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# THE SELECTION, CARE AND OPERATION OF FIRE-FIGHTING EQUIPMENT

By Harry J. Corcoran

**Presented at the First Short Course for Fire Fighters at Ames, Iowa, October 13 to 16, 1925**



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THIS publication contains one of the papers presented at the first Short Course for Fire Fighters, held at Iowa State College on October 13 to 16, 1925, under the auspices of the Engineering Extension Department. While it will not be possible to issue all the valuable material presented at this meeting, certain of the other papers will probably be published.

It is planned to hold short courses on fire fighting annually. The names of those who apply will be placed on a mailing list to receive full information concerning future courses.

# THE SELECTION, CARE, AND OPERATION OF FIRE-FIGHTING EQUIPMENT

By Harry J. Corcoran

Chief Engineer, Iowa Insurance Service Bureau,
Des Moines, Iowa

The selection, care, and operation of fire-fighting equipment is a subject about which a book might be written. Naturally, a general discussion is all that can be handled here. Consideration of minor tools and equipment will be left out for the most part in favor of the larger pieces of apparatus.

## Difficulties of Selection

In the smaller communities the selection of new or additional equipment is usually decided by the town council. Councilmen and fire chiefs in such towns are often perplexed by the variety of equipment available, and they do not always know where to get unbiased information. Almost any automobile carrying fire-fighting equipment looks fine when contrasted with hand-drawn carts, while the cost of even the cheapest truck seems enormous. It is hoped that the information given here will prove helpful to municipal officials in their selection of new or additional apparatus.

Only one thing should govern the choice, namely, the requirements for reliable protection. While, unfortunately, financial limitations are the controlling factor in the case of the smaller towns, in a city able to maintain a paid fire department there should certainly be enough money available to buy equipment on the basis of its suitability.

## Advantages of Motorized Apparatus

The introduction of motorized apparatus is spreading rapidly throughout towns of all sizes. This is mainly due, of course, to certain important advantages possessed by automobile apparatus. Motorized apparatus relieves the firemen of much labor in getting fire-fighting equipment to the fire, so that they arrive fresh instead of exhausted; it permits the carrying of more tools and equipment on one rig than is possible when hand-drawn carts are used; and such apparatus possesses the important advantage of greater speed in going to the fire.

With motorized apparatus, however, there should always be some kind of reserve equipment that can be relied upon in an emergency. Any automobile is liable to breakdown or accident; and when this happens to a fire truck on the way to a fire, it is a serious matter. In towns where one car is normally adequate for protection, a hand-drawn reserve that can be towed behind pleasure cars serves quite well in such an emergency.

## Chemical Engines

A village with two half-blocks of frame and brick buildings of one and two-story height can experience a rather severe fire. Fire protection adequate to stop the spread of such a fire would require several heavy streams of water. The total value of property in such a business district may not exceed $100,000, while the cost of the waterworks and the fire apparatus that could be counted on to stop a serious fire would easily reach $20,000, and might be entirely out of the question. In such cases, the common solution is to install a chemical engine to provide some measure of fire protection. Equipment of this type will not stop a large fire, but if it is used in the early stages of a fire it will often prevent the fire from spreading. Such a chemical engine may be hand-drawn or motor-driven and may carry from one to four tanks (usually two) with a nominal capacity of 35 to 40 gallons each.

**Soda-and-acid extinguishers.** For general use the soda-and-acid type is most suitable. With hand-drawn equipment it is better if the acid is in sealed bottles which must be broken to operate the engine, although loose-stopple types are in successful use. When pulled over streets behind automobiles the loose-stopple type may slop acid and generate pressure too soon. If the tanks are mounted on an automobile, however, there is little trouble from slopping, and in that case the simplicity of the loose-stopple type makes it preferable. Tanks are made both of copper and of steel, and they must be lined with lead or zinc. The lining of steel tanks can be successful with proper workmanship. If possible, there should be two lines of small hose provided, so that the fire can be attacked from two places.

The manner in which this type of extinguisher puts out a fire is really two-fold. When the acid and soda solutions mix, carbon dioxide gas forms, creating a pressure of 200 pounds or more. A stream of water is forced out by the pressure thus developed in the tank, and this water quenches the fire that it strikes. The carbon dioxide gas is carried out with the water and it tends to smother the fire. This gas is heavier than air and settles; hence it is most effective when the fire is low and confined. When a fire is in the open there is little effect due to the gas; plain water would serve just as well, but a pump would be necessary to furnish the pressure.

**Foam extinguishers.** A type of extinguisher that generates a thick foam is growing in favor, and it is particularly effective in fighting grease and oil fires. The foam sticks to almost any surface and it floats on oil, thus acting as a blanket to smother the flames. When used for general fires, the foam must be sprayed on all parts of the burning surfaces. The large use of oils in all cities and towns warrants the installation of such extinguishers, at least of the portable type.

**Maintenance.** All kinds of chemical engines need regular attention if they are to give satisfactory service. The soda-and-acid type should be discharged, thoroughly cleaned, and recharged once each year; and the hose, nozzles, and other working parts should be carefully inspected. There is often trouble due to corrosion, and sometimes there are leaks; these are hard to stop if once started. The tank should be carefully cleaned and the packing renewed if the trouble is bad; coating affected parts with a good grade of vaseline will sometimes help.

Chemical extinguishers of both of these types must be protected from freezing, and of course they work best when fairly warm. Occasionally complaint is heard that the acid and soda do not mix readily, and that the acid destroys cloth. When the device is properly charged, this cannot happen; if the soda solution is old and the mixture is cold it is possible that some weak acid might be discharged, but even with the worst conditions this is unlikely.

When the extinguisher is refilled, the tank should first be carefully cleaned. The new soda must be thoroughly dissolved in the water; mixing in a bucket or tub is the best way to do this. Care should be taken to use the exact amounts of soda and of acid recommended by the manufacturer. All reliable manufacturers of extinguishers furnish complete instructions for the proper care of their equipment.

**Use of chemicals.** To be effective, all chemical extinguishers must be put into use before the fire has really got a good start. This means that the firemen must thoroughly understand them, so that they will not lose time at an actual fire finding out how they work. Not long ago a serious fire occurred in a town near Waterloo because the tank had not been properly assembled after a former fire. Occasionally the tank is left uncharged in cold weather to avoid the cost of the fuel necessary to keep it warm; in such a case the money spent for the machine would better have been given to charity.

Carrying extinguisher tanks on an automobile speeds up their use, and such a machine is of course much better than a hand-drawn machine. It can also carry the ladders, axes, and other tools commonly needed at a fire. Longer hose lines will be needed than with the hand-drawn equipment, because the truck must stop at the curb.

There should be at least 150 feet of hose in each line. The machine should be able to carry five men and to make good speed under full load.

### Fire Fighting With Water

Some towns that cannot afford to install waterworks build cisterns in various parts of town and rely upon a pump carried on an automobile to force the water through hose to the fire. A few places have rivers flowing through their areas that can be used as water-supplies for fire fighting. With either plan permanent landing places for the pumpers must be provided, and definite plans made for fighting a fire in any building. The pump should of course be adapted in size to the supply of water available, and it should be of a reliable make. Home-made or assembled equipment for this purpose can only be classed as makeshift; a machine made by a reputable manufacturer should be purchased if at all possible. More will be said about this type of equipment later.

The first thing to determine, where it is planned to use water from a lake or river for fire fighting, is the actual ability of the pump to take out the necessary water. In order to get good results it must be possible to set up the pump on a solid structure or on level and solid ground, so that it is not more than 16 feet above the water surface and within 10 or 15 feet of the water edge.

When a public water-supply with street hydrants is available, water will of course provide the means for stopping a serious fire. The selection of equipment is largely a matter of determining how to get the water from the hydrant to the fire. Excluding hand-drawn hose reels, all modern fire-fighting apparatus used in connection with a waterworks is motorized. Fortunately it is divided into a few general types, with special apparatus only for large cities.

### Hose-Carrying Apparatus

Taking up first the hose-carrying apparatus, the type to choose will depend upon the pressure and quantity of water available from the water system. If there is adequate pressure at the hydrant while large quantities of water are being used, a pumping engine is hardly necessary.

The simplest type of apparatus is the hose car; one or more chemical tanks are usually carried to form what is termed the combination hose-and-chemical car. The pumping engine practically always carries hose; if large chemical tanks are carried it is called a triple-combination engine. Ladder trucks are either aerial or service trucks; they often carry chemicals. There is a combination ladder-and-hose truck made, but few are used.

When buildings are three stories in height or higher, few water systems can furnish large quantities of water at the necessary pressure direct from the hydrants. The amount of water available over the time a large fire might last also has a bearing on the question; an adequate supply of water is needed when a pumping engine is in service. The distribution of hydrants must also be studied.

**Hose-car equipment.** Ordinarily a hose car should carry 1000 feet of 2½-inch hose, a 26-foot to 30-foot extension ladder, a hook roof ladder, two or more nozzles with an assortment of ¾-inch to 1⅛-inch tips, and one or more large chemical tanks. Chemical extinguishers are used in putting out a majority of fires, even where a good water system exists, and longer lines of chemical hose will be necessary than with hand-drawn engines—they should be at least 150 feet in length.

Large hose is usually laid on the way to the fire, which permits using the chemical and a water stream together if desired. Provision should be made to supply water to the chemical line from a large hose by means of a threaded cap attached to the piping from the chemical tank. A special reducer wye can be screwed to the end of the large hose, and one to three small hose lines used for many dwelling fires and for cleaning up at fires in business buildings. This necessitates carrying small hose, which is usually 1½ inches in diameter and in 50-foot sections.

**Ladders.** More thought should be given to the selection of ladders than is usual. When a town installs an automobile hose-and-chemical car, the hand-drawn ladder truck is often allowed to become unfit for use. For this reason there should be on the car at least one good extension ladder that will reach any roof, as well as one shorter ladder.

**Design.** The particular make to select is more or less a matter of opinion. In smaller communities the number of runs per year and the size of the town will often permit a commercial truck chassis to be used to good advantage. When this is done a car with a good pick-up and strong transmission is necessary. There should be sufficient engine power to carry five men, in addition to its equipment, at a speed of at least 20 miles an hour. Local facilities for maintenance are also worth considering if a commercial-truck chassis is bought.

## Combination Cars

Larger towns handling 25 or more calls a year should get the best kind of combination car, one that is especially designed for fire service only. Such a car will prove more economical and more reliable in the long run.

Up to the past three or four years it was the universal opinion that a triple-combination car was about the last word in fire-fighting equipment for the small town; a town owning one of them (providing it was small enough to need no more than one company) was considered well fixed. Experience is showing that this is not always true.

Combining the chemical outfit with the pumping engine prohibits the most effective use of either. This is not particularly serious in itself, as only a slight delay is caused by picking up the chemical hose before going from the fire to the hydrant to connect the pump; but the congestion of traffic near a fire in even one of the smallest towns often causes delay, and sometimes the car is totally blocked. In order to overcome this trouble several towns have purchased or built straight chemical cars, each provided with two tanks, while others have installed combination hose-and-chemical cars which also serve as reserve hose carriers. Of course every community should pass and enforce a traffic ordinance containing provisions designed to keep the streets clear near fires.

Arrangements are frequently made with farmers within three to five miles from a town to furnish them protection in return for their help in buying a truck. This arrangement means that two cars are absolutely necessary, and in such a case the combination of hose and chemicals on one car, with pump and hose on another is a good one. The pumper can respond if the roads are good and water in quantity is available; while with bad roads or no water the chemical or combination car can be sent.

At least two reputable manufacturers have replaced the usual chemical tank with one or two large water tanks, the pressure being created by the regular pump. This plan has many advantages. The first cost is lower, a larger stream of greater reach is available, the capacity of the tanks is greater, and it is easier to keep a continuous stream working.

## Pumping Equipment

The development of the automobile pumping engine has just about revolutionized fire fighting in the past ten years. They are made in a number of standard sizes and combinations up to 1000 gallons a minute capacity, but only the types more commonly found will be considered here. It is safe to say that such a machine is really needed in 95 per cent of such communities in Iowa as have water systems. A safe rule of general application calls for some pumping equipment for the fire department (1) when buildings do not exceed two stories in height and a discharge of 500 gallons a minute reduces the hydrant pressure to less than 50 pounds, or (2) when buildings do not exceed three stories and the same discharge produces a hydrant pressure of less than 60 pounds.

**Selection of pumpers.** A machine of this type costs a lot of money, however, and the council or the committee entrusted with its selection must be careful to get the best the money will buy. Without question the community should purchase the very best pumping engine that can be financed. Any community that can maintain a public water-supply system suitable for fire protection should be able to invest $5000 or more for a pumping engine. The annual cost of such a machine, distributed over its normal life, is moderate.

The first thing to determine is the size of pump that can be used. Few towns under 20,000 population have water-supplies that are really adequate, and the water distribution system must be studied to learn the maximum and minimum quantities obtainable from the hydrants and, also, how many hydrants can furnish a large amount. More than one case is known where these studies were not made. When the machines were delivered to these communities it was found impossible to run them at full capacity or even three-fourths capacity except at only one or two spots in each community. Elsewhere the water mains were too small to deliver enough water.

The business district will be the scene of the biggest fires, and in general the amount of water available from hydrants in this area can be safely used as a guide to the size of pump needed. It is not necessary to run a pumper at full capacity to get good streams, but there is nothing gained by buying an oversized one. The most progressive manufacturers are recognizing this and are building machines to work satisfactorily at a small fraction of the maximum capacity. Efficiency as to fuel used is of course low, but this feature should be the last item to influence the choice of make. Plans to build up the water system in the future may justify the purchase of a larger pump than can be put to use immediately.

**Specifications and tests.** The commonly-accepted standards for these machines consist of the Underwriters' Specifications and the 12-hour test prescribed by the International Association of Fire Engineers. No machine that has not passed a standard 12-hour test at the rated capacity for which it is sold can be considered reliable; that is, a machine built to the specifications mentioned must pass this test.

The individual machine should be bought subject to a satisfactory 3-hour Underwriters' Acceptance test. The Iowa Insurance Service Bureau will send an engineer to any town in the state to test a pump when it is delivered, without charge. A local test is really more satisfactory to the town than one at the factory, though a factory test is acceptable if made by a competent and uninterested party.

This test requires that the machine shall pump water at its rated capacity against 120 pounds net pressure for 2 hours, ½ of its rated capacity against 200 pounds net pressure for 30 minutes, and 1-3 of its rated capacity against 250 pounds net pressure for 30 minutes. When these requirements are studied it will be realized that they demand very good material and workmanship.

A pump should have gauges to show the suction and discharge pressures, a positive-acting relief valve, and an ample return or churn pipe from the discharge to the suction, and a lock for the pump gear-shift levers. While not absolutely essential, a comparatively low-speed motor is more reliable than one of high speed; about 1500 r. p. m. is the dividing line between low and high speed.

It is a common experience that a pumper is seldom used to capacity, and unless regular tests are made it may fail when most needed. A half-hour test on a machine every few months at full capacity will often uncover a needed repair; defects commonly found include cracked cylinders, clogged cooling systems, leaky engine packings, dry pump bearings, defective pumps, worn clutches, and weak gears.

**Operation of pumpers.** All the members of a company should understand the principles of pumping. The regular operator should know his machine thoroughly, and should be able to keep it in first-class condition. This is very necessary in the small town. At least one other man should be able to operate it under any condition. It has been a common experience, with volunteer departments, to find the operator away from town and no one left who understands the pump. It is also very common to find that no member of the department, from the chief down, knows the rated capacity of the pump within 250 gallons. It should be easy to imagine the impression this creates. Such a condition of affairs is a fair indication of the kind of fire-fighting the community may expect.

Many departments are over-confident concerning the performance of a pumper—the machine is considered more or less automatic; all that is required to get any desired result is to connect it to the hydrant and throw in the pump clutch. Wonderful things can be done with a pumper, but a reasonably good knowledge of pressures, the friction in hose and in water systems, as well as the effect of nozzle sizes on pressure, is essential to satisfactory results. On the other hand, some departments are afraid of their pumper. It is so powerful that they do not trust it; it seems so complicated that something seems sure to go wrong if they work it up to capacity. Continued practice under varying conditions is doubtless the best remedy for both conditions, because they are largely mental.

When a pumper is owned, equipment for handling large streams is desirable, especially such equipment as deluge sets and cellar pipes.

## Ladder Equipment

Ladder equipment is necessary for two reasons: (1) to save life and (2) to help fight fires. A fire department should never lose sight of the fact that they probably will be called upon sometime to rescue people from a burning building. For this purpose ladders are indispensable, because if the normal means for getting out of a building were not cut off there would be no need for rescue. People will often climb to the roof of a building to escape the heat and smoke; this should be borne in mind and a ladder provided to reach to the highest roof in the town.

**Use of ladders.** Ladders are needed in fire fighting to carry hose and other equipment to upper stories or to the roof, to get into attics, and to provide footing for nozzlemen directing streams into windows. In addition to placing ladders, a ladder company should be equipped to open up a building for hosemen to enter, to ventilate a building, to assist generally in getting at a fire, and to protect the contents of buildings from avoidable damage. Towns and cities in Iowa are quite generally in need of much improvement in their ladder equipment.

**Ladder trucks.** In any town having as many as a half-dozen buildings of three or more stories, a ladder company with a well-equipped truck is necessary for reliable protection. When few buildings exceed three stories, a city service truck is satisfactory; but with as many as five buildings higher than this, an aerial truck is warranted. Small communities having but one or two buildings over two stories in height can usually carry sufficient ladders on the hose cars, or they may install a light ladder truck, depending on local conditions. When no building height exceeds two stories, a 30-foot extension ladder and one or two scaling ladders are satisfactory equipment. The usual practice is to carry a 24-foot extension ladder on the hose car, but this is only safe when a fully-equipped ladder truck is available. For towns with less than five three-story buildings a light truck with 40-foot, 30-foot, and 24-foot extension ladders, as well as two wall ladders and two scaling ladders, can be kept in the station and taken only to fires in the business district. If a motorized truck cannot be purchased, the ladder truck can be fitted with a tongue or rope and hauled behind an automobile when needed, but this practice is not recommended.

In the city department in Ames, a service truck with a large chemical tank and several hundred feet of hose is used as a combined hose and ladder truck; the need for ladders in this city is apparent because of congested housing during the school year and the general use of attics for sleeping rooms, brought about by this condition. Such a machine would be well suited to many towns.

**Ladder-truck equipment.** A motorized service truck should of course be provided where a ladder company is needed. With ladders up to the 50-foot size, the machine can be driven by its rear wheels and steered from the front seat; longer ladders usually mean a tiller or rear-steering device. Standard makes of service trucks carry one 50-foot, one 40-foot, and one shorter extension ladder, as well as several straight and scaling ladders. Extension ladders and the longer wall ladders are preferably of the trussed type, that is, the sides or rails are not solid but are built up of light strips so placed as to give strength without unnecessary weight. Fire-department ladders may be called upon to carry heavy weights, and for this reason the ordinary types of ladders used by carpenters and painters are not suitable.

Wrecking tools make up most of the other equipment ordinarily carried on ladder trucks, such as axes, picks, door openers, pike poles and plaster hooks, rope, wire cutters, bars, and roof cutters. Waterproof covers, brooms, forks, shovels, and mops can be carried and used to great advantage in protecting the contents of buildings from undue water and other incidental damage.

**Aerial ladders.** The modern aerial ladder is mechanically operated or raised, but a trained crew is needed for quick work. Usual reaches are 65, 75, and 85 feet, when fully extended, the ladder being in two or more parts called the 'bed ladder' and the 'fly'. Two drivers are needed on American trucks, because the length of the bed ladder requires a tillerman. The front wheels are the drive wheels, some models having a four-wheel tractor in front, partly to simplify the steering equipment and partly to distribute the weight.

A very compact model has been introduced from Europe, with a ladder in several sections. This permits a much shorter wheel base, which makes this type of truck appear to be an advance so far as handling in traffic is concerned. Only the one ladder is carried on the standard model of this type of truck.

The aerial ladder usually is and always should be equipped with a ladder pipe and nozzle. This is a large-sized hose fastened to the ladder with the nozzle at the upper end of the bed ladder. The direction and elevation of the nozzle can be controlled from the ground by ropes. Such equipment makes it possible to direct a nearly horizontal stream into upper stories, but good pressure is needed for a large stream.

A life net and safety belts are carried on an aerial truck, in addition to the usual tools. Pompier scaling ladders may be carried, and they are excellent for training; their use at fires is spectacular, but of doubtful value except in the greatest emergency.

**Care of ladders.** Fire department ladders need regular attention to check up on any development of weakness. New ladders are coated with a good grade of varnish, which should be preserved or renewed. This not only improves the appearance of the ladders, but it keeps the wood fibers from loosening and fraying. It also retards dry rot and lengthens the life of the ladders. Some departments prefer paint to varnish, but paint covers many defects that a clear varnish does not.

Ladders should of course be handled carefully in order to avoid cracking the rails or the rungs. The wood used in such ladders is carefully selected and treated to give the maximum strength and life; but such ladders are not built to use as battering rams to break doors, and they should be so used only in an emergency.

**Extension ladders.** Extension ladders have moving parts that need constant inspection. The sheaves should be free running, but not loose; the rope should lay straight and be sound throughout; and the locks should work freely and positively, both in raising and lowering the fly. Extension ladders thirty-five feet long or longer require stay poles to make raising easier and to hold the ladder steady when the fly is in use. These poles must be sound and not warped, with strong fastenings if permanently attached to the rail.

A ladder truck is built to hold the ladders securely, with quick-releasing clamps and enough supports to keep them from sagging and becoming warped. When extension ladders are carried on hose cars, similar precautions should be taken. If a ladder overhangs at the end more than four rung spaces, or if the center supports are more than eight spaces apart, the ladder is apt to sag and in time will become sprung or warped; also, a longer overhang may cause vibration or whipping during a run. The ladder must be fastened so that it will not slide back and forth with each change in the speed of the car. A ladder should never be strapped to its supports or fastened in any like manner. Such a plan discourages removal for practice purposes and will surely cause delay and confusion when the ladder is needed.

**Truss ladders.** Truss ladders have already been mentioned. Most ladders of this type have a top side and a bottom side, in much the same way that a bridge truss has a top and bottom. In fact, a trussed ladder is built on the same principle as a trussed bridge. If it is set up wrong, a ladder may break with a heavy load, this being particularly true with extension ladders. It might be well to mark ladders if seldom used, but that would look like poor firemanship.

**Raising ladders.** There is one proper way and several poor ways to raise a ladder, just as in the case of most operations. The time to learn the right way is in practice or drill. The handling of ladders seems to be one thing commonly neglected by most volunteer departments and many paid departments in this state, even when they have the ladders to use. Possibly this is because of the supposed hard work involved in such practice, or because of the inherent belief that anyone can raise a ladder. If properly done there is little difficulty in erecting a long extension ladder, but teamwork on the part of the crew is needed. It takes from three to six men to handle an extension ladder, depending on the length. A rough rule to follow is to allow one man for each eight feet of total length.

While it is true that any group of men with ordinary intelligence can get a ladder from the ground into the air, to place it just where it is needed and so that it will bear the greatest possible load requires training. A ladder must be set so that the bottom will not slip, but it must not be set up too straight or the men cannot work upon it. It is often necessary to carry hose up ladders, to fasten a hose line to a ladder, and occasionally to carry a person down the ladder. A safe rule for determining the distance the bottom should be away from the building is this: Divide the distance in feet from ground to the top of the ladder (that is the point where the top will be) by five, and then add two; this rule gives the distance in feet.

## Care of Equipment

Every piece of fire equipment, and particularly motorized apparatus, should be under the supervision of a competent person; a routine system of inspection and operation will probably prove best. An engine should be well worked before putting it into service, for it must be remembered that a fire truck may be called upon for maximum power and speed within a week after its installation and regularly thereafter. After each run the machine should be carefully inspected for loose parts, such as nuts, spring clips, engine parts, hub caps, and such other parts or fittings as are apt to work loose.

Driving such a machine is similar to driving a well-loaded delivery truck, so drivers must learn the feel of it; ability to drive a pleasure car does not fit a man to drive a fire truck. A speed of 25 miles an hour is ample in small towns, and reduces the possibility of accident.

The engine and the driving parts of the truck can best be taken care of by a local garage. The care of fire-fighting equipment is up to the fire chief. Care of chemicals is the same for motorized apparatus as it is for hand-drawn; if the chemical tank is over the hose bed (where it should not be) great caution should be taken not to spill acid on the hose. The gasoline tank is better filled at a regular filling station than from a barrel with a bucket or can.

## Concluding Suggestions

This covers the general field of apparatus normally used, and the times when special apparatus are needed are so rare that such equipment will not be discussed at this time.

There are many manufacturers who sell fire-fighting equipment and the number seems to be increasing. Certainly increased efforts to sell apparatus are under way in this state. The greatest competition is in pumping engines; more or less conflicting claims are made as to superiority of different sizes of pumps, of different types of pumps, of different drives, as to the suitability of 4 or 6-cylinder engines, and as to various other items. It can only be said that any type is satisfactory if the design is sound and the power is suited to the work demanded. Naturally no one make can be recommended over others.

When new apparatus is about to be purchased, it will pay to get the opinions of several other fire departments and experienced fire chiefs, as well as to get the specifications of the National Board of Fire Underwriters, to be used as a standard of comparison. It is human nature for a salesman to be enthusiastic about his own product, and for this reason too much weight should not be given to the statements of any one salesman. Above all, attempts to get too much for the money available should be avoided.

Probably it is not necessary to urge fire chiefs to think of additional apparatus before it is badly needed, but certainly councilmen are prone to delay until the last minute. It is not good policy to wait until fall to start selecting a machine for the following winter. It takes forty-five to ninety days to build a machine. Probably half the engines tested in Iowa in recent years have been delivered after the middle of January.

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