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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 9 Numbers 2 and 3

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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FIRE LINE SAFETY

SETH JACKSON

Administrative Officer, Washington Office, U. S. Forest Service

Probably nothing short of war is potentially more risky to life and limb than fire on the rampage. Miramichi, Peshtigo, Phillips, Hinckley, Baudette, 1910, Cloquet, Maine—these are names of spectacular forest fires. They resulted in many deaths and untold injuries to the public at large.

Less spectacular are the smaller fires which year after year maim or kill men fighting them—less spectacular, but just as serious to these men and their families. Besides the personal suffering, these injuries cause a large economic loss; loss of pay to the worker while he is off the job; medical and hospital bills to the employing agency; damage to equipment and material; and many indirect losses such as decreased production and lowered morale on the fire line.

Experience in the Forest Service shows that about a third of its injuries and deaths come from fire control activities. In addition to the 11 men killed as a result of Forest Service fires in the past 2 years, at least 25 men have been killed on State or private fires.

How do fire fighters get hurt? In fire fighting the two basic causes of most accidents—unsafe working conditions and unsafe acts—are always exaggerated. Take the case of the man who cuts his foot with an ax, one of the most common injuries on the fire line. The unsafe condition could be an ax in poor shape, poor footwear, poor footing, not enough area cleared for ax swing; the unsafe act, standing too close or too far from whatever is being cut, striking a glancing blow.

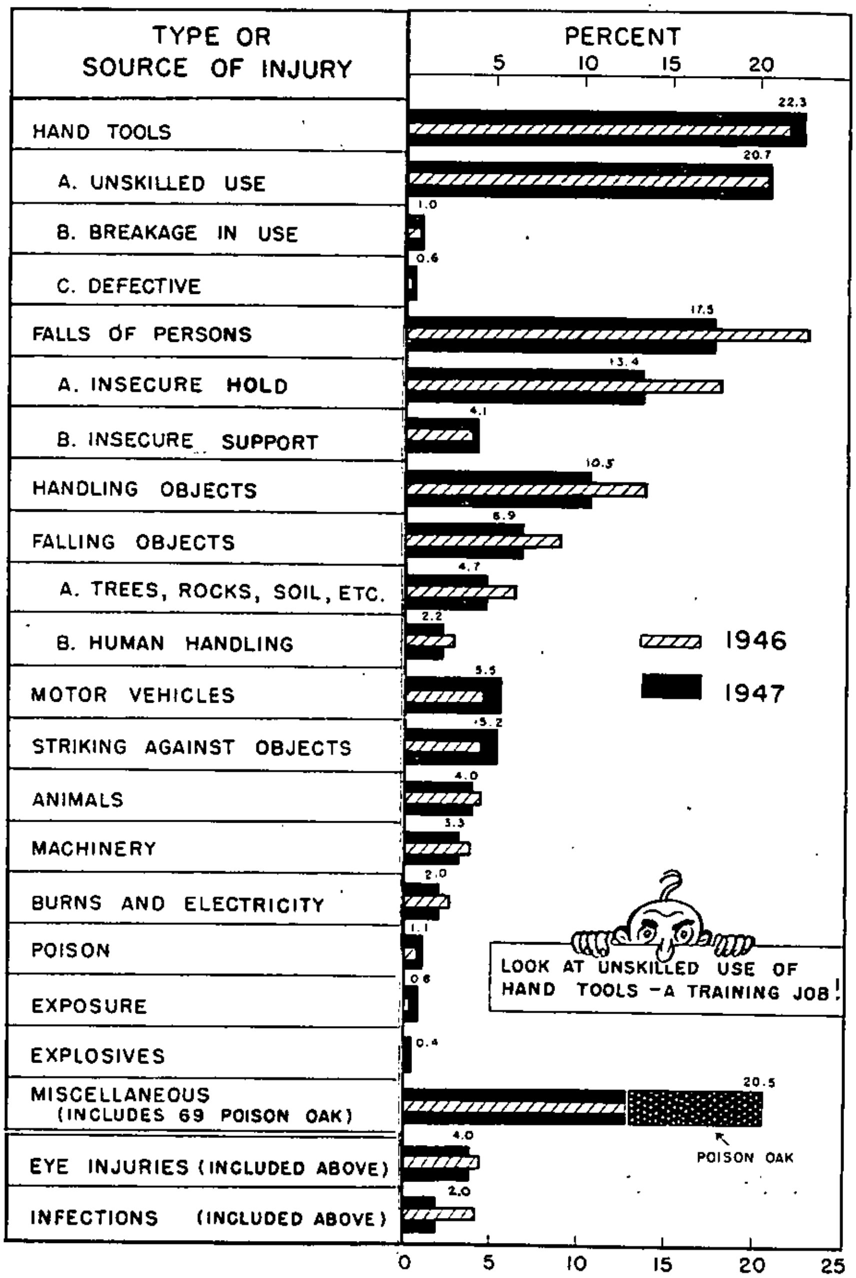
Another frequent cause, also a combination of condition and act, comes from slipping, stumbling, falling. Many cases of men being trapped on fires are attributable to this. Rolling rocks, logs, falling trees or branches—falling objects—result in many injuries and deaths. Less frequent but usually very serious are injuries due to machine equipment, such as jeeps, trucks, tractors, or bulldozers, getting out of control. The trend toward mechanization in fire fighting will increase the severity of this problem.

Land planes, seaplanes, and helicopters are going to be used more and more. Here carefully developed accident prevention plans will help to make the fire fighting game less exhaustive and safer. The helicopter especially shows great promise this way.

Curiously enough, no Forest Service smoke jumper has been killed on the job. There have been only 134 lost-time injuries on the 7,407 jumps made since 1943. Wind, an unsafe condition, played an important part in these injuries.

In general, fire-injury causes are similar to those indicated in the chart for all Forest Service work.

The accident situation is aggravated in fire control by several factors. The job is done under emergency conditions where minutes count and safety is often lost sight of. Large numbers of "green hands" must be put to work promptly without the benefit of experience or training in woods work. Under these conditions some accidents are inevitable.



Injury type analysis.

But the accident toll depends on what we do to keep it down. Four courses of action are necessary to eliminate those unsafe working conditions and unsafe acts which are basically behind most accidents.

First, of primary importance in any safety campaign, *enlist the full support of top management.* In fire suppression this means the demonstrated interest and active participation in accident prevention by all work supervisors, from Division Chief and fire bosses to straw bosses. Workers will do what their bosses want them to do. The bosses must set the example.

Second, *include safety in all fire planning.* If safety is set up as a separate job to be done when time permits, the chances are it will be overlooked when the emergency comes.

Fire controllers must be intent on methods and speed. Safety can help both if it is planned that way. Usually the safe job is the most efficient in the long run. Here are a few suggestions for fire control planning.

1. Analyze accidents, then plan the job to prevent recurrences.

2. Make safety a part of every job. Until everybody is reasonably safety conscious, accident rates will remain high.

3. Plan ahead to prevent excessive overtime. Provide in advance for overhead and worker relief on fires, and for safe traveling to and from the job, especially at night.

4. Calculate human risks. Some areas might even be abandoned where the hazards are too great and the values too low.

5. Consider assigning a man full time to accident prevention and first aid on all large fires. The usual need for overhead on a fire may overshadow this, but is this not shortsighted? An injured man is at least a double liability on a fire. He is out of service and it usually takes one or two others to care for him. A safety man will help cut down on this loss.

6. Provide for safety in all equipment development and use. Are the tractors equipped with overhead guards for protection against falling snags or branches; are their tracks so guarded that there is no danger of foot injuries; and would a handrail or step make it safer to get on and off? Should the men have better eyeshields and smoke masks, or foot and leg guards for glancing axes? The field of personal protective equipment in the woods is almost unlimited, and not greatly developed.

7. Make brief safety check lists as aids to prevent accidents.

Third, *emphasize safety when recruiting.* Prior understanding with employing agencies and recruiting officers to select only those men who are physically fit and properly clothed for fire fighting will help eliminate accidents. This also applies to recruiting overhead from among permanent employees.

Many accidents come from failure to recognize potential danger. So consider mental outlook on safety when recruiting fire bosses, foremen, and straw bosses. Previous experience and training has much to do with this, which brings us to our fourth course of action.

Integrate safety in all job instruction. Safety key points need emphasis with fire overhead as well as fire line labor. Take advantage of all available minutes to stress safety, especially during their first hour on the job. They will never need help more, nor be more willing to accept it, than when they first start work. Train them to meet the job hazards.

What's the best way to do this? First, get your thoughts in order for a safe job when planning ahead. Then arouse the worker's interest. This should not be too difficult when one's life might be in the balance. Next tell, show, illustrate what you want him to do, one step at a time, always stressing safety. Then let him do it under close coaching. Finally, test him on the job. Follow up frequently. If the worker hasn't learned, the instructor hasn't taught.

Follow up—two very important words in job instruction and accident prevention. All too often they are forgotten. But if you want a top-notch safety job, don't forget to follow up.

Now let's summarize. To prevent accidents on the fire line we can—

1. Get active safety support from top management.
2. Include safety in all fire planning.
3. Emphasize safety when recruiting.
4. Integrate safety in all job instructions.

Finally, a word to work supervisors, don't forget to follow up!

Well's Tree-Marking Gun and Back-Firing Torch—Explosion Hazard Tests.—Explosion hazard tests have been completed by the National Bureau of Standards of the Well's tree-marking gun and back-firing torch, which was described in Fire Control Notes, October 1947, page 21. The Bureau's report is summed up as follows:

"The results of the tests showed that in the torch, as represented by the sample submitted, the likelihood of explosion inside the tank by ignition through the nozzle is remote. However, in the Bureau's opinion, a fine-mesh screen (preferably conical in shape and made of brass or bronze wire) should be inserted in the base of the nozzle to prevent particles of dirt or scale from clogging the discharge orifice. This screen would act as a flame arrestor. In the condition as received, it was not possible to obtain a satisfactory flame-throwing performance of the torch. The nozzle was taken apart and a particle of foreign material removed from the orifice in which it had lodged.

"In general, any device which uses a fuel of which one-half is gasoline is hazardous in the presence of flame as in this torch, even with safeguards. It is suggested that fine-mesh wire screen be inserted under the filler cap in the manner found in safety cans for gasoline to prevent an explosion if filling is done in the presence of fire. It would be desirable to instruct each operator as to possible hazards and give precautions as to its use."—DIVISION OF FIRE CONTROL, *Washington Office, U. S. Forest Service.*

THE HELICOPTER—BELL MODEL 47B

IRA C. FUNK, *Mechanical Engineer, Region 5, U. S. Forest Service,* and FRED W. MILAM, *Operations Officer, L. A. Airways, Inc.*

This article is intended as a companion article to The Helicopter—A New Factor in Fire Control by Frank J. Jefferson appearing in the January 1948 issue of Fire Control Notes. It is based directly on Equipment and Development Report Number 12 of the Forest Service, United States Department of Agriculture.

All helicopter tests conducted to date by the Forest Service have shown that present-day helicopters have fairly definite limits of performance in mountainous country. That is, they can be depended upon to carry a full pay load to or from landing spots up to certain elevations. For landing spots above this elevation the loading must be reduced. Air temperature, wind, and other conditions at the landing spot greatly affect the amount of loading that can be safely carried.

Every one interested in the application of the helicopter to fire control and other work as well should become familiar with terminology used and the limits of operation of each make and model. Safety is a prerequisite in fire control as well as in other work and such a familiarity will aid in the prevention of accidents when using the helicopter.

DEFINITION OF TERMS USED IN HELICOPTER OPERATION

Pressure altitude is the altitude indicated by the aircraft altimeter when barometric corrector is set at 29.92 inches of mercury (N. A. C. A. standard barometric pressure at sea level).

Density altitude is the altitude under N. A. C. A. standard air conditions. True altitudes under field air conditions may be converted to the density altitudes having the same air density. Conversion of true altitude to density altitude is based on barometric pressure and air temperature. Conversion of pressure altitude to density altitude is based upon temperature only (table 1). In conversions, for the

TABLE 1.—*Density altitudes for different pressure altitudes*[1] *at various free air temperatures*

Pressure altitude (feet)	Density altitude when free air temperature is—							
	30° F.	40° F.	50° F.	60° F.	70° F.	80° F.	90° F.	100° F.
	Feet	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*
0	------	------	−700	0	600	1,200	1,900	2,500
1,000	−500	100	700	1,200	1,900	2,500	3,200	3,800
2,000	700	1,300	1,900	2,500	3,100	3,700	4,400	5,000
3,000	1,900	2,500	3,200	3,800	4,400	5,000	5,700	6,300
4,000	3,200	3,800	4,400	5,000	5,700	6,300	6,900	7,500
5,000	4,500	5,100	5,700	6,300	6,900	7,500	8,200	8,800
6,000	5,700	6,400	7,000	7,600	8,200	8,800	9,400	10,000
7,000	7,000	7,600	8,200	8,800	9,400	10,000	10,700	11,300
8,000	8,200	8,900	9,500	10,100	10,700	11,300	11,900	12,500
9,000	9,400	10,000	10,700	11,300	11,900	12,500	------	------

[1] For application in field, pressure altitude of landing spot may be assumed as equal to surveyed elevation for same.

same true altitude, summer temperatures have a greater effect than barometric pressures. Since all aircraft specifications are based upon N. A. C. A. standard air, all altitudes or ceilings given in such specifications are density altitudes.

True altitude is the measured or surveyed altitude or elevation above sea level.

Hovering with ground effect is the flight of a helicopter with zero air speed near enough to the ground or water surface to compress a cushion of high density air between the main rotor and the ground or water surface, thereby increasing the lift produced by the main rotor. Usually the main rotor must be within one-half of the rotor diameter of the ground to produce a ground cushion.

Hovering without ground effect is the flight of a helicopter with zero air speed at sufficient height above the ground or water surface to prevent the formation of an air cushion between the main rotor and the ground or water surface.

Translational lift is the lift supporting the helicopter due to the translational displacement of the craft through the air, that is, through air speed. When the helicopter is hovering or has zero air speed, under no wind condition, it has no translational lift.

Spot take-off is the take-off from hovering, usually with 2 to 3 feet ground clearance, from a landing area having a diameter about twice the greatest over-all dimension of the helicopter. The normal flight path of a helicopter on spot take-off is similar to that of a conventional airplane except the angle of climb is greater and no ground run is required.

Spot landing is the landing of a helicopter in a landing spot having a diameter of about twice the length of the helicopter.

Running take-off is the take-off of a helicopter running its wheels on the ground until sufficient air speed and translational lift are gained to permit taking off with maximum rate of climb. When operating at such high altitudes that the helicopter cannot hover, a running take-off may be necessary.

Running landing is a landing similar to that of conventional aircraft. When operating at such high altitudes that the helicopter cannot hover, it is necessary to maintain translational lift through air speed until after the wheels are on the ground.

Autorotation is the power-off operation of a helicopter in which the helicopter becomes an autogiro. By means of a free-wheeling unit the rotor is disengaged from the engine and lift is obtained through the windmilling of the blades. This is a standard maneuver which can be used for descent and emergency landings in all helicopters. Autorotation emergency landings are made in case of engine failure.

Revolutions per minute (r. p. m.), unless otherwise stated in this report, is engine speed in revolutions per minute.

Center of gravity (c. g.) is the longitudinal center of gravity of the helicopter with loading. The location of the center of gravity is the point at which the entire gross weight of the helicopter can be considered as being concentrated for the purpose of determining balance.

Gross weight is the total weight of the aircraft including pilot, passengers, cargo, fuel, oil, and any other loading carried by it.

Empty weight is the total weight of the aircraft with specified normal equipment but without residual fuel and oil, fuel and oil in tanks, pilot, parachutes, passengers, cargo, or special test equipment.

Useful load is the total weight of pilot, passengers or cargo, residual fuel and oil, and oil and fuel in tanks. This includes all loading not included in the empty weight.

Pay load is the total weight of passengers or cargo. It does not include fuel, oil, or pilot's weight.

Critical performance is the performance of a flight operation under conditions making the operation hazardous or impossible with normal power settings and flight procedure. Such flight operations can be safely accomplished if above normal engine revolutions per minute and experienced pilot technique are applied. Spot take-off and landings are classified as critical if more than normal engine revolutions per minute is necessary, or if hovering clearance, with normal engine revolutions per minute (3,000 revolutions per minute for Bell Model 47B) and full throttle, is less than 3 feet.

Easy performance is the performance of a flight operation under conditions that allow the operation to be accomplished with safety by experienced pilots with normal power settings and flight procedure.

TEST OPERATIONS OF THE BELL MODEL 47B

Tests were made to determine the pay-load capacities of the Bell Model 47B helicopters (figs. 1 and 2) in mountainous areas up to a maximum surveyed ground elevation at which the helicopter could make a spot landing and spot take-off with reasonable pay load, and with normal power. This included (1) determining the maximum gross weight for hovering, landing, and taking off from a small land-

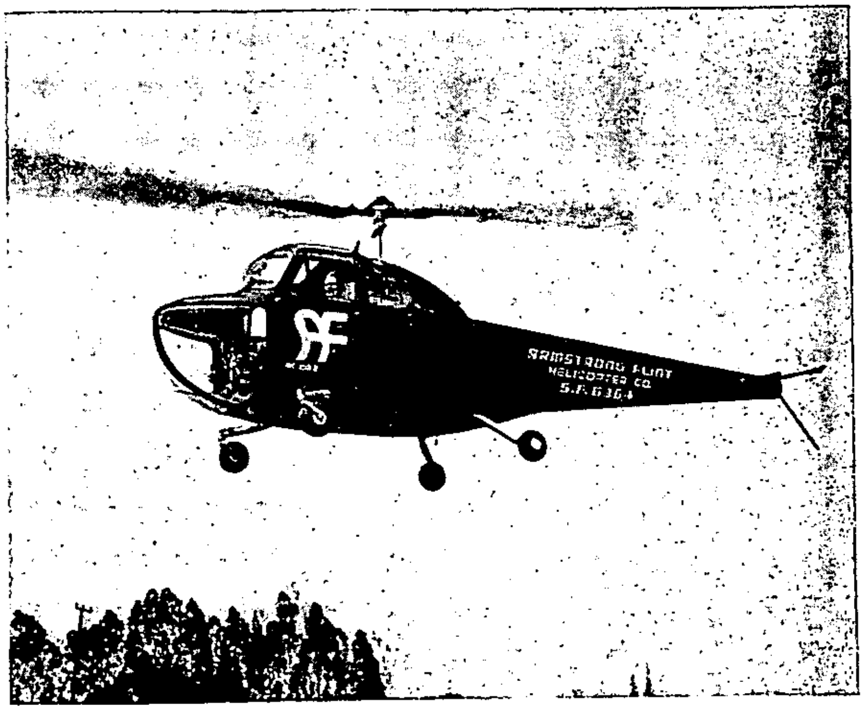


FIGURE 1.—Bell helicopter, model 47B, hovering.

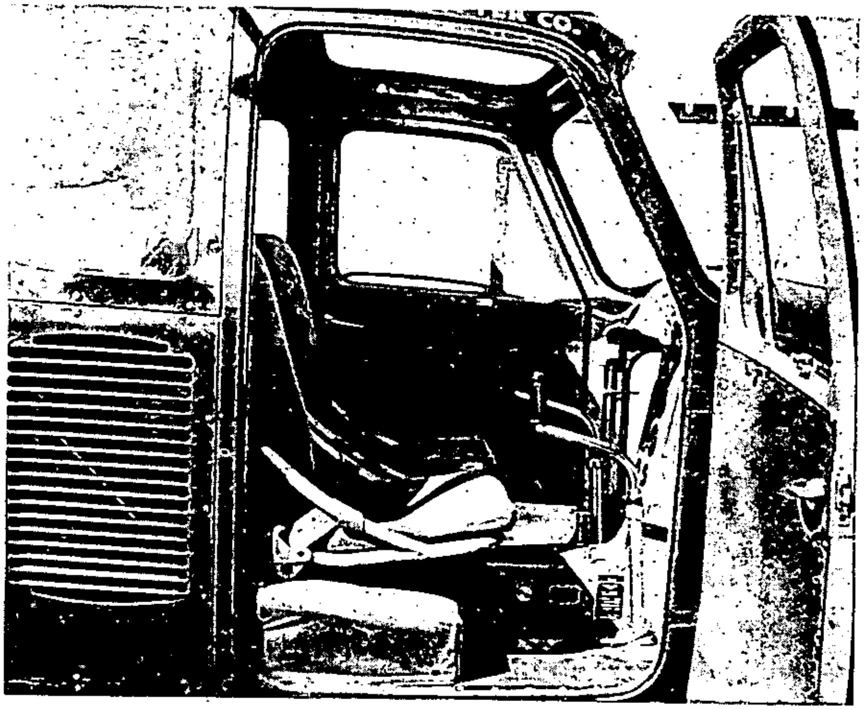


FIGURE 2.—Bell helicopter, model 47B, cabin arrangement.

ing spot with the wind velocity less than 5 miles per hour; and (2) checking tentative landing spots by flying a simulated landing approach (10 miles per hour above the indicated air speed necessary to maintain level flight at specified density altitudes) on the tentative landing spots.

This project is supplemental to the cooperative project conducted by the Air Rescue Service of the United States Army Air Force and the Forest Service, United States Department of Agriculture, with the Sikorsky (Army R5–A and R5–D) helicopters in 1946.[1] The flying of the Bell helicopter was performed under contract by the Armstrong-Flint Helicopter Co., Pacoima, Calif. The pilots of these tests were Knute Flint and Fred H. Bowen, both experienced helicopter pilots.

Normal procedure and power settings in tests for spot take-off were as follows: Helicopter was brought to a hovering position with from 1 to 3 feet ground clearance. Forward motion was maintained with this ground clearance until sufficient air speed (approximately 25 miles per hour, I. A. S.) was gained to establish translational lift. Usually 40 to 90 feet travel is necessary. Engine revolutions per minute may vary from 2,950 to 3,050, depending on density altitude, gustiness, and other atmospheric conditions, and how the ship feels to the pilot. After translational lift was gained, pitch was increased

[1] FUNK, IRA C., and KNUDSEN, CARL S. HIGH LIGHTS FROM RESULTS OF HELICOPTER TESTS. Fire Control Notes 8 (1): 10–16, illus. 1947.

mainly to reduce the engine to 3,000 revolutions per minute (usually at full throttle), and at the same time to give necessary climb while indicated air speed was further increased to at least 45 miles per hour. The remainder of the climb was at 3,000 revolutions per minute and at full throttle.

Normal procedure and power settings in tests for spot landings were as follows: Final approach was entered about 200 feet above the landing spot at 45 to 50 miles per hour with approximately 2,950 revolutions per minute. Descent was maintained so that on arrival at edge of landing spot clearance was 15 to 20 feet. Revolutions per minute was increased at this point to a maximum of 3,000 as air speed was reduced nearly to zero. At the same time, pitch was increased to check rate of descent. As soon as the ground cushion was established, pitch and power settings were reduced slightly to effect and maintain a hover. The helicopter was then let down to the ground by further reducing pitch and power settings.

Specifications of Bell Model 47B

Gross weight: 2,200 pounds.
Empty weight: 1,251 pounds.
Useful load: 679 pounds.
Allowable fore and aft displacement of c. g. (total inches): 4.88 inches.
Seating capacity:

- Pilot: 1
- Passenger: 1.

Fuel and oil capacity:

- Fuel: 33 gallons.
- Oil: 2 gallons.

Engine. Franklin, 6V4–178–B3: 178 horsepower.
Controls: Dual.
Dimensions:

- Over-all length (main rotor over tail rotor): 41 feet 2.5 inches.
- Over-all height: 8 feet 6 inches.
- Over-all width over stabilizer: 8 feet 6.7 inches.
- Main rotor diameter: 35 feet 1.5 inches.
- Tail rotor diameter: 5 feet 8.1 inches.
- Alighting gear width: 6 feet 6 inches.
- Cabin width inside: 4 feet 3 inches.
- Cabin height inside: 4 feet 4 inches.
- Tail rotor ground clearance: 3 feet 3 inches.

Performance with design gross weight

Maximum speed at sea level: 92 miles per hour.
Cruising speed at (75 percent b. hp.): 75 miles per hour.
Maximum rate of climb at sea level (45 miles per hour): 950 feet per minute.
Hovering ceiling without ground effect: 3,200 feet.
Service ceiling (rate of climb 100 feet per minute): 9,700 feet.
Fuel consumption cruising (approximately): 12 gallons per hour.

Maximum allowable gross weight for operations under various temperatures and elevations is given in table 2. Similarly pay-load values are given in table 3. Pay loads given in table 3 may be increased approximately 70 pounds when the wind at the landing spot is steady at 11 to 15 miles per hour and approximately 60 pounds when the landing spot is on a ridge top and thus permits flat approach and take-off and application of above normal engine and rotor revolutions per minute for a brief period.

TABLE 2.—*Maximum allowable gross weight for spot take-off and landing at specified pressure altitudes,*[1] *with wind velocity 0 to 5 miles per hour*

Pressure altitude (feet)	Gross weight when free air temperature is—							
	30° F.	40° F.	50° F.	60° F.	70° F.	80° F.	90° F.	100° F.
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
0	2,200	2,200	2,200	2,200	2,200	2,200	2,200	2,200
1,000	2,200	2,200	2,200	2,200	2,200	2,200	2,200	2,185
2,000	2,200	2,200	2,200	2,200	2,200	2,195	2,135	2,080
3,000	2,200	2,200	2,200	2,185	2,135	2,080	2,020	1,970
4,000	2,200	2,185	2,135	2,080	2,020	1,970	1,920	1,865
5,000	2,125	2,075	2,020	1,970	1,920	1,865	-----	-----
6,000	2,020	1,960	1,910	1,860	-----	-----	-----	-----
7,000	1,910	1,860	-----	-----	-----	-----	-----	-----
8,000	-----	-----	-----	-----	-----	-----	-----	-----

[1] For application in field, pressure altitude of landing spot may be assumed as equal to surveyed elevation for same.

TABLE 3.—*Maximum pay load*[1] *for spot take-off and landing at specified pressure altitudes*[2] *with wind velocity 0 to 5 miles per hour*

Pressure altitude (feet)	Maximum pay load when free air temperature is—							
	30° F.	40° F.	50° F.	60° F.	70° F.	80° F.	90° F.	100° F.
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
0	375	375	375	375	375	375	375	375
1,000	375	375	375	375	375	375	375	360
2,000	375	375	375	375	375	370	310	255
3,000	375	375	375	360	310	255	195	155
4,000	375	360	310	255	195	155	95	40
5,000	300	250	195	155	95	40	---	---
6,000	195	145	85	40	---	---	---	---
7,000	85	40	---	---	---	---	---	---
8,000	---	---	---	---	---	---	---	---

[1] Pay load allowing fuel for 100 miles range (16 gallons plus 4 gallons reserve), 170-pound pilot, and 2 gallons of oil.

[2] For application in field, pressure altitude of landing spot may be assumed as equal to surveyed elevation of same.

The pilot's weight is normally considered as 170 pounds. This was assumed in computing table 3. When the pilot's weight is 160 or 150 pounds, the pay load may be increased 10 or 20 pounds, respectively, over the amounts given in table 3.

Total fuel, including reserve, is 20 gallons (permitting operation for 80 minutes or 100 miles). By reducing fuel load to 16 gallons (60 minutes or 75 miles) the pay load may be increased 30 pounds. For a fuel load of 10 gallons (30 minutes or 38 miles) the pay load may be increased 60 pounds over the value given by the table.

Since conditions of landing spots affecting landing techniques vary so widely in mountainous areas, pilots must be highly experienced. Personnel directly supervising helicopter operations should have a thorough knowledge of helicopter flight characteristics and know how various factors affect their load limitations. The importance of this is illustrated by the following example.

On the Bryant Fire, Angeles National Forest, experienced pilots gradually increased loading and landing elevations until between 200- and 250-pound pay loads were carried to a ridge top landing spot having an elevation of 5,300 feet. Temperature was approximately 80° F. and wind velocity was steady at 11 to 13 miles per hour.

Application of the data given in this report indicates the maximum allowable pay load under the conditions on the Bryant Fire to be as follows:

	Pounds
Maximum pay load from table 3	40
Increase due to wind (11 to 13 miles per hour)	70
Increase due to ridge top landing spot and highly experienced pilots, and use of above normal revolutions per minute	60
Increase due to low pilot weight (150 pounds)	20
Increase due to low fuel (15 gallons)	36
Total pay load	226

Regardless of the helicopter's ability to lift a greater load, the gross weight of the Bell Model 47B should never be permitted to exceed 2,200 pounds, its licensed limit.

Landing spot requirements.—The Bell Model 47B is unusually stable in flight, and may be landed and taken off from a spot where small obstacles clear its over-all dimensions by only a few feet. Pilot fatigue is comparatively low for a helicopter.

Further study of the Bell helicopter's take-off flight characteristics is needed to determine definite landing spot requirements. Highly experienced pilots, with mountain operation experience, are capable of selecting landing spots that in most cases require little or no improvement before being used.

Experience to date, however, indicates that before any helicopter landing spots are chosen, the tentative spot should be checked *from the air by a helicopter* to determine if the approaches and take-off patterns are suitable. This cannot be done by a conventional type airplane since it is impossible to slow the airplane down to the speed that the helicopter would be flying on take-off and landing patterns. During the tests it was found that suitable landing spots could be located from the helicopter that appeared to be unsuitable when observed from conventional aircraft and from examination of aerial photographs and topography maps. Before a final decision is made to improve a landing spot, the spot must be checked on the ground to determine the amount of slope of the landing area. The Bell Model 47B does not have brakes on the landing gear, and so requires level ground where the helicopter is to stand.

There is little justification for expenditures in planning helicopter operations and preparing helicopter landing spots until helicopters are available for reconnaissance in connection with such planning work.

Maintenance.—At present there have not been sufficient Bell Model 47B helicopters in operation to give an accurate estimate of the required maintenance cost and depreciation. Under present CAA regulations it is necessary to magnaflux or zyglo inspect all parts of the rotor head and gear boxes every 100 hours. Undoubtedly, this will not be necessary as the flying time on the helicopter increases. At present it requires approximately 160 man-hours for a 100-hour inspection. This time will be reduced as experience is gained by the maintenance crew and certain precautionary measures are withdrawn by CAA. There are also a few mechanical problems that must be worked out before this helicopter could be depended upon to meet a rigid flying schedule day after day over a period of a month or longer.

The present contract cost is $50 to $70 per hour of flying time. The rate depends mainly on whether landings are to be made at unimproved spots, a factor which increases maintenance of the helicopter.

Suggested improvement of the Bell Model 47B helicopter.—The following improvements are needed on the Bell Model 47B in order to make it fully effective in all forest areas, especially where landing spots are between 4,000 and 9,000 feet, as in national forests located in Montana, Idaho, and the Pacific Northwest:

1. Increase hovering ceiling.
2. Increase service ceiling.
3. Raise tail rotor to clear higher obstacles.
4. Revise landing gear to increase clearance between fuselage and ground.
5. Provide parking brake.
6. Provide easy removal of controls from one seat.
7. Improve carburetor air filter for operating in extremely penetrating dust and ash conditions in burned over areas.
8. Provide cargo racks: in passenger's seat for such things as blankets, canteens, etc.; on floor for such things as small tools; on exterior of cabin for such things as long handled tools, shovels, and saws.
9. Provide hopper arrangements for dropping water in direct fire suppression.
10. Provide stretchers on side of helicopter for evacuating injured.

CONCLUSIONS

The tests made indicate that the Bell Model 47B helicopter, when flown by pilots that are highly experienced in operating helicopters in mountainous areas, is suitable for fire control operations up to an elevation of 6,000 feet where landing spot conditions are most favorable. In timbered areas with few bald ridge top spots for landing, its usefulness becomes limited. However, in the most diffcult situation, the Bell Model 47B can be depended upon to carry suitable pay loads to and from landing spots having elevations up to 3,200 feet and limited loads of strategic supplies to or from landing spots at higher elevations.

Plastic for Osborne Fire Finder Map Covers.—Another use was found for the versatile plastic on the Cleveland National Forest this season. A circular disk from 1/16-inch Lucite, similar to Plexiglass, was used over the map on both Osborne and Bosworth fire finders to aid in preserving the maps and to hold the map in place. The disks should be cut approximately 1/8-inch smaller than the tin map disk to allow it to fit inside the disk screws and still be held in place by the heads of the screws. By use of the disks the task of gluing the map to the tin is eliminated, as a few strips of tape will hold the map to the tin and the weight of the plastic will hold the map flat. The advantage over glass is that the plastic won't break and is easily cut. But care must be used not to scratch the plastic. Most scratches can be removed with polishing rouge.

The same plastic material is also used for call card covers in radio equipped automotive equipment.—STANLEY STEVENSON, *Fire Control Officer, Cleveland National Forest.*

OBSERVATIONS ON FOUR PRESCRIBED FIRES IN THE COASTAL PLAIN OF VIRGINIA AND NORTH CAROLINA

KENNETH B. POMEROY

Silviculturist, Southeastern Forest Experiment Station, U. S. Forest Service

The following article by Mr. Kenneth B. Pomeroy is a factual report of four prescribed burning experiments covering relatively small areas in the North Atlantic Coastal Plain designed to determine whether or not burning under controlled conditions would hasten reseeding of pine on areas where noncommercial hardwoods constituted the bulk of the stand prior to burning. The article is merely a factual report and is published here to make these facts of permanent record. It is not intended to carry a definite recommendation as to the widespread application of the principle of prescribed burning to secure seeding of loblolly pine in North Atlantic coastal areas where noncommercial hardwoods act as a deterrent to pine regeneration. The article is being published in Fire Control Notes because of the widespread interest in prescribed burning for silvicultural reasons.

Wide publicity has been given the use of fire as a silvicultural tool. Some foresters advocate prescribed burning for the improvement of seedbed conditions and as a means of reducing the competition from inferior species during the critical period of reproduction establishment. Other foresters contend that prescribed burning should not be encouraged while they are still trying to sell fire prevention to the public; that the sprouting ability of many hardwood species limits the duration of any reduction in crown competition; and that the release and preservation of existing seedlings will be the most economical means of stand regeneration.

Consequently, prescribed burning is a topic of considerable interest to foresters in the North Atlantic Coastal Plain. It was this trend toward more intensive forest management, concern over hardwood invasion, and unsatisfactory pine regeneration that prompted four organizations, three commercial and one Federal, to try prescribed burning during the fall of 1946.

THE TRACTS BURNED AND RESULTS OBTAINED

Tract 1

This 15-acre tract had been in a cut-over condition for 4 or 5 years. The seed source was ample, being 7 or 8 loblolly pine per acre, 16 to 20 inches d. b. h. Very few pine seedlings could be seen in the dense ground cover of young hardwoods, shrubs, and vines. Because of frequent summer and autumn showers, it was October 7 before weather conditions were judged to be right for burning. The intent was to burn as early in the fall as weather conditions would permit, because

the seed trees were heavily laden with cones. Vegetation was in the transition stage. A 5-mile-per-hour wind was blowing from the north. Although no fire-danger station was being maintained in the vicinity, the fire danger was probably class 3.[1] The risks common to the use of fire were emphasized when all available manpower (eight men) had to be mustered to control a breakover along the fire line. The 6-inch furrow, prepared with a turning plow, was inadequate, partially because roots had caused the plow to skip. Seed trees 80 to 100 feet tall were damaged when the fire flared up higher than had been expected. Seven months later two of these trees were dead and four other had lost more than 75 percent of their needles.

Examination during the last week of the following May indicated a good burn was obtained on this tract. The aerial portions of 99 percent of the hardwoods were killed back to the ground. Nearly all of these trees were less than 4 inches d. b. h. Sprouts were visible on 55 percent of the stumps, with indications that more stumps would put forth sprouts (table 1).

TABLE 1.—*Stand table per acre for four tracts 7 months after burning*

Tree species and condition	Trees per acre on—			
	Tract 1	Tract 2	Tract 3	Tract 4
Pine:	*Number*	*Number*	*Number*	*Number*
Alive	100	130	88	0
Dead	425	22	100	0
Hardwood:				
Aerial portion alive	25	2,554	75	25
Aerial portion dead:				
Sprouting	1,700	2,772	3,100	2,237
Not sprouting	1,400	109	338	263

Company records indicate that during the first 3 months after burning, loblolly pine seeds fell on tract 1 at the rate of 205,000 per acre. Subsequent examination disclosed an average of 15,775 seedlings per acre in the cotyledon stage of development. Most of the tract was an open pine type that averaged 18,469 seedlings per acre. A stand of 6- to 10-inch d. b. h. oak trees on the remainder of the burned area did not drop their leaves until after the fire. These leaves covered nearly all of the surface. Only 5,000 seedlings per acre were present on this portion of the tract, although the distribution of seed trees was similar to that on the pine type. Stocking percentage for tract 1 was 100, as determined by percentage of milacre plots containing one or more seedlings.

[1] According to the Coastal Plain system of measurement rating fire danger on a scale of 1 to 5. It must be emphasized that fire danger class as rated in this paper is an estimate based upon on-the-ground observations by U. S. Forest Service personnel, who gaged such local factors as days since last rain, stage of vegetation, fuel moisture, and wind velocity. Such estimates are far from recommended procedure, but they were the best available.

Tract 2

The second tract to be burned had been logged under a strip clear-cutting method the previous spring. It was designed to burn this tract in early fall in order to take full advantage of the expected seed crop. Several abortive attempts at burning were made on days with a danger rating of 1 and 2. The job was not completed until October 25 when a wind of 8 to 12 miles per hour, combined with a fuel moisture content of 9 percent, indicated a class 3 fire day, which furnished the necessary impetus to spread the fire from one brush pile to another. The final burn on October 25, of approximately 30 acres, was accomplished by three men.

A clean burn was secured where the brush piles occurred. Most of the area between the piles was only lightly singed. In the burned area, hardwood stems up to 4 inches d. b. h. were killed. The average kill for the entire tract, including the unburned spots, was only 53 percent. Eight months later 96 percent of these trees had sprouted. The average for the tract is shown in table 1. A marked contrast was noted between the tract 2 kill on class 1–2 days and that on all tracts for class 3 days. On class 1 and 2 days almost no hardwood stems bigger than 1 inch in diameter were killed back. On a per acre basis only 27 of 152 pines 1 inch or less in diameter were killed by this light fire. However, on class 3 days more than 98 percent of the hardwood stems under 4 inches in diameter were killed back, as well as 92 percent of pine this size.

In large slash piles on tract 2, fuel up to 2 inches in diameter was consumed. The duff [2] was not completely consumed, even under the slash piles. The percentage consumed is shown in table 2.

Seed talley on this tract showed 127,440 per acre. A cutting test disclosed that 67 percent of the seeds were sound. A midsummer 1947 inspection indicated an average of 4,408 seedlings per acre. The seedlings with the best development and most vigorous appearance were found in the burned areas. Over twice as many seedlings germinated in the skid trails and jammer sets, but when germination occurred on bare soil, the seedlings were small and of poor color. The best germination occurred in skid trails having a ground cover of grass and weeds. Every milacre plot that fell in a skid trail or jammer set contained from 1 to 27 seedlings. No seedlings were found in 3 percent of the plots occurring on the burned area. In the unburned areas, 20 percent of the milacre plots did not have any seedlings. Number of seedlings by surface soil condition types is shown for tract 2 as follows:

Surface condition:	*Seedlings per acre*
Unburned	2,342
Burned	3,928
Skid trails and jammer sets	8,171
Average all conditions	4,408

The tract as a whole showed 93 percent stocking.

[2] The term "duff" is used here to denote all the natural accumulation of leaves and twigs above the surface of the soil.

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Tract 3

This was a 30-acre forest-grown loblolly pine tract cut over in 1943 leaving 6 to 8 seed trees per acre. The ground on this 3-year-old slashing was covered with a dense growth of low shrubs, vines, and broom sedge, interspersed with hardwood sprouts 6 to 10 feet high. This area was burned on the same afternoon as tract 2. Wind velocity was 8 to 10 miles per hour, gusty; fuel moisture 9 percent; fire danger estimated as class 3. A well prepared fire line and good burning conditions enabled 16 men to burn this 30-acre tract in 3 hours.

TABLE 2.—*Duff consumed by fire on tract 2*

Kind of duff	Depth		Amount burned
	Before fire	After fire	
	Inches	*Inch*	*Percent*
Pine	2.9	0.8	72
Pine-hardwood	2.5	.5	80
Hardwood	2.0	.4	80

Here again, concentrations of brush in piles limited the effectiveness of the burn. Where the fire ran freely before the wind, an effective burn was obtained. In fact, the fire was so hot that a few residual pines 80 feet in height lost their crowns, although there was little or no slash near the base to cause damage to the tree trunks. Where fire was burning against the wind, it damaged only a few of the shrubs that occurred between the brush piles.

Subsequent tally indicated that 98 percent of the hardwoods were killed back to the ground. Sprouts occurred on 90 percent of these trees (table 1). Five percent of the seed trees lost a large portion of their needles but no dead trees were observed during the reexamination.

No estimate of the 1946 seed supply was made. It may have been relatively small because this was a diameter limit cutting leaving only 1 or 3 seed trees per acre. The 1947 inspection indicated 2,225 poorly distributed seedlings per acre and 68 percent stocking.

Tract 4

This 56-acre tract had been clear cut about 2 months before the burning took place preparatory to planting. All pine and hardwood trees over 4 inches d. b. h. were harvested. The interesting feature in this case was that the slash was scattered uniformly over the tract, a direct result of this company's method of logging. Eighty to ninety percent of the surface area was covered with slash to a depth of 3 to 6 feet. Seven men burned this tract in about 6 hours on an estimated class 3 day in early November.

Although the fire burned readily, the slash was not reduced to the extent desired, because of its green condition. Most of the twigs under one-half inch in diameter were consumed, but branches over 1

inch in diameter were not. The hardwoods were satisfactorily killed back to the ground. Only 1 percent produced new leaves in the crowns in 1947. Sprouting occurred on 89 percent of the fire-injured trees (table 1). The tract was planted in the spring of 1947 as no seed source remained after the clear cut.

CONCLUSIONS

More trials are needed to determine the value of prescribed burning as a silvicultural tool. The four attempts discussed in this paper are only mentioned in an effort to obtain a better understanding of the possible use of fire. Some of the conclusions, even though well known to fire control men, will bear repeating.

Good fire lines and careful planning are prerequisites to successful burning. The extra charges for fighting breakovers, having extra laborers present, and depending upon poorly constructed fire lines serve to emphasize this point.

For the season and region involved, conditions that combine to make a class 3 danger rating are required to develop a fire that will spread readily in cut-over slash area.

On days having a class 3 danger rating crowns of seed trees may be badly injured by flare-ups. It is important to move brush piles away from seed trees.

Burning on class 1 and 2 days killed the aerial portions of only one-half of the small hardwoods. On class 3 days over 98 percent of the hardwoods under 4 inches in diameter at breast height were killed back to the ground. Seedlings that germinate during the following growing season are thus given a better opportunity to become established.

Burning on class 3 days did not give a "clean" burn in the sense of consuming hardwood saplings, or slash, or duff to expose mineral soil. The fire consumed most of the limbs up to 2 inches in diameter in slash that had seasoned for 6 to 8 months. Branches over 1 inch in diameter did not burn readily in slash that was only 2 months old.

The total cost chargeable to prescribed burning was relatively high because of the safety and protective measures required.

A good initial catch of seedlings was secured when an ample supply of seed was available.

The reduction of hardwood competition will be of short duration because a large portion of the injured hardwoods sprouted during the first growing season following the fire.

PORTABLE HOSE COUPLING EXPANDER

William M. Sherman

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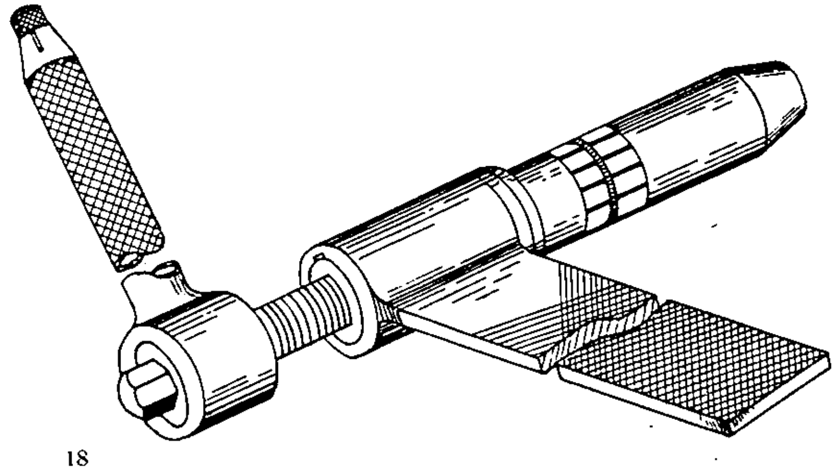
A portable tool has been devised for replacing hose couplings in the field on Forest Service standard 1½-inch hose. The tool is a small compact unit stored in a case, 4 by 5 by 14 inches and easily assembled in a few seconds. It is a radial ferrule expanding device, so constructed that it can be held with the foot, similar to holding a pipe with a stilson wrench on the floor.

The coupling on the piece of hose to be discarded is removed by driving a chisel, or tool of similar nature, between the coupling and the expanded ring and prying the ring out. A ferrule is slipped over the segments of the expander. A slight shoulder about the thickness of the ferrule stops it from going beyond the segments. The hose is then inserted into the coupling, and shoved over the end of the expander until the coupling hits the stop, which sets the expander ring in the right spot. Stops are provided for both male and female couplings on the same head. If a rubber gasket is used, put it in ahead of the hose in the coupling. When the hose with the coupling and expander ring are on the device ready for the expansion of the ring, slip the foot vise over the key, put the arch of the foot over the round part of the foot vise with the toe over the knurled wing, slip the rachet on and expand the ring. When the ring is on, turn the rachet lock, run the rachet backward a stroke or two to relieve the expanding segments, remove rachet and unscrew with fingers until tool can be removed. The operation takes only a few minutes and saves delay in replacement of hose on a fire.



THE DISK-DOZER

H. M. White

Division of Fire Control, North Pacific Region, U. S. Forest Service

Equipment Development Report No. 9, December 17, 1946, described a clearing and trenching implement designed and constructed at the Portland, Oreg., Equipment Laboratory and Shop for attachment to the Beetle Tractor.[1] This implement was aptly named the disk-dozer by the late David P. Godwin. It showed such good possibilities for fire control line clearing and trenching that three similar disk-dozers were constructed at the Portland Shop for trial in other regions, and a larger one for trial in the North Pacific Region with the new Oliver HG tractor, for which orders had been placed by several regions. This tractor, with bulldozer, weighs 4,840 pounds. Because of delay in delivery of the tractors, the larger disk-dozer could not be tested until the fall of 1947.

As shown in figure 1, the disk-dozer consists of two rolling disks, mounted at right angles, and a combination cutting coulter, log pusher horn, small middle breaker, and wings to protect the disks, the whole, assembly being mounted on channel steel for attachment to the A-frame of the tractor in place of the bulldozer blade and its arms. The change from bulldozer to disk-dozer can be made in a few minutes.

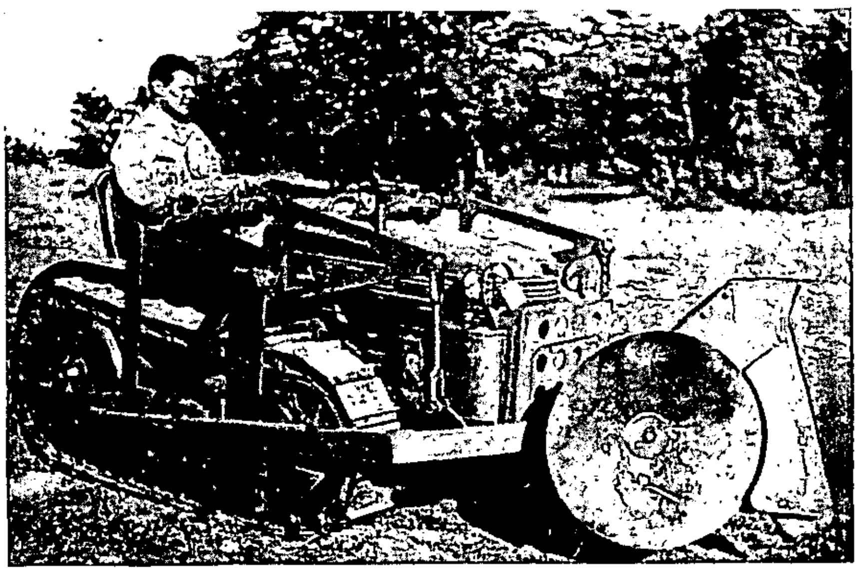


Figure 1.—Oliver HG tractor and disk-dozer.

[1] Fire Control Notes, July 1946. The latest model tractor weighs 2,200 pounds, is 33½ inches wide, and has 6-inch track plates. Speeds are somewhat lower.

The Beetle size unit has 22-inch disks and weighs 145 pounds. The larger size has 28-inch disks and weighs 390 pounds. The respective weights of the bulldozers on the two tractors are 125 and 345 pounds. It appears practicable and desirable to reduce the weight of the larger disk-dozer to less than that of the bulldozer blade which it replaces.

Tests so far made with the small disk-dozer in the North Pacific Region have indicated that, even without changes, it is better than a pull plow for use with the Beetle tractor. The first tests of the larger unit showed certain disadvantages, which it appeared might be overcome by further study and experimenting. It continuing the tests it was considered desirable to construct parallel lines with an Oliver tractor and disk-dozer and another tractor with bulldozer and Wescoatt plow.[2]

The preliminary tests were made on the east side of the Mount Hood National Forest in September, before the heavy fall rains. The soil, a heavy clay loam with considerable rock, was very dry in the open but somewhat moist under heavy cover. The tractor, with disk-dozer raised, was driven up a 50 percent south slope, having a cover of grass and weeds with occasional clumps of brush; then a trench was plowed down the slope. This operation was entirely satisfactory.

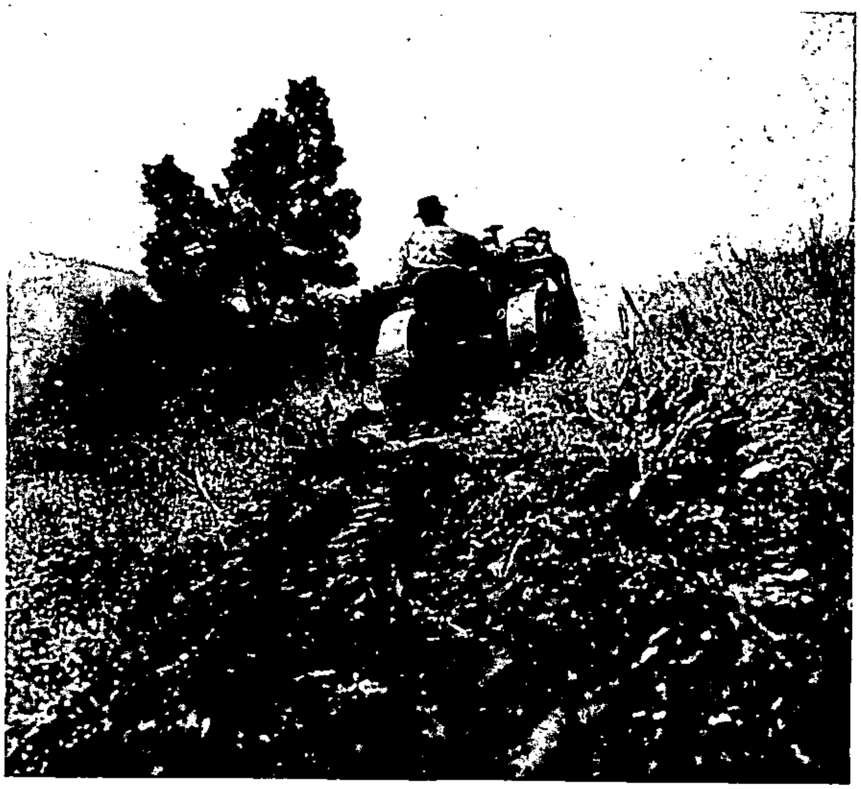


FIGURE 2.—One-disk trench along a 50-percent slope.

[2] E. D. Report No. 1.

One disk was then removed and a trench was plowed parallel with the slope (fig. 2). An excellent cupped trench was made, and the soil thrown on the downhill side lowered the grade under the tractor 4 percent.

On a north slope in ponderosa pine reproduction and brush, with quite a bit of down material and rock, the going was tough. The disks took considerable punishment without damage. Approximately 15 chains of line were constructed around an area at the rate of 38 chains per hour. The disk-dozer proved to be very effective for clearing away all kinds of ground cover, and it made an acceptable trench.

The comparative disk-dozer and plow tests were made in October on the Ochoco National Forest, on a north slope covered with a mixture of Douglas-fir, western larch, lodgepole pine, and ponderosa pine, and on more or less open ground in ponderosa pine. Reproduction was thick along more than half of the lines. The soil varied from clay loam to sandy loam, and from very rocky to little or no rock. While light rains had occurred, local men thought the implements would have made as good trench in this location at the height of the dry season, except that the roll would have been somewhat less.

Parallel lines about 20 feet apart were constructed with the two outfits, up over a hill then around and down to the point of beginning, a total distance of 96 chains. Except for one chain of 55 percent slope, where trenching was done straight down, slopes varied from 7 to 37 percent, uphill, and from 10 to 20 percent, downhill, with 31 chains approximately level and 3 chains along contour. Logs and debris were estimated as light for 57.5 chains, medium for 25.5 chains, and heavy for 13 chains.

Both outfits completed the lines in 2 hours, 5 minutes, or at the rate of 46 chains per hour. The disk-dozer went faster in thick cover and where there were logs, but the plow caught up in the open. The tractor with disk-dozer was in low gear (1.45 m. p. h.) all the way, while the other tractor was in second gear (2.30 m. p. h.) part of the time in the open.

As in the preliminary tests, the disk-dozer was especially effective for clearing away logs and other down material. The sharp coulter was much better than the bulldozer for breaking and moving logs, and hydraulic control of the implement facilitated the removal of heavy duff and rotten material. In backing, which had to be done frequently in heavy clearing, the advantage of having nothing behind the tractor was outstanding. It would, no doubt, have been more so if the tractor were equipped with a reversing clutch, as the Beetle and Clarkair are. The necessity for shifting gears reduces clearing speed with the disk-dozer relatively more than with the bulldozer and plow, because the plow interferes with backing even when a reversing clutch is used.

The bulldozer blade, used in angle position, had a tendency to "hang up" on logs and trees, and in backing the plow jack-knifed and at times interfered with turning movements of the tractor. Also, in heavy clearing where the full power of the tractor was needed for that operation, part of it was taken by the plow at times when that implement was doing no effective work but only digging deeper with every forward surge of the machine. This could be overcome to a large extent by controlling the plow hydraulically, but the lifted plow

would still interfere with backing and would be a dead weight on the rear end of the tractor.

The disk-dozer went between small trees and laid them over to either side of the line, while the bulldozer laid most of them ahead. When the disk-dozer rode over the reproduction and brush, it was necessary to back up and get under them with the disks to root them out. The plow outfit had the advantage in this respect, because the disk-dozer operator, while thoroughly experienced with bulldozers, had never practiced with the disk-dozer.

Both outfits made good trench, the disk-dozer trench averaging about 7 feet, including roll, or about 40 percent wider than the plow trench on the level (fig. 3). Width of trench, under North Pacific Region conditions, might well be sacrificed to save power and gain speed. Neither implement appeared to have the advantage in rocky soil. The rocks did not materially damage the disks, which are standard farm disks and, therefore, replaceable at small cost.

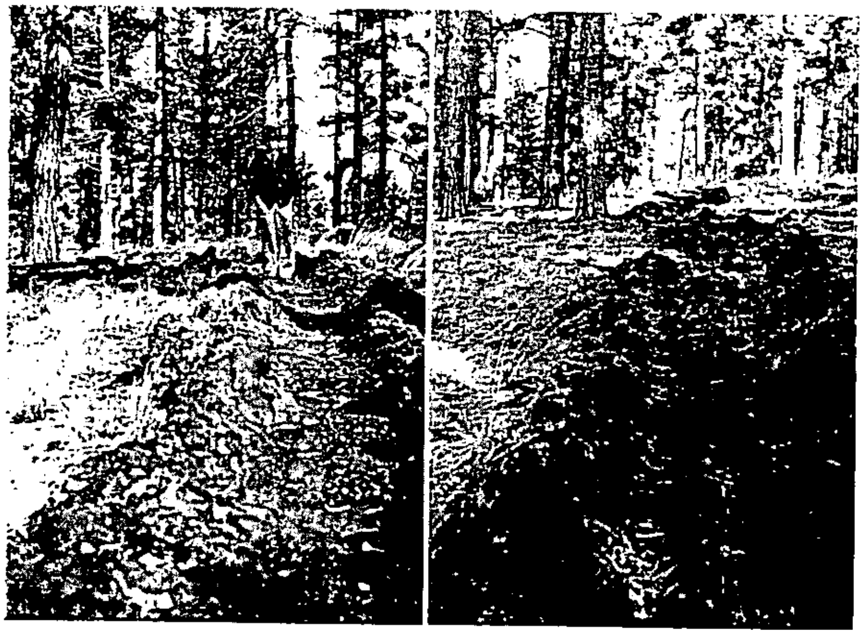


FIGURE 3.—Trenches made with Westcoatt plow (left) and disk-dozer (right).

One disk only was used on the steeper side slopes and for a short distance on level ground. The time for removal and replacement of the other disk was counted in the total time. Some practicable means of carrying the idle disk on the tractor will need to be devised. The one-disk trench was very good. On the level, in addition to less power consumption, there was the advantage of throwing no soil or debris to the "fire" side. However, the use of only one disk on the level is not practicable without some method of compensating for side thrust.

In all tests with the disk-dozer, the operator found it very difficult to control depth of trench. Working the hydraulic control almost constantly, even where there was no clearing to do, he could scarcely

keep the implement at a constant depth, because it usually went in or came out too far before the action could be reversed. It seems likely that this disadvantage can be overcome by installing depth shoes on the disk-dozer frame back of and outside the disks. With effective depth shoes, the operator should be able to maintain uniform depth with down pressure on the implement.

The tractor with disk-dozer loads to better advantage than the tractor with plow. The former is backed into a standard 1½-ton truck, with the coulter just ahead of the endgate, giving excellent load distribution. The latter must be loaded with bulldozer forward and the plow overhanging, with the endgate removed, so that the weight is too far to the rear. However, both outfits were handled nicely in 1½-ton trucks, though there was an overload.

After considering the results of the tests, further development work on the disk-dozer for the Oliver HG tractor was recommended. Improvements found desirable would, of course, be incorporated in other sizes that might be constructed. The following development work is proposed:

1. Install depth shoes, quickly adjustable, to overcome wavy trench profile and to maintain uniform depth.
2. Try smaller disks, which will make narrower trench and thus save power and increase speed in light cover. Use new super-alloy disks.
3. Decrease depth of coulter and middle breaker to save power. Decrease thickness of this part of the implement. The pilot model is overly strong.
4. Experiment on level ground with one disk only and a long finned coulter as a means of overcoming side thrust.

Experience with the disk-dozer so far indicates that improvements to increase speed and make trench of uniform depth can be worked out and that, after this has been done, it will be much better than a bulldozer-plow combination for the clearing and trenching job under most conditions in the North Pacific Region. However, in areas with light cover and little or no rock, greater speed can probably be made with a drawn plow.

Suggestion to Facilitate Fire Sign Posting.—The suggestion in Fire Control Notes of October 1947, page 27, about how to fasten fire posters to backs brought out the following suggestion from a Region 4 forest supervisor.

Use four cupped brass washers, over-all diameter ¾-inch, with ¾-inch No. 6 brass round-head screws to fasten a 9- by 11-inch poster to the birdhouse back. Place bottom washers under poster at corners, and top washers at sides just below corners. Drill holes for screws.

The advantage of this system is that after the screws and washers are once in place all one has to do to replace signs is to loosen screws, remove old posters, insert new posters, and tighten screws. The only tool required is a small screw driver and there is no hammering or marring sign back. For the 14- by 22-inch birdhouse backs two additional washers are used at the middle of the sign.—DIVISION OF FIRE CONTROL, *Region 4, U. S. Forest Service.*

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CONSOLIDATED FIRE ORGANIZATION CHART AND DISPATCHER'S BOARD

FRED G. AMES

District Ranger, De Soto National Forest, Mississippi

The combined fire organization chart and dispatching board in use on the Chickasawhay District of the Mississippi National Forests has been developed to a higher degree than is normally found. This district has had as many as 35 incendiary fires with one to scores of sets each within a 12-hour period and 254 fires in a 2-month period. Through use of the combination board and the dispatcher's individual fire record described below, the dispatcher has been able to keep abreast of each situation as it develops.

This consolidated board was developed to assist the dispatcher in keeping up with developments so that at a glance he can determine the organization and other facilities on the district available for fire duty.

The features of the consolidated board, as indicated by corresponding numbers on the diagram, are—

1. *Detection chart.*—Contains the name of each tower together with the name of the regular lookout, the name of the alternate lookout, and the tower manning schedule for that particular tower. In addition are the brief plans for emergency patrol and airplane use.

2. *Organization.*—The district organization is posted on index cards inverted and held in place by cupboard hooks to facilitate raising the cards to locate desired information. This portion of the dispatching board contains seven cards appropriately labeled: District Officers, Non-District Officers, Law Enforcement, Special Men, Food Supply, Other Supplies, and Special Equipment.

3. *Fire crew placement guide.*—A guide for the placement of all types of fire crews during the fire season, based on fire danger class ratings, lists the mechanized fire crew headquarters, the placement of Forest Service labor crews, and assignment of work projects that may be carried on along with the fire duty. The guide provides for week ends and holidays as well as work days, and also brief information on assignment of cooperator crews.

4. *Map of district (small scale).*—The dispatcher keeps locations of all crews available for call by use of numbered pins, the numbers corresponding with the crew numbers assigned as mentioned under 10, 11, and 12. (A red pin is used to denote a going fire and the individual crew pins are moved to the fire location as the crews are dispatched to that fire.)

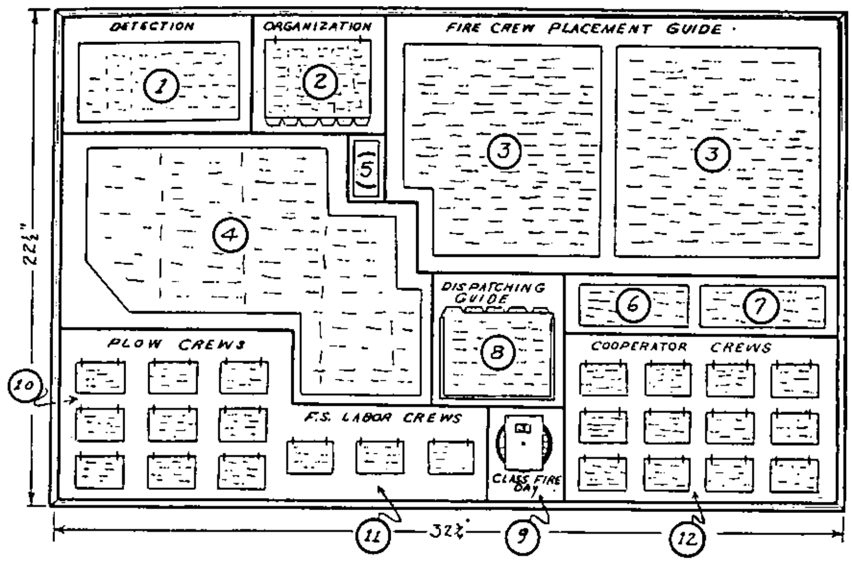
5. A small card consisting of a list of the elements necessary for a fire crew boss to know about a fire at the time he is dispatched to the fire—memory refresher for the dispatcher.

6. A small card listing conditions or occurrence of events which must be reported to the ranger by the dispatcher.

7. A small card listing conditions or occurrence of events which must be reported to the supervisor's office by the dispatcher.

8. *Dispatching guide.*—Provides information on the minimum man-power and equipment requirements for a going fire, based on the class of fire day. This information is posted on index cards appropriately labeled, one card for each class of fire day. The cards are held within slots so that the minimum dispatching requirements for the particular class of fire day can be placed in front for ready reference.

9. *Fire day class.*—A rotary chart on which the current fire day class is shown and which is the basis for organizational adjustments necessary for compliance with 3 and 8 above.



Chickasawhay Dispatching Board.

10. *Plow crews.*—Each plow crew is assigned a number and pertinent information concerning the plow crew is posted on small cards (1½ by 2 inches). The information posted on the cards is the crew number, crew base location, foreman, number of men, transportation facilities, tool cache, communication facilities, and food supply. The cards are hung on small cupboard hooks. As a crew drops out of the organization the card is turned back up.

11. *Forest Service labor crews.*—Posted and mounted similar to the cards for plow crews.

12. *Cooperator crews.*—Posted and mounted similar to the cards for plow crews.

An integral part of this concise, fast-moving fire organization plan is the Dispatcher's Individual Fire Record, which has been effectively used on the Chickasawhay District to reduce the time required by the dispatcher to record the events in connection with a fire. The form insures a more complete and concise record of events than would otherwise be possible, and with less effort on the part of the dispatcher. This is desirable on districts that often have several going fires at one time.

All information concerning detection, location of fire, and initial dispatch is recorded with relatively little writing.

This form greatly facilitates the review of action on fires. All information gathered by the dispatcher pertaining to one fire is recorded on a single letter size sheet. It is placed in a ring binder along with

This form greatly facilitates the review of action on fires. All incurring on which action is taken are recorded on the dispatcher's individual fire record, and all other types of events are recorded on the log and diary sheets. From time to time the sheets of both forms are removed, checked for chronological order, and bound for filing.

Another aid to the dispatcher is a set of aerial photographs indexed by townships and ranges with section lines marked thereon. These are conveniently filed by the dispatcher's desk so that at a glance he can tell what type and density of fuel and timber is involved and also can determine from this bird's-eye view if there are any roads or natural breaks which might not have been shown on the map.

- DISPATCHER'S INDIVIDUAL FIRE RECORD -

Twp. 6
Rge. 8
Sec. 31

Date 3/16/47
Fire No. 147
Name Plantation

- DETECTION -

Sta.	Azmt.	Hour	Min.	A/P
[illegible]	149	2	16	P
F.T.				
T.C.				
P.W.	252	2	18	P
Ston.				
B.C.				

- INITIAL DISPATCH RECORD -

Name	Location	Time	A/P	Crews: Plcs	Crews: Labor	No. Men
Coleman	Mulberry	2:19	P	✓		5
Landrum	Wausau	2:21	P	✓		5
Jones	P.W.	2:23	P		✓	8

MESSAGE: To	From	Station	Time	A/P	DIGEST OF CONVERSATION
Ranger		Laurel	2:24	P	Reported fire - Is leaving for fire
	Hyatt	P.W.	2:25	P	Reports fire spreading fast
	Coleman		2:57	P	Arr fire - Can handle fire alone
Landrum		Route	2:58	P	Ordered to return to Wausau
	Bradley	Wausau	3:14	P	Reports fire apparently under control
	Ranger	Fire	3:15	P	Arr. fire
	Coleman	Fire	3:22	P	Fire under control 3:19 P
	Jones	Fire	3:26	P	Arr. fire - mop up
	Coleman	Fire	3:34	P	Fire mopped up + out. Ordered him to
					return to Mulberry + ordered Jones
					to return to P.W.
	Ranger	Fire	3:35	P	Leaving fire

Dispatcher's Individual Fire Record.

FIRE DAMAGE APPRAISAL

J. A. Mitchell

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Fire damage appraisal is an involved and controversial subject. There is need, however, for a common policy in regard to damage appraisals for statistical purposes, if damage statistics are to be consistent and are to have historical and administrative value.

Unfortunately, forest fire damage is not an absolute quantity that can be precisely determined, since it involves certain more or less arbitrary assumptions and premises that must be established by agreement. Nor is any final settlement of the damage appraisal problem possible, since basic conditions as well as our conception of what constitutes damage are subject to change. The most that can be hoped for is agreement on a procedure that will serve current needs and give consistent and generally acceptable results. The last is important for, if damage estimates are not generally recognized as sound and reasonable, they carry little weight and tend to discredit fire control effort.

The legal basis for damages is the difference in value of the property involved before and after injury is sustained. Since the injured party is entitled to the continued undisturbed enjoyment of his property, however, his loss is not limited to the value of the part actually destroyed but to the depreciation in value of the property as a whole. Thus damage may properly include a reasonable valuation of any recognized benefits or values which may have been destroyed.

Forest fire damage, for example, may include not only the value of merchantable timber and young growth destroyed but also numerous direct, indirect, and intangible losses. The more important of these are:

Forest damage:
- Merchantable timber loss.
- Young growth loss.
- Damage to stand left.

Other direct losses:
- Grazing and wildlife values.
- Productive capacity of the land.
- Forest products.
- Improvements.
- Equipment, personal property, etc.
- Suppression costs.

Intangible losses:
- Watershed values.
- Economic values.
- Social values.
- Speculative and sentimental values.

Which of these items should be considered depends on the purpose for which the damage estimate is desired. A timberland owner, for example, suffers a direct financial loss represented by the tangible timber and property values destroyed, but is not directly concerned with such intangibles as watershed or social values. The public, on the other hand, suffers no direct property loss but is concerned with the loss of watershed, economic, and social values. Again, an indi-

vidual who has acquired timberland for exploitation is concerned only with the merchantable values destroyed. But, if the property was bought as an investment, he may also suffer a loss of potential values. On the other hand, if the property is being managed for timber production, damage may be measured by the reduction in income or yield due to the fire. From the standpoint of statistics or fire control administration, both tangible and intangible losses may properly be considered.

The validity of all of the above items of loss is recognized. It is proposed, however, to confine the present discussion to ways and means of evaluating direct damage to merchantable timber and young growth. To further focus the discussion, it is also proposed to consider damage appraisal from the standpoint of fire statistics rather than that of compensation for damages. While the two might be the same, the latter calls for the specific loss in a particular case, whereas the former calls for an average figure generally applicable to similar stands.

There are three concepts on which damage can be based: (1) Market or sale value, (2) present worth or expectation value, and (3) cost or replacement values.

Depreciation in market or sale value is the most direct measure of tangible loss, and underlies all other methods of damage appraisal since, in the final analysis, marketability is the basis of value. Damage to merchantable timber is usually figured on this basis. It presumes, however, a demand for the property in question at a price fair to both buyer and seller.

Expectation value is the usual basis of appraisal in the case of inaccessible or immature timber for which there is no current demand. This calls for discounting the recognized future value of the property to its present value as an investment.

Cost or replacement values as a measure of damage have the advantage of being relatively simple to figure, but they are the least sound since they ignore the real value or intrinsic worth of the property. While sometimes used as a basis for compensation, neither cost nor replacement value can be justified as a measure of damage if they exceed the market or reasonable present worth of the property in question.

There is no question as to the applicability of market value as the basis of valuation in the case of mature timber. If, however, the timber involved is not mature, two questions of policy arise. First, should future increment be considered; second, should present or estimated future stumpage prices be used in computing loss?

The answers depend on whether the stand under consideration was to have been cut or was being held as an investment. If it would have been cut in the near future, current market value should be used. If, however, it was being held as an investment, a reasonable increase in volume and possibly quality might justifiably be considered. The use of anticipated future stumpage prices, however, is open to question, since the values resulting are purely speculative.

If the value of a stand at maturity is accepted as the basis of value for immature stands, the simplest way of determining present worth is to multiply the mean annual value increment by the age of the stand when destroyed. This amounts to simple interest on the bare land

value at a rate which will give the predetermined maturity value in the specified number of years. This method, however, gives intermediate values higher than the actual market value at all points short of maturity.

A second method is to discount minimum merchantable value at compound interest to the age at which the stand is destroyed. The difficulty here is to determine the discount rate to be used. If the rate used is low, the initial and intermediate values derived may be too high. If high, the initial and intermediate values may be too low. From a strictly financial angle, the discount rate would be determined by the rate prevailing in the case of investments of equal desirability.

Another method is to use an agreed upon initial value. This automatically determines the discount rate but leaves the initial value to be used open to argument. It also results in varying discount rates, since the rate will change with any change in initial value, time interval, or maturity value.

As to the initial value that should be used, there are several schools of thought. One argues that it should be zero in all cases since we are dealing primarily with natural unmanaged stands, which have involved no outlay for establishment. Another argues that the average cost of planting should be used, since reproduction does not necessarily follow fire or may be slow in coming in. Others favor using planting cost where plantations are involved or artificial reforestation is likely to be necessary. The use of planting cost, however, assumes that the land is being held for timber production. It also introduces the third method of damage appraisal, i. e., cost or replacement values.

While cost and replacement values have much in common, they involve two distinctly different ideas. The proponents of cost value argue that the landowner is entitled to recapture his investment which may or may not include planting costs, but would include any actual expenditures plus interest.

Replacement value, on the other hand, ignores both actual cost and the real value of the property destroyed. The premise on which this method is based is that the cost of physical restoration is the proper measure of damage sustained. In this connection it might be pointed out that compensation for values lost, not physical replacement, is the legal basis of damage.

The policy laid down for the Forest Service by Greeley in 1925 called for determining damage on the basis of administrative and protection costs, plus compound interest at a rate determined by the expected maturity value of the stand at estimated future stumpage rates. Five dollars per acre was also added for planting where natural reproduction in a reasonable time was considered unlikely. This was all rather complicated to figure, but was reduced to tables based on site, type, and size class, for general use.

The present Lake States damage tables are based on the current average market value of 5- to 9-inch stands, discounted to the age when damaged at the rate of 5 percent. Theoretically at least, this represents the present value of immature stands as an investment. The method is simple and realistic, but admittedly conservative. Whether or not 5 percent is the proper discount rate to use may be

open to argument. The real question at issue, however, is whether real worth or cost of production is the proper basis of loss.

It is conceivable that the day will come when the market value of timber will be determined by its cost of production. At present, however, the two have no relation. Since any excess of cost over realizable value is an investment loss that would be suffered whether the timber was destroyed or not, it hardly seems reasonable to charge this investment loss to fire. Looking at the matter realistically, therefore, the soundest basis for timber damage appraisal would appear to be the present worth of the timber as an investment.

A Helicopter in Fire Control.—After more than 25 years of fighting fire I feel that I have this summer witnessed a machine that is destined to play a more important role in fire suppression than any other one piece of fire equipment that we have at our command. This piece of equipment is the helicopter that was used on the Allen Ranch fire on the Eldorado and the Schuyler fire on the Mendocino.

I had the opportunity of riding in this machine on a reconnaissance flight and of observing some of its actions and performances under actual fire conditions.

On the Eldorado it was used as a scouting plane. From my own experience I actually saw more fire and fire-line conditions in 16 minutes of flight time than I could have seen by ground travel (foot and auto) in a full daylight day. I knew after this short flight just what I was up against as night fire boss. This information was not second hand when I got it; it was my own observation, and in addition I had a clear picture of the entire fire, roads, topography, and location of fire lines. To anyone going onto a fire in strange territory this is vital. Admittedly, maps and aerial photographs help a lot but to actually see the entire picture is the real pay-off. It places the fire boss in a position where he is much better prepared to analyze ground information that comes in from the lines and scouts.

On the Mendocino fire this same plane was used for scouting and transporting food to the lines. In one case the division boss (District Ranger St. John) scouted his division and then was set down almost in the middle of it. This saved him a lot of hard foot travel and, as he expressed it, a new pair of boots. Where St. John was set down was in one of the roughest parts of the fire.

To me the important features of the helicopter as applied to fire control are as follows:

1. It can fly low (treetop height) and slow. This gives the observer an ideal chance to see the ground conditions.

2. It can land most any place. On the Eldorado it landed on top of a lumber pile and in a small meadow. On the Mendocino it was landing on a wide spot in the road.

3. It can fly in and out of areas that would be impossible to get into with an airplane.

I feel that on a lightning forest like the Klamath a helicopter would pay its way in a very short time. Men could be put on, or near, small lightning fires within a few minutes of discovery. Now it takes 4 to 20 hours of hard travel on foot to get men in where the helicopter could do the job in a few minutes. On top of that fresh men would be on a small fire, not tired men on a much larger fire.

I feel that the time is not too far off when we will have centralized kitchens and the men on the line will be served hot meals, not the conventional nose bag.

By using a helicopter on patrol of larger fires many men could be eliminated. A helicopter, radio equipped, and in communication with a few men on the ground, could certainly direct a patrol job much better than we are doing now.

Many miles of fire roads and trails might be eliminated from our transportation system, thereby saving maintenance money that could be applied to better maintaining those roads and trails that we will have to have in our system.

Afer seeing this machine at work on two fires this year I am certainly sold on it, as are other northern men who have witnessed its work.—T. A. BIGELOW, *Forest Engineer and Fire Control Officer, Klamath National Forest.*

MULTIPURPOSE TRACTOR-DRAWN TRAILER AND SLIP-ON PUMPER TANKER

R. A. MacIntyre[1] *and* George L. Bouck[2]

Region 5, U. S. Forest Service

Among the projects assigned in 1946 and 1947 to United States Forest Service Equipment Development Center, Arcadia, Calif., was the development of two tractor-drawn trailers. One was to be a lube and fuel service unit for tractors working on fire lines away from roads. The second was to be a tractor-drawn tanker trailer with pump. The first unit to be completed and field tested was a 1-ton capacity trailer with fuel and lube service equipment. This unit proved successful in "breakdown" tests, but when used on several large fires on Los Padres National Forest, the fuel capacity was found to be insufficient. As a result of this experience, field personnel recommended that the basic chassis design be retained, but the trailer be increased in size to accommodate six oil drums standing vertically and the fastenings or tie-downs be rearranged to suit general cargo hauling.

In view of these developments, it was decided that the lube and fuel service trailer and the tanker trailer be combined as a tractor-drawn utility trailer, as recommended, and that it be supplemented by a slip-on pumper-tanker unit to produce the tractor-drawn tanker trailer.

UTILITY TRAILER

The completed trailer has been constructed with a pay-load capacity of 1½ tons and the ability to travel fire line behind D–6 or larger tractor regardless of ruggedness of terrain or soil conditions. It also is capable of being drawn by vehicles other than tractors and can operate as a tractor fuel and lube unit transport, a slip-on pumper-tanker transport, or a utility supply trailer for any special purpose desired.

To meet the requirement of travel over rough terrain, the trailer body was constructed in the form of a stone boat (fig. 1, top). Sides are of 10- by 2⅝-inch channel iron. Front, bottom, and rear are of ¼-inch steel plate. The tongue, a 4 by 6 box beam, is of sufficient length to allow jackknifing of the trailer and tractor to 90 degrees. Principal dimensions are as follows: Over-all length 13 feet 2 inches, over-all width 7 feet 6½ inches, body length 7 feet 9½ inches, body width 4 feet 5¼ inches. Weight empty is 1,723 pounds. The trailer has Ford dual wheels with 8-ply 7.00 x 20 tires.

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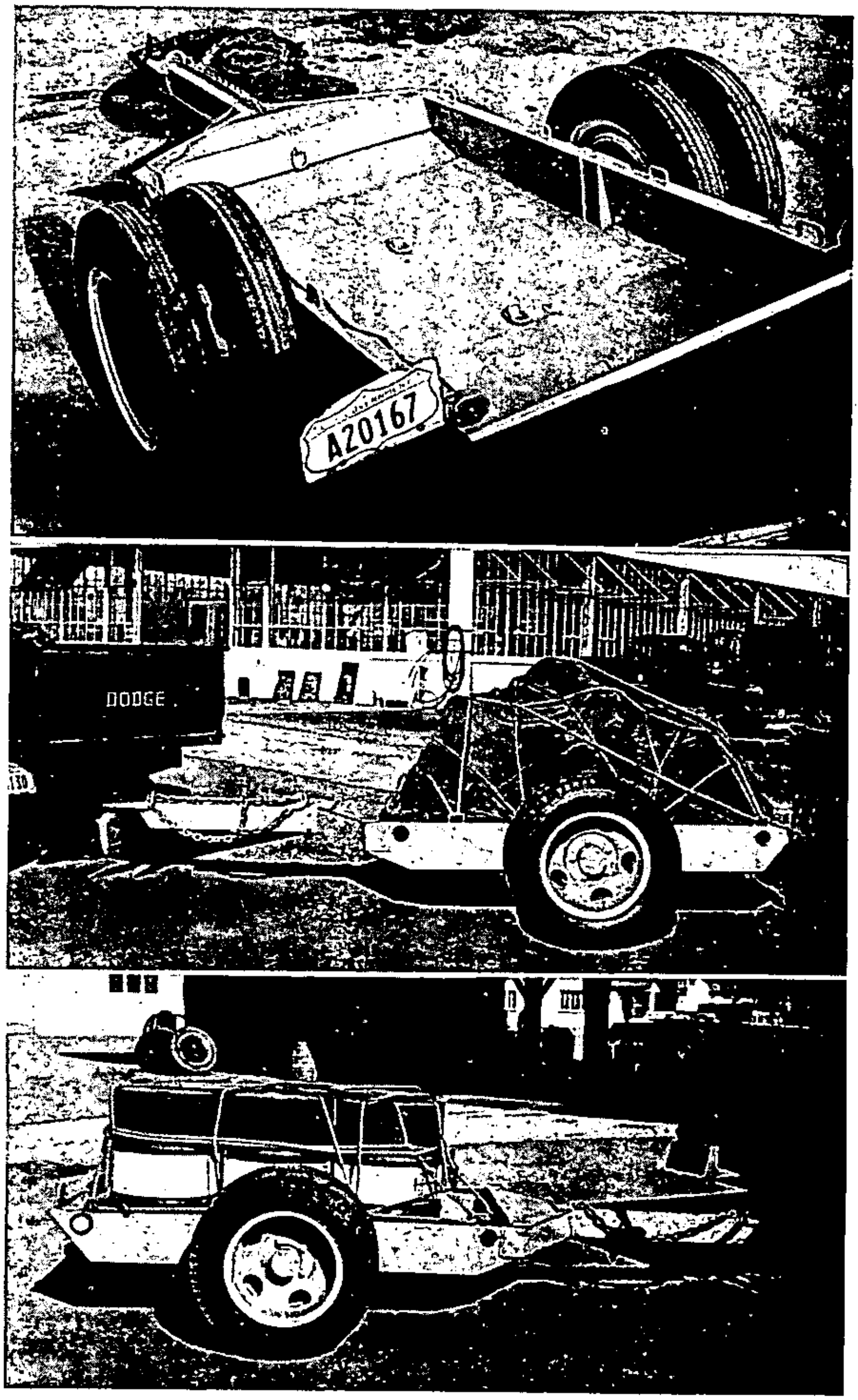

FIGURE 1.—Tractor-drawn utility trailer: Empty, with general cargo, and with load of fuel (barrels may also be carried on their sides).

Load tests and operation under actual fire line conditions at several large fires during the 1947 season have demonstrated that this trailer will follow wherever the pulling tractor can go. Hitched to a D–6, the trailer encountered no difficulty regardless of whether the wheels were mired and it was sledding along or whether it was being dragged over rocks, stumps, logs, or ditches with one or both wheels off the ground.

License plate and tail light bracket has been made detachable so that it can be removed when the trailer is operating in brush or under conditions where the bracket might be broken. The angle formed by reinforcements of the tongue has been boxed in and a hinged cover installed. This provides a storage space for tire tools, jack, lashing chains, rope, etc. Sufficient tie-downs are provided to allow for securing any type of cargo that might be put on the trailer (fig. 1).

Since the unit is primarily tractor drawn, no brakes have been installed. The tractor conforms, however, to all California State High way Vehicle Code requirements. For road work the unit has been towed behind a 1½-ton truck, but because it has no trailer brakes the use of a larger towing truck is recommended when the trailer is loaded.

Plans have been prepared, although construction has not been completed, for a slip-on convoy luber and fuel unit to fit this trailer. This luber will consist of a gas-engine-driven compressor and tank, two pressure lubrication pots, one drum of water, and four drums of fuel.

SLIP-ON PUMPER TANKER

A 400-gallon coffin-type tank is used for the skid-mounted slip-on pumper tanker (fig. 2). Tanks for such units are painted aluminum, since they are often used for hauling and storing drinking water, and it is desired that the water be kept as cool as possible if the tanks are exposed to direct rays of the sun. The hose basket on top of the tank will accommodate 1,000 feet of 1½-inch single cotton-jacket rubber-lined hose and 16 feet of 1½-inch suction hose. The tank suction pipe terminates at the suction manifold at the right center of the tank front. A 5-gallon pack-type gasoline tank is mounted to the left of the suction manifold and on top of the accessory box. The portable-type pumper unit mounts on a universal bracket to the left of the gasoline tank. Suction side of the pumper connects to the suction manifold through a short length of 1½-inch rubber hose. A relief valve is mounted on the discharge side of the pumper and its relief port discharge is returned through the ½-inch rubber hose to the tank "return" connection at top center of tank.

With the 1½-inch gate valve on the suction manifold closed and suction hose connected to manifold, water can be drafted from overboard direct to fire or to tank. With cap on the suction manifold and the 1½-inch gate valve open, water can be pumped from the tank to fire.

The back-pack gasoline tank is fitted with a ¼-inch shut-off cock near the bottom and is connected to the carburetor intake through a short length of airplane-type gasoline hose. This tank is mounted at sufficient height to insure gravity feed of fuel to the pumper unit.

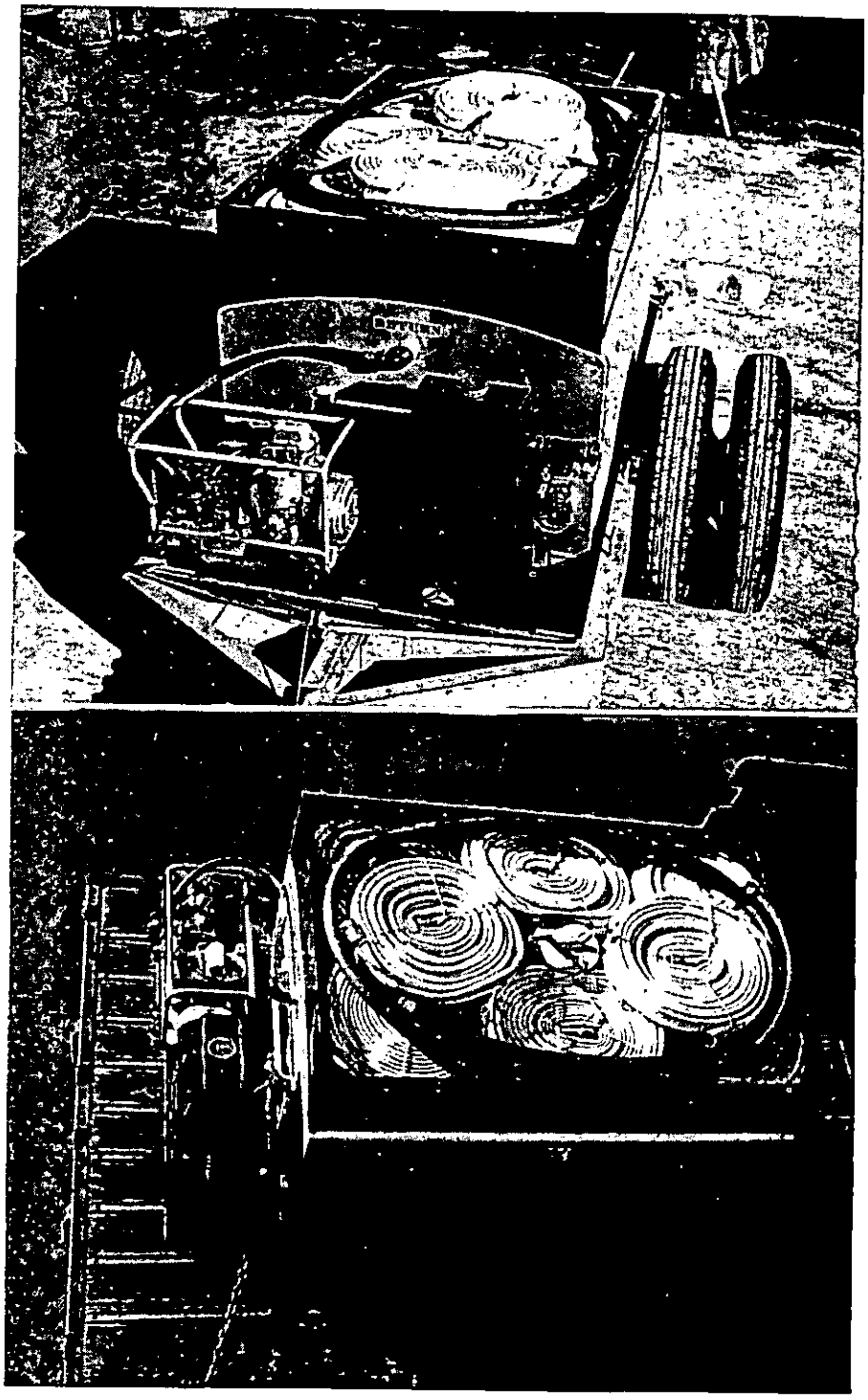

FIGURE 2.—Slip-on pumper tanker: Upper, mounted on a utility trailer; lower, mounted on 1½-ton stakeside truck.

The accessory box under the tank is used for the storage of repair tools, grease gun, nozzles, adapters, spanner wrench, etc., that are needed to make up a self-contained fire-fighting unit.

The bracket on which the pump is set has been designed for the quick mounting of the various portable pumpers in use by Region 5. This feature allows for the quick exchange of pumpers, if necessary, or for the removal of pumper for other uses while the tank is being used to haul water for other tankers.

Plans and detailed construction drawings are available and may be obtained for all of the above-described equipment from the Arcadia Fire Control Equipment Development Center, United States Forest Service, 701 North Santa Anita Avenue, Arcadia, Calif.

Sound Economy on Fire Suppression.—During the past 35 years forest fire suppression has progressed from the day when a forest officer with a few men battled a large fire using a dry yucca stalk for a backfiring torch, often quite successfully, to the present day of fire fighting with the use of all modern equipment, bulldozers, flame throwers, radios, aircraft, rain-making devices, and, yes, 8-hour working days.

I can recall during the early years when we were brought to account and seriously criticized if suppression costs exceeded 50 cents per acre. Today the cost of fire suppression is staggering; it is true, of course, that labor, supplies, etc., all cost much more than 30 years ago.

The disturbing part is that with all the modern conveniences the output per man-hour, particularly where fire suppression requires hand labor, is pitifully small; also the fact that fires are still burning thousands of acres in spite of our many fire-fighting facilities. Numerous circulars, handbooks, and articles have been written covering all phases of fire suppression, job descriptions, individual instructions, organization, logistics, ad infinitum. Each of these seems to have produced more generals and less producers. Regardless of the purchasing power of the dollar, 60 minutes still make an hour. Don't we need to tighten our belts, produce more work and less manuals?

The old idea of 50 cents per acre for suppression was, of course, unsound. Nevertheless, the cost of fire control must be kept to a defensible and businesslike basis and consistent with the values protected. Neither must we be permitted to exaggerate the possibility as to where fires would spread if large expenditures had not been made.

Prompt and efficient initial attack may prevent a holocaust, but result in high cost for the area burned.

No one should question initial attack costs of fires within areas of high flammability, but when a fire escapes from a well organized initial attack force and is running wild is the time to do some careful planning for prompt control and mop-up after the lull which always follows, but no time to get excited and pour dollars into the caldron.

Let's take a realistic and cold-blooded analysis of suppression expenditures, particularly the output per man-hour, followed by an enforced policy of economy consistent with the actual values at stake.

Keep in mind FFF dollars are no different than the hard to get P and M and have to come out of the pockets of the taxpayer.—S. A. Nash-Boulden, *Forester, Region 5, U. S. Forest Service.*

THE COEUR D'ALENE AIR DETECTION PLAN

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While the Coeur d'Alene Detection Plan evolved from the apparent success of aerial activity on the so-called Continental Area,[1] the two projects are actually as diverse as can well be imagined.

In order to appreciate the problems that confronted the planners in developing the Coeur d'Alene project, it seems desirable to briefly compare the two areas from the standpoint of their adaptability to aerial fire-control experimentation.

Continental Area.—Two and one-quarter million acres of roadless area; high, rugged, broken to some extent by barren, rocky ridge tops and open alpine meadows. Fuels in the timbered basins, mostly low to moderate hazard, with scattered pockets in the higher categories. Average fire occurrence, about 40 per season, 97 percent lightning-caused. Activity in the area confined to hunting, fishing, and other forms of recreation.

Coeur d'Alene Forest.—Slightly more than one million acres under protection, with an intensive road system. Area rough and broken, but continuously timbered with no breaks of consequence. Large continuous areas of medium to high fuels, with something over 100,000 acres of extreme artificial hazard in the nature of logging slash and smelter-fume kill. Average fire occurrence, about double that of the Continental Area or, on a per unit-of-area basis, four and one-half times as great, 30 percent being man-caused. Lumbering and mining activities extremely heavy, one or both being present over a large portion of the forest.

The Coeur d'Alene experiment differed from that of the Continental Area in that it was confined to the detection feature alone. Because of easy accessibility, suppression was handled entirely by small crews and station firemen, smoke jumping being considered impractical.

The experiment was conceived, developed, and carried out by the supervisor and his staff, with technical advice and assistance from the regional office. It is planned to continue during 1948.

PLANNING

Full advantage was taken of the knowledge gained in 1945 and 1946 in developing the combined ground and air detection scheme on the Continental Area. The first step was to make a 10-year study of fire occurrence on the Coeur d'Alene Forest, giving separate consideration to lightning and man-caused risk. A special hazard and risk-

[1] Hand, R. L., and Harris, H. K. PRELIMINARY REPORT ON AERIAL DETECTION STUDY. Fire Control Notes 8 (1): 28–32, illus.

zone map was prepared and the process of re-sorting the lookout system was carried out in the usual way by reference to seen area maps. This sorting resulted in the retention of 8 fixed and 3 moving detectors out of a total of 33 that had been in use previously, and the direct coverage was thereby reduced from 69 percent to about 43 percent. However, by careful selection, it was possible to attain approximately 90 percent coverage in the high-hazard fuels and other important areas with the 11 positions in place.

It was decided that two light airplanes would be required to build up the coverage to an acceptable level under the worst probable conditions and that three observers would be necessary to provide for the proper amount of relief during periods of excessive flying. A contract was prepared which resulted in securing a Piper Super Cruiser and a Stinson Voyager, both equipped with radio on the proper frequency and the Voyager also equipped for night flying.

Techniques developed in the Continental Area were employed in perfecting general patrol routes, but it was found that much depended upon the ability of the observer and his ingenuity in seeking out and testing new methods. With the more intensive coverage confined to a smaller, compact area of high occurrence and with high-grade observers employed and used for that purpose alone, it was possible to make considerable progress. An indication of the increasing effectiveness of the air patrol is shown by the record of first discoveries.

From July 1 to August 2, the airplanes discovered only 2 out of 50 fires, or 4 percent. During the remainder of the season, which ended early in September, the air patrol is credited with 20 out of 89 fires, or 22 percent. This improvement is believed to be due not so much to increased flying, but rather to more effective flying.

The season of 1947 on the Coeur d'Alene was not bad from the standpoint of burning conditions, but well above average in intensity of the fire load. Several peak loads of 25 fires each were handled, apparently with no greater difficulty than under the old system, and a post-season analysis of discovery time for the past 10 years, shows an improvement in 1947, so far as average discovery time is concerned. Actually, when considering all groups from 15-minute discoveries to the long-time "hang-overs," there was no significant change, the 1947 record comparing favorably with the average of the 3 highest occurrence years in the past 10.

COSTS

In regular P&M funds there was a direct saving of $4,000 over what would have been spent under the old set-up. It is not quite so easy to make direct comparisons in the FFF cost item, but the total amount expended on the forest was $17,000 less than in 1946. The Coeur d'Alene was the only 1 among the 11 "fire forests" in Region 1 that did not find it necessary to spend FFF to place emergency lookouts despite a similar fire danger rating. Many Coeur d'Alene fires were scouted from the air, and false alarms were investigated, using P&M funds. None of the flying time was charged to FFF, although a good many hours were outside a lookout's regular tour of duty, and no week-end lookouts were financed from FFF. All of this served to hold down FFF charges without using any of the P&M savings.

CONCLUSIONS

We have yet a lot to learn about air detection and it would be presumptuous to make definite conclusions or predictions on the evidence of a single season's operation. However, the following statements, quoted from a preliminary report submitted by Assistant Supervisor Frank Blackmer of the Coeur d'Alene, reflect the concensus of those who watched closely or participated in the experiment:

1. We expected that it would not be easy to get cross shots on fires and that this would handicap smokechasing. Actually, this did not prove as serious as might be expected. This year with fewer lookouts we were able to train them better and they all became quite proficient in locating fires with only one shot. In addition, the plane was often used to help locate hard-to-find fires.

2. The planes cannot be in the air during a lightning storm. This is a handicap, but records show that in the past, only 26 percent of the lightning fires are discovered during the first 15 minutes. Because we had only "key" points manned in 1947, we still got 20 percent and the plane equipped for night flying was able to get into the air at night just as soon as the storm died down. The use of planes at night needs more study. We can find the fires but with present equipment, it is difficult to get an absolutely accurate "fix."

3. We knew finding hang-over fires from a plane would be difficult since they often puff up only intermittently. The record indicates that we did almost exactly as well finding hang-over fires as the 10-year lookout average and we think we can do better. One idea we want to try is a hang-over flight at dawn to try to pick up the smoke just as it starts to rise.

4. Results indicate that a qualified air observer can with practice give a very good fire location. He can also give additional information not available to a lookout that is of help to the smokechaser.

5. In general, communication was not completely satisfactory. All too often, there was a great deal of static and the observer had to spend time and energy "fighting" his radio which handicapped his detection effort. Very high frequency radio would probably be the answer. (Region 1 plans an FM net on the Coeur d'Alene as soon as possible.)

In conclusion, here are a few facts that seem to stand out clearly. First, in air detection we are dealing with something for which the future holds great promise. Ground detection techniques are well established with relatively little prospect of startling new developments. In air detection we have most of the "bugs" yet to work out. Second, the flexibility of air detection is particularly adaptable to the unstable and fluctuating pattern of the fire seasons, allowing opportunity for considerable savings if properly applied. Third, no direct comparison between air and ground detection is necessary or even possible at the present time; it is a matter of proper balance between the two services.

FIREFOG UNIT

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Men who have had experience with grass fires know that it takes a relatively small amount of moisture to control or extinguish them. In the extensive cheatgrass areas of the West, fires frequently slow up or go out entirely in the late afternoon or early evening due to the moisture picked up from the air. However, fires in cheatgrass type are exceedingly fast spreading and it is not uncommon for them to burn 20,000 acres or more in an afternoon. And while the fuel is light, the momentum built up by such fires often sweeps them across plowed lines and even wide highways.

In South Dakota last fall, prairie fires swept over 380,000 acres of farm lands in 2 days, with losses in excess of 2 million dollars. Hastily plowed lines failed to stop the spread. It was necessary for fire crews to drop back to roads and backfire, and even this technique failed to work in many cases. Backfiring, under such conditions, is a science. It must be quickly and completely done; otherwise the backfire is apt to outflank the firing crew.

Since 1946 the Snoqualmie National Forest has been experimenting with a combination fire and fog unit attached to a tank truck, as a means of backfiring rapidly in grass types and holding the backfire with a fogged line. To date, four models have been constructed and three of them have been tested. The first two units were makeshift, but performed sufficiently well to justify further experimentation. In 1947, All-Service funds were allocated for this development, and the third model was constructed. At that time, we were still thinking of confining the idea to the control of grass fires.

This unit consisted of an angle iron A-frame, resting on a 10-inch rubber-tired caster and attached to the rear of a tank truck. A reversible fog-burner plate was carried in a slot in the center of the A-frame. On one side of this plate, liquid gas burners set the backfire, while on the other side, a single 1-inch low-pressure, low-velocity fog nozzle controlled the line.

In field tests conducted in September, we were able to fire and hold a line in cheatgrass at 8 miles per hour (fig. 1). Burning conditions were very unfavorable, with relative humidity 41 percent and wind 13 miles per hour. Previous short tests had shown that the better the burning conditions, the better the unit worked.

Further tests were made a week later on the Fremont National Forest in a sagebrush area which had been so heavily grazed that little grass remained. The line held on the windward side and to some extent on the flanks, but failed to hold on the lea side. It was reported that, because of the low position of the fog, the fire crossed the line through the tops of the sagebrush in some instances. Grazing men felt, however, that a unit of this kind might be used to handle fires in the lower sagebrush types.

FIGURE 1.—Control line in cheatgrass type, constructed in the September 1947 test.

In these tests, it was obvious that many improvements in the design and construction of the unit could be made. It was, therefore, decided to assign the old unit to an east-side forest and to construct a new one for further experiments in 1948.

The new unit (fig. 2) incorporates the basic ideas of the earlier models, and, in addition, the idea of using Diesel oil in combination with liquid gas. The various parts are as follows.

The carrier arm consists of four 1-inch square pieces of steel tubing, 6 feet long and welded together. It is attached to the rear of a tank truck, at the outside edge, by means of a bracket. This bracket allows the arm to move up and down but not sideways. The arm is held in a horizontal position by a chain attached to the truck. The four steel tubes also serve another purpose: To carry, respectively, the water, gas, oil, and ignition lines.

The burner assembly consists of a plate, locked between the tubes, on which are mounted three liquid gas burners. Each burner can be independently locked, by means of a hand screw, at any desirable angle. Each burner has its own shut-off valve and its own spark plug for ignition. The middle burner is also provided with an oil

jet, which has a number of adjustments from a long throw of 10 feet or more to a short, bushy, but terrifically hot flame. By properly adjusting the gas and oil, it is possible to leave a trail of burning oil on the fuel close to or several feet out from the fogged line.

The water bar is a 4-foot length of square tubing, the short end of which is counterbalanced with lead. This is to equalize thrust against the ball-bearing swivel coupling. The bar can be mounted either above or below the carrier arm, and also adjusted for angle. Three adjustable joints are spaced on the bar to receive the ¼-inch spray or fog tips of whatever design and water capacity is desired.

The control panel is an aluminum box containing the gas-control valve, oil-control valve, water shut-off, water strainer, and batteries, coils, and mechanism for lighting the burners. All control is in this panel. All fittings are of the quick-coupling type.

Gas and oil tanks are standard propane or "burner gas" tanks. One gas line runs through the control panel to the carrier arm. Another gas line runs to the oil tank. This line pressurizes the oil at about 100 pounds and forces it through the control panel to its tube on the carrier arm.

Fog and spray noozles of different types are on hand. These vary from free-floating fog to the driving type of jet noozles. Gallons-per-minute water consumption varies from 1.7 for the T-jet to 8 for the square spray.

Since this is still a test unit, all possible adjustments were provided so that tests could be made in different fuel types. Provisions have

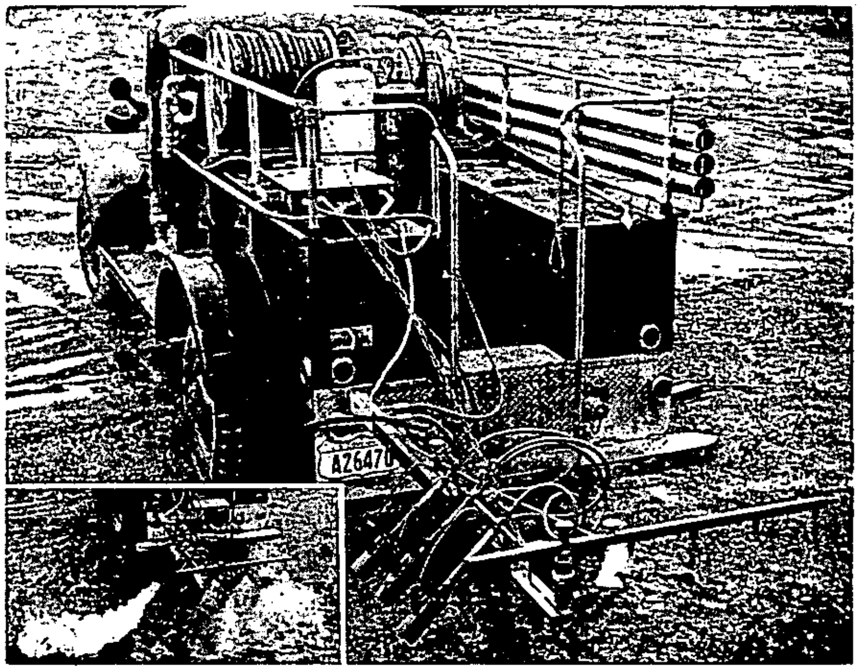


FIGURE 2.—The latest firefog unit mounted on a 1-ton 4 by 4 tank truck. Insert: Firefog unit with oil burner partly turned on and fog tips delivering 2.9 gallons per minute each at 150 pounds per square inch.

been made for using up to six spray tips if necessary. Width of fogged or sprayed line can be varied from 1 to 8 feet, water use from 2 to 22 gallons per minute.

It was found in the tests last fall that free-floating fog is dissipated considerably by the wind. The driving type of jets now on hand will overcome this difficulty. The addition of oil to the middle burner will easily handle the hard-to-ignite fuels. It was also found that the crushing effect of a dual-tired truck on the fuel was of some aid in constructing a line from which to backfire. For this reason, the carrier arm is mounted at the edge of the truck. An extra bracket is provided so that the arm can be moved to the other side of the truck, the burner assembly reversed, and firing done on that side. However, this may not always be necessary, as the burners can be adjusted so that they will shoot under the carrier arm and the water bar can be swung around to the opposite side in a minute.

It is obvious that the firefog unit will have the greatest operability if used on 4 by 4 tank trucks—possibly it can be used in areas with slopes up to 30 percent.

While intended primarily for fire suppression, the unit can also be used to burn out strips along roads, highways, and railroad rights-of-way as a fire-prevention measure.

Extensive field tests of the new unit are planned for next fall. This should furnish information as to just what an all-round unit should be, so that the design can be simplified as much as possible and a detailed specification can be written.

Report on a Wetting Agent: Drench.—We used "Drench" on the Dark River Fire (Mesaba No. 8) on October 19, 1947. The fire truck carried one ½-pint bottle of Drench for each back-pack pump. The chemical was poured into the 5 gallons of water in each pump can before packing the can to the fire.

Used with the spray nozzle, the first stroke pumped out a milky, frothy spray. The burning fuel was part swamp grass and part highland grass, dead—a hot fire. Each shot with the solution, however, immediately and completely put out a sizable spot of fire. It was fast and effective, and we are well pleased with the results of this trial on an actual fire.

We now carry ½-pint bottles with our pick-up units. The pumper pick-up has an additional ½-gallon jug of the solution ready to dump into the tank. We will report further on this commercial wetting agent as we have occasion to use it.—Louis Tauch, *District Ranger, Superior National Forest, Minn.*

MODIFYING THE ARMY INSECT SPRAYER (MODEL 3264) FOR USE AS SLIP-ON PUMPER TANKER ON ½-TON PICKUPS

Stanley R. Stevenson

Fire Control Staff Officer, Cleveland National Forest, California

To aid in meeting an increasing demand by field personnel for one- and two-man slip-on pumper units and temporarily replace pumpers worn out during the war years, the California Region of the United States Forest Service secured 83 Army insect sprayers (model 3264). They were purchased from the War Assets Administration in the spring of 1947 and used unaltered as slip-on pumpers on pickup trucks with reasonable success during the 1947 fire season.

The sprayer units consisted of a small, 2-cylinder plunger-type pump, powered by a V-belt drive from a 2-horsepower, 4-cycle, 1-cylinder, air-cooled engine. The pump and engine were mounted on a 50-gallon steel tank which, in turn, was mounted on wooden skids (fig. 1).

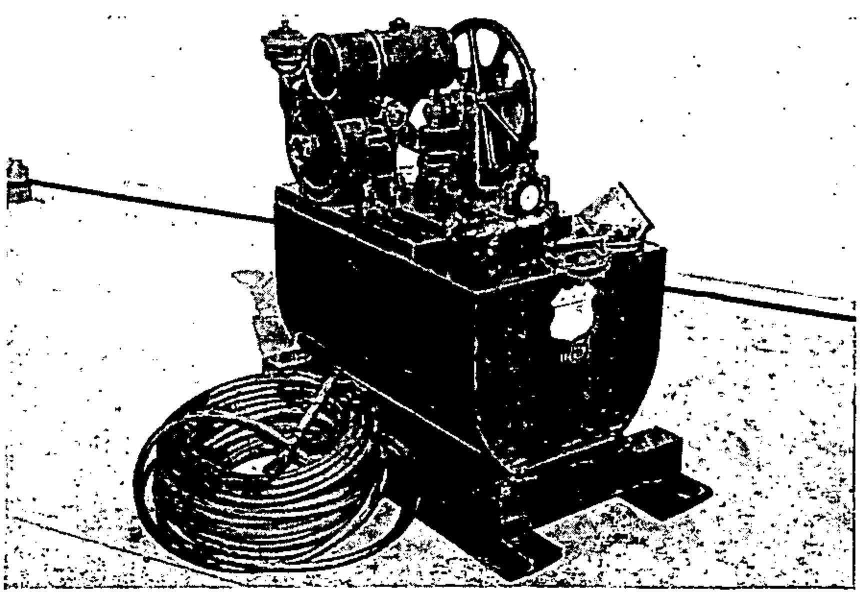


FIGURE 1.—Army insect sprayer (model 3264) before modification.

The units are capable of delivering 3 gallons per minute and operating up to 300 pounds per square inch discharge pressure. Accessories included 150 feet of ⅜-inch oil-proof rubber hose, spray nozzle, instruction books, and necessary spare parts.

As a result of field use during the 1947 fire season several improvements were suggested. A pilot model was constructed and standard

alteration plans prepared by the United States Forest Service Fire Control Equipment Development Center at Arcadia, Calif. These plans incorporated field suggestions and utilized the original parts and materials as much as possible (fig. 2).

The following alterations and additions were made in the order listed:

1. Replaced skids with 4- by 4-inch timbers long enough to allow in-line mounting of tanks and engine-pump units.

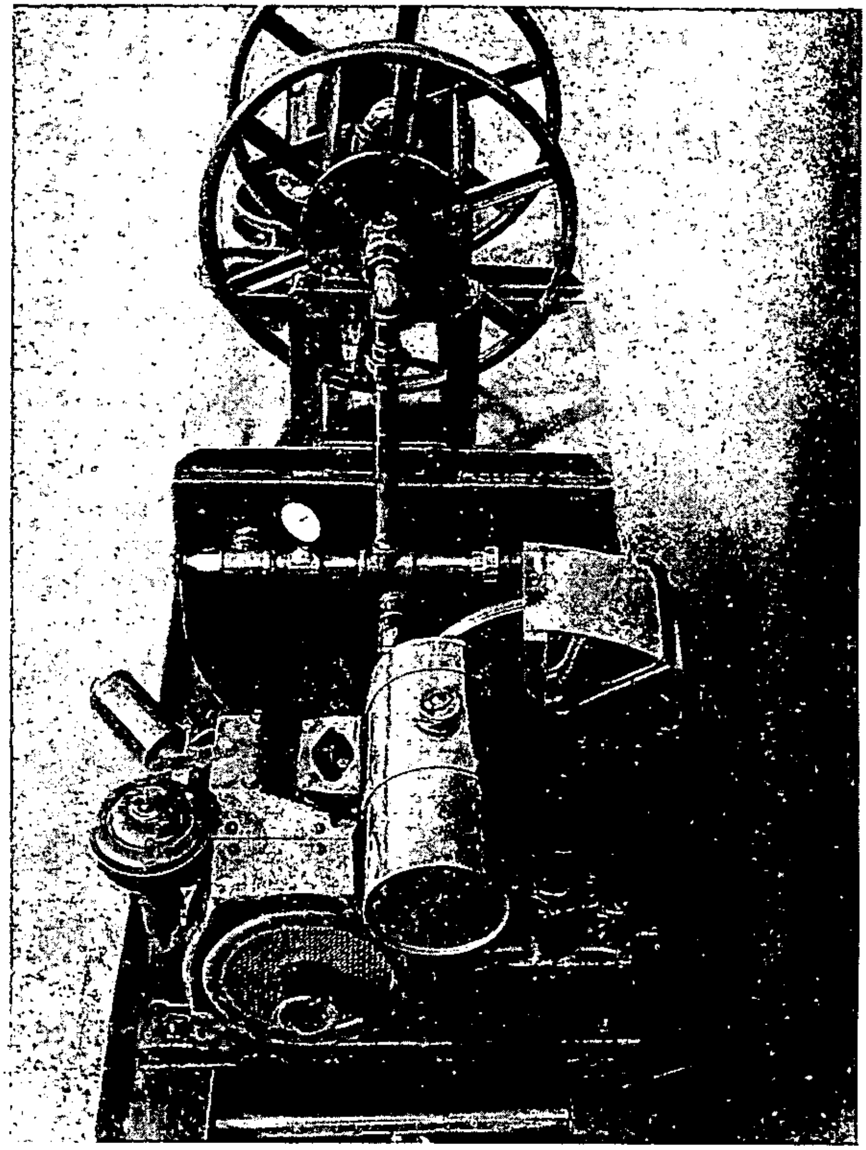


FIGURE 2.—Converted Army sprayer with engine and pump mounted in line and the live hose reel added.

2. Removed and discarded the agitator, shaft and suction strainer from the inside of the tank.
3. Installed new drain in the end of the tank.
4. Welded up all original holes in the tank, except the filler cap.
5. Welded new suction and return outlets into the end of the tank.
6. Added a clamp for fastening filler cap securely.
7. Attached a live reel capable of holding 200 feet of ⅜-inch high-pressure hose to the top of the tank.
8. Repiped the pump to the new tank outlets using as many of original fittings as possible.
9. Installed a safety guard over pump pulley.
10. Painted the entire unit except for the engine cooling fins.

The adaptations greatly improved the units by lowering the center of gravity, by making live reel operation possible, and by sealing several openings in the tank to prevent loss of water on rough roads.

The output of the pump was not affected by the alterations. Since the pumps were designed primarily for pumping Diesel oil and spray chemicals, they may not last more than 2 or 3 years in water-pumping service. However, since the cost of the entire unit was less than the normal price of the engine alone, suitable water pumps will be economically justified when and if it becomes necessary to replace the original pumps. Care in draining original pump after use and properly lubricating valves, piston, etc., will greatly aid in prolonging the life of the unit.

The adapted sprayer mounted on a pickup truck (fig. 3) is well suited for patrolmen or two-man crews covering light, flammable cover areas. One man can successfully handle the small ⅜-inch hose unaided and is assured of at least 15 minutes of continuous water application

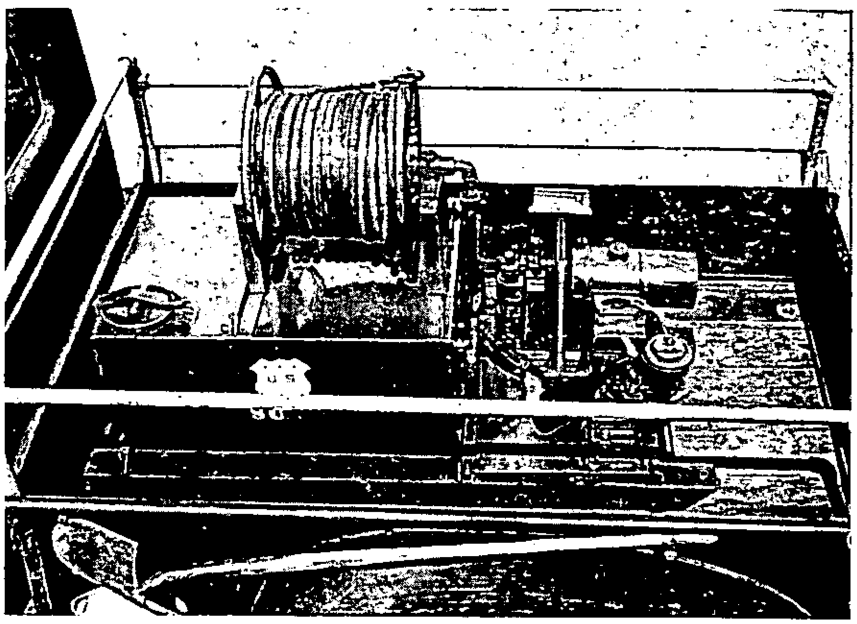


FIGURE 3.—Converted Army sprayer in a ½-ton pickup truck.

at maximum pressure and volume. The pumpers have been effective in suppressing fires in grass and light brush where fog and light sprays can be used successfully. The adjustable nozzle offers a limited selection of straight stream, spray, or fog application.

The Army sprayers were purchased new for $75 each. For each unit the conversion work, which is being done by local Forest Service equipment service branch shops, will cost approximately $55 for labor and $35 for parts and materials. The parts include $28 for the live reel. The total cost of each converted unit will be approximately $165.

Fire control agencies interested in the detailed drawings of the alterations can secure copies by writing to Arcadia Fire Control Equipment Development Center, 701 North Santa Anita Avenue, Arcadia, Calif.

Headlamp Modifications Required for Use of Metal Clad Batteries.—The use of metal clad flashlight batteries such as Ray-O-Vac has produced a material saving in our funds, because they have a much longer shelf life than the regular type battery.

Ray-O-Vac batteries will work satisfactorily in the new type 4-cell headlamps (F. S. Specification 178 Revised February 1947). Until the old 3-cell type flashlights are replaced by the new 4-cell type, a simple modification in them is necessary. The cup which contains the spare light globe in the base of the 3-cell battery case is too large in diameter to make a proper ground with the bottom of the Ray-O-Vac battery. This can be remedied in two ways. We recommend the second as the more satisfactory method.

1. A metal strip bent slightly convex is inserted at the base of the battery. This metal clip can be made of band iron 1¾ inches long by ½ inch wide. This will give the necessary contact, but the metal strip is easily lost in changing batteries.

2. Remove metal cup containing spare light globe from base spring by cutting rivet with side-cutting pliers; remove spring from screw cap; place cup containing spare globe (globe side up) in screw cap; stretch spring about one-half inch and replace in screw cap over cup containing spare globe. Cup containing globe will rattle, unless soldered or riveted in place, but will not fall out unless spring is badly twisted out of shape. Soldering of cup in place is not recommended. Spring will now give satisfactory contact with all batteries, including Ray-O-Vac.—IRA C. FUNK, *Mechanical Engineer, Equipment Development Center, Region 5, U. S. Forest Service.*

MISUSE OF THE FIRE DANGER METER

Arnold A. Buettner

Forest Ranger, Wisconsin Conservation Department, Antigo, Wis.

The Lake States Burning Index Meter, or "fire danger meter" as it is commonly called, is extensively used throughout the forest protection districts and probably is almost as much misused.

The meter, or burning index as it should rightfully be called, was prepared as a result of many experiments with every conceivable fuel type, temperature, air and fuel moisture condition, long and short periods of dryness, and large and small amounts of precipitation. As a result, it gives an accurate burning index on the factors mentioned.

Since the research work I have done on the precipitation and time factors produced nothing substantial to discredit the burning meter index, an explanation of the emphasis actually placed on these factors in its construction may clear up the skepticism of some of us toward it.

Numerous experiments showed that fuel moisture and air moisture, or absolute humidity, reach an equilibrium about 3 days after a rain. After that, the moisture in the air is the controlling factor for critical fuels. This fact was carefully incorporated in the burning index.

Some of us might not agree with this since the burning index places an increasing value on each day from the time of the last precipitation. This value is small with low hazard but increases daily with a larger rate with higher hazard. The reason for this is that "safe" is 0 to 1 percent while "extreme" is 50 to 100 percent. Therefore, an increase of 5 percent with "extreme" indicated conditions is, in reality, much smaller than 1 percent in "safe" or "very low" indicated conditions.

Most of us can remember the time when the duff hygrometer was considered to be the meter to measure hazard. It was found, however, that a dozen different readings could be obtained in the same number of tests made in close proximity. It, therefore, lost its popularity. Although the burning index or danger meter takes into account a number of factors, it can also be as unsatisfactory. This is particularly true during the shower months of July and August. A shower of considerable amount of precipitation and local in extent may occur at district headquarters and change the burning index to safe, while most of the district actually has a high burning index. In other words, it would be similar to sticking a duff hygrometer in a mud puddle; the reading would be as accurate. Of course, judgment enters into the picture and fire control measures are then based on judgment and the burning index is disregarded.

All these years we have been taking weather observations and computing the burning index for Weather Bureau purposes only, generally speaking. The burning index was correct for the headquarters and immediate vicinity but I doubt whether it gave the average burning

index or fire danger for the district more than 30 percent of the time. It would be correct only during the spring (June) and fall (September) seasons of general rains of considerable amounts at which time an accurate reading would not be too important. It can, therefore, be concluded that the misuse of the burning index is the reason for unsatisfactory results rather than the meter itself.

Since air masses are homogeneous in character over a large area, it can be assumed that the moisture content of the air (absolute humidity) would be the same. It would, therefore, be possible to compute the burning index for a whole district, or the whole State in fact, from a single observation station. The observation would apply to the whole State as far as humidity, wind velocity, and, in most cases, stage of vegetation are concerned. Now if we took the average of the "amount of last rain" from the various rain gages throughout the district and the "days since rain" on the same basis, the burning index would be accurate over more area than the area covered by the district headquarters.

A good example of how erroneous the district headquarters burning index can be occurred in district four in August 1947. The last rain that was general fell on August 2, 1947, and ranged from 0.01 to 0.19 inch. On August 6, 1947, 0.07 inch occurred at Antigo, the district headquarters, and covered about 3 square miles in extent. On August 13, another 0.10 inch occurred at Antigo and lesser amounts at a few other points. A thorough check on this rain by rangers examining old fires in various parts of the district and by towermen reporting at towers, plus a careful check of cloud and shower movements, indicated that about 20 square miles of the 1,632 square miles of the district were covered. The district headquarters burning index, therefore, applied to less than 2 percent of the area. If the average were taken of the lowest precipitation that occurred at three of the five substations in the district, the burning index would have applied to 98 percent of the district and would also have indicated the worst possible burning conditions. The tower manning schedule and number of stand-bys per station would have been correct and personal judgment would not have entered into the picture.

This example illustrates the erroneous use of the headquarters burning index from August 2 until August 19, 1947, when the entire district received over a half inch of precipitation and the headquarters burning index again applied to the entire area.

We have been discussing burning index. However, before outlining my recommendations for computing fire danger, I would like to consider risk and fuel in relation to fire danger.

Risk, i. e., the causes of fires, in Wisconsin is 98 percent human element and 2 percent nature. We can break the human element down into the main responsibility classes: farmers or settlers, fishermen, berry pickers, and hunters. Each should have a positive value to be considered with the burning index. For example, in the spring shortly after the snow is gone, there are hundreds of farmers burning debris, a potential source of hundreds of forest fires. For the same burning index the danger is greater then than it would be with very few farmers burning. The factor could be determined by the number of burning permits issued, for example, 100 to 199, factor 1; 200 to 299, factor 2; etc. The dispatcher at the district office could determine

the factor by the number of active permits on file. Fishermen could be treated similarly with the highest value or factor assigned to the opening day of trout season, the factor decreasing until the season's end. Berry pickers could be handled in the same manner as the various berries ripen. Similar factors could be given hunters during the hunting seasons.

However, it may be very difficult to place any values on fuel since they vary by districts, by type, arrangement, and amount.

The United States Forest Service, in its booklet Representative Fuel Types, has given us 38 fuel types arranged in 15 groups on the basis of rate of spread and resistance to control for spring and summer conditions, based on class 5 day. J. A. Mitchell, of the Lake States Forest Experiment Station, has recently completed a statement and tables dealing with rate of spread in fuel types with varying wind velocity and burning index. Consideration is also being given to reclassifying and reducing the number of fuel types. When this is completed, it will materially aid placing a danger factor on fuel.

At present throughout forest protection districts, an attempt is being made to prepare hazard maps from information gathered during inspections in the enforcement of the slash law. If a standard classification of fuel types were adopted, and used throughout all districts, a fuel factor could be determined for each district on the basis of percentages of the district under each fuel type and values placed on each type. The fuel factor could be also determined for subdistricts or even areas within visibility range of a tower.

Briefly, fire danger then would be based on all three factors necessary for starting a fire, namely, burning index; risk or human element, the spark or kindling agency; and fuels.

This method would strengthen the fire danger determining system by incorporating more factors. It would tend to eliminate chance since it weighs all factors, automatically increasing the hazard rating when a high fire starting potential exists and likewise reducing the hazard rating when there is very little burning being done and few people are in the woods. It will also increase the hazard rating in districts or areas with critical fuel types, and reduce it in others, definitely defining boundaries of areas on questionable days when part of the towers are to be manned and where ground crews can work.

Let us examine the method. For example we assume the burning index is 2 percent, which is a questionable point whether to man towers or not. There are over 300 active burning permits out, so let us say the risk factor is 3 percent. The district fuel factor we will say is 2 percent, making a total of 7 percent, indicating that the towers should be manned, and also indicating a stand-by of 2 men per station since fuel types are involved.

In another example the burning index is, let us say, 4 percent. There are very few farmers burning and no hunters, fishermen, or berry pickers, so the risk factor is zero. The time is late summer when fuel types are still green or dead fuels are mixed with green undergrowth. The fuel factor would be low, let us say 1 percent, making a total of 5 percent.

The second example has a higher burning index, but the other factors indicate a lower danger. Probably by using the three factors for determining danger, the maximum safe period could be placed at 6

percent. It would still mean that towers would be manned in the spring when the burning index factor is 2 or 3 percent but the other factors are high. Our present suppression system would be affected in that we would further strengthen our force when necessary and reduce to a greater extent when all factors indicate such a step to be safe.

Two recommendations are submitted for determining the burning index and fire danger.

1. Burning index for the district should be determined by using the lowest average district precipitation rather than headquarters reading. The precipitation totals from the substations and from any additional permanent gages where an accurate reading can be obtained daily should be classified in groups, 0.01 to 0.19, 0.20 to 0.49, 0.50 inch and up. Whatever group represents the largest part of the district should be used. For instance, four gages read 0.14, 0.24, 0.28, and 0.59 inch. Two readings fall in the 0.20- to 0.49-inch group, and, therefore, this group would be the one used in determining district burning index. The substation falling in the group lower than the one used would have to be considered separately. The present method should be used only for Weather Bureau reports, while the district burning index can be given on dispatcher's record and all forest protection reports. This will not increase the dispatcher's work load since the precipitation is called in daily from all substations. The weather pad is provided with extra columns in which district burning index can be recorded.

2. Fire danger should be calculated from the three factors, burning index, risk, and fuel, instead of from burning index alone. This should be done as soon as values can be placed on risk and fuel.

The risk factor can be determined by assigning positive values for farmers, based on the number of active burning permits; for hunters and fishermen, by seasons; for berry pickers, based on abundance of berries and when they ripen; and possibly for section crews during periods when they are doing right-of-way burning. The risk factor would then be the total of values for the responsibility classes applicable at the time plus a value for the class of day. The reason the class of day is taken into consideration is that the fire starting potential increases with an increase in the burning index.

The fuel factor may require considerable work. The fuel type classification needs to be standardized and hazard or fuel type maps completed for the district. When values are given fuel types, the fuel factor then would be fuel type value (based on rapidity of spread and resistance to control, at present for class 5 day) plus wind value (based on Beaufort or similar scale) plus class of day. If present fuel types were used, the class of day value would be a minus quantity for classes 1 through 4, a zero quantity for class 5, and a plus quantity for classes 6 and 7.

The recommendations and methods given are merely a different approach to rating fire danger. Some of the points outlined may have some value while others may be replaced by something much better. Nevertheless, if the material herein presented is of enough interest to arouse thought or discussion among the readers, something substantial in improved methods will surely follow, and the work already done by many will be incorporated in the results.

FOREST SMOKECHASER—A REGION 4 FIRE FILM

J. W. Mattsson

Forester, Fire Control, Region 4, U. S. Forest Service

Forest Smokechaser, Region 4's new 25-minute color fire film was released in November. This training film sets something of a record in fast and economical production. Field work began in September and took about 2½ weeks; cutting, final narration, and work print work were completed in October; processing at the Calvin Co. was done the first week of November. The over-all cost for producing this film, including processing, a master print, and contributed time is around $2,200. Prints are available to any interested region or other agency through the Chief's office and the Calvin Co., Kansas City, Mo.

This training film shows a forest smokechaser in action. The story stresses the work necessary to control a small hot fire and follows a smokechaser-lookout from the time of sighting a timber smoke until he finally suppresses the fire. The film is full of sound fundamental training practices in suppression tactics, including scouting, hotspotting, line building, and mop-up.

The actor, John W. Parker, Forester in the Division of Fire Control, Region 4, has been chasing smokes for 15 years. Parker, together with Director Horace E. Hedges, regional safety and training officer, and the writer who did the camera work, made up the production team. All three have had a good background of actual experience in fire suppression and with the knowledge gained from producing two other films in the preceding 2 years were in a pretty good position to turn out a worth while fire training film. The locale of the new film is the ponderosa pine belt in southern Idaho, country with fuel types typical of much of the western regions.

For those that have a desire to develop some training films but have hesitated because of high production costs and other problems, we want to take this opportunity in Fire Control Notes to point out some of the production problems and difficulties we encountered. We are highly optimistic in Region 4 that good films can be made without Hollywood budgets or professional actors, cameramen, or producers. It does, however, take a lot of enthusiasm and backing.

The following are points picked up in producing three films in Region 4 the last 3 years. No attempt has been made to go into technical production problems.

Administrative enthusiasm.—The basic requirement is to have the interest and enthusiasm of the Boss backed up by willingness to earmark dollars, time, and effort, with emphasis on the last two. Sure, delegation of authority is a necessity, but just as necessary is a central

spark plug who will drive right down the course until the final cutting is done—someone who will follow through from the original idea and keep a close watch on developments right up to the final processing.

Adequate advance preparation.—This includes finding out what is wanted—reducing discussion generalities to specific practical production plans; getting departmental and interdivisional deadlocks out of the way before field work begins, and slugging a clear path for production. A fundamental prerequisite is the formulation of a story or a theme, some human interest central theme that preaches what you are trying to get across. This forms the basis for the rough shooting and narrative script. This working script should tell the story in logical sequence, and if it does you are bound to tell the same story in pictures.

Equipment, films, and facilities.—The minimum equipment required for an outdoor film is as follows:

Professional 16-mm. camera.
Dependable light meter.
Sturdy tripod and T.
One-inch lens.
Two-inch lens.
Wide angle lens.
Small slate and chalk or number board.
Reflectors (exterior), homemade tinfoil frames, costing about $2.

If some inside shooting is planned, you would have to add floodlights, cable, and spots to the list. We have found it pays to hold inside shooting to a minimum; it is costly and time consuming, especially if any animation or complicated graphs or charts are included.

Plan to buy enough film at one time so the emulsion number is the same. This will aid in getting uniformity in color. You will need about three times as much film as you contemplate for the length of the finished picture, that is, a 1,000-foot film would generally require that you expose between 2,500 and 3,000 feet of film. A standard practice of 16-mm. professional producers is to shoot each scene twice; the first exposure set from a normal meter reading and the other at ½ stop light, opening up and getting a lighter scene.

One thing we learned the hard way—be sure and shoot each scene plenty long—and get extra footage on each end even though you later cut a lot of it out. You never know when this extra footage will be needed for titles, flashes, to catch all action, or to fit in with desired narration.

Practice action.—The best hours for photography are from about 10 a. m. to 4 p. m., but avoid high noon. At this time the lack of shadows seems to give a flat effect and the exposure is unnatural, especially for close-ups of people. This does not mean your working hours are limited to between 10 a. m. and 4 p. m. Before and after these hours you can get in your best licks practicing and going over actions, getting ready to shoot, and working out the next day's shooting schedules.

Tell your story in the photography.—Make your pictures carry the story, don't depend on the narration to do it. When shooting single action scenes consider all supporting action for them. Get the scenes full of primary and secondary action. this rids them of choppy sequences and helps develop the story. Don't shoot every scene from the same angle. Use close-ups, medium shots and long shots, high angles, low angles, and so on. These are mechanical aids in telling

your story. The long shots orient the audience; medium shots center attention on a definite subject first seen in a long shot; close-ups focus specific attention and magnify the impression, thus enhancing the teaching value.

Opportunity shots.—Don't depend on opportunity shots in outlining the shooting script but take advantage of those that will continually show up while you are in the field. Many times you can slip them in for a really good dramatic effect. You are not hidebound by the original shooting script. It is only your working guide.

Choice of actors.—Professional actors are not the best for our type of films. Individuals familiar with the subject and whose physical actions are easy and sure can do a good job under a little good direction. For example, someone who has a lot of practical experience in the use of a Pulaski, saw, or ax, can demonstrate the cutting down of a snag much more realistically than could someone who, although more photogenic, does not have the know-how that comes only with a lot of doing.

Choice of equipment.—Use up-to-date equipment and the latest approved techniques. Don't compromise, for example, on an "old 35" if a new RD-6 is what you want.

Choice of site.—We found that the time taken to pick a suitable site really pays. In this new film, for example, the 2 days required to find a suitable site made it possible to get all the desired shots within a small area, thus cutting down on travel time and other preparation. If your film is to be a fire picture try to avoid the use of oil or other substances to "soup" up the fires. "Souped" fires never look right. Experienced fire men know how normal smokes look. This is another factor that can be avoided by careful selection of a site and timing production to get good burning conditions.

Weather Bureau forecasts.—Good photography requires plenty of sunlight, absence of haze, especially on long shots, and clear days. We depended a lot on our direct contact with the Boise Weather Bureau for forecasts while we were filming this new picture. Luckily we could talk with them by phone over a Forest Service line. Their forecasts materially aided in planning the field shooting and served as a reliable economy measure in hiring additional help.

Animation.—If you have to have animation, hold it to a minimum and plan it carefully to avoid costly reshooting. It's difficult and expensive.

Extra help.—You will usually need some laborers for the rough work. They can speed up production a lot by relieving the production team of setting fires, putting them out after shooting, moving equipment, preparing safe fire lines, and so on. The number, of course, depends on the type of film you are producing. Hold them to a minimum because here again is a cost item that can be controlled.

Technical assistance.—While preparing original working script and doing field work, the production team, especially if it is not conversant with the subject, will find technical advisors sometimes help a lot.

Work print.—By all means, get a black and white work print even though your original may be in color. You can do almost anything with it and won't have to worry about scratches, lost film, breakage, etc. *Guard that original.* All your subsequent prints depend upon

it. Careless and unnecessary handling of originals will plague you for the life of the film. Don't run it through the "flicker" or projector if you can avoid it. If necessary to project the original once, be sure the projector is extra clean and loosen up the film gate to ease the tension on the film.

Editing.—Here again we found out how to do it the hard way through trial and error. We estimate it took us about one-fifth the time on the last film for this part of the process as for the first one. This was due to a lot of practical little things that we developed in this work. We will not enlarge upon them here, but would be glad to pass on what we learned to any interested region or agency. The following equipment seems to be about the minimum necessary for editing:

Well ventilated darkened room.
Wall film rack.
Viewer or "flicker." (Greig or Film are good.)
Rewinds.
100-foot reels and some larger 300- or 400-foot ones.
A good splicer, cement and scraper.
Wiping cloth.
Extra leader.
Scissors.
Pen and ink, and grease pencil.
Double-thread projector.

The master script.—The master script is the final written form, revised for recording. Get all the help and advice you feel necessary from skilled writers and regional trainers. The Divisions of Information and Education and Personnel Management can give you a lot of sound advice in wording the narration from the training angle. *Write to the scene and action*—this is important and a timesaver. After getting the script in final form, get some administrator to spark plug it through, preferably the boss whose enthusiasm carried the film to this stage. You will save endless arguments and changes by having him say, "This is it."

We have just touched the highlights of some of the production problems encountered in producing the new film, Forest Smokechaser, and the two others preceding it. It is hoped that the above at least indicates that regions can make pictures, fairly successful ones, too.

Protection of Tool Handles From the Powder Post Beetle.—Over a period several years the following practice in the control of the powder post beetle, in the storage of new handles and of fire tools in caches:

Place the handles in a vat of sufficient length to accommodate them and cover with a mixture of five parts used motor oil and one part kerosene. Allow them to soak for 2 days. Then remove the handles and allow them to dry 1 day in the air before wiping and placing in storage.—FRED G. AMES, *District Ranger, DeSoto National Forest, Miss.*

PROGRESS OF RECENT EQUIPMENT DEVELOPMENT

EQUIPMENT DEVELOPMENT COMMITTEE

U. S. Forest Service

During the United States Forest Service equipment meeting in February many items of equipment being developed by the various Regions were discussed. Short narrative descriptions of each project were prepared and appear in the minutes of the meeting recently distributed to a limited group. Since a number of these narrative descriptions are of general interest, we are including them here.

REGION 1

Bosworth Trencher.—In further development of this machine, the plan was changed to provide for the application of power to the wheels as well as to the digging tool. This is accomplished with planetary gears. The latest model weighs 180 pounds. It has two wheels in tandem, a rotary digging tool with strap iron hammers mounted between rubber blocks, and a 6-horsepower engine. The digging tool is reversible. The fluid drive principle is employed. Different types of digging or sweeping tools could be used. The unit has been designed for dropping from an airplane if desired. From tests made so far, the superiority over hand tools is estimated at 10 to 1. Completion of the second pilot model is delayed by the difficulty of obtaining certain gears. Completion is expected by July 1. The cost in quantity production is estimated at $325.

Iron Mule.—This was described as a powered wheelbarrow, designed to carry loads up to 200 pounds on grades up to 35 percent. It is estimated to weigh 100 pounds and will be suitable for dropping from an airplane. The development is closely related to the Bosworth Trencher and will follow that development.

Scooter.—Region 1 had experimented with a scooter on trails for some time prior to 1945. In that year scooter development was assigned to Region 6. The Cushman scooter appeared to have possibilities for Forest Service work and an Army model was acquired. Certain changes were made in this model to adapt it for trail transportation, and later two commercial models were purchased by Regions 1 and 6. While this scooter is well constructed, tests showed certain disadvantages for use on forest trails. It appeared possible to develop a machine that would weigh less, have a shorter turning radius, and be easier to control on heavy grades and rough surfaces.

In 1946 Region 1 began experimenting with fluid drive applied to a trail scooter. Plans were also worked out for light-weight construction. The latest model weighs 180 pounds. The wheels are 18

inches in diameter over-all, and have 6-inch tires. Ample power is supplied through fluid drive from a light 4-cycle, air-cooled engine. The scooter performs well on horse trails if large boulders are removed and the bad sections improved. It will climb a 45-percent slope with one man. A local manufacturer has become interested in producing a commercial scooter with fluid drive and is willing to incorporate the features needed for trail operation. The cost is estimated at $300. At present scooters are classed as passenger-carrying vehicles. Steps should be taken to get the classification changed.

Aluminum Tanker.—This unit is mounted on a Dodge 4 by 4 chassis. It has a 200-gallon tank, a live reel, and compartments for rubber-lined hose and tools. A two-speed power take-off pump is used. Since the chassis has a power winch the power take-off drives the pump through a gear box. The body, spare tire, and reel weigh 830 pounds. With a full tank and all planned equipment loaded, the total weight is 200 pounds less than the manufacturer's rated gross weight for the vehicle. The aluminum units already constructed cost $2,000 each, but it is estimated that additional units can be produced for from $800 to $1,000 each in lots of 10 or more.

Smoke-Jumper Fire Pack.—This is a one-man fire-fighting outfit similar to a smokechaser's pack, but specially adapted for dropping to smoke jumpers. The development has been completed and the report will be available soon.

Slotted Freight Parachute.—The purpose of this development is to reduce oscillation. Tests made so far indicate that slots in a freight parachute will reduce oscillation materially. Further tests will be made before a report is compiled.

The Baker parachute, which has a center shroud line, has been tested to a limited extent in Region 5. The data will be turned over to Region 1, which will go ahead with the testing and report results along with the information on the slotted parachute.

Disposable Sleeping Bag.—So far no satisfactory disposable sleeping bag has been found, but paper manufacturers are interested.

Duffle Carrier.—The primary purpose of this development is to provide a means of bringing out smoke-jumpers' equipment without pack horses. The first model, which is ready for trial, consists of a Stokes litter mounted on a bicycle wheel. Another model has been designed with a 14-inch wheel to lower the center of gravity. It will be constructed of aluminum tubing, weigh about 36 pounds, and carry up to 200 pounds. It will be collapsible so it can be dropped from an airplane.

REGION 5

Fog Nozzles.—Equipment Development Report No. 11, March 1948, Characteristics of Certain Fog Nozzles, includes a condensed revision of the project report prepared by the University of California, Los Angeles Campus. Ten commercial nozzles of fog and spray type, with various tips, having discharge rates from 3 to 40 gallons per minute, are covered.

Experience on fires on the Cleveland National Forest during the 1947 season indicates very strongly that use of fog type nozzles made water about twice as effective as spray from garden hose type nozzles. Three-and six-gallon per minute fog tips were used in most cases,

although 8-gallon per minute tips were available. Garden hose nozzles used in the same fire situations have discharge rates of about 10 gallons per minute.

All low-pressure varieties of fog nozzles tested require a nozzle pressure of about 150 pounds per square inch to produce an effective fog; i. e., mist-size droplets. All have a critical range of pressure, usually from 90 to 130 pounds per square inch, below which they act as a sprinkler, producing a medium or coarse spray. As pressure is increased through the critical range, a larger proportion of the droplets become mist size. A few observers have noticed that the addition of a wetting agent when operating a fog nozzle at the lower end of the critical range will produce, to a certain extent, the same effect as increasing the pressure. Theoretical considerations verify this.

None of the fog type nozzles now on the market fully fills our need but at least two manufacturers are coming out, this spring, with new models designed especially for forest fire work.

Wetting Agents.—The superiority of "wet water," i. e., water with added wetting agents, is believed to be grossly exaggerated. Tests run to date have given contradictory results, because sufficient controls were lacking. Effect of technique and manner of applications apparently are of much greater importance than whether the water carries a wetting agent or not.

The development of this problem indicates several things. First, that more can be gained in learning how to most effectively apply plain water and in training nozzle men. Second, that perhaps the nozzle man is the most important man on a pumper crew, instead of the pumper operator. At least, more attention should be given to training and supervision of the men in whose hands is determined the effectiveness of costly units of equipment and organization. Third, that a series of standard test fires representing principal fuel types must be developed in order to evaluate differences in effectiveness of various wetting agents when applied in the most efficient manner. Obviously, to do this we must first learn by controlled experiments how to apply each most effectively.

The University of California at Los Angeles is now starting on the fundamental work in the above. During July the California Experiment Station and the Arcadia Center plan to run some semicontrolled field tests. These will give us a few quick answers on obvious points. If wetting agents have no obvious superiority, such as greater than 2 to 1, we will have to wait for more accurate determinations with laboratory controlled fires.

While we are waiting for positive proof of wetting agents, it seems reasonable that all regions should use them conservatively on mop-up. The advantages in mop-up are more obvious. If we do this, however, premium prices should not be paid for highly advertised specialty products. Such products have little or no advantage over wetting agents sold for general commercial use. Nearly all wetting agents are toxic, like soap, and nearly all promote rust and corrosion to a high degree. Many agents cause considerable foaming if the solution is agitated in the presence of air.

This particular phase of the use of water and chemical study is now of highest priority and results of tests will be published currently.

Other Chemicals.—Mono-ammonium phosphate (technical grade) is also a useful additive to water. Truax's studies show that a 5- to 10-

percent, by weight, solution is the concentration desired. This can be added to "wet water" to give an obvious residual effect. That is, after the solution has dried the mono-ammonium phosphate will retard, and in many cases extinguish, the fire.

Helicopter Tests.—See Fire Control Notes, January 1948, page 1; and this issue, page 5.

Portable Pumper Tests.—During the past years there has been developed at the Arcadia Center the apparatus and procedure necessary to run development tests on portable and semiportable pumpers, and approval test as required by Forest Service Specifications covering portable pumpers. During the current fiscal year three pilot models of new pumpers were tested, resulting in the development of a new light weight 4-cycle engine-powered pumper more suitable for use with fog nozzles and cotton-jacketed hose. Two other pumpers are scheduled for tests this spring. One is the new Edwards model 120 and the other the Porto pump.

Utility Trailer, Tractor Drawn.—See page 31.

Specifications.—This is a Service-wide project in which the Arcadia Center is collecting information on light alloys and rubber products, and testing procedures in order to improve specifications. It also covers development and testing work necessary to permit the writing of certain specifications and the photographic, drafting, and duplicating work connected with the preparation of all Service specifications.

Tractor Tanker.—Original tractor-tanker experiments were made with tanks and pumps mounted on crawler tractors. These all proved unsatisfactory, since the additional equipment and water reduced the performance of the tractor and interfered with other operations for which the tractor was used. The Army cargo carrier (M–29), better known as the Weasel, was selected in 1946 as the crawler vehicle most nearly meeting tractor-tanker requirements. Testing and use of the Weasel on fires shows that its performance looks very promising. Twelve modified units will be in fire control service in Region 5 this year. From experience with these units it is expected that plans and specifications can be prepared in cooperation with the Portland Laboratory that will give us a currently produced track-laying vehicle for general fire line hauling missions beyond the reach of all wheel drive vehicles. Experience on fires has already shown that the Weasel is so useful for laying hose lines and general hauling that any pumper-tanker equipment should be slip-on. E. D. Report No. 10, February 1948, Tracklaying Fire Line Transport, covers progress to date on this project.

Ram-Jet.—This is a project started in Washington by T. V. Pearson. It involves the use of the products of combustion from a jet engine (or automobile engine) to extinguish fires. The Aero Jet Corp. at Azuza, Calif., is working on it, and the Army Engineers Research and Development Laboratory is interested. In principle it is best suited for enclosed structures.

Tilt-Bed Trailer.—The original project included construction of two different size tilt-bed trailers. Survey of trailers commercially available showed that this was not necessary. Funds were therefore turned back and a small amount reallotted for further survey and preparation of drawings and specifications. Progress is now just under way.

Aerial Fire Suppression.—This project covers the use of spray or dusting type conventional aircraft in extinguishing or retarding the spread of fires. The present desire is to use helicopters instead of fixed-wing aircraft for the same purpose. No work done as yet.

REGION 6

Walking-Type Power Trencher.—This project was assigned in fiscal year 1946 and carried over to later years. The purpose is to provide a light trenching machine which can be handled by one man, with gasoline power applied to both the digging tool and tractor wheels, instead of to the digging tool only, as on the original Bosworth Trencher. All known makes of small garden tractors were investigated and it appeared that none of them was adaptable for the purpose. A trial unit was then assembled and experiments made with different kinds of digging tools. This unit had a 4-horsepower engine, which proved to be too light. However, from experience with the unit, the engineers were able to work out the design and select what seemed to be the best type of digging tools for conditions with which they are familiar, preparatory to assembly of another test model.

The design of the second unit has been completed and its construction is under way. It is expected that field tests can be started as soon as weather and ground conditions permit in the spring. This unit will weigh between 250 and 350 pounds and be powered with a 6-horsepower, 4-cycle engine. Cleated steel tractor wheels 24 inches in diameter will be used. The digging tool will consist of two steel spirals, tapering from 12 inches in diameter at the inner ends to 8 inches at the outside. Each spiral will be 11 inches long to give trench width of approximately 24 inches. They will rotate at a normal speed of 350 revolutions per minute in the opposite direction from the forward rotation of the tractor wheels. Chain and V-belt drive will be used on spirals and wheels. The machine will be controlled with a T handle and power will be used for steering. Forward speeds will be 1 to 5 miles per hour and reverse speeds one-half the forward speeds. Length of machine without handles, 37 inches; width 28 inches.

Firefog Unit.—See page 39.

Disk-Dozer.—See page 19.

Insulated Carton for Keeping Food Hot.—Regions 4 and 6 have used honey cans, in paper cartons, for dropping hot foods to fire fighters (Fire Control Notes, April 1946). Recently Region 6 located an insulated carton which apparently will be satisfactory without the use of a can. It consists of an A-flute corrugated box with special cut flaps and an insulated and water-proofed liner. This type container, in 1- to 60-quart sizes, is in commercial production. The 10-quart size, 10½ by 10½ by 14 inches costs about 27 cents each in lots of 1,000. Food will be put into cold storage locker containers, which are available in sizes up to 1 gallon, as it cannot, of course, be put directly into the carton.

Fire Finder Map.—For many years Region 6 mounted fire finder maps on metal, using the method described in the Fire Control Equipment Handbook. During the past 2 years experiments have been made with maps pressed between two sheets of plastic material. Ad-

vantages of this type of mounting are obvious. The trouble has been the tendency of the plastic material to warp. Last fall, a map was pressed between sheets of Vinylite, and exposed on the roof of a building from October 1 to January 1. At the end of the period, it had not buckled nor showed signs of deterioration. A few disks of this material will be tested on lookouts in the 1948 season. The cost will be about $6, but it is expected that a lower price could be obtained on quantity bids.

REGION 7

Pressure-Type Back-Pack Can and Pump.—This project was assigned in 1945. The object was to work with the D. B. Smith Co. in developing a back-pack pump outfit which would conserve water by delivering a continuous stream with greater accuracy, be dependable and simple to operate, and be reasonably free from mechanical defects. Three possibilities for developing pressure were considered: By mechanical means in a cylinder, by mechanical means in the tank, and by pressure cartridge. The first method was selected. Three units were field tested in 1946, in Regions 7, 8, and 9. Reports were considered sufficiently favorable to warrant more extensive tests, and 10 units were distributed in the spring of 1947 to Regions 1 to 6, inclusive.

The can is well constructed of galvanized steel. It has a cylinder in one side, into which water is forced with a pump. A hose leads from the top of the cylinder to a trigger-type shut-off nozzle. In use the operator holds the nozzle in one hand and operates the pump lever with the other.

A summary of regional reports lists two advantages, as compared with the "trombone" pump and can: (1) Better direction and accuracy of stream, which conserves water, and (2) greater compactness, requiring less space in shipment and transportation to the job. Disadvantages reported are (1) too heavy, (2) operation is fatiguing, (3) in operation, the can twists and hurts the back and (4) the handle is hard to disengage from the catch. Another disadvantage in going through thick timber or brush is that, in the carrying position, the movable cylinder extends several inches above the can and may catch on limbs. It was also mentioned that the pump sucks air when the water in the can is below the 2-gallon level.

Suggestions for improvement were to reduce weight by reducing tank capacity and using light metal, to reduce diameter of cylinder, to redesign pump lever and provide some means of preventing the twisting and "sawing" of the can on the back, to use a noncorrosive ball valve, to provide heavier shoulder straps with a carrying clip for nozzle, and to provide a handier pump lever clip.

Insulated Food Container.—This was an investigation of a container used in New England for transportation of fish and lobsters. Its dimensions are 14 by 14 by 26 inches, and the capacity is 40 to 50 pounds of live lobsters, 80 pounds of lobster meat, or 100 pounds of fish. A dry ice unit, 6 by 6 by 12 inches is claimed to hold temperatures from 50° to 20° F. Temperature is controlled by regulating CO_2 pressure. Three pounds of dry ice is necessary for a 24-hour period. Latest price quoted is $1.50 each. This container is not being manufactured at the present time.

Fire Control Tower.—The State of Maine purchased from WAA for $200, 102 feet, or two units, cataloged as "The Wayne Steel Portable Tower for Observation and Triangulation, type B." The steel was purchased for three 34-foot towers, with 8- by 8-foot cab. One has been erected at a total cost of $425. The sides have no batter. The tower is anchored in 14- by 14-inch concrete blocks and secured with 3/4-inch cables 65 feet long. An inside stairway was substituted for the standard iron-rung ladder and a trap door was constructed in the roof for safety in making repairs. The tower is capable of supporting a load of 44,000 pounds.

REGION 8

Mathis Plow.—Produced by Mathis Machine Works. This is a 3,300-pound plow, with rolling coulter, middlebuster, and disks. It has been used for some time in areas where a light plow is not adequate. The lift is operated from a power take-off on the tractor. The plow requires a tractor in the D-4 class.

Husky Plow.—Used in Texas. It is a one-man fire fighting outfit consisting of a Husky garden tractor and a wide-angle middlebuster plow. It travels 3½ miles per hour and makes a 36-inch shallow trench.

Hi-Low Trailer.—Built to haul the Mathis plow and tractor. The capacity is 9 tons. It was fabricated from the back end of a truck at a cost of $800 in the Forest Service shop. A folding ramp proved unsatisfactory, so a sliding ramp was constructed. This is on rollers and can be moved by one man.

Tilt-Bed Trailer.—Constructed to haul the HG tractor and Ranger's Pal Plow, so as to save transportation equipment. It has tandem axles and single 7:00 x 16 tires. The axles and wheels are house-trailer type, with Corson coil springs to eliminate side sway. The brakes are electric. The Army pintle hook hitch is used. Cost of the trailer is $600.

REGION 9

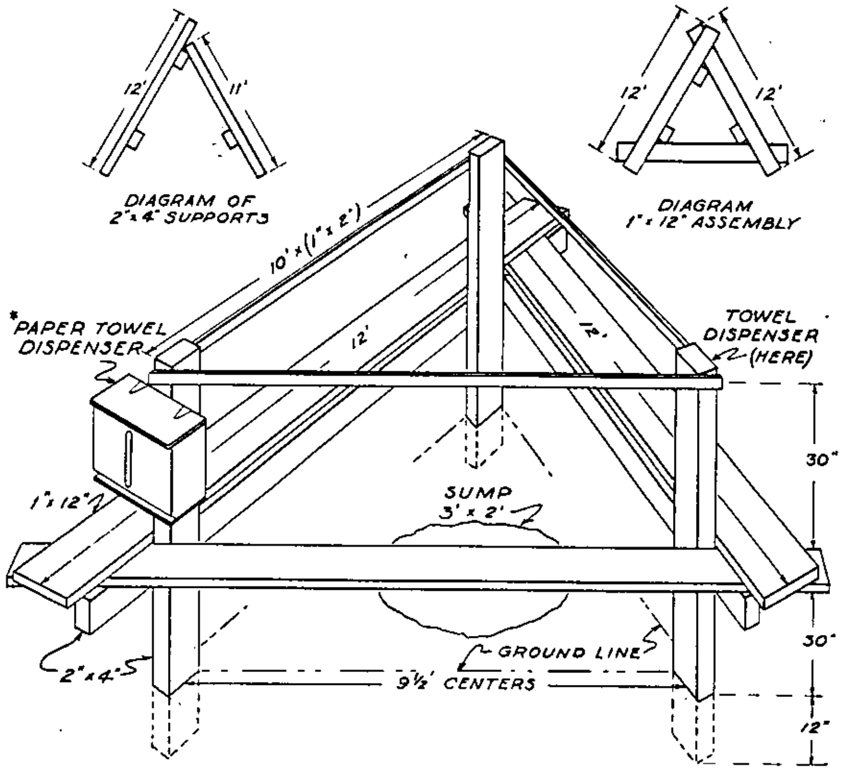
Stubby Plow.—This plow is described in Fire Control Notes, April and July 1947. It is a low cost double-bottom plow, which rides close to the tractor and folds compactly for roading. The bottoms are standard manufacture. The complete plow weighs 255 pounds and can be pulled with a light tractor. It has proved very successful and its use has stimulated interest in mechanized fire-control equipment. Construction of 45 of these plows is now in progress.

Smoke Masks and Goggles.—In testing numerous kinds of smoke masks, it was found that the hospital gauze mask was as good as specially designed smoke masks. Water must be available to keep the mask moist. Goggles with double glass were found to be little better than those with single glass. Each individual should have his own goggles and smoke mask for sanitary reasons.

Rotary Broom Rake.—The Gravely tractor and rotary broom was experimented with for line construction in hardwood leaves. The broom proved to be too long and was shortened, but still consumed too much power and was not very satisfactory. A 20-inch disk with spring tines, such as are used on the International hay bailer, has been constructed but not yet tested. It is expected to require less power than the broom, so that the 5-horsepower Gravely tractor will be adequate at a speed of 2 miles per hour.

Fire Camp Wash Rack.—The wash rack as shown in the diagram has been used successfully and will in most cases eliminate the sloppy conditions which will develop where fire fighters have to wash up.

The installation provides (1) a sump to dispose of waste water; (2) a bench of convenient height for wash basins; (3) rails to support towels, mirrors, etc.; (4) paper towel dispenser (folding, or roll type optional); (5) large cartons or GI cans for waste paper. The paper towel dispenser recommended is the one designed and used by the Plumas National Forest and which holds four to six packages of folded paper towels at a time. Two or more such dispensers are needed per rack.



It will be instantly noted by camp bosses and others concerned with the need for a wash rack, that it can be constructed by using native materials or whatever is at hand. Size, shape, and material specification will make little difference as long as the five functional elements listed above are provided.

The use of slotted strap iron hangers fastened to the bench boards and so designed to slip onto fixed studs set in the posts will do away with the 2- by 4-inch rail supports and provide a permanent and portable rack which can be used repeatedly.—K. McDonald, *Fire Control Officer, Tahoe National Forest, Calif.*

INFORMATION FOR CONTRIBUTORS

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

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

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

Illustrations, whether drawings or photographs, should have clear detail and tell a story. Only glossy prints are acceptable. Legends for illustrations should be typed on a strip of paper attached to illustrations with rubber cement. All diagrams should be drawn with the type page proportions in mind, and lettered so as to permit reduction. In mailing, illustrations should be placed between cardboards held together with rubber bands. *Paper clips should never be used.*

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The approximate position that illustrations bear to the printed text should be indicated in the manuscript. This position is usually following the first reference to the illustration.