VOL. 6 JULY 1942 NO. 3

FIRE CONTROL NOTES

A PERIODICAL DEVOTED TO THE TECHNIQUE OF FOREST FIRE CONTROL

FOREST SERVICE • U. S. DEPARTMENT OF AGRICULTURE

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

Volume 6 Number 3

FIRE CONTROL NOTES

A Quarterly Periodical Devoted to the TECHNIQUE OF FIRE CONTROL

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

Address DIVISION OF FIRE CONTROL
Forest Service, Washington, D. C.

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Much as we regret it, this will be the last issue of Fire Control Notes during the war. However, if you have any suggestions that might be helpful to others engaged in fire control activities, and will send them to the Forest Service, Washington, D. C., such data as seem to warrant it will be passed along to those most likely to be interested by including in administrative memoranda or by other means.

Erratum.—In the article by H. T. Gisborne, "Review of Problems and Accomplishments in Fire Control and Fire Research," Fire Control Notes for April, 1942, line 31, page 55 should read—"economic theory, but merely as a moderator of evener. This is * * *"

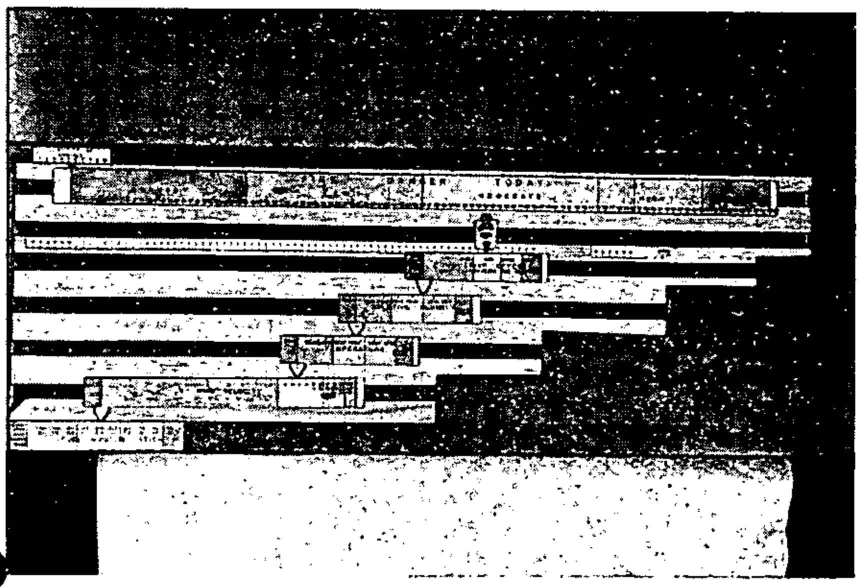
STREAMLINING THE R-2 FIRE-DANGER METER

Paul P. McCord

Assistant Supervisor, Pike National Forest, Region 2, U. S. Forest Service

"I wish we had our fire-danger meter so arranged that when all the component factor scales have been set the fire danger would be automatically shown." Thus spoke Mr. A. A. Brown of the Regional Office at the time of an inspection trip on the Pike last fall. Following some humor about connecting the scales to rheostats and other electrical gadgets, Messrs. Brown, Dakan (Project Superintendent, F–60 CCC camp), and I did some serious thinking about the matter without serving at any definite conclusion as to how it could be done. For a couple of months I amused myself at odd moments thinking through the possibilities of solving the problem by designing a meter that would be simple and cheap to construct, stand up well under use, have a certain amount of eye appeal and eliminate necessity for off side calculations either mental or scribbled.

Finally these ideas crystallized and the preliminary model shown in the accompanying photograph was constructed. As can be seen, the FIRE DANGER TODAY is indicated by the upper scale which contains 100 points. Below this, in turn, are scales for CUMULATIVE EFFECTS, RELATIVE HUMIDITY, TEMPERATURE, WIND VELOCITY, and FUEL MOISTURE STICK.



R–2 fire-danger meter.

(Continued on page 91)

FIRES IN ALASKA

J. N. Hessel

Information and Education, U. S. Forest Service, Washington, D. C.

When the heat's on in the timber and above the jangling of the telephone or the cracking of the flames you hear in strident, stentorian tones something like this: "I'm gonna quit this business and find me a place somewhere in the middle of a swamp"—you can figure you're in the presence of an experienced fire fighter and that everything is being well taken care of. The more stentorian and profane this proclamation, the more experienced the fire fighter is likely to be.

Top-notch forest-fire fighters go around making this fervent announcement all summer and brood about it all winter. None, or at least very few of them, ever actually do any thing about it. This also is typical.

And another item these heroes of the hot spots hold largely in common in this connection has to do with Alaska. In their most morose moments, Alaska is the land generally regarded as the utopian escape from all fire-control worries and troubles—a land where the need for fire control and the problems thereof drop to an irreducible minimum—a land where the forester can proceed with his anointed silvicultural endeavors unmolested and forget about forest fires once and forever.

Granted the opportunity of an extensive Alaskan junket with Dr. Dow V. Barter of the University of Michigan, and his student assistant Fred Walker, last summer, I set this matter down as one for special investigation.

Via the Alaska Steamship Line's S. S. *Alaska*, after stops at Metlakatla, Ketchikan, Juneau, Cordova, Valdez, and half a dozen isolated salmon canneries, we eventually arrived in Resurrection Bay and disembarked at Seward.

Anyone can see that the relationship between fish and fire, except for the alliteration of the two words, is almost purely antithetical. And after 8 days on the S. S. *Alaska*, during which I had talked fish, smelled fish, seen fish, eaten fish, and otherwise become so full of fish as to believe nothing else in Alaska commanded any attention, it was natural that on arrival in Seward the business of fire was farthermost from my investigative apparatus. The only connection was a nausea for fish the same as I had felt for fire in other times and climes.

On turning up at the Forest Service headquarters of the Kenai Division of the Chugach National Forest in the Federal Building in Seward, searching for one Emil "Whitey" Norgorden in charge, I was therefore due for a shock.

Ranger Norgorden, I was informed by office manager Joe Werner, was at Kenai Lake where he had been and where he would remain for the duration of the *fire season*. It was then late July, and as nearly as I could gather this meant from early June to early September, depending on the time of spring break-up and fall rains, just as in the Northern Rockies and Pacific Northwest.

Although an occasional fire is started by brush-burning homesteaders, by prospectors, or by sportsmen who travel far to enjoy the famed hunting and fishing of the Kenai country, the chief hazard—believe it or not—is a railroad. Also, believe it or not, it's a Government-owned railroad.

This railroad extends from Seward to Fairbanks, and the trains which run at odd, infrequent, and indeterminate intervals have at one time or another started whopping big fires practically from one end of the route to the other. One of the features of the line is the famous screw trestle which gets the road out of the valley and over the mountain in a hurry. This is a renowned scenic thriller for the sightseer, but to the Kenai ranger it's a pain in the neck.

The matter of screens on the locomotive smokestacks has never been satisfactorily settled. During the burning season a speeder patrol

F-94157

Forest fire along Iditarod River, Alaska.

after every train making the haul over the mountain is considered essential.

We traveled over the Alaska Railroad to Anchorage. In an office in the Anchorage Federal Building I found W. N. "Bill" McDonald and Roger R. Robinson representing the Department of Interior's Alaska Fire Control Commission. Bill, an old-time Alaskan, put in many years as a member of the Region 10 Forest Service organization, previous to taking over in Anchorage. Robinson, a graduate forester from New York State College, also previously served with the Forest Service in West Virginia, Colorado, and Alaska.

"Folks in the States have no idea of the fire job there is to do up here," they told me. "Here's Alaska with an area of 546,000 square miles, about a fifth the size of the 48 states. And outside the twenty-five-million-odd acres in the Tongass and Chugach National Forests, we're responsible for protecting the whole of it. We get a total appropria-

tion of between 30 and 40 thousand dollars—sometimes not that much. You can see what we're up against."

"Yeah," I replied, "but I've flown over much of the country and there must be a whale of a hunk you don't have to worry about. And besides, I can't see much need for spending a lot of money protecting any of it. As far as I can see all the good and accessible timber is along the coast in the national forests. What do we lose if this back country does burn over?"

"Look," said Bill, "you like to hunt migrating birds don't you? Well, this is where your migratory birds come from. They nest up here and when those nesting grounds burn over as they do, the answer is obvious—fewer birds."

F-17989A

Old burn in hemlock and spruce, Skagway Valley, Alaska.

"Sure," Robinson backed him up. "You've flown over a big area and you've seen a lot of rock and muskeg country that we don't have to worry about, it's true. But there's more of it you haven't been over. You haven't been up in the interior around Fairbanks. There's some good timber up there too, and timber means a lot to the isolated people mining and trapping and developing that area.

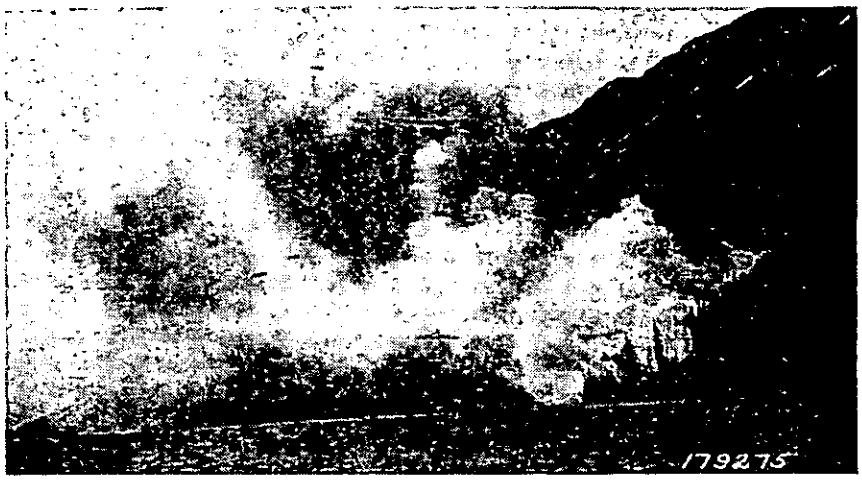
"Then take the case of the reindeer range. Reindeer are mighty important up here for meat and hides for the Eskimos and white population too. They're suitable for export, and the day may come when there'll be enough of them to make an important industry. But that'll never happen if we continue to let the range burn. A good stand of reindeer moss doesn't spring up over night. It's slow growing—a good thick growth takes years. But she burns just like grass once she gets started."

"Yeah," wound up Bill, "and don't think fires don't get started and don't burn. They start in the spring and burn all summer. Cover

thousands of acres every year. And we can't even spot 'em. We've got to depend on reports from prospectors or whoever happens to be in the country to know about 'em. Sometimes they burn for weeks before any word ever gets out to us.

"The only way we can get to 'em is by plane and we've got no planes. Once we get to 'em they're too big to handle with the few men we can hire to fight 'em. With our little money all we can do is hammer away at prevention.

"You go back to the States and tell 'em we've got a fire control problem up here that's a dinger. Tell 'em we've got to have more money, more equipment and specialized equipment, more manpower. Especially tell the sportsmen—they've got an immediate interest."



F-179275

Forest fire on Chugach National Forest, Alaska.

So it went. I heard about fires and saw evidences of past fires in Alaska. And on the way outside in middle September I had an opportunity to actually fight two fires where you'd least expect to find them—in the heavy rain forests along the southeastern coast.

After a day's run in the Ranger 8, one of the fleet of Forest Service boats, we were cruising in to a late anchorage in one of the countless small coves. Fred and I were in the galley cleaning up the evening meal dishes, and Fred was looking out of the shore-side porthole.

"Hey," he said suddenly, "look across there—there's a fire."

Taking a look I could make out a dim illumination. "Maybe it's just a beacon of some kind," I said. "I'll go up in the wheelhouse and take a squint through the glasses."

Up in the wheelhouse Skipper George Reynolds and Harry Sperling of the Juneau office had already spotted the light.

"It might be a gas boat on fire close to the shore," said Harry.

"Too high," said George.

"How about a settler's cabin?" I asked.

"Nobody along this part of the coast that I know of," replied George.

We were nearer now and daylight was growing very dim. Flames suddenly broke out brightly and raced up almost to the top of the shore line trees. "Just like fire going up into the crowns of a piece of timber," I thought. And then it dawned on me.

"That's what it is," I said. It's a fire in the timber."

Both George and Harry laughed. "You're in Alaska now, fella," said Harry. "It's a little different up here than down in western Montana."

Not long after, however, they incredulously came to agree with my opinion. Anchoring a safe distance offshore we put the dingy over and with pump, hose, shovels, Pulaski tools, and axes rowed in to a landing. Pushing through a dense growth of shore grass, head high and reeking wet, we emerged suddenly at the edge of the conflagration.

Under the thick canopy of great spruce trees the fire had caught the dry matting of needles and spread over about a tenth of an acre. The shooting flames we had seen was a run of fire up through the branches. With the exception of this one catch, which had been of brief duration, the crowns were apparently impervious. At the base of one of the trees were what we took to be the remains of a campfire—apparently how and where the blaze started.

Setting up the pump and coupling together enough hose to reach all parts of the fire required but a few moments. Among other things loaded into the dingy on leaving the boat, George had included one of the steel folding chairs, out of the galley. This, when set upon the beach, served as an elevated stand for the gas tank, gravity feeding the pump. Because of the corrosive effect of salt water, pumps when not in use are kept thoroughly capped and filled with oil.

Within less than an hour all visible sparks had been doused with brind from the Pacific. Mopping-up was left for the morning. Since the fire had obviously been smouldering for several days before actually breaking out in the open, it had become deeply established under roots and rocks, which called for considerable digging and hacking.

Additional atmosphere and interest was furnished the evening's engagement by a school of whales frolicking just offshore. Over the hum of the pump motor the spouting of these animals sounded like an engineer letting steam out of a locomotive. This type of cheering from the sidelines, I am told, is a fire-fighting feature infrequently encountered and exclusively Alaskan.

Hardly had we again got under way after dispatching this fire than another was sighted. Except that it was smaller and of more recent origin, this second fire in all respects was identical with the first. About 2 hours was all that was required to drown and dig it out completely. A driftwood board set up at one end of the beach near the fire had been shattered with bullets. At the opposite end of the beach we found a number of empty .30–06 cartridges, establishing this as a hunter's fire almost unquestionably.

I am not generally credited as a scientist nor do I by any manner of means represent myself to be one. That my investigative technique

in this instance might have been faulty and incomplete is quite likely. But to me the dictum is clear: Fire fighting is a disease as unshakable as a bad habit.

Two fires in two days in the heart of Alaska's swamp utopia leaves nothing more to be answered. Recognizing my fate I resign myself to fire fighting unconditionally and regardless, wherever I may be.

STREAMLINING THE R-2 FIRE-DANGER METER

(Continued from page 85)

In operation the pointer above the FUEL MOISTURE STICK scale is set at the FUEL MOISTURE STICK reading and so on until the RELATIVE HUMIDITY reading has been set. Just above the CUMULATIVE EFFECTS scale is a fixed scale and by noting the figure opposite the zero point, the daily cumulative effect can be read. (Unfortunately part of the scale just to the right of the CUMULATIVE EFFECTS scale was lost before the photograph was taken.) Here enters the only mental calculation necessary—the daily cumulative effect is added to the CUMULATIVE EFFECTS figure for the previous day and the pointer above the scale is set and the FIRE DANGER TODAY is read direct. It will be noted that a CONDITION OF ANNUALS scale appears above the left end of the FIRE DANGER TODAY scale. By setting the zero point on the latter opposite the current deduction figure, the deduction is automatically made.

It is felt that this new design is an improvement over the present one, but actual use will be needed to demonstrate this.

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BOY SCOUTS AND AMERICAN FORESTS

Capt. E. C. Mills

National Director, Health and Safety Service, Boy Scouts of America

The playgrounds and workshops of Scouting are the forests, fields, mountains, and waterways of America. Nature forms the back drop against which the great outdoor program of the Boy Scouts of America has been built.

An inseparable part of that program is training in citizenship and the traits of character essential to maintaining the "American way" of life.

"And just what," may be asked, "does such training have to do with preventing forest fires, or putting them out, or of replacing the losses with young trees?"

Before attempting to answer that question, your attention is called to a statement quoted from Scouting's Health and Safety Magazine of August 1939:

> The Boy Scouts of America is interested in the protection of American forests and homes from fire for a number of excellent reasons, chief of which is that it is an American institution dedicated to character development and the training of young men for citizenship. It believes that an educated and trained citizenry conserves its national resources and protects its people. By the same token, it believes that destruction caused by carelessness indicates weaknesses not conducive to strong character building and that the causes of such destruction can be removed through better understanding, training, and the assumption of personal responsibility.
>
> As an organization it has a moral and economic obligation for the magnificient gifts of thousands of citizens which have made it possible for Scout Councils to lease or own more than 160,000 acres of wild land for Scout camps well equipped with facilities for the use of American boys. The value of the properties owned by various councils is close to $10,000,000. The man-made equipment on these sites can be replaced, but the timber and wildlife cannot, except through nature's efforts and then only after many years—if at all.
>
> Is the future of your council's camp property protected as well as is possible, or will its usefulness and the happiness of this and future generations of Scouts be dissipated in wood smoke?

Today more than 1,150,000 boys are registered members, 923,000 of these being Scouts—boys over 12 years of age—divided among 42,000 troops. The adult leader of each troop is the scoutmaster who has one or more adult assistants. The camping program is of great importance to every troop. Between 350,000 and 500,000 Scouts spend one or more weeks at camp each year. Many troops carry on their overnight and week end camping activities throughout the year, weather permitting, and some regardless of weather.

Because the use of fire for cooking, heat, and ceremonies is very important in a camping program, a great deal of training in fire making, use, and extinguishing is necessary. It must be carried on almost constantly by leaders, who, in turn, must have training. Courses for leaders are conducted throughout the year by the 542 Scout Councils into which the country is divided.

Scouting has a special award plan for advanced study in more than 100 different subjects. This is known as the Merit Badge system. One of these merit badges is for "Firemanship." Requirement No. 2 of the 6 which must be passed to win this badge has to do with forest-fire prevention. It reads:

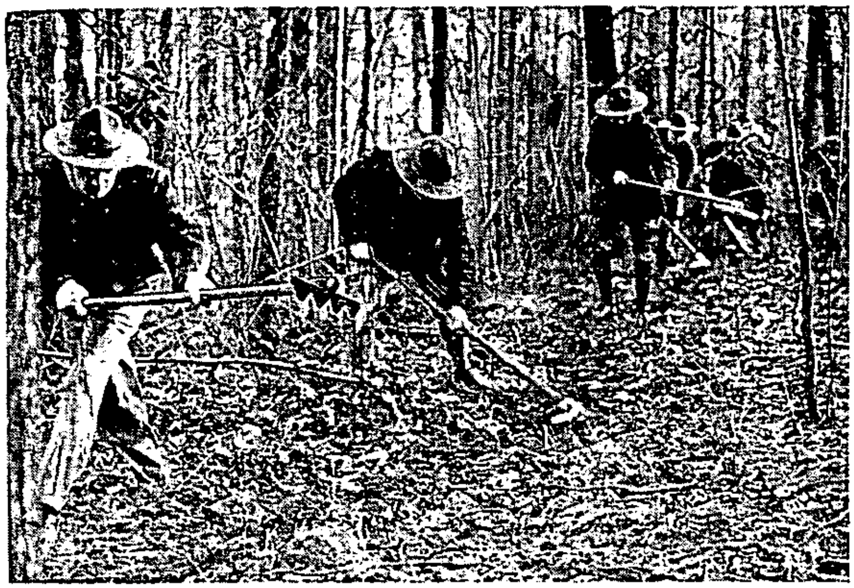
Demonstrate or submit sketches illustrating two of the following:

a. Proper building of campfire with relation to inflammable material both around and under place where fire is laid.

b. How to extinguish a campfire.

c. Three practical methods of forest-fire prevention.

d. Three simple methods of forest-fire fighting where elaborate equipment is not available.



Boy Scout National Training School students in "one-lick" method forest-fire drill.

In another requirement is found the following:

Demonstrate (*a*) How to light and discard a match safely.

In the past seven years 206,800 Scouts have won this merit badge. Another merit badge of particular importance in the protection of forests and wildlife is "Conservation."

This excellent course has to do with conserving wildlife of forest and stream. In studying it, Scouts learn better to appreciate and protect animal life, and this means giving thoughtful consideration to their environment. They soon learn that adequate ground cover means protection for animals and water in rivers and lakes, and that fire destroys it. The necessity of saving timber and replacing that which has been destroyed becomes immediately apparent.

It would be impossible and of little value to attempt even to estimate the number of acres of seedlings that have been planted by Scouts since

the organization's inception in 1911. Planting is a part of the program for every Scout Council. Every Scout is a tree planter and consequently a potential conservationist.

Another very valuable source of training for Scouts and their leaders has been the cooperative relationships with National and State forest authorities.

Scouting believes in the principle of "learning by doing." Giving service is a great educational medium, and Scouts have given service of many kinds, ranging from posting fire prevention signs, distributing pamphlets, notices, and "fag bags," and carrying warning posters in public places, to serving as fire watchers, guards, and fire fighters.

During the past 3 years the relations of the Scouts with the Division of Fire Control of the U. S. Forest Service have been very close, and it is felt that as a result the education of Scouts and their value to their country have been greatly extended. This expansion began with a series of conferences between Roy Headley, chief of the division, and members of his staff and officials of the Boy Scouts of America. These discussions resulted in the publication and wide distribution and use of an article on the "one-lick method of forest fire fighting," written by Mr. Headley; the extensive showing of the motion picture on the same subject; the securing of Forest Service personnel to give technical training in methods; the correction of potentially dangerous conditions existing at Scout camps; the placing of Forest Service members on Scout Council health and safety committees; and the training of Scout executives in methods at the National Training School at Schiff Scout Reservation.

Schiff Scout Reservation at Mendham, N. J., is the National Training School of the Boy Scouts of America. Many training courses are carried on there for leaders, in addition to those for Scout executives. These include, among others, camping, emergency service, health and safety, and aquatics. Each group is shown the "one-lick method" film, and in many instances the men are taken into the woods, equipped with proper tools, and put through the "one-lick" drill.

Since Scouting was developed in our country 31 years ago, Scouts and Scout leaders have been working energetically to prevent and halt the ravages of fire. Tales of effective and oftentimes heroic action in fire fighting are a part of Scouting's traditions. Scouting is an American institution that constantly strives to improve on past results by learning to do things more effectively. Complacency is the enemy of progress. The Boy Scouts of America has never been a complacent organization. IT CAN DO BETTER. IT WILL DO BETTER.

HAVE WE GONE FAR ENOUGH IN THE USE OF AIRPLANES?

JAMES BOSWORTH

Assistant Supervisor, St. Joe National Forest, Region 1, U. S. Forest Service

The airplane-parachute method of transporting firemen for attack on forest fires was suggested by Forest Service employees as early as 1934, possibly earlier. It has been put to practical test on limited national-forest areas with encouraging results. (Fire Control Notes, April 1940, Technical Report on the Parachute-jumping Experiment, and October 1940, Wings and Parachutes over the National Forests.) The author now advocates an "all out" application of the method on a full national-forest basis, indicating savings in personnel, improvements, and transportation costs, reduction in damage values, and savings in time, which he believes to be possible. In view of the enormous increase in air-mindedness which has grown with the national emergency, the author's plan may rank with other progressive items which may persist to the benefit of society because of untrammeled thinking and courage exercised now by their sponsors.

Parachute smoke jumping, although still somewhat in the experimental state, has proved according to all reports, that such a method of attack on small fires is practical.

Airplane transportation has been developed to such an extent that this mode of travel is about as safe as automobile travel.

Freight transportation by plane is coming into use throughout the country and we have proved to our own satisfaction in the Forest Service that dropping supplies from a plane by the use of parachutes is also practical, if we have the funds to buy adequate parachutes and other equipment.

With these factors in mind, I propose that we select one forest in Region 1 and go "all out" with an experiment in the use of planes and parachutes for carrying on all work connected with fire control. In other words, the forest organization would be so planned that it would operate and function, so far as possible, by the use of planes and parachute jumpers.

Such a forest should be one where the main activity is fire control, where national-forest land or land under paid protection is more or less blocked up, where a flying base could be located within or close to the area, and preferably close to a large town or city.

Under such a plan, detection would be obtained by airplanes patrolling in the forest in a gridiron fashion on strips 12 miles apart, making from 1 to 8 trips per day, depending on the fire danger. Each plane would carry 2 smoke jumpers, 1 observer, 1 pilot, radio, and other equipment.

In comparing detection by air patrol with our regular look-out system, I believe that a plane flying 100 miles an hour, with 4 men watching a strip of land 12 miles wide would give as good, if not

better, detection than our present look-out system, since the observers in a plane would have the advantage of seeing 25 percent more area than is seen by our regular season force. This is on the basis that the observers from a plane could see 95 percent of the area, while our regular season force has a "seen" area coverage of about 70 percent.

The fire-discovery time, however, would be somewhat increased because of the small number of trips per day during low fire danger and the fact that patrol flights would be made only in daylight. The St. Joe records show that in 1940, 18 percent of the fires were discovered between 9 p. m. and 4 a. m. compared with 10 percent in 1941. Personally, this does not worry me for the reason that a great many of these fires are not actually worked on until daylight hours. Furthermore, there are only a very few nights during which a fire will travel to any extent.

During daylight hours it would probably be desirable to arrange the flights so that the last one would be just before dark and the first one just after daylight. It may also be possible to patrol at night, but these are points which would have to be worked out later.

When a fire is discovered on a flight, the plane would go to it immediately and unload the jumpers. In this way, travel and hunting time would be reduced to about 30 minutes or less, compared with the average on the St. Joe Forest of 2 hours 58 minutes in 1940 and 2 hours 31 minutes in 1941, based on 150 and 69 fire reports, respectively—a factor which I believe will more than offset the slower discovery time.

The hazards in parachute jumping may appear to be much higher than for a ground organization, although reports show that so far the only lost-time accidents sustained by our smoke jumpers were two sprained ankles. The indications are that the accident rate is not any higher than would normally be expected in our smoke-chaser travel.

I am not qualified to judge the type of plane best suited for the purpose, but it appears to me that a twin-motored plane would be the safest and most suitable. If this type of plane had been used in the past in our flying, some the serious and near-serious accidents that we have had could probably have been avoided.

One of the most difficult things to work out might be to obtain sufficient parachute smoke jumpers and keep within the fire-control allotments. My solution for this would be:

1. A crew of at least 15 men trained and qualified as smoke jumpers and observers to be held at the flying base to man the patrol flights.

2. At least 10 men to be trained in smoke jumping and employed in accessible crews located on the forest. These men would be paid while training and given a $30 per month bonus to act as smoke jumpers when called.

3. To have the adjacent forests cooperate by furnishing two smoke jumpers each who would be available on short notice near landing fields. These men to be trained and given a subsidy of $30 per month.

4. The air base for the forest should be located at or near the largest city, where it would be possible to obtain up to 40 or 50 men

(volunteers) who could meet the standard requirements, to be trained in jumping and fire suppression and given, for example, $25 per jump and $1 per hour for working time when called. These men could be employed by private concerns at various jobs in the city and arrangements made with their employers to release them when needed. This would be the force from which our overload of fires would be handled.

I believe it would be possible in a town of 5,000 or more to stimulate enough interest in parachute jumping so that men could be obtained under such arrangements. It might be possible, also, to interest the Army to the extent of having them finance the training in connection with the war program, since the candidates might be available as parachute troops.

With such an organization, it should be possible to man up to 40 fires in 1 day. Since this would not catch the peak load on most of the heavy-fire forests, it would be necessary to rely on trail- and road-maintenance men, other crews, and help from other forests as we do now.

In discussing an aerial organization, other members of the Forest Service seem to feel that the peak load of fires on a forest would break down such an organization. Personally, I can't see it, since the regular schedule flights would be made to obtain location even though it was impossible to send smoke jumpers to fires at the time they were discovered. Detection and location would be more regular and at least as accurate as it is now and no more difficulty would be encountered in dispatching men to unmanned fires than exists under our present management.

A break-down is also predicted during smoky weather. Some of the men seem to feel that it would be impossible to see small fires from a plane, but it is my theory that smoke usually lies just over the mountain in a blanket of various thicknesses, and a look-out—in order to see a fire—must look through the smoke blanket horizontally, while an observer flying overhead would look through the smoke blanket vertically or at an angle and would have better visibility. At least the look-out is up against the same visibility conditions as the observer in a plane.

With an "all out" aerial organization on a forest, it would be necessary to make a number of changes since there would be no protection force. The amount of work on a back district would not justify a year-long ranger, and a 6-months alternate could be used to handle public administration, supervise trail-maintenance crews, take care of weather reports, and pick up the parachute jumpers. These men would form part of the fire-overhead organization and should be trained and capable of taking over the fire-boss job on medium-sized fires.

All telephone-maintenance funds except those needed to maintain the main-line circuits could be transferred for aerial use.

Pack stock could be reduced to the actual number needed to handle the progressive trail-maintenance crews during the fire season.

Smoke-chaser and suppression equipment could be concentrated at flying base and reduced considerably.

Elaborate ranger station set-ups, look-out houses, towers, and other fire-control structures could be practically eliminated.

A large reduction could be made in travel time and transportation.

In order to show the possibilities of the experiment, I am proposing, and to clarify it, I will work out roughly a plan for the St. Joe Forest, not that the St. Joe should necessarily be the one to practice on, but because I have some facts and figures to work with. The St. Joe lacks landing fields and the flying base would have to be located near Moscow, Idaho, which would require deadhead travel. Two districts have numerous activities other than fire, and the land under paid protection is not as compact as it should be.

To start with, I have prepared a tabulation showing fire danger each day for the past five seasons and the average number of days for each class of fire danger in order to determine about how many trips over the forest would be needed during an average season. I then assumed that when the fire danger is 2.4 or less no patrol would be needed. From 2.6 to 3.0, inclusive, 1 patrol trip per day; 3.2 to 3.6 inclusive, 2 patrol trips per day and so on until the danger reached class 5+ when 8 patrol trips per day would be flown.

Using 12-mile strips with base at Moscow, Idaho, the round trip distance will be 270 miles. This has been increased 30 miles per trip to take care of extra miles needed to look over suspicious or false smokes and extra trips.

Since the primary job of the rangers on the Avery, Roundtop, Red Ives, and Calder districts is fire control, rangers would be eliminated and replaced with 6- or 7-month alternates. The Palouse and Clarkia districts, because of the numerous other activities would have yearlong rangers and 6-month public contact men. Road maintenance would be supervised from the supervisor's office.

Blister rust control crews would also be handled from the supervisor's office as they are now.

Pack and saddle stock could be reduced 60 percent by handling trail maintenance under the progressive system during fire season.

The clerical force could be reduced 20 percent because of the decreased number of employees, less purchasing, vouchering, and other miscellaneous details.

Equipment could be reduced and concentrated with a saving estimated at about $2,000.

There have been 77 look-out houses and towers constructed on the St. Joe; 30 more are needed to meet the fire plan. Under average season conditions, a total of 107, at an average cost of about $1,500 each, including visibility clearing, amounts to $160,500—assuming a life of 30 years, a maintenance cost of $20 per year each and interest at 5 percent, the annual cost amounts to $15,515.

By replacing the four yearlong rangers with temporary men and practically all the protection force, the headquarters improvement could be almost entirely eliminated on four districts and reduced 60 percent on the other two.

A conservative figure for the cost of a ranger station set-up is about $30,000. On this basis, the total would amount to $156,000. Assum-

ing a life of 40 years, maintenance at $1,600 on all and interest at 5 percent, the annual savings would be $13,300.

An analysis recently made on the forest showed that during the past 12-month period, rangers, alternates, contact men and supervisor's staff spent a total of 2⅓ years driving a car. With a reduced force and travel made on the regular patrol flights, travel time and travel costs could probably be reduced 75 percent.

Summary of Estimated Savings

4 yearlong rangers and expense	$10,900
Reduction in pack stock	3,000
Saving in clerical help	2,000
Saving on equipment	2,000
Elimination of look-out houses and towers	15 515
Reduction in headquarters, improvements	13,300
Saving on telephone maintenance	2,000
Total	48,715

Cost of Proposed Aerial Fire Control Organization

1 yearlong forest officer in charge	$2,700
1 dispatcher, 6 months @ $175	1,050
15 smoke jumpers at base	8,750
10 smoke jumpers, trained and subsidized (on forest)	3,000
8 smoke jumpers, trained and subsidized (on adjacent forests)	2,400
40 volunteers, training, etc	8,000
Annual equipment costs	2,000
4 ranger alternates, 6 months @ $175	[1] 3,150
2 contact men, 5 months @ $166	1,660
Travel and expense	2,000
843 flying hours @ $25 per hour	21,075
	55,785

[1] Paid 25 percent from trail- and road-maintenance funds.

The average annual presuppression expenditures during the past 5 years, including FF E. P., have amounted to $56,900. Thus there would be a slight difference in favor of an aerial organization, but there still remains $48,715 accumulated in other savings based on a long period of time.

In arriving at a cost of $25 per hour for plane service, I assumed that since we are able to obtain planes at $35 under bid now with a limited number of flying hours, we should, by increasing the number of hours, be able to get a cheaper rate and eliminate the stand-by service, if any.

In an average or bad fire season, at least three planes would be required to handle the increased number of trips per day.

I realize that I am proposing a radical plan, that it sounds fantastic, and that most of it is based on theory, but I really believe we have enough sound facts to justify some pretty serious thinking along this line.

We have fire plans in Region 1 that have been estimated to cost $250,000 and so far as I can see they are just as fantastic as the plan I

(Continued on page 102)

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TRUCK TOOL BOX AND STALLS SOLVE FIRE-TOOL CACHE PROBLEMS

WALDO M. SANDS, *Project Superintendent, Camp Wellston, F-68, Manistee National Forest, Region 9, U. S. Forest Service*

At Camp Wellston, on the Manistee National Forest, a new system has been adopted for making up fire-tool caches in preparing stand-by trucks for immediate action and use as first attack and reinforcement units on fire calls.

Trucks at this camp are equipped with a combination tool box and truck seat, which is designed to accommodate all tools, water cans, and back-pack pumps. The closed covers of the boxes make safe and comfortable riding seats for enrollee workers and fire fighters.

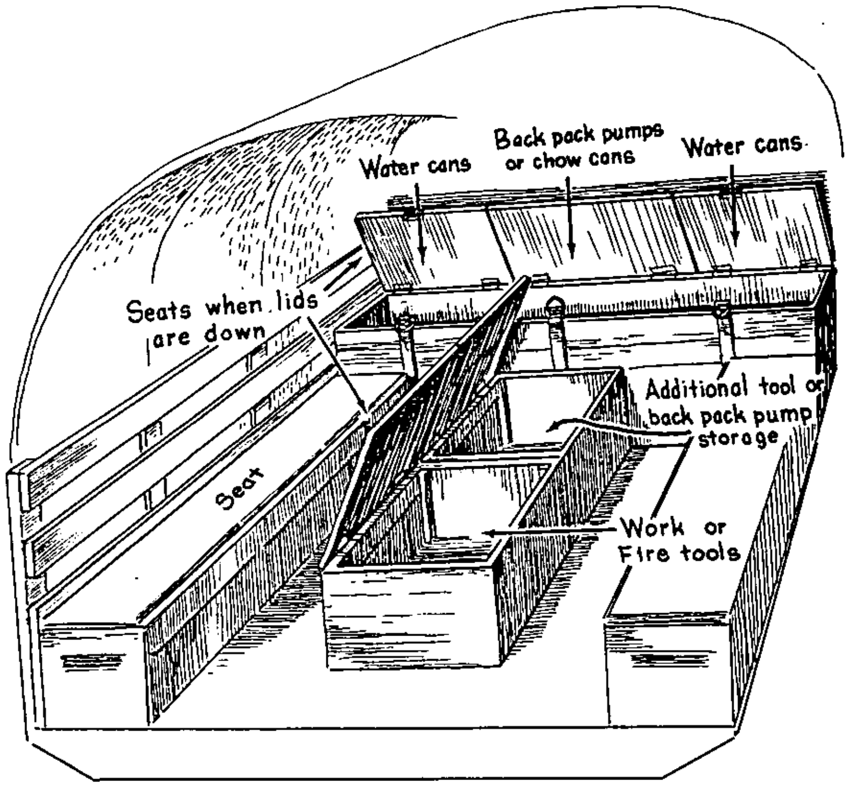
Typical stall in fire-cache building containing fire equipment ready for transfer to fire trucks.

Complications and safety measures have prohibited the efficient use of devices for attaching or anchoring both tool boxes and seats and fire-tool cache boxes on stake trucks. To simplify matters and to save time and labor in removing crew seats, and in loading fire-cache boxes and fastening them down, it was decided to organize and store the contents of all 5- and 10-man caches in separate stalls in the fire-cache building, thus permitting the equipment to be transferred from these stalls to the truck tool boxes very easily when needed. One man can now do the loading, as compared with 4 or 5 formerly needed to remove the heavy seats and install the equally heavy fire-tool boxes.

In the former use of separate fire-tool boxes, only one 10-man unit could be loaded and fastened down, thus limiting the size of the crew and seating capacity, with no provision for safe, comfortable riding of the men and equipment; also, it is doubtful that the heavy cache boxes would withstand the strain of being tossed around in case of accident, as it is necessary to place them in position on the truck floor

and fasten them down with the same fasteners that are used to hold the regular crew seats.

Normally a stand-by fire truck loaded with a 15-man fire-tool cache is maintained and stationed at Camp Wellston throughout the fire season. When this truck is dispatched to a fire, it is a comparatively simple job to back up another truck in front of the equipment stall in the fire-cache building, break the seal on the 5- or 10-man fire-tool cache stall, or even two or three stalls, and transfer the equipment to the combination crew seat and tool box on the truck.



Tool boxes installed in truck body, with lids open.

Increasing the carrying capacity of each individual truck reduces transportation and other important costs, principally through the reduction in the number of trucks sent to a fire, thus allowing the extra trucks to be equipped and used on emergency stand-by and elsewhere. Also, with the present war emergency, more economical use of trucks is desirable.

This method of loading and transporting fire-cache tools during the 1941 fire season was satisfactory and efficient. No difficulty was experienced in maintaining equipment after a fire, as the equipment was inspected, reconditioned, and placed in its proper place in a numbered and sealed stall until needed again. Another advantage was use of the wall space for the cache stalls, which were divided into an upper

and lower compartment for various sized tools. The floor was clear of miscellaneous items and each stall was accessible for each inspection checking and inventory.

Advantages of the cache-stall system over the fire tool-box system are as follows:

1. Facilitates loading and unloading operations.
    a. Reduces accidents caused in handling heavy fire tools and back-pack pump boxes.
2. One tool box is used for two purposes.
3. Permits secure attachment of tool box and seats to truck bed.
4. Minimizes risk, and has added safety features in case of accident.
    a. Provides safe and comfortable means of riding.
5. Speeds dispatch, and permits more men and equipment to go to a fire in a single truck.
6. Reduces transportation and many other important costs in fire control and suppression work, by reducing number of trucks required.
7. Increases general utility of storage building by providing more available floor space.

HAVE WE GONE FAR ENOUGH IN THE USE OF AIRPLANES?

(Continued from page 99)

propose here. As an example: Last year we started out with a loss of about 45 percent of our old experienced men. We managed to fill these vacancies, trained the men and another 40 or 50 of our best men, and wound up the season short-handed and with a number of inferior fire-goers. Fortunately, we had one of the easiest fire seasons most of us old-timers have ever seen.

Suppose next year we have a fire season that demands a class 5.5 organization. Our fire plan shows that we need 177 detectors and fire-goers and 40 overhead. That's 112 more men than we had last year. If we couldn't get them last year with 600 B. R. C. men to pick from, what are the prospects? If, in the next year or two, we should get a season rated 6.7 danger class, the quarter-million-dollar fire plan would show the St. Joe needing 342 fire-goers and 41 overhead, plus an enormous amount of equipment and supplies which we would be unable to obtain.

FIGHTING PRAIRIE FIRES IN THE NEBRASKA SAND HILLS

DONALD W. SMITH

District Forest Ranger, Nebraska National Forest, Region 2
U. S. Forest Service

From articles appearing in the July and October issues of the 1940 FIRE CONTROL NOTES, it is apparent that other forests and foresters have grass-fire problems and are working on applicable suppression techniques. Most fires on the Nebraska National Forest are grass fires, and 39 years of study and fire fighting by past and present personnel have developed several worth-while practices.

The so-called Austin rotary organization or "spinning firemen" technique, wherein fire fighters move along a line of fire in a rotating circle, has been in use in this vicinity for a number of years. Many local ranchers through years of experience in fighting prairie fires had developed the art of sand throwing to a high degree, and when working on fires in small groups, they frequently fell into a revolving circle as they worked along the line. Both the sand-throwing practice and the type of crew organization were picked up from them and developed into a planned method of fire fighting with the advent of CCC crews on the Nebraska. Our method is similar to that described in earlier (FIRE CONTROL NOTES) articles in all but one respect. We start out with larger crews, as many as 12 men, in order that extra men will be available for patrol and mop-up along extinguished fire line. By advancing extra men in the crew and dropping them as needed, they can be located by the man in charge of the suppression crew. At the same time, these men assist in control work as they move around the fire into position.

The job of throwing sand along a line of fire is an art in itself and is quite different from an ordinary shoveling job. A short, D-handled, round-pointed shovel is preferred. Among local ranchers, the technique of throwing sand for maximum effect varies a great deal with the individual. Most of them can wield a D-handled shovel equally well either right- or left-handed regardless of whether the fire perimeter is to their right or to their left, and can reverse their hold to avoid undue strain. For maximum force in a narrow radius the best working position is different than for maximum scatter over a wide arc. For CCC use the techniques involved are taught as a standard set of motions. Flames along 10 to 12 feet of the perimeter of a running fire can be knocked down by a single shovelful of sand properly thrown.

Backfiring, or the burning of barrier strips ahead of a fire, is, of course, a most important method, too, in combating fast running, dry grass fires. We use a simple and inexpensive kerosene torch for this purpose. It consists of 3/8-inch tubing fastened to a small gate valve on a 1-quart can. The tube is nearly filled with a cotton wicking and the can is filled with kerosene through a cap on the opposite end from the tube. The valve is opened so that kerosene soaks the wicking and slowly drips. With this simple torch, a man can set grass fire as fast as he can walk.

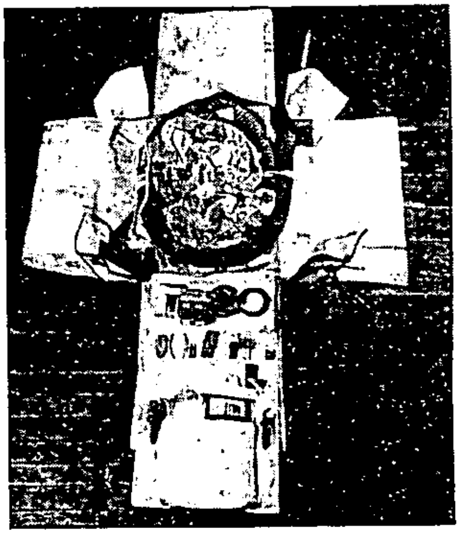
THE ROUTT PUMP ACCESSORY PACK

SAMUEL W. ORR

Forest Ranger, Routt National Forest, Region 2, U. S. Forest Service

For some time it has been felt that a back pack was needed in which to transport the essential tools and accessories necessary to place in operation the type Y Pacific Marine pump used on this forest.

First experiments along this line were undertaken in 1940. About a year ago, in 1941, a model pack was made of scrap material picked up around headquarters. The results were encouraging, so a request was made for funds with which to make a serviceable pack. These funds being granted, the pack illustrated in the accompanying photographs was made up.



Fire-pump accessories assembled, ready for packing. Canvas container packed with fire-pump accessories.

The illustrations describe the pack better than words can do, except for a few details which are not apparent from the photographs. The body of the pack is made of 15-ounce canvas, carrying straps are of 4-inch pack-cinch material, and all leather used is grade A. The two heavy pieces attached to the back of the pack are of the heaviest leather obtainable locally. The weight of the pack without the contents is 4½ pounds and with the contents it weighs 40 pounds. The outside dimensions when packed are 4 by 15 by 22 inches. Contents of the pack are as follows:

50 feet 1½-inch linen hose.
1 1½-inch nozzle with 2 extra tips.
1 8-foot suction hose.
1 suction strainer.
1 6-inch stillson wrench.
1 6-inch crescent wrench.
1 spauer wrench.
1 magneto wrench.

1 pair slip joint pliers.
1 pair large pliers.
1 emergency ration.
1 first-aid kit.
1 canvas bucket.
1 piece sash cord, 12 feet long.
1 headlight with 3 batteries.
1 starting rope for engine.
2 extra spark plugs.
3 extra headlight batteries.
1 screw driver.
1 coil stovepipe wire.
1 engine record book.
6 rubber hose washers.
1 6-inch machinist punch.
1 packing gland wrench.
1 spark-plug gauge.
1 check and relief valve.
¼ pound rags.
1 can cup grease.
1 pencil.
1 box pencil leads.
1 notebook.
1 set instructions.
1 2½-gallon water bag.

In making up the pack, straps and buckles were used rather than snaps and rings, as was suggested, because the pack must be cinched up tight in order to carry well, and this could not be done with snaps and rings. Also snaps have a tendency to break easily. At different times during the process of construction the addition of a tump line, belt, and breast strap was suggested. All of these suggestions were rejected for one reason or another. However, if any of these features are needed they can be added at small cost.

The addition of a small hand ax to the pack seems desirable. Often an ax can be used to advantage in placing the pump, or while traveling through the brush to the site of the fire. I would recommend a single-bitted hatchet similar to that turned out under the "Marble" tradename. This hatchet should be carried on the outside of the pack in loops where it would be easily accessible without opening the pack. Probably the best place for it would be on the side of the pack behind the left shoulder. In this position, it would be a simple matter for a man to reach over his left shoulder with his right hand and withdraw the hatchet and go to work. A single-bited hatchet is recommended because it could be used as a hammer and thus the extra weight of a hammer in the pack would be eliminated. The 50 feet of hose is included to be used at the working end of the hose line. How often it has happened that the first 100 feet of hose has come back from a fire full of holes, usually because the hose has been dragged over the ground by the nozzle man. Since the working end of the hose line must be moved around more or less, it seemed more economical to wear out a 50-foot length rather than a 100-foot length. This hose also acts as a cushion to keep the hard objects in the pack away from a man's back.

In arranging the pack, various methods were tried with the idea of securing a well-balanced pack. The method finally selected provided that all the heavier objects should be placed in the center of and towards the top of the pack. This method of packing resulted in throwing the center of gravity well up on a man's back at just the proper point for easy carrying.

The items included in the pack are those which we feel are needed immediately, to get the pump working and to keep it working until additional equipment can be brought up. However, the contents can be varied to suit local conditions. It should be borne in mind, though,

(Continued on page 107)

RECREATION GROUPS ON THE FIRE FRONT

Robert S. Monahan

Information and Education, Washington Office U. S. Forest Service

Recreation visitors are traditionally classed as fire risks. Does not our present extensive system of recreation improvements stem back to the belief that such visitors were two-legged firebrands who must be corralled in fireproofed areas?

Responsible leaders of outdoor organizations have always been sensitive to this blanket indictment. They seem to have recognized 1942 as the year when they can demonstrate the fire-consciousness of their followers not only by an effective prevention campaign but also by what is even more timely—an organized fire-fighting auxiliary.

Reports originating from all over the country emphasize the sincere desire of recreation groups to bolster regular suppression personnel. The Pacific Camping Association at its annual meeting studied suggestions for training fire suppression squads from camps of older groups.

In a special appeal to its 300,000 subscribers, the editors of Outdoor Life declared:

> The Forest Service still has trained and experienced leaders and modern equipment, but it is dangerously short of manpower. * * * Sportsmen's organizations and individual sportsmen who are willing to give their efforts and some of their spare time to helping to protect our national forests against fire during the war are asked to write to the supervisor of their nearest national forest. * * * If you can't do your bit on the firing line, do it on the fire line!

The Portland Oregonian struck a responsive chord when Bob Webb, a staff writer, challenged his outdoor colleagues:

> You have long felt a debt of gratitude toward the Government that opened these areas for your recreation and toward the men who have protected the forests against their greatest enemy—fire! You can repay that debt by joining the newest of the important home defense units, the Forest Service reserves.

Fred H. McNeil, one-time forest guard and now night editor of the Oregon Journal, addressed a stirring appeal, We Can Help Some More, to the Ski Bulletin, official publication of the National Ski Association. Writing as the first vice president of that far-flung organization, McNeil concluded his plea:

> The foresters have done much for mountain sports, winter or summer. They have come to our assistance so often in the extremity of a tournament crisis or in helping us get established in new skiing centers. So now, in a dire time, we can aid them.

Skiers are particularly well adapted to fire fighting. At the drop of a hat they are on their way whether it's a report of "new powder on Baldy" or "forest fire up Sandy." The average skier's outfit is a veritable depot of outdoor necessities. His womenfolk are a hardy,

resourceful crew. And in the summer, unlike many other potential fire fighters, his muscles and lungs conditioned from a long winter season of vigorous exercise, are ready for action.

Officials of ski tournaments, familiar with adjusting split-second differences in competitors' times and spelling the names of Scandinavian contestants, should have little difficulty in preparing time reports. With uncanny sense of grade and personal knowledge of mountain terrain, cross-country skiers should be well qualified as smoke chasers. In fact, there is a place to utilize the varied capabilities of experienced skiers in every forest-fire organization plan.

These spontaneous offers from recreation groups have received the equally sincere acceptance of forest-protection agencies. Fire plans have been revised to give such volunteers the opportunity they deserve. But to be truly effective when initial enthusiasm may have waned, such cooperative understandings must be based on strong organization, positive commitments, and dependable obligations.

As Roy Headley put it, "I am confident that the readiness of cooperators to cooperate will not outrun Forest Service readiness to welcome, organize, train, and utilize their help."

THE ROUTT PUMP ACCESSORY PACK

(Continued from page 105)

that every piece of equipment added increases the weight of the pack, and weight is what we have tried to cut down. It is possible to reduce the present weight of the pack a pound or so by combining some of the tools contained in it into one tool, such as the 6-inch crescent and 6-inch stillson wrenches, the spanner wrench, the packing gland wrench, etc. The pack might be improved by using narrower material for the shoulder straps. It has been suggested that the edges of the straps as they now are might have a tendency to rub a man's shoulders. I have used 4-inch material, but 3-inch would probably be better.

All points of the pack which are subject to severe strain are double-sewed with harness thread and, in addition, are riveted with copper harness rivets. The heavy pieces of leather on the back of the pack, referred to elsewhere, were placed there to act as stiffeners and to hold the pack to shape.

458654—42——4

THE CYPHER HAND-OPERATED PICK-UP FIRE PUMPER

RALPH D. CYPHER

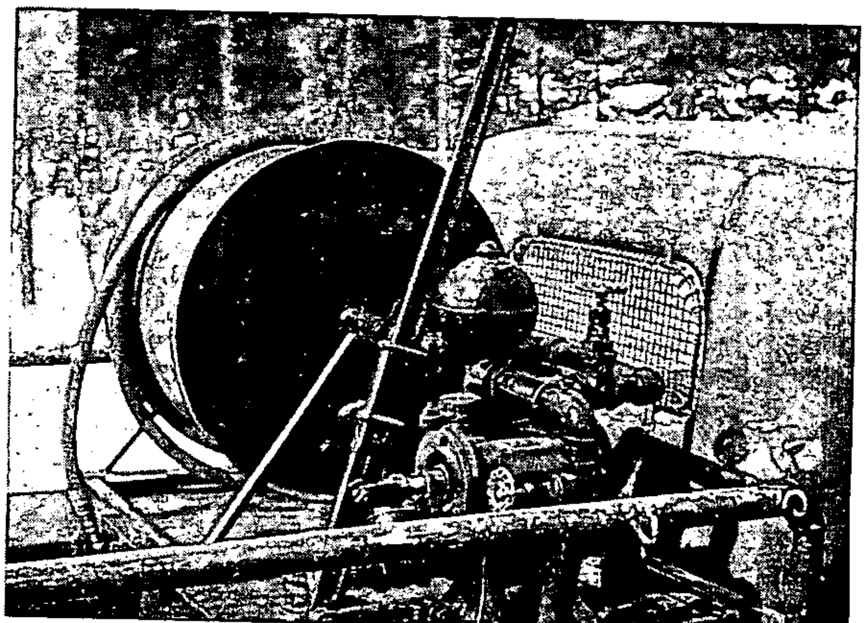
Project Superintendent CCC Camp, Sheridan F-24, Harney National Forest, Region 2, U. S. Forest Service

After observing the embarrassment of inexperienced operators attempting to start various types of temperamental power pumps and the numerous fires on which it has been impracticable to get pumpers on first attack, the idea of a small hand-operated pump that could be mounted on a pick-up and moved easily from pick-up to pick-up was considered. With this idea in mind experiments were started.

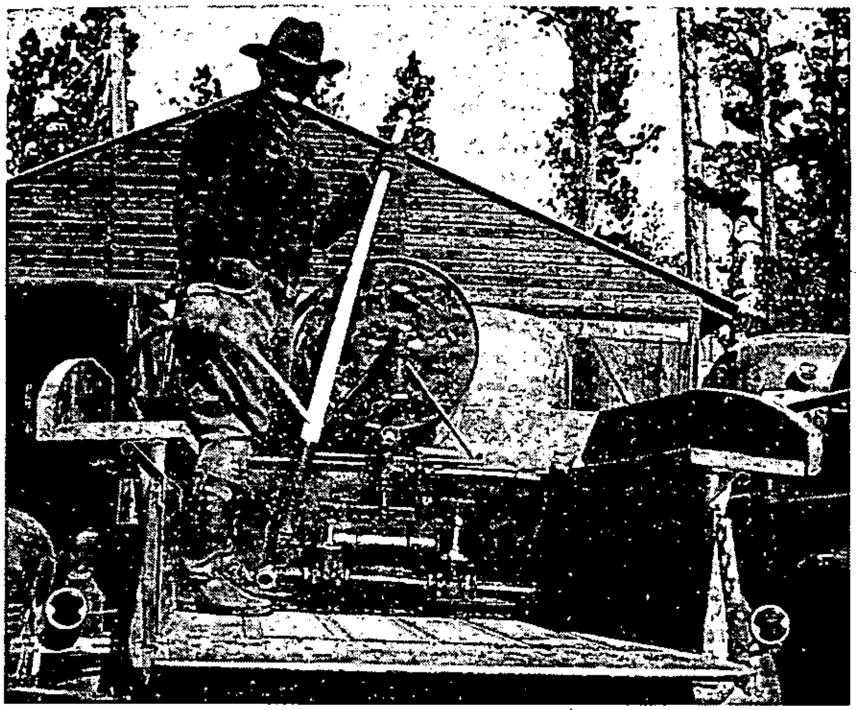
The first pumper built and still in use was made with an ordinary thresher pump mounted on a tank of 90-gallon capacity.

This outfit worked very successfully on first attack on small fires. Usually in the Harney Forest, it is possible to drive directly to the fire and in controlling lightning strikes and fires resulting from such strikes, the pick-up pumper is very valuable. It is easily operated by one man on the pump and one on the hose.

During the winter of 1941–42, two more units were constructed at a cost of less than $50 per unit. Pressure pumps of similar design to the thresher pump, but more easily operated and more efficient, were used.



Portable hand-operated water pump constructed from a used threshing machine unit.



Portable hand-operated water pump of later model.

Tanks of various capacity and shapes, partly for experimental reasons and partly because of necessity, have been used in connection with these pumps. At present, tanks of 90-, 85-, and 80-gallon capacities are in use.

A live reel, constructed from the ends of an oil barrel and a grease drum mounted on a frame of ½-inch welded pipe, carries 200 feet of 1-inch hose. This length of hose seems to fit the local situation in the most practical manner, although more or less may be used.

The tank may be filled by the pump from any source of water, such as a pond or creek, and each unit carries 20 feet of 1½-inch hose for this purpose. The tanks in use can be filled in about 3 minutes and the water supply will last from 20 to 30 minutes where a ¼-inch nozzle is used.

The entire outfit when loaded weighs less than 1,000 pounds and can be taken anywhere a pick-up truck will go. The hand pumper is not designed to compete with motor-driven pumps now in use. Its primary purpose is to fill a need for a light first-attack unit that is cheap, easily built, and operable by anyone regardless of experience, and that will deliver an amount of water sufficient for normal first-attack purposes.

EXPERIMENTS WITH FIBROUS WATER HOSE

Glenn C. Charlton

District Ranger, Williamette National Forest, Region 6, U. S. Forest Service

In this article the author described a fibrous water hose of very light weight and low cost, easy to extend over forest terrain, and of sufficient strength to deliver water by gravity flow over long distances in quantities practicable for use in controlling and mopping-up forest fire areas.

The purpose of the experiments described was to develop a light hose for conveying water by gravity to points where it can be used in fire-suppression work. In order to be practical, the hose must be strong enough to withstand the pressure developed when it is run over uneven ground and across shallow depressions or over logs and other obstacles normally encountered when laying out a gravity system; light enough to enable one man to carry several thousand feet over rugged mountain terrain; durable enough to outlast the life of an ordinary fire; and so packaged that it can be laid out at a high rate of speed.

The Visking Corporation, of Chicago, has developed a casing under the trade-name "Fibrous Sausage Casing," which they use as a covering for all kinds of sausages. It is a transparent casing made from sheets of fibrous and chemical cellulose glued together with a waterproof glue. To date, it is manufactured in 3 sizes, approximately 1½ inches, 2 inches, and 2½ inches in diameter. All sizes are made from the same weight and grade of paper. The casing comes in random lengths that vary from 50 to 500 feet. The company has stated that they can develop a process that would produce 500-foot lengths and by gluing these together, they could give us a continuous casing of any length desired. The 1½-inch casing weighs 11 pounds per 1,000 feet, or 58 pounds per mile. The 1½-inch cotton-jacketed rubber-lined hose commonly used weighs 320 pounds per 1,000 feet, or 1,689 pounds per mile.

The fibrous casing costs $0.00648 per foot or $34.21 per mile. The cotton-jacketed rubber-lined hose costs about $0.202 per foot or about $1,066.56 per mile.

The experiments with the hose began with the pressure testing of some 5-foot sample lengths furnished by the manufacturer. The test on the 1½-inch casing showed that it had a breaking strength of about 12 pounds per square inch. The breaking strength of the two larger sizes was much lower, and further experiments were not carried on with them. The next step was to purchase 500 feet of the casing and lay it out under actual field conditions. The site selected made it possible to secure a 60-foot fall in 400 feet. The ground cover consisted of slashing left from a cutting of cedar poles, which which the limbs had been lopped but the slash had not been burned, and which offered unusual opportunity for puncturing the

hose. Logs and other obstacles were crossed where encountered, and no special attention was paid to where the hose fell on the ground. At the end of the 400-foot length, the hose was strung uphill 100 feet for a total vertical raise of 26 feet. All the water that could be forced into the hose through a regular sump bag was then turned in. The hose was checked daily for 3 days and every week thereafter for 4 weeks. At the end of 21 days, there was no apparent deterioriation, but on the twenty-eighth day it had ruptured at the low point. The break was repaired, but numerous small holes were found throughout the entire section that was under pressure, and new ruptures occurred when an attempt was made to raise the water to the original height of 26 feet.

Additional hose was purchased and numerous tests were made during the summer to determine its breaking strength. It was found that rupture occurred when an elevation of 28 to 29 feet above the low point was reached. When the hose was stretched between two logs, the weight of the water, combined with the internal pressure, lowered the breaking pressure in proportion to the distance the hose was suspended above the ground. Very little trouble was experienced with puncture from sharp sticks or rock, and with ordinary care this trouble can be practically eliminated. When the hose was strung over very uneven ground across logs and other obstacles, it was necessary to leave about 1 foot of slack for every 4 feet of horizontal distance in order to compensate for the extra length required when the water-filled hose sank into all the depressions. On fairly smooth slopes it is not necessary to leave additional slack.

Fibrous water hose line laid over logs.

A final test was made in the fall of 1941 with casing that had been in storage for 4 months to determine the loss of strength from deterioration and the effect of friction on 800 feet of hose, and to measure the volume of water in gallons per minute that could be forced through the hose under certain conditions. The test was made on ground where conditions were more severe than will ordinarily be encountered when the hose is used on fire.

The route followed by the hose line was divided into stations and the distance and difference in elevation were determined for each station.

Distance between hose line stations and difference in elevation

From station	To station	Distance [1]	Difference in elevation	From station	To station	Distance [1]	Difference in elevation
		Feet	*Feet*			*Feet*	*Feet*
A	B	79	−40.0	F	G	66	−15.0
B	C	66	−22.8	G	H	132	+4.0
C	D	59	−0.7	H	I	50	+2.6
D	E	50	+16.5	I	J	50	+24.0
E	F	53	−1.5				

[1] The distance between stations represents the shortest distance between them, not the actual length of hose used.

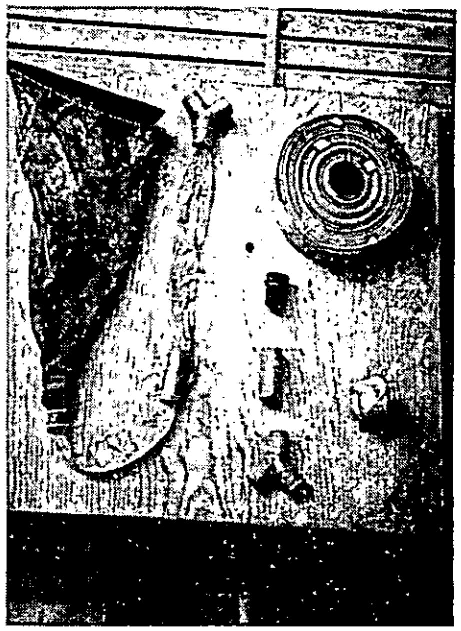
The difference in elevation between the outlet and intake was 32.9 feet, and between the low point and the outlet 30.6 feet. The latter difference is about 2 feet more than that which was used in former tests and indicates that the hose had not deteriorated in the 4 months it was in storage. Friction was also too low to make a noticeable difference as the hose ran flat down the hill to a point approximately level with the outlet. After the hose was tested for breaking strength it was leveled off so the outlet was 26 feet above the low point, and all the water that the sump would hold was turned in. The sump bag was suspended so there was a 2-foot head of water above the actual intake of the hose. The rate of flow was checked at the outlet several times and found to be 17.6 gallons per minute.

As the hose is received in random lengths and also because it is sometimes necessary to repair a break, a light coupling made of 12-gauge sheet metal was designed. It consists of a straight tube slightly smaller in diameter than the hose and has two corrugations on each end. A Y connection was also designed so that water could be diverted in two directions if necessary. The amount of water in each branch can be regulated by tying a string around the hose about 1 foot from the connections and tightening the string until the desired flow is obtained. The hose is fastened to the connections by slipping the ends over the tube and tying with a small but strong cord. A suitable reel for stringing the hose can be made similar to the reel used for stringing emergency telephone wire. A more suitable reel, however, is one made similar to the front forks on a bicycle with a handhold fastened on top. This type of reel gives the man stringing the hose a better chance to place it in the best locations and makes it easier to put it under logs or over the top of other obstacles. Since the 1,000-foot rolls weigh 11 pounds and are only 12 inches in diameter a large or strong reel is not required.

The storage of the hose does not require special facilities. Instructions from the company are to store in a cool place where it does not get wet but at the same time does not dry out. Storage in a basement away from steam pipes is considered satisfactory. Hose used on fire can be drained, rolled, and moved to a new location a

number of times provided that the periods between use are not more than a day or two. It does, however, deteriorate rapidly when subject to wet and dry conditions, and salvage is not recommended when the date for future use is uncertain.

An inquiry sent the Visking Corporation in regard to the development of a stronger casing resulted in the manufacture of a slightly smaller and heavier casing. This casing withstood the pressure of a vertical column of water 39 feet high. It will weigh about one-third more, but since only 100 feet were manufactured its cost could not be determined. The Visking Corporation feels that an order of 100,000 feet would be necessary in order to justify tooling-up to make the heavier casing.


Fibrous water hose, gravity intake, and connections.

The hose does not have sufficient strength to permit use on any kind of pump system. For gravity systems it can be used to replace the regular hose wherever the outlet is not more than 28 feet vertical above low point. If pressure is needed the light hose can be run into a sump, and a power pumper with a short length of regular hose used. It can also be used to carry water to a location above the point of use and connected to the regular hose for developing pressure for gravity mop-up. Its use to carry water close to the point where mop-up is being done with pump cans will often eliminate the long pack necessary under present conditions. Another planned use is to have special smoke chasers carry it out to small fires in well watered country to expedite the mop-up.

The results of experiments carried on at the district ranger station during the past summer may be helpful to those planning to use the hose on fires. The materials needed are a sump bag with the male end of the connection from regular hhose fitted into the lower corner, a female connection of the type used for making emergency repair of regular hose in the field and which has a corrugated projection about 3 inches long, light sleeves, Y's, and a ball of small but strong twine.

Although one man can string the hose at a high rate of speed, two men can more than double the length strung out in any given time. The first man starts stringing the hose at the point of intake, while the second man places the sump bag and makes the necessary connec-

(Continued on page 123)

FIREBREAK PREVENTS LARGER FIRES

A. J. Wagstaff

Assistant Forest Supervisor, Uinta National Forest, Region 4, U. S. Forest Service

Steep slopes with flash fuels have been the scene of a number of large and rapidly burning fires, usually man-caused, in limited lower portions of the slope areas frequented by persons in travel and other activity. The author has indicated one effective method of isolating the greater portions of the inflammable slope areas from the limited lower danger zones and confining man-caused fires to these limited portions with resulting reduction in area burned, suppression costs, and damage.

In the spring of 1935 an addition was made to the Uinta National Forest, the new area extending from the valley floor above the cultivated fields at an elevation of approximately 5,000 feet to higher country some 3 miles distant at elevations of 8,500 to 11,000 feet. The vegetative cover consisted of a belt of cheat grass (*Bromus tectorum*) at the lower elevations, gradually merging into oak brush, with aspen and smaller patches of alpine fir and Douglas-fir at the higher elevations.

The cheat-grass belt at the base of the mountain presented a new fire problem, which was accentuated after the area was added to the forest. Watershed protection was of first importance, so the land previously grazed was given total protection, which resulted in the growth of a rank vegetation.

The cheat-grass belt remains very inflammable from the time the grass seeds start to ripen in early June until late October, depending upon the amount and frequency of precipitation. The annual normal rainfall over this area is 4.82 inches from June to October, inclusive.

There are no data available to show the number and size of fires previous to 1935, although fires were common occurrences.

Through the 5-year period of 1935 to 1939, however, 25 fires occurred on the area under discussion, which burned over 1,222 acres of important watershed land, costing $1,080 to suppress, with an estimated damage of $1,222.

During this time a CCC camp was located near the area and most of the suppression was done with CCC labor. Otherwise the suppression costs would have been much higher. Also it is reasonable to assume the CCC boys put the fires under control faster than a crew of civilians could have done, considering time in recruiting and previous training, which all resulted in smaller fires.

Under extremely dry conditions these fires spread very fast. Some of them have actually traveled ½ mile in 10 minutes. It was observed that trails and small openings in the grass, if they occurred before the fire reached the brush type, often controlled the bounds of the fires.

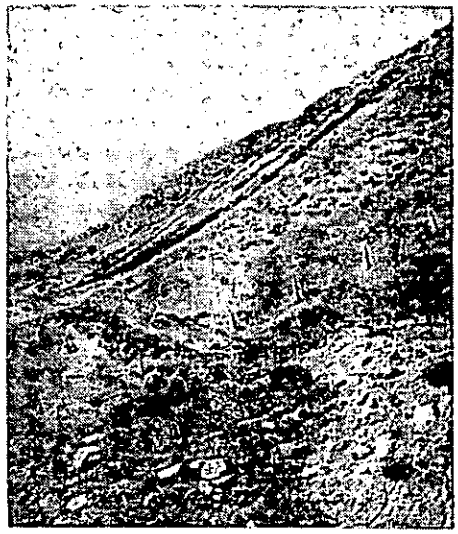
Most of this area is near U S 91 with its heavy travel load. Also the cities of Provo and Springville, with a population of approximately

25,000 people, are adjacent to the area. The human element of fire hazard is therefore high, and all fires have been man-caused.

It was thought that if fires could be checked before reaching the steeper part of the mountain, the large fires would be prevented. With this in mind, it was decided to build a firebreak, which was done in the early spring of 1940.

The firebreak was located as near as possible around the old Bonneville Lake terrace, which forms a small bench and makes construction less difficult. This location is generally at the foot of the steeper mountain but above the areas where the fires ordinarily start.

A caterpillar tractor with bulldozer and a grader were used, and the cost amounted to approximately $20 a mile. The width of the break is 8 to 9 feet, or just wide enough for the tractor. Ten miles of this type of break were constructed. No car travel is permitted over the break.



A section of the firebreak located at the base of the steeper part of the mountain.

Maintenance is not difficult and requires but one annual trip, before the cheat grass starts to ripen. The cost runs from $2 to $3 a mile.

While the break has been in use for only 2 years and one of these was the most favorable in precipitation known, it is believed the break was a good sound investment.

During the 2 years of operation, 10 fires have occurred, burning 24 acres with a suppression cost of $90 and a damage estimate of $50. The number of fires the past 2 years has averaged the same as the previous 5-year period, with the average acreage burned one-twentieth of the 5-year average.

The 5-year suppression cost average is slightly higher than the total construction cost of $200. The savings over suppression costs the past 2 years have paid for the break nearly twice. The damage costs are likewise low as compared with the 5-year average. A direct comparison follows:

Suppression and damage costs, compared with cost of constructing new firebreak

	Number fires	Acreage burned	Suppression costs	Damage estimates
5 years, 1935–39, inclusive	25	1, 222	$1, 078	$1, 222
Average	5	244	215	244
2 years (after break constructed) 1940–41:				
Total	10	24	90	50
Average	5	12	45	25

(Continued on page 127)

FIRE TRUCK WITH CHAIN MESH AND ASBESTOS MAT DRAGS USED ON THE BLACKFEET INDIAN RESERVATION

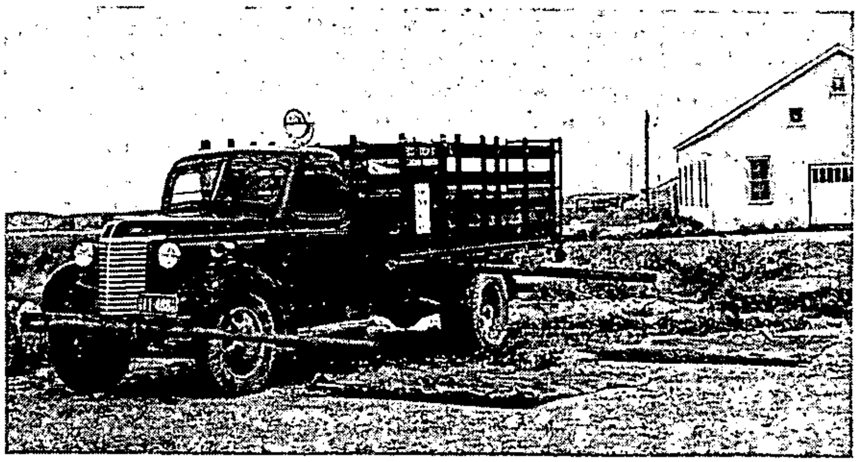
HENRY F. WERSHING

Associate Range Examiner, Districts 3 and 4, U. S. Indian Service

A fire truck equipped with the chain mesh and asbestos mat drags has been used successfully for the past 3 years in the control of grass fires on the Blackfeet Indian Reservation. Its origin dates back many years. During the early days in the western plains the control of grass fires received very little attention except when they threatened ranch property and livestock. It was then a common practice to use two saddle horses to drag over the fire a wet blanket or other material, such as a green hide, or even a freshly killed animal split down the middle. This method has been mechanized by the use of chain mesh and asbestos mat drags attached to a truck.

Several men have had a hand in the development of the fire truck, both on and off the reservation. The specifications for the chain mesh and asbestos mat were worked out from equipment used by ranch operators in South Dakota. Similar equipment is being used by other Indian reservations in the Prairie States.

This type of equipment can be used only on areas that are relatively flat or rolling. The outfit has not been tried out on heavy sagebrush or shrub areas, but it is believed not to be practical for vegetation of such type. Its application is confined largely to areas of grassland and light shrubs in flat or rolling country. In general, the equipment can be used in areas which can be negotiated by a light truck.



U. S. INDIAN SERVICE

Truck rigged for action.

The chain mesh and asbestos mat drag is designed to accomplish two purposes: The chain mesh, the position of which is directly on top of the fuel, serves to break up the material and mix it to some extent with dry top soil; the asbestos mat, which is fastened over the chain mesh, shuts off oxygen from the burning material.

In areas of light to medium cover, one trip over the fire line is usually sufficient to extinguish the fire. Where the grass cover is heavy it may require more than one trip to extinguish the fire in the line made by the drags. However, the first trip usually deadens the fire to such an extent that it will not run for a considerable period of time. Mop-up crews are then used, if available; otherwise a second or third trip is made over the line with the truck. A certain amount of mop-up work is nearly always necessary to remove or extinguish the dry dung usually found in these areas. This may be done by spraying with water, burying, or tossing well within the burned line where it will burn out.

The original specifications for the chain mesh and asbestos mats are as follows:

1. The chain mesh shall be rectangular in shape, shall not be less than 80 by 100 inches and shall be constructed of round, welded rings made of 3-16-inch round steel stock, 1½ inches inside diameter. Every odd-numbered row of rings of the chain mesh shall form a complete chain having an odd number of rings. Every odd-numbered ring in each of these chains shall be connected with a single ring, forming the even-numbered rings of the mesh.

2. The asbestos mat shall be made of good-quality wire-inserted cloth weighing approximately 4 pounds per square yard, and shall be finished to 80 by 100 inches including all seams and hems, which shall be securely sewed and riveted. The manufacturer shall fasten the two mats together with heavy metal fasteners every 15 inches in rows 15 inches apart, and shall securely bind the chain mesh and mat together on all outside edges.

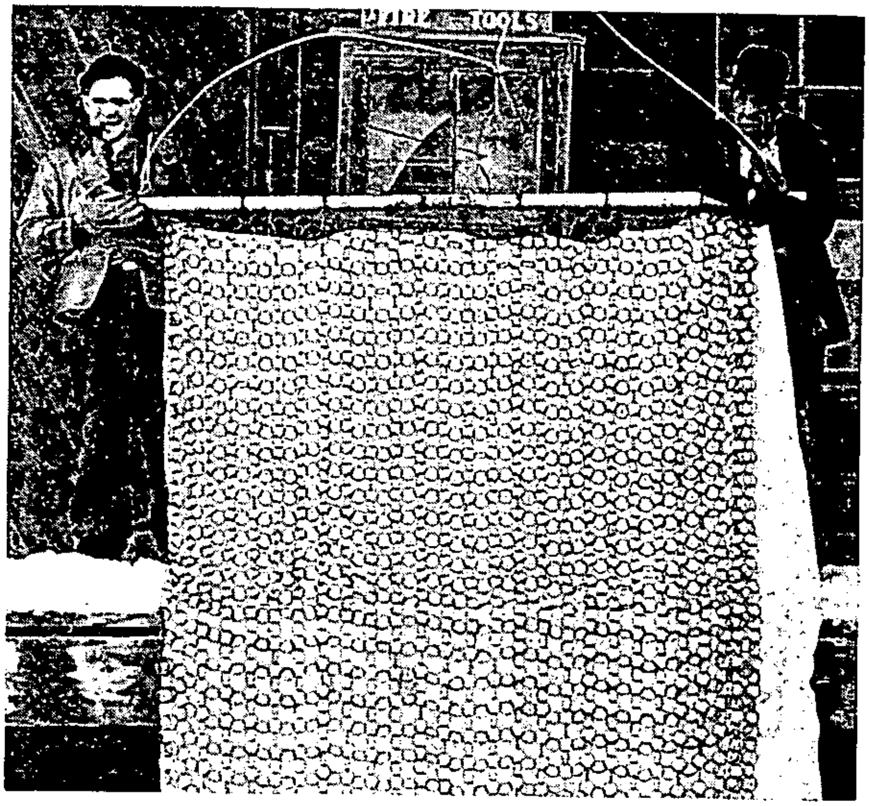
Since it is somewhat difficult to visualize the construction of the chain mesh, a detail drawing showing how the rings are put together is given in the following diagram. This diagram also gives the specifications for rigging the truck.

It will be noted that the over-all dimensions of the mats as given in the specifications differ somewhat from those given in the diagram. This difference is due largely to the fact that the mesh and mat measurements as given in the specifications, are made with the rings and asbestos stretched tight, while those in the diagram are after actual use, causing them to be loose and somewhat wrinkled.

The asbestos mats of very recent construction are equipped with snap fasteners, with which they are attached to the chain mesh instead of rivets.

The diagram and photographs give all construction features necessary to rig the truck. The mats should be attached on the driver's side so that he may watch them closely in order to prevent damage by running into obstacles and to see that they are functioning properly.

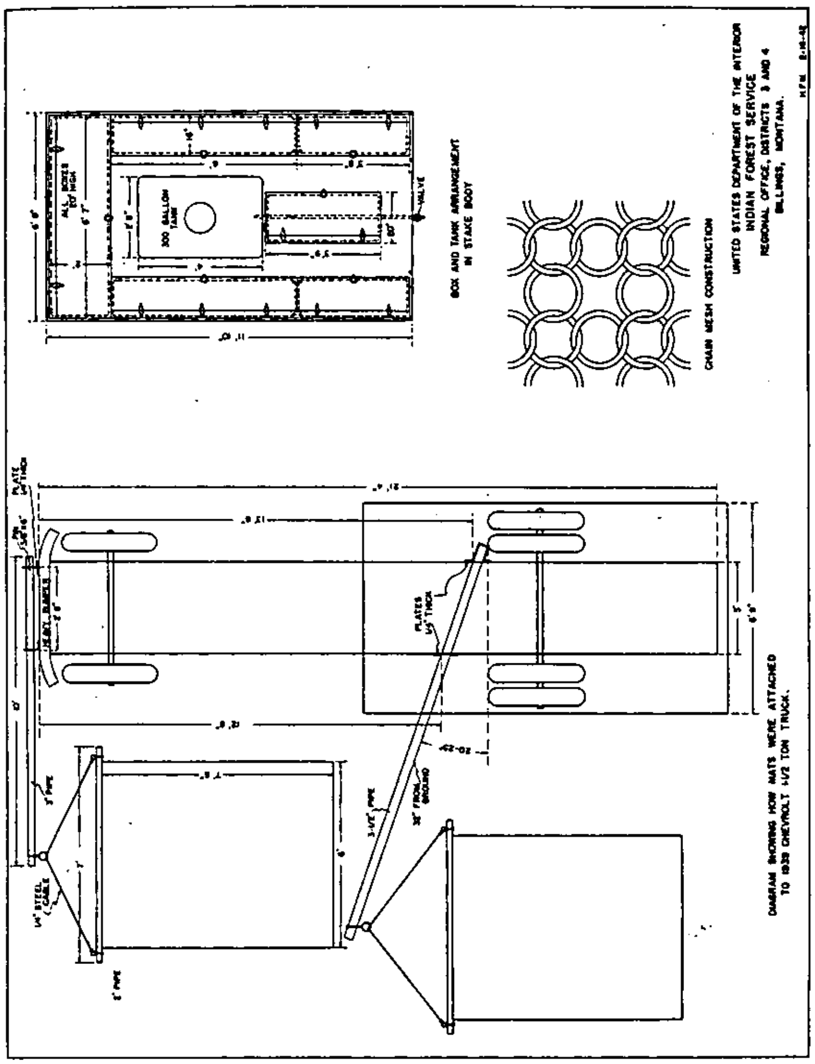
The front mat is attached to a pipe 3 inches in diameter and 10 feet long. This pipe is fastened to the heavy front bumper with steel plates welded to it and containing holes large enough to receive the pipe. A pin on either side of one of the plates is necessary to keep the pipe from slipping out. A pig-tail hook is fastened into the end of the pipe to receive the cable attached to the mat.



Close-up of chain mesh and asbestos mat.

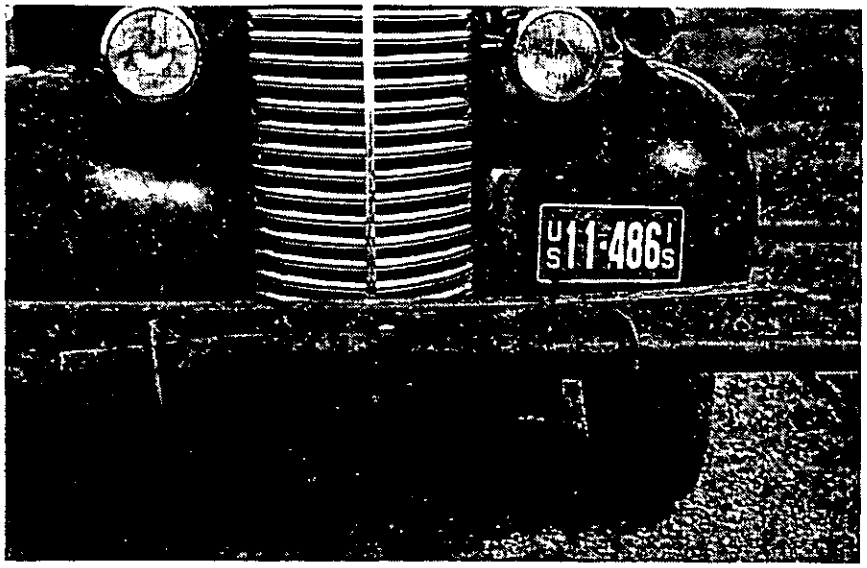
The rear pipe is set at an angle. The proper angle was determined by experimentation and may vary somewhat on other trucks. About 20° to 25° forward proved to be most satisfactory on the trucks used. The two steel plates and the method of attaching them are shown in the photographs. The left-side plate is relatively simple—a hole cut into it being large enough to accommodate the 3½-inch pipe—and is bolted to the chassis and body of the truck. The right-side plate has a band welded to it to keep the pipe from slipping through. This is all the fastening necessary to keep the rear pipe in place, as the drag of the mat keeps it from slipping forward and out. Both right and left turns can be made without difficulty.

Length of the cables which attach the mats to the projecting pipes is a matter of judgment. The shorter the cable, the steeper the angle will be between the pipe and the front of the mat. If the cable is too short there will be considerable loss of efficiency due to the mats lifting from the ground when the truck is in motion. For the front mat it has been found that the leading edge must be at least 28 inches from a perpendicular line extended from the end of the pipe to the ground. The distance on the rear mat must be somewhat greater since the pipe is much farther from the ground.



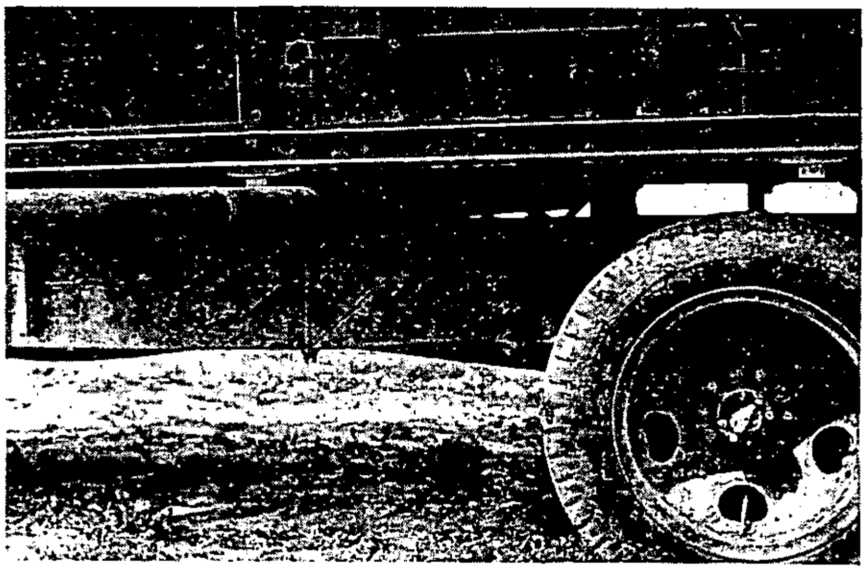
U. S. INDIAN SERVICE

Diagram for rigging truck.



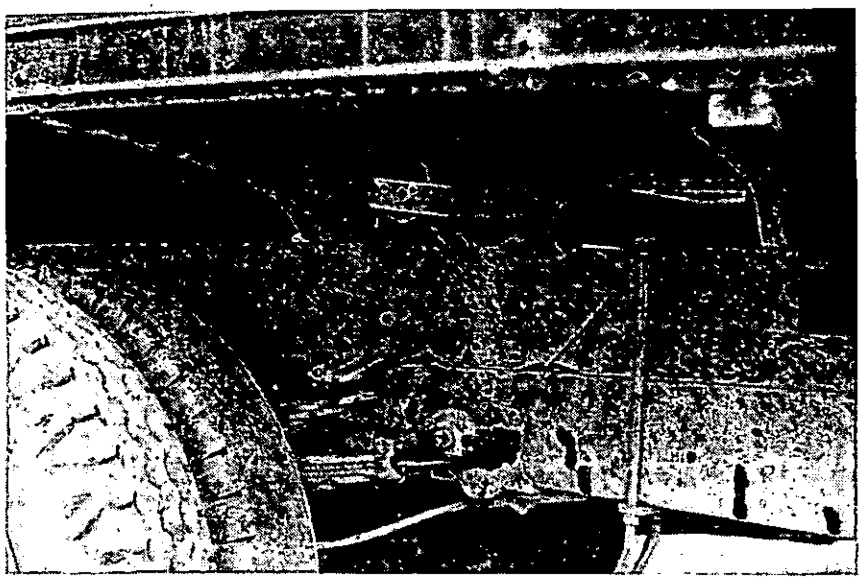
U. S. INDIAN SERVICE

How the front assembly is attached.



U. S. INDIAN SERVICE

How left rear plate is attached.



U. S. INDIAN SERVICE

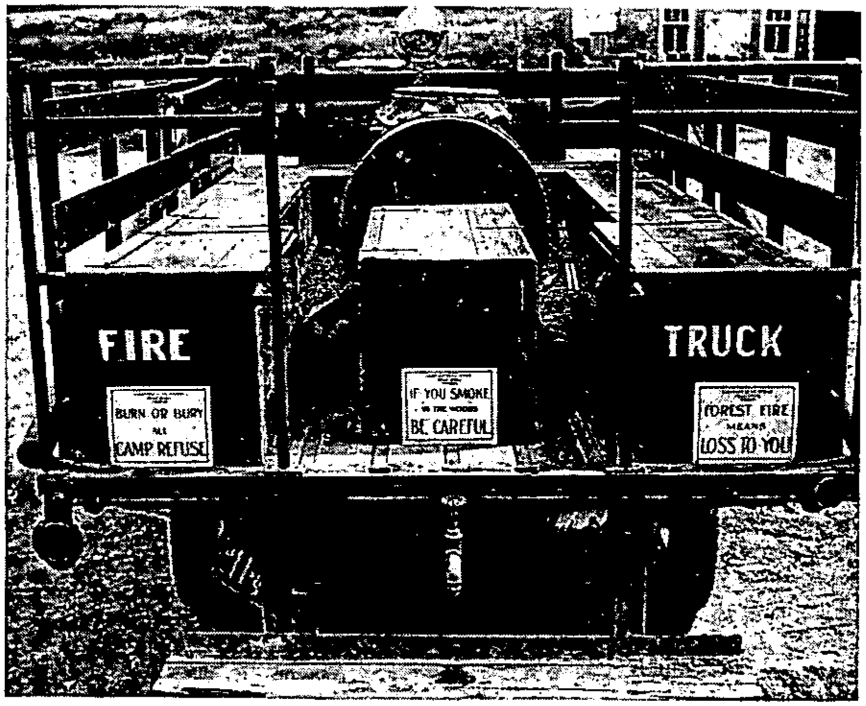
Right rear construction which keeps pipe from slipping through.

If the cables are too long there may be some difficulty in negotiating turns as the mats may be caught under the wheels of the truck. Experience has shown that there is a high proportionate loss of efficiency as the truck approaches a speed of 10 miles per hour. The arrangement on the truck causes the mats to lift from the ground at a speed of about 9 to 10 miles per hour. Best results are obtained at a speed of about 5 miles per hour, since this allows the drags to remain for a sufficient time over a given area to cool the burning material, gives the driver more time to maneuver the truck, and prevents serious damage if an obstacle is encountered.

The mats are usually dragged directly over the fire line, with the truck on the outside of the fire. However, if the ground cover is quite dry, and not too dense, a line may be dragged outside of the fire line with equally good results. A line is formed which is from 6 to 8 feet wide and is generally sufficient to stop a grass fire. Under very high wind conditions it may be necessary to drag several lines fairly close together. Occasionally it is necessary to backfire a small area which may be too rough to drive through but around which a line can be dragged. At other times a line of fire can be started with a torch, the truck being driven behind to extinguish the outside of the fire, allowing the inside to burn in toward the main front.

The truck is equipped with a large searchlight which is operated by a crew member for night work. It is useful to penetrate smoke and to allow the driver to plan his route as far in advance as possible.

The body of the truck is equipped with boxes and a tank, as shown in the diagram and photographed. The boxes were made of surfaced material a full inch in width. The hinged lids were made of heavy



U. S. INDIAN SERVICE

Tank and tool box arrangement in body of truck.

material about 1⅛ inches in thickness, since they are used as seats for the crew. The tank has a capacity of about 300 gallons and is provided with a valve at the rear of the truck for filling back pumps and water bags. The opening in the top of the tank is large enough to admit a bucket and is kept closed with a piece of canvas held in place by a band made from an inner tube. The water in the tank is changed every other day to provide fresh drinking water for the crews. On long runs a bucket of water is occasionally thrown on the mats by a crew member to cool the mats, as they become quite hot from friction with the ground and the fire.

The pipes to which the mats are fastened are carried on hooks attached to the outside of the stake body of the truck. The mats are rolled, with the pipe to which they are attached on the inside, and fastened with wire. They are carried between the tank and boxes in the truck. The truck driver has been able to assemble the mats in about two minutes without help. With help, the assembling takes less time. The loading of the mats on the truck can be accomplished by one man but is somewhat difficult.

The boxes contain equipment that can be used on both prairie and timber fires. Enough equipment is carried to outfit at least 25 men. A Pacific Marine pump and about 1,200 feet of linen hose, as well as other pump accessories, are carried in the box at the front of the truck body. Other equipment is as follows:

12 fire mops (swatters).
6 bags, water, canvas, 5-gallon man-pack.
6 pumps, hand-spray, with hoses and nozzles.
1 torch, propane, with backboard.
6 flashlights, headsets.
16 shovels, lady.
16 Pulaskis.
6 axes, d. b., 3½ pound.
1 saw, C. C., 5½-foot, with handles.
10 rations, emergency, one-man, one-day.
1 lantern, gasoline.
1 gasoline, high-test (gallon).
1 kit, medicine.
1 radio, SPF.
2 buckets, canvas, folding.
2 poles, antenna.
Files, stones, hammer, wedges.

The antenna poles are equipped with three rope guys and pegs so that they may be set up quickly at any place. Frequently the truck serves as one antenna pole. With two poles the radio may be set up independent of the truck. Otherwise the aerial is wrapped around the top of the stake body on the left side. The radio is carried in the cab, on the driver's seat, to cushion the jolting and prevent damage to it.

This truck is held in instant readiness for action at all times during the fire season. With the help of the truck nearly all grass fires on the Blackfeet Reservation during the past 3 years have been controlled by the "flying squad" which is loaded on the truck whenever there is a call. Under ideal conditions the truck can do the work of 50 men using hand tools.

EXPERIMENTS WITH FIBROUS WATER HOSE

(Continued from page 113)

tions. When the first man reaches the end of the first length he stops and inserts a sleeve in the second joint and continues to string out more hose. This process is continued until the desired point is reached. A little practice will enable the man stringing the hose to leave the proper amount of slack.

The second man places the sump bag and connects the hose. He regulates the flow of water to about 5 gallons per minute and follows through to the end of the first section. He straightens out bad kinks and may move the hose a foot or two for better location. He then connects the first and second joints and repeats the process. When the water reaches the desired point this man returns to the intake and gradually increases the flow of water to all that can be forced through the outlet of the sump bag. Two men should carry their own supply of hose and connections and string about 1½ miles per hour over ordinary mountain terrain.

HOW ABOUT THE ESPRIT de CORPS

E. F. Barry

Staff Assistant, Flathead National Forest, Region 1, U. S. Forest Service

This article, which relates to the method of attacking and suppressing the Honey Fire (1,092 acres, Kisatchie National Forest, Louisiana, 1938) should be read in connection with Mr. Headley's article in Fire Control Notes, vol. 3, No. 4, October 1939, pp. 40–41, Lessons from Larger Fires of 1938, under the heading "Honey Fire." Methods of attack on fires in various situations in this location have formed a controversial subject, and it is not surprising that Mr. Barry has raised some questions in this instance. Based upon all the facts now known it appears that the only method of controlling the Honey Fire at a smaller acreage would have been an immediate attack by the indirect method of backfiring. The direct attack made, failed. The action showed clearly the need for the special study in fire behavior made on this area, to supply detailed facts for training and improved action in connection with future fires. (See Fire Control Notes, vol. 5, No. 4, October 1941, pp. 161–178, An Analysis of the Honey Fire, by C. F. Olsen.)

On most fires in some regions an early direct attack can be expected to help toward the final suppression accomplishments. In this instance, where the fire in dry grass aided by the wind spread very rapidly, a direct attack by the studies crew with hand tools a few minutes ahead of the suppression crew would have been ineffective toward reducing the suppression job or the final area. Also, as is indicated in footnote 2 on the first page of Mr. Olsen's article, the studies crew upon arrival near the fire was confronted with two fences and a railroad track which prevented passage of their truck. Although Mr. Olsen's article may permit of the question as raised by Mr. Barry, it appears the discovery by the studies crew of the errors made in action methods on the Honey Fire is of greatest value and vital in future suppression work. The criticism offered by the studies personnel is wholly constructive, pointing out actual faults as they occurred, and was given only to guide our protection organizations to better accomplishment when they may be confronted again with similar fire problems. The supervisor had previously agreed that the members of the studies crew were relieved of any obligation to assist in fire suppression, it being recognized that their full attention should be given to the essential research duties on fires.

A reading of the article of C. F. Olsen, entitled "An Analysis of the Honey Fire," in the October 1941 issue of Fire Control Notes, brings to attention a situation hard to imagine. Of course, it is practically impossible for us at this remote location to visualize all the factors; nevertheless, after making generous allowances, I still experience an unpleasant jolt when I think of what happened.

There were two branches of the same department involved in the suppression of a fire, one interested in determining how the fire would behave on a bad burning day, the other charged specifically with the responsibility for stopping its spread.

The branch interested in behavior arrived at the Honey Fire first, 3 minutes after its origin according to the article. A four-man fire-behavior crew had been traveling on a paralleling highway about a mile behind a train that stopped to service a hot box. The train crew carelessly threw some burning waste into dry grass and the behavior crew happened along 3 minutes later. They found it "definitely too big for them to hold." (See footnote 2, of Mr. Olsen's article.)

The decision of the fire-behavior crew—equipped with a car having various fire-fighting tools—to refrain from an attempt to check or retard the spread of this fire when it was approximately 100 feet long is hard to understand. We would expect more from four untrained men off the street as a quality of citizenship. Forest Service guard-training instructions have emphasized for years that there is always something that even a single guard can do to retard the spread of a fire, although it may be obvious that a frontal attack is impossible. The failure to make some attempt in that direction on the part of this fire-behavior crew indicates that they did not believe in such a theory. Won't the morale and fighting spirit of our temporary guards be lessened by such an example? The public, too, may find such action, or lack thereof, confusing.

If the fire-behavior crew admitted that they were unskilled in fire fighting and limited their report to the factors of weather and rate of spread, their disregard for attempting control action could be overlooked to some extent.

The fact that suppression foremen, who apparently did their best to stop this fire, were subjected to criticism by such men indicates an oversight in personnel management that cannot help but decrease spirit and morale in a marked degree. Moreover, the fire-behavior crew has been permitted to make capital of their questionable action by printing the results of their study.

There is no quarrel with the policy of conducting fire-behavior studies, and the men assigned to that duty should not be expected to take part in the suppression work on fires that have escaped first control efforts. However, there should be no tolerance of a policy permitting an organized crew of men to travel about the country looking for fires to study unless they are willing to lend a hand in an effort to check the spread of small fires pending the arrival of regular suppression crews.

It is hoped that in the future this fact will be made clear to all, so that even though a fire cannot be entirely stopped, it may be retarded, thereby permitting arriving suppression crews to handle it more easily. That kind of action will make far better reading than the one referred to above, and the results after the fire is out will go far toward strengthening the spirit and morale of the whole organization.

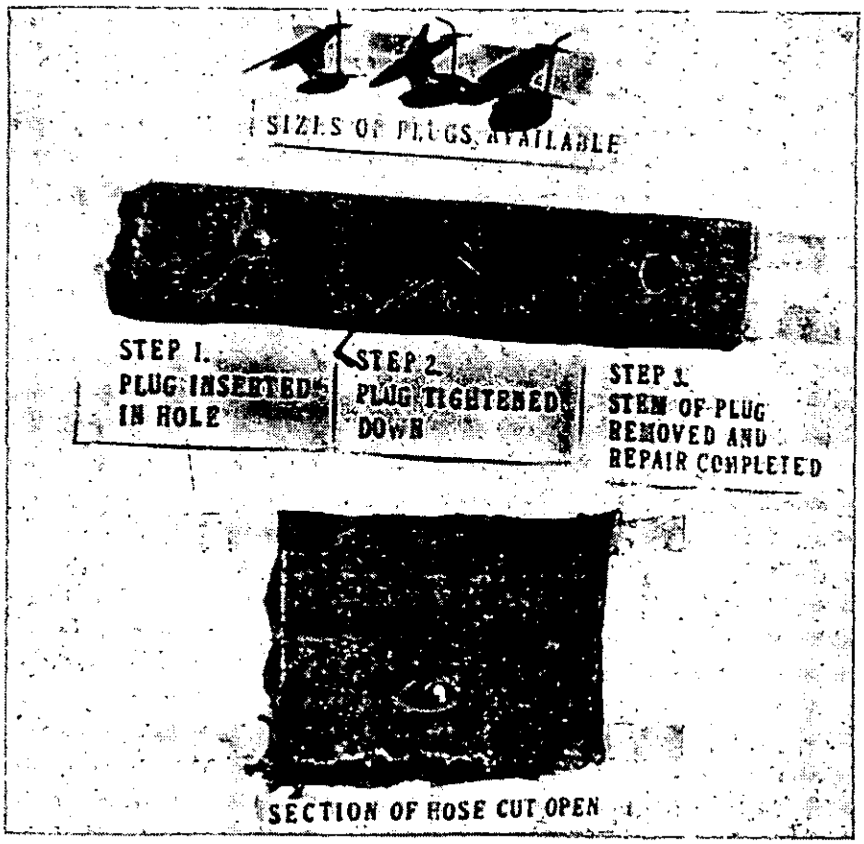
REPAIRING LINEN FIRE HOSE

ANNE C. ALLEN

Chief, Cedar Hill State Forest Fire Experiment Station,
Cedar Hill Fire Department, Cowesett, R. I.

An easy and efficient method of repairing the leaks, or "weepers," in linen fire hose has long been the aim of many departments. All forest-fire-fighting organizations have had the experience of placing in use brand-new hose and finding holes that emit streams the size of a lead pencil. These holes, caused by the knotting of the thread during manufacture are annoying, to say the least. Furthermore, lengths of hose that have been in service for a time will spring serious leaks.

With an eye to saving hose for war needs, this station began intensive research into the matter of repairing hose. Finally evolved was a method for repairing that will work, not only on linen fire hose but



Plugs used in linen hose.

on regular rubber-lined fire-department hose. The method is easy and efficient, may be employed while the hose is in use, and is low in cost.

M. L. Holst, Chief Forester for the Cedar Hill Forest Fire Experiment Station, conducted the research and tests over a period of several months and under various conditions. It was found that the most inexperienced members of the Rhode Island State Forest Fire Service crews could, by using the method, make repairs on filled hose at 150 pounds pressure, or even higher.

Back in the "gay nineties" when bicycles were the rage, a small brass plug to stop air leaks in single tube bicycle tires was invented. There were several different makes, among them the Sampson brass plugs, patented April 1898, and the Spooner brass plugs. All bicycle stores carried the plugs then and they and the large mail-order houses still carry them. These small brass plugs have now been put to a new use—that of repairing the leaks in fire hose!

The plugs come in three sizes—large, medium, and small. The two larger sizes are best for repairing fire hose.

The efficiency and durability of the plugs could be greatly increased if they could be dipped in some sort of rubber solution, which would cover the bottom and cap with a coating of rubber. It has not been possible, however, to interest anyone in manufacturing a rubber-covered plug, because of present war conditions.

FIREBREAKS PREVENT LARGER FIRES

(Continued from page 115)

In other words, during the past 2 years there has been a direct saving on the area of 464 acres of burned area, $340 of suppression costs, and $438 of estimated damage.

It is not expected that this firebreak is going to stop all the fires on the area, nor has it solved all of the fire problems, but so far no fires have crossed it.

The evidence is that thus far it has been a great help in limiting the size of fires, which has resulted in smaller suppression costs and less damage. Its value will be better appraised in the future.

WHERE ARE WE GOING WITH CONFLAGRATIONS?

Lowell J. Farmer

District Ranger, Powell National Forest, Region 4, U. S. Forest Service

Looking ahead to new fire-control methods as one forest officer sees them.

It is the year 2042. Tremendous acreages of second-growth timber cover the areas that 100 years ago had scarcely known the ring of the woodsman's ax and saw. The summer is hot and dry, and every lookout is at his post, tense and waiting. An electric storm slowly darkens a vast panorama of forest land and the fireworks begin. Suddenly the headquarters radiophone booms out information on two smokes. Within 3 minutes two planes are following the radio beam to the fires. Approaching the rising smoke columns, they circle low, emitting dense billows of oxygen-eating gas that settle rapidly to the ground smothering the flames that are already getting under way. As the planes circle to return for a recharge of gas two more take their places. Two transports discharge small smoke-chasing crews by parachute and within a short time the fires are under control.

Combined research and experience in dealing with forest fires today (1942) is approaching the point where, in probably much less than 100 years conflagrations will be unknown. Developments in technique all point toward a methodical and precise handling of potentially large fires. Radio is used now in all the ways mentioned. There is every reason to believe that a direct beam to any point will be used in the future. The gas may be one we know or it may not yet have been developed.

The other angle is simply consideration of forest fires from the point of view that combustion is a chemical reaction, while we have not given suppression activities a strictly chemical approach.

Those who studied elementary chemistry learned that the requirements for combustion are:

1. Proper mixing of fuel and air in proportions which will insure complete combustion.
2. Exposure of fuel particles to oxygen throughout a period of time sufficient for their combustion.
3. Maintenance of the combustion zone at a temperature above that of the ignition zone.

Fire-danger rating charts now in wide use successfully forecast the first requirement, and we prevent the other two by removing the fuel. As far as I know, we have never attempted to handle a potentially large fire by removing the oxygen supply. Will this be the next experimental step in suppression technique?

Theoretically, as determined from a table on the combustion properties of fuels, 11.5 pounds of air are required to burn 1 pound of car-

 (Continued on page 130)

LIGHTNING VERSUS BOMBS

L. L. Colvill

Assistant Forest Supervisor, Siskiyou National Forest, Region 6, U. S. Forest Service

On July 13, 1941, at 10 p. m., the Bear Basin Lookout house, elevation 5,300 feet, was struck by lightning and the same strike started the Bear Basin fire.

District Ranger Quackenbush and the writer investigated the results of this strike the next day, and the following is a brief description of what we found.

The look-out building is a gabled-roof, 14 by 14 Alladin house, equipped with standard lightning protection, and with the ends facing north and south.

Apparently the lightning bolt was horizontal and struck the north end of the building at the top of the window sash and in the approximate center, and appeared to have exploded when it contacted the lightning conductor which extends across the end of the building at the top of the window frame. This end of the building was blackened for several feet in all directions. A considerable portion of the charge was carried from the building by the northwest guy line, as evidenced by the ground which was torn up for several feet where the line was anchored. At practically every point where the lightning conductor was fastened to the building, there were indications of a heavy voltage. The impact against the building was so great that it shattered one window sash, and approximately two-thirds of the window panes in the building. Much of the broken glass was pulverized and there was hardly a piece bigger than a dime. The nails in the building at the north corners were so loosened that many of them could be pulled by hand. A radio antenna wire, which extended for about 50 feet on the north side of the building and which was disconnected before the storm and left lying on top of the brush, was completely burned and the brush was scorched.

A considerable portion of the charge went through the building directly over the fire finder, striking a gasoline lantern which hung from the ceiling and shattering the globe but leaving the mantels untouched, then passed out through the window at the opposite end of the building, resulting in two holes in the top panes approximately 5 inches in diameter. The look-out and his wife were standing on opposite sides of the fire finder, and this portion of the charge going between them and slightly over their heads knocked them unconscious for approximately 1 hour.

The master switch for protection of the telephone was located on a pole approximately 10 feet from the south end of the building and directly in the line of travel of the lightning. It was struck at the point where the copper U-connectors holding the ground rod are fastened to the box. The charge was further broken at this point, and a portion went through the discharge gap in the switch with such

force that it broke the bakelite base and went out over the telephone line, eliminating all traces of the line for one-fourth mile. A part of the charge was deflected down the copper ground conductor to where it connected with the No. 9 galvanized telephone ground line. This telephone ground was anchored in a spring approximately one-fourth mile distance, and the lightning eliminated all traces of this ground line for approximately 400 feet and set the brush on fire for this distance. The telephone was not damaged. No doubt the lightning conductors carried away a large volume of the charge, but the fact that the building failed to catch on fire and cremate the unconscious bodies of the look-out and his wife is miraculous.

Thirteen days later lightning again struck at Bear Basin, but this time its course was more conventional. The lightning struck a tree located several hundred feet from the building, on which the telephone line was anchored, followed the telephone line through the master switch which had not been opened, burned out the lightning protection fuse, and entered the telephone instrument and burned out the generator, thus completing the job started July 13.

WHERE ARE WE GOING WITH CONFLAGRATIONS?

(Continued from page 128)

bon. Mr. Fredrick T. Morse, assistant professor of mechanical engineering at the University of Virginia, has devised the following formula to determine the number of pounds of air necessary to burn 1 pound of coal:

$$\mathrm{Air}=11.5C+34.5\,(H-\frac{S}{0}+4.35S)$$

Substituting in the formula where the symbols represent fractional portions of the elements, it should be a simple matter to determine the amount of air necessary to burn any of the forest fuel types. The reducing action might then be accomplished by any gas having sufficient weight and density to adhere to the ground level and possessing the ability to absorb enough oxygen to bring the available amount below that required. The factors of atmospheric density, pressure, temperature, and motion would all enter into the computations.

At the end of this year we will read quotations on the thousands of acres of timberlands destroyed by fire. Next year the figures will be compared with those of previous years and remarks will be cast about peak years and good years. New forest-fire films will be made. The public educational program will be expanded. New features such as "hula dancers" and "fag bags" will catch the public fancy and make them fire conscious. But we still summarize our annual fire losses in *thousands* of acres. The fag bag has served its purpose when it prevents a fire, but there will always be lightning storms and there are too many fires that get out of bounds before men can be placed on them. Let's not wait until 2042. Conflagrations can be licked and some day someone is going to figure out a way to do it.

CEMENT AS A FIRE EXTINGUISHER

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SCIENCE, January 23, 1942, contains a short article "Pitch the Best Incendiary Extinguisher," by Dr. R. R. Sayres, Director of the U. S. Bureau of Mines.

It would seem to the writer that a good deal of caution should be used in the application of pitch to extinguish fire, even though it originates from a magnesium incendiary bomb. It has been the experience of the writer with a great variety of small fires in oil, metals, and other materials, that there is nothing so satisfactory and so foolproof as portland cement as it is placed on the market. In many cases in the writer's experience it has been highly successful in extinguishing fires where water, carbon tetrachloride, foam, and similar substances have been unsuccessful. This very common material so easily available and so safe to use should be placed at points where there is danger from fires either from incendiary bombs or from normal causes.

In our own laboratory, such material is easily available in kegs and we find it far more successful than the usual fire extinguishers. Furthermore, it gives off no injurious gases and is in itself not combustible, as is the case with pitch.