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Janssen

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[54] **MINING METHOD**

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[52] **U.S. Cl.** **299/13**, 299/18, 299/19

[51] **Int. Cl.**.....**E21c 41/10**

[58] **Field of Search**.....299/2, 11, 12, 13, 18, 19; 214/1 MS

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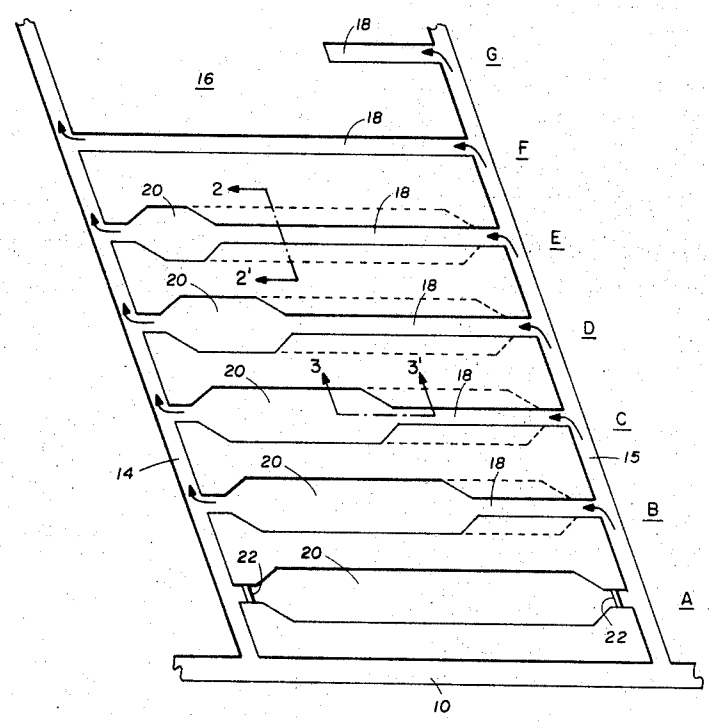
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[57] **ABSTRACT**

A chamber mining technique whereby a series of horizontal slopes 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. The mined-out area need not be entered and there is no need for support or scaling since failure of walls between stopes will at no time endanger men and equipment.

10 Claims, 3 Drawing Figures



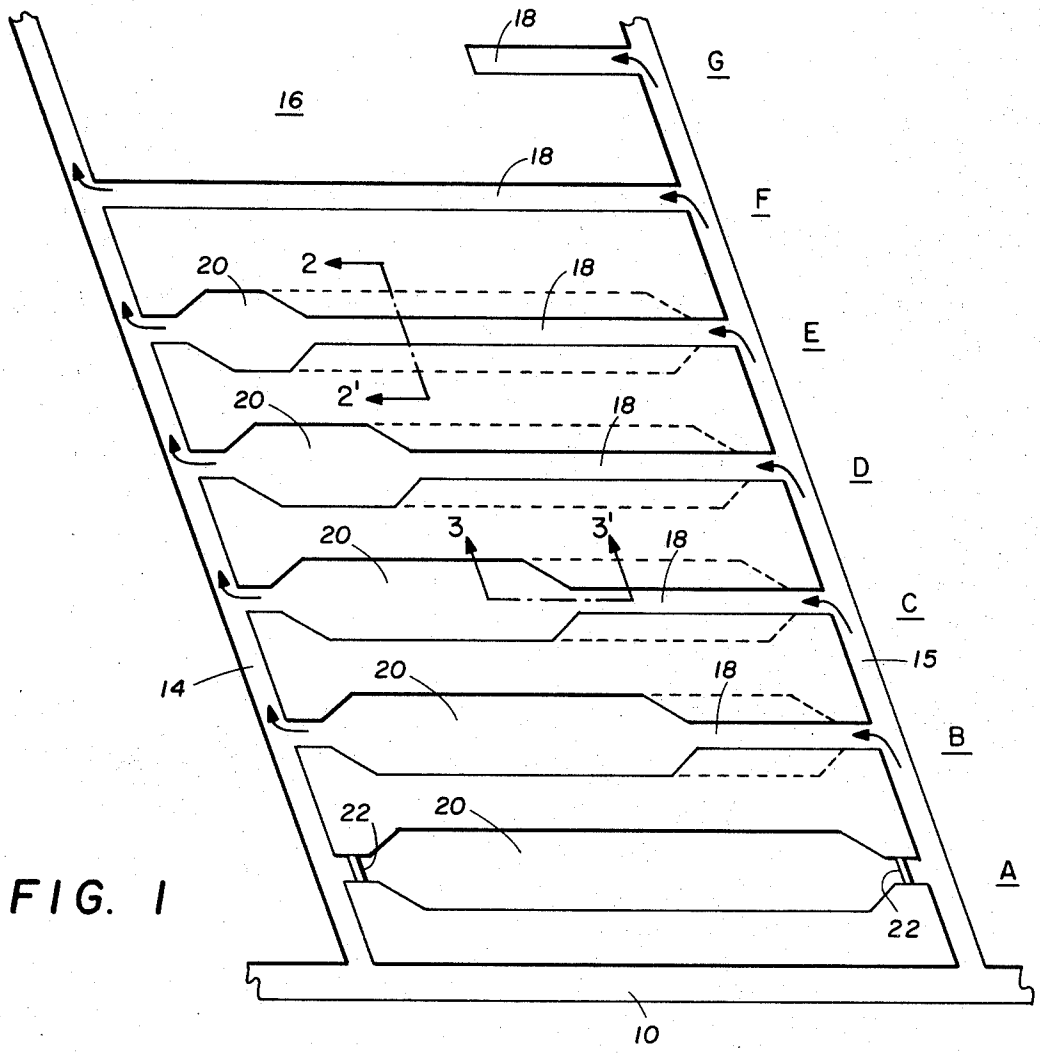


FIG. 1

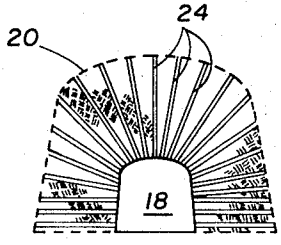


FIG. 2

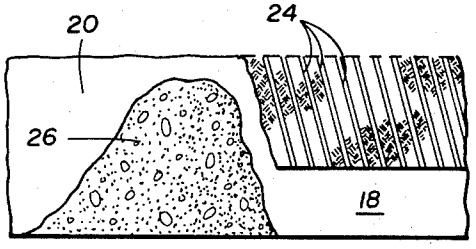


FIG. 3

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MINING METHOD

BACKGROUND OF THE INVENTION

This invention relates to mining operations and in particular to a retreat mining method which can be used in place of room-and-pillar and other conventional mining systems.

In mining flat, thick-bedded deposits of minerals, such as oil shale, a difficulty arises in that men and equipment have to move through large underground openings. As a consequence, these openings have to be supported and periodically scaled to render them safe for necessary mining operations. In addition, the openings left behind by conventional mining methods, such as room-and-pillar, do not easily lend themselves for disposal or stowing of waste materials such as tailings or spent shale.

Obviously, whether or not any mining method is practical in the long run depends on the economics. The method is used which is most economical at a high degree of reliability. In regard to oil shale, there has been a recent realization that the cost of roof and pillar control may make any room-and-pillar venture uneconomic.

What is needed is some new oil shale mining method where roof bolting and scaling operations are eliminated or minimized. Prime consideration should be given to mine health and safety by eliminating the need of men and equipment to move in large openings and providing for uncontaminated air to all working areas. Also, provision should be made to provide means for disposal of spent shale in worked out areas.

SUMMARY OF THE INVENTION

The present invention is based on the principle that flat, thick-bedded deposits of minerals can be mined by driving a crosscut between haulage and bleeder entries and recovering the ore by a retreat mining operation. The broken ore is transported from the working place directly into the crosscut so that the resulting stope need never be entered by men or equipment after the ore is loaded out. The ventilation flow is from the haulage entry through the crosscut and stope to the bleeder entry. After completion of a stope, bulkheads can be installed at both ends and the mined out opening filled with waste, tailings, etc.

Any number of crosscuts can be driven in parallel between the haulage and bleeder entries so that a series of stopes can be in operation side by side to attain desired production. By incorporating an overall retreat direction of mining, a high extraction percentage of the available ore can be obtained because the walls between chambers can be designed to take more pressure than pillars in room-and-pillar methods.

The mining method invented by Applicant is a much more economical system than room-and-pillar mining. The essential differences are that no men or equipment are required in mined-out areas so that bolting and scaling operations are not needed in the stopes. Other advantages are the simple ventilation system and ability to use the empty stopes for waste disposal.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a sectional view of a mining development according to the invention.

FIG. 2 is an enlarged section taken on line 2—2′ in FIG. 1.

FIG. 3 is an enlarged section taken on line 3—3′ in FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The invention will be described in conjunction with an oil shale mining operation; however, it is equally applicable and can be used to advantage in mining coal, lead-zinc, copper, or evaporites such as salt, trona, potassium, limestone, etc.

Referring to FIG. 1, a mining development is shown with stopes in different stages of operation in order to illustrate the overall mining method. From drift **10**, haulage entry **15** and bleeder entry **14** are driven horizontally into oil shale ore deposit **16**. Bleeder entry **14** is extended to an adit or shaft (not shown) connecting to the outside. From haulage entry **15**, crosscuts **18** are driven toward bleeder entry **14**. Upon completion of a crosscut, mining commences from the far end backward by drilling and blasting ore deposit **16** to form stopes **20**. After the shale is broken loose, it is conveyed through its crosscut to haulage entry **15** and then out of the mine through drift **10**. Ventilation air passes up haulage entry **15** into crosscuts **18** and stopes **20** and out of bleeder entry **14** as indicated by the arrows.

When a stope is mined out, it is closed off with bulkheads **22** on either one or both ends in order to increase the efficiency of the ventilation system. Where desired, the empty stope can be utilized as a waste material collector or to store spent shale. If waste material is introduced, it may be blown in from haulage entry **15** so that the dust is carried off by bleeder entry **14**; alternately, it may be hydraulically transported into the chamber.

FIG. **2** shows a cross-section of crosscut **18** prior to blasting. Blast holes **24** are drilled radially from crosscut **18** in upward and lateral directions. The ends of blast holes **24** define the boundary of stope or chamber **20**. As shown in FIG. **3**, the blast holes are drilled at a predetermined angle to limit the throw of the blasted rocks. Ore is removed from rock pile **26** backward through crosscut **18** prior to extending stope **20** by blasting the next section of ore. Material that is thrown too far and any large boulders are neglected.

Referring again to FIG. **1**, letters A, B, C, D, E, F, and G denote stope or chamber developments formed in ore deposit **16** in different stages of operation. Stope development A is the oldest while G is just starting. G shows the start of crosscut **18** and F shows its completion. E, D, C, and B show the development of stope **20** by a retreat chamber mining process whereby broken ore is collected at the stope end of crosscut **18** and carried to haulage entry **15**. In development A, stope **20** is complete and all the recoverable ore has been removed.

The dimensions of entries and crosscuts depend on space required and heading costs. The length of the crosscuts is a matter of economics since the stopes can be unlimited in longitudinal length. Distance between stopes and the pillar dimensions depend on the material being mined, overburden pressure, etc. Although pillar failure does not present any particular problem, support should be adequate to maintain the stopes if they

are to be used as storage bins. Only the entries need be bolted since the crosscuts should be stable for their comparatively short life span. Most important, there is no need to bolt the roof of the stope or to perform any scaling operations.

By way of example, the stope dimensions may be 60 × 60 feet and the distance between chambers on the order of 20–40 feet. The crosscuts should be no larger than necessary to accommodate equipment, e.g. 15 × 15 feet. The angle between the crosscuts and haulage entry may be anywhere between 90° and 45°.

Belts will follow the development work as closely as possible and, in the case of the crosscuts, are used for later stope production. Belts can be designed in detachable sections having a length equal to the round pull. The drilling of blast holes can be accomplished by mobile drill-jumbos with two or more drills. Since the pattern, when optimized, will be exactly the same for each stope, a high degree of mechanization, and perhaps automation, is possible.

After the shale is broken loose, it can be loaded with a front-end loader, with a side dump bucket, into a pan feeder. Thus, the loader can operate very efficiently since it need not wait for trucks to convey the ore to the pan feeder. From here the material can pass through an impact crusher, preferably equipped with a grizzly. The pan feeder and crusher should be mobile enough to move up to some extent as loading of a round progresses. The crushed ore is then conveyed through its crosscut to a main conveyor in the haulage entry and out of the mine.

The basic operational steps envisioned for the mining crew are as follows:

1. Move pan feeder and crusher rearward.
2. Shorten the belt and transport the detached section to another crosscut in development.
3. Drill the round.
4. Blast.
5. Move pan feeder and crusher toward the broken ore.
6. Start loading.

Many stopes can be in operation simultaneously in a stepwise manner as indicated in FIG. 1. Subsequent mining developments can be started by driving a second haulage entry parallel to the first haulage entry and using the latter as a bleeder entry. This process can then be repeated as often as desired by driving a new haulage entry each time. Instead of driving the development into the ore body, under some circumstances it may be desirable to start work at the periphery of the mining property and mine back toward the adit.

While a preferred embodiment of the invention has been shown, it is understood that the invention may be practiced in other ways and that various modifications and changes can be made within the spirit of the invention by those skilled in the art.

What is claimed is:

1. A method of mining thick-bedded minerals by a retreat chamber process comprising,

a. driving a drift to a mining zone,
b. driving haulage and bleeder entries into the mining zone,
c. driving approximately parallel straight crosscuts between the haulage and bleeder entries,
d. sectionally drilling and blasting radially outwardly from the walls and roof along the length of each crosscut, starting at the bleeder entry and working backward toward the haulage entry to enlarge the crosscut, leaving an unmined zone adjacent thereto, and
e. removing the broken ore resulting from the blasting.

2. A method according to claim **1** where ventilation flow is directed from the haulage entry through the crosscuts to the bleeder entry.

3. A method according to claim **1** where the resulting stopes are barricaded and backfilled with waste material.

4. A method according to claim **1** where a plurality of stopes are concurrently developed with new crosscuts being started when a stope is mined out.

5. A method according to claim **1** wherein the mineral being mined is oil shale.

6. A method of mining thick-bedded materials by a retreat chamber mining process comprising,

a. driving haulage and bleeder entries to define the longitudinal boundries of the chambers,
b. driving a series of parallel straight crosscuts between the haulage and bleeder entries,
c. drilling and blasting the top and sides of the crosscuts to form the chambers while retreating toward the haulage entry, and
d. removing the broken ore.

7. A method according to claim **6** where the crosscuts are drilled and blasted so that adjacent chambers are in progressive stages of development.

8. A method according to claim **6** where a bulkhead is installed at at least one end of each chamber as it is mined out.

9. A method according to claim **6** where oil shale is the mineral being mined.

10. A method according to claim **9** where spent shale is deposited in the empty chambers.

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