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VIRGINIA AGRICULTURAL

EXTENSION DIVISION



The Use of Explosives on the Farm

By

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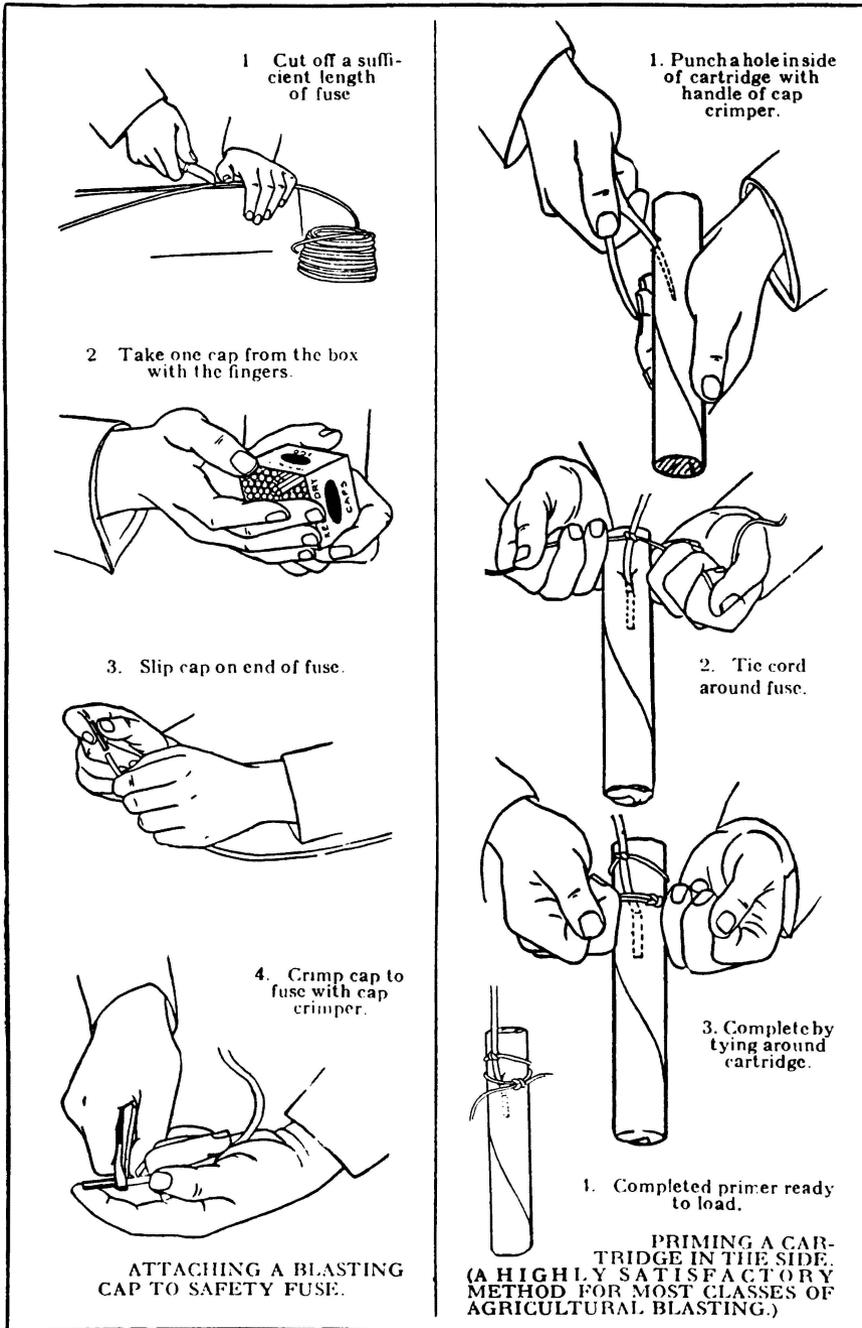


Fig. 1—Approved Method of Attaching Blasting Cap to Fuse and Priming a Cartridge

The Use of Explosives on the Farm

INTRODUCTION

Stumps, boulders, gullies, wet spots and other obstructions in fields take up valuable space, prevent economical cultivation, cause damage to machinery, restrict the use of improved labor saving machinery, create breeding places for weeds and crop pests, and make the fields unsightly. Agricultural explosives offer an effective means of removing these obstructions.

The distribution of surplus war explosive for agricultural purposes has served to stimulate interest on the part of the farmer in the use of explosives. He is using increasing quantities each year for blowing stumps and for other purposes. The farmer is in need of information on the proper use of explosives for best results. This Bulletin is prepared to supply as briefly as possible this information.

MATERIALS

Explosives are often spoken of as low grade and high grade. These terms do not mean good explosives and medium or poor explosives. What is meant is low or high percentage, referring to the powder violence. A low percentage dynamite explodes more slowly than a high percentage dynamite. It is the slower or heaving action that is wanted in stump blowing rather than the fast or shattering action. When the bore hole is put in the right place, and the charge is properly tamped, better work will be done in stump blowing with the "slow" or low grade explosive and at a lower cost.

Modern dynamites are a mixture of explosive materials. Many different materials are used in the various brands. They are not affected by ordinary temperatures. Salvaged war explosives, such as pyrotol, are prepared in cartridges similar to dynamite and are used like dynamite.

CAPS: Blasting or detonating caps are dangerous when not properly used. They should be handled with caution. The shell is filled with sensitive shattering explosives. It is exploded by fire or heat, friction or by shock. Caps should be kept away from children. Caps should be kept dry and away from direct sunlight, matches and heat, and should be taken from the box in which they came and put in a safety box to carry them to the field. Caps should never be pried out of a box. Tip the box over and remove the caps with fingers. Figure 13 shows a simple, home made safety box.

ELECTRIC BLASTING CAPS are used for electric blasting. They are similar to a common cap, but are set off by a fuse wire in the cap which is heated red hot by the electric current from a blasting machine. Electric caps are usually supplied with four foot wires. No fuse is used. A number of these caps can be wired together and fired at the same time. All caps should be handled **carefully**.

Double insulated leading wire, 250 to 300 feet long, should be used in electric blasting. This permits the operator to stand at a safe distance, out of danger, when firing the charge. The two wires are separately insulated and enclosed in one cover. (Connecting wire is used when loads several feet apart are connected for firing at once, 20 to 24 insulated connecting wire is used.)

A blasting machine should be used to furnish the current to set off the blasting caps. Blasting machines are made in various sizes to fire up to 150 caps, although the larger sizes are seldom needed. The ten cap size is the one most commonly used in stump work. The thirty cap size is a very good size for general work. Several farmers can buy a blasting machine co-operatively to advantage.

FUSE: A good grade of safety fuse should always be used for agricultural blasting. Safety fuse comes in packages of two 50 foot rolls, one wrapped inside the other. Poorer grades of fuse should never be used. Fuse should be handled carefully in cold weather so as not to break or injure it. If fuse becomes pinched or kinked, cut out the damaged portion, as damaged fuse causes misfires or hang fires which result in accidents.

CAP CRIMPERS: A good cap crimper should always be used. A knife, pliers, or the teeth are very inefficient as cap crimpers and decidedly unsafe.

BLASTING TOOLS: The tools necessary for blasting work are a soil auger, tamping stick, punch bar and sledge hammer. Soil augers can be purchased locally or made at home. A 2" ship auger welded to a 5/8" iron rod to make a length of five feet is a satisfactory auger. In moist soil and stiff clay the auger works well. In gravelly soil, the bar is indispensable. Both can be used to advantage. A handle from a long shovel makes a good tamping stick, although any round, smooth stick will work well, provided it is at least 1½ inches in diameter. Never use a metal rod to tamp with.

STUMP BLASTING

Stump blasting is the most important use of agricultural explosives. The proper location and size of the charge depend upon the kind, size, and age of the stump, the kind of soil and the amount

of moisture in the soil; and the method of firing the charge which is to be used.

There are two main types of root development, **tap** roots and **lateral** roots. In tap root stumps, the main root grows straight down into the earth, generally with a fringe of small roots near the surface. Long-leaf pine, hickory, blackgum, and white oak are among the trees that have tap roots.

In lateral root stumps, the roots spread out from the stump in all directions and are generally all near the surface. The elm, hemlock, cypress, soft maple, locust, dogwood, and alder are typical lateral root stumps. There is also a semi-lateral type, such as the white poplar, chestnut, walnut, red oak, black oak, and persimmon.

The age of the stump should be considered in determining the size of the charge. Green, freshly cut stumps require the largest quantity of explosives. The quantity required for an old stump will depend on the age of the stump and the stage of decay. It is generally cheaper to let stumps stand at least a year after cutting before removing with explosive.

The greater the resistance of the soil to the force of the explosion, the greater will be the force exerted against the stump. The nature of the soil, therefore, must be considered in fixing the size of the charge. Stumps in loose, sandy soils must be more heavily loaded than those in firm, stiff soils. Better results will be obtained in blasting stumps, in sandy soils especially; when the ground is wet. In the spring, when the soil is wet, one pound of explosive will do the work of 1½ to 2 pounds when the soil is dry. Explosive can be used to advantage in the fall after heavy rains.

SIZE OF CHARGE

There is no exact rule for the size of charge for blasting stumps. The inexperienced blaster should experiment with a few charges of various sizes on the smaller stumps. After firing a few shots, he will be able to tell how much explosive will be required. The following table is given simply as a guide to the beginner in blasting stumps:

AMOUNT OF EXPLOSIVE USED FOR PINE STUMPS

Diameter of stump in inches...	12	18	24	30	36	42	48
Pounds of explosive	1	1½	2½	3	3½	4	5

For sound, hardwood stumps, the charge should be approximately three times the size of charge used on pine stumps.

PRIMING THE CHARGE

Priming consists of placing the cap and fuse on the blasting cap in the charge of explosive. This is usually done with one cartridge. Careless and inefficient use of cap and fuse is responsible for most accidents with explosives. The materials are usually

standard and very uniform and when properly used give good results. Always use cap crimpers in attaching cap to fuse. They help to prevent hang-fires. Fig. 1 illustrates an approved method of priming a cartridge.

METHODS OF FIRING

The safety fuse and electric current are the two methods of firing charges of explosives, and the method of firing will determine the size and location of the charge. Only one charge can be fired at a time with a safety fuse. The electric current method permits a number of charges to be fired simultaneously. Since only one charge can be placed under the stump at one time with the safety fuse method, the charge must be larger and differently located than when a number of smaller charges are to be fired electrically. The first cost in the electric method is greater than the fuse method, but the saving in time when several hundred pounds of explosive is used is generally sufficient to offset the first cost. The electric method is also much safer.

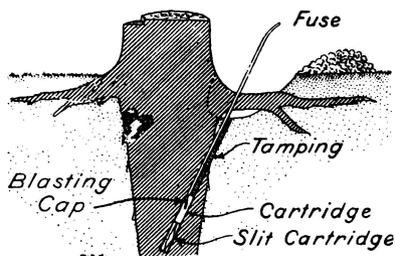


Fig. 2—Location of Bore Hole and Cap-and-Fuse Charge in a Tap-Root Stump

PLACING THE CHARGE

In tap-rooted stumps, the charge should be placed so as to cut off the stump. This is best accomplished by placing the charge inside the tap root as shown in Fig. 2. With an auger the hole should be started at the surface of the ground and bored at an angle of 45 degrees into the stump, so that the bottom of the hole will be well past the center of the tap root, and at a depth where it is desired to cut the root off. When the explosive is placed in the hole, shavings or other material should be tamped lightly into the hole with the tamping stick. The force of tamping can be gradually increased, using clay or shavings, until the hole is at least half filled.

Another method consists in placing two or more charges against the tap root, as shown in Figure 3. A crowbar, or driving bar, can be used to make the hole into which the charges are to be placed. The holes should be at least three feet deep and so placed

that the charge will be directly against the root. It is necessary to use an electric blasting machine with this method.

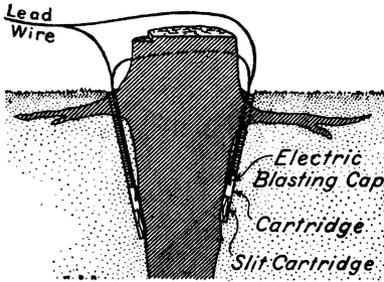


Fig. 3—Method of Loading for Blasting Tap-root Stump with Distributed Charges Electrically Fired

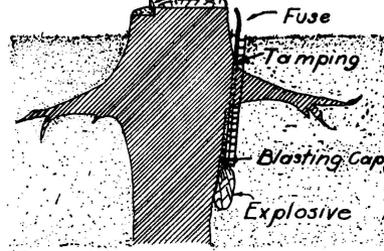


Fig. 4—Method of Loading for Blasting Tap-root Stump with Cap and Fuse Charge

If a wood auger or blasting machine is not available, a tap root stump may be blasted by placing one charge against the root at a good depth and firing with a cap and fuse as shown in Fig. 4.

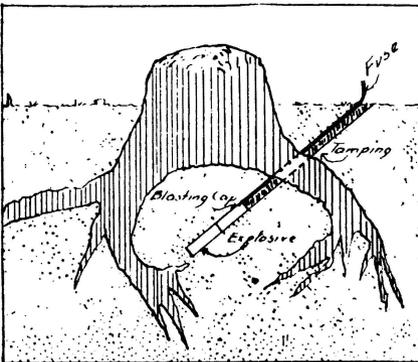


Fig. 5—Method of Loading a Lateral-root Stump with a Single Charge

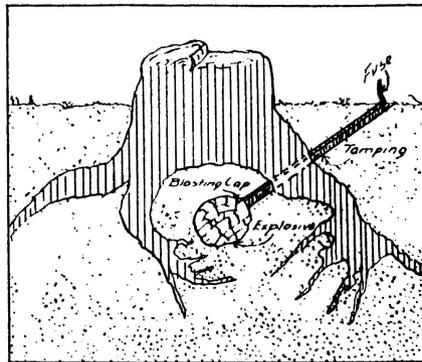


Fig. 6—Method of Loading Large Lateral-root Stump

In lateral or semi-lateral root stumps, the hole can be made by a soil auger, wood auger, or a driving bar and hammer. When the cap and fuse method of firing is used, the hole should be made directly beneath the center of the stump at a depth varying with the size of the stump, but deep enough to blow out the lateral roots. Figure 5 shows this method.

In the case of large stumps where larger loads are needed and an electric outfit is not available, it is necessary to spring a hole under the stump to hold sufficient explosive. A hole should be bored as deep as necessary to locate the charge properly under the center of the stump, and cap and fuse attached to a small piece of explosive (one to three inches of a cartridge, depending on the size of hole needed and kind of soil), is placed in the bottom of the bore-hole and exploded without tamping. The primer is fired, making a

small chamber as shown in **Figure 6**. This hole should be left for a short time to cool before loading it with explosive. To load the chamber, slit each cartridge once and pack tightly. The primed cartridge is placed in last and care should be taken that it is in contact with the rest of the charge. The hole should then be tamped full of moist soil and the charge fired. Long, narrow charges waste explosive, so care should be taken that charges are bunched as much as possible to get the best effect with the least explosive.

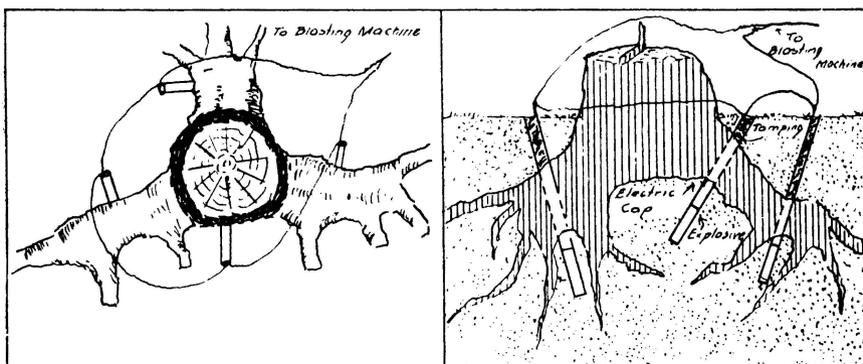


Fig. 7—Electric Method of Loading Distributed Charges Under and Around a Large Lateral-root Stump

Figure 7 shows the electric method of placing the charge for lateral rooted stumps. Insert the electric cap in a hole slit in the side of a cartridge near one end, so that the cap will be lengthwise of the cartridge. Make a half hitch about the end of the cartridge with the wire. In loading, the first cartridges should be slit the same as in cap and fuse blasting. The primed cartridge is put in last and the hole tamped full of moist earth, holding the end of the wires while tamping.

A number of charges under several stumps or under one large stump can be fired at once with the electric method. The cap wires of one are connected to the cap wires of the next and so on until all the loaded caps are connected into the series and the last two wires connected to the leading wires. All connecting wires should be clean so as to make a good electrical connection. Before connecting with the blasting machine, everything and every one should be out of danger. The blaster should call "Fire," loudly and then connect the two wires of the leading wire to the binding parts of the blasting machine, and if everything is ready, push down the handle and set off the charge.

ROCK BLASTING

Explosives are effective for removing boulders and breaking ledges of rock in fields. There are several ways of using explosives in breaking field boulders. The most common are block holing, snake holing, mud capping and seam blasting. The first three

methods are illustrated in Figures 8, 9, 10. Explosives having a high shattering effect (40% to 50%) are best for rock work.

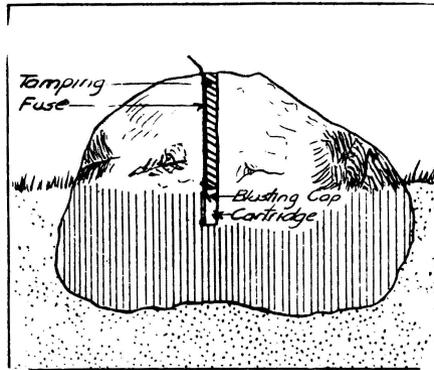


Fig. 8—Block Holing Method of Loading Charge

The **Block Holing** method of rock blasting requires less explosive than the other methods, but the labor in drilling is considerable. A hole is drilled about two-thirds through the rock. The cartridge with cap and fuse attached is inserted as shown and the hole tamped full of moist clay. Care must be taken against jamming the cap against the side of the hole. A few trials will determine the time and amount of explosives required. This is the best method to use on rock ledges or very large boulders.

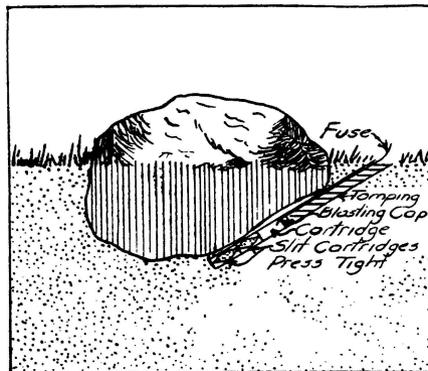


Fig. 9—Snake Holing Method of Loading Charge

The **Snake Holing** method is generally used to lift boulders out of the ground. If it is desired to shatter the rock, a larger charge of high percentage explosive should be placed tight against the under surface of the rock. If it is not intended to break the rock with this method, a low grade, slow acting explosive may be used. About 3 to 4 cartridges per cubic yard are needed to lift boulders out of the ground if the top is exposed. With a bar or soil auger sink a hole at an angle under the center of the rock as shown in Fig. 9. Place the explosive and tamp well. Snake holing

is intermediate between block holing and capping as to amount of explosive and labor required.

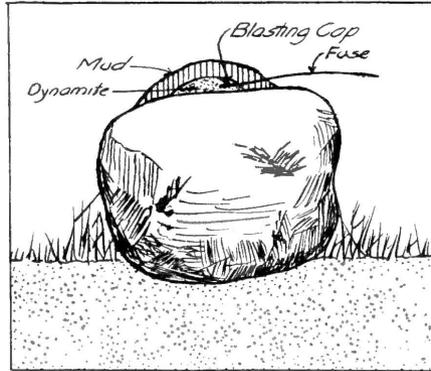


Fig. 10—Mud Capping Method of Loading Charge

The **Mud Capping** method should not be used on rock more than four or five feet thick. Slit the cartridges so they can be packed down solid against the rock in a depression or weak spot. The cap and fuse is inserted and the charge then covered and packed tightly with heavy, sticky clay mud. This method requires the least labor but a considerably larger amount of explosive.

Seam Blasting: When ledges or boulders have deep seams, they can be blasted successfully by packing the explosive in the crack and tamping securely with moist clay. Seam blasting requires about the same amount of explosive as snake holing.

DITCHING WITH EXPLOSIVES

In some cases it is economical to use explosives for ditching, such as in straightening ditches along roads and through woods or places where obstructions such as, roots, stumps and rocks prevent other methods. It is not practical, however, to use explosives for blasting ditches less than 6 feet wide at the top and 2½ feet deep. It is not economical to blast a ditch which can be easily excavated with teams and scrapers or with any kind of machinery.



Fig. 11—View of Ditch Before and After Cleaning Out by Use of Explosives

There are three methods of ditching with explosives, the propagated method, the pot hole method and the electric method. Of

these the electric method is best and cheapest where the proper equipment can be had.

The **propogated method** is most commonly used and is most widely known. To ditch by this method, a fast or high explosive (not less than 50%) is required. The holes are put down to the required depth, according to the size of the ditch and type of soil, and spaced from 14 to 24 inches apart. In these holes the required amount of explosive is placed with a primed cartridge in the center hole. (For a ditch 6 feet wide at top and 2½ feet deep, one stick in the hole will usually be sufficient.) See Fig. 12. The concussion from the primed charge sets off the others. The ground must be soggy in order to be successful with this method.

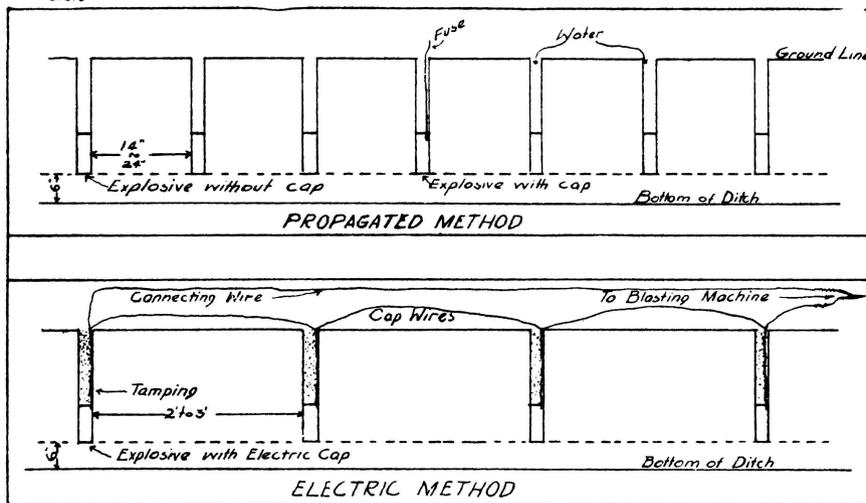


Fig. 12—System of Loading for Propogated and Electric Methods of Ditching

The **electric method**, shown in figure 12, may be used with any type of explosive. Pyrotol the government explosive and insensitive or slower ordinary dynamites can be used with this method. As in other methods, the holes are put down to the required depth, but the spacing is considerably more. Usually from 36 to 42 inches is a good distance, although soil conditions may vary this. Trial shots will determine depth and quantity needed. The electric cap is placed in each charge and the whole is set off by the blasting machine which has been described earlier in this circular. If used in water, the primer must be waterproofed. The hole should be tamped full.

The **pot hole method** is used only for short ditches and may be used with both low and high explosives. One charge at a time is put down and exploded. Five or six sticks to the hole spaced 5 feet apart, is usually sufficient for a ditch 6 feet wide at the top and 2½ to 3 feet deep. This method has its disadvantages, due to the fact that excessive explosive must be used in order to clear the ditch and therefore it is not recommended for ditching in general.

SUBSOILING AND TREE PLANTING

Under certain conditions, it may be economical to subsoil or to blow holes for trees with explosives. Subsoiling is sometimes profitable on tight soils and over small areas. It will effectually break up the hard pan in these pockets and allow the water to seep through. Subsoiling should be done when the ground is as dry as possible and is most effective at depths of about four feet. Holes for trees should be blown in the fall in order that the freezes and thaws of winter will break up any puddling that may take place under the force of the explosive. In either case, it is best to consult the Extension Service of your State before undertaking the work.

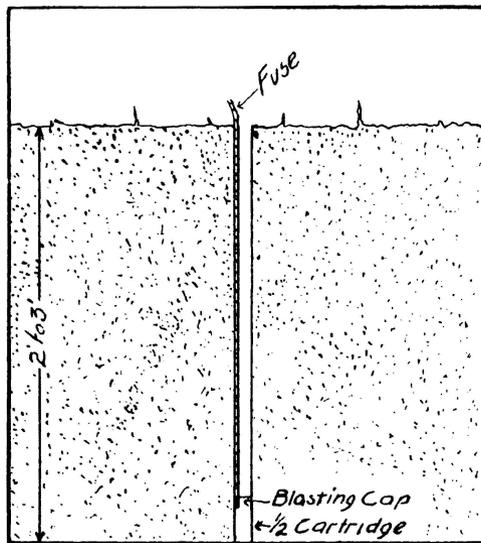


Fig. 13—Method of Loading for Sub-soiling and Tree Planting

STORING AND HANDLING EXPLOSIVES

Explosives are made to explode and, therefore, the greatest care should be observed in handling and transporting the material. They should be stored in a dry place where the chance of freezing is not great. Frozen dynamite is dangerous. Pyrotol and low percentage explosives do not freeze as readily as the high percentage dynamites, but explosives should be well protected against moisture.

Thaw frozen dynamite by placing it in warm water or a steam bath. **Never in front of an open fire.**

HANG-FIRES AND MISFIRES

The hang-fire is a charge that does not go off at the proper time. It is the most dreaded of all adverse conditions in handling explosives, although if handled correctly, it can do no damage.

In case of a hang-fire, do not investigate until the next day. By that time the hang-fire will have become a misfire and may be handled in comparative safety. Do not forget a hang-fire and try to reload it. Wait until next day.

To remove a misfire, carefully work the dirt from around the charge with a wooden stick (never use metal), taking plenty of time to avoid explosion of the cap by friction or impact. The charge can then be removed, or if the explosive is still dry, a new, carefully primed cartridge can be placed on top of the charge and fired in the usual manner. To prevent hang-fires, use good fuse, cap crimpers and proper tools: avoid sharp bends in fuse, prime carefully, and use new caps (not over a year old).



SAFETY AND PRECAUTIONS

All explosives are dangerous, and because of this fact, certain rules must be observed in using explosives in order to protect the blaster.

Explosive should be handled carefully. Rough handling causes trouble in almost every case sooner or later. It is nearly always the old blaster who gets hurt with explosives. The novice does not know and, therefore, takes no chances. One should never allow experience with explosive to influence him to take the smallest chance. The man who makes one mistake with dynamite usually never makes another.

Never transport explosives and caps together. Caps are more dangerous than dynamite alone, and the combination of the two makes the hazard twice as great. Store the two in different buildings and **keep both under lock and key.**

Never handle explosives in a hurry, as a slip may cause a serious accident. Take plenty of time.

Caps carried loose in the pocket are about as dangerous as live steam, so provide a safe method of carrying caps. The box shown in Figure 14 is simply made and will allow caps to be carried safely.

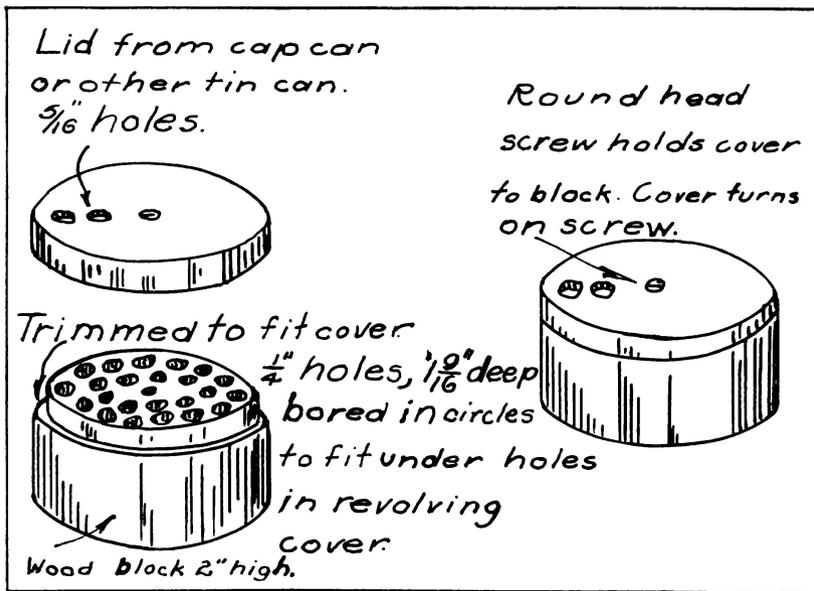


Fig. 14—A Home Made Safe Cap Box

SOME "DON'TS" TO BE OBSERVED IN HANDLING EXPLOSIVES

- DON'T forget the nature of explosives, but remember that with proper care they can be handled with comparative safety.
- DON'T smoke while you are handling explosives, and DON'T handle explosives near an open light.
- DON'T leave explosive in a field or any place where animals can get at them. Cattle like the taste of soda and salt petre in explosives, and the other ingredients would probably make them sick or kill them.
- DON'T handle or store explosives in or near a residence.
- DON'T leave explosive in a wet or damp place. They should be kept in a suitable dry place, under lock and key, and where children or irresponsible persons cannot get at them.
- DON'T explode a charge to chamber a bore hole and then immediately reload it, as the bore hole will be hot and the second charge may explode prematurely.
- DON'T do tamping with iron or steel bars or tools. Use only a wooden tamping stick with no metal parts.
- DON'T force a primer into a bore hole.
- DON'T hurry in seeking an explanation for the failure of a charge to explode.
- DON'T use frozen or chilled explosives. Dynamites other than the low-freezing ones often freeze at a temperature between 45 degrees and 50 degrees F.
- DON'T thaw dynamite on heated stove, rocks, bricks, or metal, or in an oven, and DON'T thaw dynamite in front of, near, or over a steam boiler or fire of any kind.
- DON'T take dynamite into or near a blacksmith shop or near a forge on open work.
- DON'T put dynamite on shelves or on anything else directly over steam or hot water pipes or other heated metal surfaces.
- DON'T cut or break a dynamite cartridge while it is frozen, and DON'T rub a cartridge of dynamite in the hand to complete thawing.
- DON'T allow thawed dynamite to remain exposed to a low temperature, but use as soon as possible.
- DON'T prime a dynamite cartridge or charge or connect bore holes for electrical firing during immediate approach or progress of a thunder storm.
- DON'T carry blasting caps or electric blasting caps in your pocket.
- DON'T tap or otherwise investigate a blasting cap or electric blasting cap.
- DON'T attempt to take blasting caps from a box by inserting a wire, nail, or other sharp instrument.
- DON'T try to withdraw the wires from an electric blasting cap.
- DON'T fasten a blasting cap to safety fuse with the teeth or by flattening it with a knife; use a cap crimper.
- DON'T store or transport blasting caps or electric blasting caps with high explosives.
- DON'T keep blasting caps or electric blasting caps in the same box or container with other explosives in the field. Keep them separate.

The following circulars have been consulted in preparing this bulletin:
Circular No. 88—Alabama Polytechnic Institute.
Circular No. 164—Wisconsin State College.
Circular No. 191—U. S. Department of Agriculture.
Publications of Manufacturers of Explosives.

ASSISTANCE THAT CAN BE RENDERED BY THE EXTENSION DIVISION OF THE VIRGINIA POLYTECHNIC INSTITUTE

The Extension Division carries the Agricultural College and the United States Department of Agriculture to the farmer and farm home. It endeavors to meet their problems in soils and crops, horticulture, dairying, live stock, poultry, agricultural engineering, home economics, and community development. This is done by personal visits, meetings and correspondence of County Farm and Home Demonstration Agents and Specialists, through boys' and girls' and women's club work, cow testing and purebred live stock and other associations and organizations, and the distribution of bulletins, circulars, newspaper articles, etc.

Application for information or assistance with any farm or home problem should be made to the Director of the Extension Division, Blacksburg, Virginia.

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