the markedly improved energy transmission to the borehole wall that is obtained when a detonating fuse is utilized for detonation of the dynamite charge. Thus, the highest effectiveness factor, 2.3, was observed when utilizing a 55-inch length of detonating fuse under which conditions exceptionally high quality lump breakage with minimum formation of fines was obtained. When the dynamite charge was detonated by electric blasting cap only, a satisfactory breakage was obtained but was accompanied by considerably higher yields of fines and a broader gradation of lump coal as demonstrated by the effectiveness factor of test 1. The unpredicted function of the detonating fuse is further demonstrated by a comparison of tests 2 and 3 which show an increase in effectiveness factor with increased length of detonating fuse utilized.

Although a permissible dynamite was employed in shooting down coal in the practice of the process exemplified hereinabove, it is to be understood that the present invention is not limited to coal mining operations or to the use of permissible explosives.

Any suitable means for charging the gel to the borehole can be utilized. In Examples 1–3 the gel was introduced into the hole by means of a pressure cylinder filled with compressed air which exerted air pressure upon the gel in a reservoir and forced it through the tube and into the hole. In Example 4 and 5 the gel, in all tests, was charged by positive displacement pump. The hole in the tests of Examples 4 and 5 was partially filled with the gel and the cartridge and detonator assembly then inserted through the gel body into position for shooting followed by filling the remaining hole space with gel and insertion of a stemming plug.

While bentonite gel is now preferred both from the standpoint of economy and operation, and a gel comprising water, carboxymethylcellulose and a precipitating agent such as aluminum sulfate can be advantageously employed, other gelling agents can be utilized. Agents suitable for gelling water include:

Bentonite
Water soluble cellulosics such as carboxymethylcellulose, sodium carboxymethylcellulose, methyl cellulose, hydroxymethyl and hydroxyethyl cellulose, and cellulose sulfate
Polyvinyl alcohol
Polyacrylic acid, its copolymers and salts
Copolymers of maleic anhydride with styrene or vinyl acetate
Sodium vinyl sulfonate
Alginates
Starch
Natural gums such as guar
Psyllium seed
Locust bean
Irish moss
Animal proteins such as gelatin, glue or casein

It is, of course, desirable to the economy and simplicity of the operation that agents be chosen which require only small amounts to produce a gel of the desired viscosity. Preferably, the gel will have a viscosity such that it will remain in a hole even when the hole is inclined from 20–30° above the horizontal.

As illustrated, the use of a tamping plug is desirable but not essential, since the gel transmits the force of the explosion or expanding gases to the wall of the hole before it is forced out of the borehole at the instant of the shot. Moreover, it will be seen that the use of a gel instead of water obviates the necessity of saturating the entire strata with fluid, the necessity of maintaining the fluid under pressure and the necessity of practically hermetically sealing the mouth of the borehole. The advantages of the invention are multiplied as the number of holes is increased. Thus, all of the advantages of the use of a fluid are obtained with much greater economy and facility in the blasting operation. The reduction in smoke and fumes, moreover, makes it possible to employ the process of the invention in on-shift operations and, moreover, permits miners engaged in tunnel operations to return to the scene of the blast much sooner than with permissible explosives currently employed. The method of the invention may be employed in multiple hole shooting with either regular or short period delay techniques.

Since many modifications may obviously be made in the invention as disclosed, it is intended that the scope of the invention shall be limited only by the appended claims.

What we claim and desire to protect by Letters Patent is:

1. A method for blasting coal deposits which comprises forming an elongated borehole in a coal deposit, introducing into said borehole, as elements of a blasting system therein, a detonatable blasting charge, having a volume substantially less than that of the said borehole, and a noncombustible nonexplosive gel; retaining said charge entirely within said borehole and disposing said gel around said charge in sufficient amount to also substantially fill the remaining space in said borehole; and then detonating said charge.

2. In a blasting method of claim 1, closing the mouth of said borehole prior to detonating said charge.

3. A blasting method of claim 1 wherein said borehole is first filled with said gel and said charge is then introduced through the gel body into the said borehole.

4. A blasting method of claim 1 wherein said charge is introduced into said borehole prior to introduction of said gel into said hole.

5. A blasting method of claim 1, wherein said blasting charge is a dynamite, affixing a detonating fuse to said dynamite charge of sufficient length to extend from said dynamite charge to a point within said borehole in close proximity to the open end thereof, and initiating said dynamite charge by detonating said fuse at its end near the borehole open end.

6. A method of claim 1 wherein said gel is formed from water and bentonite.

7. A method for blasting coal deposits which comprises substantially filling a borehole in a coal deposit with an acqueous noncombustible nonexplosive gel; affixing to a dynamite cartridge a detonating fuse of sufficient length to extend from said cartridge as described hereinafter and affixing blasting cap means for detonating said fuse to the end thereof opposite said cartridge; introducing the resulting primed cartridge assembly, cartridge first, into said borehole toward the closed end thereof through the column of gel therein so as to dispose said cartridge in said hole surrounded by said gel, and extending said detonating fuse and blasting cap means affixed thereto from said cartridge to a point within said hole in close proximity to the mouth thereof, positioning a closure plug in said hole at the mouth thereof and extending lead wires from said blasting cap means from the borehole intermediate said plug and the borehole wall into communication with a suitable power source for initiating said blasting cap means; and then detonating said charge by electrically initiating said blasting cap means, whereby coal deposits in the area of said hole are brought down in uniform lump size; and recovering lump coal product so produced.

8. A method of claim 7 wherein said gel comprises bentonite and water.

9. A method for blasting coal deposits to produce lump coal, comprising affixing a detonating fuse to a dynamite cartridge; affixing an electric blasting cap to the remaining unattached end of said fuse; forming an elongated borehole in a coal deposit; inserting the resulting primed cartridge assembly into the said borehole; introducing a noncombustible nonexplosive gel into said hole around said cartridge and in an amount to substantially fill said hole; closing the resulting filled hole with a closure plug and detonating the dynamite charge by initiating said