diately joined the Department of Lands and Forests, Ontario, where he spent his entire career in forestry. He became well informed on the forests of Ontario through his work on surveys and his continuing contact with every part of the Province while attached to the Forestry Branch and the Woods and Forests Branch of the Department.

In 1941 he was appointed Chief of the Division of Timber Management on the reorganization of the Department. From then until his retirement in the spring of 1958 he was widely known through his close contact with the forest industry on all matters dealing with timber licensing and forest operations.

He was a member of the Canadian Institute of Forestry for thirty-three years and was one of the first to actively promote a professional society in Ontario. He was representative on the Board of Directors from 1933 to 1935 and in 1937.

"Frank" Sharpe's life was dedicated to forestry with emphasis on forest management and practical administration. In all his undertakings he advanced this cause and even at times when there was reason for discouragement he maintained his faith in the principles of good forestry. His interest in forestry extended to his own property near Barrie where he planted over fifty thousand trees in a period of twenty years.

Knowing Frank Sharpe was a privilege which will be treasured by many foresters and a host of others.

MURRAY B. MORISON.

TECHNICAL NOTES

WHAT'S IN A FIRE PUMP?

By W. B. Gayle¹

What type of fire pump is best suited for fighting forest fires? What type of equipment should be installed on this pump? Many experienced fire fighters have very definite answers to these questions, yet each answer would be entirely different from every other.

This difference of opinion usually stems from a lack of knowledge of the basic facts of elementary hydraulics. There are at least a dozen good pumps on the market, all of which are generally classed as "suitable for fire fighting," yet each is designed for a special purpose. Unless we know something about hydraulics, we can easily make the dangerous mistake of buying the wrong pump.

Even some of the best informed people become entirely confused when talking about pressure and volume. One day an experienced fire warden was filling the fuel tank of a donkey engine by means of a fuel truck and neoprene hose. He had screwed a small nozzle on the end, which of course resulted in

¹ Forester, Powell River Company Limited, Vancouver, B.C.

a higher pressure at the pump. Incredible as it seems, his reason for doing this was that, because he was getting more pressure, he must then be getting more volume, and he would be able to fill the tank faster.

Another fire warden was filling up a water tank located on top of a fifty foot tower by means of a pump set up in a creek near the bottom of the tower. There was an outlet and valve near the bottom of the tank to which he easily could have attached the hose, but instead he went to all the trouble of tying up the hose over the top of the tank, because he didn't want all the water in the tank to press down on the pump and ruin it. He could not understand that, if anything, he was increasing the pressure at the pump by having to pump the water higher over the top of the tank.

To simplify the matter of hydraulics we can say that the pump develops pressure which is used to:

1. Push the water through the nozzle orifice and produce a usable stream. For a given nozzle opening, the greater the nozzle pressure, the greater is the volume produced. It is generally accepted that, using a 5/16" nozzle, a nozzle pressure of 50 lbs. will give adequate volume for fighting forest fires (20 gallons per minute).
2. Overcome the friction of the water passing over the inner lining of the hose. For 1½" rubber lined hose, with a velocity of 20 gallons per minute, the friction loss is about 2 lbs. per hundred feet of hose.
3. Overcome hydrostatic pressure which is nothing more than the effort required to hold the column of water from one elevation to another. A column of water 1" square and 1' high weighs 0.43 lbs. Thus, it requires 43 lbs. per square inch to hold up a column of water 100' high.

This latter factor is usually the most important because it takes as much pressure to push water up only 100 feet (43 lbs.) as it does to push water along the flat for a distance of 2,200 feet. We cannot, therefore, rate a pump by how far it pumps water, rather how high will it pump.

Suppose, for example, there was a water hole near the home tree and that we were yarding logs from above, through a distance of 1,200 feet. We find, by looking at the logging engineer's map that the elevation of the water hole is 1,410 feet, and that the back block of the rigging is 1,830 feet. There is, then, a difference of 420 feet through which we have to pump water.

Now then, to know which pump will put water up to the back end, all we have to do is to calculate the pressure required as follows:

1. Nozzle pressure—assume 5/16" nozzle opening, to get 20 gallons per minute we need _____ 50 lbs.
2. Hose friction—at 20 gallons per minute, friction for 1½" rubber lined hose is 2 lbs. per 100 feet. To push water through 1,200 feet we need _____ 24 lbs.
3. Hydrostatic pressure—to lift water 420 feet we need 0.43×420 or _____ 181 lbs.

TOTAL PRESSURE REQUIRED _____ 255 lbs.

Thus if we have all our pumps properly tested, and we know how much pressure each pump will develop, we will know what kind of a job each pump will do. Most certainly it would be foolish to put out a pump which will give us only 100 lbs., or 200 lbs. Based on our previous knowledge of pump performance, we would put out a pump that is capable of producing 255 lbs. Of course, anything more than that is even better.

If we find that the pressure required is so great that not any one pump is capable of producing the required pressure we can either put two pumps together in tandem at the bottom of the hose lay, or else set up a relay system, with one pump at the bottom and one more farther along the line.

A tandem setup is usually preferable providing the hose is strong enough to take the added pressure. This means that both pumps are in operation at one location under the watchful eye of only one man. Refuelling, maintenance, water delivery and performance can, therefore, be more effectively controlled.

A pressure gauge is a useful accessory on every pump. It is unfortunate that, to decrease the selling cost, most pump manufacturers are not including it as standard equipment. With the foregoing knowledge of elementary hydraulics it will give a good indication of what is happening to the nozzle end of a hose lay. A pressure gauge is just as important to a pump as a speedometer is to a car. Neither are really necessary, but both will perform a useful service.

A small wooden box should be supplied for and identified with each pump. This box will contain a spare spark plug, spark plug wrench, screw driver, adjustable 8 inch wrench, grease gun, grease, one quart oil (non-detergent), hose wrench, some hose coupling gaskets, a siamese valve, a spare nozzle, and some wiping rags.

What about the pump of the future? Certainly there is room for a great deal of improvement. There is still one pump on the market which is advertised as "giving emergency fire protection for the forest" yet only produces 100 lbs. pressure. It has a high capacity (over 100 gallons per minute at 50 lbs.) but what good is volume if there isn't enough pressure to put it anywhere?

Logging in B.C. is progressing farther and farther up the sidehills and is becoming more remote from adequate sources of water. This means still more pressure is required. The hose manufacturers have made hose which will withstand 600 lbs. pressure and can make it to give good service at 900 lbs. The need for greater pressures is apparent, and surely power supplies are available. Has anyone thought about what a wonderful engine the Volkswagen would be when attached to a properly designed pump? Outboard motors are now manufactured with a rating of 70 horsepower—what an effective power supply one of these larger motors can be when attached to a pump of proper design.

We should also not forget the qualities of the gas turbine engine which make it very suitable for pumper use. There is one already available in England designed more for fire brigade work (high volume, low pressure). The total unit weighs 215 lbs., produces 60 shaft horsepower, and pumps up to 500 gallons per minute. Something like this, about half the size, with a smaller high pressure pump might be an ideal combination.

Generally we could classify our needs in three groups:

1. A high powered, multi-stage centrifugal pump. It should have some sort of shifting device to put the pump stages in parallel to give high volume at low pressure for filling tanks or pumping along the level, or shift the stages into series to provide very high pressure at low volumes for pumping up-hill. As a suggestion, it should pump 200 gallons per minute at 30 lbs. pressure in the volume phase, and 10 gallons per minute at 600 lbs. pressure in the pressure stage. It should not weigh more than 90 lbs. so that two men can carry it to the water source.
2. A low-powered light-weight pump producing pressures in excess of 350 lbs. weighing not more than 35 lbs. Volumes should be kept low (8-12 gpm) purposely. This is to be used on 300-gallon Harrodyke tanks, metal water tanks on colddeckers, sump holes, or wherever the water supply is limited.
3. A pump that is capable of pumping fire retardant chemical at least with a 400-foot head. This chemical (Sodium-Calcium-Borate) is very abrasive and to date there is no inexpensive pump that will successfully pump this suspension to adequate heights.

With these three types we should be able to meet all requirements on the fireline.

Knowing this we should no longer buy a pump merely because it is advertised as being "suitable for fighting fire." Instead we can purchase a unit that is tailor made to suit a specific purpose.

THE TOWILL PHOTO-CONTOUR MAP¹

By A. M. Nelson²

There are many kinds of maps used in forestry ranging from unscaled sketches through mosaics to the standard conventional topographic map. The preparation of the detail of these maps is usually kept to a minimum to aid the map user to solve his immediate problems, and having such a map, it has served its purpose.

Today, however, the trend is to secure maps that have all possible detail plotted for operational uses. This is time consuming, and any interpretation of detail from the air photo is subject to the ability and judgement of the interpreter.

However, the Towill photo-contour map is a map which provides contours and all possible detail, the detail being added from a rectified photographic image. Therefore, contours and detail are at constant scale.

The advantage of such large-scale maps over conventional maps is that features and detail are not omitted; therefore, personnel using the photo-contour

¹ A contribution of Photogrammetry News, one of a series of reports by a committee under the chairmanship of Mr. J. R. Collins, Forestal, Forestry and Engineering International Limited.

² Vice-President, McElhanney Nelson Air Surveys Ltd., Vancouver, B.C.