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de Jong

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[54] **HYDRAULIC MINING METHOD**

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[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.** **299/17**; 175/53; 175/67; 299/18; 299/19

[51] **Int. Cl.**[2] **E21C 25/60**; E21C 41/04

[58] **Field of Search** 299/17, 18, 19, 81; 61/72.7; 175/67, 53, 422

[56] **References Cited**

UNITED STATES PATENTS

2,274,431	2/1942	Renner	61/72.7
3,651,872	3/1972	Smith et al.	175/53

FOREIGN PATENTS OR APPLICATIONS

1,008,679	5/1957	Germany	299/19
1,036,791	8/1958	Germany	299/19
52,959	3/1967	Poland	175/422

Primary Examiner—Ernest R. Purser

[57] **ABSTRACT**

This invention is a process for mining material, especially coal, from an underground seam, which method comprises digging at least two, preferably parallel, trenches which reach into the seam; drilling a dipping hole between the trenches through the seam; disintegrating material in the walls of the hole while contacting with water to form a slurry which flows downdip through the hole to one of the trenches; and lifting the slurry from the trench to the earth's surface. Preferably the disintegrating step is done by hydraulic jetting.

5 Claims, 3 Drawing Figures

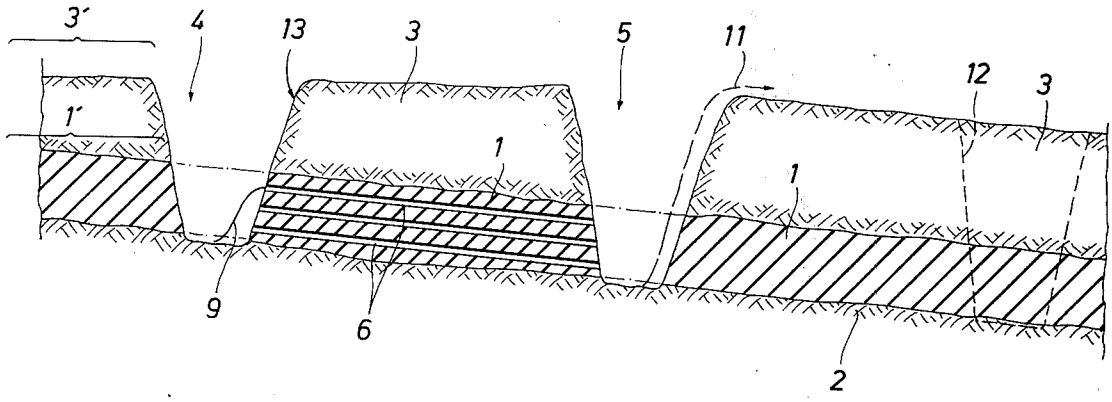


FIG. I

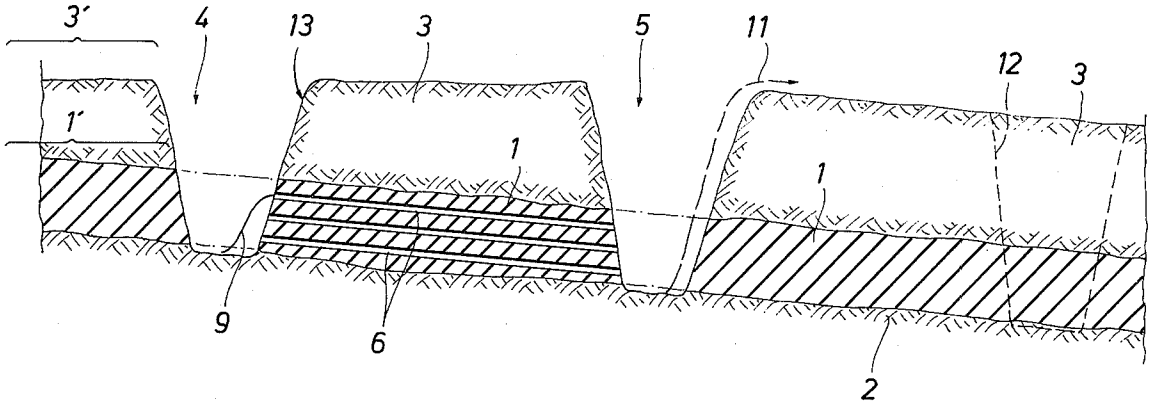
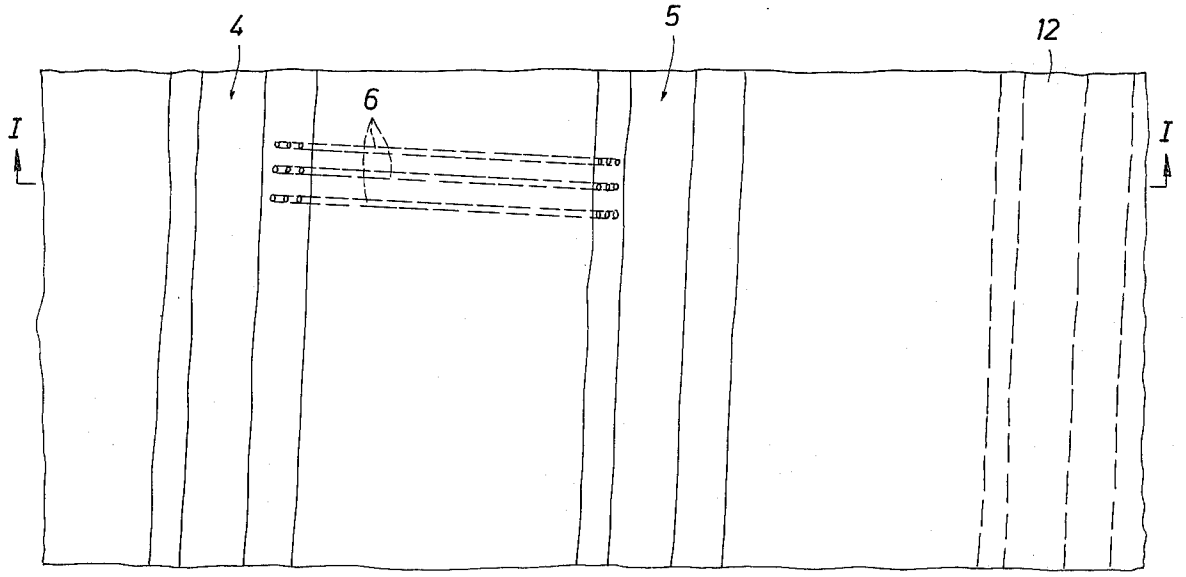


FIG. II



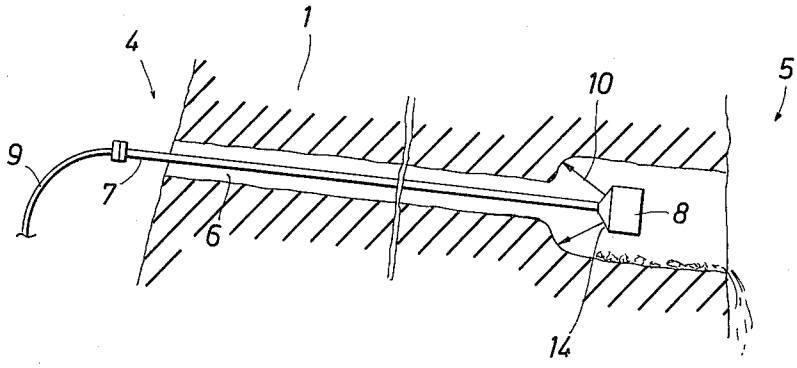


FIG. III

HYDRAULIC MINING METHOD

FIELD OF THE INVENTION

This invention relates to a process for mining naturally occuring raw materials, especially coal, from an underground seam.

PRIOR ART

It is generally known that coal can be mined from the ground either by strip mining above ground or by the room and pillar or longwall methods below ground. However, where overburden is too thick for the coal to be mined by stripmining or the seam is not deep enough for shafts being drilled into the seam, neither of these methods is particularly useful. The process of this invention is particularly useful for the coal or other seams which are found too deep for stripmining but too shallow for the room and pillar or longwall methods.

Various mining techniques have been proposed for mining underground valuable raw materials such as oil shale or coal. For example, in U.S. Pat. No. **3,712,677** to Jansen, a chamber mining technique is described whereby a series of horizontal stopes are formed between haulage and bleeder entries. Upon completion of a crosscut, the top and sides are drilled and blasted in a retreat operation and the broken ore is hauled out. Although by this method the mined-out area need not be entered and there is no need for support or scaling since failure of walls between stopes doesn't endanger men and equipment, it is still required that the disintegrated material, i.e., oil shale in this case, must be hauled out using mechanical means of conveyors, buckets or similar devices.

Australian Pat. No. **165,638** to Moynihan and Moynihan describes a method wherein a coal seam is hydraulically mined by hydraulically erroding the face of the exposed coal seam or by drilling into the coal seam from an exposed face and hydraulically disintegrating the coal material to form a slurry which is then collected in a sump area and pumped out as a slurry line. This method has the disadvantage of the slurry returning to the general area where the men are working and thus making the working area difficult to operate in.

Another patent, U.S. Pat. No. **3,837,324** to Aschacker describes a process and apparatus for drilling large holes between galleries in mineral formations without using extraordinarily heavy equipment. The process comprises drilling a small pilot hole between two underground galleries, extending a line through the pilot hole, connecting the line to a drilling head and pulling the drilling head from one gallery to the other while the drilling head is operating. The material disintegrated due to the drilling head contacting the coal must then be hauled out by whatever mechanical means is available.

By the process of this invention valuable raw materials, particularly coal, can be mined from an underground seam without the disadvantage of having to haul the mined coal by mechanical means, but instead the coal can be pumped out via a slurry. Further, by the process of this invention the coal can be hydraulically mined for example without having the resulting fluid washing back onto the working area in which the miners find themselves.

SUMMARY OF THE INVENTION

The process of this invention is a process for recovering valuable raw materials from an underground seam and comprises digging at least two spaced apart, and preferrably substantially parallel, trenches in the earth surface, the trenches at least extending into the underground seam; making at least one dipping passage extending between the trenches, the passage extending through at least the major portion of the seam; disintegrating the material in the side walls of the passage while simultaneously contacting the disintegrated material with a fluid so that a flowable mixture of said disintegrated material and the fluid flows through the passage toward the lower end thereof into one of the trenches; and lifting this flowable mixture out of the trench to the earth surface. This process is most suitably carried out using a device which hydraulically disintegrates, e.g., coal with water.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. I shows a section over a dipping seam taken in the direction of the dip.

FIG. II shows a top view of the earth surface overlying that part of the seam shown in FIG. I.

FIG. III shows (on a larger scale than FIGS. I and II) a longitudinal section over a bore in which a jetting head is arranged.

DETAILED DESCRIPTION OF THE INVENTION

The invention will be further explained by way of example with reference to a dipping coal seam. It will be understood that although in the following discussion only coal is mentioned as a material to be recovered from an underground layer by method according to the present invention, any other valuable raw material that can be disintegrated and simultaneously washed away with a suitable fluid can be recovered in the same manner as described hereinafter. Such other materials include mineral ores of various types known in the art and oil shale.

Referring first to FIG. **1**, it can be seen that the coal seam **1** dips from the left to the right side of the drawing, that is that coal seam is higher on the left side than on the right side. The underlying formation **2** and the overburden **3** consist of mineral material other than the coal and it is assumed these are not worth recovering.

Two trenches **4** and **5** which are preferably substantially parallel to each other are dug in the overburden **3** and extend into and substantially through the coal seam **1**, thereby exposing parts of the seam. The trenches are sufficiently wide to allow a working space for equipment and men, and have the walls of the face of the trench reinforced if prevailing conditions are such to require reinforcement. This reinforcement or supporting of the walls of the trenches may be arranged in any of the manners known in this art for this purpose, and the type of reinforcement does not form a part of this invention.

Subsequently, a number of holes or passages **6** dipping in the direction of the trench **5** are drilled through the coal seam **1**, each hole communicating at its ends with the trenches **4** and **5**, respectively (that is, the end of passage **6** found at trench **4** is higher than the end of passage **6** found at trench **5**). The drilling of the passages **6** is performed by equipment that is normally employed for drilling holes in coal seams. After a hole **6** (or series of holes) has been drilled the drilling equipment is removed from the trench. Then equipment is introduced into the trench **4** which will ultimately disin-

tegrate the material in the side walls of the passages extending between the trenches while simultaneously contacting the disintegrated material with a fluid to form a flowable mixture, e.g., a slurry, of the disintegrated coal and the fluid. Generally an extention 7 (see FIG. III) is introduced into the hole, the extension extending from trench 4 to trench 5. The extension is a means for transmitting power to a disintegrating device 8 which is used to dislodge the material from the seam while at the same time contacting it with water to form a slurry which flows down the passage way into the trench 5. The face 14 of the disintegretating head 8 may mechanically contact the coal seam while at the same time supplying water to the disintegrated material so that it is washed away into trench 5. Preferably the extension is a pipe 7 which is subsequently coupled to a jetting head 8 at the end of the pipe 7 where this pipe protrudes into the trench 5. Then a hydraulic hose 9 is coupled to the other end of the pipe 7. The other end of this hydraulic hose is coupled to an outlet of a pump (not shown) which supplies the water at a suitable pressure for the hydraulic action. Equipment known in the art and not shown in the drawing is placed in the trench 4, the equipment being adapted to move the pipe 7 through the passages 6, the conduit and the jetting head 8 coupled thereto may be rotated around their axes either continuously or intermittently. It can be seen that when a hydraulic jetting head 8 is employed in the process of this invention, the hydraulic pressure is the means by which the coal is disintegrated as well as the source of fluid which forms a flowable mixture with the disintegrated material. It can be further seen that by initiating the disintegration of the material at the lower end of the passageway 6 and progressing updip through the seam the operator of the device will not be working in water.

By suppling water under pressure via the pump and the hose 9 to the interior of the pipe 7, this water is transported to the jetting head and emerges therefrom under pressure in the form of a number jets 10 that are directed to the wall parts of the passageway 6 and the flowable water mixture (a slurry) resulting from this disintegration action flow through the passageway 6 (in the direction of the dip) and into the trench 5 where it is collected and passed on by suitable transporting equipment (not shown), such as a system comprising pumps and conduits to the surface of the earth. This way a transport is indicated by the dotted line 11 in FIG. I.

To remove the coal from seam 1 between the trenches 4 and 5 a large number of bores 6 are drilled through the seam all these bores extending between the trenches 4 and 5. The spacing between the bores is chosen such that the amount of coal not touched by the water jets during the passages of the jetting head 8 through the various bores 6 is as small as possible. The bores may be arranged according to any pattern suitable for the purpose.

If desired, more than one jetting head 8 may be passed through the seam 1 simultaneously through the bores 6. Also, more than one jetting head may be passed through a borehole. Thus, a jetting head for enlarging the bore 6 to a certain diameter may be followed by a jetting head suitable for further enlarging the diameter of the borehole. Mor than two jetting head may be used for this purpose. The jetting heads may be mounted on a single tube.

It will be appreciated that the tube on which a jetting head is mounted and by means of which it is passed axially through a bore, consists of more than one section. The sections are interconnected in fluid communication to each other by suitable coupling elements. During the axial passage of the jetting head through a bore, the length of the tube is decreased from time to time by removing the pipe section nearest to the hydraulic hose 9.

During removal of the coal around the bores 6, the remaining part of the coal seam is allowed to cave in. However, if the distance between the bores is chosen sufficiently large, the resulting honeycomb structure may have sufficient strength to support the overburden 3.

It will be appreciated that after the coal seam 1 located between the trenches 4 and 5 have been depleted, a further trench 12 (see dotted line in FIGS. 1 and 2) may be dug and the part of the coal seam 1 extending between the trenches 5 and 12 may be removed in the same manner as described above with reference to the trenches 4 and 5.

It will be understood that although the above method described with reference to FIGS. 1 and 2 has been applied to a dipping coal seam, this method may also be used for substantially horizontal coal seams, provided that the dip of the bores 6 is suffiently large to allow the coal/water slurry formed during the passage of a jetting head through these bores, to flow under influence of gravity to one of the two trenches between which the bores extend.

Although the trenches are arranged parallel to each other in the method described with reference to FIGS. 1 and 2, the present method may also be carried out by means of non-parallel trenches, if such an arrangement would be considered suitable at a particular site.

Further, the method according to the invention may be carried out simultaneously between more than one pair of trenches.

If coal is to be recovered from a dipping coal seam which starts at the highest point thereof with a small or even no overburden 3, this seam may first be strip-mined. When a depth has been reached at which strip-mining is no longer economic, a trench is made, and the method according to the invention is applied in the way as described with reference to FIGS. 1 and 2, with the difference that since part 1′ of the coal seam and part 3′ of the overburden have been completely removed, the trench 4 only consists of the wall 13.

It will be appreciated that application of the invention is not restricted to use of jetting heads of the type as schematically indicated with reference to the drawing. A great variety of jetting heads and jetting nozzles is known in the field of hydraulic mining techniques and those suitable for the purpose of being displaced through a passage in a coal seam with the object of disintegrating the coal surrounding such passage, can be applied with advantage.

Further, the pipe 7 which is used for passing the jetting head 8 through the seam 1, may be formed by the pipe which has initially served as drill pipe for drilling the bore 6. The drill pipe (7) is then left in the bore 6 after finishing the drilling operation. Subsequently the driving motor coupled to one end of the pipe and the drill bit coupled to the other end of the pipe are detached therefrom. Thereafter the hydraulic hose 9 and

the jetting head 8 are coupled to the ends of the pipe 7 in the manner shown in FIG. 3 of the drawing.

It may further be advantageous to arrange the bottom of the trench 5 in a sloping manner to promote the flow of water carrying the disintegrated coal to one end of the trench 5, where it is lifted from the trench along the transport way 11 (see FIG. 1).

I claim as my invention:

1. A process of mining valuable materials from an underground seam, which method comprises

digging at least two trenches in the earth surface, said trenches at least reaching into said seam;

making at least one dipping passage extending between the trenches, said passage extending through at least the major part of the seam;

disintegrating material in the side walls of said passage while simultaneously contacting the disintegrated material with a fluid so that a slurry of said disintegrated material and said fluid flows through the passage towards the lower end thereof into one of the trenches; and

flowing this slurry out of the trench to the earth surface.

2. The process of claim 1 wherein said underground seam is a coal seam.

3. The process of claim 1 wherein said material is hydraulically disintegrated with water.

4. The process of claim 1 wherein the step of disintegrating the material is initiated at the lower end of said passage and progresses updip.

5. The process of claim 1 wherein several dipping passages are made and sufficient coal is removed from the sidewalls of said passages to form a thin-wall honeycomb structure in said seam having sufficient strength to support overburden above said seam.

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