

Oct. 11, 1960

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2,955,534

BLASTING METHODS AND MATERIALS

Filed May 17, 1956

6 Sheets-Sheet 1

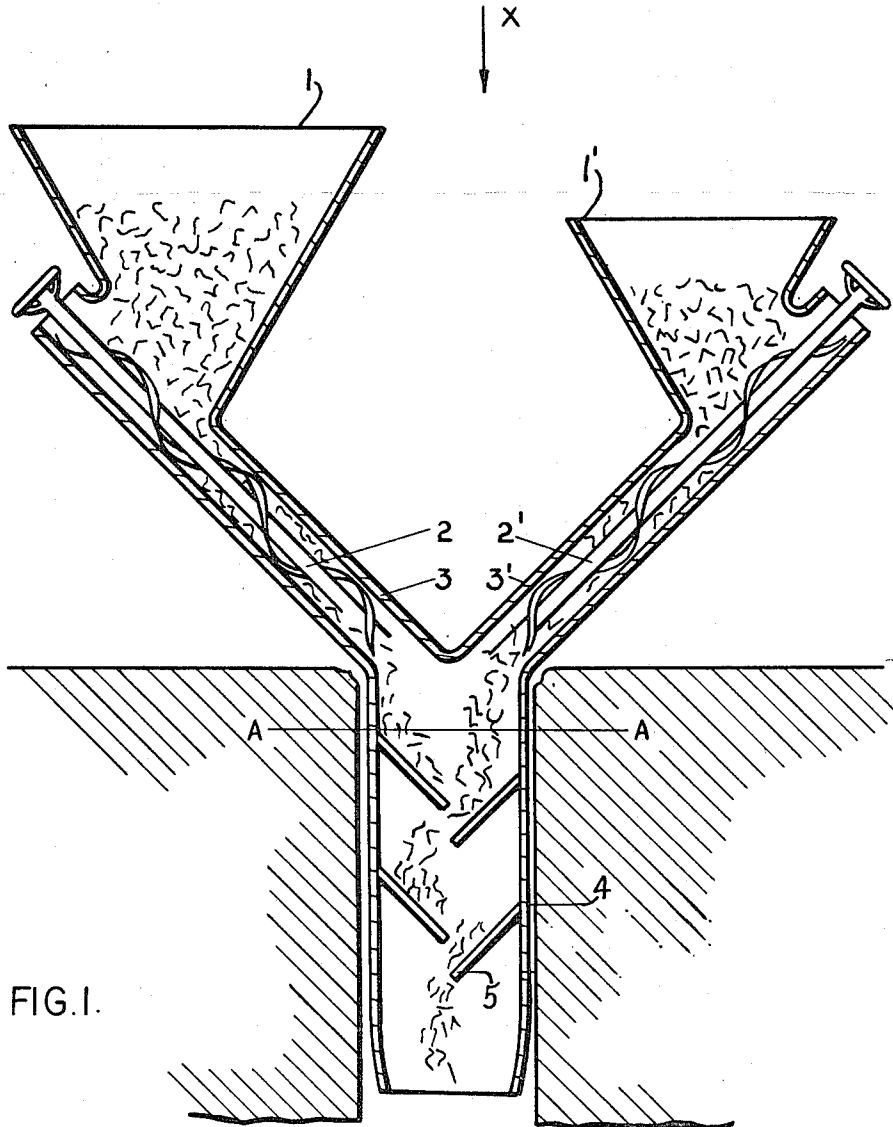


FIG. 1.

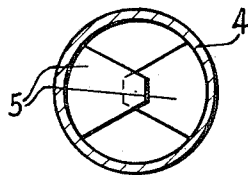


FIG. 2.

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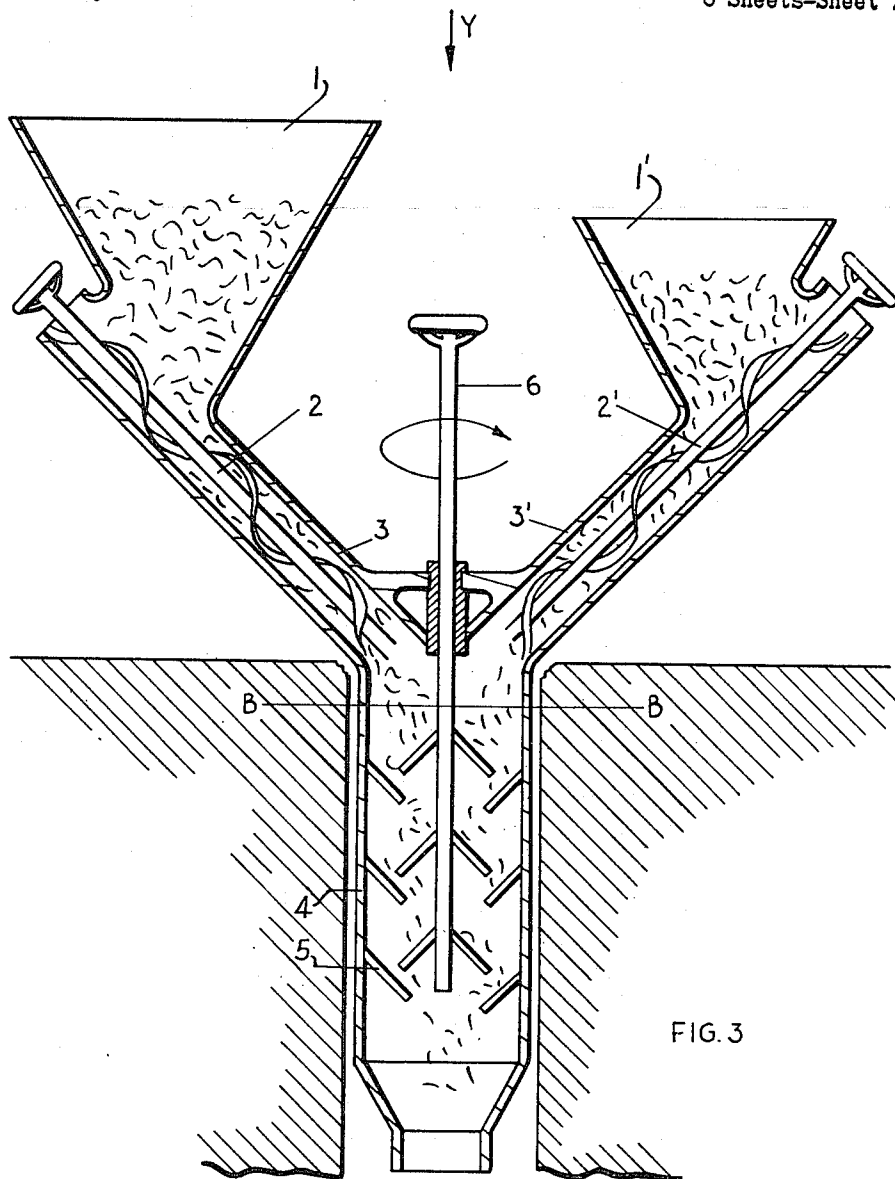


FIG. 3

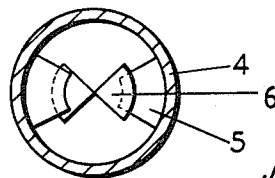


FIG. 4

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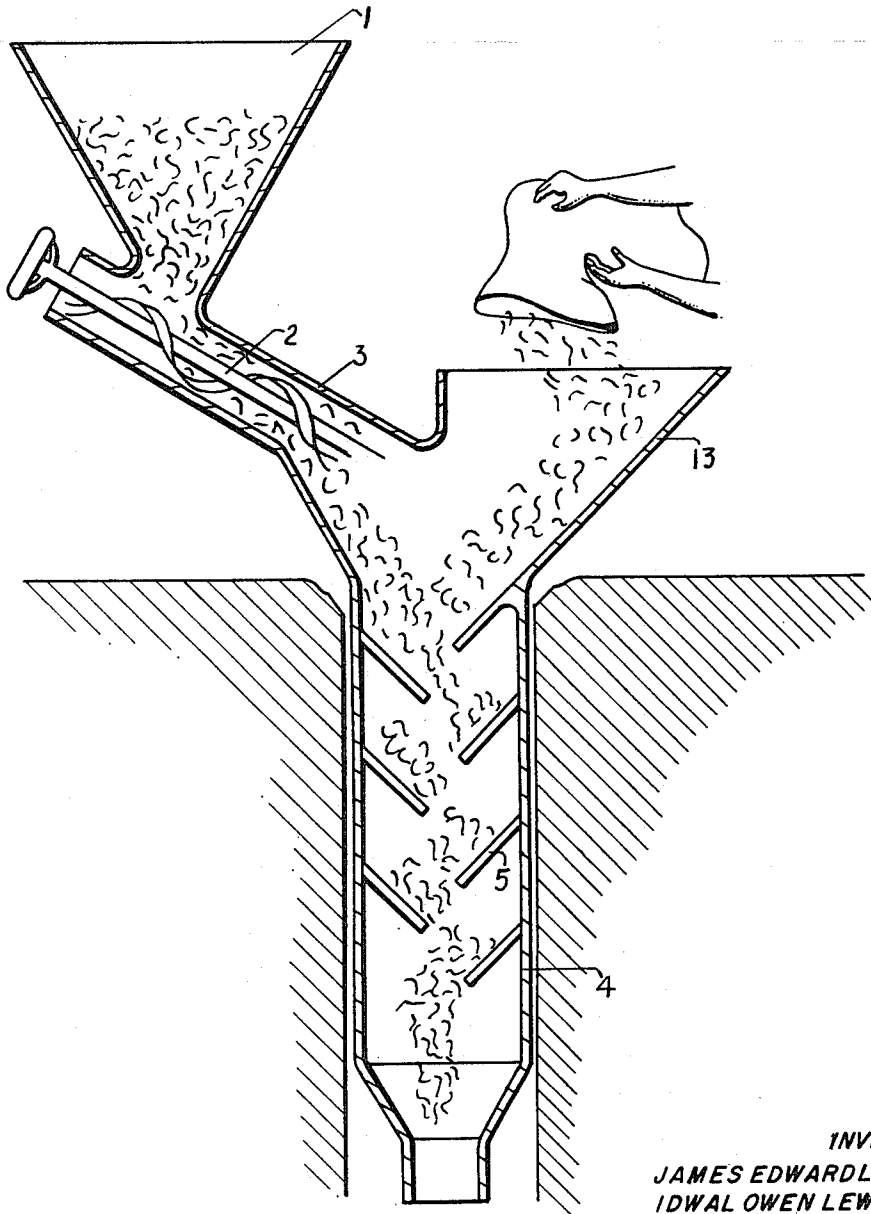
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FIG. 5

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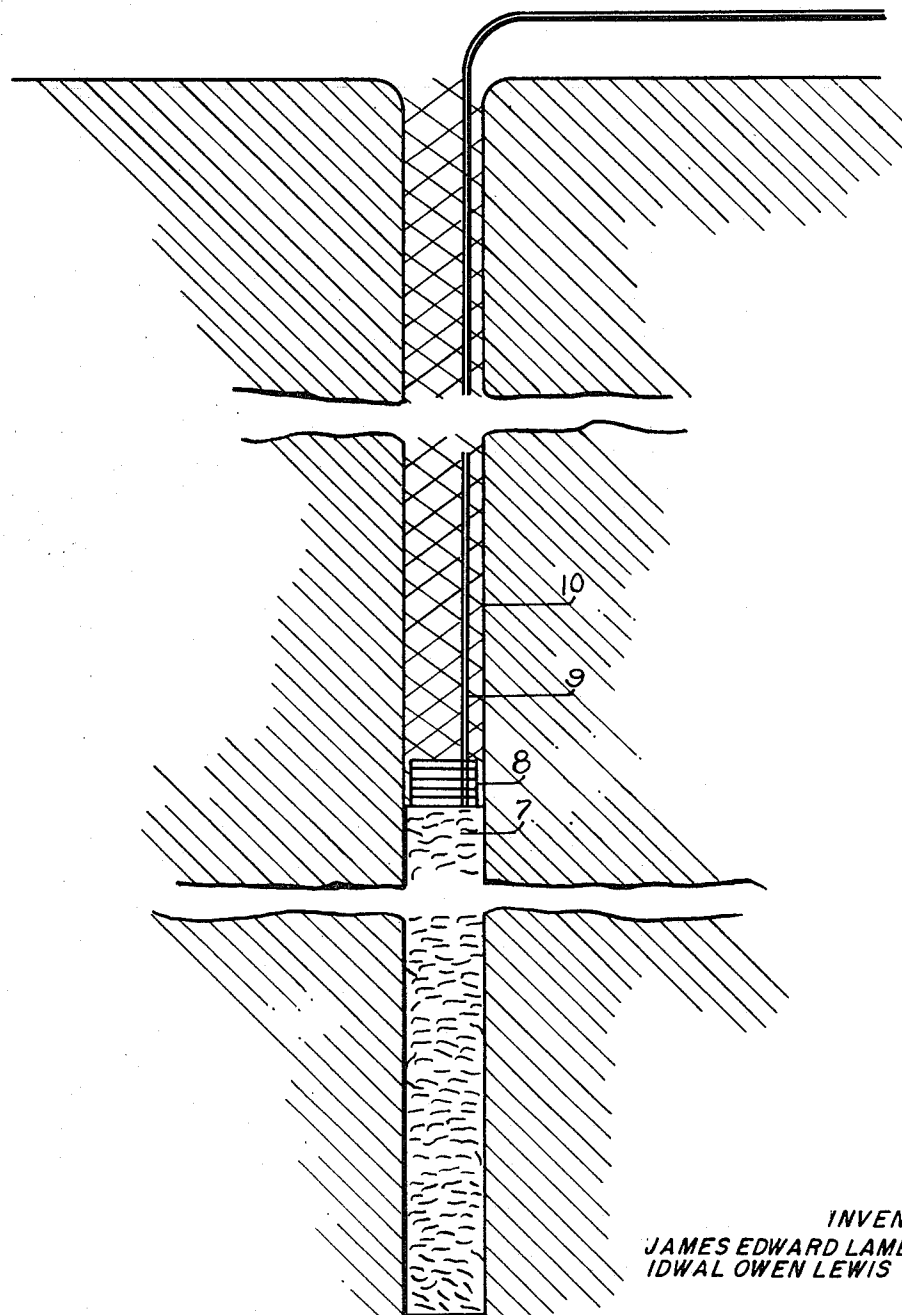
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FIG. 6. By *Cushman, Darby & Cushman*
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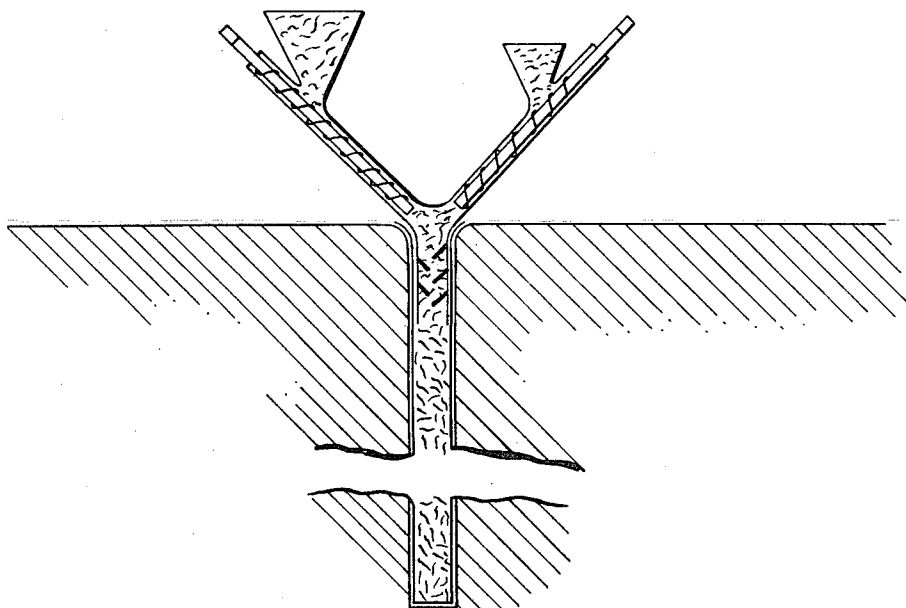
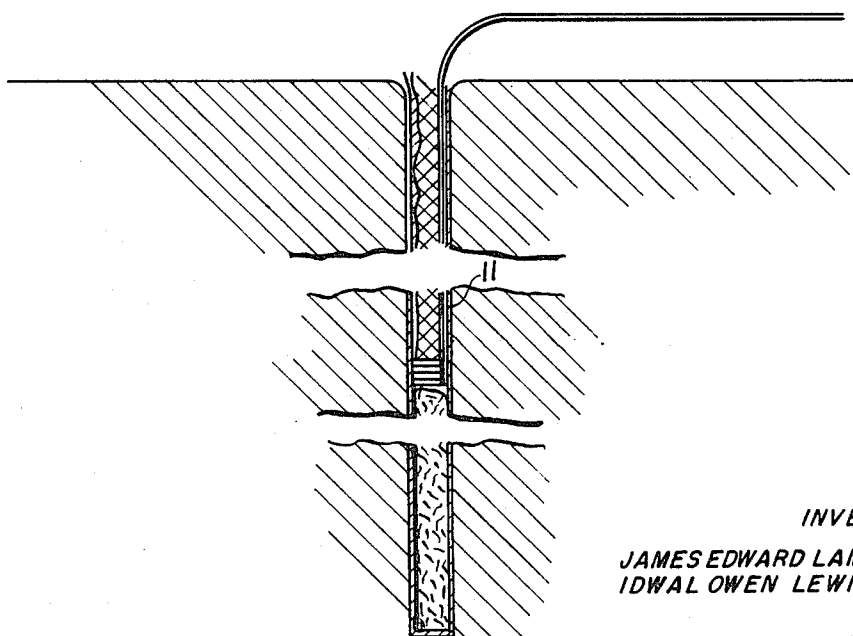


FIG. 7.



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FIG. 8.

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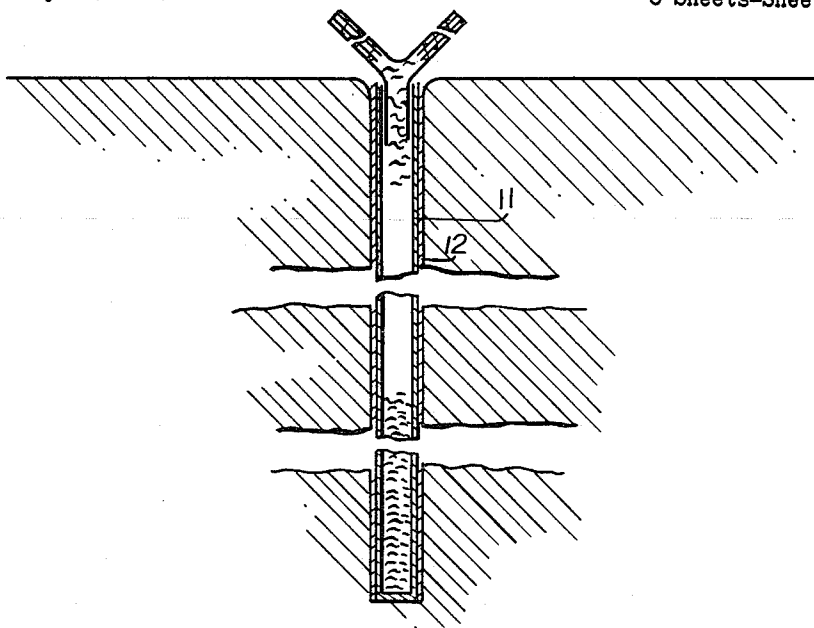
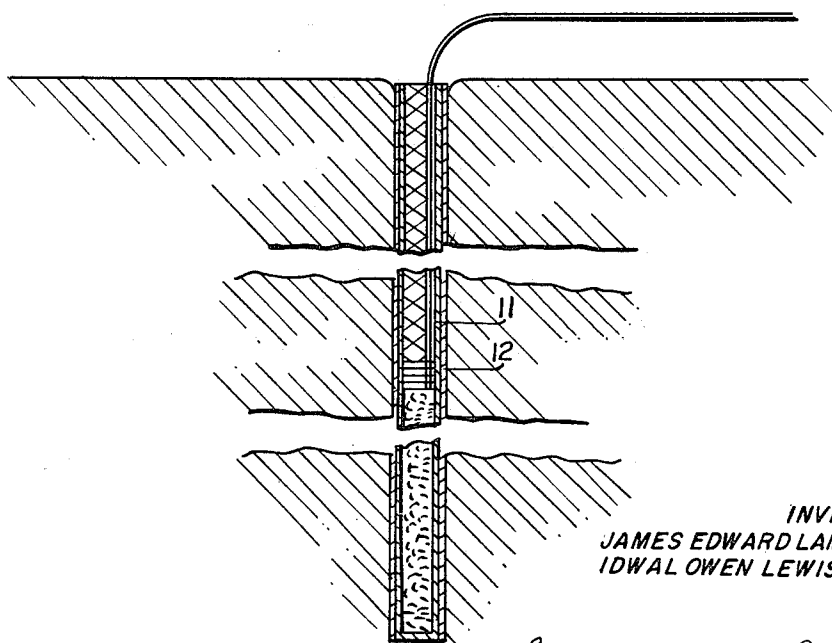


FIG. 9



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FIG. 10 By *Cushman, Darby + Cushman*
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BLASTING METHODS AND MATERIALS

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Claims priority, application Great Britain July 27, 1955

3 Claims. (Cl. 102—23)

The present invention is concerned with a new method of winning coal, rock, metal and the like in opencast working, quarrying or strip mining with blasting explosive compositions and more particularly with blasting explosive compositions containing a substantial proportion of ammonium nitrate and to apparatus therefor.

Hitherto it has been the practice to manufacture a blasting explosive composition and to cartridge or otherwise package it in a factory, to transport the cartridges or packages to the blasting site and to load the borehole with the explosive composition either in its waxed paper cartridge casing or other container or to empty the explosive composition out of its containers into the borehole. This procedure entails the observing of statutory regulations for the production, transport and handling of explosive compositions. Since ammonium nitrate can be handled and transported otherwise than as an explosive there would be economic and safety advantages if the mixing of ammonium nitrate and the other ingredients forming explosive compositions containing a substantial proportion of ammonium nitrate were delayed as long as possible, for example if the mixing were done in a building at the blasting site or better in a borehole.

According to the present invention the method of winning coal, rock, metal and the like in opencast working, quarrying or strip mining comprises forming in a substantially vertical bore hole an ammonium nitrate blasting explosive composition by introducing into it concurrently and at a predetermined rate at least one stream of ammonium nitrate and at least one stream in solid form containing the other ingredients of the blasting explosive composition so that the streams co-mingle during their descent in the borehole.

It is often desirable that said streams should only co-mingle below ground level.

In carrying out the method of the invention in accordance with one embodiment thereof the particles forming said streams can have superimposed on their gravitational descent at least one non-vertical component of motion for example by means of stationary baffles or by means of rotating baffles or paddles mounted on a suitable rotating member. Proceeding in this way often increases the efficiency of the co-mingling.

In accordance with a further embodiment of the invention protection of the blasting explosive composition containing the water-soluble ammonium nitrate from moisture in wet boreholes can be achieved by inserting into the borehole, prior to the introduction of said streams, a tube of any suitable waterproof material sealed at its lower end, which if necessary may be protected against mechanical damage on the rough side of the borehole by the use of a borehole liner interposed between the surface of the borehole and the waterproof tube which may be for example of waterproof laminated paper or cardboard. If desired the container may be closed at its upper end after being loaded.

Apparatus for carrying out the method of the invention comprises a tube having fixed to its internal surface

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a plurality of baffle plates so positioned that with the axis of the tube substantially vertical powdered or granular material poured into the top of the tube will be deflected more than once and also having attached to the end which is to serve as the top of the tube at least two branched conduits.

At least one of said conduits may contain a screw conveyor or other means for conveying powdered or granular material. Alternatively at least one of said conduits may be connected to a source of compressed air.

The invention also includes forming ammonium nitrate blasting explosives by a method which comprises introducing into a substantially vertical borehole concurrently and at a predetermined rate at least one stream of ammonium nitrate and at least one stream in solid form containing the other ingredients of the blasting explosive composition so that the streams co-mingle during their descent in the borehole.

By way of example the invention will be described with reference to the diagrammatic drawings accompanying the specification.

Figure 1 is a longitudinal axial section through one form of apparatus according to the invention and Figure 2 is a section on the line A—A viewed in the direction of the arrow X. In Figures 1 and 2, 1, 1' are hoppers, 2, 2' are screw conveyors situated co-axially in their respective conduits 3, 3' which lead to tube 4. Tube 4 contains four internal baffles 5.

One of the hoppers 1, 1' contains for instance that quantity of ammonium nitrate and the other hopper for instance that quantity of the complementary ingredient or ingredients of a particular ammonium nitrate blasting explosive composition that about 150 lbs. of the explosive compositions can be produced in a borehole. The two screw conveyor spindles 2, 2' may be manual or power operated. Tube 4 is about 5 feet long and 5 inches internal diameter and can be inserted into a vertical borehole approximately 30 feet deep and 6.5 inches diameter.

Another form of apparatus according to the invention is illustrated in Figures 3 and 4 in longitudinal axial section and in section on line B—B in the direction of arrow Y respectively. This apparatus has in addition to the features illustrated in Figures 1 and 2 a vertical stirrer 6 capable of continuous rotation (which may be adapted either for manual operation as shown or for power operation), to assist further the mixing of the ammonium nitrate and the complementary ingredients of the blasting explosive composition in the vertical tube.

In yet another form of apparatus according to the invention illustrated in Figure 5 a metering device for example a screw conveyor as illustrated is provided for the admission of ammonium nitrate contained in a hopper. The complementary ingredients of the ammonium nitrate blasting explosive composition are added manually in the required proportion from a container into a wide-mouthed conduit leading into the vertical tube.

Figure 6 illustrates a vertical borehole ready for blasting after having been loaded according to the invention in which 7 is the complete explosive composition, 8 is a primer cartridge of for example a gelatine explosive such as 5 in. x 5 lb. cartridge of "Opencast Gelignite," 9 is a length of detonating fuse and 10 is earth stemmed tightly into the borehole.

Figure 7 illustrates a vertical borehole being loaded with an explosive composition employing apparatus according to one form of the invention.

Figure 8 illustrates a vertical borehole loaded according to the invention and differs from Figure 6 in that a waterproof tube 11 is employed to protect the explosive composition from moisture in the borehole.

Figures 9 and 10 illustrate a vertical borehole being

loaded and ready for blasting respectively and differ from Figures 7 and 8 respectively in that they show the use of both a waterproof tube 11 and a borehole liner 12 of smooth material for example cardboard for the protection of the waterproof tube from mechanical damage.

Examples of ammonium nitrate blasting explosive compositions for which this invention is particularly suited are as follows.

Example 1

A-----{Nitroglycerine 20% (by weight).
Coarse sawdust 80% (by weight).
B-----Ammonium nitrate.

By combining A and B in the ratio of 1 part by weight to 5 parts by weight an explosive composition is produced which has a power of 80% blasting gelatine when measured on the ballistic mortar and which detonates at a velocity of 3,000 metres per second in a 5" diameter column when initiated by a 2 lb. gelignite primer.

Example 2

C-----{Trinitrotoluene 64% (by weight).
Ground anthracite 36% (by weight).
D-----Ammonium nitrate.

By combining C and D in the ratio of 1 part by weight to 7 parts by weight an explosive composition is produced which has a power of 83% blasting gelatine as measured on the ballistic mortar and which detonates at a velocity of 3,500 metres per second in a 5" diameter column when initiated by a 2 lb. gelatine primer.

Example 3

E-----{Trinitrotoluene 38% (by weight).
Ground anthracite 62% (by weight).
F-----Ammonium nitrate.

By combining E and F in the approximate ratio of 1 part by weight to 9 parts by weight an explosive composition is produced which has a power of 81% blasting gelatine as measured on the ballistic mortar and which detonates at a velocity of 3,000 metres per second in a 5" diameter column when initiated by a 2 lb. gelatine primer.

Example 4

G-----{Sawdust 50% (by weight).
Paraffin oil 50% (by weight).
H-----Ammonium nitrate.

By combining G and H in the ratio of 1 part by weight to 12 parts by weight an explosive composition is produced which has a power of 80% blasting gelatine as measured on the ballistic mortar and which detonates at

a velocity of 3,500 metres per second in a 5" diameter column when initiated by a 5 lb. gelatine primer.

Example 5

I-----Ground anthracite.
J-----Ammonium nitrate.

By combining I and J in the ratio of 1 part by weight to 13 parts by weight an explosive composition is produced which has a power of 76% blasting gelatine as measured on the ballistic mortar and which detonates at a velocity of 2,500 metres per second in a 5" diameter column when initiated by a 4 lb. gelatine explosive primer.

What we claim is:

1. A method of loading boreholes for the purpose of winning coal, rock, metal and the like in opencast working, quarrying or strip mining which comprises forming in a substantially vertical borehole an ammonium nitrate blasting explosive composition by introducing into it concurrently and at a predetermined rate at least one stream consisting of dry solid particles of ammonium nitrate and at least one stream of dry solid particles containing the other ingredients of the blasting explosive composition so that the streams co-mingle during their descent in the borehole.

2. A method as claimed in claim 1 wherein said streams only co-mingle below ground level.

3. A method as claimed in claim 1 wherein the particles forming said stream have superimposed on their gravitational descent at least one non-vertical component of motion and wherein said non-vertical component of motion is created by causing said streams to impinge upon a rotating upwardly converging conical surface within said borehole during their descent.

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