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FIRE CONTROL NOTES

A PERIODICAL DEVOTED TO THE TECHNIQUE OF FOREST FIRE CONTROL

FOREST SERVICE • U. S. DEPARTMENT OF AGRICULTURE

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

Volume 17 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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PAPER BAGS FOR AERIAL WATER BOMBING OF FOREST FIRES

A. P. LESLIE AND J. D. NICHOLS
Division of Research, Ontario Department of Lands and Forests

The Ontario Department of Lands and Forests became sufficiently interested in the possibility of forest fire suppression by bags of water dropped from aircraft to conduct field tests in the Sault Ste. Marie district in 1949. This form of attack showed definite merit and was developed into an efficient aid in fire suppression operations.

Water bombing of forest fires is selective and the effectiveness is limited, but it is felt that this practice can play an important part in the suppression of forest fires and will continue to do so until such time as helicopters are readily available.

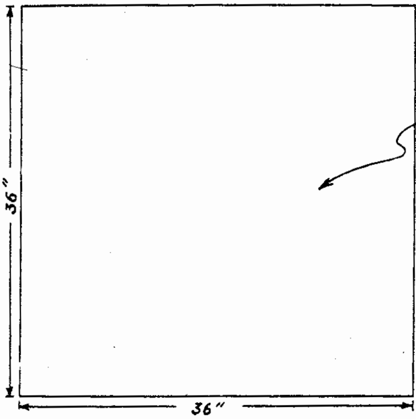
This attack is primarily intended to retard the rate of spread of small forest fires in situations that are difficult to reach on the ground. Under such conditions it may slow down the fire until suppression crews reach the area. The method has been found effective also in assisting fire fighting crews in bringing portions of the fire edge of large fires under control and has proved quite good on these fires during the early hours of the morning. Assistance to the suppression crew is carried out through the medium of air-to-ground and ground-to-air communication and care is taken that no bombs are dropped until the suppression crew has retired from the target area.

The water bombing of small, inaccessible fires generally follows a set pattern. The aircraft lands on the nearest water, two smoke-chasers are dispatched to the fire, a third man is kept to assist the pilot in the water bombing operation. The water bombing equipment is installed, 17 to 24 bombs are filled with water, and the bombing begun. Bombs are dropped in salvos of up to eight per salvo.

The water bombing equipment used in the standard De Havilland Beaver aircraft of the Department consists of conveyer, camera hole fixture, water bombs, and pail for filling water bombs. Description of this equipment and procedure followed during bombing operations is available in a technical bulletin, Aerial Water Bombing Instructions, issued by the Ontario Department of Lands and Forests.

The water container bag or "water bomb" is manufactured to Department of Lands and Forests specifications, as illustrated in the accompanying diagrams, by a specialty firm who assisted and worked with the Department on the development of this bag. Fifty- and sixty-pound wet strength Kraft papers, plasticized and coated with a self-seal adhesive compound are used in the manufacture of the water container bag. The properties of the adhesive compound make the bag waterproof and supply a quick and efficient method of sealing.

Diagram 1



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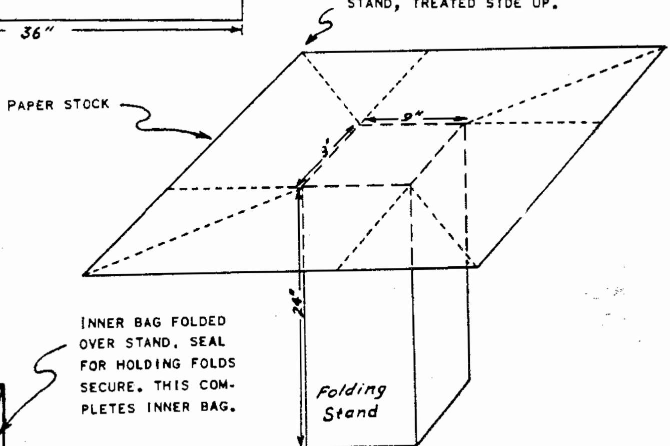

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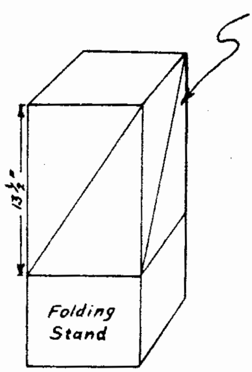

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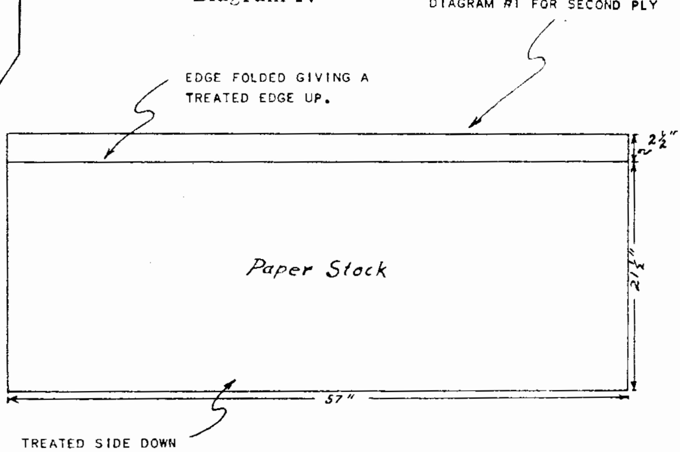

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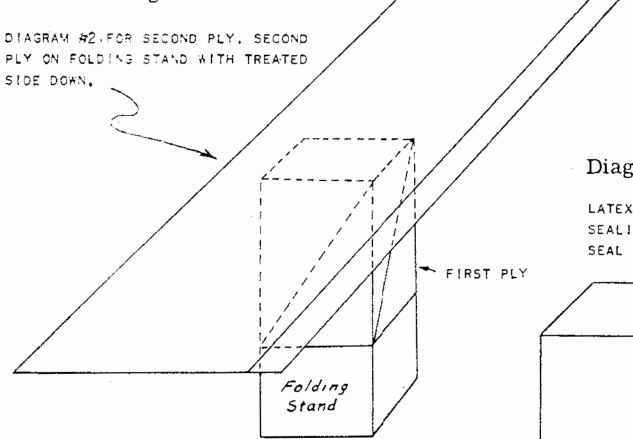

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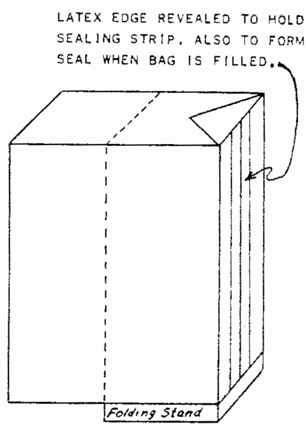


Diagram VII

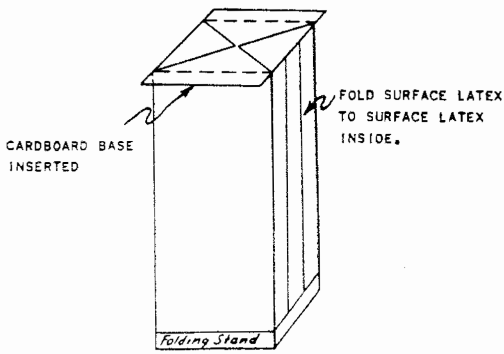


Diagram IX

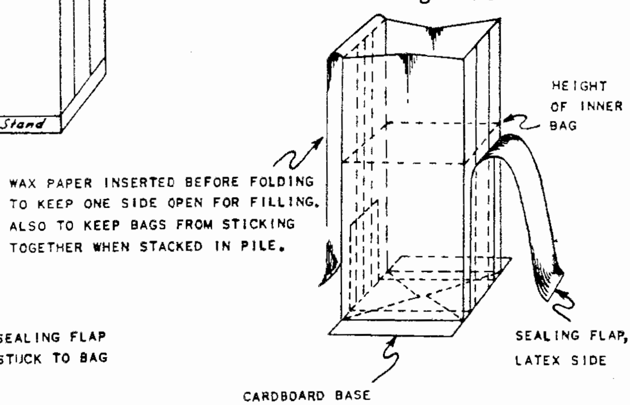


Diagram VIII

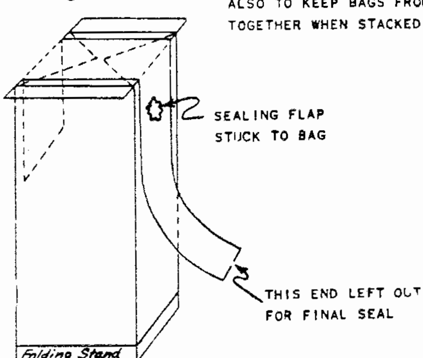
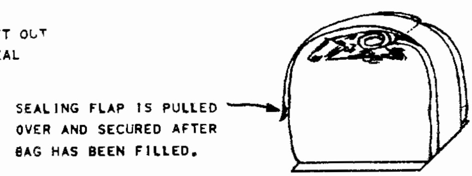


Diagram X



On the top 7 inches of the bag, the sealing compound is on the inside of the paper and forms the watertight seal when closed. This seal is prevented from sticking before use by the insertion of a piece of waxed paper that is removed and thrown away when the bag is filled. The compound is between the two layers of paper on the rest of the bag which is the container section.

To give rigidity when filled, a piece of treated cardboard is held to the base of the bag by the sealing flap as shown on the accompanying diagrams. Correct folding of the outer ply of paper forms a sealing strip on the side opposite the flap side.

When the bag is filled with water the top section is sealed and folded down onto the top of the container section and held in this position by attaching the sealing flap to the sealing strip. Filled and sealed correctly the bag roughly resembles a cube. Specification details are as follows:

Paper		Kraft, wet strength.
Inner ply		60-pound.
Outer ply		50-pound.
Self-seal compound		Latex.
Dimension of base of bag	inches	9 x 9
Dimension of cardboard	do	9 x 11
Height of bag	do	18
Width of mouth opening	do	9
Width of sealing flap	do	7
Width of sealing strip	do	4
Dimension of bag when filled	do	11 x 11 x 11
Capacity of bag	gallons	3.5

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Fire Finder Maps: Protected, Yet Kept Up-to-Date

Most methods of protecting the maps on top of fire finders require coating with transparent liquids or impregnation as in the Lamacoid process. The disadvantage is that once the map is treated no changes can be made either in the road locations or in the ownership status. To overcome this disadvantage we have used the following method. It is cheap, easy to use, not messy. Changes can be made on the base map as often as needed.

The untreated base map, after it has been mounted on the map plate, is covered with a sheet of heavy glass called "crystal sheet" in the glass trade. This is almost as heavy as plate glass, but much cheaper; a 20-inch circular piece costs $4.65 at today's prices. The untreated map is mounted on the circular, removable base of the Osborne fire finder with rubber cement. We remove the center pin used to center the map in order to eliminate the need for having a hole bored in the glass. The map is oriented in the usual manner, and the screws tightened down. Then the piece of crystal sheet glass is placed over the map. This protects the map yet may be readily removed so that changes can be made.—A. J. QUINKERT, *District Ranger, Wayne-Hoosier National Forest.*

PROSPECTS OF EXTINGUISHING FIRES FROM THE AIR

A. A. BROWN
Chief, Division of Forest Fire Research, U. S. Forest Service

Aircraft have participated in varying degrees in forest fire fighting since 1919. At first, use was limited to detection or verification of the existence and location of small fires and to aerial reconnaissance of large going fires.

We did some experimenting in the late thirties on the possible effectiveness of spraying or bombing fires with water and other extinguishers. We found at that time that free liquids released from a plane dissipated so rapidly in the air that very low flying would be required. Mountainous terrain, turbulent air, and poor visibility due to smoke ruled this method out at the time. Preliminary tests of water bombing showed some promise, but the low capacity of planes available and the lack of suitable facilities discouraged operational use.

However, experimental and other test work at this time demonstrated the feasibility of delivering men and equipment close to a fire in roadless country by parachute. Intensive work was done in developing suitable parachute equipment and methods that could reduce safety hazards of such an operation and that could make it a feasible substitute for numerous but widely disseminated, seasoned ground fire fighting forces. This was accomplished in 1940 to a degree that "smokejumpers" and aircraft became a regular part of the forest fire fighting organization for the large blocks of roadless forest country that exist in parts of Idaho, Montana, Washington, Oregon, northern California, and New Mexico. The complete story of smokejumping is separately available.

Further development of aerial methods of detecting fires has also taken place and the substitution or supplementing of fixed lookout systems by regular patrol from the air has proved its value, particularly where lighting fires are prevalent and forest fuels are relatively slow burning.

These uses of airplanes are successful and are now well established. In addition, small helicopters have come in for increasing use for shuttle service on large fires. Their ability to move key men or critically needed equipment up a mountain slope or across rugged terrain in minutes compared to hours, and their ability to land in a small, hastily prepared spot are such valuable assets, that high cost of such service, limited carrying capacity, and their inability to carry sizeable loads when operating from landing spots at high elevations, have not prevented fire agencies from taking advantage of their capabilities. But these uses are primarily a matter of aerial transportation. The attractive possibilities of utilizing helicopters and fixed-wing airplanes to fight fires directly have not developed very far to date.

In 1947 a renewed effort was made to develop aerial bombing of forest fires as a joint project with the Air Force. The purpose was to test the effectiveness of such methods and to develop equipment and technics adaptable to military planes and operations. Good results were obtained on small fires with large water bombs exploded at treetop heights dropped from B-29's and modified wing tip tanks dropped from P-47's by skip or dive bombing technics. In typical forest fuels, fires of ¼ acre or less were never fully extinguished but the spread was stopped and burning was held down to a point where there was ample time for a small ground crew to get to the fire in an inaccessible location to complete the job. The effect on large fires was less encouraging with the methods used.

In 1948 the propeller drive fighter bomber aircraft used successfully in bombing small fires became obsolete for military purposes. At that time new jet type fighters were not believed suitable for such missions in mountainous areas. Because of priority of military requirements it was not considered practical for the Air Force to commit a fleet of bombers with crews in the degree of readiness necessary for further tests on an operational basis. For such reasons, the Air Force withdrew from the experiments leaving many questions unanswered.

Since that time many economic and technological changes have occurred that justify a new look at all possibilities. Timber and watershed values and cost of fire protection by ground methods have increased enormously. The cost of aerial operations has not increased in the same proportion. Similarly, plain water delivered through a nozzle onto a going fire is no longer "cheap." So new "expensive" additives that can increase its extinguishing power might pay off handsomely. The capabilities of aircraft have been enhanced and the tactical and strategic measures that they might carry out successfully need not be confined to bombing.

If dropped in sufficient mass, water can be delivered in an effective pattern from much higher flight levels than we have previously believed possible. Plastic or paper envelopes might serve in other situations and large carrying capacities might offset to a considerable degree what has formerly been regarded as a prohibitive cost of transporting water in the volumes necessary to have a definite effect on a fast-burning fire front. Usually, it would be necessary to apply ¼ to ½ inch of water per unit area to most of the burning area to have much effect.

If a standard of this order is assumed, the prospects of directly extinguishing a large fire that has assumed conflagration proportions appear quite remote. An airplane with a 2,500-gallon load of water or liquid extinguisher might accomplish it for an area of only a half acre or less. Larger capacities such as possessed by the C-74 or C-124 would increase the possible area of coverage. But it is apparent that a prohibitively large fleet would be necessary to have a positive extinguishing effect on a large fast-moving fire of several thousand acres. Such a fire sets up violent convection currents which also create dangerous hazards to aircraft. For these reasons even large capacity for carrying extinguishers does not offer a ready solution to such situations.

In spite of such limitations, there are critical situations in the early spread of every fire when extinguishing action at the right time and place on only a portion of its perimeter would insure prompt control of the fire at great savings in damage and fire fighting costs. Too often such action is beyond the resources of ground fire fighting forces in rugged terrain.

It is for these reasons that even limited but timely action from the air offers attractive possibilities. To realize such possibilities in emergency operations, we believe a systematic research and development program, including a series of extinguishment tests, will be necessary. So far personnel and facilities available for such purposes have been too limited to enable a satisfactory rate of progress.

In 1953 disastrous fires in southern California focused attention again on the need to develop new and better methods of reducing the disastrous losses inflicted by runaway fires. All fire agencies in that area volunteered help in organizing a project to test out a number of unconventional methods and ideas. Since defense against such fires is also a grave problem in civil defense, the Federal Civil Defense Administration gave sponsorship and six branches of the Department of Defense gave assistance in various ways. With this remarkable pooling of resources and interest, an ambitious and highly successful one-year exploratory project, known as Operation Firestop, combining field and laboratory tests was carried out.

They demonstrated that new chemical retardants have possibilities of effective application from the air, that water in sufficient volume, can be released suddenly from a modified torpedo bomber and delivered on a fire with considerable accuracy without undue loss in the air, that small helicopters have many tactical possibilities for laying hose, and for first-aid action in fire fighting that have not been exploited, and that large helicopters can deliver men and fire pumps with water to any part of a fire in rugged topography at will and can apply water to a fire at close range.

This has been a fine start. Of necessity Firestop had to be largely exploratory. Few of the new things tried could be developed to a point where they could be applied directly by fire agencies. Much further research and development is needed. It will be costly. It calls for a much stronger research staff than has so far been available to the Forest Service. But there is so much loss and human suffering at stake and the problem is so important to wartime defense that many are optimistic that ways will be found to solve the many problems that still exist in making fire fighting from the air a new stage in the progress of forest fire control.

The prospects of extinguishing a fully developed conflagration from the air are still not encouraging. But there are excellent prospects of preventing such a conflagration from developing by early aerial action. The prime advantage of aircraft is in their capability for speed and for access, which can increase success in taking action at the right time and right place. Inability to do so at critical times is the major handicap of ground forces under conditions of heavy cover and rugged terrain. Much may be accomplished by "first aid" from the air at the moment a fire is on the point of escaping from ground forces.

The many small but timely actions that might be taken directly from the air to help the fire fighter on the ground to win more victories can be summed up in military terms as *giving close aerial support* to *ground fire fighting*. Most forest fire fighting agencies agree that a full program of research to develop aids in this way and to develop new methods is very much needed.

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Published Material of Interest to Fire Control Men

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METEOROLOGICAL PROBLEMS ASSOCIATED WITH MASS FIRES

DEVER COLSON
U. S. Weather Bureau

Weather plays an important role in the behavior of mass fires. The knowledge and understanding of the meteorological conditions existing prior to and during these fires are essential for efficient fire fighting and control in both urban and rural situations. Ordinary fires or even large fires which are burning and spreading in a regular manner do not present the major control problems. Serious situations often develop when what seems to be a routine fire suddenly intensifies or begins to spread at a greatly increased rate or changes its direction of spread abruptly. In forestry parlance, the term "blow-up" or "explosive" has been applied to such forest fires since these fires often seem to explode. However, many fires have been designated as "blow-ups" simply because of a lack of understanding of the factors controlling the behavior of these fires.

There is much to be learned both in identifying these factors and in forecasting the occurrence of these factors. Some of the possible meteorological factors will be discussed briefly in this paper.

General burning conditions.—Most serious fires occur with extremely low fuel moisture caused by severe or extended drought conditions. These conditions are usually combined with high surface temperatures and low relative humidities and often with strong surface winds.

One notable example involved the famous Chicago fire on October 8, 1871, and the associated fires in Wisconsin and Michigan on the same day which burned over 1,000,000 acres, including the entire town of Peshtigo where over 600 lives were lost. Weather data indicate extreme dryness and strong winds on that date. On days with less hazardous burning conditions, these fires might well have been controlled before they had reached such disastrous proportions.

In the preparation and planning for the fire bombing raids over the Tokyo area, weather conditions were studied in connection with brush fires in North Carolina, a region climatically similar to the Tokyo area. The following factors were used: precipitation, relative humidity, and maximum wind speed. The maximum wind speed on the day of the fire was used while the precipitation and relative humidity were weighted over the day of the fire and the three previous days. These same factors are used directly or indirectly in most current fire danger rating systems.

Surface wind patterns.—The details of the surface wind patterns are necessary for efficient fire fighting operations. These details would include: the actual local surface wind patterns; the diurnal variations in these patterns; and the dependence of these local patterns and their diurnal variations on the surface pressure patterns as well as frontal and storm passages, the upper level weather patterns, atmospheric stability, wind and temperature profiles, and topography.

A knowledge of the local wind patterns and their variations is even more essential in areas of rugged terrain. In these areas, there are the additional effects of general drainage patterns (mountain and valley winds) and the diurnal up- and downslope winds due to the differential heating of the slopes. The relative influences of all these factors vary greatly with the ruggedness of the terrain.

Two local wind surveys have been conducted, one by the U. S. Weather Bureau in 1949-52 at Oak Ridge, Tenn., and the other by Operation Firestop in 1954 at Camp Pendleton, Calif. Unfortunately, much of the data from these surveys cannot be applied to other areas because of the influences of the local terrain and weather conditions. However, as data from additional surveys are accumulated, more and more generalizations can be made that can be applied to other areas. Such wind studies are important in air pollution and smog control.

It is the unusual cases that cause the most trouble. Some recent cases are the 1949 Mann Gulch in Montana and the 1953 Rattlesnake and 1954 Sierra City fires in California. At each of these fires, fire fighters lost their lives when the fire spread rapidly in an unusual and unexpected manner. In the Mann Gulch fire, the unusual currents may have been due to the strong surface winds resulting from descending currents from the high level thunderstorms in that area. In the other two cases, the rapid spread of the fire may have been due to a combination of the normal night downslope air drainage acting simultaneously with a pressure gradient across and through the passes. As more is learned about these wind patterns, more of these unusual fires and their behavior patterns can be anticipated.

Topography.—With the proper pressure gradient across mountain ridges and through passes, strong local winds will be set up as the air flows down the lee side. Examples of such strong local winds are the Santa Ana winds in southern California, the east winds in western Oregon and Washington, and the chinook winds on the east slopes of the Rocky Mountains. These winds have a tremendous effect on fires since they are associated with high temperatures and low relative humidities.

Upper level winds.—As fires spread into the crowns of high trees, a different rate of spread can be expected since the wind speed and direction at this level may be quite different from that near the ground. Also, with burning buildings, the surface winds may have little connection with the fire spread at higher levels. With convection currents carrying burning embers up into even higher levels, the rate and direction of the spread of the fire due to spotting may be entirely different from that which would be expected from just a knowledge of the surface winds alone.

Turbulence.—In addition to the actual local wind patterns, the turbulence or the fluctuations in both the wind speed and the direction must be considered. The magnitude and frequency of these fluctuations have been found to be closely associated with the degree of atmospheric instability. Also, the magnitude and frequency of these fluctuations will be greater at well exposed sites than at well sheltered locations. Mechanical eddies and turbulence can be generated as air flows across and around sharp features of terrain and buildings.

Convection.—Under certain atmospheric conditions, better convection can be sustained which will promote more efficient burning. These conditions are usually associated with atmospheric instability, that is, with near or superadiabatic temperature lapse rates. However, the convection column will not attain great heights if the wind speed increases too rapidly with height. Too strong a wind speed may cause the column to be broken away from its energy source.

Temperature inversions tend to act as a lid on free convection. However, under these conditions, as the free air temperature reaches a certain value or as the energy of the fire becomes great enough, the convection can break through the inversion and can suddenly extend to much greater heights, especially if the atmosphere is unstable above the inversion. When this breakthrough occurs, sudden changes will take place in the fire behavior and the spread.

Much experimental and theoretical work is now in progress on the general problems of turbulence, diffusion, convection and allied problems at many air pollution and micrometeorological projects.

Thunderstorm and lightning.—The high level and often dry thunderstorms present a great hazard in the Rocky Mountain area because of lightning fires. Project Skyfire has been set up in the Northern Rocky Mountain area to study the origin, development, structure and intensity, movement, distribution of these storms, and the possibility of modification of these storms to reduce the lightning hazards.

Meteorological phenomena induced by a large fire.—Once a fire develops, the original wind and temperature distribution around and over the fire will be changed. A complete study of this problem requires accurate and detailed data on temperature, humidity, wind speed and direction, and the composition of the gases in the convection column. From these results, it will be possible to determine the rate of transfer of heat, momentum and the distribution of energy about the fire. In addition to experimental studies at actual fires, much information has been gained from model studies.

Strong indrafts, usually referred to as the firestorm have been observed in the vicinity of some large fires and may become quite appreciable at times.

Conclusion.—As more is learned about the meteorological factors as well as a better knowledge of the fuel distribution and efficiency of combustion, fewer fires will be designated as "blowups." These fires can be anticipated and their behavior patterns expected. However, a vast amount of difficult experimental and theoretical work will be necessary to accomplish this goal.

FIRE EXTINGUISHERS, THEIR TYPES AND USE. IV. FOAM EXTINGUISHERS

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In appearance the foam hand extinguisher resembles the soda-acid extinguisher. It operates in the same manner—by inverting the container to mix the chemicals, which builds up pressure for discharging the foam.

Foam is essentially a Class B extinguishing agent, but it is also effective on Class A fires. In certain types of Class A fuels, such as excelsior, rags, overstuffed furniture, etc., foam is not apt to bring about complete extinguishment because it will not penetrate. Reignition will probably occur. It will help to control, but not extinguish, such fires. Foam should *not* be used on Class C fires.[1]

There are two intriguing characteristics of foam: its expansion, and its insulating qualities. The 2½-gallon foam extinguisher, which is the one we generally think of as a hand extinguisher, will produce 20-22 gallons of foam with a projection of 30-35 feet from the discharge hose. The foam will cling to vertical surfaces, thus providing insulation from the flames. There are instances of 40-gallon foam units that have stopped the spread of well-involved Class A fires by insulating adjoining buildings from the flames. The fire was not controlled, in the general sense, but it was contained.

The foam produced by hand extinguishers should not be confused with the foam used by the fire departments, oil refineries, and naval craft where large volumes of foam are required. That type of foam is a liquid which is mixed with the water at the rate of 6 percent. A special type of nozzle is required. The method of generating foam in the hand extinguishers, or even the 40-gallon wheeled type, is quite different.

The chemical charge contains two packets. One of these, bicarbonate of soda and a foam stabilizing agent, is dissolved in water outside the extinguisher and then placed in the outer compartment. The other charge, aluminum sulfate, is dissolved in water and placed in the inner shell.

When the extinguisher is inverted the two chemicals mix and the resultant reaction generates carbon dioxide gas. Unlike the soda-acid extinguisher, however, the discharge, because of the aluminum sulfate, is foam.

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[1]For more information on classes of fires and types of extinguishers see: *Fire Extinguishers, Their Types and Use. I. Carbon Dioxide Extinguishers, II. The Dry Chemical Extinguishers,* and *III. Water-type Extinguishers,* by A. B. Everts. Fire Control Notes 15(4): 1–5, illus. 1954; 16(1): 9–12, illus. 1955; 16(2): 24–26, illus. 1955.

Sizes of extinguishers.—Hand extinguishers are nearly always of the 2½-gallon size. Wheeled "engines" are usually manufactured in 20- and 40-gallon sizes. Formerly the hand extinguishers were made of drawn copper. New models are made of stainless steel and drawn brass and are tested to 500 pounds' pressure.

How to use the extinguisher.—Carry the extinguisher to the fire. Upend it to start the chemical reaction. For Class A fires direct the stream at the burning material or coat the burning surface.

Because of the insulating characteristics of foam the extinguisher is a good one to use along with a typical Class A extinguisher—soda acid or loaded stream. While one operator applies water directly on the fire, a second operator can insulate the adjacent material by the application of foam.

On Class B fires the method of application varies: on gasoline or oil spills the foam is applied direct; but on fires in open vats or tanks the best method of application is to direct the foam stream against the inside wall of the vat or tank just above the burning surface, so as to permit the foam to spread back over the burning liquid. Extinguishment is by smothering.

Maintenance.—Foam extinguishers should be recharged annually. All parts should be washed thoroughly with water. Check to make certain that the hose is not clogged. Commercial recharges cost about $2.50, if done in a dealer's plant, but the recharge chemicals can be purchased for about 50 cents. If you do your own recharging, mix the chemicals in accordance with the instructions on the packages.

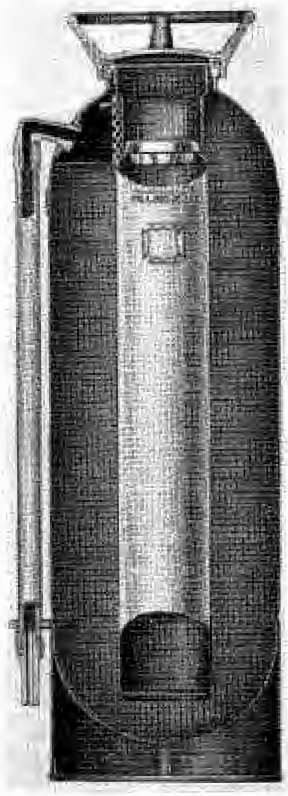

FIGURE 1.—Cutaway photograph of a foam extinguisher showing the inner container.

WARNING: Do not use antifreeze ingredients in a foam extinguisher. To do so will reduce the effectiveness of the discharge and may result in internal corrosion which will make the extinguisher dangerous to use.

Foam extinguishers need to be protected from freezing.

Summary.—Foam extinguishers (a) should be used on Class B fires, secondary on Class A fires; (b) need annual recharging at a commercial cost of $2.50 or a do-it-yourself cost of 50 cents; (c) cost around $30 (charged); (d) have length of discharge stream of 30-35 feet; (e) produce 20 gallons of foam; (f) will freeze (Note: Do not use antifreeze salts).

A CASE FOR SIMPLIFIED FIRE EXTINGUISHERS[1]

CALVIN H. YUILL

Director, Fire Technology, Southwest Research Institute

Have you ever tried to use a fire extinguisher only to find that it was designed for a different kind of fire? Or discovered that a particular extinguisher operated differently from any that you had used before? Or breathed the deadly fumes generated in using some extinguishers? Or spilled acid on your clothing while servicing another type of extinguisher? All of these mishaps, and worse, have happened to many people.

Most fires could be stopped in their early stages by judicious use of a hand fire extinguisher. Prompt action by an alert employee could save his job and his employer's business. It is estimated that nearly a third of all fires—more than two-thirds of fires in industry, are extinguished with hand operated fire extinguishers.

This record is impressive when considered by itself. In relation to the annual toll of fire, it loses much of its significance.

Our direct fire losses today amount to over a billion dollars a year and indirect losses are several times that figure. Some 12,000 people lose their lives in fire and thousands more are severely burned each year. Every possible means of reducing these fire losses is worth considering. Simplification of the design of fire extinguishers is one avenue of approach that would be worthwhile.

There are eight types of fire extinguishers commonly sold today. Five can be used on fires in ordinary combustibles such as wood, cloth, paper and rubbish. Five are available for use on burning oils, greases and other flammable liquids. There are three types available for fires involving electrical equipment.

Some extinguishers can be used on two different kinds of fire. None can be used successfully on all three.

Confusion Confounded

Among the eight basic types of extinguishers are a multitude of operating techniques. One recent publication of a recognized laboratory illustrates four methods of actuating carbon dioxide extinguishers and five methods for operating dry-chemical extinguishers. Here indeed is confusion confounded. Is it any wonder that many fires get out of hand while the bewildered worker tries to figure out the method of operating a particular extinguisher.

Recognizing the value of present-day fire extinguishers, it is believed their utility could be measurably increased if the eight types could be reduced in number and the operating mechanism standardized.

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[1]Reprinted from *Tomorrow Through Research,* by permission of Southwest Research Institute, San Antonio, Tex.

Let us explore the possibility of reducing the number of fire extinguishers by examining well established characteristics of each. Extinguishers for fires in ordinary combustibles are a good starting point.

The common soda-acid extinguisher is probably the oldest and most widely used. This unit, however, must be inverted so that the sulphuric acid will mix with the bicarbonate of soda solution to generate gas to expel the mixture. It must be emptied, washed and recharged each year using care to avoid spilling the acid. It is good only for fires in ordinary combustibles.

Foam extinguishers operate much as the soda-acid type but with aluminum sulphate in place of sulphuric acid and a stabilizer is added. The same objections to method of operation and maintenance apply plus the fact that the sticky foam solution is hard to clean up after the fire is extinguished. This extinguisher is suitable for use on both combustile and flammable liquid fires. Since the solution is conductive, it should never be used on fires involving electric equipment.

Another extinguisher is the "loaded stream" type. Here a proprietary liquid is expelled by gas from a pressurized cylinder. There is a wide divergence of opinion on the merits of this extinguisher and it is not recognized by one of the two large laboratories engaged in testing and approving fire extinguishers. It also can be used on combustible and oil fires but not on fires in electrical equipment.

Another common type is the water pump tank. For outdoor work—on grass, brush or trash fires—this is unexcelled because it can be refilled quickly and kept in constant operation. However, the pump tank requires more maintenance than many types and is not convenient for use on indoor fires.

The charged water extinguisher uses pressurized gas or a small gas cylinder inside the body of the unit and plain water. This type of extinguisher is easy to use, clean and simple to maintain. Again, it is limited to use on fires involving combustibles.

Simplicity Is Possible

From a purely functional point of view, the number of extinguishers for use on fires in combustibles could be reduced from five to one.

Now let us look at the five extinguishers sold for use on oil, grease or gasoline fires. As we have just seen, the foam and "loaded stream" types have definite drawbacks.

The vaporizing liquid extinguisher using either carbon tetrachloride or chlorobromomethane as the extinguishing agent can be purchased from the mail order house, the corner drug store or neighborhood hardware store. Few of the people selling or buying this type of extinguisher realize the high toxicity of fumes produced by the liquids used. Many health and medical authorities condemn this type of extinguisher. We would do well to eliminate it from the list.

This leaves the carbon dioxide and dry chemical extinguishers and a choice between these two is difficult. For many, the carbon dioxide extinguisher is attractive because it leaves no residue. On the other hand, trained fire fighters often prefer the dry chemical type for certain fires because of its lesser tendency to "flash back" with use.

Finally there are three common types of extinguishers recommended for electrical fires. All three can be used on oil fires, and have been considered already. Leaving out the vaporizing liquid extinguisher for reasons already stated we have left the carbon dioxide and dry chemical types.

We have then eliminated five of the eight common types of fire extinguishers for use in buildings and have left only three:

1. Charged water extinguishers for fires in combustibles.
2. Carbon dioxide and dry chemical types for oil and electrical fires.

Since the last two types are rather close in performance, it is quite possible that one of the two could be adopted as a standard. Exhaustive testing under a wide variety of conditions would be necessary to establish a preference.

A Plea for Uniformity

Actually, substantial differences in performance do not exist and selection of any one type for each of the three kinds of fires is based largely upon personal preference.

Now how about the operating mechanisms of these basic types—could they be standardized? The answer is an unqualified yes, and such standardization is not only possible but has already been done.

One manufacturer has on the market charged water, carbon dioxide and dry chemical extinguishers that are practically identical in appearance and operation. The method for operating them is so simple that it is obvious even to the uninitiated.

There are many reasons that would explain the present situation. Tradition, customer demand, or competition, would impede a change in established practices. Nevertheless, from the viewpoint of public safety, much would be gained from the transition. Confusion in customers' minds would be eliminated and the stage set for much wider use of this important fire fighting device.

Here indeed is a challenge to industry. An opportunity to serve the public better and to expand markets at the same time. At the same time thought should be given to further improvements such as lighter weights, better design—even an all purpose extinguishing agent. These things will come in time—the opportunity for simplification is here today.

BUNK TOOL RACK

LLOYD E. MYERS
Forest Fire Warden, Division of Forestry, Ohio Department of Natural Resources

Storing handtools in a warehouse is frequently a problem. Fire rakes, for instance, can be dangerous when hanging from the wall. One solution is the bunk tool rack. It is cheap, and can be easily moved from one place to another (figs. 1 and 2).

The frame is made of 2 by 4's in the form of a double bunk bed. Four pieces 6 feet long serve as side rails, 4 pieces 36 inches long as legs, and 4 pieces 32 inches long as crosspieces. The bottom and top rails are 22 inches apart. Cyclone wire stretched and stapled over top and bottom rails will hold fire rakes, broom rakes, swatters, axes, shovels, and about any other handtool used in fire fighting.

Where there are large numbers of tools to be stored, bunks can be laid on their sides and stacked one on top of the other, or stood on end to save space.

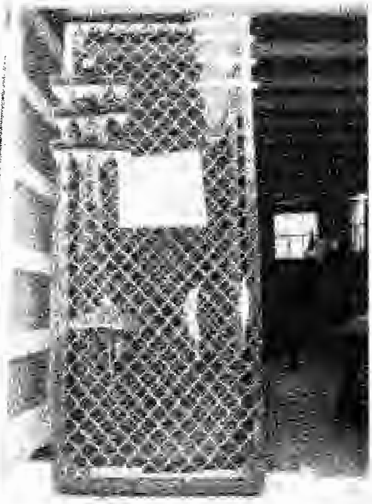

FIGURE 1.—Rack on end.

FIGURE 2.—Bunk tool rack in normal position.

FIRE SUPPRESSION UNIT FOR THE SMALL FOREST

Don M. Post

Assistant Professor, School of Forestry, University of Florida, Gainesville, Fla.

At a cost of less than $700 this fire protection unit may be the solution to your problem. This machine was designed for farmers and owners of small forests who can't justify a high capital outlay for fire protection equipment.

Tractor drawn, the unit has a 325-gallon tank with a 1-inch, high-pressure centrifugal pump and a 6-horsepower, air-cooled motor (fig. 1). The pump is capable of delivering 5 to 65 gallons per minute at 20 to 140 pounds pressure, 16 minutes supply of water at full spray at 20 gallons per minute. A gear type pump

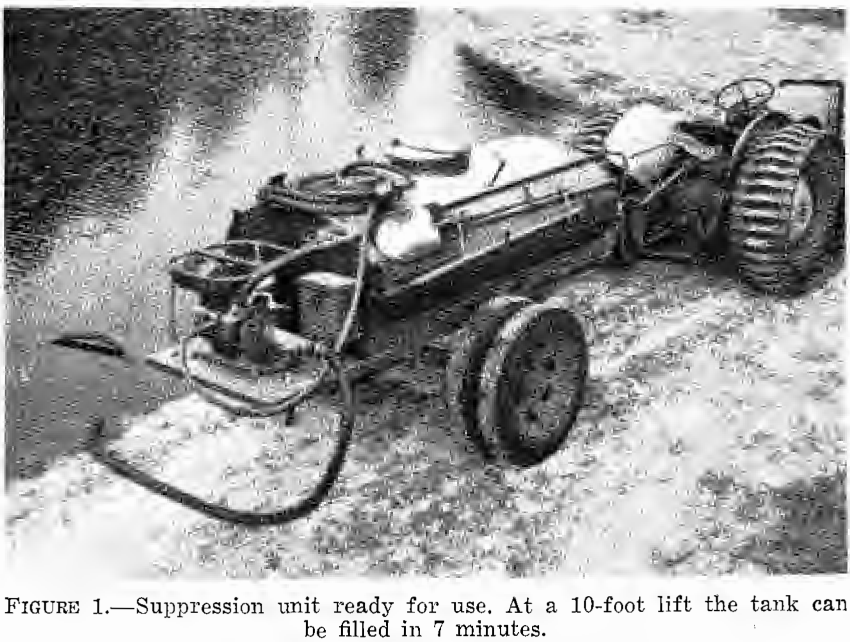

Figure 1.—Suppression unit ready for use. At a 10-foot lift the tank can be filled in 7 minutes.

and motor, or power takeoff arrangement on the tractor could be substituted for the centrifugal pump and motor at a substantial reduction in cost. However, when the tank is to be refilled from streams or pond with sandy bottoms the gear type pump may not be satisfactory.[1]

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[1]Further details concerning the construction of this tanker-trailer may be obtained by writing the author.—Ed.

The unit weighs 654 pounds empty, 3,324 pounds fully loaded. It can be towed easily by a medium-size farm tractor through most woods areas. For use along woods roads a pickup truck would be suitable (some States require trailers grossing over 1,500 pounds be equipped with approved brakes).

Forest fire suppression is only one use to which this unit lends itself. It can be used to protect farm buildings or could serve as a supplementary unit for the fire department of a small community. It can also be used to irrigate small nurseries or gardens, or clean logging or farming equipment.

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Ash-Tray Smokey Bear

The life-size Smokey Bear poster makes a very good "Use ash tray" fire prevention sign that is also handy at service stations. The cut-out Smokey and cubs are mounted on plywood with a large "Please Prevent Forest Fires" across the bottom. At Smokey's left paw is mounted a gallon oil can, with "Empty Ash Trays Here" above it. The plywood is cut ¼ inch larger than Smokey and dark brown paint is used to trim. A transparent sprayed-on plastic coating to preserve Smokey is planned. The sign stands by itself and is placed in a convenient location. Demand for the signs exceeds supply.—MILO PETERSON, *Area Forester, Iowa Conservation Commission.*

CANOE SMOKECHASER TOOL UNIT

W. W. Wentz

District Ranger, Green Mountain National Forest

Smoke chasing along the relatively inaccessible fourteen miles of shoreline of the Somerset Reservoir in the Green Mountain National Forest is most effectively carried on by canoe transported crews. In waters frequently quite choppy for canoe travel a unit was necessary to provide safe transportation of tools in the limited space available and to protect the somewhat fragile structure of the canoe from damage. A lightweight, compact unit was constructed to provide these safeguards as well as to speed up the time involved in launching the fully equipped canoe (fig. 1).

Figure 1.—Smokechaser tool unit designed primarily to lie flat in a motor-driven canoe.

On a base of salvaged 3/8-inch fir plywood a sheet of light gage metal was formed around the head of a shovel and tacked in place. A light plywood box the size of a double-bitted head was screwed to the board and a buffer strip of 1- by 3-inch spruce was fastened to the end of the base to prevent the council tools from sliding. Another piece of light metal was formed around the ax bit of the pulaski tool under the shovel handle and tacked in place. The other head of the pulaski tool was sheathed in a single-bitted ax sheath which is secured to the board. In the center of the board a short length of leather strap with a buckle was screwed and a "U" bolt placed to receive a snap swivel on the end of the strap. The strap firmly secures all tools together and on the board. A carrying handle has been cut at the balance point of the unit for ease of carrying.

The unit as designed fits a local need for use in a canoe with a 3-man capacity but could be well adapted to provide a lightweight complete unit placed in other types of vehicles on a temporary emergency basis.

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Coronado Fire Camp Table

Until recently the Coronado National Forest fire camp table consisted of an assorted pile of lumber, cut to various lengths and put together at the selected camp with hammer and nails. This did not produce a very serviceable table and there were far too many pieces of lumber to keep track of. Oftentimes, the carpentry was not of the best. It was decided that something better might be designed. The table now used on the Coronado is considered far superior, goes together in a fraction of the time, and is far sturdier. It is made as follows:

Cut in half a piece of ¾-inch plywood; 4 by 10 feet is a good size though it may be larger or smaller. Join the two pieces, which are 4 by 5 feet, with two heavy strap hinges, about 12 inches long. Attach ½-inch pipe flanges near all corners of both pieces of the plywood; cut eight pieces of ½-inch pipe to about 32 inches, threaded on one end. It is very important to use stove bolts that fit the holes in the hinges and the flanges, and to secure the nuts by lightly riveting them. The hinges should, of course, be mounted on the underside of the plywood so they are not in the way on the tabletop. If single tables are desired hinges are not necessary.

To set up the table, simply screw the pieces of pipe in the flanges, turn the table over, and it is ready for use. No tools are needed to set up the table, hand twisting of the pipes is ample.

To transport the table in a truck or pickup, fold the two sections together and tie the pieces of pipe in a bundle. The whole thing takes up very little room; several tables may be carried if desired.—GILBERT SYKES, *District Ranger, Coronado National Forest.*

PROTECTOR FOR HOSE ACROSS ROADS

Rolfe Anderson
District Ranger, Siuslaw National Forest

In 1954 District Assistant Willis Horner and District Ranger Rolfe Anderson of the Hebo District devised a protector for hose lines lying across roads where traffic must be kept moving during the operation of a pumping system.

The hose protector was constructed from 4 pieces of 4- by 12-inch spruce plank cut 42 inches long, beveled on the ends for easy crossing by trucks, and with a cutout through the center to accommodate one or two 1½-inch hose lines. For dual-tired vehicles such as logging trucks double planks are necessary. These may be hinged so they will stay parallel and in place while in use and yet can be folded for ease in transporting (figs. 1 and 2).

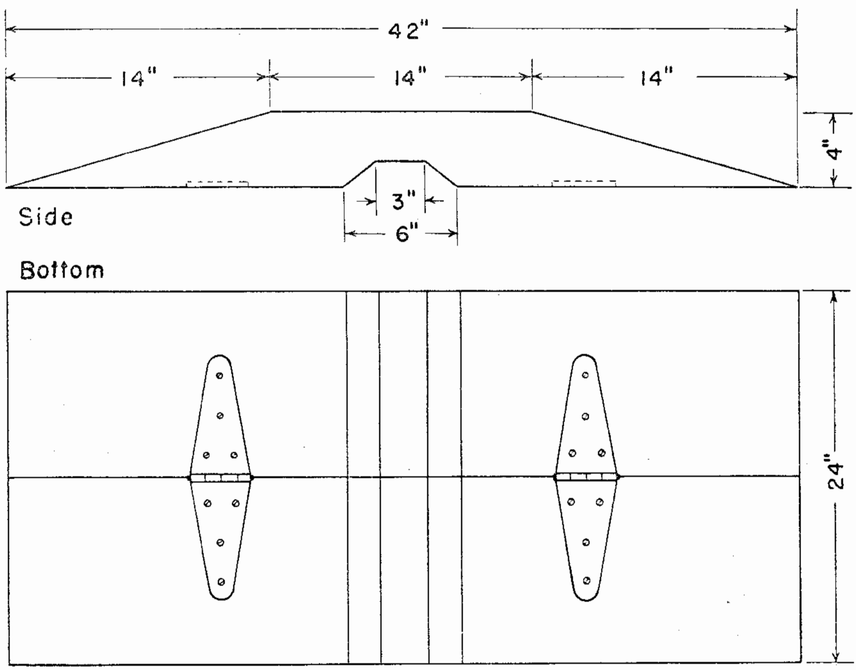

Figure 1.—Hose protector construction details.

These hose protectors have proved their value on the Hebo Ranger District and elsewhere on the Siuslaw; they fill a definite need on slash burning operations or fire fighting when it is necessary to lay hose across roads without interrupting traffic, or risk-

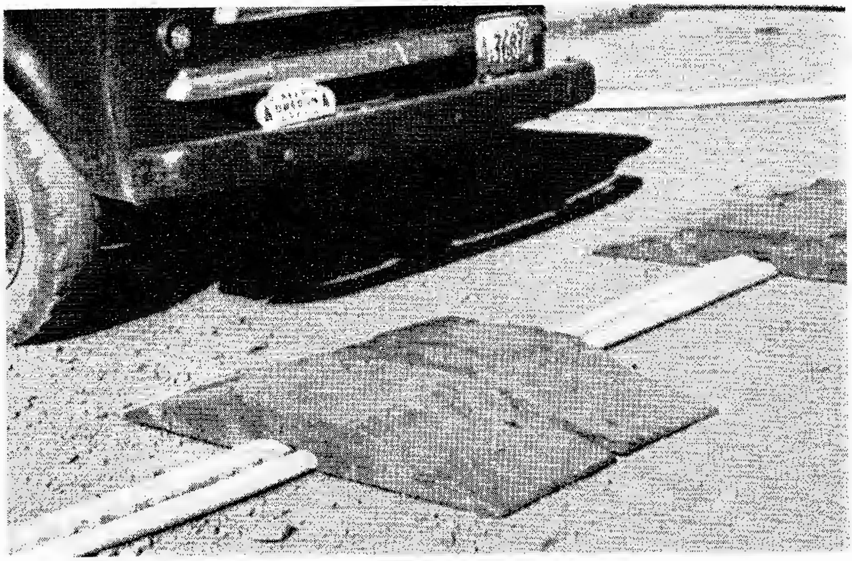

FIGURE 2.—Hose protector in place.

ing broken hoses. Two primary values are simplicity of construction and the fact that, once in place, they "stay put" without the constant attention so commonly needed with planks and other usual protectors.

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Stop Power Saw Fires Tags

In order to reduce the number of man-caused fires started in Oregon's forests by power saws the Keep Oregon Green Association has prepared a red tag, approximately 3 by 6 inches, listing fire precautions. Quantities of this tag will be distributed to power saw agencies and their repair shops in Oregon so that a tag can be attached to each power saw sold or repaired. District wardens, U. S. forest rangers, and U. S. Bureau of Land Management foresters will have tags for distribution, and the State Forester plans to include one in every envelope that contains an operating harvesting permit for 1956.

These are the fire precautions for power saws listed on the tag:

1. Place power saw on mineral soil when fueling, NOT in dry litter or slash.
2. Permit hot power saw to cool two or three minutes before refueling.
3. Use non-spill gas can to fill tank and avoid spilling of inflammable fuel.
4. Use proper oil and gas mixture to minimize carbonization.
5. Do not start power saw at place of filling.
6. Keep power saw clean of sawdust and inflammable material.
7. Keep muffler on the power saw and in good condition.
8. Don't operate your power saw if it is backfiring.
9. Keep spark plugs and wire connections tight.
10. Keep a filled fire extinguisher and shovel with power saw at all times.
11. Clear inflammable material from point of saw cut.
12. Put out any fires started and report them to the foreman, together with causes.
13. All fires should be promptly reported to the proper forest protection agency.—ALBERT WIESENDANGER, *Executive Secretary, Keep Oregon Green Association.*

TELEVISION TESTED FOR FOREST FIRE DETECTION IN CALIFORNIA

JOHN HASTINGS
State Forest Ranger, California State Division of Forestry

As a part of its program of equipment development and research, on June 7-10, 1955, the California State Division of Forestry participated with the Hancock Electronics Corporation of Oakland in a test and demonstration of closed circuit industrial television as adapted to forest fire detection.[1] This demonstration served the twofold purpose of acquainting the Division of Forestry with the possibilities of television for forest fire detection and demonstrating to the manufacturers some of the requirements of a good fire detection system and the ability of their equipment to fulfill these requirements.

No specific equipment was developed for this test and all equipment used was that which had been previously developed for other uses. However, it was stated that a complete installation embodying any features that we might desire could be constructed.

Prior to the test, a platform was constructed at the 90-foot level of a 100-foot steel lookout tower 200 feet from our El Dorado Ranger Unit headquarters. The platform was constructed so that it projected out about 5 feet beyond the west side of the tower and permitted a camera sweep of about 270 degrees free from interrupting tower girders and framework.

The television installation consisted of a television camera, control unit, and monitor mounted upon the tower platform and linked by coaxial cable to three 12½-inch monitors in the nearby dispatch office. Of the three monitors in the dispatch office, one was used by the lookout-observer, one was used with a 4 x 5 Speed-Graphic camera to record what was observed upon the monitor screen, and one was used to film a limited amount of 16-mm. movie film.

In this demonstration, all camera movement was controlled by the lookout-observer using a small remote control unit adjacent to the monitor. The remote control unit consisted of a small box with two momentary switches, one moved up or down for tilt control and one moved left or right for azimuth control (fig. 1).

As there was no provision for registering the azimuth at which the camera was pointed, it was necessary that the lookout-observer be able to orient himself by familiarity with the terrain as it appeared upon the monitor screen. In order to aid in this orientation and to facilitate evaluation of the scene viewed, prior to the start of viewing, all of the permanent mill smokes in the area and

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[1]Several other States have made or are making similar tests. Louisiana is now operating a TV lookout alongside a manned lookout for a season's evaluation. Two problems still to be solved are (a) more definite determination of the effectiveness of TV observations at maximum distances, and (b) best method for indicating azimuth, a requirement that has a direct bearing on cost of an installation.

FIGURE 1.—Monitors used in viewing by TV lookout-observer and in taking pictures of scene observed; remote control unit on desk.

certain terrain features were plotted upon a map and identified as to distance and azimuth from the camera. In addition, possible points for the ignition of test smokes were located.

During the period of the test and demonstration, observing was done using 8-, 16-, and 20-inch focal length telephoto lenses (fig. 2). With each lens, prominent terrain features and all of the permanent mill smokes in the area were observed and photos of their appearance upon the monitor screen were made. The mill smokes were located at varying azimuths and at distances of 6 to 16 miles. Test smokes were ignited at distances of 7, 10, and 13 miles to test the ability of the lookout-observer to pick them up. In all instances, when the test smokes were ignited, the camera was pointed in the direction of the expected smoke.

Results of this limited test have indicated to us that the television camera is a feasible means of fire detection although at this time we did not have the opportunity to make a firm comparison between the merits of a manned lookout tower and a TV-observer. Further tests will be needed to determine the comparative efficiency of each method as well as the relative costs of each system.

The 8-inch lens appeared limited to about 10 miles for picking up small smokes and detail although the field of vision seemed good for routine scanning. The 16- and 20-inch focal length lenses brought detail at distances not reached by the 8-inch lens, but they were not satisfactory for scanning. Haze penetration was improved by the use of an improvised filter.

Best results would appear to be obtained by the use of a camera with a multiple lens installation—a 6- to 8-inch focal length lens for general scanning rotated at a rate such that the observer can spot small smokes with a minimum of difficulty and

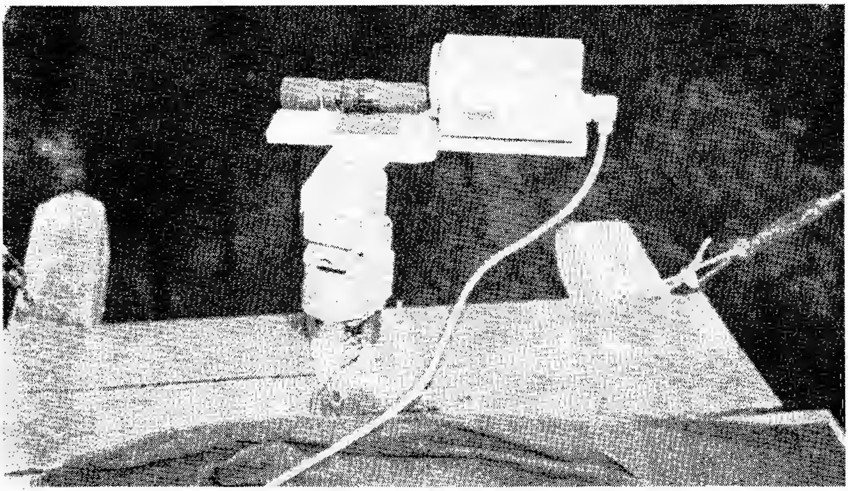

FIGURE 2.—TV camera with 8-inch focal length telephoto lens installed.

a lens of 16- to 20-inch focal length for close scrutiny of specific areas, particularly out towards the edge of the 15-mile radius. Use of proper filters will probably materially improve the visibility during hazy conditions.

Some problems that still need to be solved are these:

1. What is the best lens to use for routine scanning considering field of vision and magnification.
2. Given the desired lens, what is the optimum rate of scanning that will permit satisfactory coverage of the area and easy observation of small smokes.
3. What are the desirable filters to use.
4. How many monitors can one observer watch and what are the fatigue factors involved.

The various problems encountered during this test were discussed with the manufacturers. None of them appear to be insurmountable. As the problems are overcome, it is the intent of the California Division of Forestry to continue to evaluate the television camera as a means of providing a primary detection service or supplementing the existing system.

ACCIDENT FACTORS ARE "DANGEROUS DOMINOES"

JOSEPH RADEL

Safety Officer, Region 5, U. S. Forest Service

[Adapted from a talk given by the author at the California Region's 1955 Supervisors Meeting at San Francisco.]

A well-known author in his book on industrial accident prevention used dominoes to illustrate accident factors. We have borrowed the idea but adapted it to Forest Service use. If these principles of dangerous dominoes are understood they can be further adapted to our use so that current gains in safety will be continued. There is every good reason, in fact, to look forward to the day when Region 5 will practically eliminate accidents. But first let us look back at our injury frequency rate.

There has been a constant downward trend in injury rates since 1947. From 38 lost-time accidents per million man-hours worked in 1947 to just slightly over 10 in 1954 for an all time low represents a 74 percent reduction in injury frequency. This constant betterment in our record of employee safety represents hard work, ingenuity, and leadership by many people in the Region.

It has been said, "There is no hope for the satisfied man." We believe it true for us in safety, too, so our goal is an injury frequency of 5 or less. By process of extrapolation we can extend the present average trend to show that by 1959 the Region should be below 5. This means less than 30 lost-time accidents annually for the entire Region. A worthy objective which, when reached, will mean we have eliminated much suffering, grief, and financial hardship for our people.

One of the most successful salesmen in America lists determination and willingness to pay the price as qualities needed to achieve our goals, whether it be in our personal or official life. We can reach our goal in safety if we want to eliminate injuries enough to make accident prevention a vital part of all activities.

Accident factors occur in a given sequence to produce a final result. Like dominoes standing in a row when the first is tipped over it will cause the rest to fall successively. Injury or death is the final domino. Preceding the injury is occurrence—an accident which may or may not cause an injury. (For example, the top coming out of a burning snag, which narrowly misses the fire fighter, is an accident but in this case doesn't result in injury. The next time a similar occurrence might cause a fatality.)

Preceding the occurrence or accident there is in every case either an unsafe act of a person or persons (such as carrying an ax on the shoulder or using a file without a handle) or an unsafe physical or mechanical condition (unguarded machinery, mushroomed striking tools, etc.) or both. Back of these stand several more dominoes—the reasons for the unsafe act or hazardous condition. Sometimes we refer to these dominoes as "the cause behind the cause." So we have our train of dominoes on end, culminating in an injury. Our aim is, of course, to discover the key dominoes which cause accidents and remove them.

Key Dominoes

Environment, heredity, habit: these are the first three dominoes. They influence production as well as accidents. Environment is defined as "the external conditions and influences which affect the life and development of people." These influences, for good or bad, make their impact before the Forest Service gets the employee. Certainly there is no question about hereditary traits, those physical characteristics transmitted from parent to offspring. Habits, good or bad, are also pretty well ingrained by the time we hire an individual. Does this mean we are helpless? No, I don't think so. Our choice here falls within a solid recruitment program, and like the two poles of a battery has a positive and negative side. Positive will result in development of methods to attract the best, whether they be seasonal or year-round professional and nontechnical people; negative, in rejecting those not fit for Federal service whether it be for a few weeks or for a lifetime career.

Recruitment

In presenting a guide for a positive program of recruitment Clare Hendee, our former regional forester, said, "Recruitment of qualified people who can be trained to give loyal, efficient public service is one of the Region's basic problems. We all agree that public service goals will best be achieved with and through good people . . ." He also listed several recruitment factors, such as (1) attitude which demands the best; (2) arrest records held to a minimum; (3) physical exams for employees; (4) standards of discipline kept high but fair; (5) set a right climate for growth and satisfaction on the job; (6) faith in the willingness of able employees to be loyal and enthusiastic.

In Region 5, seasonal personnel outnumber yearlong personnel two to one. Counting turnover we hire more than 3,000 seasonal workers each year. Many of these come from the city where they have had little or no opportunity to observe us or our work. Integrating such workers into the Forest Service for top public service is extremely difficult. Job training, orientation, supervision and, perhaps most of all, safety become a tremendous challenge to those of us who supervise. Thus we can't afford the additional handicap of using inferior parts when trying to weld a striking force together under these circumstances. Perhaps we can't always compete salarywise with private industry, but we can use our ingenuity to sell other desirable benefits and opportunities available to employees who work for the Forest Service.

We no longer automatically get the best forestry graduates from the schools. A prominent forestry school recently wrote us concerning this very problem. Despite the urging of the entire forestry school staff, less than half of the students took the "JF" examination in 1954. "A decade or two ago," the dean said, "most of our students wanted a Forest Service career. Today this is changed. Private industry is competing for and getting some of the best forestry graduates."

The same situation holds true for engineering graduates. This situation means many things in terms of recruitment ingenuity—such as adequate housing, treatment on the job, climate favorable to growth, and satisfaction on the job. It will also have to mean full appreciation of student employment as a significant step in recruitment of year-round personnel. For, after all, how we treat the student and the opportunities and challenges presented during summer employment may be the deciding factor as to whether or not he desires to make the Forest Service his career.

Unsafe Conditions

Here we have one of the less subtle dominoes. An unsafe mechanical or physical condition is simply defined as "a condition which might have been guarded or corrected." From the standpoint of accident prevention this is the one sequence factor most easily corrected or changed. We have done well in eliminating this deadly domino but not well enough. I have yet to go on one forest without finding at least several instances where safety engineering could be improved. Last year I found these "unsafe conditions" which could have been eliminated but which were not: Unguarded belts, inadequate machine guarding, mushroomed tools and other defects of tools, unsafe overhead storage, poor lighting, poor housekeeping, no goggles sent out to a fire for use with grinders, ungrounded electrical equipment, electrical outlets and pull chains accessible from shower stall, dangerous location of garage in relation to a busy transcontinental highway.

Unsafe Acts

An unsafe act or faulty behavior is usually associated with some degree of physical hazard. Thus this dangerous domino is usually found in combination with other equally dangerous dominoes. In the Forest Service, however, regardless of the good job we might do in safety engineering we still have the steep slope, burning snags, rolling rocks, explosive brush fires, scaling logs at a busy landing, driving trucks and cars over winding mountain roads, and many other highly hazardous jobs.

Obviously we cannot level the slope or put a machine guard around a man to protect him from rolling rocks if his job causes him to be on a steep rocky slope. Nor can we at this stage in our development of fire fighting techniques prevent the smoldering brush fire from taking off when weather factors are right. Therefore, in the Forest Service, we must not only know and practice commonly accepted safe procedures but, in addition and under certain circumstances, we must be familiar with the techniques of "injury avoidance." There is a difference. Let me illustrate.

A worker uses a power grinder. Since he can finish the job in about 3 seconds he makes a decision not to use the goggles. He takes a chance and a piece of steel flies into his eye, causing a painful and lost-time injury. He definitely committed an "unsafe act" by violating a commonly accepted safe procedure—in this case his decision not to wear goggles. An unsafe act can be something a person does or something he should not have done or perhaps done differently. He may have done so deliberately with full knowledge that he was doing something unsafe or he may not have known. The criterion here is usually "would a cautious and well-trained person have done the same thing under the same circumstances" or in the above example used the grinder without goggles?

Good injury avoidance techniques can be illustrated by the precautions a well-trained fire boss will take when leading his men down to a spot fire in brush. Under certain circumstances he knows that such action would be suicide. Therefore, before he takes his men in on such a mission he considers wind, humidity, slope, density of brush, escape routes, lookouts, experience and physical condition of his men. His personal action in taking his men to such a fire should not be considered an unsafe act merely because it is hazardous. If proper precautions are taken, we have here an illustration of a Forest Service injury avoidance technique. If because of lack of know-how the fire boss took his men into a situation which later developed into a trap and several were seriously burned, we have an illustration of an unsafe act. Many actions are normally quite safe, such as smoking, for example. However, smoking in an oil refinery or an explosives plant could be the means of blowing you to Kingdom Come!

An unsafe act domino stands in our way every time an accident occurs and it is evident that there was a reasonable and less hazardous way that could have been followed. If the hazard remains despite our best efforts to eliminate it and the job has to be done, then we train, supervise, demonstrate, inspect, and otherwise use all the safety gadgetry at our command to sell injury avoidance. Sometimes this domino isn't removed because of haste, fatigue, or just downright disregard for common sense. Usually, however, our people commit unsafe acts and take chances because they don't know. The slogan on the fire tool decal "Be safe—do it right" could just as well read "Do it right and be safe."

An analysis of Forest Service accidents for 1954 reveals that over half of our injuries were a result of not knowing how to avoid injury while performing a hazardous or semihazardous job. The reason may have been a physical defect such as poor vision or hearing; it may have been mental, such as an inclination to take a chance, or, as is too often the case of our seasonal employee, lack of experience and understanding of the job.

Each one of us can think back on our own Forest Service experience. I believe you will agree that most, if not all, of our serious and fatal injuries can be eliminated when we determine to plan for safety and then insist on systematic training in the actual performance of safe work practices. Nonroutine work such as we do in the Forest Service can be performed safely if supervision will insist upon a high degree of technical know-how, and then follow through to see that we are practicing that which we know. Let's rid the Region of all "Dangerous Dominoes"!

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DROWN YOUR CAMPFIRES
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