FIRE CONTROL NOTES

A PUBLICATION DEVOTED TO THE TECHNIQUE OF FOREST FIRE CONTROL

FOREST SERVICE - U. S. DEPARTMENT OF AGRICULTURE

Fire Control Notes, April 12, 1937

Date	Name	Date	Name	Date	Name
5/19	Hunt				
5/24	Mountain				

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The value of these publications will be determined by what you and other readers contribute. Something in your fire control thinking or work would be interesting and helpful to others. Write it up and give other men some return for what they have given you.

Articles and notes are wanted on developments of any phase of Fire Research or Fire Control Management: theory, relationships, prevention, equipment, detection, communication, transportation, cooperation, planning, organization, personnel management, training, fire fighting methods or reporting, and statistical systems. Whether an article is four lines or ten typewritten pages in length does not matter. The only requirement is that articles be interesting and worth while to a reasonable proportion of readers.

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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 technology may flow to and from every worker in the field of forest fire control.

RETARDER METHOD IN DROPPING SUPPLIES FROM PLANES

LAGE WERNSTEDT

Engineer, Region 6

Where ground transportation systems have been highly developed and where topography is favorable to fast movement, air delivery of supplies may seem relatively unimportant. In many parts of forested America, however, package dropping from airplanes is, and will continue to be, a vast aid in equipping and supplying fire crews. The experimental work in Region 1 employed *free descent* and the work in Region 4 developed the *loose package* method (described by Supervisor Shank in Issue No. 1), which gave the falling body more air resistance. Carrying on from these inspiring efforts Region 6 last fall undertook to develop the possibilities of lowering heavier units and reducing wastage. These results were achieved largely through more completely *retarded descent*, and the devices used are improvised and can be made up quickly anywhere. Here are methods which can be employed generally, without elaborate preparation.

Early in August a few dropping tests were made near Winthrop, Wash., in the presence of Mr. Headley of the Washington office and Mr. Campbell of Region 6. Both the tight package method of Region 1 and the so-called loose package method which originated in Region 4 were tried out on a limited scale.

About 50 per cent of the weight and more than 50 per cent of the bulk of the packages are taken up by the packaging material used in the tight package method. In this method the bundles are wrapped in a quantity of excelsior and heavily roped canvas. These bundles are then dropped free. In the loose package method a small quantity of supplies is discharged in loosely tied gunny sacks or other larger sacks. The loose flapping end of the sack offers a certain amount of resistance and the packages land with less impact. In general there was a considerable loss in the packages put up by the Region 1 method. With the loose package method the loss was very small. A restricted number of items in small amounts only were tried out.

On the recommendation of Mr. Headley, Region 6 later undertook to carry out further tests with a view to ascertaining if other items than those already tried could be dropped successfully, if larger quantities could be dropped, and in general if a better method of dropping could be developed. These tests were carried out during the month of October at Pearson Field, Vancouver, Wash., using a 7-place Traverlair cabin plane. Field tests were also carried out in dense woods near Vancouver. All these tests were made at sea level, and it would be necessary to make further field tests at high altitudes in order to make sure that the results are applicable to ordinary field conditions.

The tests were very successful and developed the fact that it is not only possible but easy and simple to drop every sort of supplies and equipment in substantial quantities with sufficient accuracy to be readily found by the ground crew, and to do so without any loss or damage whatever to either supplies, equipment, or containers.

The idea followed up was to retard the speed of the load, and in some instances to pack the articles so that there would be no impact from other articles placed on top of them. Various retarding surfaces, such as described in the attached tabulation, were tried out, each possessing some advantages. All these devices, except for very light items which are best dropped in a loose sack, with or without another loose sack or two trailing behind, pointed to the conventional chute as providing the best combination of desirable properties in the way of efficiency, compactness, strength, low cost, ease of making, ease of discharging, uniformity of drift and ease of recovery.

The standard chute selected is made of a burlap wool sack, opened up and tied in the four corners to shrouds 17 feet long. A wool sack was selected because such sacks are cheap and can generally be obtained in all small towns near the western national forests. When opened up the sack forms a sheet of suitable size. Burlap by the yard or gunny sacks split open and sewed together so as to form approximately a 7-foot by 7-foot sheet would serve the purpose as well. This chute will lower 100 pounds of some items, compares in efficiency per square foot with other chutes—such chutes, for instance, as are used by the Army—can be made in less than five minutes, costs about 40 cents, and may be used repeatedly.

The loads dropped consisted almost 100 per cent of supplies, the packaging material used being negligible both in weight and bulk. Since the loads are so compact, it is possible to load the airplane to its full load capacity, leaving a small space only for the dropper. Following is a description of airplane, chute, method of packing various items, the pilot's and the dropper's business, etc., and tabulation of tests, with diagrams.

Equipment

The airplane should be a high wing cabin monoplane with the door preferably, but not necessarily, back of the wingstruts, and the door should be removed. All chairs, except the pilot's seat, should also be removed.

The chute, as illustrated by Fig. 1, should be made from a wool sack. The seam along one side is opened up by untying the thread at the end which frees the thread and opens the entire seam. The sack is cut at the bottom and spread out. It then forms a sheet about 6½ feet by 7¼ feet, containing close to 50 square feet.

The shrouds are made preferably of clothesline or sash cord, each shroud 17 feet long and tied with a slip knot around the corner, which is folded single over a short stick of wood about 2 inches long. No corner made in this way ever tore. The shrouds are tied together about 1 foot to 2 feet from the end, the remaining foot or two being used for tying loads. If the shrouds are made of twisted material they have a tendency to tangle up, especially if new rope is used. If rope is used, the size should be about ¼ inch.

In order to be able to spot the load easier a chrome yellow streamer is firmly attached to the top of the chute with blanket pins, or it may be sewed on with a sack needle through two or three thicknesses. The streamer should be from 4 to 6 inches wide and from 30 to 50 yards long, and should be made out of material easily ripped into ribbons. A good material is percale or cambric. The cost is from 10 to 19 cents a yard as sold by the bolt. One bolt will make several streamers. Where a band saw is available the bolt is readily cut into streamers already rolled up and ready to use. Note that one cut will make two streamers rolled up together, since the fabric in the bolt is folded once. The bolt can probably be cut with a fine-tooth hand saw also, if placed between two boards. It saves work to use the bolt as it comes rather than ripping the cloth into ribbons, each of which would then have to be rolled up by hand. In open country a shorter streamer would be satisfactory, or the streamer could be dispensed with entirely. In heavy timber and underbrush a long streamer is necessary, and the bolt of material as purchased contains just about the right yardage.

The chute is stretched out flat and the two upper corners are brought together at the middle of the lower side. The sides of the chute are then folded but not rolled together, in the manner shown by Fig. 1, the folds being not unlike the folds of an umbrella. In this manner the air is free to open a channel through the middle. All corners are brought together at

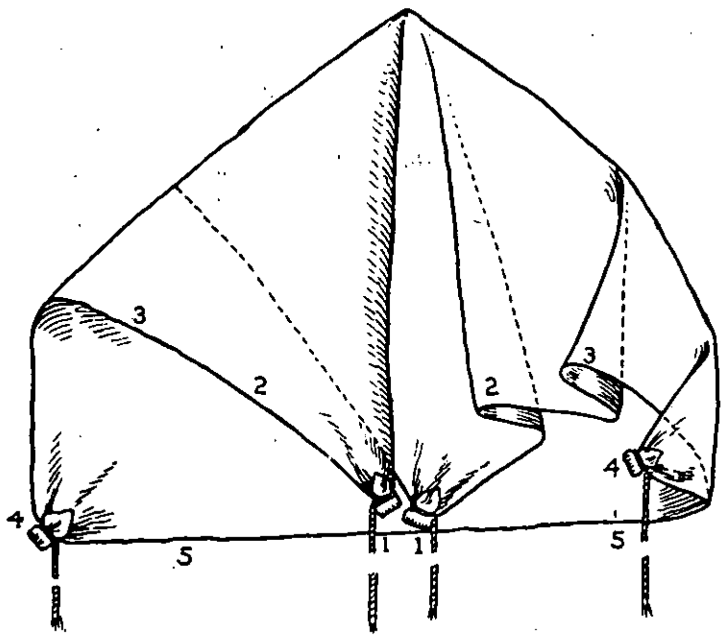


Fig. 1 Bring corners 1 together.
Pick up corners at points 2, 3, 4 and 5
and fold as indicated.

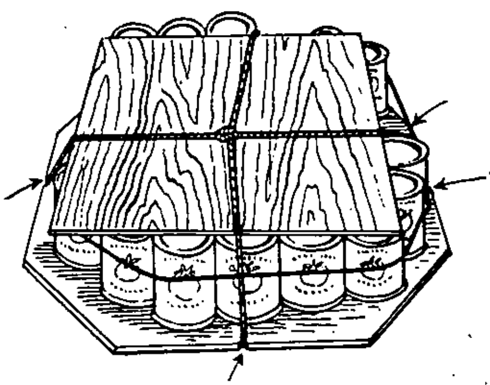


Fig. 2. Method of packing canned goods.

the same place. As now folded it will occupy a space of about 18 by 50 inches. With the streamer placed at the end and the shrouds lined out on the ground without crossing each other, the chute, streamers, shrouds, and all, are now rolled up, beginning at the top and ending with the shrouds. It should not be rolled tightly. The load is then tied to the chute and the chute is placed on top of the load ready to discharge.

Care should be taken to use strong material and substantial ties, for the chute will open up with a violent snap. As rolled up the chute forms a bundle about 6 by 18 inches. None of these chutes ever failed to open with the packs as described later. This chute has been loaded up to 100 pounds, but then falls about twice as fast as when loaded with 50 pounds. Loads in excess of 100 pounds would be difficult for the dropper to handle, so none were tried. It is probable that a 100-pound sack of grain or other similar material slipped into another and larger sack, such as a mail sack, will land successfully and stand the impact, but this was not tried. Ordinarily not over 50 pounds of supplies should be lowered. The folding of the chute does not have to be done with any great care. But keep in mind that it must be made to open as free as possible with the inrush of air through the middle.

The Pilot and the Dropper

The pilot's business is to approach the target while heading directly into the wind. After each load has been discharged the pilot should commence to turn so that the dropper may watch each bundle as it lands without getting too far away from the place. It is particularly important that the pilot pass directly over the target. The pilot ordinarily cannot see the target when close to it or on top of it without side slipping, which is not advisable, since he is then not only losing elevation, but the loads also have a tendency to pass under the fuselage and may foul the tail surfaces. The pilot must, therefore, approach the target from some distance back so that he can get lined up.

The dropper watches the target, and the pilot notes his course and watches his altimeter so as to keep his elevation the same throughout. The general wind direction may be ascertained in various ways—from information obtained from nearby lookouts before taking off, from the direction of travel of cloud shadows, from putting the airplane on different courses on the way out and noting on what course there is no drift, and from a smudge on the ground, which should always be built by the ground crew. The final wind direction and its force is ascertained from the drift of the pilot load and chute, as explained later.

The dropper's business is to watch the target, drop the loads and map the landing of each load. After the ship is unloaded he will drop this information to the ground crew. He will also correct the pilot's flying. It is absolutely essential that the dropper be equipped with one of the more expensive grades of goggles and a helmet. If not, he will stand a chance of seriously injuring his eyes from particles of oil, as well as air, driven into his face. The dropper is tied to a lineman's belt and strap, secured forward to a structural member of the fuselage. The strap should be adjusted just long enough so that he may stick his head out comfortably through the door while leaning against the belt or the front door jamb.

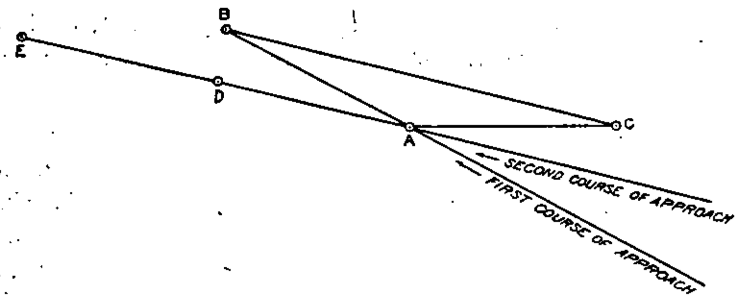
Dropping

The dropper first discharges a pilot load in order to ascertain the accurate direction and force of the wind. This load may consist of a chute loaded with a sack of gravel weighing about 30 pounds, or may consist of a gunny sack with a 2- to 3-pound load in it and tied at the top. The chute load is the best. All chute loads will land in about the same place if discharged directly over the same spot; and, in a slight breeze, flying at 500 feet, will land close to the target, if discharged directly above it.

The dropper, standing at the door opening, watches the target, and when he is directly over the target discharges the pilot load. He uses the door jamb against which he leans as a sight to determine when he is directly over the target. The next load he drops over a point which is the same distance from the target on the opposite side from where the load landed. There are different variations to doing this.

Probably the simplest method is as follows: The pilot, as previously explained, has ascertained the approximate wind direction and brings the target directly to the windward. He then heads for the target. The dropper drops the pilot load when directly over the target. The pilot then starts turning to permit the dropper to watch the load land without getting too far away. The load may or may not land in the direction of the approach to the target, but may land to one side. The dropper looks over the ground and estimates that the line from load to target and the line of approach form a 30-degree angle, for example. Next time the ship should approach the target from a point half way between the load and the line of first approach. The dropper now tells the pilot to approach the target more from the north, or whatever the direction may be, by 15 degrees in this case. The dropper drops the second load when he reaches a point which is on the other side of the target and as far from the target as the pilot load is. He then uses this point for a secondary target for all other loads, unless he thinks that he could improve the accuracy by repeating the operation a second time.

The following diagram explains this procedure:



Pilot load

- First course of approach as indicated on diagram.
- A—Target and point of discharge of pilot load.
- B—Momentum took pilot load to point B.
- C—Wind carried pilot load from point B to point C, where it landed.

Second load

- Second course of approach as indicated on diagram.
- This is half way over towards C.
- D—Point of discharge of second load.
  This point of discharge is about the same distance from the target as the distance to the load from the target, or DA=AC.
- E—Point to which momentum carried the second load.
- EA—Wind carried second load from E back to target at A, same distance as wind carried the first load from B to C.

BC and EA indicate the direction of the wind.

If the pilot was correct in his first approach, which is shown by the load landing directly in the line of flight, there is no call for any correction, and all that the dropper has to do is to pick out a secondary target on the other side of the first target. The pilot and the dropper should read over the instructions for dropping before taking off.

The dropper takes hold of both the load and the chute with one hand and discharges both at the same time by pushing them out and down. If the load is heavy he may have to help it along by an additional shove with his foot. If very heavy he may set the load partly outside, nearly balancing it on the edge of the door opening, from which position it may easily be tipped over for discharge.

The loads all act with surprising uniformity, and there should be little trouble of coming within 200 feet of the target. Towards the end of these tests few loads landed more than 50 to 75 feet from the target, and there were a few bull's-eyes, while discharging from 500 feet. It may be necessary at times, depending on the topography, to drop from 1,000 feet or more. In such a case a greater distance between target and load must be expected.

The loads should be numbered and marked, and the dropper should make a small diagram showing the north and south directions and local features, and should plot the position of each load on this map. He should drop this information to the ground crew in a weighted streamer before leaving. Although two or three loads may be dropped simultaneously, it is believed better practice not to do so, as the dropper may then not have time to spot every load.

The reason why chutes have not been used more extensively in the past is perhaps because it was thought that the chutes would catch in trees, were expensive or difficult to make, and that the drift would be too great and uncertain. Chutes do occasionally land in the tops of trees. Out of 17 loads discharged over dense woods, one landed in the top of a tree, which had to be climbed. More frequently they land on the lower branches, from which they may be pulled down directly or by throwing a weighted line through the shrouds or over the load. Out of 17 loads, 3 landed in this way.

Owing to the relatively small area of the chute as compared to the distance between trees, and also because of the tendency of the shrouds to push the chute away from the branches, most loads land on the ground. The dropper can easily see when a load lands in the top of a tree, as the trailer is conspicuous from the air, and he can throw down a pair of tree climbers if necessary. The tree could, of course, also be cut down.

From what has been said already, it is evident that the chute is simple to make and that it is inexpensive, and that the drift of the load, be it large or small, offers no problem.

In order to be able to pull the load off the trees more readily a line was tied underneath some loads. Where this line was weighted it sometimes caught, hoisting the weight up until it jammed. If the line is not weighted it may at times be helpful, but its value is somewhat doubtful.

Particularly heavy or fragile articles may be lowered in a larger chute or in a cluster of chutes looking something like toy balloons. This method of tying the chutes was tried with groups of two and three chutes and worked well.

When two chutes were tied in tandem through a hole in the lower chute the upper chute never opened, so this method does not seem to work. It is also more bother to arrange the chutes in this way.

There is, of course, a limit both to the weight that a man can handle and the bulk that he can get out through the door. This door opening usually is from 26 to 28 inches wide, and one should figure on having about 3 inches clearance on each side, which limits the width of the load to about 22 inches.

A dropper must be sure not to let go of the chute until the load is sure to go also. Failure to observe this precaution may cause the chute to catch on the tail surfaces and wreck the ship. All chutes and loads used cleared the tail nicely, with plenty of room to spare.

Packing: Kinds and Amounts

1. *Canned goods*

   The smaller the cans the more impact they will stand. Cans up to No. 2½ were tried out, but No. 2 is probably the best can to use. The cans are placed on a square board, standing, as many as the board will hold. The largest board used was 22x22x⅜ inches plywood board. Use only a single layer of cans.

   The group of cans are tied around tightly with twine and will form a more or less circular group. A loose and somewhat smaller board is placed on top of the group. The package is then tied up together tightly across the sides. The edges of the boards are notched in the middle so the cord will not slip. The package is then suspended flat to the chute.

   A 22x22-inch board with corners trimmed off, so as to catch less air and thus increase the efficiency of the chute, will hold about 34 No. 2 cans, weighing approximately 50 pounds. A 12x12-inch board will hold approximately 9 No. 2 cans, weighing about 13 pounds. Where no plywood is available, a square board larger than 12x12 inches can be made up by nailing slats across smaller boards.

2. *Fresh meat, ham, bacon*

   Place each item in a sack and all together in a gunny sack suspended flat, if heavy, and tied across the ends and the sides. Load up to 50 pounds.

3. *Dry foods*, such as sugar, salt, rice, spaghetti, beans, raisins, rolled oats, prunes, apples, dry vegetables, etc.

   These will stand a considerable impact, and it is a question of bulk rather than weight which determines the maximum load.

Place each item in separate small sack and load in box, carton, or gunny sack suspended flat, with the more susceptible articles on top. Do not pack very deep.

4. *Pickles and preserves in glass jars*

Place several 1-pint jars, each jar standing and well wrapped in flour sacks or similar material on a board and load same as canned goods. Attach a bread shock-pad underneath. This pad is made of loaves of bread sliced and put into a sack side to side. The sack is then drawn up tight and tied to pack underneath.

Largest load tried was 8 jars, weighing 22 pounds. The bread will probably not be damaged.

5. *Bread—sliced (white)*

Place bread in carton, gunny sack, or box, and lower flat. If in gunny sack put each group of three loaves in small sack and all in gunny sack, with a board under or inside the sack so the rope will not squeeze the contents when chute opens.

A sack full of bread (white, sliced) may also be lowered in a gunny sack suspended flat and tied in three places to the end of a wool sack as is, the wool sack serving as a trailer without chute.

6. *Fresh vegetables*—cabbage, cauliflower, lettuce, radishes, carrots, turnips, onions, etc.

Put each head or bundle in small sack and place all in a gunny sack suspended flat. Pack lettuce on top of the rest. If a board is used underneath it will prevent rope from cutting into contents. The sack will hold about 35 pounds. Do not pack very tight.

7. *Spuds*

Lower a 50-pound sack flat. There may be a slight breakage, but the spuds can all be used.

8. *Oranges and grapefruit*

These were only tried in flat 12x18x4-inch and 12x24x4-inch boxes. Oranges used were small and hard.

9. *Butter*

2—1-pound packages of butter, not in tins, was lowered in a 28-inch braced gunny sack, but can be lowered in flat box. Do not lower over 10 pounds at one time.

10. *Lard*

Three pounds of bulk lard was put in paper wrapper and in small sack, all in gunny sack tied at end—no chute. Can be lowered in tins packed as tinned goods.

11. *Coffee and cocoa*

Pack same as tin cans, but put small sack around each item.

12. *Eggs*

Nine dozen eggs were placed in a half crate box used for packing eggs on horseback. The rest of the box was filled on top with rags. Eggs were packed with ordinary separators and cells. Lowered with eggs on end and a bread pad under the load. It is probable that the full half crate, or 15 dozen, could have been lowered without damage. Load was 18 pounds with box.

It is probable that lowering eggs may at times prove disappointing. On the other hand, it may well be that the old hen has never been given sufficient credit for the lopsided sturdiness of her product.

13. *Water in Osborne rubber bags*

Fill two bags half full of water and put them side by side in flat box. Bags should each be in a knapsack and lie flat. Weight about 45 pounds.

14. *Osborne rubber bags—empty*

Put several bags in a gunny sack tied at top and discharge.

15. *Water, gasoline, or other liquids*

Use a heavy type 3-gallon milk can with conical throat. Fill to the cone and suspend in rope harness with spacing twine tied between and to ropes to prevent ropes crossing bottom from sliding off. Tie around top also. Fit a board in space between flange and bottom. Weight 32 pounds, can included.

16. *Matches*

Put each box of matches in a small sack and put a few of these into a gunny sack tied at top. Discharge without chute.

17. *6-man cooking outfit (standard)*

Place the kit on a board with bread pad underneath. Weight 27 pounds.

18. *5-gallon tins or single kettles*

Place each can in a gunny sack tied at top. Tie all the sacks together in a circle, spaced about 1 foot and discharge without chute.

19. *Gas lanterns*

Leave lantern in original container or place in box padded with rags. Stand on board with bread pad underneath. Weight 11 pounds. Put box of mantles inside box. The chute will probably lower two lanterns without damage.

20. *Propane gas tank*

Place in rope harness with spacer twine between and tie around top. Suspend standing up. Weight 33 pounds.

21. *Shovels*

Take a 6-shovel bundle and suspend at point of balance. Weight 23 pounds. The chute should lower one dozen shovels without trouble.

22. *D. B. axes*

Take a 6-axe bundle with axes standing in standard box protecting bits. Pad between bits and also between bits and top of box. Suspend, handles up, by rope around bottom of box leading up through handles and tied around top of handles. Weight 37 pounds. The chute will probably take care of one dozen.

23. *Six-foot saws*

Put hose around cutting edge and tie hose to saws. Put two saws on top of a board bolted to them through handle holes. Suspend saws level and flat in a bridle tied to each end. Board should be wider and longer than saws. Discharge by putting one end of package out edgeways and downward about two feet and give final shove when over point of discharge.

24. *Axe handles, etc.*

A gunny sack filled with axe or hoe handles may be discharged directly without chute from a moderate altitude. If over 300 feet use chute.

25. *Emergency rations*

A sack full of emergency rations suspended flat should land without trouble, although this has not been tried.

26. *A few don'ts*

a. Do not use wire hooks for attaching bundles. They straighten out too easily and cut and rip too much.

b. Do not discharge a bundle if pilot passes to one side of the target. Wait till next time.

c. Do not fail to drop a pilot chute first. It furnishes all the information needed for a good aim.

d. Do not be too much in a hurry. Spot every load. Five or 10 minutes' extra time spent on dropping may save the ground crew some time in searching and the dropper his reputation.

e. *Do not let go of the chute until you are sure that the load will also go.*

It is probable that these methods may be improved and enlarged upon by further tests or by experience in the field, but it is believed that field men can be guided by the present information so that they may use their own judgment when discharging unusual items, or items not mentioned, or solving some particular dropping problem. It would be particularly desirable to make further tests on dropping radios.

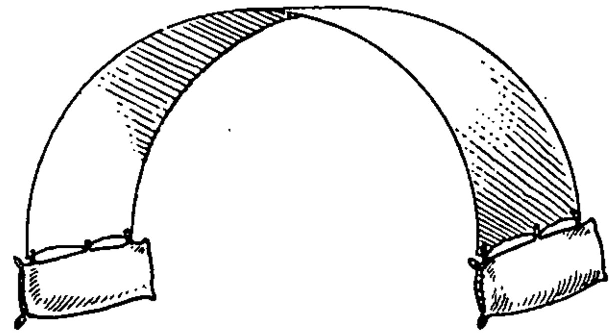


Fig. 3. Woolsack. Double ender. Efficient but a little inconvenient to handle

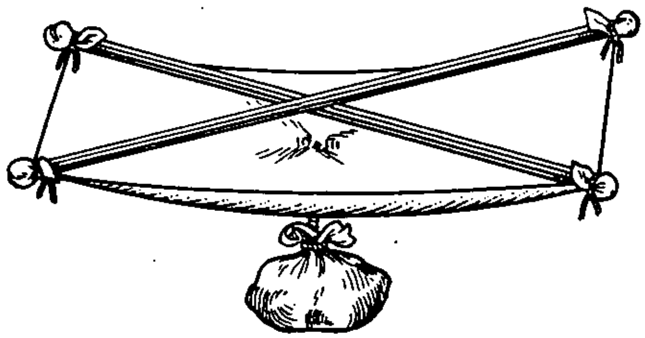


Fig. 4. Braced burlap. Piece of burlap stretched by two sticks. Efficient but difficult to discharge. Bulky

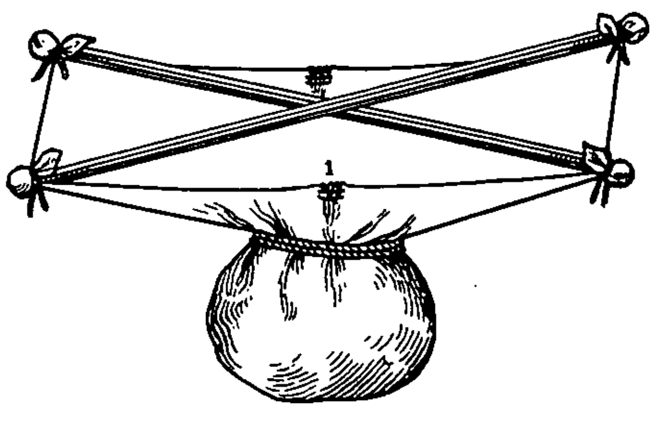


Fig. 5. Braced gunnysack. Efficient but small capacity. Difficult to discharge when sticks too long. Bulky. Sack is split down to point 1.

TABULATION OF DROPPING TESTS

(Italics denote approved method)

Drop Ft.	Area Retarder Sq. Ft.	Time in Sec.	Load Lbs.	Load per Sq. Ft.	Retarder	Kind	Description of supplies and how packed	Condition after landing
500	3.5	11	10	0.29	34" braced sack	Bread, sliced	10-lb. loaves, sliced, 3 rye, 7 wheat	All wrappers broken; all in good condition except 1 rye, some slices broken
500	4.5	9	12	0.27	40" braced sack	Milk	2 doz. small cans in flat 12"x18"x4" box, no top, with partition. Cans in single layer. Box not wired	1 can dented but not leaking; all others OK
500	3.0	11	6	2.0	28" braced sack	Bread, sliced	4—1½-lb. loaves bread (1 wheat) sliced	All wrappers broken; bread OK
500		11	6		Gunny sack free	Bread, sliced	3—1-lb. loaves in 50-lb. sack 3—1-lb. loaves in 50-lb. sack All in gunny sacks, tied loosely	All bread OK; 4 wrappers intact
500		5	20		Free	Water	1 Osborne rubber bag half full of water in knapsack	Bursted into shreds
500		7	20		Free	Water	1 Osborne rubber bag half full of water, no knapsack	Bursted into shreds
500		18			Gunny sack free	Matches	1 box matches in 10-lb. sack in 100-lb. gunny sack	OK
500		19			Gunny sack free	Matches	*3 boxes matches each in 5-lb. sack, all in 100-lb. gunny sack*	1 box on fire but went out; 2 boxes intact OK. Suggestion: May tie another sack trailer to it.
500	6.2		18	3.2	45" braced burlap	Bread, sliced	12—1½-lb. loaves bread, sliced, packed in a square cardboard case suspended by wire hook from burlap, in middle. Box tied around.	Burlap slipped on stick at one corner and retarder did not work properly. Box bursted and all wrappers broken, but *bread OK*

TABULATION OF DROPPING TESTS

(Italics denote approved method)

Drop Ft.	Area Retarder Load	Time in Sec.	Load Lbs.	Load per Sq. Ft.	Retarder	Kind	Description of supplies and how packed	Condition after landing
500	9	9	15	1.6	10" round burlap chute 8 shrouds Burlap double	Milk	30 small milk cans in 40"x8"x3" box. Milk in a row inside 2 cardboard tubes, 15 in each tube, loose board on top of box. burlap tied around. Box suspended flat by twine tied to staples in box (holes are better, but best way is to tie the box around with twine across the four sides)	Chute pulled out the staples from which box was suspended and box fell free. Nails pulled partly out of box, but boards not broken and box held together. Tubes OK; 1 can bursted, 2 cans leaking slightly; all other cans dented, but *contents OK*
500		9	11		Trailer made out of 2 gunny sacks in tandem	Potatoes	Single layer potatoes in 12"x24"x4" box with c partition. Some sawdust in bottom. Box suspended flat.	Out of 36 potatoes, 3 bursted. All OK
500			8		2-sack trailer	Milk	8—1-lb. cans milk in 12"x18"x4" box with c partition, 4 in mailing tubes lying on side, 2 standing, 2 on side. No top to box. Suspended flat, tied in 3 places so as to spread trailer.	2 cans in tubes leaking; 2 more badly dented, but OK; 2 standing, OK; 2 on side dented, but OK; bottom of box cracked some
500	3.5	9	16	4.5	34" braced sack	Water	1 Osborne rubber bag in knapsack 2 gals. water in 34" braced sack	Knapsack bursted in seam on side; rubber bag and water OK. Suggestion: 2 Osborne bags half full in flat box in stand. chute

TABULATION OF DROPPING TESTS

(Italics denote approved method)

Drop Ft.	Area Retarder Load	Time in Sec.	Load Lbs.	Load per Sq. Ft.	Retarder	Kind	Description of supplies and how packed	Condition after landing
500	13	11	18 (22)	1.4 (1.7)	45"x45" 4-shroud burlap chute	Assorted cans	11 cans, mostly No. 2 and some tall No. 1 cans in 12"x18"x4" box suspended flat. Only 1 layer of cans, all standing up.	2 No 2 raspberry OK; 1 Karo OK; 1 lb. chocolate slight dent, OK; 1 No. 2 peas OK; 1 No. 2 peas, slight dent, OK; 2 tall peach OK; 2 tall peach dented, OK; 2 No. 2 corn, dented (1 badly) OK; box OK
500		9	2		Gunny sack free	Lard	3 lbs. lard in paper wrapper in 25 lb. sack in gunny sack.	Paper wrapper broken, OK. Suggestion: 4-5 lbs. packed the same way.
500			16		Wool-sack trailer	Bread (white) sliced	*1 doz. loaves bread in gunny sack suspended flat under wool-sack trailer tied in 3 places at one end. Bread packed as shown next column.*	3 loaves loose at top end of load, wrappers broken, OK; 1 loaf in single sack, OK; 2 loaves in single sack, wrappers broken, OK; 3 loaves in single sack, wrappers broken, OK; 3 loaves in 1 sack, wrappers broken, OK. All bread OK.
500	3	18	2	0.7	28" braced gunny sack	Butter	1 lb. butter in wrapper, whole pounds. 1 lb. butter in cardboard box in ¼ lb. each full pounds in small sack put into 28" braced sack.	OK; wrappers not broken; shape retained. Suggestion: Try 3 lbs.

TABULATION OF DROPPING TESTS

(Italics denote approved method)

Drop Ft.	Area Retarder Sq. Ft.	Time in Sec.	Load Lbs.	Load per Sq. Ft.	Retarder	Kind	Description of supplies and how packed	Condition after landing
	22		40	1.8	Wool-sack, double ender	Sawdust	2—20-lb. sacks of sawdust suspended flat, one on each end of wool-sack, not opened. Loads tied in 3 places so as to keep chute flat. Suggestion: In this kind of chute, sticks of wood should be tied to ends of sack to keep it flat.	Chute worked OK and opened up well in a half circle with load on each end. Quite effective. Chutes used later, however, are easier to handle and discharge
600	13		12.5 (15)	1.0 (1.1)	45"x45" burlap 4-shroud chute	Assorted cans	10 cans on a board; twine tied around the group. No burlap or sack. Bundle tied around and suspended flat. Board 12"x14"; 12½-lb. cans, 2½-lb. board	3 tall apple butter OK; 1 tall apple butter slight dent, OK; 1 tall peas OK; 1 tall tomato slight dent, OK; 1 tall tomato OK; 2 No. 1 corn OK; 2 soup OK. Suggestion: Board should be 12"x12"
600	56	21	19 25	0.34 0.45	90"x90" square *chute* made of 2 lengths of 45" burlap sewed together	6-man standard cooking outfit	*6-man kit. 5 loaves of bread in a sack drawn fairly tight was tied underneath as a pad. All set into a gunny sack. 90"x90" chute.*	Bread, which had been dropped before, remained OK. Cooking kit without any dent at all anywhere. Perfect. OK.

TABULATION OF DROPPING TESTS

(Italics denote approved method)

Drop Ft.	Area Retarder Sq. Ft.	Time in Sec.	Load Lbs.	Load per Sq. Ft.	Retarder	Kind	Description of supplies and how packed	Condition after landing
600	22	15	25.5 (33)	1.2 1.5	Wool-sack double ender	Assorted cans	32 assorted cans packed on end in two 12"x18"x4" boxes, each with a c partition and hung from each end of a wool-sack. flat. One hung by wire hook, other by twine through holes bored in the four sides of the box. Each box in a gunny sack, tied tightly. No top on boxes. We'ght of cans 25½ lbs., weight of boxes 8 lbs; total 33 lbs. Some burlap in bottom of boxes. Somes of the milk had been dropped before.	Box No. 1: 1 No 2 peach badly dented, OK; 1 clam slight dent OK; 1 small milk, OK; 2 small milk slight dent, OK; 1 No. 2 pears *opened up;* 4 small milk, OK; 1 small milk dented, OK; 1 tall peaches, slightly dented, OK; 1 Log Cabin slight dent, OK. 1 Log Cabin OK. Box No. 2: 1 No. 2 pear dented, OK; 1 tall peaches, OK; 1 small milk *opened up;* 5 milk, OK; 1 No. 2 peaches, OK; 6 small milk, OK; 2 small milk dented, OK; 1 clams slight dent, OK. Out of 32 cans, 2 lost. Note: This is an efficient retarder, but not so convenient to handle.

TABULATION OF DROPPING TESTS

(Italics denote approved method)

Drop Ft.	Area Retarder Sq. Ft.	Time in Sec.	Load Lbs.	Load per Sq. Ft.	Retarder	Kind	Description of supplies and how packed	Condition after landing
500	30		24	0.8	5½'x5½' chute 4-shroud	Assorted No. 2 cans	19 assorted No. 2 tins placed on a 17"x17"x⅛" plywood board. Group tied around with twine. Board tied square with tins on top and suspended. Chute made of 45"x67" burlap and one gunny sack opened up and sewed onto it along one edge. 4 shrouds as long as diagonal.	Some tins fell out high up with load upside down before chute opened up and package did not land properly. 5 cans fell out and smashed; 14 cans OK; board OK. Suggestion: Put a board on top to prevent cans from falling out.
500	56		30	0.55	90"x90" chute	Fresh vegetables	*30 lbs. vegetables, each large head of cabbage, cauliflower, lettuce in separate bag, each bundle radishes, carrots, etc., in separate bag; all in gunny sack suspended flat to 4-shroud 90"x90" burlap chute made of 45" burlap, board along side inside gunny sack. Shrouds as long as diagonal.*	3 cabbages OK; 3 lettuce OK; 3 cauliflower OK; 2 carrots OK; 2 turnips OK; 3 radishes OK. Board OK; no blemishes whatever.
500	13	18	11	0.8	45"x45" burlap chute 4 shrouds	Assorted No. 2 cans	9 No. 2 cans on 12"x12"x⅛" plywood board suspended flat	All tins OK, no dents; board OK
500			2		Gunny sack free	Pickles in glass jars	2 small glasses pickles, each in sack and wrapped in cloth. All in loose tied gunny sack.	1 glass pickles OK; 1 glass pickles OK

TABULATION OF DROPPING TESTS

(Italics denote approved method)

Drop Ft.	Area Re-tarder	Time in Sec.	Load Lbs.	Load per Sq. Ft.	Retarder	Kind	Description of supplies and how packed	Condition after landing
	48		30	0.6	82"x82" wool-sack chute 4-shroud	Dry foods	30 *lbs. dry foodstuffs, some in cellophane. Each item in separate sack, all in flat suspended gunny sack in wool-sack chute*	5 lbs. rice, cellophane broke, OK; 3 lbs. spaghetti broke, OK; 5 lbs. sugar, paper, broke, small sack had small hole, OK; 3 lbs. spaghetti, cellophane, broke, OK; 5 beans, sack broke, OK; 2 pkgs. raisins, OK; 1 pkg. shredded wheat, pkg. OK but contents pulverized; 3 lbs. prunes, cellophane broke, OK; fastening to sack broke through 4" of burlap and pkg. fell free all the way; all contents OK except shredded wheat.
500	48	8	26	0.55	6½'x7¼' wool-sack chute 4-shroud	Assorted tins, No. 2	21 *cans No. 2 on* 18"x18"x⅛" *plywood board. Nearly all of these tins had been dropped before. Suspended flat in* 6½'x7¼' *wool-sack, 4-shroud chute. (Boards should be* 17"x17" *with smaller board loose on top)*	Chute tore loose; pack fell free and only 8 badly dented cans left. I think this was tied by canvas webbing which broke when chute opened.
500	48	26	9	0.2	7' wool-sack chute 4-shroud	Water	2—½ gal. square tins filled with water nearly full. Sack 4½ lbs. Both on a board.	Tins and water OK. 1 very slight dent.

TABULATION OF DROPPING TESTS

(Italics denote approved method)

Drop Ft.	Area Retarder Sq. Ft.	Time in Sec.	Load Lbs.	Load per Sq. Ft.	Retarder	Kind	Description of supplies and how packed	Condition after landing
500	48		12 (19½)	0.25 (0.4)	7' wool-sack chute	Water	1 back pack can 7½ lbs. with 12 lbs. water in it. Can in original carton with board in bottom inside.	Can and water OK
500	13	23	6.5	0.5	45"x45" burlap chute	Gas lantern	1 gas lantern in original carton only. Weight 6½ lbs. Suggest: (*Put gas lantern in wool-sack chute.*)	Top of reservoir buckled some but lantern OK. This would be OK in larger chute and with bread pad under.
500			1		Gunny sack free	Gas lantern mantles	*1 pkg. gas mantles wrapped around with several muslin sacks all in loose tied gunny sack*	Mantles OK
500	48	6	33	0.7	7' wool-sack	D. B. axes	*6—3½-lb. swamping axes in regular box. Padded between and on top of bits. Gunny sack around bottom. Lead under bottom tied to end of handles. All tied to wool-sack chute.*	Load tore away from chute; canvas webbing used for tie ripped; no good; load fell free. 5 axes OK; all bits OK and sharp; 1 handle broke but bit OK; box broken, but did not open. This would land fine even in a smaller chute.
500	48	21	22 (29)	0.45 0.60	Wool-sack chute	Water	22 lbs water in back pack can on wool-sack chute	Can opened slightly along lower back seam in bottom and leaked some; not a suitable shape for dropping. Can had been dropped before.

TABULATION OF DROPPING TESTS

(Italics denote approved method)

Drop Ft.	Area Retarder Sq. Ft.	Time in Sec.	Load Lbs.	Load per Sq. Ft.	Retarder	Kind	Description of supplies and how packed	Condition after landing
500	48	18	26	0.55	Wool-sack	Assorted No. 2 cans	21 cans all No. 2 except 2 tomatoes No 2½ cans. Total 26 lbs. Placed on a board 18"x18"x⅜". Board should be 17"x17"x⅜".	All OK; board OK
500	48	25	18	0.38	Wool-sack	Sugar	2—9-lb. sacks sugar in 50-lb. sacks each, all in gunny sack on wool-sack chute.	All OK
500	48	12	2		Gunny sack free	Salt	1 carton salt in small sack padded by large sacks wrapped around, all in gunny sack, no chute, but yellow streamers.	Top of carton loosened some; salt OK.
500	48	25	13	0.27	Wool-sack chute	Oranges	13 *lbs. of small, hard oranges in 12"x24"x4" box with c partition. Burlap tied on top box. Suspended flat in wool-sack chute.*	A few oranges fell out high up and were mashed; all that stayed in box were OK; box OK. Suggestion: Put loose board on top of box
500	48	25	23	0.5	Wool-sack chute	Shovels	6 *shovels tied in a bunch suspended (tied in one place only) at center of gravity by twine to wool-sack chute. No wrapping.*	All shovels OK. Suggestion: Should be able to handle 12 shovels, which would be about all the dropper could manage.
500	48	25	?		Wool-sack chute	Saws, 6'	2—6' *saws with ½" plywood board on each side, 2" wider on each side and 4" longer. Bolts through handle holes and boards. lowered in bridle tied to ends and suspended flat. Cutting edges in rubber hose.*	Saws OK; boards OK. Suggestion: *Probably only 1 board on bottom needed*

TABULATION OF DROPPING TESTS

(Italics denote approved method)

Drop Ft.	Area Retarder Sq. Ft.	Time in Sec.	Load Lbs.	Load per Sq. Ft.	Retarder	Kind	Description of supplies and how packed	Condition after landing
500	48	28	10	0.21	Wool-sack chute	Grapefruit	*1 doz. grapefruit in 12"x18"x4" box. Burlap around on top. Some wrapped in small sacks suspended flat.*	OK. Suggestion: Put loose board on top.
500	56	24	22	0.38	90"x90" chute	Pickles and jam in glass jars	*6 jars pickle and 2 jars jam placed on ⅛" board. Placed board on top of 4 loaves bread in sack, all suspended in 90"x90" chute. Also put smaller loose board on top to prevent load from falling out. Jars wrapped with cloth.*	OK.
500		11	2		Gunny sack free	Coffee	2 lbs. coffee in paper bag in small bag, in gunny sack.	Paper sack broke; coffee OK.
500	56	20	40	0.71	90"x90" chute	Water	*3 gals. water in 3-gal. milk can placed in rope harness in 90"x90" chute. A board was cut to fit inside and flush with bottom flange of can.*	Water OK; can OK.
500	48	20	14 (18)	0.3 0.38	Wool-sack chute	Eggs	*9 doz. eggs placed in half crate square box used for packing eggs on horses. Ordinary separators used. Filled rest of box on top with rags. I think I had a bread pad underneath.*	Eggs OK; out of 108 eggs, 2 had small crack, but none of these was leaking. Probably could have lowered the full crate with eggs.
500	56	8	54	0.98	90"x90" chute	Milk	1 case milk in regular cardboard box suspended flat. Note: Case probably caught too much air. Possibly shrouds too short. We lowered same weight later in single layer in smaller chute.	Chute did open but did not spread out. This was too much weight for the chute? Would require larger chute? 1 doz. cans in bottom opened, rest dented. Cans in top layer good, only 1 can dented. Load fell very fast.

TABULATION OF DROPPING TESTS

(Italics denote approved method)

Drop Ft.	Area Retarder Sq. Ft.	Time in Sec.	Load Lbs.	Load per Sq. Ft.	Retarder	Kind	Description of supplies and how packed	Condition after landing
500	48		19 (23)	0.4 0.48	Wool-sack chute	Assorted cans	14 cans mostly No. 2 in wool-sack chute, in flat box 12"x18"x4". A loose board on top.	These two loads of cans were thrown out simultaneously; chutes opened fine without interference; all OK. Most of cans thrown out before.
500	48		19	0.4	Wool-sack chute	Assorted cans	15 cans No. 2 mostly, but including some smaller cans and 1 small Log Cabin and 1 No. 2½ tomato and 2 square 1-lb. chocolate cans placed on side (with pressed lids) in flat box, loose board on top.	
500	48	17	35	0.7	Wool-sack chute	Gravel	Gravel in gunny sack	OK
500	48	17	40	0.8	Wool-sack chute	Gravel	Gravel in gunny sack	OK
500	48	14	45	0.9	Wool-sack chute	Gravel	Gravel in gunny sack	OK
500	48	14	50	1.0	Wool-sack chute	Gravel	Gravel in gunny sack	OK
500	48	14	50	1.0	Wool-sack chute	Gravel	Gravel in gunny sack	Chute with 6" hole cut in top keeps load from swinging, but is liable to enlarge and fray after use. On the whole does not seem worthwhile.
500	48	14	55	1.1	Wool-sack chute	Gravel	Gravel in gunny sack	OK
500	48	14	60	1.2	Wool-sack chute	Gravel	Gravel in gunny sack	OK
500	48	14	60	1.2	Wool-sack chute	Gravel	Gravel in gunny sack	Chute with 6" hole OK.
500	98		80	.80	Wool-sack chute	Gravel	Gravel in gunny sack	2 chutes tied to sack; OK.

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Drop Ft.	Area Retarder Sq. Ft.	Time in Sec.	Load Lbs.	Load per Sq. Ft.	Retarder	Kind	Description of supplies and how packed	Condition after landing
500	145		100	.73	3 wool-sack chute	Gravel	Gravel in gunny sack	3 chutes tied to sack: 1 opened a little after the other two: OK
500	48		100	2.05	Wool-sack chute	Gravel	Gravel in gunny sack	2 chutes in tandem. Upper one failed to open and unroll, as it fell at about the same speed as load. Both chutes tied to sack and separated by 25 ft. approximately: OK.
500	48	6	100	2.05	Wool-sack chute	Gravel	Gravel in gunny sack	2 chutes in tandem. Upper one again failed to unroll and single chute brought load down OK.
500	48	17	37	0.76	Wool-sack chute	Axes, D. B.	*6 D. B. axes in regular hinged box. Handles tied at top and ropes around bottom of box lead out at top inside tie-twine. Padded between and on top of bits.*	All axes OK; all edges OK; box OK except hinge bent a little.
500	48	19	27	0.55	Wool-sack chute	6 men kit	*6-men standard cooking outfit placed on a board with a bread pad under.*	Kit OK; no dents; bread OK.
500	48	17	33	0.67	Wool-sack chute	Propane gas tank	*1 propane gas tank loaded, hose disconnected. Tied in rope harness.*	OK
500	48	15	51	.98	Wool-sack chute	Assorted No. 2 cans	*34 No. 2 cans with a few tall No. 1 mixed in: assorted cans on a 22"x22"x ⅜" board on bottom and a loose 18"x 18"x⅜" board on top. Twine tied around the cans, lowered flat.*	OK; no dents whatever.

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Drop Ft.	Area Retarder Sq. Ft.	Time in Sec.	Load Lbs.	Load per Sq. Ft.	Retarder	Kind	Description of supplies and how packed	Condition after landing
500	48	19	32	0.65	Wool-sack chute	Water	*3 gals. water in milk can. Board inside bottom flange. Total weight 32 lbs.*	OK
200			25		Free	Hoe handles	*Gunny sack full of handles tied around and pushed out. 4 loads dumped at fire camp.*	OK
500	48	17	51	1.03	Wool-sack chute	Potatoes	1—50-*lb. sack of potatoes, roped across ends and side. No board under. Sack suspended on side.*	45 lbs. OK; 5 lbs. bruised or cracked but usable. Suggestion: A board underneath would keep ropes from cutting into sack.
500	48		11	0.22	Wool-sack chute	Gas lantern	*1 gas lantern in original carton set on board and bread pad.*	Lantern OK; pad fell off. Bread OK.
500	48	16	33	0.67	Wool-sack chute	Fresh vegetables	*1 sack full of cabbage, cauliflower and lettuce, each head in canvas bag, all in roped gunny sack lowered on side. No board under. Suggestion: Put lettuce so it will be on top.*	All vegetables OK. Board on bottom would prevent any possibility of rope cutting into load.
500	48		70	1.42	wool-sack chute	Water	17½ lbs. water in each of 4 Osborne rubber bags, each in knapsack and in gunny sack. Each suspended from one free shroud, so one load at each corner of wool-sack as opened up. Suggestion: This would probably have been OK if each sack had been tied close to corner, leaving out shrouds. These caused yawing and swinging of individual sacks collapsing retarder.	This load was shapeless and a little hard to handle. Sack opened and collapsed alternately. 3 bags had holes in them, 2 near bottom valve, 1 OK. If sacks had been laid flat probably OK, but in this shape could not handle them. Best way to lower 2 to 4 sacks on side in gunny sack or box.

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(Italics denote approved method)

Drop Ft.	Area Retarder Sq. Ft.	Time in Sec.	Load Lbs.	Load per Sq. Ft.	Retarder	Kind	Description of supplies and how packed	Condition after landing
500	48		9	0.19	Wool-sack chute	Water	2—½-gal. tins filled with water. Square cans. Placed on top of small board and loose board on top. Suspended on wool sack.	OK; tins had been thrown out before; slight dent in one.
500					Free in gunny sacks	5-gal. tins (cooking)	*5-gal. tins, each in gunny sack, all sacks tied together at top and spaced about 1 foot; no chute.*	Winthrop test. All cans had slight dent. 1 leaked some. Wash basin in single sack OK. Same with single Pulaski tool, with bit wrapped in 2 layers of heavy canvas.

All the following packages were dropped over dense woods. Trees about 100 feet tall. Most loads had streamers attached to chute and some had snubbing line hanging from bottom with and *without weights.*

500			16 18 20 25		Wool-sack chute	Cans Potatoes Ham Bacon	3 packages of cans in flat boxes each package weighing from 16 to 20 lbs. and 1 sack with about 25 lbs. of potatoes. Boxes 12"x18"x4". 3 loads had streamers about 30 ft. or more long. *23 lbs. in sacks all in gunny sack wool-sack chute.*	These all were watched while falling, and landing place with reference to target (snag) noted on diagram made in the air. These all fell within 50 feet as mapped. All fell to the ground, except 1 load which hung up to tree by chute about 15 to 20 ft. above ground and was pulled down by throwing pilot line rope through shrouds. Pilot line weight caught on limb of another one. It took 5 min. to find

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(Italics denote approved method)

Drop Ft.	Area Retarder	Time in Sec.	Load Lbs.	Load per Sq. Ft.	Retarder	Kind	Description of supplies and how packed	Condition after landing
								3 loads; it took 10 min. to find the one hanging on the limb, which had no streamer. Streamers were yellow and quite effective. All contents OK; all boxes OK.

4 boxes and boards with canned goods weighing 20 to 30 lbs. with 150 ft. *yellow streamer attached to each.* Each in wool-sack chute. Streamer sawed out by cutting bolt with bandsaw. Farmer picked up 3 loads and said that none hung up. The fourth load was never found, but we suspected to a dead moral certainty that this load landed squarely in the farmer's pantry. Loads OK

3 boxes and 1 sack. None hung up except one chute on lower branches from where it was easily pulled down by shrouds. Plumb line caught another and load was hanging in it near ground. *Plumb line with weight not so good.* All these loads were found in a few minutes and streamers helped considerably. All contents OK. Ham and bacon in sack.

3 boxes and 2 sacks. Took about 5 minutes to find packages. *Load* 1, *guide line* not completely unravelled off stick. *Better to wind it in ball shape without stick.* Chute on top of bush load on ground. *Load* 2 hung up one-third way up a tree. Guide line fell on top of bush, pulled the pack down by it. *Load* 3 chute and all caught near top of tree, where we had to climb up and get it. Streamer could be *plainly seen from air on top of tree. Load* 4 on ground. Streamer on tree. *Load* 5 *trial load for ascertaining wind direction and strength for correcting dropping. Fell in open field. All contents OK. Out of 17 loads thrown down in the timber, only 1 was out of reach from the ground.*

FOREST SERVICE RADIOPHONE EQUIPMENT

A. Gael Simson

Radio Engineer, Region 6

Year by year the use of radio in forest fire control grows greater. Continuous study and work by competent men connected with the Forest Service Radio Laboratory in Portland, Oregon, has made available to the Service and to other forestry agencies a series of radio instruments splendidly suited to our peculiar requirements. In this article they are fully described.

Following is a description of the short-wave radio equipment developed by the Forest Service for use on the National Forests. The weight data are for complete outfits ready to put in operation, and include batteries. The high-frequency equipment may be built to operate on any frequency between 2,000 and 20,000 kilocycles, although the Forest Service usually operates in the vicinity of 3,000 kilocycles. The ultra-high frequency may be built to operate on any frequency between 30 and 50 megacycles (30,000 to 50,000 kilocycles).

Requisitions for Forest Service radio equipment and correspondence on technical matters should be addressed to: Regional Forester, Box 4137, Portland, Oregon.

Type P Radio Unit

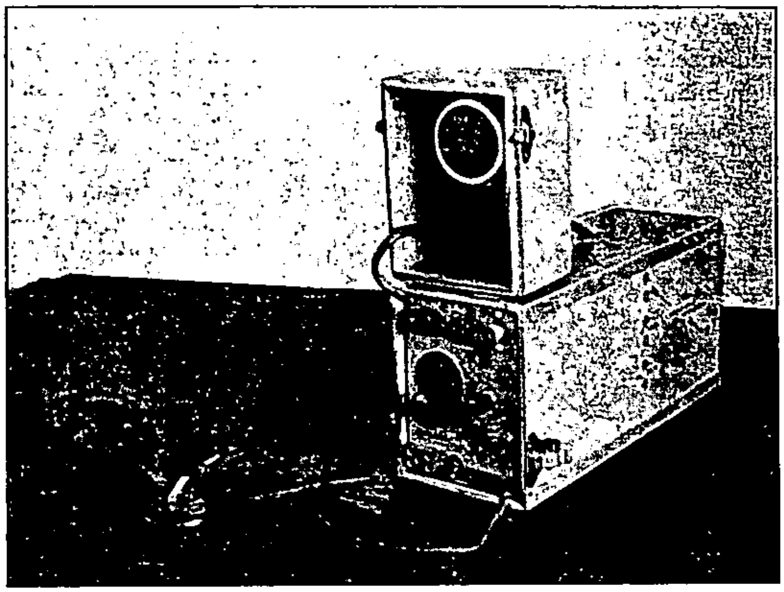
Transmits code (c. w.) only, but receives both voice and code. Its rated working range is 20 miles. This set was primarily designed for smokechaser use in extremely rugged country, where the last word in portability is essential. The complete unit weighs only about 9 pounds, but, because it does not transmit voice, has only a limited use.

Type PF Radiophone

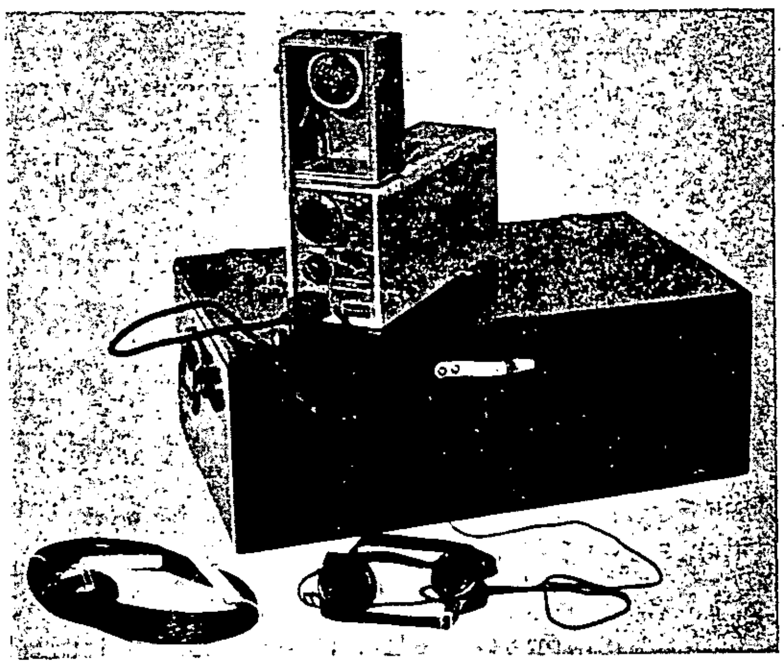
The type PF radiophone transmits and receives both voice and code. It weighs about 15 pounds, and has a rated working range of about 10 miles on voice and 20 miles when code is used. The PF was designed primarily for use by smokechasers and the like where reasonably compact and portable voice communication is required. These sets are often carried by road and trail crews, rangers, and other traveling forest officers, on fire trucks, and in some instances are made a part of fire outfits of 25-man size and larger.

PF Kitbox

The PF kitbox is a small chest containing heavier batteries than are regularly furnished with the PF radiophone and a half-wave antenna for semi-permanent installation. A compartment is also provided to house the PF radiophone. The kitbox, batteries, and antenna, exclusive of the PF



Type PF Radiophone

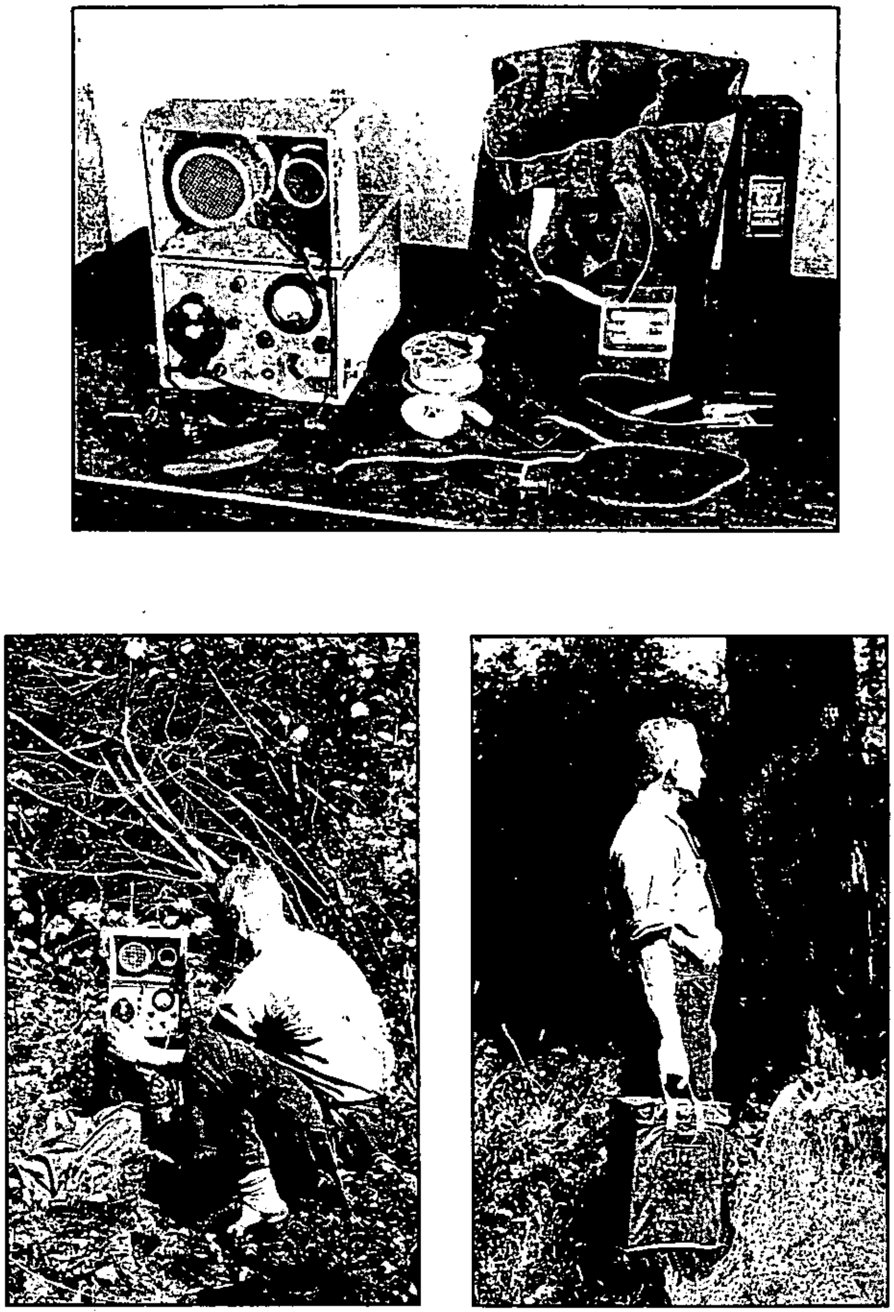


Type PF Radiophone with kitbox

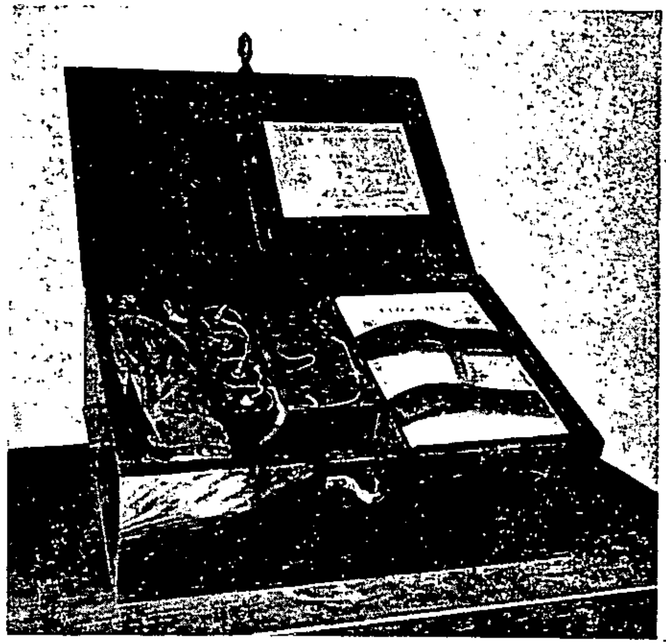
radiophone, weighs about 35 pounds. The PF kitbox, together with the PF radiophone, were primarily designed to serve secondary lookouts (lookout firemen), small fire crews, and small construction or maintenance crews. In such lookout use the half-wave antenna is permanently installed at the lookout and the PF radiophone plugged into the batteries contained in the PF kitbox. Then, should the lookout need to take his radio set to a fire, it is only necessary to unplug the PF kitbox battery cable, drop the set into the PF radiophone bag, which already contains batteries and a short antenna, and he has a complete 15-pound voice set ready to go. Another illustration of the use of this equipment is the case of a small road camp that had a PF set as the only means of communication. In camp they used the permanently installed half-wave antenna and the kitbox batteries, but during bad fire-weather periods, when working some little distance from camp, they carried the 15-pound radiophone outfit out on the job each morning and set it up to keep contact with the fire detection organization during the day and brought the set into camp each evening after work, where it was again hooked up for the evening and early morning schedules. This saved holding the men in camp during dangerous fire weather.

Type SPF Radiophone

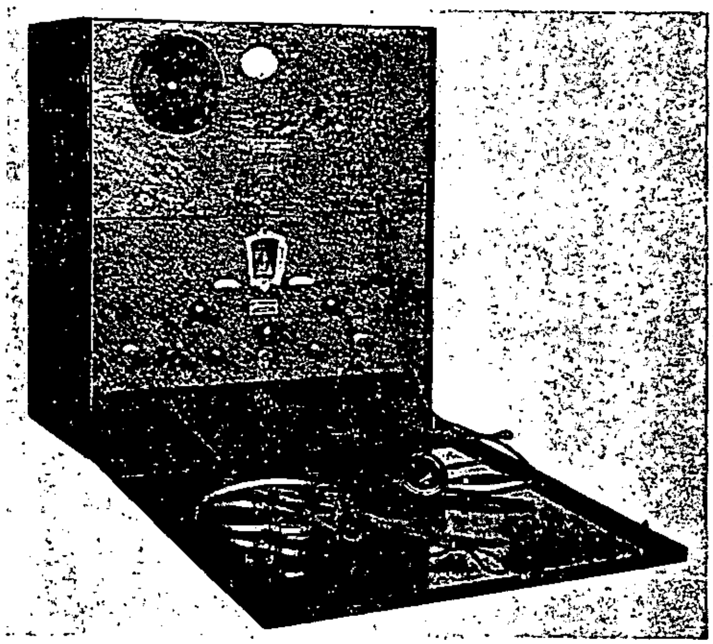
This unit employs the same transmitter as the PF. The receiver section is entirely new, and is a sensitive 5-tube superheterodyne which requires less skill to operate than is necessary with the PF receiver. It can be operated on the same batteries as the type PF, that is, with "portable" or "kitbox" batteries. It is not recommended that "portable" batteries be used, except in emergency, as the battery drain is greater than on the PF. This unit is suitable for "stand-by" operation with "kitbox" or heavy-duty batteries, as it has a built-in loudspeaker. The SPF has a definitely greater communication range than the PF, and is recommended to take the place of the PF where back packing is unnecessary, or at most where it is limited to short distances. The SPF, with carrying bag and portable batteries, weighs about 20 pounds. With kitbox and both "kitbox" and "portable" batteries the weight is approximately 58 pounds. The SPF kitbox is similar to the PF kitbox. Unless otherwise specified, the SPF will be furnished with kitbox and semi-portable batteries (Burgess No. 5308 or General No. V-30-B, or equal) and with portable bag and accessories, but without portable batteries. The type SPF is recommended for field use in preference to the types P or PF wherever the additional weight of the type SPF is not objectionable.



SPF Radiophone



SPF Radiophone with kitbox



Type M Radiophone

Type M Radiophone

The type M radiophone has been consolidated and simplified so that the transmitter, receiver, and loudspeaker are all built in one unit. It is a voice and code transmitter-receiver, weighing about 125 pounds. The rated working range is about 50 miles. The receiver is a highly selective superheterodyne. At present Hammerlund Comet Pro. USFS Model is being used. The type M operates on a 110-120 volt, 60 cycle A. C.—ordinary commercial current—not on batteries or other direct current power. It may be plugged into any light socket or outlet where alternating current (A. C.) is available. Where 110-120 volt A. C. is not available, either of the two portable generator units listed below may be used as a source of power for the type M. The M radiophone has been especially designed for communication with the field from Supervisors' headquarters and central equipment depots, and for use as a central communication station on large project fires.

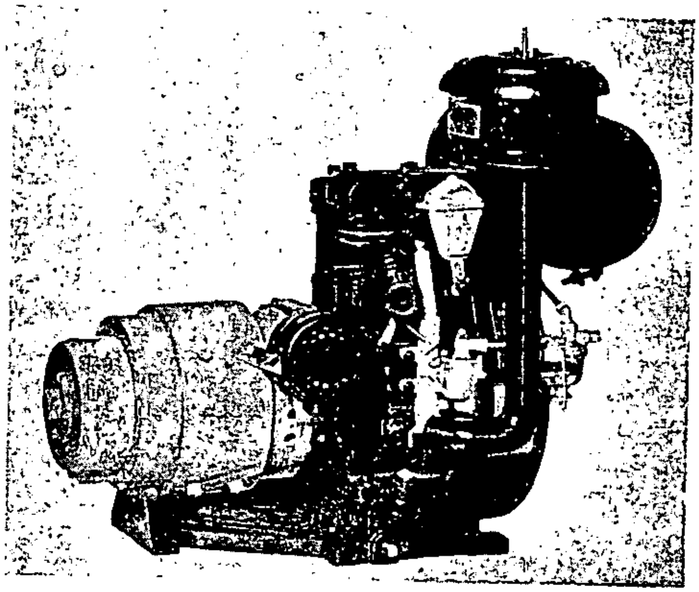
Type M sets may be expected to cause interference over a radius of several hundred miles, and should never be used except where lower powered sets will not furnish satisfactory communication. Where M sets are used they should be adjusted to emit the minimum power that will give satisfactory service.

Portable Generators

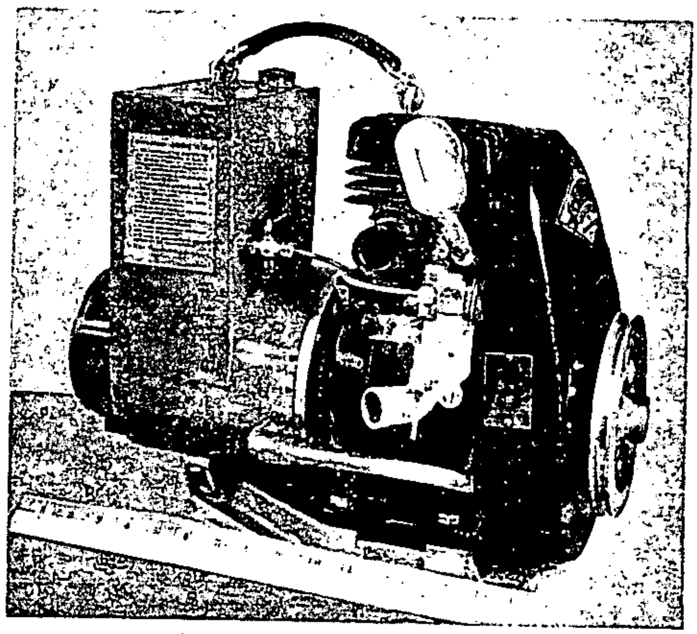
Two portable generator units are commercially available for use where commercial A. C. electric current is not available. Each consists of a self-excited, self-regulated A. C. generator driven by a Briggs & Stratton gas engine, which will supply current to operate the type M radiophone and any ordinary A. C. receiver of the short-wave or all-wave type. The 500-watt unit weighs about 90 pounds and the 700-watt unit weighs about 105 pounds. The 700-watt unit is recommended because of greater capacity and dependability.

Ultra-High Frequency Radio Equipment

Ultra-high frequencies (UHF) have the limitation of being good only over optical, or nearly optical ranges. For example, usually it is not possible to communicate between two points when the optical path between the antennae at the respective stations is obstructed by a hill or mountain. But where it is possible to use UHF equipment it offers many advantages over the ordinary short-wave radio. There is practically no fading or static; the equipment can be made quite light and compact; the antenna is short, being of the order of 15 feet; receiver battery drain is small enough so that "stand-by" operation of battery receivers is possible. By using one



700 Watt Generator



500 Watt Generator

frequency for transmitting and another for receiving a pair of stations may be operated "duplex," that is, talk and receive simultaneously.

UHF lends itself admirably to linking up emergency lookouts with the regular lookout system. It has also been used successfully for communication nets on large project fires.

Two-way communication with moving vehicles is also possible

UHF operation is still quite new. Almost daily new tubes, parts, and technique are being developed. In order to keep step with this progress and take advantage of new developments in circuits and parts, the Forest Service is making sweeping revisions in its ultra-high frequency equipment at relatively frequent intervals. Therefore, the following description of Forest Service UHF radiophones may be out of date shortly with respect to equipment details, though the same general types herein listed will be continued in a gradually improved form.

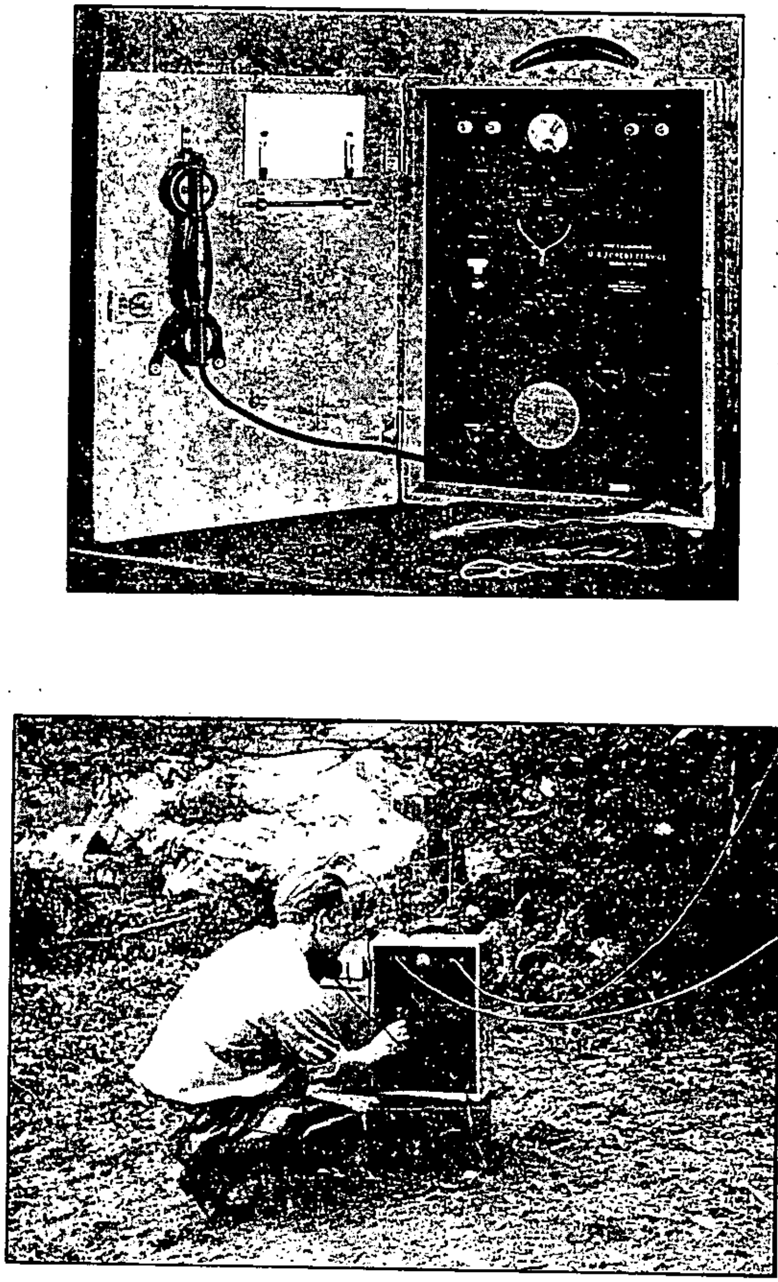
Type T Radiophone Transmitter-Receiver (UHF)

The type T radiophone transmits and receives voice only. It weighs from 50 to 100 pounds, depending on the type of batteries used. Rated working range is about 100 miles over *optical paths*. The set is designed for stand-by operation, and has a built-in loudspeaker. With this set it is possible to talk and receive simultaneously when working with another type T or U radiophone. Numerous battery combinations are available depending on the type of service. In ordering specify whether for long period stand-by or intermittent service. If for intermittent service, a battery box will be supplied to carry medium weight batteries. If long period stand-by service is indicated, the set will be shipped without battery box but with battery diagram indicating proper connections for various types of heavy batteries.

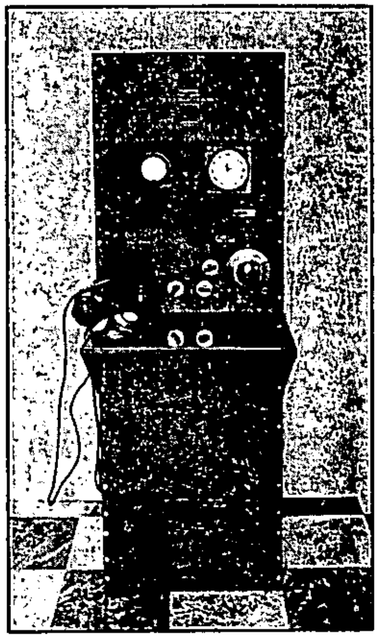
Due to the several battery combinations possible and the cost of shipping batteries, the heavy duty batteries will not be supplied unless specifically requested. Ordinarily they can be purchased locally.

Type S Radiophone Transceiver (UHF)

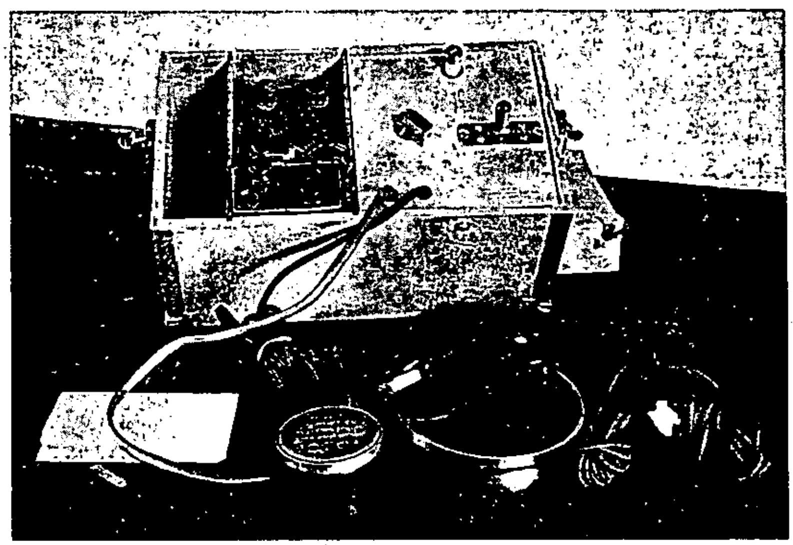
The type S radiophone transceiver transmits and receives voice only; it weighs about 8 pounds. The rated working range is about 50 miles *over optical paths*. Working with antennae close to the ground over level ground the range may be reduced to no more than 3 or 4 miles. This set will not work duplex, as the same circuit it used for both transmitting and receiving. It has been used by smokechasers and by scouts and fire chiefs on large fires. Its principal features are its portability and the quickness



Type T Ultra High Frequency Radiophone



Type U Ultra High Frequency Radiophone



Type S Portable Ultra High Frequency Radiophone complete with all accessories with which it may be put in operation. Type S sets have occasionally been used for two-way communication with moving vehicles.

Type A Radiophone (UHF)

The type A radiophone has been especially designed to meet Forest Service requirements in airplane use. It can be installed in practically any type of plane without special tools or mechanical skill; will communicate plane-to-ground over limited distances even in unshielded planes. Weight of complete radiophone, including dynamotor but exclusive of storage battery, is about 40 pounds; operates from a 6-volt storage battery or from the storage batteries regularly incorporated in most airplanes.

The type A radiophone lends itself to automobile installation for two-way communication from moving vehicles under favorable topographic conditions. Unless specifically requested, a storage battery will not be furnished with the unit, as it can best be purchcased locally.

Type U Radiophone

This is an A. C. operated ultra-high frequency radiophone transmitter-receiver especially intended for central station use, such as at central fire dispatcher offices. The unit is 19 inches wide, 4 feet 9 inches high and 12 inches deep. The approximate shipping weight is 300 pounds. It has an output of about 20 watts. No antenna is furnished with the unit, as the antenna for each installation should be built at the location where the set is to be used to conform to the physical limitations of the location. Wherever the outlying stations to be communicated with are all within one general direction from the U set (an arc of 180 degrees or less) directional or "beam" antennae should be used.

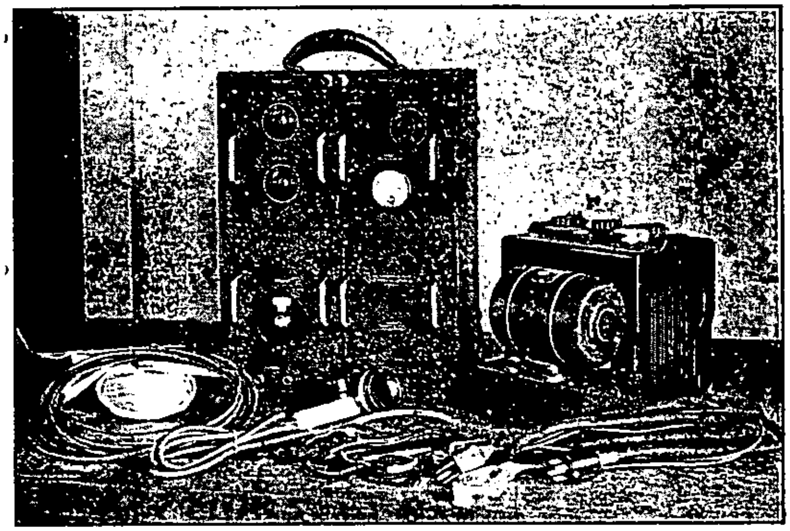
The outstanding feature of this unit is its simplicity of operation. When a call is received on the stand-by loudspeaker it is only necessary to pick up the handset to answer. Lifting the handset automatically turns on the transmitter.

The U set communicates with the types T, S, A and U radiophones and works "duplex," that is, talks and receives simultaneously with the type T and other U sets.

Radio Channels (Frequencies)

The first thing to be done by any agency contemplating the use of radio is to determine whether or not a suitable radio channel is available. If such a channel is available permission must be obtained to operate on it.

There are two closely related radio channel authorizing agencies: (a) the Interdepartment Radio Advisory Committee (IRAC), which allocates



Type A Ultra High Frequency Radiophone

channels within the bands of frequencies set aside for Government use by Executive Order; and (b) the Federal Communication Commission (FCC), which administers all non-federal Government radio communition.

The Forest Service deals with the IRAC, which is made up of representatives of the several Government departments, and not with the FCC. Therefore, all Forest Service radio matters which ultimately must be referred to the IRAC or FCC should be taken up with the appropriate Regional Forester, who, in turn, will take them up with the Chief, Forest Service, if necessary. In no case should letters be addressed directly to the Federal Communication Commission. Questions of purely technical nature should be referred directly to the Regional Forester, Portland, Oregon, by the Regional Forester.

All non-federal Government agencies must obtain station licenses from the Federal Communication Commission, Washington, D. C., before attempting to operate radio transmitting equipment. A separate construction permit and a license is necessary for each radio transmitter, regardless of how small or low-powered it may be. Each station must be operated by or under the direction of a licensed radio operator. The operator requirements vary with the class of service and transmitter output power.

HELD LINE PRODUCTION

Theodore Shoemaker

Fire Control, Region 1

Held line is the line on which successful work is done to stop the spread of a forest fire. It may be the edge of a grass or brush fire which has been "swatted" out or "cold trailed," a scraped ribbon of bare soil a few feet from the edge of the fire or a scraped or plowed line which, when constructed, was fifty feet or more from the edge of the fire. Any portion of any such line which is abandoned and replaced by relocated control line becomes "lost line" and no longer counts as held line. When fully thought through, fire suppression, a major division of fire control, is found to have as its objective the production of held line. To start such production quickly after the start of a fire and continue it efficiently until the fire is corralled is the heart of fire suppression—it *is* fire suppression. Creative fire control thinking, after neglecting the management of held line production for thirty years, is at last turning seriously to the problem. Any effort to get at the facts is confronted not only by the inherent complexity of the subject but also by the lack of clarity and accuracy in records and—worst of all in the procedures under which such facts are recorded in our fire reports. The author opens up this problem and points out some of the elementary things which must be done before we can even get a firm grasp of the facts.

Now that we have got around to start a study of held line production and to make a special drive to increase the output, isn't it time we looked at the formulas for computing it? Look at Form 929 on this point.

Isn't it quite within the range of probability that a variation of from 25 to 50 per cent exists right now just because of a difference in the way different men are computing the rate of held line production?

In line 17 we are instructed to exclude "travel time" in determining the "approximate number of man-hours . . . to corral." What travel time? In line 19 the instructions say to "Exclude *primary* travel time," and "Include all men on the fire—laborers, cooks, F. O.'s, etc.," in determining the output per man-hour. We might assume the interpretation would be the same in both these cases, but probably it is not. If it is intended they should be the same, why shouldn't it be made to read the same, or else cover it in the "Explanatory Notes" at the bottom of the form? If interpreted the same, the answer in line 19 could easily be found by dividing the difference between chains built and chains lost (line 18) by the first item in line 17. That is the logical way to do it, but is it the way it actually is done in all cases? I doubt it very much.

Then there is the question of time used in mop up, prior to the time of corral. We are not told either to include this or exclude it. Is there any assurance that everybody is including it in arriving at the man-hour production rate? Again I doubt it. Indeed there may be good arguments for not including it.

What are we trying to get from these figures, anyway? Do we want a measure of how much line those men build who are actually building line, or do we want to get a measure of the efficiency of the whole job, up to the crucial point of corralling the fire? In the one case, we might be studying the efficiency of the equipment in use, or of the equipment combined with the ability of the men directly in charge to organize and supervise actual line building; or both of these combined with the character of the labor in use on the fire (ERA or CCC as against hired fire fighters, or Spokane lumberjacks against sidedoor Pullman tourists, etc.). In the latter case we might be getting the measure of the ability of the fire boss and the section boss in disposition of men as between actual line building and camp duties, or as between workers on the line and water carriers, or as between line builders and line holders, or as between travel time from camp to the fire and the time actually engaged on the line.

As will readily be seen, these are entirely defensible reasons for variations in any of these items; and when we put them all together it tends to rob the figure of meaning because excellence in one feature of management or the advantage of more favorable fuels, even within the same resistance class, may easily offset or obscure the effect of poor equipment or unbalanced use of men to the extent that a poorly managed job will look like the best. Everyone knows the camp cannot be so close to the fire in one case as in another, and that the proportion of man-hours on mop up, under the best of management, will vary accordingly to the severity of weather, the slope, and the character of the fuels.

So what? Merely that we have in the output per man-hour only a very general basis for comparison as between individual fires, forests, and Regions, or as between this year and preceding years, but not a measure of the efficiency of the equipment or the men or the overhead in actual line construction.

If we want this figure to stand for more than that, then we shall need to break the items down so they will show how many hours go into camp work, into water carrying, into travel between camp and the line, and into holding line prior to time of corral. If we are going to use it to compare current output with that of previous years, we will have to take into account the effect of heavier manning to meet first work period objectives, for inevitably output per man will drop as numbers engaged increase.

I do not know the answer to these questions. I do know that what we are after is the greatest output that can be attained; and I very strongly suspect that this will be approached through careful attention on each fire to man-power distribution, to the quality of supervision and to tactics and technique, including elimination of useless work and choice of the equipment and methods best adapted to the condition involved. Output on fires of comparable fuel resistance, and of equal numbers of men engaged will increase as men in the overhead, through analysis of action plus actual experience on fires under competent direction, learn where lost motion is likely to occur and how to prevent its occurrence. Here again I suspect the place to find out what is holding down held line output is on the fires rather than from the figures on the reports, although the latter may be very valuable as a means of measuring progress if they are obtained by clearly defined formulas.

Lookout Visibility Betterment and Bugs—Extract from a Region 5 Insect Control Report. "Early in 1936 about 200 ponderosa pine trees were cut on Folsam Peak (Stanislaus National Forest) to improve visibility from the lookout station. These trees became so heavily loaded with bark beetles that it was decidedly advisable to treat them. This was done with ERA labor at a cost of about $512." in addition to the prior cost of felling.

If the cutting had been done to create trap trees, the bugs would probably have let them alone. But in this and other instances, clearing is not a finished job if coniferous tree trunks are left, unpeeled and unburned as happy homes for Mama Dendroctoni and the babies, or Mama Ips and their offspring.

Estimates and plans for jobs of felling patches of timber which obscure the view may well provide for cleaning up of material which otherwise may become the starting point of a bad bug infestation, especially if the trees to be cut are conifers. This clean-up process might require peeling and burning of bark or decking and burning of timber which is not too large for such treatment. Cleaning up is also usually needed to prevent an unsightly mess.—*E. E. Carter, Forest Service, Washington, D. C.*

POWER-DRIVEN SAW

G. W. DUNCAN

Equipment Engineer, Region 1

Here is presented the story of the development and performance of a tool which may go a long way to displace slow and fatiguing hand and back work. The comparative costs are remarkable and the speed-up of the saw-crew work should have great appeal to fire bosses.

The first tests of power-driven saws in Region 1 were made in 1934. Results indicated that the "Wolf Portable Timber Sawing Machine," manufactured by the Reed-Prentice Corporation, had greater possibilities for Forest Service work than other gasoline or electric saws tried out. It was determined that by making changes in the carburetor, oiling system, clutch and the volume of air for cooling, tempering of teeth, and reducing the weight, the machine would develop into an important unit for fire control and snag clearing.

During the winter of 1935 the following changes in construction were made:

(1) Flywheel was cut to increase air draft over cylinders, and a section between each air-driving fin cut out to permit centrifugal force to act, thereby increasing air draft. (2) Two 9-ounce pieces cut off of center section of crankshaft to lighten it. (3) An aluminum carburetor installed which cut the weight over two pounds and permitted finer adjustment. (4) Entire lubricating system rebuilt to obtain even and positive oil distribution. (5) Valve and ignition timing reset.

Tests were made durng the winter of 1935-1936, sawing 250 cords of wood. Trouble with the carburetor and clutch continued, and as a result the carburetor was changed and a new type clutch was developed.

Three Wolf saws were in use in Region 1 during the 1936 season. These machines are equipped with 5 horsepower (at 1800 to 2400 r.p.m.), 4-cycle, air-cooled Reed-Prentice motors. The motor weighs 47 pounds; the entire unit weighs 85 pounds. The new type hand-grip controlled clutch, center balance handles for double cutting, oiling gun, crank case oiling feature, reversible blade, and new type carburetor have greatly improved the efficiency and practicability of the machines. All of these features have been developed by Mark Forrest, mechanical expert of Region 1.

The first test in 1936 was made in May on the Columbia and Deschutes National Forests in Region 6. The saw used was the Region 1 improved model with new type clutch and a two-foot blade. Results were an average of 2.8 cuts per minute in timber from 5 to 11 inches in diameter.

A regular sample fire line was cut during the test runs which varied in width from four to eight feet. No peavy, pry pole, axe, hammer and wedges, or other forms of tools were used during the test. Logs which pinched down on the saw were double cut. Each log was completely cut in two before a cut was credited.

The test demonstrated the value of the saw with two-foot blade in small timber. Some trouble was experienced which made adjustments necessary, but as Mark Forrest operated the saw, these were quickly overcome. This test, however, gave rise to the question as to how efficient the machine would be in the hands of inexperienced operators, and those witnessing the test seemed doubtful that it could compete with an experienced saw gang when working under adverse conditions and with inexperienced operators.

Another test was conducted sawing fir trees, ranging from 4 to 6 feet, which were felled with the 3-foot saw by the double-cutting method. The largest tree measured 72 inches one way by 91 inches the other, and the area of the top of the stump was approximately 40 square feet. Sawing time was one hour,, which indicated that the use of the 3-foot blade was practicable and economical in large as well as in small timber.

Results of test up to January, 1936, showed clearly the value of the saw on forest work, but showed weaknesses as follows:

1. The engine would run only two or three hours when, because of poor distribution of oil in the crank case, piston rods were burned out and scored. This was overcome by installing a sight gauge to show if there was oil in the crank case and placing a small pump on an auxiliary oil tank to put oil in the case easily when the oil registered low on the gauge, without stopping the engine. Also, suitable dips were installed on the crank shaft to insure proper distribution of oil.

2. The carburetor was too sensitive and another type (Schebler M-GX-1) was put on. This carburetor is a little large, but by using a half throttle it worked satisfactorily. At present another smaller carburetor is being tried out which it is hoped will meet our needs.

3. Spark plugs fouled easily, and pistons were drilled to allow excess oil to drain back.

4. Magneto became oil soaked and fouled the breaker points. More efficient oil seals were installed to overcome this.

5. Intake manifold leaked air and had to be rebuilt so the packing glands could be screwed down to exclude the air which caused the engine to miss.

In August the saw was used on the Edna Creek Fire on the Flathead National Forest and on the Colt Creek Fire on the Kootenai. On the Edna Creek Fire the clearing gang left all logs over 4 inches in diameter for the power saw. One saw doubled the speed of a 25-man crew clearing fire line through heavy windfalls. The saws were also used for clearing trail between camp and the fire line for men and pack horses and on mop-up work on burning logs and snags. They were more efficient on the front line clearing, where there was more sawing and less moving than on mop-up work, which was scattered and required frequent moving.

In September a test was made on the Flathead felling snags. An average of 10 cuts per hour was made during actual sawing time in fire-killed larch timber.

A check on six experienced average saw gangs over a period of several days on the same work disclosed that the best that the top gang could accomplish was 16 trees in an 8-hour day, or two cuts per hour.

This test on the Flathead revealed the fact that more improvements must be made on the clutch, since out of a possible 206 sawing hours, 67 hours, or 32 per cent of the time, was lost because of clutch trouble. At first a copper disc was installed which worked satisfactorily for 10 or 12 hours and then developed slippage until the plate wore out. A certain amount of slippage was necessary to give proper operation, and it was necessary to develop a disc that would give this slippage and yet would be lasting. In August a representative of the Velvetouch Products Company called at this office regarding clutch material for tractors. Our problem was described and a sample of the clutch disc desired was sent to the factory at Cleveland. A test clutch disc was made up by this Company, and after five days' use no trouble had developed; the clutch was taken apart and found to be in good condition.

The Flathead tests were started by Mark Forrest but turned over to inexperienced men who have been developed into operators.

In October the saw was run for 111 hours, sawing timber averaging 26 inches in diameter, much of the time on steep side hill, and in this time no trouble at all was experienced. An average of 11.4 cuts were made per hour.

The actual sawing hours of the three Wolf saws operating a 2-foot blade in this Region, to October 30, 1936, are as follows.

No. 1	256 hours
No. 2	337 hours
No. 3	210 hours

After this use the motors are in first-class condition, start easily, and develop practically as much power as when first put into service. The only trouble now experienced is with the ignition, because the wiring becomes damaged by rough usage. This is a very minor problem, however, as the wiring is inexpensive and easily replaced.

No heating of motors is now experienced, because of the type of oil dips developed on the crank shaft to distribute oil and the cutting away of sections of flywheel, which increases the air draft over the cylinders. Also because of the intermittent service required of a saw motor, heating is not a problem. It is not believed that this motor could be used for pump service where a full, steady load is required.

To illustrate the possibilities for reduced costs and increased production on road construction, snag clearing, roadside cleanup, hazard reduction, as well as on fire control, the following comparison of operating costs of the Wolf power saw and a hand saw gang is shown below.

Operating Costs Per Hour

	Wolf Power Saw	Cross Cut Saw Gang
Gasoline, 2 pts. per hr. in heavy sawing	0.10	......
Oil, 1 qt. per hr. for motor and saw	0.04	......
Upkeep, saw chain (600 hours)	0.10	......
Clutch lining (200 hrs.)	0.03	......
Miscellaneous	0.03	0.01 (filing)
Operators (based on 60c. an hr.)	1.80	1.20
Depreciation (est. life 2000 hrs.)	0.37	......
Depreciation (est. life 500 hrs.)	......	0.01
TOTAL	2.47	1.22
Average No. cuts per hour	10	2
Average cost per cut in timber averaging 26 inches	0.25	0.61

The above is believed to represent a conservative estimate of the savings to be made over old methods by using the power saw. Even though the saving were only 50 per cent of the amount estimated, however, it would still represent a great saving in clearing costs, to say nothing of the time conserved, particularly on fire line construction, where speed is such an important factor.

An ordinary cross cut saw has to be filed every day. The teeth on the chain saw need filing only every three days. The time required to file each is about the same.

Conclusions

1. Two radical changes must be made to obtain desirable efficiency of the power saw unit, namely, (a) sufficient horsepower to handle a 4-foot

blade for large timber, and (b) reduction of the width of the blade to reduce the kerf cut by the saw.

(a) The present Reed-Prentice 4-cycle 5-horsepower engine has sufficient power to run satisfactorily a 2-foot saw with a 3/8-inch kerf, but is not quite powerful enough for a 3-foot saw, and is entirely inadequate for a 4-foot length. The use of the center balanced handles makes it possible, however, to double cut large trees, and by this method the 2-foot blade will handle trees up to 54 inches in diameter, and the 3-foot blade will cut trees up to 78 inches in diameter. The center balanced handles permit the use of three additional inches of the saw. For this reason the use of the 4-foot blade is not advised at this stage of development of the saw because the extra weight of the 4-foot blade makes it impossible to double cut, and if double cutting is not possible, the 4-foot saw will not cut over a 4-foot tree, while the 3-foot saw will handle a 6½-foot tree by double cutting.

(b) If a saw with a narrower kerf, say 5/16 inch, is developed it probably will be found that the present Reed-Prentice 5-horsepower motor will handle a longer saw. The Pacific Marine Supply Company is working on the development of an inserted tooth chain to secure a narrower kerf.

(c) If a 4-foot blade is desired, and a 9-horsepower motor be needed to handle this length of blade, it will be necessary to go to a 2-cycle, air-cooled type in preference to the 4-cycle, as the former will be lighter per developed horsepower.

(d) Because no manufacturer could promise definitely that a 2-cycle air-cooled motor of 9 horsepower will be developed, the plan now is to air cool a Pacific Marine Type Y 9-horsepower motor on the Northern Pump at the engineering shop in Missoula and apply it to the saw. The work will go forward at once. This hand-built model may not be satisfactory in all respects, but should prove its practicability. If it should prove sufficiently promising, patterns and casts will be made with proper fast-cooling metal and an attempt made to interest some manufacturer in building them. If this motor can be air cooled on the pump, where a constant load condition exists, it should easily handle the chain saw where the service required is intermittent.

2. Even at this stage of its development the saw can be utilized to much greater extent on forest work. For this reason, it is recommended that more of the 24-inch and 36-inch saws be put into operation for the following reasons:

(a) If there were a greater demand, manufacturers would be more interested in developing the machine to conform to our needs, and the price would be lowered if production were increased. At the present time it takes 10 weeks to get one of the Reed-Prentice models.

(b) I see a real need for the saw on road construction where clearing is to be done in advance of construction, which is the present policy of the Region. If, as indicated in the last test made on the Flathead, 3 men and a Wolf saw working in 20- to 30-inch timber will do as much work as 11 sawyers in an 8-hour day and the cost per day for the saw crew is $19.76 as against $53.68 for the saw gangs, the saving in one month of 25 working days will amount to $850.00.

These, of course, are estimated figures, but being entirely familiar with clearing costs where the work is done in advance of construction and camp equipment and subsistence supplies for large crews, as well as hay and oats for the pack string, have to be packed in for long distances, I believe these figures to be conservative.

Where work is done by CCC and ERA labor there is not so great an argument in favor of the power saw other than to speed up the clearing on certain areas in order to complete the job within certain time limits.

By having a more varied use for the saws, more of them could be put into service, and they could be concentrated for fire duty during the summer and used on snag clearing and road clearing in the spring and fall. More varied use would reduce the cost by reducing the amount of depreciation to be charged off because of obsolescence while they are not in use.

COUNTY NEWSPAPER SUPPORT

FRED B. MERRILL

State Forester, Mississippi

Seldom do we hear of a really *new* way to get the fire prevention message carried. This is one. These issues of the county newspapers carried many columns of effective copy, and each advertisement, large and small, was highlighted with a forceful slogan. The printed word, from local sources, carries weight. This ingenious method calls for vigorous application, generally.

Low-paid stand-by crews and other fire control members of the Mississippi Forest Service personnel feel sometimes that the town people are not interested in fire protection work. To offset this, the editor of every county paper in 17 counties, containing 5,000,000 acres of potential forest land under protection through the State Forest Service, was contacted by the local county ranger, with the idea of getting our special publicity during Mississippi Conservation Week, February 1-5, inclusive.

The Rangers expanded on the idea of town support for county forest protection, and asked the editors for a list of their advertisers, and if they would insert a forestry slogan free of charge in every advertisement. In every case the insertion was granted, and the Ranger then approached the advertisers with the same story, asking for increased or new advertising space.

The result was that the Rangers brought the editors between $10 and $200 worth of new advertising, and the special editions, when published, contained so much forest fire prevention propaganda that any reader must be impressed. The Rangers spent from one to six days on these special editions.

It seems that the results have more than justified the expense, not only through letting the protection personnel and county people know that the towns were interested in what they were doing, but in selling the various editors, thus assuring better publicity for the regular news releases.

EMERGENCY LANDING FIELD FLARES

C. S. CROCKER

Fire Inspector, Region 1

With the increasing use of airplanes for transportation of men and supplies comes the problem of night landings on remote fields. Last summer Region 1 undertook a study of night lighting adapted to their peculiar needs, and in this article describes practical selected equipment.

Demands for rapid control action on fires bring into play all modes of travel. The faster the travel, the smaller the bill for the whole operation.

This supposition (if it may be called such) caused numerous landing fields to be built in those areas not readily accessible by ground travel. Experience has taught even the confirmed landlubber the value of these fields in making possible the quick delivery of shock troops to absorb the overloads of fire work which frequently occur. Many potentially bad fires have been nipped in the A stage by men whose stomachs were still revolving to the rhythm of an airplane propeller. However, our air deliveries cease when the sun sets, and we must lose one-third of the 24-hour day on account of darkness.

After being balked by darkness several times, Region 1 started investigating the field of lighting devices. We had 20 landing fields, all unusable from 9:00 p. m. to 4:00 a. m. Calls for smokechasers usually reach headquarters during the late evening, since most of the bad situations develop during the afternoon. Waiting for daylight to dispatch the plane precludes the possibility of control before the peak of the next morning period. We need lighted fields in the forests—hence, our search for lights.

Electrical equipment was investigated but found too expensive for consideration. Carbide and gasoline flood lights were searched for, but nothing worthy of consideration was discovered.

Flares were studied and experiments made. Some designed for dropping from planes are not suited to our use. They are fire starters, and are subject to drift in strong winds. Furthermore, such flares cost $60 to $80 each. Our efforts were next pointed toward obtaining a ground flare. Some of these proved inadequate in volume of light, some gave dull light which exaggerated shadows, and others burned out too quickly. One proved satisfactory. It is a magnesium candle flare made by the Newmanlite Company for emergency use on landing fields. It has a rated candle power of 75,000 to 80,000, and burns three minutes. It will adequately illuminate an ordinary field, and also will light up the surrounding country for a mile sufficiently to eliminate the need for boundary lights.

Several landings have been made with these flares. Best results are obtained by using large metal reflectors mounted on tripods which hold the candle at least five feet above ground. This reflector serves a dual purpose. It focuses the light on the desired area, and it acts as a curtain to prevent glare to the incoming pilot. The latter is important, since the light is intensely bright and blinding to anyone facing it. (Its brightness is comparable to that of 500 single-mantle gasoline lanterns.)

Two reflectors, stationed on opposite sides of the runway near the end from which the plane will land, are arranged so the beams of light will intersect at a point three-fourths of the way down the runway. This minimizes shadows made by weeds and other obstructions to light.

One flare is lighted and the attendant, recording the time of its start, crosses to the second flare. The pilot begins maneuvering into position for his glide to the runway. The flare attendant waits two minutes, then lights the second flare. The pilot now has one minute in which to land with the advantage of two flares. If he is late, he still has two minutes to go with one flare.

Satisfactory landings are made with only one flare. In using two, we provide insurance against a failure in one candle and also eliminate the shadow difficulty. It increased the period of illumination from three to five minutes. That last minute *may* be important.

It is necessary that a trench be built around the tripod, and as additional precaution a shovel should be handy. These flares are most incendiary.

We are experimenting with acetylene and gas in an attempt to develop a longer burning light.

NATIONAL FOREST FIRE CONTROL COSTS

M. R. SCOTT

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Many sharp differences and trends are unveiled by this presentation of comparative costs. There is material here for much interesting study.

The tabulation below, computed by the Division of Fiscal Control, presents the complete costs of fire control in the Forest Service by Regions for the fiscal years 1934, 1935, and 1936. Subdivisional cost analysis of the main activity is afforded by the breakdown into prevention, presuppression, and suppression.

Prevention includes the cost of educational, admonitory, hazard reduction, and law enforcement work.

Presuppression includes the cost of organization and allied expense up to the point where action starts to suppress actual or reported fires.

Suppression includes the cost of suppressing actual fires; work in connection with false alarms; damage appraisal necessary for preparation of fire reports, and reconditioning of fire tools and equipment after use in suppression work.

The full cost of the various Forest Service activities was not available until the fiscal year 1934, when the present cost accounting system was put into effect. Prior to that time the data included only the current year's expenditures for any given activity. Such expenditure figures alone do not give a true picture of the costs of an activity such as fire control.

The tabulation shows not only the direct expenditures but the "cost adjustments," which are composed of general expense or burden properly chargeable to this particular activity. Cost adjustments include the following items:

(a) Maintenance of fire control improvements.

(b) Fire control's share of maintenance of general improvements, such as ranger station improvements, roads, trails, telephone lines, etc. Distribution is made on the basis of hours of direct labor contributed to the activity by Forest officers.

(c) Depreciation on fire control improvements.

(d) Depreciation on equipment used for benefit of fire control. The amount is computed on basis of use applied at standard rates per hour or mile for motorized and other large equipment, and on basis of original cost of small tools and equipment applied only at time they are worn out, broken, or lost.

(e) Fire control's share of depreciation on general improvements, such as ranger station improvements, roads, trails, telephone lines, etc. Distribution is made to activities concerned on the basis of hours of direct labor on such activities by Forest officers.

(f) Value of Civilian Conservation Corps enrollee and similar labor used on fire control work where such expenses are not paid from allotments to the Forest Service. For the fiscal years concerned this procedure applied in all cases, except Region 10 and Puerto Rico in Region 8. The value was placed at $1.50 per effective man-day. The following table shows the total amounts involved in such CCC and related labor:

Region	F. Y. 1934	F. Y. 1935	F. Y. 1936
1	$ 1,600.00	$275,721.09	$ 67,859.22
2	176,185.40	264,984.95	74,974.50
3	1,434.88	12,339.25	11,172.60
4	40,385.90	39,029.25	56,338.91
5	482,650.23	407,608.04	335,390.03
6	23,504.34	95,973.02	254,255.42
7	58,915.35	116,685.50	209,138.08
8	83,520.27	258,076.48	370,046.26
9	115,454.58	563,599.78	424,262.27

For readers unfamiliar with the geographic subdivision of the Forest Service organization, the Regions are described herewith:

Region 1: Montana, northern Idaho, northeastern Washington, and northwestern South Dakota.

Region 2: Colorado, western Oklahoma, Nebraska, Wyoming, and South Dakota, except for northwestern portion.

Region 3: Arizona and New Mexico.

Region 4: Utah, southern Idaho, Nevada, and western Wyoming.

Region 5: California and southwestern Nevada.

Region 6: Oregon and Washington.

Region 7: Kentucky, Maine, New Hampshire, Pennsylvania, Vermont, Virginia, and West Virginia.

Region 8: Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, eastern Oklahoma, Puerto Rico, South Carolina, Tennessee, and Texas.

Region 9: Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, North Dakota, Ohio, and Wisconsin.

Region 10: Alaska.

FIRE CONTROL COSTS PER GROSS ACRE—BY REGIONS

Given in cents per acre to nearest mill

	R-1	R-2	R-3	R-4	R-5	R-6	Av. R.1-6	R-7	R-8	R-9	Av. R.7-9	R-10	Av. R.1-10
F. Y. 1934													
Prevention:													
Expenditures	.001	.001	.000	.000	.012	.002	.003	.008	.003	.003	.004	.000	.003
Cost adjustments	.001	.003	.000	.001	.011	.005	.003	.015	.006	.026	.014	....	.004
Total cost	.002	.005	.001	.001	.023	.008	.006	.023	.008	.029	.018	.000	.006
Presuppression:													
Expenditures	.013	.002	.003	.002	.015	.013	.008	.005	.014	.017	.013	.000	.008
Cost adjustments	.018	.011	.007	.008	.034	.037	.019	.030	.043	.012	.030	.000	.018
Total cost	.031	.013	.009	.010	.049	.050	.027	.035	.057	.030	.043	.000	.025
Suppression:													
Expenditures	.003	.000	.002	.000	.005	.002	.002	.004	.005	.020	.010	.000	.002
Cost adjustments	.000	.000	.000	.000	.009	.001	.002	.005	.007	.019	.011	.000	.002
Total cost	.003	.000	.002	.000	.014	.003	.004	.009	.012	.039	.021	.000	.004
Total Fire Control:													
Expenditures	.017	.004	.005	.003	.033	.017	.013	.017	.022	.041	.027	.000	.012
Cost adjustments	.019	.014	.007	.008	.053	.043	.024	.050	.056	.057	.055	.000	.023
Total cost	.036	.018	.012	.011	.086	.061	.037	.067	.078	.097	.082	.001	.036
F. Y. 1935													
Prevention:													
Expenditures	.004	.003	.000	.000	.008	.002	.003	.007	.002	.004	.004	.000	.003
Cost adjustments	.005	.010	.001	.001	.019	.005	.006	.042	.009	.018	.017	....	.007
Total cost	.009	.013	.001	.001	.026	.006	.009	.049	.011	.022	.021	.000	.010
Presuppression:													
Expenditures	.014	.002	.004	.004	.015	.018	.010	.009	.012	.015	.013	.000	.009
Cost adjustmets	.031	.008	.011	.009	.047	.034	.023	.062	.063	.029	.049	.001	.024
Total cost	.045	.010	.014	.013	.057	.052	.033	.071	.075	.044	.062	.001	.033
Suppression:													
Expenditures	.046	.001	.002	.011	.015	.010	.015	.005	.004	.003	.003	.000	.012
Cost adjustments	.009	.001	.000	.002	.011	.003	.004	.003	.008	.006	.006	.000	.004
Total cost	.055	.003	.002	.013	.025	.013	.019	.008	.012	.008	.010	.000	.016
Total Fire Control:													
Expenditures	.063	.007	.006	.016	.038	.029	.027	.021	.018	.022	.020	.000	.024
Cost adjustments	.046	.019	.012	.012	.072	.042	.034	.107	.081	.053	.073	.001	.035
Total cost	.109	.026	.018	.028	.109	.071	.061	.129	.098	.075	.093	.001	.058
F. Y. 1936													
Prevention:													
Expenditures	.004	.001	.000	.000	.010	.003	.003	.009	.006	.004	.005	.000	.003
Cost adjustments	.006	.002	.000	.001	.017	.007	.006	.026	.020	.014	.017	.000	.007
Total cost	.010	.004	.001	.001	.027	.010	.009	.035	.026	.018	.023	.000	.010
Presuppression:													
Expenditures	.026	.002	.004	.006	.024	.021	.014	.021	.023	.018	.020	.000	.014
Cost adjustments	.038	.010	.012	.012	.048	.044	.028	.087	.082	.033	.055	.001	.030
Total cost	.065	.012	.016	.018	.071	.065	.042	.108	.104	.051	.075	.001	.043
Suppression:													
Expenditures	.006	.002	.002	.010	.008	.006	.006	.007	.008	.003	.005	.000	.005
Cost adjustments	.002	.001	.000	.00[illegible]	.005	.006	.003	.009	.013	.004	.007	....	.003
Total cost	.009	.003	.003	.011	.012	.012	.009	.016	.021	.007	.012	.000	.008
Total Fire Control:													
Expenditures	.036	.005	.007	.016	.041	.030	.023	.038	.036	.026	.030	.001	.022
Cost adjustments	.04[illegible]	.013	.013	.014	.070	.057	.036	.122	.115	.050	.080	.001	.040
Total cost	.083	.018	.020	.030	.111	.086	.059	.159	.151	.076	.110	.001	.062

In computing the costs for Regions 1 to 6 and Region 10, the gross acreage is the total area within National Forest boundaries.

For Regions 7, 8 and 9, however, a different system was employed: For the fiscal year 1934 the acreage consisted of the net National Forest area plus areas approved for purchase. For fiscal years 1935 and 1936 acreage consisted of the total area within the established protection boundaries.

In arriving at unit costs the following acreages were used:

Region	F. Y. 1934	F. Y. 1935	F. Y. 1936
1	26,560,286	26,651,296	26,759,309
2	21,214,607	21,200,646	21,618,845
3	22,017,681	21,999,988	21,998,101
4	30,783,865	30,862,188	31,049,653
5	24,210,342	24,210,502	24,210,956
6	26,914,005	27,041,094	27,710,474
7	2,555,547	3,183,314	4,722,199
8	5,451,017	10,760,017	10,827,735
9	4,276,675	9,835,430	19,794,082
10	21,396,933	21,397,082	21,396,941
TOTALS	185,380,958	197,141,557	210,088,295

The fiscal year 1934, covering the period July 1, 1933, to June 30, 1934, includes the summer fire season of 1933 and the spring season of 1934, during both of which the fire situation was relatively favorable. The fiscal year 1935, covering the period July 1, 1934, to June 30, 1935, includes the particularly difficult 1934 summer and fall fire season and the 1935 spring season. The fiscal year 1936, covering the period July 1, 1935, to June 30, 1936, includes the relatively easy fire seasons in most Regions during the summer and fall of 1935 and the spring of 1936. The spring season of 1936 was, neverthless, an unusually severe one in Regions 7, 8, and 9.

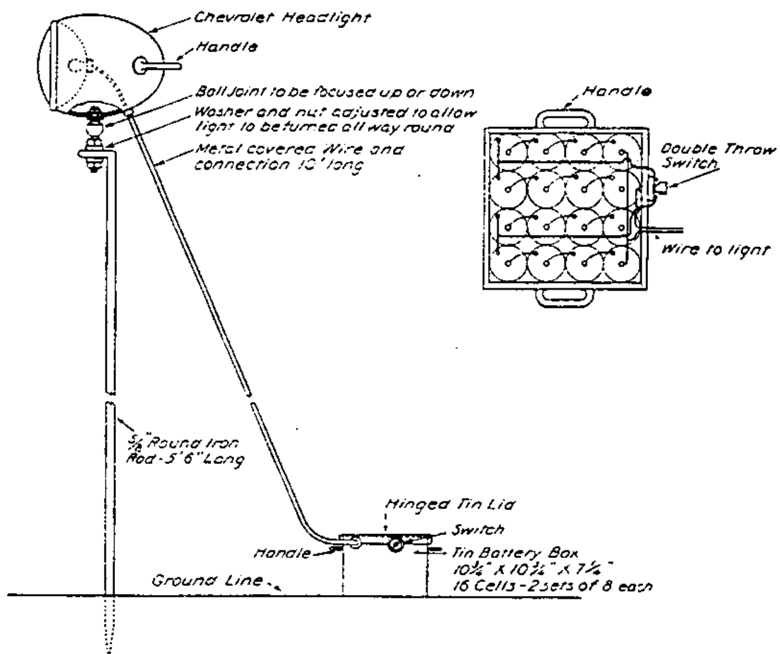
PORTABLE LIGHT FOR NIGHT CREW WORK

H. R. Ewing

Project Superintendent, Superior National Forest

To meet the need for a light weight portable lighting system for fire line construction at night, the rig here described was developed at the Partridge River Camp.

The attached sketch gives most of the details of construction. A pointed ⅝-inch round iron rod is used as a standard. It is bent at the top at a right angle, flattened and a hole drilled to take the support bolt of a Chevrolet headlight. Washers and nuts are used to adjust firmness of this connection and allow easy swing. The light has a ball socket which permits focusing of light up or down as needed. A metal covered insulated wire with



Portable electric light for night fire fighting

connection for light runs to tin battery box, which is large enough to hold 16 No. 6 cells. These are wired in two sets of 8 each, and can be switched from one set to the other whenever one set runs down. This avoids trouble in field of rewiring in the dark or failure of light when needed most. Socket connection to light can be removed when the light is to be moved any distance. Battery box is carried complete in pack sack, while standard and head lamp are carried in the hand. When continually moving, the battery box is carried in pack sack connected to light.

In tests of this light on the Markham Fire for night work it was found that one light could be used to advantage with a crew of 8 men on line work. To take complete advantage of the limited light supply, a double crew was used, one working for 15 minutes at top speed and resting while the other crew took its turn. It was found that one set of 8 batteries lasted from 6 to 8 hours.

The light is adaptable to any kind of fire crew organization as long as it is not expected to cover too much territory. It is best suited to a small, compact and well-organized crew moving along as a unit.

INFORMATION FOR CONTRIBUTORS

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

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

If there is any introductory or explanatory information it should not be included in the body of the article, but stated in the letter of transmittal.

Illustrations, whether drawings or photographs, should have clear detail and tell a story. Text for illustrations should be typed on strip of paper and pasted on back of illustration. All diagrams should be drawn with the type page proportions in mind, and lettered so as to reduce well. In mailing illustrations, place between cardboards held together with rubber bands. Paper clips should never be used.

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

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