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SLIP-ON TANKERS FOR FOREST FIRE SUPPRESSION

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TABLE OF CONTENTS

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INTRODUCTION

During the last decade, and particularly during the last several years, the use of mobile equipment in forest fire suppression has attracted considerable attention, and each year, as the forested lands become more interlaced with roads, the advantages of such equipment have become more and more obvious. Some fire protection organizations have found that the majority of fires in their forests start within one-quarter-mile of roads, a distance readily overcome from a tanker. Permanent type tankers of various makes and capacities are presently being used in many areas and a wide variety of slip-on or drop-on type units are also finding much favour.

A tanker may be defined as a truck fitted with a securely mounted water tank which may not be removed readily. A power pump, activated by the truck engine or a separate pump engine, is generally considered to be an integral component of the tanker. A tanker-trailer may be defined similarly except that the tank is mounted on a specially constructed trailer.

Slip-on or drop-on tanks are water containers which are not permanently attached to any one vehicle and may be transported by any available truck of sufficient load capacity. The complete fire suppression unit of truck, slip-on tank, pumper, and hose, etc., is known as a slip-on tanker. In some instances, however, a slip-on may be left on a vehicle year round and this unit may be considered for all intents and purposes as a tanker.

USES OF MOBILE EQUIPMENT

Mobile tank equipment, of course, is most useful in getting water to fires quickly where roads are available, but where there is no source of water nearby. Even when there is a stream or pond near the fire, tankers may well provide a means of hastening the initial attack. They are also of great value in patrolling for and extinguishing campers' roadside fires, and while used on patrol they offer an excellent means of advertising forest fire protection to the public. Tankers, and slip-ons in particular, may be used to advantage as relay tanks, several units employed in this manner permitting the utilization of water from distant sources. The value of mobile equipment for controlling rapidly spreading grass fires and for filling back-pack pumps for mop-up work has often been demonstrated.

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SLIP-ON TANKS

An advantage of the slip-on tank is that it may be removed at any time, thereby liberating the truck or trailer for other purposes. This feature is of particular interest to the forest industries since all trucks may be in demand for various purposes during all seasons. A further advantage of the slip-on is its versatility—if truck roads are not available, the unit may be hauled on a sloop or a stoneboat by tractor. Perhaps he main superiority of the slip-on tanker over the permanent type tanker is its economy, since special vehicles are not required to make up the units. The slip-on tank may be placed on almost any available truck.

Steel Slip-ons:

At the present time, 12- or 14-gauge steel is the material most commonly used in slip-on tank construction. Although these tanks vary in size from 50 to 2,000 gallons, few have capacity greater than 500 gallons and, in general, tanks of the 100- to 200-gallon sizes are most popular. Larger units are very heavy and bulky; consequently, they are difficult to handle and often require special apparatus, such as block and tackle, to load them onto trucks. Tanks of not more than 200-gallon capacity are favoured since they will fit into pickup trucks which are usually more readily available for service at a moment's notice than are larger vehicles. Steel tanks of 200-gallon capacity weigh approximately 300 pounds empty while larger tanks of 500-gallon capacity usually weigh between 700 and 1,000 pounds.

Oval, cylindrical, and rectangular designs are used in slip-on tank construction. An oval shape is more suitable than a cylindrical one since it gives the tank a lower centre of gravity. This is an important consideration, expecially in mountainous country or where roads are very rough. Both the oval and cylindrical designs are used principally for the larger tanks (500 gallons and up) which are carried by two- or three-ton flat-bed trucks. These tanks are frequently secured to flat-bottomed metal frames which cradle the tank. The tank may be held to the truck platform by nailing down 2 inch by 4 inch lumber, or similar material, around the tank frame; by placing chains around the tank and securing them to eye-bolts in the truck platform; or by bolting the tank frame to the truck bed. Rectangular tanks are usually designed to fit snugly into a pickup truck or power wagon. If the tank does not fit snugly into the truck box, it may be secured by placing boards of the required thickness at its sides and rear, or it may be bolted to the truck floor.

Baffle plates, the number depending upon the size of the tank, should be included in the design specifications. They are required to prevent excessive water movement in the tank which might make the vehicle very difficult to operate. They perform the second function of increasing the overall strength of the tank. Baffles should be welded in place and they must have openings at their bases to permit water to flow from one compartment to another.

In the construction of the tank proper, the joints should be welded if leakage is to be prevented. On the other hand, it would be advantageous to have some means of access to the tank's interior for inspection and maintenance purposes. One type of rectangular tank currently in use has hinged lids which render the tank interior easily accessible. The Department of Lands and Forests of Nova Scotia has fitted the tops of their 500- and 800-gallon oval tanks with filling holes large enough to permit a small man to enter them. The hole at the base of the baffle plate is also large enough to crawl through. Such arrangements make cleaning and rust preventive treatment possible.

The U.S. Forest Service has designed a slip-on tank especially for use on pickup trucks. There are two sizes available, their capacities being 160 and 200 U.S. gallons. Both tanks have a 47-inch-square base, but the height of the larger one is 21 inches and that of the smaller one 17½ inches. The design calls for 14 gauge welded steel construction with a tank weight of 252 pounds for the 200-gallon size. Two solid partitions divide the tank into three compartments. In the 200-gallon tank, the centre compartment holds 75 gallons, and each side compartment holds 62·5 gallons. The centre compartment of the 160-gallon unit holds 60 gallons, the side compartments 50 gallons. The compartments are connected at the base of each partitio by two 1½-inch pipe half couplings with 1½-inch by one inch brass bushings and one-inch brass plugs. Water may be used from the entire tank by removing the plugs, or one or both side compartments may be used as tool boxes by leaving the plugs in place and by putting water in the centre compartment only. Each compartment is fitted with a folding baffle plate and drain plug. Lids with continuous piano hinges are provided for each compartment. They are held shut with quarter turn clamps and are made watertight with molded cellular door weatherstripping.

A four-inch filler spout, 18 inches high, is mounted on the lid of the middle compartment. The upper portion of the spout is equipped with a 10-inch filter screen and a cap with air vents. Both the by-pass return from the pressure relief valve and the tank suction pipe are connected to the lower part of the filler spout and enter the tank through it.

Although these tanks are specifically designed to fit half-ton to one-ton pick-up trucks, both are too wide to fit on the floor of the box on those trucks which have rear fender wells extending into the box. If this type of truck is used, the tank must be raised about five inches to clear the fenders, which causes an undesirable rise in the centre of gravity of the load.

It has been suggested that one or two compartments of the tank could be used to carry tools while the other compartments are used to carry water. Because of the high initial cost of the tank, it may not be advisable to subject it to the wear and tear of tool-box use and, of course, it would not be desirable to reduce the already limited capacity of the tank, unless the truck capacity or road conditions necessitated light loading.

Protection from Corrosion:

Besides being rather heavy, steel tanks have the further disadvantage of being subject to excessive corrosion if preventive measures are not taken. Several preservative treatments have been tried and some have met with marked success. A metal spraying process known as "metallizing" (1) has been used in other industries to coat various surfaces with copper, stainless ste l, zinc, or other metals and in so doing has made con ainers corrosion-proof, or nearly so. A metallizing gun using compressed air, oxygen, and acetylene is used in conjunction with wire of the des red metal which is fed from a reel into the gun. Before the surfaces can be metallized, they must be sand-blasted to clean them thoroughly and to roughen them in order to ensure a good bond. It is said that a coating of 0·01-inch should provide protection for at least 30 years.

A good quality base paint plus several thin coats of automobile enamel will provide good protection from rust. There are also several special rust preventive paints available under various brand names. Other preventives that are merely added to the water are also marketed and some are very effective (2). One system currently in use is that of adding a small amount

of oil to a full water tank and then permitting the tank to drain slowly. As the water level drops a thin film of oil is deposited on the tank walls. This method is usually used just prior to putting the tank into winter storage and should be practiced with care, as oil will damage hose, particularly the rubber-lined variety.

Aluminum Slip-ons:

Since steel tanks are comparatively heavy and are subject to rust, several forest protection agencies have been experimenting with tanks made of aluminum. The material most commonly used in Canada is Alcan 064-575½H aluminum sheets.

One tank has been designed specifically to fit snugly into a half-ton or one-ton pickup truck. This is a rectangular unit measuring 57½ inches by 46 inches by 23 inches. It has a capacity of 210 Imperial gallons and a weight of 135 pounds. There is a four-inch opening in the top of the tank which is large enough to permit simultaneous emptying and filling, and a three-quarter-inch opening with tap attached, located at one end of the tank for draining the unit or for filling back-pack cans. Two cast-iron handles are provided on each side to facilitate loading and unloading. All joints should be welded to ensure watertight construction.

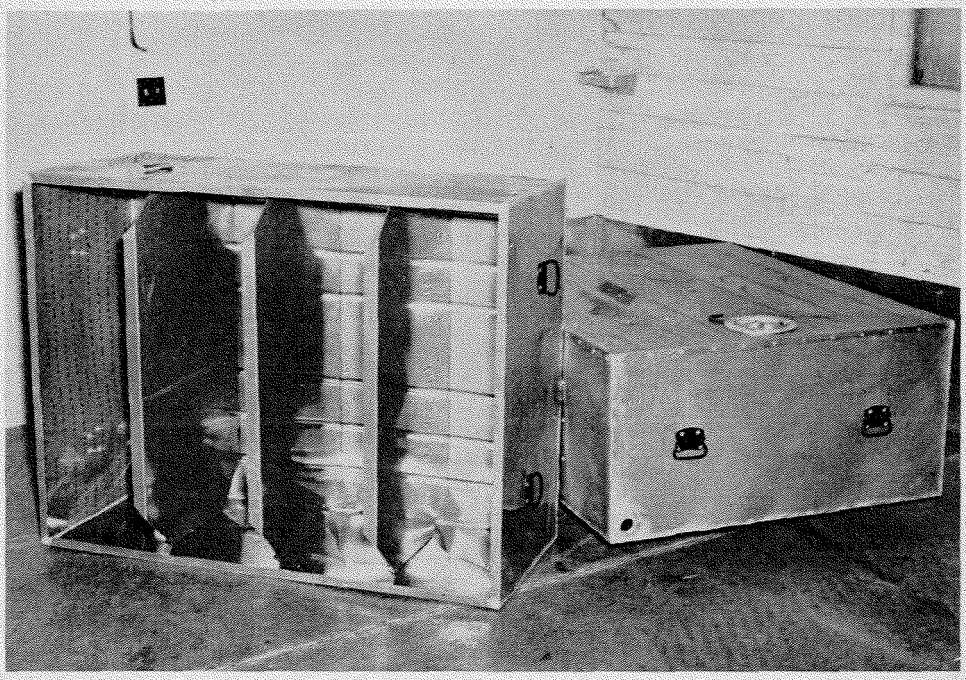

FIGURE 1—Aluminum slip-on tank.

Although built with three baffle plates, the aluminum tank does not possess the same strength and ruggedness found in a steel tank. Mounting a pump on it, having men sit on it, or having it hit by hand tools being tossed onto the truck might result in damage. It has been the experience of some forest officers that these tanks should not be left outdoors at caches in the woods; it seems that hunters are prone to shoot at any shining object they come upon. With reasonable care, an aluminum tank should give little trouble.

A singular advantage of aluminum over steel or iron is its resistance to corrosion, which obviates the need for expensive and tedious preservative treatments. This rust resistance and the light weight of aluminum make it desirable for slip-on tank construction. It has been found in some quarters, however, that there is an electrolytic action between chemicals sometimes found in water and the aluminum alloy which has resulted in baffles pulling loose at spot welds.

Canvas Slip-ons:

Some forest officers are using a variety of canvas relay tank as a slip-on. Built of heavy canvas duck with a reinforced square base, these tanks have the shape of a truncated pyramid. The top of the tank is covered except for two holes for the inlet and outlet. Each hole is fitted with a canvas sleeve so that in normal usage loss of water will be minimized. The pyramidal shape

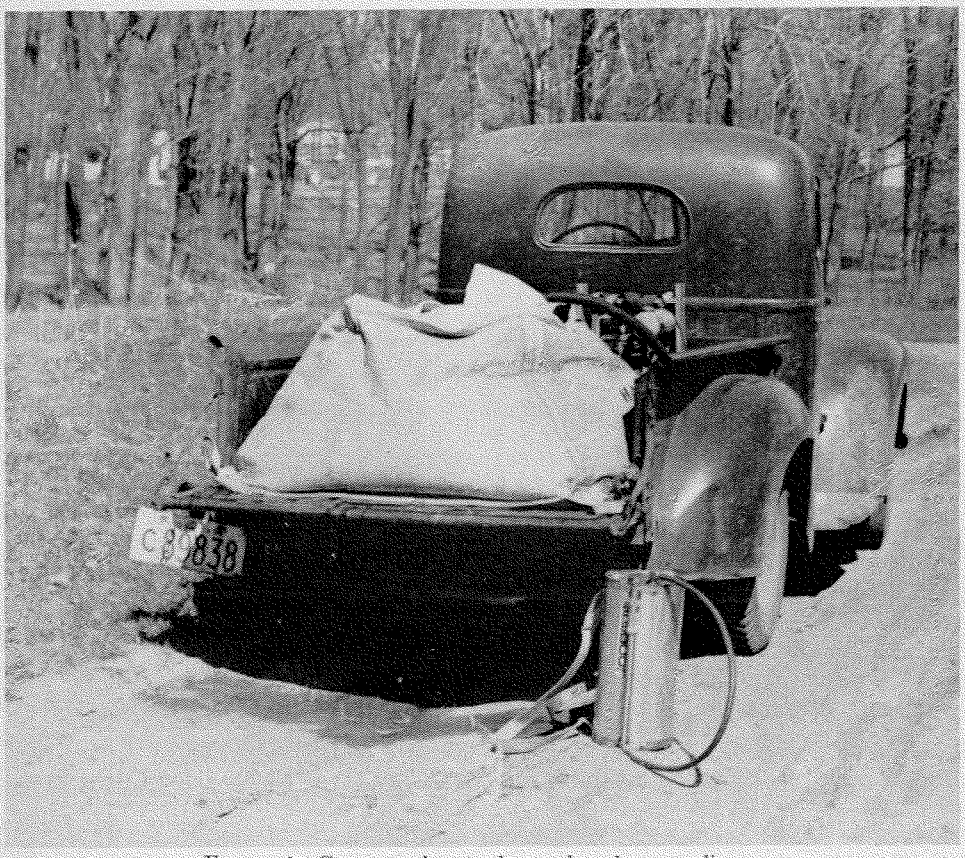

FIGURE 2—Canvas relay tank employed as a slip-on.

makes the tank completely self-supporting when filled and eliminates the need for stakes or tiedown ropes even on steep slopes. The canvas is chemically treated to prevent mildew damage. A tap is provided near the base of the unit for filling back-pack cans or for draining. Manufactured commercially, the tank is available in sizes of 125 and 250 Imperial gallons. The 125-gallon tank has a base 48 inches square which should fit any half-ton truck; the 250-gallon tank has a base 60 inches square and would require a larger truck. The tanks

weigh only 18 and 25 pounds, and can be folded into compact packages; therefore, they can be handled very easily by one man when being loaded onto a truck or when being carried through the bush. Storage of canvas tanks is a much simpler problem than with metal ones since they take up very little space. The cost of these tanks compares quite favourably with that of the aluminum slip-on described above. Since canvas tanks are so light and because they can be used with ease either as relay tanks or slip-ons, they should receive serious consideration.

Storage and Loading:

Storage and loading facilities usually present no serious problem. The 210-gallon aluminum tank, which weighs 135 pounds, may be stored either in the open or in a garage and may be loaded by one man by hand. The much heavier steel tanks are usually stored on a wooden platform the same height as the truck body and may be slid on or off the truck with the aid of pipe rollers. A cut-bank of suitable height might serve just as well. Ramps and block and tackle are sometimes used for loading. No attempt should be made to load either the canvas or the aluminum tanks when filled. The canvas tank would be extremely hard to handle and the aluminum tank does not possess the necessary strength. The advantage of storing steel tanks filled with water and ready for immediate service is partly offset by the difficulty in loading the tank on the truck.

TYPE OF TRUCK REQUIRED

Although tanks up to 200-gallons capacity have been designed specifically for the body of a half-ton truck, experience suggested that a heavier and more powerful vehicle is required. A three-quarter-ton or a one-ton truck, preferably with four-wheel drive, would be much more suitable for carrying the combined load of a full tank, pump, hose, hand tools, and extra men. The half-ton truck could handle the load on a relatively level dry road but might fail to negotiate hilly country or bad roads, thus failing to provide the quick initial fire attack which should be a characteristic of tanker use. A truck with four-wheel drive would be most desirable as it can travel over roads and trails impassable to two-wheel-drive vehicles.

TANKER-TRAILERS

Several forest fire protection organizations have experimented with trailers rather than trucks for their slip-on tanks. Advantages claimed for this system are that the tanker-trailer is ready to go at a moment's no ice; it can be unhooked at the scene of the fire, thereby permitting the tru k to return for a second trailer or to perform other duties; any truck available can be used to pull it; it can be hauled to off-the-road fires by a tractor. The tanks usually are securely bolted to the trailer and are ordinarily not removed for the duration of the fire season although in some cases a box is provided on the trailer into which the tank will fit. Under such conditions the tank need not be bolted down and may be removed readily so that the trailer can be used for other purposes such as carrying hand tools or food supplies. Several types of trailer are available commereially although a su table reinforced farm wagon may be used or a trailer may be made from materials locally available.

FIGURE 3—Tanker-trailer from which tank can be readily lifted out.

EQUIPMENT

Pumps:

Self-powered portable pumping units, pumps operated by independent motors, and pumps operated by a power take-off have all been used with slip-on tankers. A self-powered portable unit of some kind is most commonly used. Since it can be removed from the tanker and carried through the bush to fires inaccessible to the tanker, it is more versatile than the other pumping systems which are confined to the truck. The portability of the pumping unit is also of advantage for filling the tank, as in many instances the water supply may be beyond the suction capacity of the pump on the tanker.

Although almost any forestry pump may be used with a slip-on tanker, it is most practical to use one that is easily mounted on the tank and one that can be carried without too much difficulty. The type of pumping unit having a vertical shaft with the motor above the pump does not meet these qualifications. A pump which does not permit the water from its motor cooling system to be returned to the tank should not be used as considerable water wastage would occur. Pumps having high discharge capacities are usually unsuitable because of the limited water supply carried.

It is known that a given amount of finely atomized water, or high pressure fog as it is commonly called, is a great deal more effective in cooling burning fuels than is the same amount of water applied as a straight stream. This water

conserving characteristic will show up to greatest advantage where the water supply is very limited as it is on a tanker. At least two forest fire protection organizations are using high pressure systems on their slip-on tankers and are pleased with the results obtained.

Although high pressure fog would help conserve the limited water supply of a tanker through its more efficient water utilization, its uses are somewhat limited in respect to forest fires. Fog is highly efficient in cooling grass fires, slash fires, and other hot surface fires, but in most cases, after the fire has been initially subdued with fog, water must be applied as a straight stream to extinguish it completely. The uses of fog are very limited in respect to crown fires or deep-burning ground fires. Full advantage of the water supply may be had by using an adjustable nozzle which will deliver either a straight stream or fog as required.

A drawback to the use of high pressure fog is the extra expense entailed in the purchase of a high pressure pumping unit and high pressure hose. It might be found to be more economical to use a standard self-power portable pumping unit with a combination straight stream and fine spray nozzle. Fine spray will produce almost as satisfactory results as fog.

Nozzles:

No matter what type of nozzle is used, whether fog, straight stream or combination, it should have a shut-off mechanism so that water will not be used unnecessarily. Of course, when using positive action pumps, there must be a relief valve at the pump (together with a short length of pipe or hose to carry the water back to the tank) so that the motor will not stall each time the nozzle is shut off. By judicious triggering, 200 gallons can be made to last about 45 minutes; through an ordinary nozzle it would last for a much shorter time.

Eductors:

Tanks are usually loaded onto a truck when they are empty, and are filled from the nearest suitable water supply on the way to a fire. Often the same pump used in fire-fighting is used to fill the tanks, although separate pumps having high volume and low pressure characteristics are sometimes used for filling. Both a high-volume low-pressure pump and a regular forestry pump may be powered by the same motor, the first to be used for filling the tank and the second for fire suppression. Some tankers carry special adapter connections making it possible to fill the tanks from hydrants. The addition of an inexpensive industrial eductor (sometimes referred to as an ejector or an injector) to the standard equipment carried on the tanker may greatly facilitate filling the tank, in that it will enable the pump to draw on water sources as far as 300 feet from the tanker. In addition to this, an eductor will enable the pump to lift water up to a maximum of about 100 feet while the pump itself may produce only enough suction for a 20-foot lift. A further advantage of using an eductor is that the suction hose connections do not have to form a perfectly airtight seal. Moreover, an eductor obviates the necessity of removing the pumping unit from the tanker and carrying it to the source of water.

In order to use an eductor there must be a small amount of water in the tank to start with, about 25 gallons, as water must be pumped through the eductor to start the flow to the tank. The Ontario Division of Forest Protection has designed a slip-on tank especially suited to fit this requirement. This is a 327-gallon rectangular tank containing a separate tank of 27 gallons which is

used only for priming the eductor. The small tank receives the overflow when the main tank is filled and also receives any water coming back through the relief valve. This ensures that the priming tank is kept filled at all times.

Hose Reels:

Live hose reels have been added to the standard equipment of slip-on tankers by several forest fire protection agencies. The United States Forest Service has designed one to be mounted on the slip-on tank which was described above. The reel, together with the pumping unit, is mounted on an angle-iron frame which can be attached or detached with ease from the lid of the middle tank compartment. The core of the drum of this reel is of the cage type with slats on metal hubs, the slats covering between 30 and 60 per cent of the total core surface area. Such an arrangement is necessary to allow air to circulate around the hose. The two reel rims are made of steel pipe and the spokes are of solid steel. A quick-throw friction drag brake is provided for in the specifications.

The connection between the feed pipe from the pump and the main shaft of the reel may be provided for in several ways. A lubricated turning union may be used and kept in efficient operation by tightening the packing nuts as the packing becomes worn. The Ontario Department of Lands and Forests employs a connection whereby packing is eliminated. It consists of two tanned rawhide leather cones approximately one-quarter inch thick, one set at each side of the revolving hub, with the smaller ends pointing inward. The axle and feed shaft are threaded through the hub. The greater the pressure, the more tendency the leather cones have to hug the feed shaft. The cones should give little, if any, trouble.

Hose:

Either one-inch or three-quarter-inch cotton rubber-reinforced hose or solid rubber hose is generally used on a live hose reel. The reels described above have capacities for approximately 200 feet. It would be of advantage to carry adapters so that lengths of standard one-and-one-half inch forestry hose could be added to the hose on the reel if required.

Most forest protection agencies supplement their slip-on tankers with a complete set of hand tools, extra hose lengths, siamese valves, nozzles, back-pack pumps, eductors, suction hose, and other pieces of equipment. These complete slip-on units permit rapid initial attack on a fire, which is the essence of good forest protection.

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