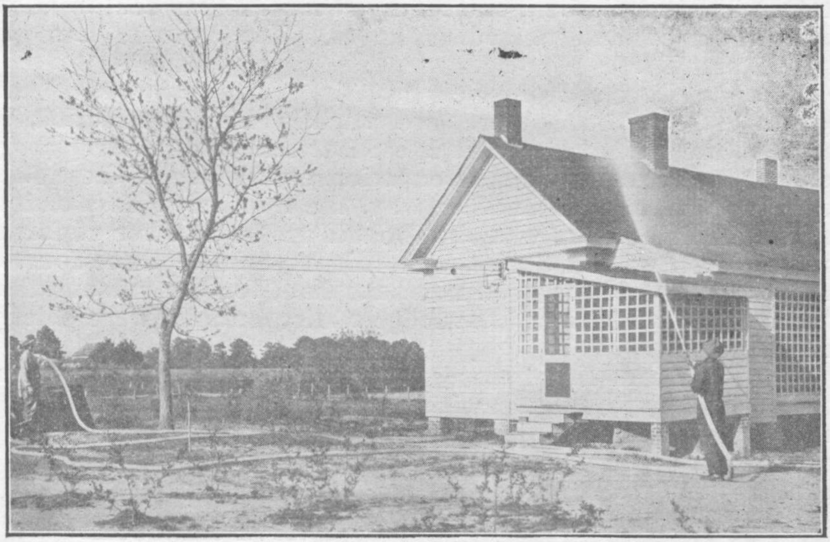
Mr. Robinson

CIRCULAR 49 MARCH 1926

Protecting the Farm Against Fire

By

M. L. NICHOLS AND T. B. CHAMBERS



Electrical power makes fire fighting possible.

AGRICULTURAL EXPERIMENT STATION
of the
ALABAMA POLYTECHNIC INSTITUTE

M. J. FUNCHESS, *Director*
AUBURN

PROTECTING THE FARM AGAINST FIRES*

By
M. L. NICHOLS AND T. B. CHAMBERS

The census of 1920 values all farm property in Alabama at $690,848,720. Of this amount, $415,763,862 is given as the value of the land, $127,893,893 as the value of the buildings, and the balance is the value of implements and livestock. This means that over one-third of the farm property (when livestock and implements are housed part of the year) is subject to a fire hazard.

That this fire hazard is a real menace to the farmer's property is shown by statistics. The Acturial Bureau of the National Board of Fire Underwriters records the farm fire loss from 1918 to 1921 as $89,460,525, or $61,274 per day for the United States. This should be increased by at least 25 per cent to allow for unreported and uninsured losses. The average loss per claim was $594.

To quote directly from their bulletin, *Safeguarding the Farm Against Fire*: "Since there are slightly less than 6,500,000 farms in the United States, it is evident that *one in every forty* had a more or less disastrous experience with fire in these four years; or, to put it in another way, the number of loss claims for the whole country was about equal to the number of farms in the New England States, and this experience three-fourths of the afflicted farms need not have had, for the reasons that carelessness and lack of knowledge of fire hazards were chiefly responsible."

It is true that fire hazards vary with different farms, but this variability is largely within control of the farmer. The following information has been compiled and supplemented with experimental data as a part of the work in connection with rural electricity studies.

SOURCES OF FIRES AND PREVENTIVE MEASURES

The causes of fires on farms as discussed in this bulletin are listed as the more important by the fire underwriters. A knowledge of fire-resisting construction is necessary to obtain the maximum safety but an understanding of a few simple points of construction will enable the farmer to see that his buildings are so constructed as to eliminate a larger part of the hazard. A "fire consciousness" is necessary to prevent carelessness which, in many cases, is criminal since human life is frequently involved.

Lightning. —Lightning ranks first as a cause of farm fires.

* Investigational work done on funds provided by the Alabama Power Company.

The National Board of Fire Underwriters reports that over 18 per cent of the fires recorded in the period of 1918-1924 was due to lightning. Crosby, Fiske, and Forster in their *Handbook of Fire Protection* (D. Van Nostrand Co. 1924) state that in an analysis of over 40,000 rural fires 51 per cent was found to be due to lightning.

A building properly protected by rodding is virtually immune from damage by lightning. The essentials of a properly rodded building as set out by the National Fire Protection Association are:

"That the conductors be constructed of iron or copper, and copper cables must have a weight of not less than 3 ounces per foot or 187.5 pounds per 100 feet. For star section steel, the weight must not be less than 320 pounds per 100 feet in length and must be provided with a protective coating of zinc, or other approved material. The couplings must be of copper or brass of substantial construction, working upon the threading, crimping, or clamping principle. Set screws are not approved. The air terminals must be of the same construction as the conductor when made of steel or of copper tubing having an outer diameter of at least ⅝ of an inch, and a wall thickness of .032 inch. The point should be solid, terminating in one or more points, and provided with a screw cap or dowel."

The efficiency of a rod system depends upon the thoroughness with which it is grounded. One of the following methods should be used:

(1) Where there is a system of underground metal water pipes, the rods may be grounded to this by a brass screw plug with the rods soldered to the pipe, or by putting clamps around the pipe and screwing the rods to the clamps.

(2) Burying a plate of 16-guage copper 1 yard square at least 8 feet in the ground, embedded in coke or charcoal to hold moisture.

(3) Extending rods into permanently moist earth where this can be reached readily.

General Suggestions

Air terminals are required on or within two feet of all high points such as chimneys, gables, spires, cupolas, etc. Terminals should not be over 25 feet apart along ridges. Elevated tanks or stacks over 60 feet high require 2 rods and 2 grounds. The minimum number of grounds per building is usually two, which will suffice for 6 points. Three are required for 12 points.

It is advisable to ground metal roofs, ventilators, and pipings which come close to outside walls, clotheslines, or metal construction. Wire fences also require rodding. Horses and cattle frequently drift along in a storm to a fence which may be highly charged if not grounded. To ground it a cable equal to a No. 9 wire should connect with each horizontal wire of the fence and extend at least three feet into the ground at every corner. This wire should extend a few inches above the fence to prevent strokes in this vicinity. Where a fence connects with a building, the fence should be well grounded and, in addition, the grounding rod of the building should be connected with the fence. *

Defective Chimneys. —Fires originating from defective chimneys are next in importance to lightning. In the four-year period previously mentioned defective chimneys caused 12 per cent of the total loss. Chimney fires are particularly dangerous as they usually start in an attic or other concealed place and gain great headway before they are detected. Fig. 1, page 5, gives a plan for a reasonably safe chimney.

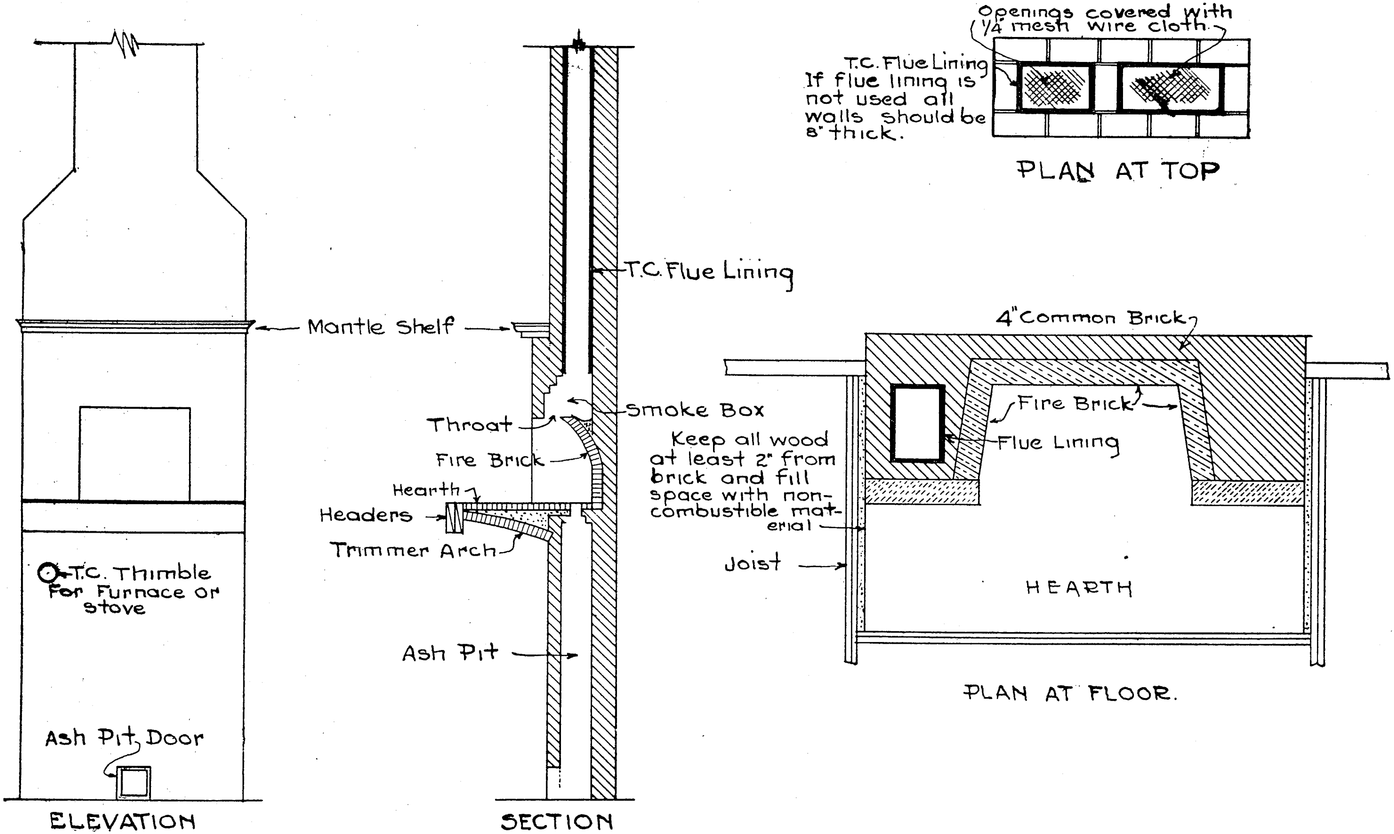
The essentials of an ordinance produced by the National Board Committee on the Construction of Buildings follow:

"(a) Brick chimneys 3¾ inches thick; single thickness concrete block; stone chimneys 8 inches thick; or rubble 12 inches thick, should, in all cases, have a fire clay flue lining.

The chimney that is not solid to the ground is always a menace. The fire in this picture started from this chimney, probably due to the settling or shrinkage of timbers supporting it.

---

* For further information on lightning protection, see Technological Paper No. 56, Bureau of Standards, Dept. of Commerce, Washington, D. C.



Mantle Shelf
T.C. Thimble
For Furnace or
stove
Ash Pit Door
ELEVATION
T.C. Flue Lining
Smoke Box
Throat
Fire Brick
Hearth
Headers
Trimmer Arch
Ash Pit
SECTION
Openings covered with
1/4 mesh wire cloth
T.C. Flue Lining
If flue lining is
not used all
walls should be
8" thick.
PLAN AT TOP
4" Common Brick
Fire Brick
Flue Lining
Keep all wood
at least 2" from
brick and fill
space with non-
combustible mat-
erial
Joist
HEARTH
PLAN AT FLOOR.

FIG. 1

"(b) For dwellings, flue linings may be omitted if walls are 8-inch brick with inner course refractory brick.

"(c) Chimneys shall not rest upon or be carried by wooden floors, beams, or brackets, or be hung from wooden rafters. Iron brackets or stirrups attached to wooden construction shall not be used to support chimneys. In frame buildings, chimneys shall always be built from the ground up, or rest on basement walls.

"(d) Chimneys shall be built upon concrete or masonry foundations properly proportioned to carry the weight imposed without danger of settling or cracking. The foundation for an exterior chimney shall start below the frost line.

"(e) A special cement-lime mortar is specified for chimney construction.

"(f) Minimum clearance of wood joists, beams, and rafters from face of chimney is 2 inches, and behind a fireplace, 4 inches.

"Chimneys set on brackets have a tendency to settle and open up cracks from which sparks can issue. Poorly built chimneys may be rocked by the wind and dangerously cracked."

Sparks on the Roof. —Closely related to defective chimneys is the fire caused from sparks on the roof. This is responsible for over 7 per cent of our rural fires. There are two means of reducing this hazard. First, by putting on a fire resistant roof of metal, slate, or any of the prepared composition roofs which have the underwriter's approval. Many of these prepared roofs are covered with various materials, such as slate, which give a satisfactory resistance. The second safety point is a screen over the chimney which will prevent any large sparks or balls of burning soot from coming over on to the roof. This plan not only has the advantage of being cheap and efficient, but also prevents the entrance of birds and insects into the chimney at times of the year when they are not used.

Fig. 1, page 5, shows a plan of such a screen. However, these devices should not take the place of regular cleaning of chimneys. A handful of table salt scattered over a fire when the draft is on has the effect of reducing soot deposit.

Stoves and Heating Equipment. —Ranges, and coal and wood stoves offer more or less of a hazard. They should be installed with certain safety features in mind. First, they should always have a ventilated place under them. Ordinarily the legs will give this protection. When within 24 inches of a partition, the partition should be protected for a space equal to the length or width of the range, plus 6 inches on each side and extending from the floor to the ceiling where pipes occur, and not less than 4 feet high elsewhere. This may be effected by cellular asbestos not less than ½ inch thick, covered with metal lath and plaster. Iron or tin may be used if an air space is left behind it. Stovepipes should enter the chimney horizontally and pass through an insulating thimble which fits snugly. The pipes should not be closer than 24 inches to any woodwork or closer than 6 inches to metal lath and plaster. They should not pass through combustible floor, roof, or partition unless a section is removed and suitable insulation of at least four inches of non-combustible material with ventilation provided. Smokepipes should not be permitted in closets or concealed places. In addition to these precautions, a floor protection of zinc plate extending at least 18 inches in front of stove and 12 inches beyond each side and back to wall should be provided.

Matches.—The fourth fire hazard is the common match. This danger is greatly increased when smoking is permitted around farm buildings. This danger may be eliminated largely by the use of safety matches and by keeping matches in earthenware jars.

Spontaneous Combustion.—The fifth fire hazard is spontaneous combustion. This is a partly preventable cause. Crops which are stored in a partly cured condition give a rise of temperature, due to bacterial and chemical action. Frequently, this is sufficient, if the heat is stored up, to ignite the material. Common salt scattered through the mass will render it less likely to overheat. Linseed oils and cottonseed oil are both apparently conducive to this action. Oily clothes and waste are subject to similar action, and rags used in painting have been known to start fires resulting in great damage.

Gasoline.—Gasoline ranks sixth as a source of fire. Safety measures should be taken for the storage and handling of this highly inflammable material. It should always be kept away from matches and open lights. Blue flame kerosene stoves are as satisfactory, and safer. Gasoline should not be stored in the farm buildings. A special outside storage is desirable. Under ground is better. A separate garage is not only safer but probably cheaper in the end. An automobile or truck should not be stored in the barn with hay and other inflammable material under any condition.

Lighting.—Lanterns and lamps around the barn bring in an element of danger. Electricity greatly reduces this hazard but all wiring should be carefully installed according to the national electric code. Circuits should be fused carefully with fuses of the prescribed amperage. Properly installed wires with porcelain tubes and brackets are of little danger. For safety, they should be in conduit. Nothing should be allowed to rub against them. All switches around the barn should be in iron-clad boxes, operated externally and kept tightly closed.

Good Housekeeping. —Among the other numerous but less important causes of fires are many which may be eliminated by good housekeeping. Rubbish or refuse piled in corners are a minor menace. Carelessness in handling ashes frequently results in fires, as they may contain hot coals which will smolder for several days. When these are dumped in a wooden barrel they are a prolific source of fires. A national loss of over $11,000,000 has been attributed to this cause in one year.

GENERAL FIRE PROTECTIVE CONSTRUCTION

Most farm buildings in Alabama are constructed of wood, the high cost of other materials making their use uncommon. Obviously it is important to consider types of construction which will reduce the fire hazard to a minimum. Laist (in the *Journal of Agricultural Engineering,* Oct. 1924) gives three distinct ways of doing this. First, by adopting as far as possible the principles of mill construction as used in industrial buildings. Second, avoiding concealed spaces or ducts, using fire stopping devices and avoiding small members wherever practicable. Third, a limited use, or employment in extra hazardous positions, of fire resistive construction, which consists of wood covered with a material which offers resistance to fire; for example, metal lath and plaster.

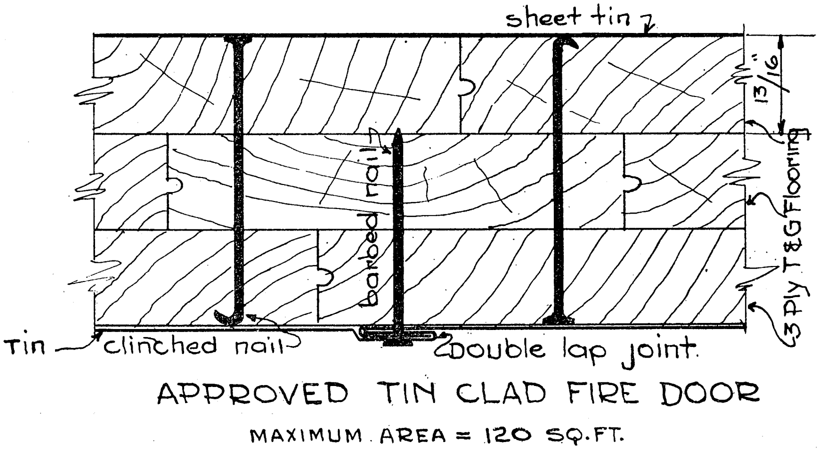


FIG. 2

Concealed air spaces, the use of timber of large cross section, and the very large floor areas without the intervention of fire walls are avoided in mill construction. The mill type of construction is generally accepted as one of superior qualities and offers no greater hazard than the so-called "fire-proof" construction; and when provided with a sprinkler system it obtains the same insurance rating as if "fire-proof."

The actual value of this construction can be seen when the difficulty of starting a fire, except at the edge of a heavy timber, is considered. For this reason the corners are chambered or rounded. It is also difficult to start a fire on a solid plank floor. Actual tests have shown that unprotected timber columns will stand longer than unprotected steel columns when sustaining a load in the presence of the heat of a fire.

The merit of this type of construction for the farm lies chiefly in allowing time for the farmer to save his livestock and equipment. No type of practical construction will withstand the heat of a burning mow of hay. However, when the animals are housed on the ground floor of a barn, the upper part of which is used as a storage for hay, a heavy beamed ceiling with tight two-inch plank for flooring will hold back the flames for a considerable period of time. This is particularly true if fire doors are installed between the two floors. These doors should be constructed so as to close on their own weight. If they are

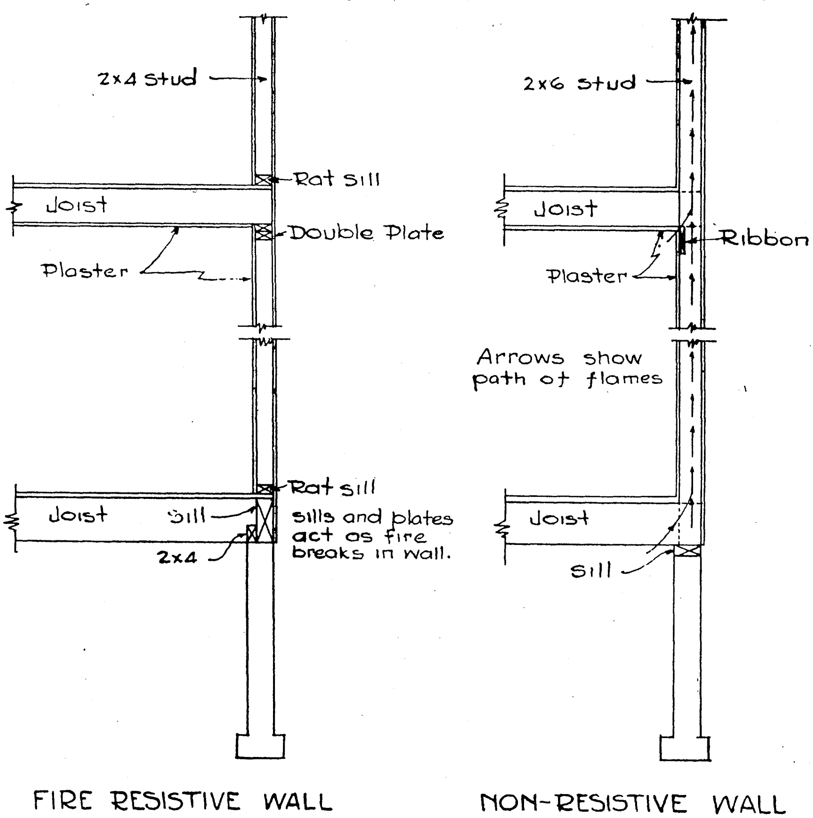


FIG. 3

kept open they should be suspended with a cord of fusible link which will burn through readily and permit the door to fall shut, thus cutting off the fire from the lower portion. A section for this type is shown in Fig. 2, page 8.

Plans embodying the essential points of resistive construction in house walls and partitions show the essential details of resistive construction (Fig. 3 and Fig. 4). When metal laths and plaster are properly used on walls and ceiling, tests made by the underwriter's laboratories show that fire will be confined one hour to the room where it started. This not only allows time for escape and for the removal of property, but frequently holds the fire to proportions where equipment available to the farmer will be able to cope with it.

Further details of this construction may be obtained from the Association of Metal Lath Manufacturers, 123 W. Madison Street, Chicago, Illinois. The underwriter's data show that 96 per cent of all fires originate within the building involved. This shows the value of interior protection.

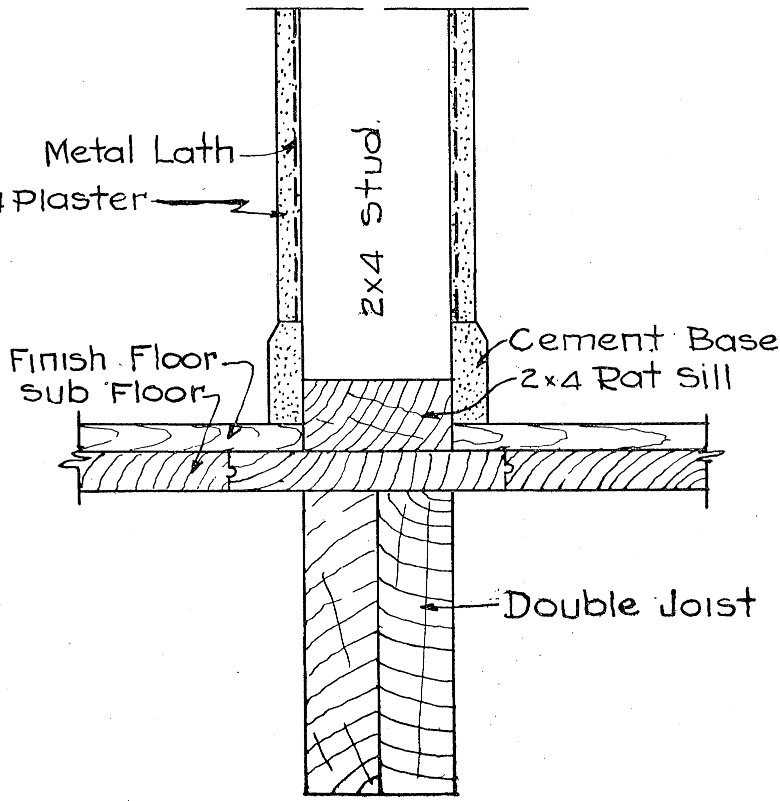


Fig. 4

FIRE CONTROL MEASURES

It is always easier to prevent a fire than to fight one. Next to prevention, the best thing is to put it out while it is small. Fires start in a small way. If the construction and arrangement of a building are such as to confine them to small proportions for a period of time sufficient to allow the farmer to bring into play equipment for the extinguishing of small fires the risk is naturally reduced.

Every farm should have some means of extinguishing fires. The amount of money which should be invested in this equipment depends upon the value of the buildings. A brief description of means to this end follows:

Buckets of water hung in convenient places are the cheapest and simplest fire extinguishers. There should be at least two of these buckets at a place. They should be used for fire only. To keep them from freezing, they should contain a solution of calcium chloride (common salt corrodes the bucket), and a thin film of oil should cover the water to prevent mosquitoes breeding. A barrel of water containing a stock of several buckets is a very satisfactory arrangement.

Common 2½-gallon portable extinguishers of types approved by the fire underwriters should be available. These should be located in accessible places and be recharged at least once a year to insure being in operating condition. There should be at least three in the house and two about the buildings. If oil or grease is present, extinguishers containing carbon tetrachloride or some similar smothering chemical are needed. Dry powders are of little value. A bucket of sand is satisfactory for grease or oil fires. An axe and a ladder of sufficient length to reach the highest roof should be convenient.

WATER SUPPLY TESTS AT AUBURN

When there is an automatic pressure or gravity water system on the farm it is possible to extinguish a small fire if garden hose is available. Frequently, when a fire has become of such proportions that the available water will not extinguish it, other buildings can be saved by this means.

To determine something of the value of this equipment, the Alabama Experiment Station made a study of a special installation designed for the purpose of determining the variables entering into the use of farm water supply for fire protection. The facts obtained from this study follow:

The source of water supply on the Station farm where these tests were made consisted of a shallow well which contained, under normal conditions, from 500 to 600 gallons, depending upon the conditions of the water table in the soil. At the time the tests were run, which was during an unusual drought, only a little over 500 gallons were available in the well when pumping was started. However, as the pumping proceeded at a rapid rate, the water channels supplying the well were opened up so that as much as 1460 gallons were pumped from it in 1¾ hours. This effect is to be expected as an accompaniment of large capacity pumping. From observations of a number of wells equipped with farm water supply systems, this well is considered typical of those of the Piedmont and Coastal Plains sections of the State. *

Fire Fighting Equipment

The equipment tested consisted of a *Gould "Pyramid"* pump attached to a 36 by 120 inch electrically welded horizontal tank of 530 gallons operating capacity, equipped with standard 100-pound pressure guage, a 14-inch glass water guage, and 2-inch pipe connections. All pressure readings were made on this guage.

The pump is one of the larger standard types used for domestic water supply and is known as a *Pyramid Outfit 0.* It has a 4-inch piston, 5-inch stroke, and a capacity of 1260 gallons per hour for 150-feet elevations, with a 2-inch suction and discharge pipe. The pressure was controlled by an automatic pressure regulator governing the operation of a 1½ h. p. standard motor. During the tests this was set to start the pump when the pressure in the tanks fell to 35 pounds and to cut out at 45 pounds.

The entire equipment is located in a concrete pump house. The pump is 42 feet from the well and 12 feet above the normal surface of the water. There are three fire plugs, respectively 74 feet, 80 feet, and 95 feet from the well. Each has 3 right angle bends made by standard 2-inch elbows.

The hose used was permanently connected at the fire plugs and housed in hose boxes especially constructed for this purpose. These boxes are closed with a breakable glass door so that the hose is accessible and ready at any time for immediate service.

The entire cost of this outfit, exclusive of pump house, is estimated to be between $450 and $500, or about $150 more than ordinary installations of smaller capacity. When a relatively large amount of water is needed, as on larger plantations, and

---

* For detailed information as to water supply of Alabama, see bulletin of the State Geological Survey, *Underground Water Resources,* by Eugene A. Smith.

where the investment in buildings is considerable, the value of such equipment is unquestionable. Exact data are not available as to the percentage of reduction of the fire hazard; but, in the opinion of the writers, it is at least equal to the protection given in many small towns by volunteer companies and with much more expensive equipment.

Test of Installation

During the tests, a standard water meter was attached between the plug and hose, and the volume of water recorded. The height to which the water could be thrown was measured by triangulation and the range measured by a tape. The pressure was recorded at the tank, and the time measured by a stop watch. One hundred feet of two-inch cotton fire hose was used with 5/8, 1/2, 3/8 and 5/16 nozzles. The tank being between the hose and the pump made it possible to use the pressure in the tank to throw a large quantity of water in a few minutes. With the 5/8-inch nozzle 944.5 gallons of water were thrown in 28 minutes, which is at a rate of approximately 2020 gallons per hour. This is at a rate of 760 gallons above the capacity of the pump.

However, in this case, the pressure in the tank fell very rapidly and at the end of 8 minutes only 15 pounds were registered at the tank. This pressure gave a range of only 20 feet, which was too short for practical fire fighting. With the 1/2-inch nozzle, the pressure fell to 15 pounds in one-half hour and continued at this point for the next half hour when the test was stopped. With the half-inch nozzle, 15 pounds pressure gave a minimum effective range of 22 feet. For many purposes, this would be an effective use of water, as 1583.8 gallons were delivered in one hour.

The 3/8-inch nozzle delivered 1965 gallons in 1 1/2 hours, at which time it was delivering 21 gallons per minute at an effective range of 24 feet. This being the capacity of the pump, this flow and this range were maintained constantly until 2264.5 gallons were delivered at which time the test was stopped.

Calculations from the above data showed that a 5/16-inch nozzle would give approximately the capacity of the pump at 43 pounds pressure. In tests, a nozzle of this capacity maintained a stream of 21.75 gallons per minute, at an effective range of 38 feet, for one hour, with 600 gallons remaining in the tank. The nozzle used in this test was so made that the top could be screwed off to give a larger flow for a few minutes. With the tip off, 224.5 gallons were delivered in 4 minutes and 10 seconds. This is slightly more than twice the capacity of the pump. A tip which would be adjustable would be preferable to the one above described, as no time would be lost in getting the tip on and off. The selective rate appears to be particularly desirable when the total amount of water available is limited and must to be used to the best advantage.

The 5/16-inch nozzle outfit was considered as the most desirable equipment, for it gave the operator the opportunity of using approximately twice the capacity of the pump for several minutes to get fire under control, or a continuous stream at high pressure could be used to protect one building from another burning close to it.