. This expansion in logging operations has provided access to many ridges and low mountain tops that offer excellent intensive detection coverage of the slash and timbered areas. If the slash on the logged units is burned successfully, it still represents a major change in fuel type and a somewhat hazardous area for a few years until the next crop is well established.

This change in hazard, from inaccessible areas of unbroken timber to accessible areas of highly flammable fuel types, calls for supplementing the fire detection program.

A ready answer to the problem is the use of a lightweight house trailer for mobile detection quarters. The house trailer should be relatively small with an abundance of windows. It should be light enough to be readily pulled up steep pitches by a ¾-ton or 1-ton vehicle to the desired location. It should be short enough to negotiate sharp road curves. A firefinder does not have to be installed in the trailer; it can easily be installed on a fixed table or stump on the selected site to permit an unobstructed view of the surrounding country. It would need to be properly oriented and its position spotted on the platting map of the dispatcher. A waterproof plastic or canvas hood is all that is needed to cover the firefinder when it is not in use. A radio in the trailer provides necessary communications.

On the Olympic National Forest in northwestern Washington, logging operations and resulting conditions brought on the need for intensive detection of the cutover areas. The use of house trailers to provide mobile detection facilities was decided on and locations selected. Two trailers were placed strategically in the Forks Burn of the Soleduck District. This burn of 35,000 acres occurred in 1951 and has since been completely salvage logged. This resulted in a major slash area of mixed ownerships where further slash burning was not advisable. The nature of the terrain and the need for intensive detection are evident in figure 1, which shows some of the area blind to fixed lookout stations.

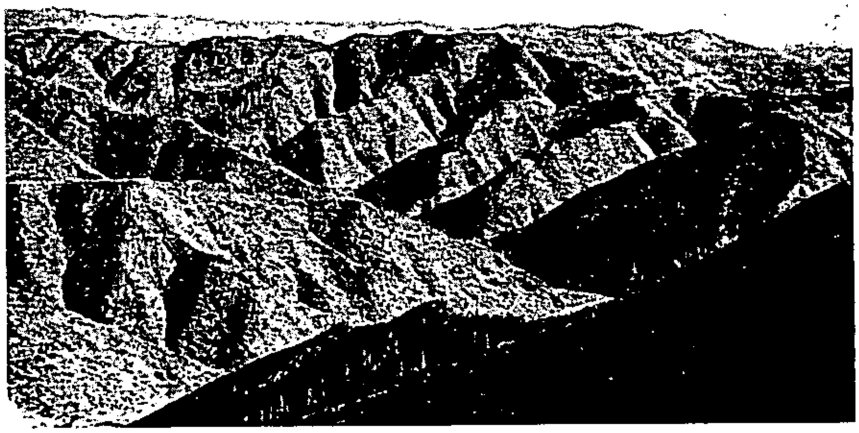

FIGURE 1.—Area seen from house trailer used for intensive detection on Burma Point in the Forks Burn. This broken terrain is not covered by direct visibility from fixed lookouts.

In the spring of 1956, a fire that could not be seen by the fixed lookouts was detected from one of the house trailer points in the Forks Burn.

A house trailer in 1956 cost $2,178 delivered to the Shelton Ranger District. Transporting it into position on the Canyon River drainage cost an additional $25. By comparison, the cost of a standard 14 x 14 ground lookout house constructed in place is from $4,000 up ($2,400 f. o. b. Portland). Compactness of the trailer and size of the conventional windows can be seen in figure 2.

After two fire seasons the merit of house trailers for detection in high-hazard areas has been established for conditions on the Olympic National Forest. To date, four house trailers have been purchased for this purpose. Two additional sites where this type of detection unit will be of value in logged-over areas are already selected for the 1957 season.

On the basis of experience on the Olympic National Forest, the use of a house trailer, with modified design if possible, offers

FIGURE 2.—House trailer on Burma Point in the Forks Burn. Opportunity is evident for increasing the size and number of windows for better vision.

an excellent means of supplementing fixed detection over logged areas with highly hazardous fuel types. This could become an effective and relatively low-cost method of insuring economical and flexible detection in one phase of fire control work in the Northwest.

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Fire Hazard Data Available At Brooklyn Public Library

"To save even one life or prevent one injury to a civilian or fireman" was the aim of Fire Lt. Martin Chayette, a fireman in Brooklyn since 1945. Lt. Chayette was recovering from injuries received in battling a fire when the idea of collecting literature on fire hazards occurred to him.

Although he knew that the field of fire prevention and protection was vast, he also knew that there was no place where this information had been assembled. With this as a goal, he sought to establish a center where firemen, architects, businessmen, laymen, and students could find source material for further study. Deciding to create this source, he sent out more than 1,500 letters requesting available literature from fire underwriters, fire departments, insurance companies, and equipment manufacturers.

Pamphlets, bulletins, magazines, and books have been collected. Lt. Chayette has assembled more than 4,000 publications on fire hazards covering the field from acetylene and air conditioning to wiring and woodwork. The collection fills a dozen shelves and eight filing cabinets in the Science and Industry Division of the Brooklyn Public Library.

Lt. Chayette speaks with high praise of the cooperation given him by the Brooklyn Public Library. Plans for the future are progressing. The library allotted $500 of its current budget to expand the collection. Eventually, it is hoped that the material on fire protection and prevention will be operated as a section of the library.—From an article in the New York World-Telegram and Sun, April 23, 1957.

FIRE TRAILER FOR A TREE FARM

JUDSON PARSONS
Mountcrest Tree Farm, Siskiyou Summit, Oregon

For our 1,800-acre tree farm in southern Oregon we constructed a small trailer (fig. 1) which can be pulled by a jeep, over our many roads, to any area on the tree farm.

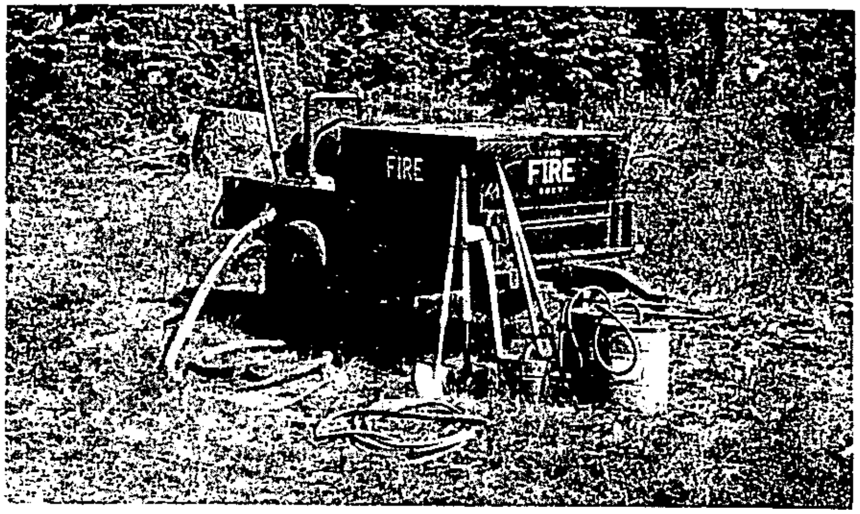

FIGURE 1.—Trailer and equipment. The trailer, drum, and box are painted red with white "FIRE" signs on the sides and ends.

On the rear half of the trailer is mounted a 55-gallon drum with two valves connected to the lower bunghole. Next to the drum is a hand-operated pump with 10 feet of suction hose. Water is pumped into the drum through the bunghole on the upper side. The pump will fill the drum from a small pond in 2½ minutes.

On the front of the trailer is a box in which fire tools are stored. The box is kept sealed, but not locked. The tools include two back-pack cans each containing 5 gallons of water, two shovels, two fire hoes, one ax, one bucket, and 75 feet of ½-inch garden hose with a trombone type pump similar to those on the back-pack cans.

The water in the drum can be used to refill the back-pack cans or with the garden hose and pump to pump water directly to the fire when the trailer can be brought within 75 feet of the fire.

We believe that this trailer and its equipment could control a small fire, or be used to advantage in helping to control a large fire. Also, the trailer, with its red color and white letters, is a constant reminder to those on the tree farm of the everpresent fire danger.

MOPUP KITS FOR REGION 6

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

Even though water is a great aid in quick and efficient mopup, great quantities may not have to be used; small amounts properly applied will do the job. The technique of "proper application" is to put water where it will do the most good. Region 6, as a third step in its efforts to secure more efficient use of water in fire control, particularly in mopup, has assembled a standard mopup kit.

The first step was to standardize on tank-truck and portable-pumper accessories.[1] The second step was to supplement pumping equipment with various items such as 1000-gallon folding canvas tanks, relay tanks, gravity intakes, and the pyramidal tanks whose use can make "nurse" tankers out of any flat bed vehicle. These items, along with small slipon tankers and portable pumps, provide the means of getting water to fires.[2] The third step was the assembling in one kit box those accessories needed for applying water efficiently over a wide area (fig. 1).

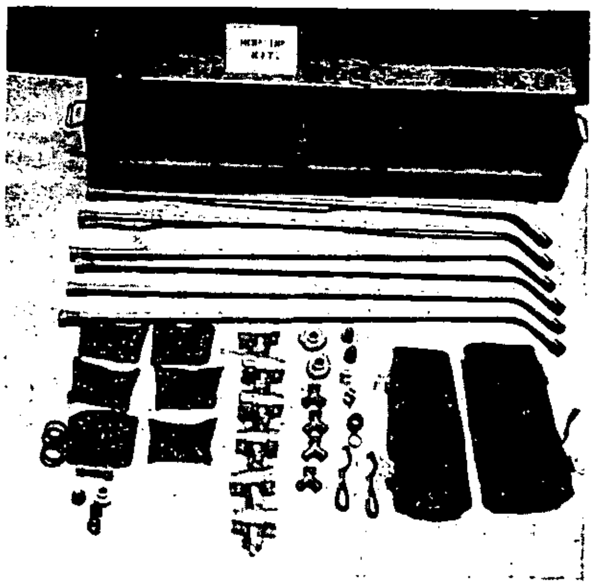

FIGURE 1.—Region 6 standard mopup kit.

[1]A. B. Everts. *Versatility in Water Application.* U. S. Forest Serv. Fire Control Notes 15 (2): 30-34, illus. 1954.

[2]A. B. Everts. *Canvas Water Show.* U. S. Forest Serv. Fire Control Notes 17 (2): 12-15, illus. 1956.

The contents of a mopup kit are as follows:

	Number
Applicators, 4-foot aluminum	6
Packsacks	2
Spray tips, 15 g. p. m.	2
Straight stream tips, ¼-inch	2
Garden hose Y's	4
Hose tees (1½-inch with 1-inch takeoffs with caps)	6
Reducers (1½ to 1-inch)	2
Spanner wrenches	2
Nozzle pouches (red canvas for easy visibility), each containing a 3 g. p. m. spray tip (¾-inch garden hose threads), a reducer (1 to ¾-inch garden), and a sleeve-type shutoff (with an assortment of 1½-, 1-, and ¾-inch washers	6

This equipment permits the use of six lateral takeoffs from a 1½-inch main line, using either 1-inch CJRL hose or garden hose or both. If the water source is from tankers where the conservation of water is a factor, the sleeve-type shutoff is used on the applicator; otherwise, it is not used.

Nozzlemen should work in pairs, one man digging, stirring, and rolling out burning material, and the other applying the water (fig. 2). The applicator permits the ramming of the spray tip into the smoldering material. For conservative use of water the 3 g. p. m. spray tip is sufficient. It is the favorite tip in the region.

FIGURE 2.—Four-foot aluminum applicator with 15 g. p. m. spray tip.

A foreman should be in overall charge of each mopup sector. It is his job to determine where the takeoffs are to be placed in 1½-inch main lines and how far out lateral lines are to extend, to check on the thoroughness of the mopup crews, and to see that all the items are returned to the kit box when the job is done.

The cost of the entire kit, including box, is approximately $200.

RECORDS AND EXPERIENCE OF DISCOVERING FIRES FROM AIRCRAFT

WILLIAM G. MORRIS
Forester, Fire Research, Pacific Northwest Forest and Range Experiment Station

During the period 1950-56 about 250 fires on four national forests of Oregon and Washington were discovered by searchers in airplanes; 93 percent were only small spots when discovered.

To learn some of the circumstances of fire discovery from aircraft, the four national forests that were the most frequent users of aerial patrol were selected for study. The personnel kept special records concerning fires discovered and fires missed by aerial patrol, method of using the eyes while looking for fires, and conditions that might affect efficiency of an aerial observer. Of the 247 reports on fires first discovered by aerial observers, Wallowa-Whitman National Forest submitted 134, Okanogan 89, Mt. Baker 13, and Siskiyou 11.

Distribution of these fires according to size when discovered was as follows: (1) Spots too small to warrant an estimate in terms of a fraction of an acre—93 percent; (2) larger than the foregoing but not more than one-quarter acre—4 percent; (3) more than one-quarter acre—3 percent.

Lightning caused 96 percent of the fires and the remainder were man caused.

Discovery time—elapsed time from origin to discovery—was 3 days or more for 9 percent of the fires, and, as commonly happens with sleeper lightning fires, a few were discovered after 3 weeks. For those discovered in less than 3 days, the average time was 15 hours. Fires that were larger than one-quarter acre when discovered had, on the average, longer discovery times than the smaller fires. A fairly long average discovery time by aerial observers can be expected on these national forests. As shown above, most fires were caused by lightning. Since a large proportion of lightning occurs late in the afternoon or after dark, clouds and darkness usually prevent aerial search before the following morning.

Distance from observer to fire at time of discovery was recorded for 105 fires, and the average was 1.3 miles.

Most aerial discoveries—85 percent—were made during the first flight near the fire after ignition, while 10 percent were made during the second flight and 5 percent during later flights.

The forests reported 34 fires missed by aircraft searchers and later discovered by other kinds of detection. Average distance at which the flight passed the fire was 2.3 miles, and only

3 fires were in areas invisible to the aerial observers. These fires were very small at the time they were missed by aerial observers. Two-thirds were still only small spots when later discovered. Lightning fires often smolder several days[1] or even weeks before producing enough heat and smoke to be visible above the forest canopy. Many of the missed fires may have been this type.

In several years, reports were submitted giving the proportion of reportable and miscellaneous smokes first seen by quick scanning compared to slow and careful looking. By far the greater proportion were first seen while quickly scanning. As shown by supplementary memoranda by observers, some were found only after repeated circling and painstaking scrutiny of the general location where the observer knew a smoke had been previously seen. These were the thin small smokes that reflect little light and would probably be missed by quick scanning. Some observers stated they usually used a quick scanning method, but others usually used a slow and careful looking method. Some gave the visible area a preliminary quick scanning to detect clearly visible smokes and followed this with slower, systematic searching as time permitted. This method probably makes the best use of available time in completely covering the visible area and searching for poorly visible smokes.

In two years the observers were asked to determine whether length of flying time, rough air, or airplane noise and vibration affected their alertness in seeing the frequent nonreportable small white smokes, such as those from certain chimneys, mills, and permitted bonfires. They were equally divided in opinion as to whether long flying time decreased their detection efficiency. Most thought neither rough air nor noise and vibration were important factors.

The foregoing records of experience in aerial detection of fires on four widely separated national forests of Oregon and Washington should be useful when considering use of this detection system, estimating its reliability, and training aerial observers.

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[1]MORRIS, WILLIAM G. *Lightning Fire Discovery Time on National Forests in Oregon and Washington.* Fire Control Notes 9 (4): 1-5. 1948.

SIUSLAW FIELD HOSE WASHER

ARVID C. ELLSON, *Forester*, and ALBERT B. SHROY,
District Assistant, Siuslaw National Forest

The Siuslaw National Forest has a large and complex slash disposal problem. After a unit has been burned, mopup starts immediately. Water is used extensively. The hose used becomes caked with mud and ashes. The Siuslaw washer was devised for washing hose on the job as it is gathered in from the line.

The washer, made in a local shop at a cost of $13.65, consists of a stem and ring of 1-inch water or boiler pipe, two guide rings to keep hose centered, and a C-clamp for mounting the washer in any convenient place (fig. 1). Eighteen 1/16-inch holes are drilled in the pipe ring. Water is pumped into the washer under pressures of from 100 to 200 pounds.

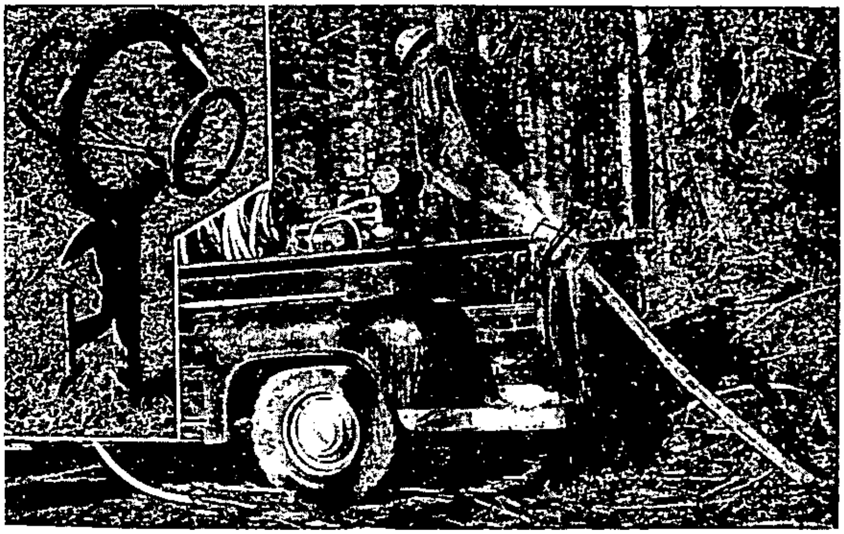

FIGURE 1.—Siuslaw field hose washer; in use clamped to tailgate of pickup.

At 100 pounds pressure the water use is approximately 21 g. p. m. At 200 pounds it is 30.7 g. p. m. These deliveries are well within the capabilities of the pumps used in Region 6.

SCOOTERS FOR TRAIL TRAVEL[1]

Compiled by Equipment Development Section
Region 1, U. S. Forest Service

A few years ago, leisurely foot or horse travel over scenic forest trails was considered by many as a part of the reward of forestry work. Foresters in general have not changed in this appreciation, but the steadily increasing cost of nonproductive trail travel is of considerable concern.

During the past 10 years, administrators have given serious thought to the possibilities of modified commercial scooters and other machines for use on selected trails. Experimental use has been attempted in various regions with not too promising results. Region 1 has been building, testing, and conducting a limited operational use program since 1945. Slow field acceptance has been due largely to an almost total lack of up-to-standard trails or to below-standard sections in the trail which are bottlenecks to scooter travel.

The comparatively recent program to mechanize trail maintenance, a cooperative effort of Regions 1, 4, 5, and 6, clearly demonstrates the need and the possibilities for faster and easier trail travel. Through this program, the development of scooters has been accelerated and present designs are proving highly successful in operational tests.

TRAIL SCOOTER DEVELOPMENT

Early commercial scooters tried on forest trails were underpowered for the steep grades and rough trail treads encountered. In 1946, a commercially made scooter was modified to obtain increased performance. This machine was powered by a 5-hp., 2-cycle engine. It incorporated a fluid coupling that eliminated the usual clutch and provided torque for holding the machine on steep grades by advancing the throttle. Other modified scooters were also tested to determine necessary performance requirements. The Forest Service completely designed and constructed a scooter for the first time (fig. 1).

A 1948 Forest Service model, built for testing over selected trails, provided loading space for equipment at the lowest possible position on the frame. Weight was again reduced slightly and performance increased. This machine is in current use and has worn out two sets of rear tires in trail travel.

In 1952, a "powered wheel" was constructed to test the balance and advantages of a large-diameter tire (fig. 2). With a trailing, stand-on platform, it became a slow-speed scooter. Although not successful, it was the first in a series of the stand-on type.

In 1954, a test scooter using the stand-on principle was constructed (fig. 3). The 2½-hp. motor provided power for 30- to

[1]This is a slightly shortened version of *Scooters for Trail Travel*, U. S. Dept. Agr. Forest Serv. Equip. Devlpmt. Rpt. 46, 10 pp., illus. 1957. [Processed.]

FIGURE 1.—This Forest Service 1947 model used a 6-hp., 4-cycle engine, with a fluid coupling incorporated in the drive arrangement. Weight was reduced by the liberal use of aluminum angles and tubing.

35-percent grades and a top speed of about 12 m. p. h. Where trail treads or grades did not permit safe riding, the handle over the gasoline tank actuated the clutch and provided power for "walking" the machine. With the operator in standing position, he needed only to step to the ground when trouble developed. Where treads were narrow and dangerous, one foot could be used in a manner similar to that of a boy riding a sidewalk scooter.

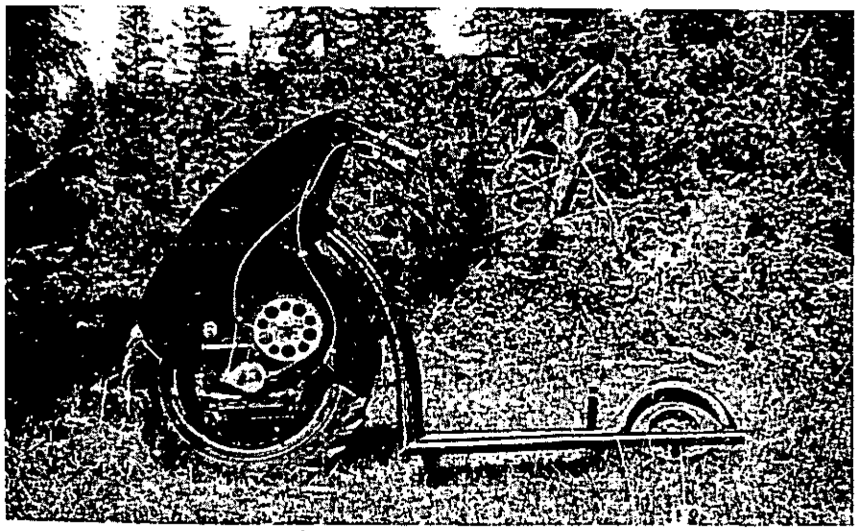

FIGURE 2.—"Powered wheel" with stand-on platform.

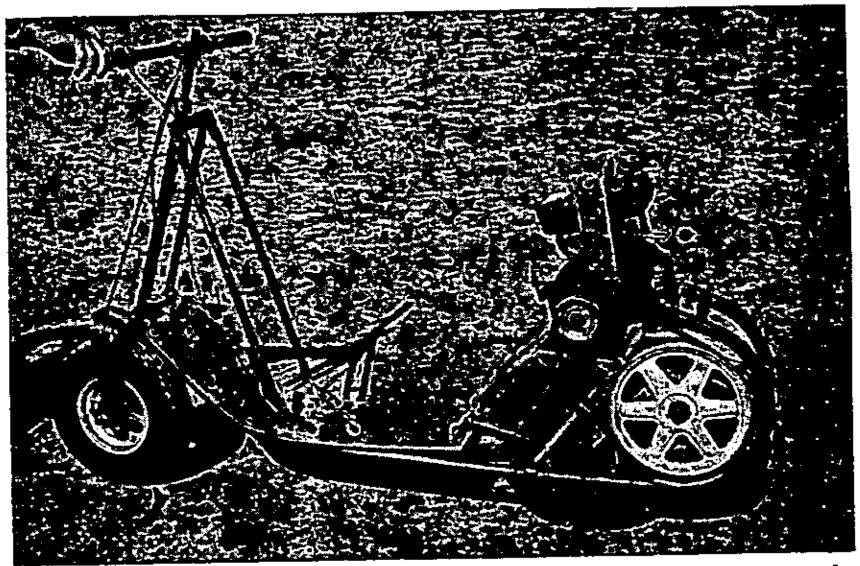

FIGURE 3.—This pilot model weighed only 126 pounds and could easily be manhandled at creek crossings and slides, or over logs. It could be folded for transportation in a passenger car.

A standard commercial model, modified in 1954 for trail travel, has adequate performance for any trail improved to a reasonable scooter standard. Initial cost, including modifications, is approximately $500. Space for hauling heavy loads or maintenance tools has been provided.

An improved model of the 1954 stand-on machine was built for field testing, and the next year performance was further improved and our experience broadened. Weight of the 1955 model was 135 pounds.

Another commercial model was modified for operational testing during the 1955 season, and a second machine, with modifications listed below, was used during 1956 (fig. 4). Riders state that the tank, located between the legs, gives better balance and control. They believe the advantages of this arrangement offset any reduction in safety compared with the open frame of the standard model. Considering that these heavy commercial machines are intended primarily for use on trails improved to at least scooter standards, any reduction in safety may be insignificant.

Modifications on this machine include the following:

1. Maximum possible reduction through enlarging the final driven sprocket and reducing to a minimum size the final driving sprocket.
2. Increase clearance of frame approximately 3 inches front and rear.
3. Remove footrests and modify frame so both feet are placed inside the frame for protection.
4. Rearrange brake and clutch controls so brake may be applied with either foot, and clutch is engaged by use of throttle only.
5. Rearrange carrier rack to accommodate greater load at minimum height.
6. Attach a smooth skid-pan to underside of frame to protect machine in rocky areas.

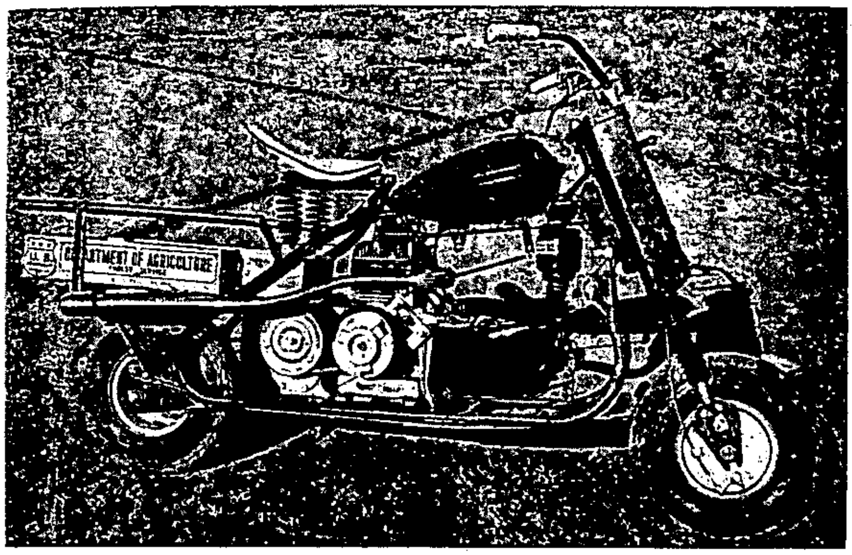

FIGURE 4.—The 1956 model has proved to be a nimble performer, and field forces in Region 1 prefer this machine for heavy hauling and travel over mechanized trails.

The 1956 model Forest Service stand-on scooter (fig. 5) incorporates several new features for observation and operational testing: (1) low-pressure air wheels without inner tubes used with special hubs that grip the tire bead to prevent any possibility of turning on the hub—a problem with conventional tires; (2) load space in front of operator for light loads such as

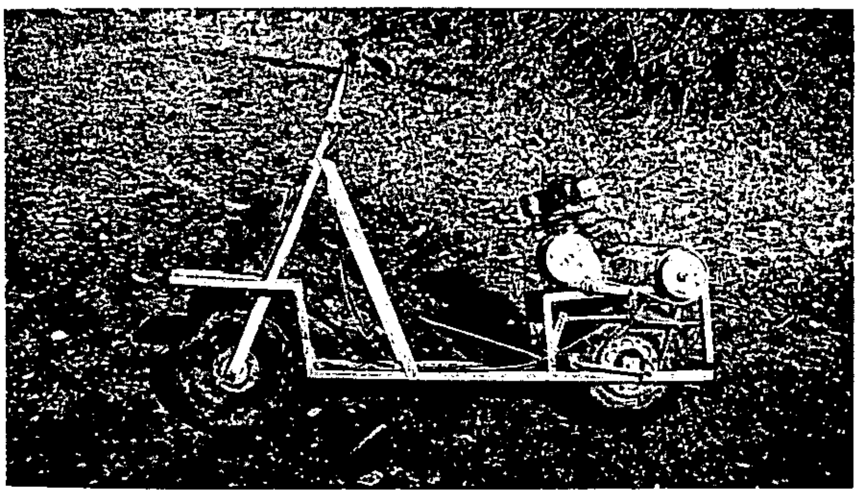

FIGURE 5.—This model has exceptional climb performance due to the increased traction. The low-pressure air wheels have also contributed materially to the clinging ability on sloping trail treads, and to a softer ride on rough trails. It is somewhat harder to steer and possibly slightly harder to balance than the previous models with smaller tires.

sleeping bag, personal gear, chain saw for "logging out," etc.; (3) simplified clutch and speed-change arrangement; (4) hydraulic front and rear brakes. Other features developed and tested in two previous models were generally maintained.

Our several years of exploratory and development work lead us to believe that there will be a need for two general types of trail scooters. The stand-on model offers maximum performance and safety for use on substandard trails. The cost advantage (commercial stand-on machines are estimated to cost less than $250) will permit a larger number for light maintenance work and administrative travel.

The standard and special commercial models, modified for improved safety and better trail performance, will be used on trails maintained to scooter standards. They are generally more comfortable to ride and can carry a substantial load in addition to the rider. If used on improved trails, where manhandling is not necessary, the heavy overall weight is not particularly objectionable.

A trail maintenance unit has been developed for scooter transport which permits one or two nights away from roads and stations. This usually provides sufficient time for maintenance men, riding scooters, to complete a continuous section without backtracking. Present plans in Region 1 contemplate mechanization for selected trails only. Their mileage is estimated to be about 50 percent of the total trail system or approximately 14,000 miles. The program will require 10 or 12 years with presently available financing.

CONTINUING DEVELOPMENT

We anticipate continued improvement in operational use, dependability, and handling characteristics over the next few years. Although no major programs are contemplated, a limited development program should be continued.

A design for commercial production of a stand-on machine for operational testing during the summer of 1957 had these important specifications:

1. Total empty weight not to exceed 135 pounds.
2. Air-cooled, single-cylinder motor of 3 to 4 hp.
3. Air-wheel tire in rear, 8:00 x 4 or larger. Front tire not less than 5:00 x 6 and may be normal pressure.
4. Usable trail speed 2 to 12 m. p. h. by means of variable-speed belt transmission with automatic clutch.
5. Dual wheel brakes; rear brake may be on jackshaft. Applied by hand pressure.
6. Arranged for "stand-on" operation.

Our experience has proved the stand-on principle for rough or dangerous trail use. There is a good possibility that the motor could be located immediately behind the front wheel to increase the torque leverage. (Present machines are limited in absolute climb by the tendency to "rear up" in front on 45-percent-plus grades, due to the considerable torque requirements and the exceptional tractive ability of the air wheel.) A seat could be provided (it probably would be desirable in some situations) that would swing back when the operator stood up or when he wished to "pedal" the machine with one foot for safety. All controls should be arranged on the handle bars to enable the operator to control the machine while walking alongside.

We have made arrangements to obtain a prototype air wheel, 16 inches in diameter, 12 inches in width, and with a 4-inch hub. This soft tire, which utilizes the "rollagon" principle, may be entirely suited to the stand-on scooter. A test program now under way will determine the possibilities.

Although the modified commercial scooters now available have proved very successful in operational use on improved trails, some development investigation should be continued. Early heavy-duty Forest Service designs proved the value of a fluid coupling in the final drive. We believe that if this coupling could be incorporated in the modification of heavy-duty commercial machines, there would be a considerable improvement in safety performance and handling qualities.

SCOOTER REQUIREMENTS AND PERFORMANCE

Any system for rating development progress will provide room for argument. A rating system does, however, provide a tentative comparison between machines and stress items of performance that are believed to be most essential. It is doubtful if any present carrier (scooter or motorcycle) would be rated 100 points (table 1). All would have some deficiencies.

Safety. The ideal personnel carrier for narrow trails and off-road use must first of all be a safe machine when operated properly.

Rough trail travel ability permits greater utility and contributes to many other performance features.

Mechanical dependability is achieved through proper design, skillful workmanship and the correct use of proper materials. The proof is found by experience.

Effective speed range. A machine capable of 25 m. p. h. would be useless for rough trail travel. To obtain an effective range from 3 to 25 m. p. h. is extremely difficult. The three scooters compared here have an approximate effective range as follows: USFS stand-on, 2 to 12 m. p. h.; modified commercial model #1, 4 to 18 m. p. h.; modified commercial model #2, 6 to 25 m. p. h.

The type of intended use has considerable bearing on the speed selection. The stand-on, for example, is intended for very rough trails, therefore, a slower speed is necessary. With a sacrifice of top speed, we were able to utilize a small and light motor to climb very steep grades, and maintain minimum machine weight for ease in manhandling when necessary. The modified commercial models would have rough going in these areas since the operator would need to travel too fast for maximum safety in order to obtain necessary traction.

Ease of handling has been rated 10 points, maximum. It is possible that a machine might rate zero for ease of handling but have superior performance in all other respects.

TABLE 1.—*Scooter requirements, tentative rating, and comparison of performance*

Requirement	Maximum rating point	Forest Service stand-on	Modified commercial model #1	Modified commercial model #2
Safety of operation (controls, brakes, skill requirements, position)	20	18	15	13
Rough trail travel ability:				
Climb grades of 45 percent or more (average traction)	5	5	2	3
Descend grades of 45 percent or more (average traction)	5	4	2	3
Travel rough, rocky trails; stream crossing	5	4	4	4
Traverse sloping trail treads (sidehills)	5	5	2	3
Mechanical dependability	15	10	12	12
Effective speed range (3 to 25 m. p. h. trail and road travel)	15	10	13	13
Ease of handling:				
Easy to balance and steer (crooked, rough trails)	5	4	3	4
Easy to manhandle (turning, walking, loading, lifting, carrying)	5	5	1	2
Load capacity, 100-pound load plus rider	10	5	9	9
Economy of operation	5	4	3	3
Comfort of operations, riding (fatigue elements; quality of ride)	5	3	3	4
Total	100	77	69	73

Load capacity of 100 pounds in addition to the rider would certainly add to the utility of any carrier. The stand-on scooter is limited in its ability to carry equipment and supplies in excess of 30 or 40 pounds. It is, therefore, rated accordingly.

Economy of operation.—Exceptional performance could easily offset poor economy.

Comfort of operations.—The same argument applies to comfort as to economy of operation.


Smokey Says:
BE CAREFUL
WITH MATCHES
WITH SMOKES
WITH ANY FIRE
SMOKEY
Remember - only you can
PREVENT FOREST FIRES!

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.