March 10, 1959 L. W. HOUSEHOLDER 2,876,700

BLASTING PLUG

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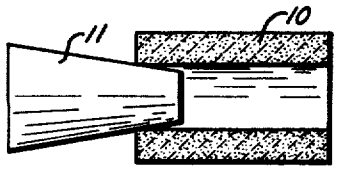


Fig. 1

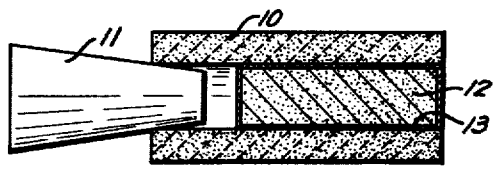


Fig. 2

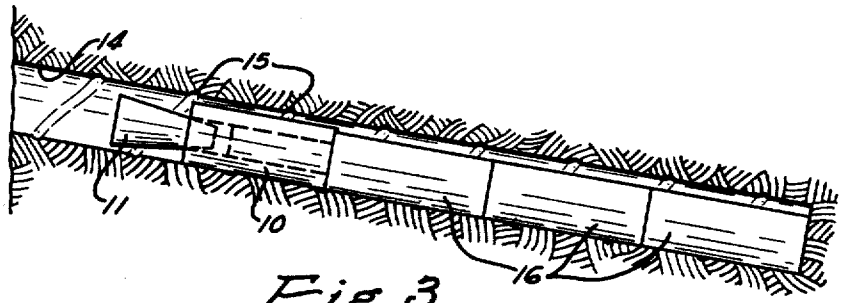


Fig. 3

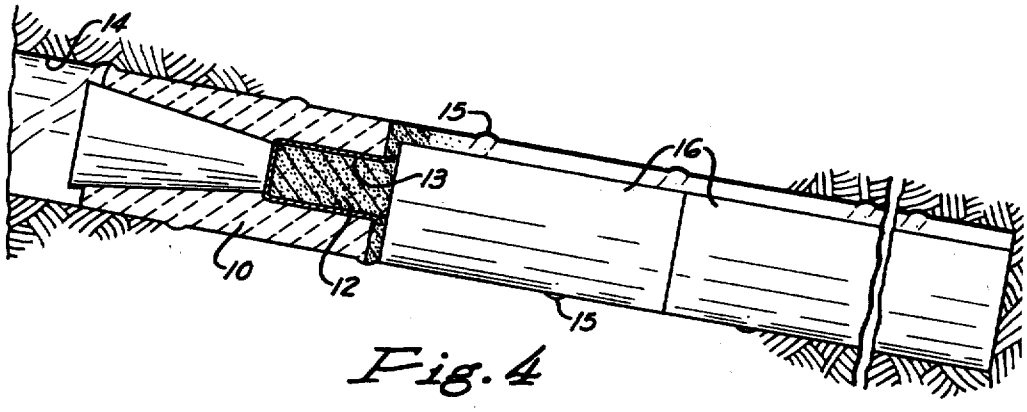


Fig. 4

INVENTOR.
LESLIE W. HOUSEHOLDER
BY
Brown, Critchlow, Flick & Peckham
HIS ATTORNEYS

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BLASTING PLUG

Leslie W. Householder, Indiana, Pa., assignor to National Mine Service Co., Pittsburgh, Pa., a corporation of West Virginia

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7 Claims. (Cl. 102—30)

This invention relates to a plug used to close the open end of a blasting hole in which a charge of explosive has been placed. The plug must be of such a nature that it will resist the back-pressure and cause the force of the explosion to be expended primarily in breaking up the rock, coal, or other material being blasted.

In the past the conventional method of stemming the hole has been by the use of extruded clay plugs tamped into place. But the use of such clay plugs is attended with a number of disadvantages. In the first place the clay plug must be very long, at least 2 feet in length. In addition, the clay plugs must be kept wrapped to preserve them with a proper degree of moisture, because when they become dry and hard they are unusable. The wrapping must be removed prior to using the plugs, and since a number of small clay "dummies" must be used to build up the required 2 feet, the handling takes considerable time. Moreover, in spite of all precautions, many of them dry out during storage and become unusable. For these and other reasons, clap plugs are not very satisfactory.

Various efforts have been made to substitute for the two feet of clay plug, a shorter, more convenient plug formed of some other material. One suggestion was to use a rubber plug, but the heat of the explosion chars the rubber to produce a disagreeable odor, and breaks the rubber into relatively large pieces which are dangerous when blown back out of the hole.

It has also been proposed to use a cylinder formed of folded asbestos fabric to be expanded by a wooden wedge. In this case the wedge of wood, or other similar material, produces dangerous flying particles, and the asbestos fabric disintegrates into a fine white dust which is harmful to the human lungs.

A primary object of the present invention is to produce a compact blasting plug that is easy and convenient to use, and which under the impact of the explosion disintegrates into a coarse dust which settles fast, and is non-injurious.

These objects are accomplished by forming both the cylinder and the wedge from a mixture of fine clay and a fire-resistant plasticizer, such as chlorinated paraffin. Since the clay itself is an ideal tamping material, just enough of the chlorinated paraffin is added to keep the compound in a tacky and pliable condition so that it will not crack when tamped into place. The wedge is made of the same compound, but is firmer, so that it can be forced into the cylinder to spread the cylinder into contact with the blasting hole.

In a preferred form, a charge of a cooling agent, such as sodium chloride, is inserted in the cylinder. The explosion causes this cooling agent to vaporize and form an envelope of gas which surrounds and cools the flame of the explosion.

These, and other objects and advantages of the invention, will become apparent as the description proceeds.

In the drawings:

Fig. 1 is a section through a blasting plug formed according to the present invention.

Fig. 2 is a similar view of another form of the blasting plug.

Fig. 3 is a diagrammatic section through a blasting hole showing the position of the parts prior to tamping.

Fig. 4 is a view similar to Fig. 3, but showing the parts after tamping.

Preferred forms described

Referring to the drawings in greater details, Fig. 1 shows a simple form of the invention, which includes a cylinder **10** having a relatively thick wall. This cylinder may be of various sizes. In one size the dimensions are as follows.

Cylinder:	Inches
overall length	2¼
outside diameter	2¼
inside diameter	1
wall thickness	⅝

The cylinder is formed of a compound which includes fine fire clay and a fire-resistant plasticizer. These materials will now be described in greater detail.

The clay is the well-known fire clay, powdered and passed through a screen having a mesh known as No. 16, American Society for Testing Materials. The largest particles passing through a screen of this size have a size of 1190 microns. It has been found that by using clay powder of this degree of fineness a compound can be formed that is plastic and closely adherent, whereas if larger particles are used, the compound tends to become brittle and to crack when deformed.

The fire-resistant plasticizer used is preferably unpolymerized resin in the form of chlorinated paraffin. This material, in different degrees of plasticity, is sold by the Diamond Alkali Company under the registered trademark Chlorowax. In order to produce the proper degree of plasticity it has been found desirable to mix two different grades of Chlorowax, one of which, Chlorowax No. 70, contains 70% of chlorine, and the other, Chlorowax No. 40 (low viscosity) contains 40% of chlorine.

For the cylinder **10** the materials discussed above are combined in approximately the following proportions:

	Percent
Fine clay powder	80
Chlorowax No. 70	9
Chlorowax No. 40	11

The tapered plug **11** forms a wedge which is driven into the cylinder **10** in order to expand the wall of the cylinder into contact with the bore. For a cylinder of the size given above, the wedge **11** would have the following dimensions:

	Inches
overall length	2
diameter at large end	1¾
diameter at small end	⅞

Because the wedge is to be used to expand the cylinder, it must be firmer, and it is formed of the above materials combined in the following proportions:

	Percent
Fine clay powder	87
Chlorowax No. 70	7
Chlorowax No. 40	6

In a preferred method of producing the cylinder **10** the materials are thoroughly mixed and are then extruded in the form of a continuous tube. Individual cylinders are sliced from the tube as it emerges from the extruder.

The wedge **11** is molded in any convenient type of mold.

It has been found that the materials compounded in

the proportions mentioned above produce a blasting plug which perfectly meets all of the requirements.

The Chlorowax acts as a plasticizer to keep the parts plastic, and to prevent them from drying out and becoming hard and brittle. If the parts should become hard, there would be a tendency for them to break up into dangerously large pieces.

Another advantageous characteristic of this blasting plug is its "delatability," i. e., delayed response to pressure. The conventional clay blasting dummy has this property, and the plug made according to the present invention preserves this property. As a result, the plug forms a perfect stemming material during the initial stages of the blast, but immediately thereafter disintegrates completely into a relatively coarse dust which is non-injurious and which settles very rapidly.

The blasting plug illustrated in Fig. 1 and described above is a simple form of the device adapted for use in rock quarries, iron mines, and other installations where there is no danger from combustible dusts or gases. For use in installations where combustible dusts or gases are encountered, it is preferred to use a blasting plug as illustrated in Fig. 2. In general the materials used in the plug of Fig. 2 are similar to those described above, but a coolant material is added in order to reduce the danger of a mine fire being started by the explosion.

It is well understood in this art that certain salts, such as sodium chloride and sodium bicarbonate, when present near the explosion, are vaporized by the heat and form an envelope of gas which surrounds and cools the flame of the explosion, thereby confining the flame and preventing it from reaching any nearby explosive gases.

In the device of Fig. 2 a charge of coolant, preferably sodium chloride, is shown at **12**. This charge **12** is sealed within an envelope **13** of material which is waterproof, but which will rupture during the tamping operation. The envelope **13** may be formed from the plastic material sold under the trademark "Cellophane." Sodium chloride in granular form is a preferred coolant because of its low cost, granular form, and rapid vaporization.

A preferred device of the type illustrated in Fig. 2 would have the following dimensions.

Cylinder:	Inches
overall length	3⅜
outside diameter	2
inside diameter	1⅛
wall thickness	7/16

Wedge:	Inches
overall length	2¾
dia. at large end	1⅝
dia. at small end	1

The coolant charge **12** is preferably placed and sealed in a cylindrical envelope **13** which closely fits within the bore of the cylinder **10**. In order to provide a substantial charge of coolant, the charge should extend over more than half of the length of the bore of the cylinder.

As an added deterrent to the spread of fire, a small percent of the coolant may be added to the compound from which the cylinder **10** is formed. The maximum amount of salt which may be so used is approximately 3%, since above that amount the salt draws so much moisture that the cylinder **10** does not retain its other desirable properties. A typical compound for the cylinder **10** when salt is added is as follows:

Minus 16 mesh clay—177.93 grams, or 77.36%
Sodium chloride—6.07 grams, or 2.64%
Chlorowax No. 70—20.91 grams, or 9.09%
Chlorowax No. 40 (LV)—25.09 grams, or 10.91%

Operation

Fig. 3 shows a plug of the Fig. 2 type placed in position prior to tamping. The blasting hole **14** is drilled through the solid formation by a drill, and normally has irregularities on its wall, such as the spiral grooves **15** left by the drill. The explosive charge **16** lies at the bottom of the bore. The blasting plug is first pushed into the hole until it contacts the charge **16**, this position being illustrated in Fig. 3.

A tamping stick, which is of approximately the same diameter as the hole, is then used to tamp the blasting plug into place against the charge. During the first part of the tamping action the wedge **11** engages the coolant charge **12** and ruptures the envelope **13**. This action forces the salt out of the cylinder **10** and around the explosive charge. As the tamping progresses the cylinder **10** is compressed in length and its wall is expanded to conform to the wall of the blasting hole, filling any irregularities of the hole. The cylinder **10** is expanded uniformly throughout its length because the part of the bore engaged by the wedge is deformed to conform to the shape of the harder wedge and the remainder of the bore is uniformly expanded by the outward pressure transmitted by the granular salt.

The final tamped position is illustrated in Fig. 4. Here it is shown that the salt **12** has been forced to completely surround the outer end of the charge of explosive. The cylinder **10** has been deformed and expanded throughout its length into firm contact with the wall **14** of the blasting hole.

When the blast is detonated, the flame of the explosion immediately encounters the salt and vaporizes it to produce a gas, which escapes from the hole ahead of the flame and forms an envelope surrounding the hot gas and flame of the explosion.

The body of the blasting plug, due to its "delatability," firmly stems the hole against the initial blast, causing the main force of the explosion to be exerted inwardly of the hole to blast the solid formation. Immediately after having performed this stemming function, the entire blasting plug, including the cylinder **10** and plug **11**, disintegrates into a coarse dust which is blown out of the hole and settles quickly. It will be seen that the blasting plug does not include any parts that would fracture into dangerous flying particles, and since the coarse dust is not injurious, the blasting plug is quite safe.

Possible variants

It should be understood that the blasting plug may be produced in different sizes to fit different size holes and different conditions, the above examples being merely illustrative. In all cases the wall of the cylinder should be sufficiently thick to furnish enough plastic material to adequately stem the hole. The overall length of the plug should be kept as short as possible, consistent with safety, in order to facilitate handling and storage.

The preferred proportions of the different materials given above adapt the blasting plug for storage and use at the temperature most frequently encountered in mines, which averages about 60° F. However, the proportions may be varied as much as 10% from those given without encountering great difficulties.

Conclusion

The present invention provides a blasting plug which is economical to manufacture, which is convenient to use, and which meets all safety requirements. Tests show that this blasting plug is able to efficiently and safely stem a blasting hole against the action of the most modern and powerful blasting explosives.

The blasting plug has withstood severe rough-handling tests which prove that it can survive the rough handling to which such objects are subjected in mine service.

The plug has also been subjected to extremes of temperature, being held for periods of 24 hours at 35° F. and 125° F. The plug withstood both of these tests, the cylinder remaining as "tacky" and pliable as before the tests. The plug does not dry out, and will withstand storage for long periods of time.

According to the provisions of the patent statutes, I have explained the principle of my invention and have described what I now consider to represent its best embodiment. However, I desire to have it understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically described.

I claim:

1. In a blasting plug of the type in which a short cylinder is adapted to be expanded by a wedge into contact with the wall of a blasting hole, the improvement which comprises: a short cylinder having thick walls formed of a compound comprising approximately 80% of fine clay powder and approximately 20% of a permanent flame-resistant plasticizer, and a tapered wedge fitted into the cylinder, the wedge being formed of a compound comprising approximately 87% of fine clay and approximately 13% of a permanent flame resistant plasticizer, the wedge being adapted to spread the cylinder into contact with the wall of the blasting hole.

2. A device as specified in claim 1 in which the clay particles are minus 16 A. S. T. M. in size, and the plasticizer is chlorinated paraffin.

3. In a blasting plug of the type in which a short cylinder is expanded by a wedge into contact the walls of a blasting hole, improvement which comprises: a short cylinder having thick walls formed of a compound comprising approximately 75% to 80% of fine clay powder and approximately 20% of a permanent flame-resistant plasticizer, a charge of granular cooling agent inserted in the bore of the cylinder, and a tapered wedge fitted into the cylinder, the wedge being formed of a compound comprising approximately 87% of fine clay and approximately 13% of a permanent flame resistant plasticizer, the small end of the plug being in engagement with the charge of cooling agent, whereby when the plug is driven into the cylinder, the walls of the cylinder are expanded into contact with the bore, and the granular cooling agent is forced from the cylinder.

4. A device as specified in claim 3 in which the charge of granular cooling agent is composed of sodium chloride.

5. In a blasting plug of the type in which a short cylinder is expanded by a wedge into contact with the walls of a blasting hole, improvement which comprises: a short cylinder having thick walls formed of a compound comprising approximately 75% to 80% of fine clay powder and approximately 20% of a permanent flame-resistant plasticizer, a charge of granular cooling agent occupying at least 50% of the length of the bore of the cylinder, the cooling agent being sealed in a water-proof rupturable container, and a tapered wedge fitted into the cylinder, the wedge being formed of a compound comprising approximately 87% of fine clay and approximately 13% of a permanent flame-resistant plasticizer, the small end of the plug being in engagement with the charge of cooling agent, whereby when the plug is driven into the cylinder, the walls of the cylinder are expanded into contact with the bore, and the granular cooling agent is forced from the cylinder.

6. In a blasting plug of the type in which a short cylinder is adapted to be expanded by a wedge into contact with the wall of a blasting hole, the improvement which comprises: a short cylinder having thick walls of a compound formed predominantly of fine clay particles which are minus 16 A. S. T. M. in size, and containing enough chlorinated paraffin to keep the compound in a plastic condition at the temperatures encountered in a mine, and a tapered wedge fitted into the cylinder, the wedge being of a compound similar to the composition of the cylinder, but containing more clay and less chlorinated paraffin, whereby the wedge is harder than the cylinder and is adapted to spread the cylinder into contact with the wall of the blasting hole.

7. In a blasting plug of the type in which a short cylinder is adapted to be expanded by a wedge into contact with the wall of a blasting hole, the improvement which comprises: a short cylinder having thick walls formed of a compound which comprises 75% to 80% of fine clay particles which are minus 16 A. S. T. M. in size, and approximately 20% of chlorinated paraffin; and a tapered wedge fitted into the cylinder, the wedge being formed from a compound which comprises approximately 87% of fine clay particles which are minus 16 A. S. T. M. in size, and approximately 13% of chlorinated paraffin; whereby the wedge is harder than the cylinder and is adapted to spread the cylinder into contact with the wall of the blasting hole.

References Cited in the file of this patent

UNITED STATES PATENTS

1,078,442	Johnson	Nov. 11, 1913
2,296,504	Crater	Sept. 22, 1942
2,403,386	Lubelsky et al.	July 2, 1946
2,590,882	Morton	Apr. 1, 1952
2,632,390	Madill	Mar. 24, 1953

FOREIGN PATENTS

440,085	France	Apr. 24, 1912

OTHER REFERENCES

The Condensed Chemical Dictionary, 5th edition. (Copy in Div. 46.) Reinhold Pub. Co. New York, 1956, page 260.

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 2,876,700 March 10, 1959

Leslie W. Householder

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 5, line 24, after "contact" insert -- with --.

Signed and sealed this 23rd day of June 1959.

(SEAL)
Attest:

KARL H. AXLINE
Attesting Officer

ROBERT C. WATSON
Commissioner of Patents