DU PONT

BLASTING ACCESSORIES

EXPLOSIVES themselves demand first consideration when blasting is to be done, but the fact must not be overlooked that they cannot be properly exploded and will not develop their full strength without certain materials and appliances especially designed for the purpose. In addition to those articles necessary to develop the energy of a charge of explosives, there are other devices which, although they may not be absolutely requisite, contribute to safety, certainty and economy in the use of explosives. These are called "Blasting Accessories."

The importance of using Blasting Accessories that are up to the highest standard in every respect cannot be overestimated. The very best grade costs but a trifle in comparison with the charge of explosives with which they are used. It is poor economy to attempt to detonate explosives with an inferior detonator, for this always results in a considerable waste of the explosives.

The Du Pont Company has learned by more than a hundred years of experience just what is required in the shape of Blasting Accessories, and jealously maintains its standard of highest quality.

VIEWS OF BLASTING CAP WOR :S AT POMPTON LAKES, NEW JERSEY

Blasting Accessories

Classes of Explosives

There are two general classes of explosives—deflagrating and detonating.

Deflagrating Explosives.—This class of explosives includes all of those which are fired by sparks furnished by the spit (flying

DU PONT BLASTING POWDER GRAINS

sparks) from an electric squib, safety fuse or a miners' squib. This class of explosives may also be fired by means of any of the detonators intended for high explosives. The principal deflagrating explosive is blasting powder.

Detonating Explosives.—This class of explosives includes all the dynamites, nitroglycerin, ammonia, gelatin and Arctic and Judson powders. They are not fired by sparks or flame, but

A CARTRIDGE OF DYNAMITE

require some powerful intermediate agent, such as an electric blasting cap, blasting cap or cordeau. These agents are called detonators.

Deflagrating explosives, when loaded in large quantities, are frequently fired or exploded by charges of high explosives.

to some extent, especially in coal mining, but on account of the electric resistance of iron being about six times as great as that of copper, a blasting machine cannot fire as many electric detonators when iron wires are used as when copper wires are used. (See page 40 for table of resistance of iron wires.) The standard lengths of iron wires are 2, 4, 6 and 8 feet. Longer lengths will be supplied on special order, but they are not recommended. The iron wires are carefully insulated. For general work copper wires are far superior.

CARTON OF 50 ELECTRIC BLASTING CAPS

Electric blasting caps are packed in pasteboard cartons, which are inclosed in heavy wooden cases. The cartons contain either 25 or 50 electric blasting caps, depending on the length of the wires. Electric blasting caps with wires from 4 feet to 16 feet long are packed for domestic trade 500 to the case, while those with longer wires are packed 250 to the case.

The storage of electric blasting caps should always be given careful attention by the consumer. If they are permitted to remain for a long time in a very warm place, the waterproofing material in the insulation dries out to such an extent that the insulation may break when the wires are bent, and misfires result if an attempt is made to use them in wet work.

The explosive charge in the electric blasting caps is very easily affected by moisture, and if they are stored too long in a damp or wet place they may deteriorate. This charge is also very sensitive, and may be exploded by a moderately hard knock or jar. Electric blasting caps should, therefore, be handled carefully. Careful handling is also necessary on account of the delicate bridge wire (see sectional view of electric blasting caps), which may be broken by rough usage. When broken, the electric blasting cap is absolutely useless. The wires must not be bent sharply or forcibly separated at the point where they enter the copper cap, as this may break or loosen the filling material and permit water to enter and damage the explosive charge. These precautions are necessary with all classes of electric detonators.

Care must be taken when tamping the bore hole not to break either the electric blasting cap wires or the insulation on them, or to pull the electric blasting cap out of the primer.

Many misfires are due to carelessness in loading and tamping bore holes.

In each carton of electric blasting caps there is a paper tag called the "follow-up" tag. In case any trouble is experienced with the electric blasting caps, this tag should be preserved, as well as any unused electric blasting caps, and, in addition, the markings on the wooden cases in which the cartons were packed should be recorded.

SHIPPING CASE OF ELECTRIC BLASTING CAPS

Du Pont Electric Blasting Caps are so constructed as to be highly satisfactory for moist and wet work. They can be used under several feet of water if the time between loading and firing is not too great. They are not intended for use under great heads of water, or for submarine work.

Waterproof Electric Blasting Caps

Although electric blasting cap wires and copper shells are well insulated against water, they are not intended for extremely wet work, and if used in water, particularly under pressure, water may leak into the cap so that the explosive charge is destroyed or the electric current may "short circuit" through the water instead of passing through the bridge wire, which is of high resistance. For such work electric blasting caps with special insulation for wet work are used. These specially insulated electric blasting caps are called Du Pont Waterproof Electric Blasting Caps.

These are made in the same strengths, No. 6 and No. 8, with the same lengths of insulated copper wires as the electric blasting caps. Iron wires are not used. In order to give better waterproofing the copper shell is longer than for electric blasting caps so as to allow more space for filling material, shown at G (see sectional view of electric blasting cap on previous page). The copper wires have a special insulation which allows their use in water not over 30 feet deep. Where the depth of water is over 30 feet and where the primers are to remain in the water for a period longer than two days, the Submarine Electric Blasting Caps are strongly recommended because of their special water-resisting insulation.

Waterproof electric blasting caps must be placed within the charge of explosives just the same as Electric Blasting caps, with

the important difference that safeguards must be taken to protect the primers from water. The waterproofing of primers and charges is discussed on page 61.

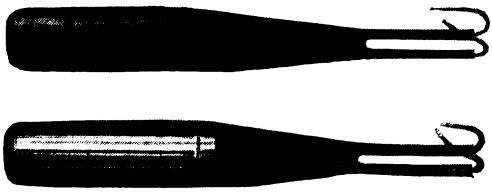
DU PONT WATERPROOF ELECTRIC BLASTING CAP

They must be handled in the same careful way as electric blasting caps. They are packed in cartons, and then in cases of the same size as are used for electric blasting caps. The weights of packages are slightly greater than those of electric blasting caps.

Submarine Electric Blasting Caps

For under-water work, where the greatest safeguards against water are necessary for safety and for developing the full strength of explosives, a special Submarine Electric Blasting Cap is used. It is made somewhat like the waterproof electric blasting

DU PONT WATERPROOF ELECTRIC BLASTING CAPS AND SUBMARINE ELECTRIC BLASTING CAPS ARE MADE TO STAND THE SEVEREST UNDER-WATER CONDITIONS



DU PONT SUBMARINE ELECTRIC BLASTING CAP AND SECTION OF SAME TO SHOW THE GUTTA-PERCHA COVERING

cap, with well-insulated wires and a long waterproof shell for the detonating charge. It is further waterproofed by having a heavy covering of gutta-percha over the shell and the lower or cap ends of the wires.

Submarine Electric Blasting Caps are made in the same strengths as Electric Blasting Caps Nos. 6 and 8.

To meet the requirements for under-water conditions, Submarine electric blasting caps are furnished (on special factory orders only) with gutta-percha insulated wires.

They are primed, connected and fired as are other electric blasting caps, and the necessary precautions are taken to guard against water entering the primed cartridge. (See page 61.)

Submarine electric blasting caps require the same careful storing and handling as do other electric detonators. They are packed in cartons as are electric blasting caps, but weigh slightly more.

Delay Electric Blasting Caps

In some kinds of blasting, particularly in tunnel and shaft work, it is necessary to blast each round of bore holes in sections or in rotation. It is generally a saving in time if this can be done in such a way as to obviate the necessity of returning to the working face after each section has been blasted to arrange for the next blast. When fuse and blasting caps are used to detonate the explosive, the sections of fuse for the different bore holes are cut in different lengths so that the charges will explode in the proper

First Delay (Size Reduced). Length of Shell, 1 Inch

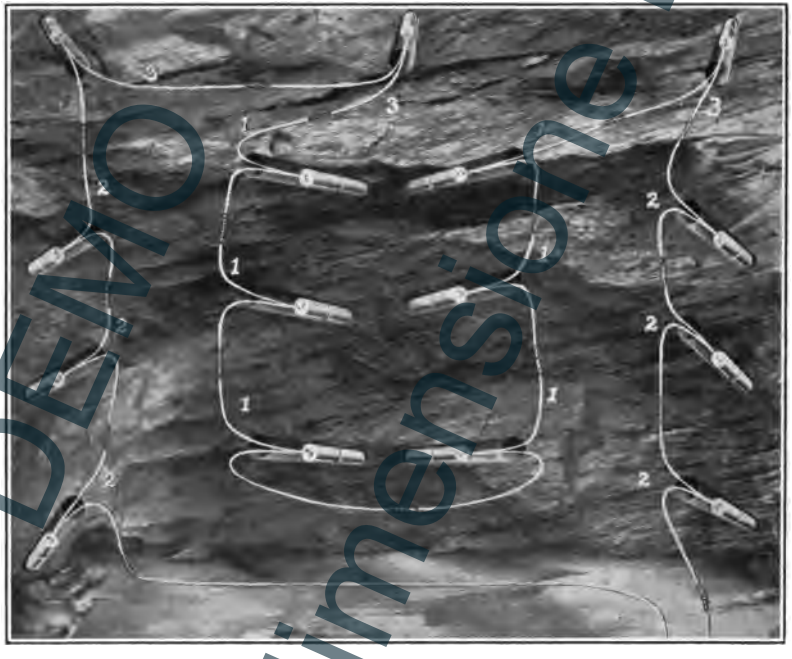
Second Delay (Size Reduced). Length of Shell, 1 ½ Inches

DELAY ELECTRIC BLASTING CAPS

sequence if the fuses are lighted at about the same time. There is practically no limit to the number of charges which can be exploded in sequence with fuse and blasting caps in this way, but electric firing is much more satisfactory for the many reasons of safety and effectiveness pointed out in the chapter on Electric Blasting. Under most conditions there is nothing to be gained by dividing the round of holes into more than three sections. This permits of cut, relief and rib shots.

The Du Pont Delay Electric Blasting Caps have been developed for such conditions so that these three classes of shots may be fired in rotation with a single set of wiring and with but one application of the electric current, and in such a way that there is no trouble from the first round of shots breaking the wires for the second and third rounds, as is the case when two or three sets of wires are used for a series of shots using only electric blasting caps.

There are two kinds of delay electric blasting caps—first delay and second delay. These are so constructed that there is a short lapse of time after the current is applied before the first delays explode, and a longer delay before the second delays



METHOD OF CONNECTING INSTANTANEOUS, FIRST DELAY AND SECOND DELAY ELECTRIC BLASTING CAPS

Electric Squibs

Blasting powder is best ignited in the center of the charge. It is impossible to do this with certainty with miners' squibs or safety fuse. It can easily be done with Du Pont Electric Squibs.

When a charge of blasting powder in a long bore hole is ignited at one end, it is always possible for some of the coal or rock to move before the entire charge explodes, and thus relieve the confinement from the powder in the far end of the hole. This is most likely to happen when large charges are ignited at the end nearest the mouth of the bore hole. Then more or less of the powder at the back of the bore hole, where the burden is usually the heaviest, does very little execution, and a large flame and a great volume of smoke are projected into the working place.

Attempts to ignite the charge at the center are sometimes made by extending the fuse to that point; but this is seldom successful, owing to the fact that most fuse will spit fire from the sides and ignite the charge where the fuse enters it. Even the very best tape and gutta-percha fuse will do this occasionally. The expense attached to the use of the highest quality of fuse has caused this method of igniting charges of blasting powder in bore holes to be practically abandoned.

EXACT SIZE OF DU PONT ELECTRIC SQUIB

Miners' squibs, often used for igniting blasting powder charges in bore holes, are sometimes uncertain in their rate of burning, and may give but little time for the blaster to reach a place of safety after lighting them. This makes it necessary, when a number of shots are ready to be fired, for the blaster to return to the face several times, causing the loss of valuable time. The miners' squib also necessitates an opening in the tamping which may result in the flames from the blast blowing back into the open and igniting mine dust or gas. This opening makes gas-tight tamping impossible.

All of these disadvantages are overcome by the use of Du Pont Electric Squibs that give all the general advantages of electrical firing. These Electric Squibs are similar in general appearance to Du Pont Electric Blasting Caps, but have a heavy paper shell or cap instead of a copper one. The end of the shell is closed with a small cork, which should be taken out before using. The charge in this cap does not detonate as does that in electric blasting caps, but merely shoots out a small flame. When electric squibs are

used, the charge of blasting powder can be ignited in the center, thus giving a little quicker and stronger action, and insuring the explosion of the entire charge before any of the surrounding material can fall and cut off a portion of it. The bore hole can be tamped solid, leaving no vent for a partial loss of the strength of the powder. When the entire charge is exploded at once, less smoke is given off by the blast. This, with the elimination of smoke from burning safety fuse, or miners' squibs, results in purer air, making it possible for both miners and draught animals to do more work. Aside from better blasting and greater safety, this one feature is of sufficient advantage to warrant the use of electric squibs.

Another advantage in using electric squibs is that when it is possible to fire more than one shot at a time all of the bore holes can be connected in series and fired at the same instant. This results in a very considerable saving of time, as well as powder, as shot firers can cover much more ground than when using fuse or miners' squibs.

CARTON OF ELECTRIC SQUIBS

It is much safer to blast with electric squibs than with fuse or miners' squibs, because shots are not fired until everyone, including the blaster, is a safe distance away, and because danger of hang fires is entirely obviated.

Advantages resulting from the use of electric squibs are:

Instantaneous firing.
Control of moment of firing.
Simultaneous firing of a number of shots.
Greater efficiency of blasting powder.
Saving of time.
Greater safety.
Elimination of fumes from safety fuse.
Decrease of smoke from blasting powder.

Electric squibs require the same good storage conditions as electric blasting caps. Although they cannot be exploded by shock or concussion as can electric blasting caps, they must be handled just as carefully, for their construction is necessarily delicate and they can be easily broken by rough handling.

They are manufactured with 4, 6, 8, 10 and 12 foot copper wires, and 4, 5, 6 and 8 foot iron wires. Those with iron wires are somewhat less expensive, but require a stronger electric current to explode them, because of the inferior conductivity of iron as compared with copper wire. They are also more easily affected by moisture. We do not recommend electric squibs with iron wires longer than 8 feet, nor do we carry them in stock.

ELECTRIC SQUIB WITH 6-FOOT WIRES

Electric squibs are packed 50 to the carton and 10 cartons to the case. Gross and net weights of cases are as follows:

Quantity	Length	Kind of Wire	Gross Weight	Net Weight	Outside Dimensions of Cases
500	4 ft.	Copper	23 lbs.	15½ lbs.	22″ x 9½″ x 9½″
500	6 ft.	Copper	29 lbs.	21½ lbs.	22″ x 9½″ x 9½″
500	8 ft.	Copper	36 lbs.	27½ lbs.	22″ x 11½″ x 9½″
500	4 ft.	Iron	25 lbs.	16½ lbs.	22″ x 11½″ x 9½″
500	5 ft.	Iron	27 lbs.	18½ lbs.	22″ x 11½″ x 9½″
500	6 ft.	Iron	32 lbs.	23½ lbs.	22″ x 11½″ x 9½″
500	8 ft.	Iron	39 lbs.	29 lbs.	22″ x 15½″ x 9½″

Cases of ½″ material. For inside dimensions deduct one inch from each dimension.

The method of wiring electric squibs is exactly the same as for other electric detonators. This is described on pages 45 to 51.

Photographic Squibs

The use of electric squibs is highly successful for firing photographic flash powders. By their use any number of flashes may be fired at the same time. The action is positive. For this work the squibs may be fired by means of a blasting machine or an electric lighting circuit. Photographic electric squibs are made with 6-inch copper wires. They are connected up in exactly the same manner as Du Pont Electric Squibs and Electric Blasting Caps.

Connecting Wire

Connecting wire is insulated copper wire (No. 20 Brown & Sharpe gauge). It is put up in 1-pound and 2-pound spools. A 1-pound spool is 3 inches in diameter, 4 inches long and holds

about 210 feet of wire. A 2-pound spool is 3 inches in diameter, 5½ inches long and holds about 420 feet of wire.


Connecting Wire (1-lb. Spool)

Connecting wire is used to join the wires of the electric blasting caps together, when they are not long enough to reach between the adjoining bore holes. The ends of the connecting wire must be scraped bright before connections are made. The joints should not be permitted to lie in water or on wet ground. If this cannot be prevented, the joint should be covered with insulating tape.

No. 21 (Brown & Sharpe gauge) Insulated Copper Wire is also used for connecting wire, but is not recommended because it is considered too small for best results.

A 1-pound spool of No. 21 Connecting Wire holds about 260 feet and a 2-pound spool about 520 feet.

The resistance of No. 20 gauge Insulated Copper Connecting Wire is 10.14 ohms per thousand feet. The resistance of the No. 21 size is 12.78 ohms per thousand feet.

Leading Wire

The wire commonly used for connecting electric blasting caps, other electric detonators and electric squibs to the blasting machine is known as leading wire. It is insulated copper wire (No. 14 Brown & Sharpe gauge) and is furnished in coils of the following lengths and weights:

200 ft.....about 4 lbs.	300 ft.....about 5.8 lbs.
250 ft.....about 5 lbs.	500 ft.....about 9.6 lbs.

The leading wire should always be long enough to keep the blaster well out of the zone of danger.

Duplex leading wire is made by binding together two insulated copper wires with an outside insulation, thus giving a return circuit cable that may be handled the same as a single wire. It weighs approximately twice as much as the same length of single leading wire and can be had in coils of the same lengths.

Duplex wire is more satisfactory for use where the two end holes in a blast are not far apart, as in stump blasting and similar work. Single wire is generally preferred to the Duplex where the end holes are far apart, as in quarry and electric ditch blasting. Single leading wire is frequently used for connecting wire instead of the small gauge connecting wire, especially in large blasts.

ROLL OF LEADING WIRE

SINGLE LEADING WIRE SLIGHTLY REDUCED

DUPLEX LEADING WIRE (ACTUAL SIZE)

Special Leading Wire for Miners

For the use of miners and a few other blasters who fire but from one to three charges in a blast, and then under conditions where it is not necessary to be far from the blast, a special 18-gauge Duplex Leading Wire is furnished on special order in 100 and 150 foot lengths. This wire weighs 1.85 pounds per hundred feet. This leading wire is intended only for the work specified and is not intended for general blasting.

Leading Wire Reels

The leading wire reel is a valuable accessory in enabling the blaster to coil up his leading wire with a minimum of kinking of the wires. It keeps the two wires separate, avoiding the chance of accidental short circuits. The crank is built in the form of a handle for the easy carrying of the leading wire reel. Aside from the convenience, its use will save its price many times over in the course of a few years.

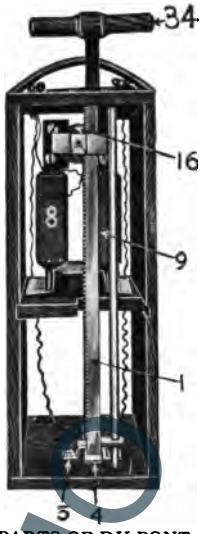
LEADING WIRE REEL

Blasting Machines

Blasting machines are used to generate the current for firing blasts by electricity.

Du Pont Blasting Machines, with the exception of the Pocket Blasting Machine, are small portable dynamos, in which the armature is rotated by the downward thrust of the rack bar, thereby converting muscular energy into electrical energy. They are not magnetos, although they are often erroneously so called.

A magneto has a permanent magnet for a field, whereas the dynamos in the Du Pont Blasting Machines have electro-magnets. They are wound somewhat differently from a dynamo built for delivering a continuous current for power or lighting purposes, in that the current in the Du Pont Blasting Machines is short circuited through the field magnets for the purpose of building up, intensifying and storing the current until the end of the rack bar stroke, when the whole accumulated current is sent out through the firing line.



PARTS OF DU PONT BLASTING MACHINE

The construction of the push-down Du Pont Blasting Machines is shown in the accompanying illustration. 1, Rack bar, showing teeth which engage the pinion on end of armature; 4, the contact spring, which, when struck by the bottom of the descending rack bar, breaks the contact between two small platinum bearings, one on the upper face of the contact spring and the other on the under side of the bridge 5, and in this way throws the entire current through the outside circuit; that is, leading wire, electric blasting caps and connecting wire; 8, 9, field magnets; 16, revolving armature; 34, rack bar handle.

They are rated according to the number of electric blasting caps that they can be depended upon to fire when connected in series. For convenience, the electric blasting cap with 30-foot copper wires is taken as the unit. There are six different sizes, all of which are two-post machines.

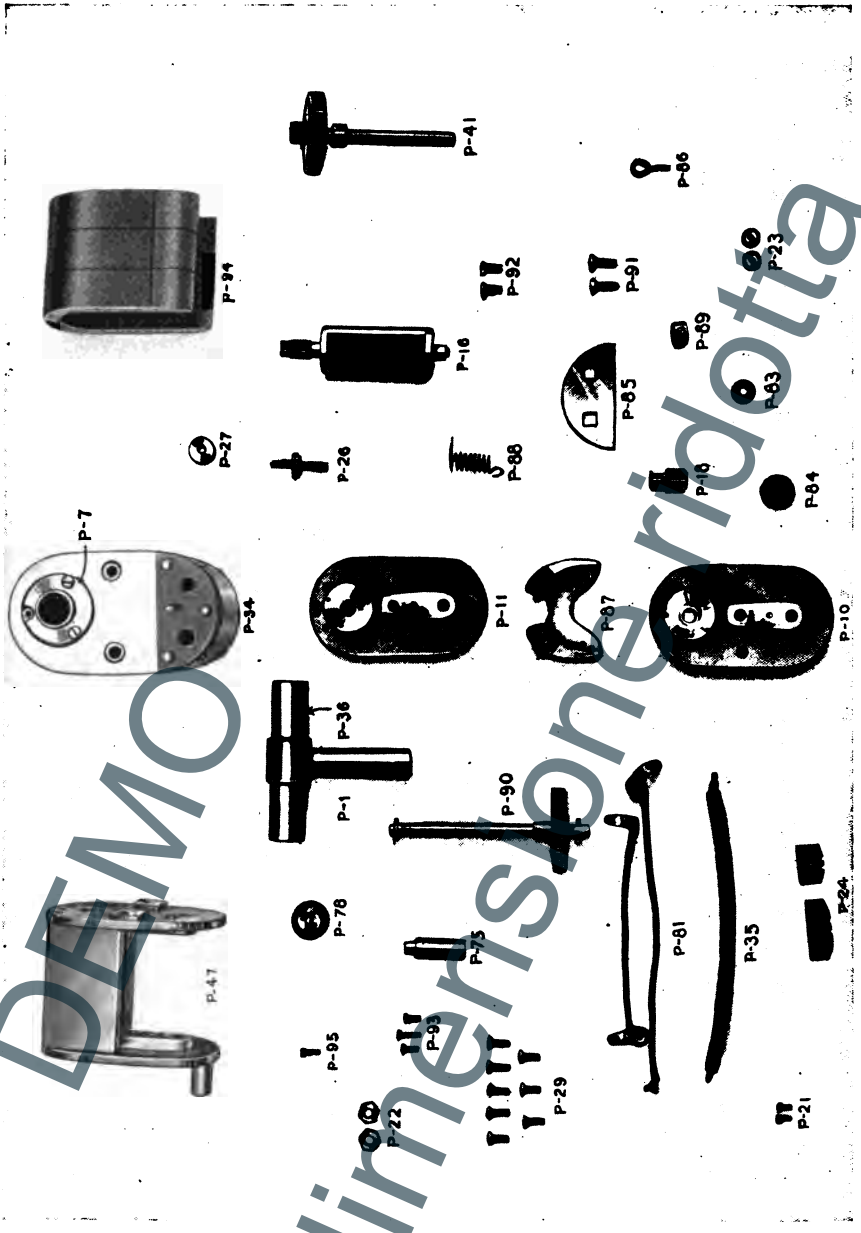
Du Pont Pocket Blasting Machine

The Pocket Blasting Machine is a light-weight machine, having permanent field magnets, especially made for coal mining, where it is not often required to fire more than one charge at a time. It is also serviceable for small jobs, such as stump and boulder blasting. It has a capacity of three electric blasting caps. It weighs 4½ pounds. It is furnished with a removable handle, which prevents its being operated by any other person than the blaster.


Pocket Size

Method of Operating

To operate the Du Pont Pocket Blasting Machine, first remove the carrying handle from the socket and insert the firing handle,



PARTS OF DU PONT POCKET BLASTING MACHINE

to knock the bottom out of the machine. As the rack bar approaches the bottom, it becomes more difficult to operate, because of the "building up" of the current; but the speed of the thrust should not be diminished, because the finish of the operation is more important than the start. Do not be afraid of pushing the rack bar down too hard. The machine is built to stand it, and this is the only way to use it successfully.

OPERATING A DU PONT BLASTING MACHINE

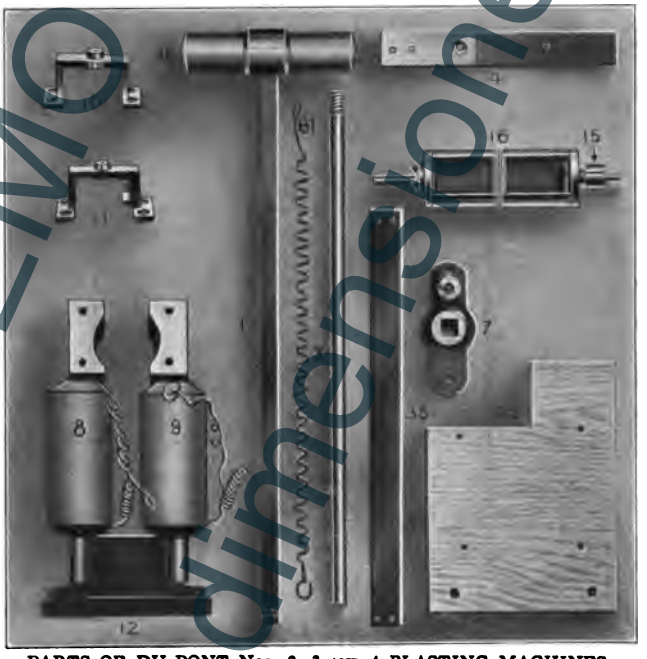
Blasting Machine Parts

The parts of these blasting machines are all standard, and when worn out or broken can be replaced at a small cost. When ordering, give the style and number of the blasting machine in which they are used, as well as the number of the part as shown in illustration on the following pages. Do not return a blasting machine to us to be repaired without first securing proper shipping directions from our nearest branch office.

List of Parts of Du Pont Pocket Blasting Machines

P– 1. Winding Key.
P– 7. Guide Plate for Winding Key. (Should be ordered together with P–34 Brass Case only.)
*P–10. Commutator Bearing. (Should be ordered in pairs with P–87 Gear Shield.)
*P–11. Gear Bearing.
P–16. Armature, complete with Heads and Commutator.
P–18. Armature Pinion.
P–21. Brass Screws (2) for Brushes.
P–22. Hexagon Nuts (2).
P–23. Brush Screw Insulators.
P–24. Brush Insulators.
P–26. Binding Post.
P–27. Thumb Nut for Binding Post.
P–29. Iron Screws (8) for Bearings $\frac{3}{8}'' \times \frac{6}{32}''$.
P–34. Brass Case, complete with P–7 Guide Plate for Winding Key.
P–35. Brass Chain, with Rubber Cover.
P–36. Wooden Handle.
P–41. Ratchet Gear with Clutch, Ball Bearings, Pinion and Shaft.
P–47. Two Pole Pieces with Ends.
P–75. Half Gear Stop.
P–78. Brass Cap for Key-Hole.
P–81. Connecting Wire with Contacts.
P–83. Binding Post Insulators.
P–84. Leather Washer.
P–85. Fibre on Top Plate.
P–86. Hook for Chain.
*P–87. Gear Shield. (Should be ordered together with P–10 Commutator Bearing and P–11 Gear Bearing.)
P–88. Release Spring on Half Gear.
P–89. Brass Collars with Set Screw.
P–90. Half Gear, Shaft, Contact Spring and Copper Bur.
P–91. Screws (Oval Head) 2 for top of case.
P–92. Screws (Flat Head) 2 for bottom of case.
P–93. Brass Screws (Oval Head) for Guide Plate.
P–94. Magnets (3) Esterline.
P–95. Screws (1) for Pinion.

*Parts P-10 Commutator Bearing, P-11 Gear Bearing and P-87 Gear Shield should all three be ordered together so that they may be properly drilled and fitted up.



PARTS OF DU PONT Nos. 2, 3 AND 4 BLASTING MACHINES

Parts of Blasting Machines Nos. 2, 3, 4

(Specify Number of Blasting Machine See Page 30)

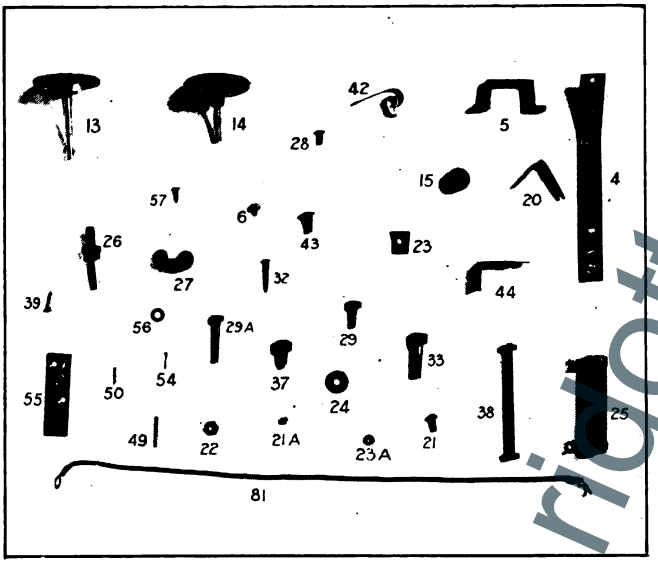
1.	Rack Bar.
2.	Guide Yoke.
3.	Guide Rod.
4.	Contact Spring.
5.	Bridge.
6.	Contact Screw.
7.	Guide Plate.
8 and 9.	Fields, a pair.
8.	Field.
9 and 12.	Field and Base Block.
10 and 11.	Bearings, a pair.
12.	Base Block.
13 and 14.	Armature Heads and Shaft, a pair.
15.	Commutator.
16.	Armature.
17.	Clutch.
18.	Armature Pinion.
19.	Pinion Spring.
20.	Brush.
21.	Brush Screws.
22.	Brass Nut.
23 and 24.	Insulators.
26.	Binding Post.
27.	Wing Nut.
28.	Armature Screws.
29.	Bearing Screw.
30.	Iron Screw for Base Block.
31.	Copper Rivet.
32.	Iron Screw.
33.	Iron Screw with Nut to Bolt No. 12 to No. 45.
34.	Mahogany Case.
35.	Leather Strap.
36.	Wood Handle.
45.	Shelf.
81.	Connecting Wire.

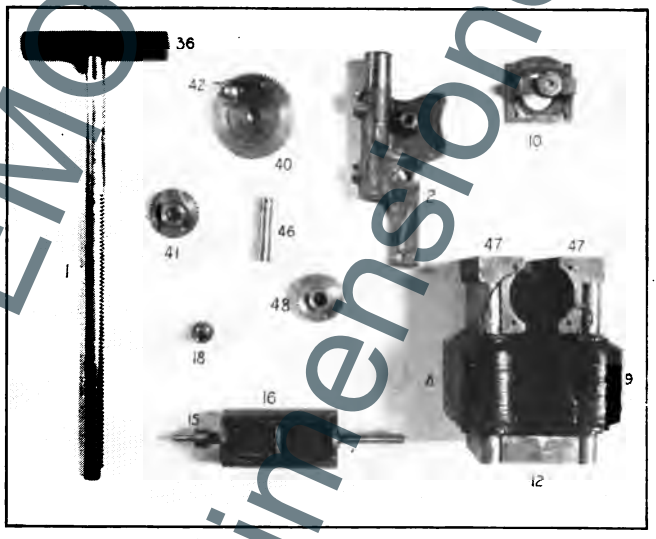
On No. 2 machine parts No. 9 (Field) and No. 13 (Base Block) are cast together and cannot be sold separately.

Parts of Blasting Machine No. 5

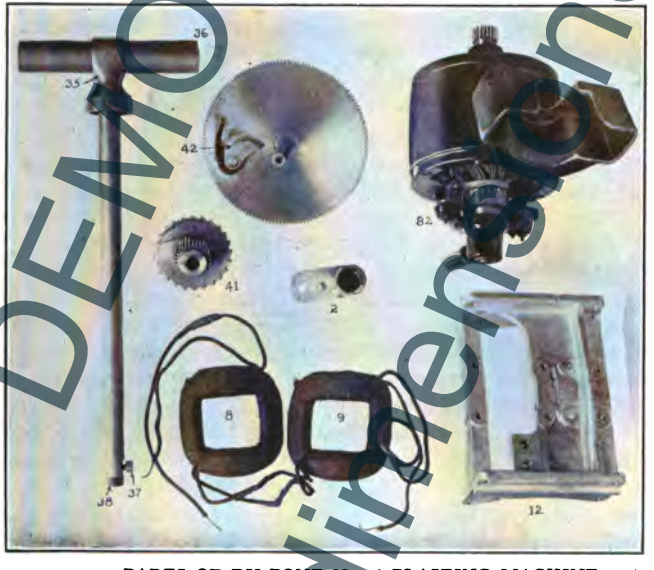
(Specify Number of Blasting Machine See Page 32.)

1.	Rack Bar.
2.	Rack Guide and Rear Bearing.
4.	Contact Spring.
5.	Bridge.
6.	Contact Screw.
8 and 9.	Fields.
10.	Front Bearing.
12.	Base Block.
13.	Armature Rear Head and Shaft.
14.	Armature Front Head and Shaft.
15.	Commutator.
16.	Armature Complete with Commutator.
18.	Armature Pinion.
20.	Brush.
21 and 21a.	Brush Screw.
22.	Brass Nut.
23 and 23a.	Brush Insulators.
24.	Resistance Coil Insulator.
25.	Resistance Unit.
26.	Binding Post.
27.	Wing Nut.
28.	Armature Screw.
29 and 29a.	Rear Bearing Bolts.
33.	Iron Supporting Screw.
34.	Mahogany Case.
35.	Leather Strap.
36.	Wood Handle.
37.	Rack Bar Stop Screw.
38.	Bolt with Nuts for Resistance Unit.
39.	Brass Screw for Resistance Unit Brackets.
40.	Large Gear.
41.	Ratchet Gear.
42.	Pawl and Spring.
43.	Pawl Pin.
44.	Resistance Unit Bracket.
46.	Large Shaft.
47.	Pole Pieces.
48.	Intermediate Pinion.
49.	Pin for Intermediate Pinion or Ratchet Gear.
50.	Pin for Pinion.
54.	Pin for Pawl Spring.
55.	Contact Plate.
56.	Brass Washers.
57.	Screw for Contact Plate.
81.	Connecting Wire.





PARTS OF DU PONT No. 5 BLASTING MACHINE



PARTS OF DU PONT No. 6 BLASTING MACHINE

DU PONT GALVANOMETER WITH CARRYING CASE AND STRAP

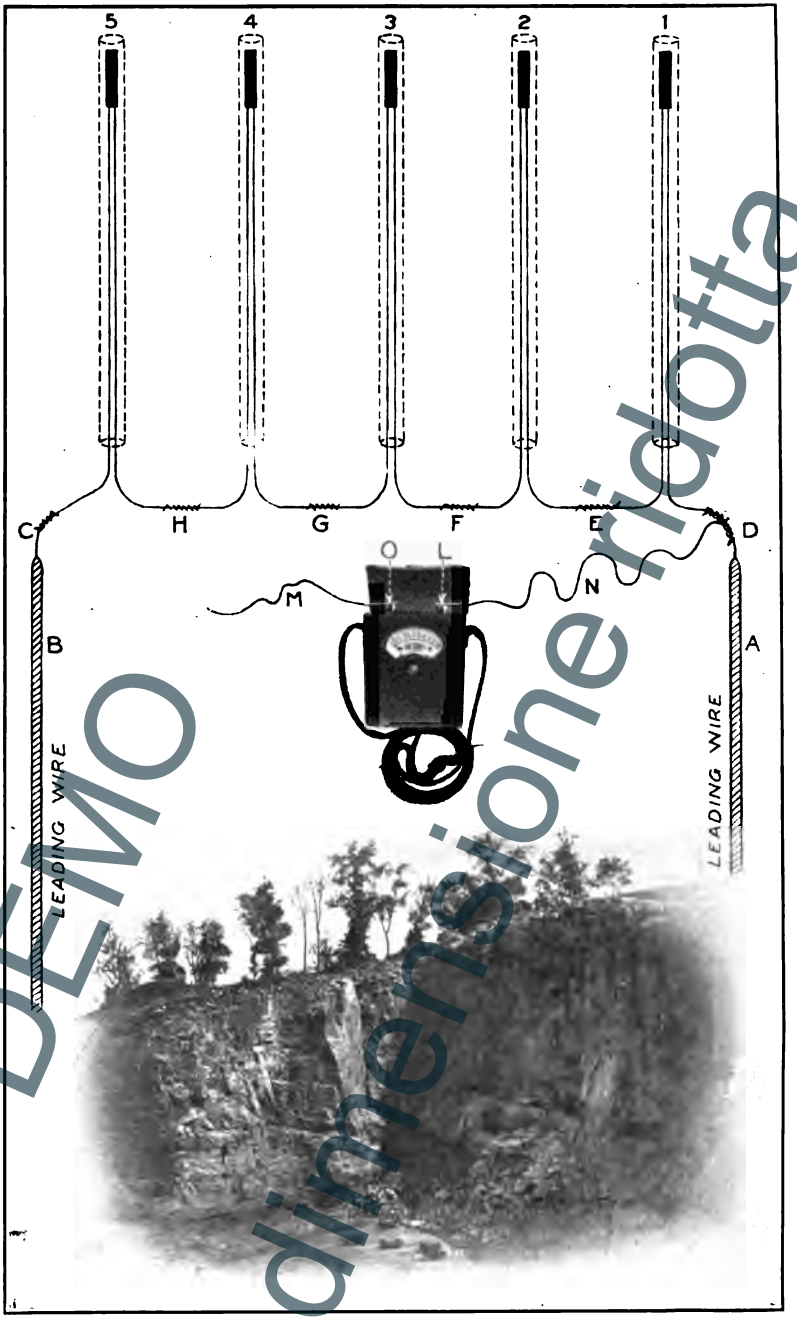


DIAGRAM SHOWING METHOD OF LOCATING A BREAK WITH A DU PONT GALVANOMETER

leading wire M, touch the other contact post of the galvanometer to the joint C. If the galvanometer now shows circuit while it did not when the test was made from the other end of the leading wires, the break is in the leading wires and they must be repaired. If it does not show circuit, find the break in the electric blasting cap or connecting wire by holding the end of wire N to contact post L and touching the other contact post (or the short piece of wire M touching the contact post on the galvanometer) to each of the bare joints E, F, G, and H in succession. As long as you are "inside" the break, these contacts will cause the needle to be deflected. As soon as you get beyond the break or point of high resistance, you get either a very slight deflection or none at all. In this way the trouble can be quickly traced to the break or bad joint. For instance, if a wire in bore hole No. 3 is broken, you get a deflection when M is touched to F, but none on touching G; this shows that the break is between F and G. The break can then be easily repaired if above the tamping.

If below the tamping and there are two electric detonators in the hole, the broken one can be left out of the wiring and the hole fired by the good one.

If there is but one electric blasting cap in the hole and its wires are broken off below the tamping, the hole must be handled as a misfired shot.

Testing Single Electric Blasting Caps.—Single electric blasting caps can be tested, both before and after putting them in the bore hole, simply by touching the ends of the electric blasting cap wires to the two contact posts.

It is an excellent practice to test all electric blasting caps after finishing the loading, but before tamping the hole, as well as while tamping if the tamping is several feet deep.

Resistance Table

The following table gives the resistance of Du Pont electrical firing devices.

These include Electric Blasting Caps, Electric Squibs, Delay Electric Blasting Caps and Delay Electric Igniters, with both copper and iron wires, and Waterproof and Submarine Electric Blasting Caps, with copper wires. Note that the Submarine and Waterproof Electric Blasting Cap wires are No. 22 gauge up to 18 ft. lengths, inclusive. In lengths of 20 ft. and over, the wires are No. 20 gauge.

Copper wires, which are enameled, have the same resistance as plain copper wires but have much better insulation.

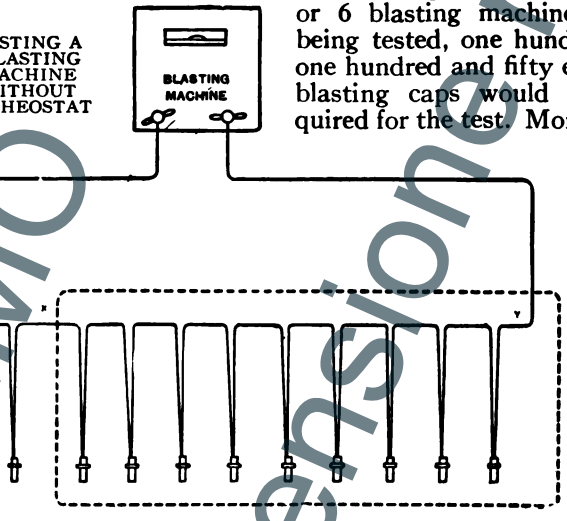
Rheostat

The Du Pont Rheostat is a simple little instrument used for testing the efficiency of blasting machines in an economical and positive manner.

Dimensions, ¾" x 1¾" x 4 11/16"
Weight, 5 oz.

One way to test, for example, a No. 2 blasting machine, which has a capacity of ten electric blasting caps, is to connect ten electric blasting caps in series and then to the blasting machine and operate the machine. If all the electric blasting caps fired, the machine would be working up to its rated capacity; if the electric blasting caps did not fire, the machine would not be up to standard. The results obtained would be absolutely accurate. The objection to this method is that it consumes so many electric blasting caps, thus causing needless expense. If a No. 5 or 6 blasting machine were being tested, one hundred or one hundred and fifty electric blasting caps would be required for the test. Moreover,

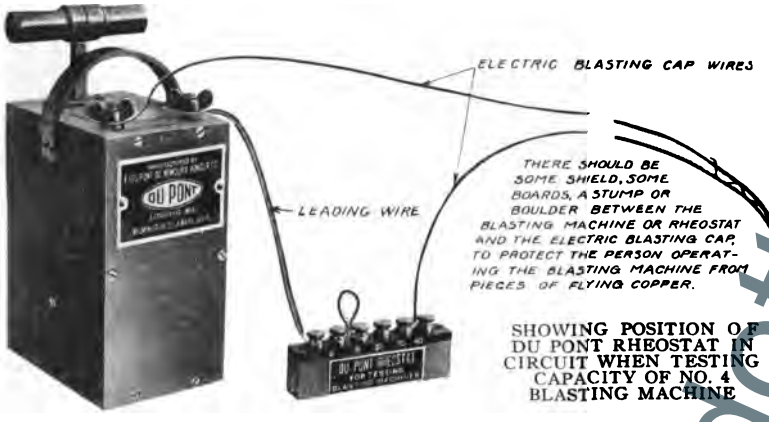
TESTING A BLASTING MACHINE WITHOUT A RHEOSTAT



the firing of so many electric blasting caps in the open would be dangerous.

To obviate this expense, the Du Pont Rheostat is substituted for all but one of the electric blasting caps, as is indicated in the following diagram.

When such a series connection is made and the blasting ma-



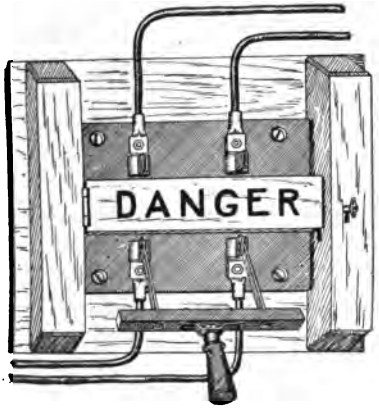
SHOWING POSITION OF DU PONT RHEOSTAT IN CIRCUIT WHEN TESTING CAPACITY OF NO. 4 BLASTING MACHINE

chine operated, the single electric blasting cap either fires or does not fire, and indicates whether or not the blasting machine is up to capacity.

The internal construction of the Rheostat is shown diagrammatically on page 44. It is an arrangement of coils of high resistance wire of a certain length, with the binding posts 1 and 6 attached to its ends, and the binding posts 2, 3, 4 and 5 attached to it at intermediate points. The entire length of the resistance wire in the Rheostat has a resistance sufficient to represent a test of one hundred 30-foot electric blasting caps, with the leading wire, connecting wire and all connections in the blasting circuit.

It will be noted that the binding posts, 1, 2, 3, 4, 5 and 6 are not attached to the resistance wire at equal distances. The purpose of this is to afford different resistances between different binding posts, each representing a test of a certain number of electric blasting caps. If wires X and Y are attached to binding posts 1 and 2, the test represents a test of five electric blasting caps; if to posts 2 and 3, of ten electric blasting caps; to posts 3 and 4, of twenty electric blasting caps; or to posts 4 and 5, of twenty-five electric blasting caps. But the wires X and Y need not be attached to adjoining posts. If, for instance, they are attached to posts 1 and 4, the test represents the sum of the intervening numbers, five, ten and twenty, or a total of thirty-five electric blasting caps.

As shown by the numbers stamped upon the hard rubber between the binding posts, a large number of tests, representing from five up to one hundred electric blasting caps, can be easily made.



SAFETY FIRING SWITCH FOR POWER CIRCUITS

Safety Firing Switch

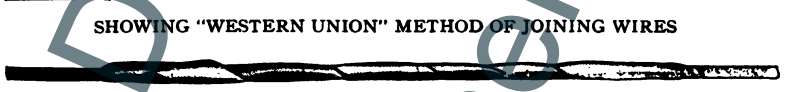
The illustration shows a very simple and effective way to prevent the premature closing of a circuit used to supply current for electrical detonation of explosives. With the key in the hands of the shotfirer he is the only one able to close the circuit until he is prepared to "set off" the shots.

Making and Protecting Wire Connections

The wiring or connecting of an electric blast must be well and correctly done to insure success. The work of wiring may be divided into three parts: connecting the detonator or squib wires together either directly or by means of connecting wire; connecting the proper detonator wires to the leading wire; and connecting the leading wire to the blasting machine.

Connecting Detonator Wires.—Connections between detonator wires or between detonator wires and connecting wires must all be well made. First scrape the bare ends of the wires with a knife blade, and then join them with a long twist (generally known as "Western Union Twist") such as is shown in the accompanying sketch. Such a twist should be tightly made to

SHOWING "WESTERN UNION" METHOD OF JOINING WIRES



CORRECTLY TWISTED WIRES COVERED WITH TAPING

keep the resistance in the joint down to a minimum. If there is no bare end to the connecting wire, skin off about two inches of the insulation. A later paragraph will give detailed information about protecting these bare joints.

Never, under any circumstances, loop wires together as is shown as the wrong way.

Twenty-four holes with two electric blasting caps in each hole—48 electric blasting caps in all—connected in series. The blast should be fired with a No. 4 or a No. 5 Du Pont Blasting Machine, or with a power or lighting circuit of 110 volts and 1½ amperes.

LOOPED WIRES—THE WRONG WAY

Connecting Detonator Wire to Leading Wire.—In making connections between detonator wires and leading wires the same precautions must be observed with regard to cleaning the ends of the wires. Wrap the detonator or connecting wires tightly around the end of the leading wire about one inch from the end.

AN EXCELLENT METHOD OF CONNECTING AN ELECTRIC BLASTING CAP WIRE TO A LEADING WIRE

Then bend the end of leading wire back sharply and take a turn or two of the detonator wire around the loop. This last loop is simply to make a stronger connection to withstand any accidental pull on the leading wire that might tear the connection loose.

Connecting the Leading Wire to Blasting Machine.—The connection of the leading wire to the blasting machine is made by loosening the wing nuts on the two binding posts, inserting the ends of leading wire into the small holes in the binding posts and tightening the wing nuts down on the wires.

Protecting Bare Joints.—The naked joints in the wires of a blasting circuit must always be protected against short circuiting, especially through water. This is done in several ways. When connections lie on moist ground they may be held up by supporting them on stones, blocks or sticks so that only the insulated parts of the wires touch the ground and supports; or the joints may be insulated with tape. While not generally needed where the joints can be held off the ground, the taping of joints is strongly recommended where the joints are covered by tamping, where they cannot be held out of the water on props, and where blasting must be done in a rainstorm. It is very desirable to tape the joints of leading wire.

Blasting with Cap and Fuse

Blasting Caps

Blasting caps are the detonators used for firing high explosives when electric blasting is not practiced. They must always be used with safety fuse, and are in no way interchangeable with electric blasting caps. Using blasting caps and fuse, it is not possible to fire a number of blasts simultaneously. Such blasting must be done with electric blasting caps or other electric firing agents.

METAL BOX CONTAINING 100 No. 6 DU PONT BLASTING CAPS.

Blasting caps are small drawn copper cylinders, closed at one end and loaded with a small charge of a very sensitive and violent explosive that is exploded by the spit of sparks from safety fuse.

Dimensions of Du Pont Blasting Caps

	No. 6	No. 8
Outside Color of Box	Red	Green
Length of Copper Shell	1½"	2 1/32"
Outside Diameter of Copper Shell	.234"	.24"

NOTE.—The *inside* diameter of both the No. 6 and the No. 8 Du Pont Blasting Cap is .2205"

Du Pont Blasting Caps are manufactured in the No. 6 and No. 8 sizes and are exactly the same strength as the corresponding designations of Electric Blasting Caps.

A No. 7 Blasting Cap is intermediate in strength between Nos. 6 and 8, but as one of these two numbers is adaptable to all general classes of blasting, the No. 7 strength is not recommended and is furnished only on special factory order.

All blasting caps are packed in tin boxes, each containing 100. Ten boxes are in turn packed in cartons and the cartons, with sawdust, in wooden shipping cases.

No. 6 DU PONT BLASTING CAP

No. 8 DU PONT BLASTING CAP

Packages of Du Pont Blasting Caps for Domestic Shipment

Gross Weight of Packages

No. 6 Blasting Caps

No. of Case	Quantity per Case	In Oblong Boxes	In Round Boxes
0	500	5½ pounds	6 pounds
1	1,000	10½ "	11½ "
2	2,000	18½ "	17 "
3	3,000	29 "	30 "
5	5,000	40½ "	43 "

No. 8 Blasting Caps

0	500	11 pounds	11 pounds
1	1,000	15½ "	16 "
2	2,000	24 "	24 "
3	3,000	44 "	45 "
5	5,000	62 "	65½ "

It will be seen that with the exception of case No. 0 the number of the case indicates the number of thousands of blasting caps in the case. As no cases contain 4,000 caps, there is no No. 4 case.

All cases are well made of sound lumber. Cases for export trade are tin lined to give the blasting cap additional protection. They weigh slightly more than those for domestic shipments.

CARTON OF BLASTING CAPS

Blasting caps should be stored in a dry place. When conveying them to the work where they are to be used no moisture whatever should be permitted to get into the charge which they contain, as this charge is very quickly affected by dampness, and will absorb moisture and deteriorate. Storage in damp places, such as open sheds or tool boxes in mines, is likely to affect the charge in blasting caps, and may weaken them to such an extent that they will not properly detonate high explosives.

The methods of attaching the blasting cap to the fuse, and of priming high explosive cartridges with the blasting cap and fuse, are described in other portions of this catalogue.

Du Pont Blasting Caps are manufactured with the same care and undergo the same rigid inspections as do all other Du Pont products. When properly used, they can be depended on to do the work for which they are intended.

In each box of blasting caps there is a small card known as the "follow-up" card or inspector's ticket. In case trouble is experienced with the blasting caps this ticket, with any unused blasting caps, should be preserved in order to facilitate investigation.

CASE OF BLASTING CAPS

Safety Fuse

Safety fuse is the medium of bringing sparks to fire blasting caps or to ignite a charge of blasting powder. It is made up of a thin train of powder tightly compressed in, and more or less waterproofed by inner and outer wrappings or coverings.

Storage and Handling of Fuse

Safety fuse cannot be kept in good condition unless stored in a *cool, dry* place. If stored in a hot place, the heat is likely to melt the waterproofing material, causing it to penetrate to the powder core or making the fuse too soft; or the heat may dry out the fuse so that it will break when unrolled. If stored in a damp place, the powder in the fuse soon absorbs moisture and fails to burn properly.

When handling safety fuse, do not twist or "kink" it. Always cut off at least two inches of the end of the coil and insert the fresh cut end of the fuse in the blasting cap, because the powder in the end becomes damp and ineffective very quickly. It is also likely to spill out of the cut end after the fuse has been handled a little. In either case a misfire might occur.

DOUBLE ROLL OF SAFETY FUSE WITH PAPER WRAPPING REMOVED

Always cut the end of the safety fuse which is to be inserted in the blasting cap squarely across and not diagonally, as the point made by a diagonal cut may be bent forward when the safety fuse is pushed into the blasting cap, and in this way prevent the spark from shooting into the blasting cap charge.

Always press the end of the safety fuse gently against the charge in the blasting cap before crimping the blasting cap. All safety fuse, except Cotton and Hemp, is made to fit as snugly as possible into the blasting cap in order to prevent water or moisture from entering. If the safety fuse is found at any time to be a little too large to enter the blasting cap, do not attempt to cut off any of the tape or yarn, but squeeze or roll the end between the thumb and finger until it is small enough.

It occasionally happens that when subjected to summer heat the waterproofing of some kinds of fuse will absorb the white material put on the outside, causing it to appear black or of a dingy yellow color. This unfavorable appearance does not necessarily indicate that the fuse is damaged. It is probably perfectly good, but it should be tested, and this will readily determine its condition.

If fuse is stored too long, it may be dry and hard, or the powder may be impaired by age. Gutta-percha fuse is most likely to deteriorate from age because the gutta-percha becomes oxidized by contact with air.

In tape fuse, places may be found where the diameter is slightly enlarged for about an inch in length. This is caused by the over-

lapping of the ends of the tape where two pieces are sewed together. It does not indicate any defect in the fuse.

Cap Crimpers

When using blasting caps and safety fuse, it is essential that the blasting caps be securely fastened or crimped to the fuse. If the joining is not firm, there is danger that the fuse will be pulled out when the primed cartridges are loaded and the bore holes tamped. An imperfect joining makes the waterproofing of the cap difficult. The most satisfactory crimp can be made by using a cap crimper,—an instrument designed for the purpose.

No. 1 DU PONT CAP CRIMPER

The Du Pont Cap Crimpers make a flat sleeve crimp which holds the cap securely on the fuse and makes waterproofing possible with but a small amount of waterproofing material.

Du Pont Cap Crimpers are made in two types, No. 1 and No. 2.

No. 1 Cap Crimper is made of blued steel. It is 5½ inches long and is made with the sleeve type of crimping jaws, having one handle pointed for use as a punch in priming dynamite cartridges.

No. 2 Cap Crimper is made of steel, nickel plated. It is 7 inches long. In addition to the crimper, it is provided with a most effective fuse cutting device, so designed as to prevent accidental cutting of blasting caps. One handle is pointed for use as a punch and the other has a screwdriver point.


NO. 2 DU PONT CAP CRIMPER

Both of these crimpers are so made that they cannot squeeze the copper shell far enough into the fuse to interfere with the burning of the powder train and cause misfires. They are well made of good material and, if used only for the purposes intended, will give good service for a long time.

BLASTING CAP CRIMPED TO FUSE

Du Pont Cap Sealing Compound

Du Pont Cap Sealing Compound is a material for sealing water-tight the space between the shell of a blasting cap and the fuse which is inserted into the blasting cap.

However well the cap may be fastened to the fuse by the crimper, it is almost impossible to make a joint that will prevent water from leaking in and spoiling the cap. The cap is especially liable to damage from water when "countered" fuse is used, because the uneven surface of such fuse formed by the spirally wound cords leaves small air spaces between the fuse and the shell through which water may leak down into the cap. Therefore, whenever the cap is to come in contact with water, it should be made waterproof by sealing with Du Pont Cap Sealing Compound.

DU PONT CAP SEALING COMPOUND

After the blasting cap is crimped on the fuse, the cap with two or three inches of the fuse is dipped for a few seconds into the cap sealing compound and hung up to dry. It is not necessary to soak the cap in the compound. By the time the compound has dried for about thirty minutes, a water-tight joint is formed which will resist almost any amount of water commonly encountered in blasting with cap and fuse. The cap should be used soon after it is dry, as the Cap Sealing Compound becomes brittle after a few days and is liable to crack and admit water.

Du Pont Cap Sealing Compound is put up in half-pint, pint, quart and gallon cans.

CAP SEALING COMPOUND APPLIED TO CRIMP

Making Primers

A high explosive cartridge containing an electric blasting cap or other detonator is called a primer.

Primers must be properly made to insure the complete detonation of the explosive; to keep the detonator from pulling out of the explosive; to guard against moisture; to permit easy and safe loading of bore holes; to keep the safety fuse, when blasting caps and safety fuses are used, from pulling out of the blasting cap.

Priming a Cartridge with Blasting Cap and Safety Fuse

In making a primer with blasting cap and fuse, cut off a sufficient length of fuse to reach from the charge of explosives loaded in the bore hole to three or four inches above the collar or top of the bore hole. In all classes of blasting, the length of the fuse must be governed by the time required for the blaster to reach a safe place after lighting the fuse.

After removing the cover of the blasting cap box, allow a single blasting cap to slide gently into the hand. Never try to pick a blasting cap out of the box with a wire, knife blade, stick, or other hard substance. See that no foreign matter, such as dirt or grit, is in the open end of the blasting cap; if there is any, shake it out gently. If the end of the fuse is flattened, roll it between the thumb and finger to round it out again and slip the blasting cap gently over the end of the fuse so that the fuse reaches down to the explosive charge in the blasting cap.

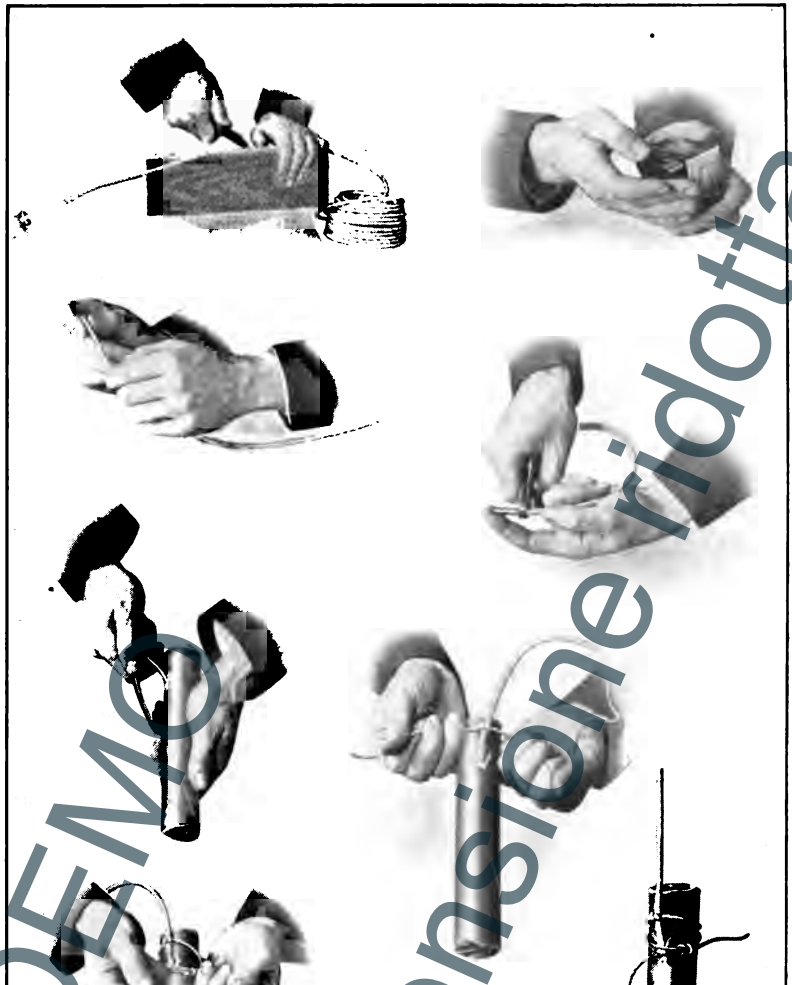
Do not twist the fuse into the blasting cap, and do not use violence or force when handling the blasting caps or when making primers.

When the blasting cap is placed on the fuse, fasten it securely in place with a Du Pont Cap Crimper. The crimp must be made close to the open end of the blasting cap as shown on page 62. To make the crimp further down would in all probability cause a premature explosion and seriously injure the blaster.

When the primer is to be used under water, the union between the blasting cap and the fuse should be protected against moisture by a coating of Du Pont Cap Sealing Compound or other suitable material.

Priming in the Side of Cartridges.—To prime a cartridge in the side the blasting cap and fuse are handled as has just been described. The hole is begun about an inch or an inch and a half from one end of the cartridge, and should point in and toward the other end, so that when the blasting cap is inserted it will be as nearly parallel as possible to the sides of the cartridge. *It should never be punched straight through the cartridge,* as such a hole would not place the blasting cap in the proper position for detonating the explosive. A blasting cap placed in such a hole would be easily displaced or injured in loading. The correct location and angle of such a hole are indicated page on 62. The hole should be deep enough to receive the entire copper shell of the blasting cap.

The blasting cap with fuse attached is slipped into the hole and securely fastened by means of a cord tied around both the fuse and cartridge, as is illustrated on page 62.

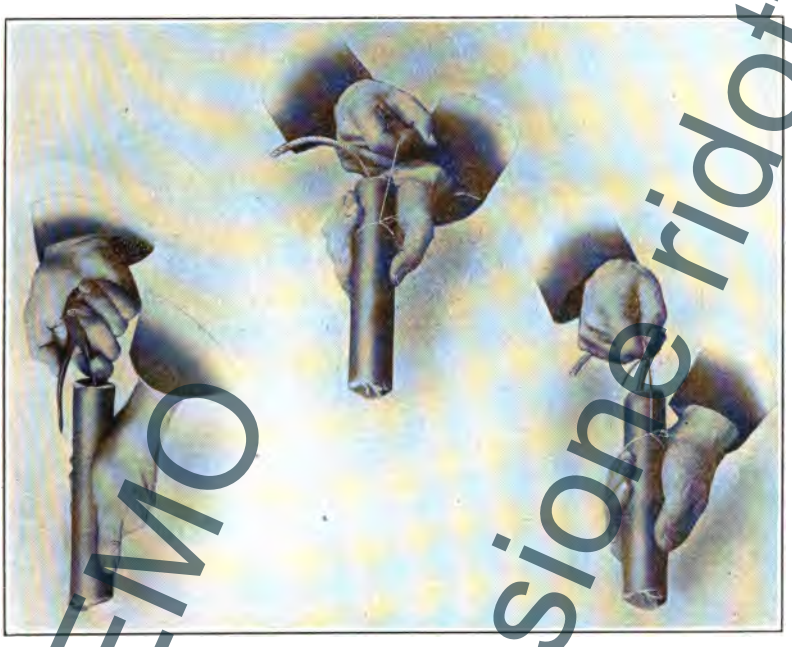


MAKING UP A PRIMER WITH A BLASTING CAP AND SAFETY FUSE

This method of priming in the side has the advantage of leaving more space for placing the tamping stick on the primer, but it cannot be used in such small holes as can the end primers on account of the fuse lying alongside the cartridge and thereby increasing the total diameter. This method does not place the blasting cap in quite so good a position as priming in the end.

Such a primer is waterproofed by covering the joint between the fuse and paper shell with a waterproofing material.

Priming in the Ends of Cartridges.—There are two good methods of priming cartridges in the end.



PRIMING IN END OF CARTRIDGE

(*a*) With the handle of the cap crimper or a wooden awl, punch a hole straight into the end of the cartridge to a sufficient depth to receive all of the copper shell of the blasting cap and fasten it there by means of a cord tied first around the cartridge and then around the fuse, as is shown above. This is an easily made and highly satisfactory primer.

To waterproof such a primer, close the hole where the fuse enters the cartridge with suitable sealing materials.

(*b*) The other method is to unfold the paper from the end of the cartridge and punch a hole directly into the center of the exposed dynamite, close the loose part of the paper shell around

the fuse, and tie it tightly. The process of waterproofing is the same as stated in the preceding paragraph.

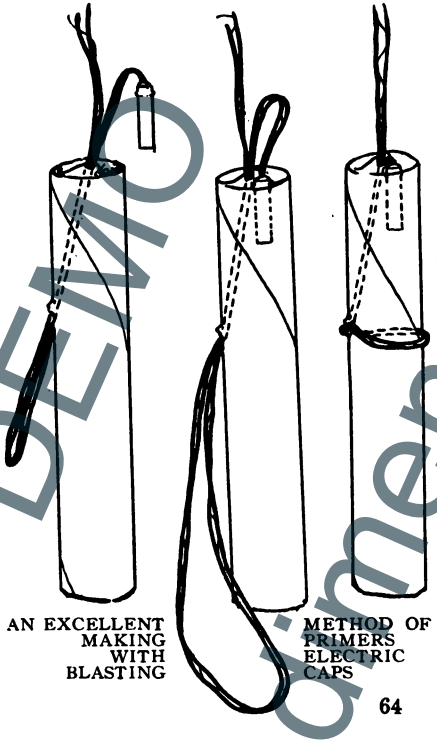
Priming in the end has the advantage of placing the blasting cap or other detonator in the best possible position for detonating the explosives used; but it sometimes has the disadvantage, especially when the bore holes are small, of bending the fuse too sharply and causing it to be scraped or torn, and also of not leaving sufficient room to place the tamping stick on the primer to slip the latter into place in the bore hole.

There are a number of other methods of making primers, but the three methods described are the only ones that have proved to be safe and reliable.

Fuse should never be laced through cartridges of high explosives, as the powder inside of the fuse may burn through the covering or "side spit" and ignite the dynamite before the cap explodes. This materially reduces the force of the blast.

Priming with Electric Blasting Caps

Primers can be made with electric blasting caps or other electric detonators by any of the methods described for the use of blasting cap and fuse. The waterproofing is done in exactly the same way.



AN EXCELLENT METHOD OF MAKING PRIMERS WITH ELECTRIC BLASTING CAPS

Many blasters, however, prefer to use a slightly quicker method, which has been found entirely satisfactory. Punch a hole from the center of the end of the cartridge in a slanting direction so that it will come out at the side two or three inches from the end, insert the end of the doubled over wires of the electric blasting cap, loop these around the cartridge, and punch another hole in the top a little to one side of the first and straight down. Insert the capsule in this last hole as far as possible and take up the slack on the wires. You then have a primer in which the wires do not cross each other at any point and the capsule is lying nearly along the center line of the cartridge,

a primer which hangs vertically, so that it is possible to load it in the bore hole without its lodging against the sides.

The wires of electric blasting caps should never be fastened around high explosive cartridges by half-hitching them, as a strong pull might either break the wires or cut the insulation.

Priming with Other Du Pont Electric Detonators

Primers with other electric detonators, such as delay electric blasting caps, submarine electric blasting caps and waterproof electric blasting caps, are made exactly as are primers with electric blasting caps, with the single difference that deeper holes in the explosive cartridge are required to receive the detonators.

Priming with Du Pont Delay Electric Igniters

When delay electric igniters are used to detonate high explosives a blasting cap is crimped on the end of the fuse, and the priming then done as with blasting cap and safety fuse.

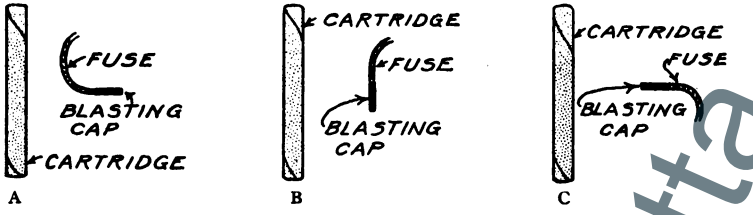
Operation of Detonators

The force of all explosives is exerted equally in all directions, but blasting caps, electric blasting caps and all other Du Pont detonators have copper shells so constructed that the shock from the explosion is greater from the closed end than from the sides. This is the end away from the fuse or wires. This closed end is frequently referred to as the "business end". It should not be understood that all of the shock from an exploding detonator goes out from the end, for such is not the case. There is shock in all directions, but the greatest shock is from the end. This is indicated by the arrow in the following sketch.

ARROWS INDICATE THE DIRECTION OF GREATEST SHOCK FROM A DETONATOR, THIS BEING IN LINE WITH THE LARGE ARROW.

The purpose of detonators is to give off shock and heat to charges of high explosives to cause detonation. The greater the shock, the stronger the detonation and the better the work that is done by the explosive. For this reason it is desirable to have the detonators point directly toward the explosive charge. A better understanding of this may be had by referring to the accompanying figures. A shows a detonator pointing directly away from a cartridge of high explosives. Using an insensitive dynamite, the explosion of the blasting cap would not detonate the explosive. B-shows a blasting cap the same distance from a

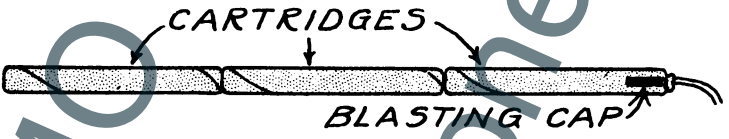
cartridge of high explosives, but pointing parallel to the cartridge. Using the same insensitive dynamite, if this cap caused any detonation at all, it would be incomplete and weak.



C shows the same insensitive dynamite and the blasting cap the same distance away as before, but pointing directly toward the dynamite. In this position the detonation of the dynamite should be complete.

These positions of blasting cap and dynamite are purely demonstration examples, and should never be attempted in actual work. However, they illustrate just how a blasting cap or other detonator should point.

A detonator should point, as nearly as possible, directly toward the main portion of the charge of explosives.



SHOWING HOW BLASTING CAP SHOULD POINT WHEN BORE HOLE IS LOADED WITH SEVERAL CARTRIDGES

Were the single blasting cap pointed diagonally across the cartridge primer, as shown below, the shock to, and effect on, the cartridges in the other end of the bore hole would be much less.

PLACING BLASTING CAP DIAGONALLY LESSENS EFFECTIVENESS OF DETONATOR

Additional Blasting Accessories

Thawing Kettles

Many high explosives containing nitroglycerin chill or freeze and become insensitive in cold weather. When frozen, dynamite is difficult to detonate or it may burn instead of explode. Burning dynamite gives off fumes so poisonous that men have been killed by them. Dynamite when chilled or frozen cannot develop its full strength in a blast. Some provision, therefore, must be made for thawing it and for *keeping it thawed* until it is loaded into the bore hole.

On work where these explosives are used in large quantities, thawing houses are necessary; but even then the thawing kettle should be employed to take the explosives from the thawing house to the place where they are to be used, to prevent them from becoming chilled or frozen again.

DU PONT THAWING KETTLE

If not more than two or three hundred pounds of explosives are used at one time, three or four large thawing kettles are all that are necessary, as they will thoroughly thaw that quantity of frozen dynamite in a few hours.

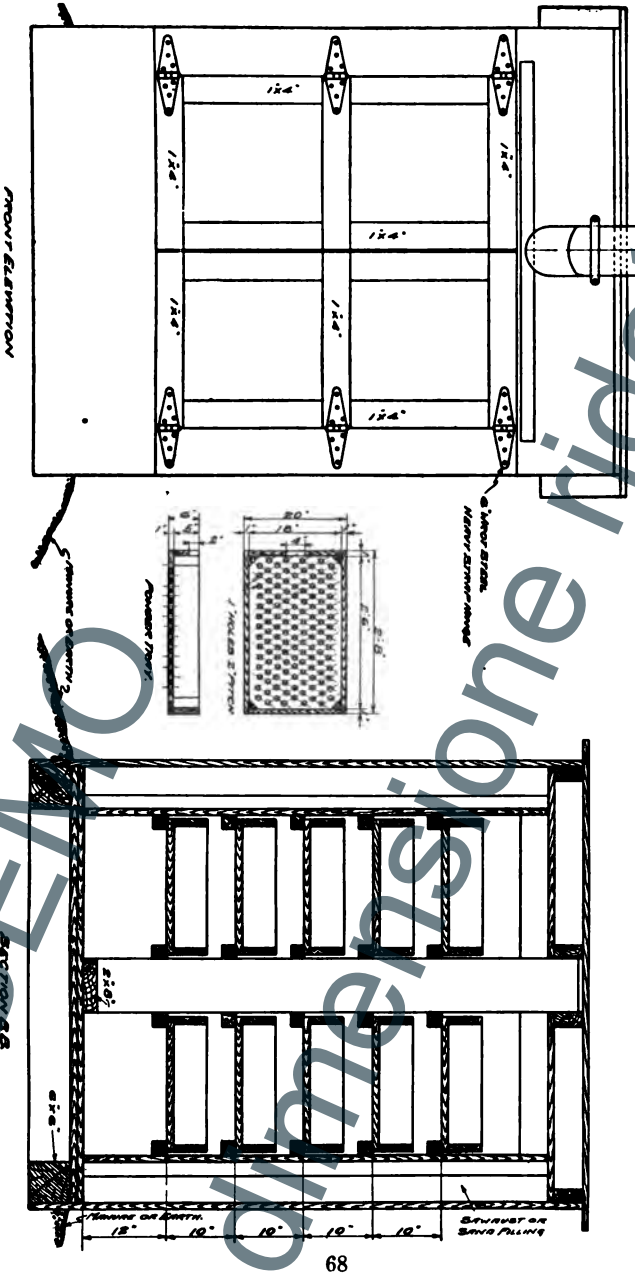
Du Pont Thawing Kettles are all made in one piece with a watertight compartment for the explosives, which is surrounded by the receptacle for the hot water used to furnish the heat for thawing. This hot water must not come in contact with the dynamite.

While Du Pont Thawing Kettles will retain their heat and keep the explosive thawed for a considerable time, depending, of course, on the nature of the weather, this effective period can be increased to about five times as long if the warm kettle is kept in a barrel or box with dry hay surrounding it. This hay can be held in place by a cylinder of wire screen, so that the thawing kettle can easily be removed and replaced. If the barrel be mounted on two wheels with a tongue attachment, the dynamite can be readily drawn from point to point about the outside work without being exposed to the cold air until it is to be loaded in the bore hole. The explosive may also be kept thawed by wrapping old blankets or sacks around the warm kettle.

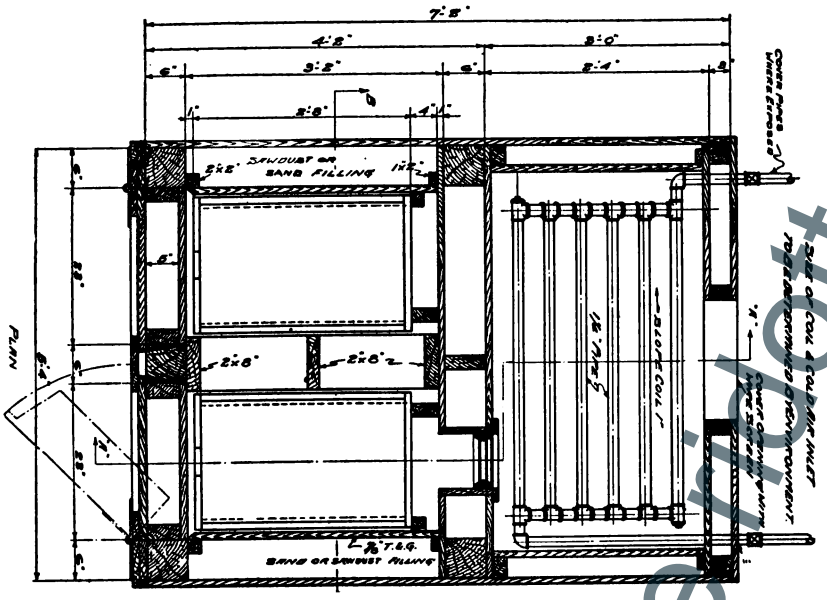
Under no circumstances must the water be heated in thawing kettles, even though the explosives be first removed, because nitroglycerin exudes readily from warm dynamite, and enough of it is likely to be found in the bottom of the explosives compartment of a thawing kettle that has been in use for some time to cause a serious accident if the thawing kettle should be placed

Dynamite Thawing House Heated by Hot Water

Plans and Specifications for This and Other Thawing Houses Furnished on Application



Dynamite Thawing House Heated by Hot Water



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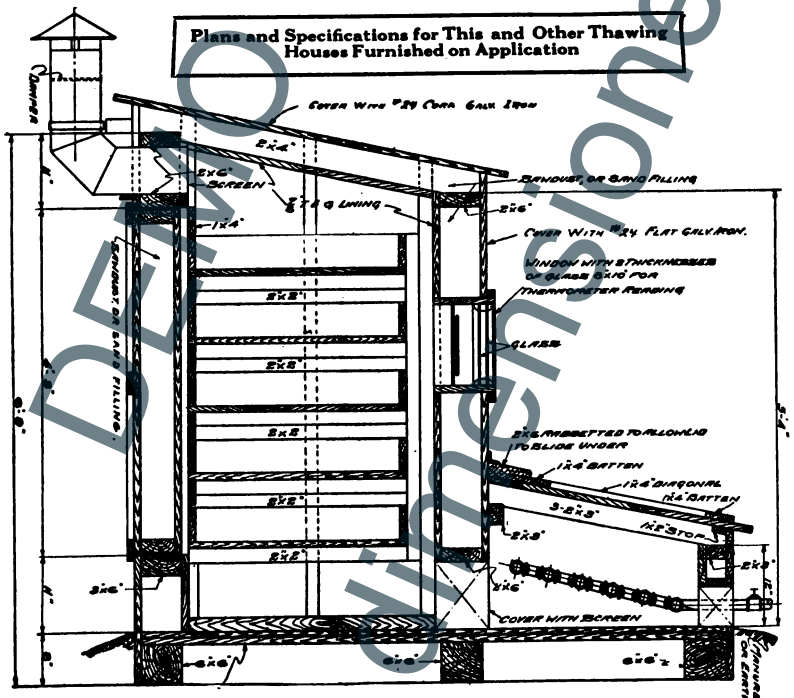


over a fire. It is necessary to heat the water in something else before filling the water jacket. *The hot water must always be tested before filling the dynamite compartment. If it is hot enough to burn the hand, do not put the explosives into the thawing kettle.* Never fill the water jacket unless the explosives compartment is empty. See that the explosives compartment is perfectly dry before it is filled.

Thawing kettles should be kept clean at all times. Should any of the explosive compounds leak out, the explosives compartment should be thoroughly cleaned with a solution of sal soda.

The use of thawing kettles can, to a large extent, be done away with by using low-freezing explosives such as Red Cross Extra Dynamite and Red Cross Gelatin. Arctic Powder does not freeze and never requires thawing.

Capacities and Dimensions of Thawing Kettles

	Capacity	Weight Empty	Weight of Water	Total Weight Filled	Outside Dimensions
Du Pont No. 1.	30 lbs.	12½ lbs.	40 lbs.	82½ lbs.	14″ x 14½″
Du Pont No. 2.	60 lbs.	17½ lbs.	77½ lbs.	155 lbs.	17½″ x 21″

TAMPING BAG (Empty) TAMPING BAG (Full)

Tamping Bags

Tamping bags made of heavy paper are used in many places as containers for sand, clay or loam used for tamping. They save time and trouble when loading bore holes, particularly those pointing upward.

Tamping bags are a great convenience to miners, and their use often saves many times their cost in economy of explosives.

They are also employed as containers for blasting powder when the miner or blaster desires to make up the charge in cartridge form, as is generally the custom when it is used in mines, in open work that is damp, and in holes pointing upward.

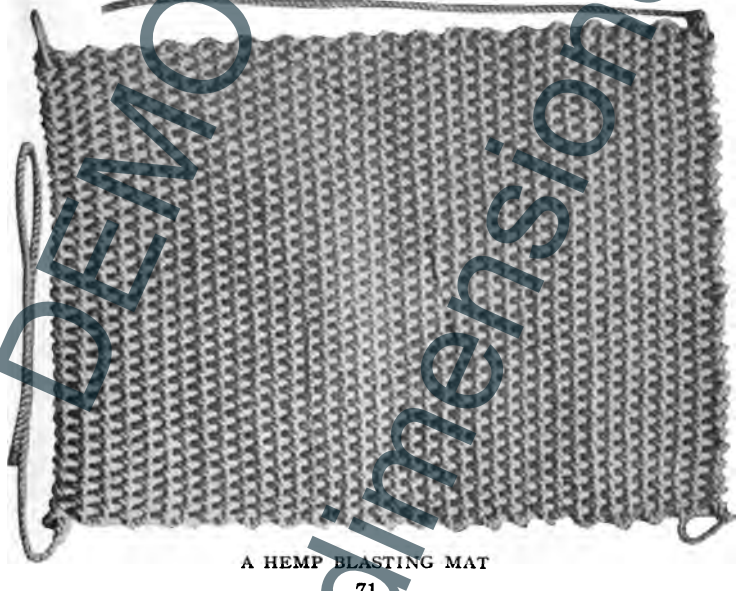
Tamping bags are made approximately two inches longer than shown in the table below in order to provide for folding at the end when filled.

Tamping bags are put up in bundles of 500 each, and packed ten bundles to the bale. They are manufactured in the following sizes:

Size No.	Size	No. in Bale	Shipping Weight per Bale
A	1″ x 8″	5,000	28 lbs.
B	1¼″ x 8″	5,000	31 lbs.
C	1¼″ x 10″	5,000	37½ lbs.
D	1¼″ x 12″	5,000	45 lbs.
E	1½″ x 8″	5,000	36 lbs.
F	1½″ x 10″	5,000	44 lbs.
G	1½″ x 12″	5,000	48 lbs.
H	1½″ x 16″	5,000	62 lbs.
J	2″ x 18″	5,000	86 lbs.

Blasting Mats

Blasting mats are closely woven mats of hemp or wire rope. They are used over blasts or between blasts and property to catch or hold material flying from the blasts. Hemp rope is generally used and is considered the best, although steel wire rope has been tried with success. The mats are made of 1 inch, 1¼ inch or 1½ inch rope, according to the demands of the customer. They are not carried in stock, but are woven on order and are made in any size required. If the blasting mats are to cover light charges of explosives, they may be spread directly over the bore holes; but



A HEMP BLASTING MAT

if heavier charges are used, railroad ties or logs should be put down first and the mats on top of them. Sometimes the mats are propped on lightly supported uprights several feet above the blast, so that when the blast is fired the flying rock is stopped by the under side of the mat.

These arrangements are very effective in preventing the rock from being thrown into the air and should always be adopted when blasting is done near thoroughfares or buildings. Boards and logs alone are not sufficient.

Cordeau

Cordeau, or detonating fuse, is a small lead tube, about the same diameter as triple tape fuse, filled with a yellow explosive compound which has a velocity of detonation of about 17,000 feet (more than 3 miles) per second. In other words, a piece of cordeau 17,000 feet long, if detonated at one end, will explode throughout its entire length in about one second. It is now used principally in deep well-drill blast holes and similar large blasts.

In spite of the great velocity and strength of the detonation of cordeau, it is very insensitive and cannot be exploded by hammering, pinching or burning. It is, therefore, safe to handle and load. It is exploded in actual use by means of blasting caps, electric blasting caps or by detonating dynamite

The extreme violence of the explosion of cordeau is sufficient to detonate high explosives lying alongside it in a bore hole.

Cordeau is furnished either with the plain lead covering or with the lead covering surrounded with a second covering of cotton

Plain Countered

SPOOLS OF CORDEAU

General Precautions to be Observed with Regard to 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 shoot into explosives with a rifle or pistol, either in or out of a magazine.

DON'T leave explosives in a field or any place where animals can get at them. Cattle like the taste of soda and saltpeter in explosives, but 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 explosives 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 explode a charge before everyone is well beyond the danger zone and protected from flying debris. Protect your supply of explosives also from danger from this source.

DON'T hurry in seeking an explanation for the failure of a charge to explode.

DON'T drill, bore or pick out a charge which has failed to explode. Drill and charge another bore hole at least two feet from the missed one.

DON'T use two kinds of explosives in the same bore hole, except where one is used as a primer to detonate the other, as where dynamite is used to detonate Du Pont Low Powder. The quicker explosive may open cracks in the rock and allow the slower to blow out through these cracks, doing little or no work.

DON'T use blasting powder, permissible explosives or high explosives in the same bore hole in coal mines.

DON'T use frozen or chilled explosives. Dynamite, other than Red Cross, often freezes at a temperature between 45° F. and 50° F.

DON'T use any arrangement for thawing dynamite other than one of those recommended by the Du Pont Company.

DON'T thaw dynamite on heated stoves, 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 anything else directly over steam or hot-water pipes or other heated metal surface.

DON'T cut or break a dynamite cartridge while it is frozen, and don't rub a cartridge of dynamite in the hands to complete thawing.

DON'T heat a thawing house with pipes containing steam under pressure.

DON'T place a hot-water thawer over a fire, and never put dynamite into hot water or allow it to come in contact with steam.

DON'T allow thawed dynamite to remain exposed to low temperature, but use as soon as possible.

DON'T allow priming (the placing of a blasting cap, or electric blasting cap in dynamite) to be done in a thawing house.

DON'T prime a dynamite cartridge or charge or connect bore holes for electric firing during the immediate approach or progress of a thunderstorm.

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 the 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 the safety fuse with the teeth or by flattening it with a knife; use a cap crimper.

DON'T keep electric blasting caps, blasting machines or blasting caps in a damp place.

DON'T attempt to use electric blasting caps with the regular insulation in very wet work. For this purpose secure Du Pont Waterproof or Gutta-percha Covered Electric Blasting Caps.

BLASTING ACCESSORIES

DON'T worry along with old, broken leading wire or connecting wire. A new supply won't cost much and will pay for itself many times over.

DON'T handle safety fuse carelessly in cold weather, for when cold it is stiff and breaks easily.

DON'T store or transport blasting caps or electric blasting caps with high explosives.

DON'T store safety fuse in a hot place, as this may dry it out so that uncoiling will break it.

DON'T lace safety fuse through dynamite cartridges. This practice is frequently responsible for the burning of the charge.

DON'T operate blasting machines half-heartedly. They are built to be operated with full force. They must be kept clean and dry.

DON'T cut the safety fuse short to save time. It is a dangerous economy.

DON'T expect a cheap article to give as good results as a high-grade one.

DON'T expect explosives to do good work if you try to explode them with a detonator weaker than a No. 6 (red label).

DON'T leave detonators exposed to the direct rays of the sun.

DON'T leave detonators where the rays of the sun will strike them after passing through glass.

DON'T have matches about you while handling explosives.

DON'T store explosives so that the cartridges stand on end.

DON'T open cases of explosives in a magazine.

DON'T open cases of explosives with a nail puller, pick or chisel.

DON'T prime both ends of a cartridge of explosive when making primers of half cartridges, with a blasting cap or electric blasting cap, before cutting it in two. Cut the cartridge in half and prime each piece separately.

DON'T use a needle of iron or steel when firing by means of miners' squibs. Use one of copper or brass.

DON'T keep blasting caps or electric blasting caps in the same box or container with other explosives in the field. Keep them separate.

DON'T use electric blasting caps of different manufacture in the same blast.

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"SAFETY FIRST" RULES

For Handling, Storing, Delivering and Shipping EXPLOSIVES

THE Du Pont Company will furnish, upon request, a set of rules printed on cloth for posting in magazines. Provision is made for the signature of the official in charge of the mine or other work requiring explosives.

DU PONT