United States Patent

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[54] MINING METHOD FOR METHANE DRAINAGE AND ROCK CONDITIONING

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[51] Int. Cl. **C06c 5/00,** E21c 27/20

[58] Field of Search 299/2, 12, 13, 11; 102/21, 102/23

[56] **References Cited**

UNITED STATES PATENTS

1,867,758	7/1932	Ranney	299/2

FOREIGN PATENTS OR APPLICATIONS

119,519	10/1918	Great Britain	299/13
76,136	4/1919	Austria	299/13

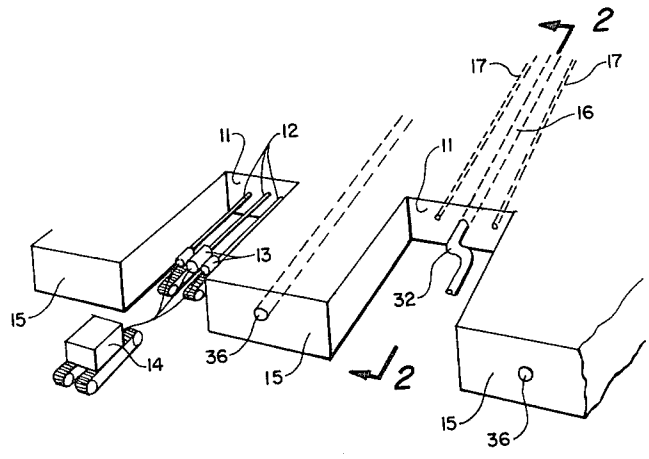
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[57] **ABSTRACT**

Deep (long) parallel holes are drilled into a mine or tunnel face and explosive charges selectively exploded in some, but preferably not all, of such holes to fragment surrounding rock and join the holes. Methane migrates through the fractured formation to the hole which has not been exploded, or to a separately drilled drainage hole, and the unexploded or separate hole is first used to draw off explosive gases, where this is a problem. Then water is pumped through such hole or holes to saturate the formation to reduce dust suspension and also to cause additional gas migration. The fractured formation facilitates mechanical boring machines and reduces tool wear. The explosives are preferably provided at spaced intervals along a carrier tube with stiffeners to enable the tube to be pushed into the deep hole and with built-in electrical connections and stemming. The carrier for the explosives is preferably plastic and thus does not damage boring tools.

9 Claims, 6 Drawing Figures



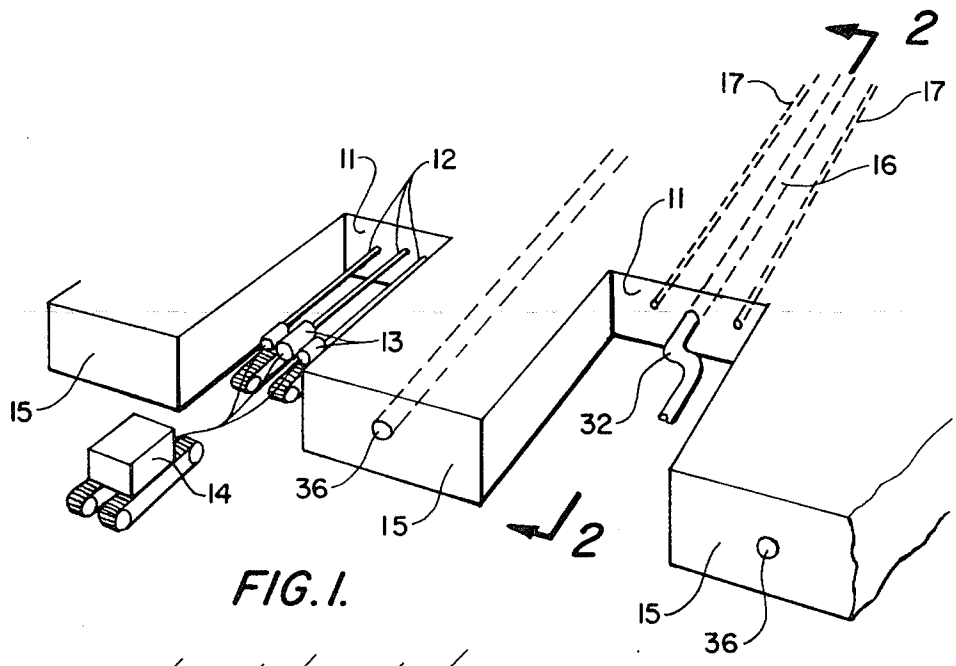


FIG. 1.

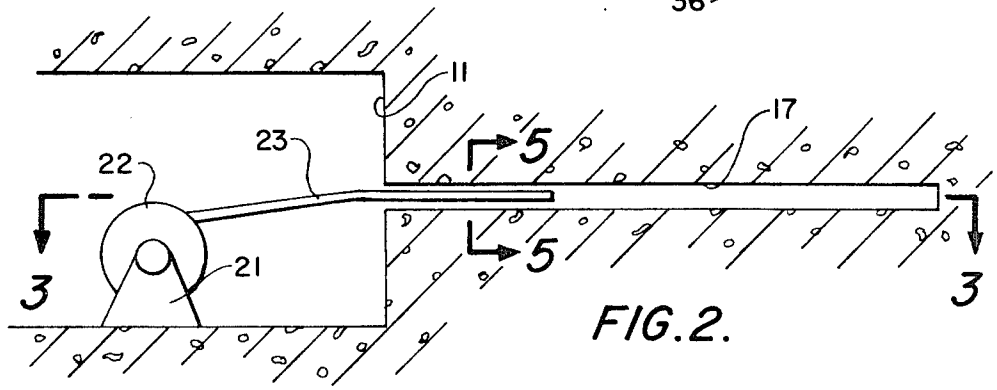


FIG. 2.

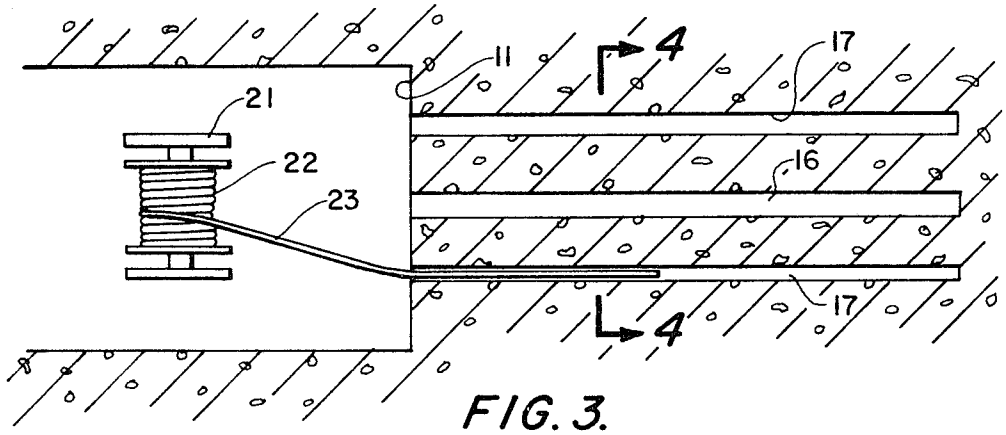


FIG. 3.

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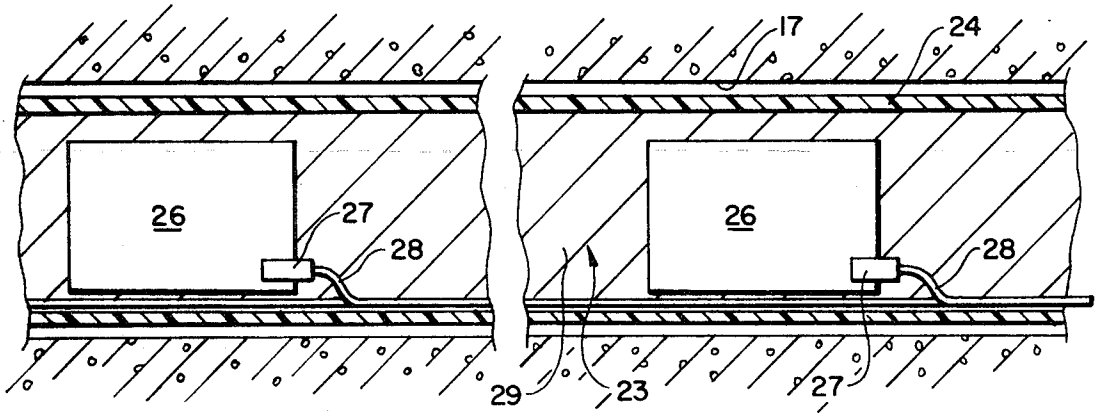


FIG. 6.

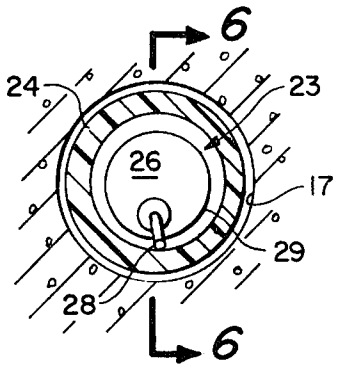


FIG. 5.

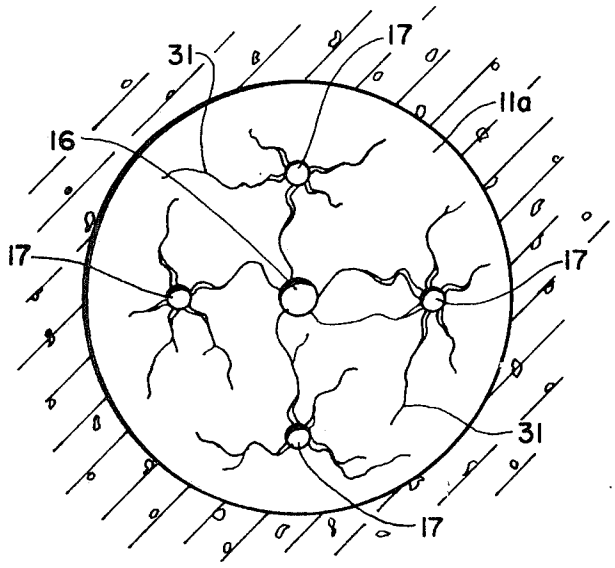


FIG. 4.

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MINING METHOD FOR METHANE DRAINAGE AND ROCK CONDITIONING

This invention relates to a new and improved mining method for methane drainage or rock conditioning.

One of the principal purposes of the present invention is to more effectively solve the problems arising from the presence of explosive methane gas which occurs in coal seams and other rocks associated with carboniferous deposition. The gas may occur under high pressure and may be present either in actual cracks in the seam or absorbed within the pores of the coal. When the coal is mined, the methane is released as mining proceeds and since rapid mining methods increase the rate of advance the rate of release of methane also increases. Additionally, the methane problem becomes more serious in deeper seams which in nature tend to retain methane in larger quantity than shallow mines. Furthermore, because of the heavy overburden it is frequently necessary to make mine openings smaller at greater depths, and this likewise increases the problem of disposing of methane gas.

Heretofore it has been proposed to drill drainage holes into blocks of coal ahead of the mining face. These holes have been depended upon to work independently of each other and hence there effectiveness has been limited. In some instances, water has been flooded into one hole in order to force gas to migrate to another hole but this also has been only partially successful, due to the impermeability of coal. The present invention overcomes the deficiencies of methane drainage holes of the prior art.

Dust suppression is another problem of great concern in mining because the dust is in many cases explosive and also causes respiratory problems to miners. Where methane is a serious problem, ventilation must be conducted in large volumes, creating higher velocity and this in turn, increases dust hazards because more dust is forced into suspension as well as greatly increasing ventilation costs. The present invention not only reduces the presence of methane at the working surface by predraining the same but also reduces dust suspension by decreasing volumes of air needed for dilution of methane. It further provides safer working conditions at less cost for power of fan operation.

In the present invention, water is flooded into the holes which are drilled for methane drainage and this presaturates the coal or other substance being mined so that the mining machine is less likely to cause suspension of the dust in the air. Heretofore presaturation has been limited because the formations in which the holes had been drilled are generally impermeable. In accordance with the present invention, the structure in advance of the face being mined is fractured resulting in better permeability and hence enhancing water saturation ahead of the boring machine.

Still another problem in mining is the use of fast production methods. Various boring machines have been used but where the rock is hard the rate of penetration is slow and the wear of the cutters is high. Therefore the use of boring machines such as are used in tunneling has been limited in mining practice. In accordance with the present invention, the structure ahead of the face being mined is fractured and preweakened thereby reducing the amount of work which the boring machine must do and also reducing the cost of replacing cutters.

Accordingly, the present invention provides a method which causes the mineral to release its methane more rapidly in a manner so that it may be drained to the surface or to a nondangerous area. At the same time, the permeability of the mineral or rock is increased so that it may be saturated with water to improve dust suppression. Finally, the rock is preconditioned for more rapid and efficient boring with conventional tunnel boring machines.

Still another feature of the invention is the precise drilling of holes far in advance of the face being mined and then the splitting of the rock or other mineral between the holes so that the coal and mineral is fractured in a manner to release its gas more rapidly and to create a permeable carrier but at the same time in such a controlled manner that the future mine or tunnel roofs, floors, walls and supporting pillars are left undisturbed for later mining and permanent support.

Another feature of the invention is the provision of a tube containing explosive charges spaced apart about 15 feet along the length of the tube. The charges are preferably equipped with delayed firing devices so that charges are exploded serially. The tube may be attached to a stiff rod which is used to insert the tube into the entire length of the hole which has been drilled. Preferably the materials used are such that the mining machine will not be damaged when it contacts the same. The serially energized fracturing of the formation may be accomplished by means other than explosive charges, as by such means as gas release cartridges, continuous or interrupted prima-cord or hydraulic fracturing.

The present invention provides a means for accurately presplitting the formation in a manner to achieve the purposes heretofore described so that those areas which are intended for future supports are left intact. However, holes may be drilled therein for permanent methane drainage or for transmission of water with provision made for continuing the hole, as by means of a pipe, where connecting galleries or "breakthroughs" occur between main headings.

Other objects of the present invention will become apparent upon reading the following specification and referring to the accompanying drawings in which similar characters of reference represent corresponding parts in each of the several views.

In the drawings:

FIG. 1 is a schematic perspective view of a portion of a mine in which the present invention is used.

FIG. 2 is an enlarged, sectional view taken substantially along the line 2—2 of FIG. 1.

FIG. 3 is a section taken substantially along the line 3—3 of FIG. 2.

FIG. 4 is a further enlarged transverse sectional view taken substantially along the line 4—4 of FIG. 3.

FIG. 5 is an enlarged transverse sectional view taken substantially along the line 5—5 of FIG. 2.

FIG. 6 is a further enlarged sectional view taken substantially along the line 6—6 of FIG. 5.

The method of the present invention is shown schematically in the accompanying drawings. In FIG. 1, reference numerals 11 indicate the faces of a mine, such as a coal mine, which are being developed. The faces 11 are here shown rectangular but in many installations where the present method is used, the faces may be circular because of the use of conventional tunnel boring machines which cut a circular face. Pillars 15 may be left at intervals to support the overburden, all as well understood in the mining art.

Each face 11 is drilled with a plurality of holes by means of drills 12 located in drilling heads 13 under the control of a portable drilling machine 14. The structure shown in FIG. 1 is, in this respect, quite schematic. The number and spacing of the drills 12 is also subject to considerable variation as hereinafter explained. Preferably, the center drill 12 is of a larger diameter than the others and drills a "burn" hole 16 disposed centrally of face 11 and surrounded by a pattern of blast holes 17. In the rectangular face 11 illustrated in FIG. 1, there are two holes 17 spaced to either side of the larger diameter center hole 16. However, where a circular face 11*a* is bored (as is shown in FIG. 4) the holes 17 may be four in number and spaced radially about central burn hole 16. The number and spacing of the holes is subject to considerable variation.

In a preferred form of the invention, after the holes 16, 17 have been drilled, each hole 17 is provided with a charge of explosives. As shown in FIGS. 2 and 3, a reel stand 21 may be installed opposite each hole provided with a reel 22 of plastic tubing 23 containing the explosive.

Directing attention to FIGS. 5 and 6, each tube 23 has an outer plastic casing 24 of a diameter to fit within the hole 17. Disposed longitudinally of casing 24 at about 15 foot intervals are blocks 26 of an explosive, each provided with a blasting cap 27 connecting to electric firing wires 28. The remaining area of each casing 24 is filled with stemming 29. After the plastic tube 23 has been inserted the full length of each hole

17, which may be drilled a considerable distance such as 3,000 feet, the charges **26** are set off serially or in some pattern so that the explosions are carefully controlled. Fractures **31** occur in the formation interconnecting the various blast holes **17** and, quite importantly, intersecting the burn hole **16**. Explosive forces so released naturally seek an opening or relief area such as is provided by the burn hole **16**, thus eliminating damage to the roof or sidewalls. The location of the holes is such that pillars **15** remain to support the roof but the areas behind the face **11** or **11***a* are fragmented in a predetermined and desired pattern.

Instead of explosive charges **26**, cartridges of gas may be released at intervals to fracture the formation or hydraulic means or other means may be used to accomplish the same purpose.

Fracturing of the formation causes the methane trapped in the coal or other carboniferous material to migrate to the burn hole **16** and a pipe **32** may be connected to the exposed end of hole **16** to conduct the methane to the surface or to some other safe location. In some instances it may be desirable to force water into one or more of the holes **17** to increase the migration of methane to burn hole **16**. After the methane has escaped or, if the presence of methane is not a problem, water may be forced under pressure through pipe **32** and hole **16** causing dispersion of water in the formation in advance of face **11** or **11***a*. Hence as the face is moved forwardly by means of mining machines or tunneling machines, the formation is fairly saturated with water and dust is suppressed. This permits the use of higher velocity ventilating fan and improves the safety of the mine both from the standpoint of explosive hazard and respiratory dangers.

Because of the fracturing of the formation, the mining machine or tunnel boring machine may advance more rapidly and the replacement of cutters is reduced.

Alternatively, an additional hole **36** may be drilled in the relatively undisturbed pillar areas **15** for drainage of methane to the outside or to a safe disposal area. Location of the hole **36** in the pillar areas would interfere with mining only occasionally during the driving of connecting galleries between the main headings.

Although the foregoing invention has been described in some detail, by way of illustration and example for purposes of clarity of understanding, it is understood that certain changes and modifications may be practiced within the spirit of the invention and scope of the appended claims.

I claim

1. A method of excavating earth comprising drilling a first hole and a second hole into the formation extending deep from the face of an area to be excavated, said holes being parallel to each other and generally parallel to the direction in which the excavation is to proceed, inserting in said first hole, but not in said second hole, a series of explosive means, and exploding said means at selectively longitudinally spaced intervals along the length of said first hole, said method being characterized by the fact that fractures are formed in said formation intersecting said first and second holes to fragment the rock between said holes, said holes originally located closely enough together so that said fractures extend between both said holes.

2. A method according to claim **1** in which exploding step comprises serially exploding said explosive means.

3. A method according to claim **1** which further comprises connecting said second hole to a conduit and withdrawing through said second hole and conduit methane gases and conducting said methane away from said excavated area to a safer area.

4. A method according to claim **1** which further comprises forcing liquid under pressure into said second hole to saturate the rock surrounding said second hole and then excavating in the area of the length of said second hole, the said liquid suppressing dust which would otherwise be created during said excavating.

5. A method according to claim **1** which further comprises boring said face with a rotary boring machine proceeding in a direction parallel to the direction of said holes, the fragmenting of the rock facilitating progress of said boring machine.

6. A method according to claim **1** which comprises drilling a first plurality of first holes in said face distributed around said second hole, said first holes being substantially equidistant from said second hole, inserting second explosive means in each of said plurality of first holes, and exploding said second means at selectively longitudinally spaced intervals along the lengths of said first holes.

7. A method according to claim **6** which further comprises drilling a second plurality of first holes located at a distance from said first plurality of first holes and also a second second hole centrally located relative to said second plurality of first holes all generally parallel to said first mentioned holes, inserting in said second first holes a third series of explosive means, and exploding said third means at selectively longitudinally spaced intervals.

8. A method according to claim **7** in which the third volume of rock between said first and second volumes of rock is maintained unexcavated to provide a roof support pillar and which further comprises drilling a third hole in said third volume generally parallel to said first and second pluralities of first holes, and conducting methane out from said third hole.

9. A method according to claim **1** in which said fragmenting step comprises providing an elongated tube of a frangible material dimensioned to fit said one hole with a plurality of spaced explosive charges in said tube, firing devices for each said charge, firing wires to energize individually each said firing device extending out one end of said tube and stemming between explosive charges, inserting said tube in said one hole with said firing wires extending out of said tube and then individually electrically energizing said firing wires to explode said charges at different times and which further comprises excavating said face in the direction of said holes by boring said face and said tube.

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