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Pennington et al.

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[54] **TRONA MINING METHOD**

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[52] **U.S. Cl.** **299/11,** 299/44

[51] **Int. Cl.** **E21c 41/08**

[58] **Field of Search** 299/11

[56] **References Cited**

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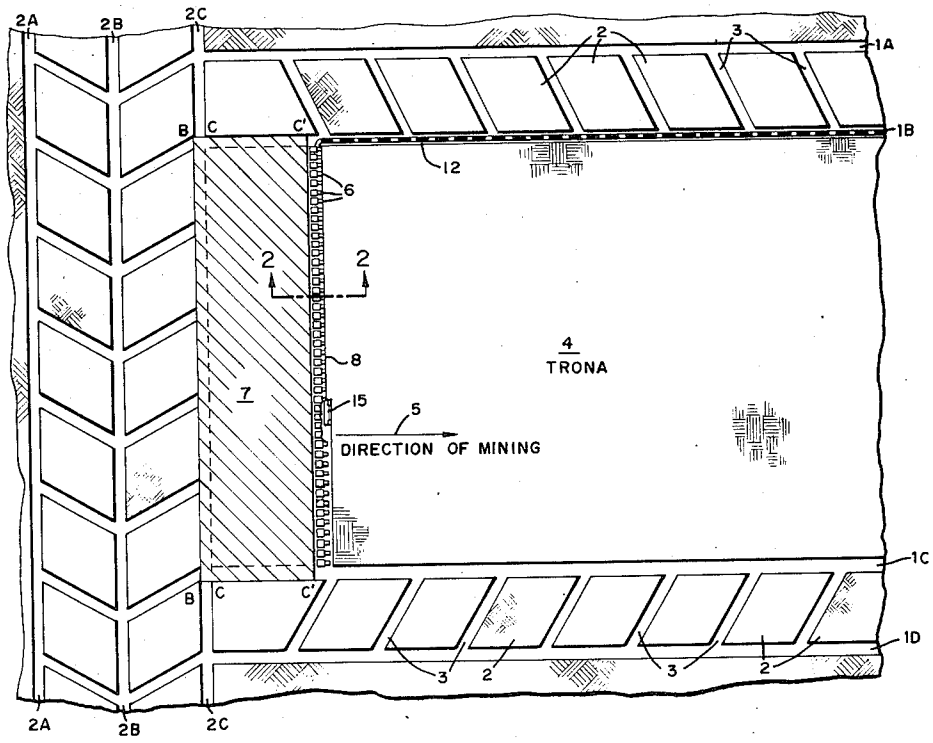
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[57] **ABSTRACT**

In the mining of a substantially horizontal bed of trona, stronger than the overlying and underlying strata, the method of driving substantially parallel entries into the trona formation, connecting said entries by at least one primary passage thereby defining the main trona pillar to be mined, supporting the roof of a primary passage by means of a movable roof supporting structure and mining the exposed face of the trona pillar under the protection of the roof supporting structure, removing the mined material and advancing the supporting structure so that it remains essentially adjacent and parallel to the mine face as it recedes, continuously advancing the roof supporting structure to incrementally effect caving of the previously supported roof and continuing the mining of the exposed face of the trona pillar under the protection of the roof supporting structure, removing the mined material and advancing the supporting structure so that it remains essentially adjacent and parallel to the mined face as it recedes.

3 Claims, 2 Drawing Figures



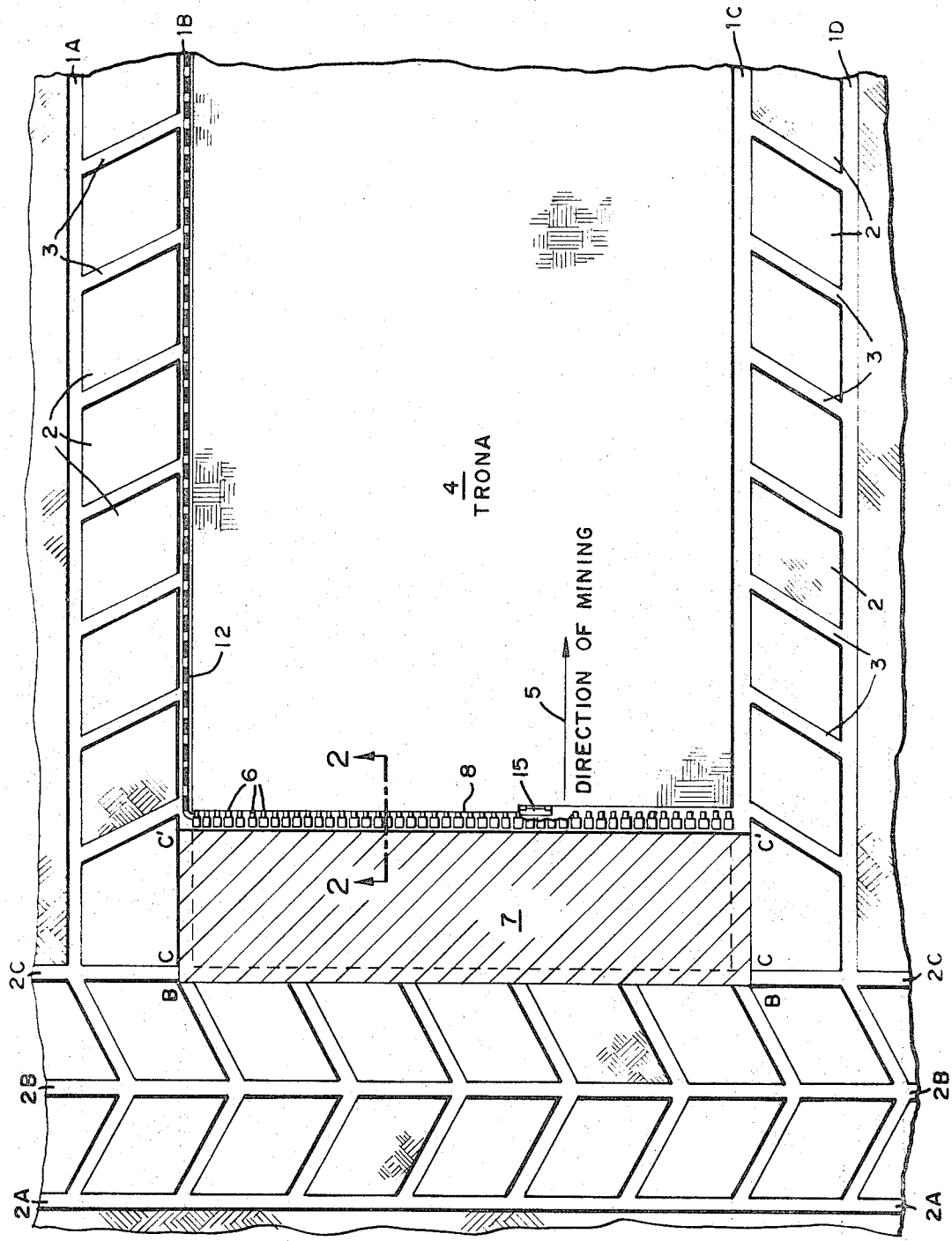
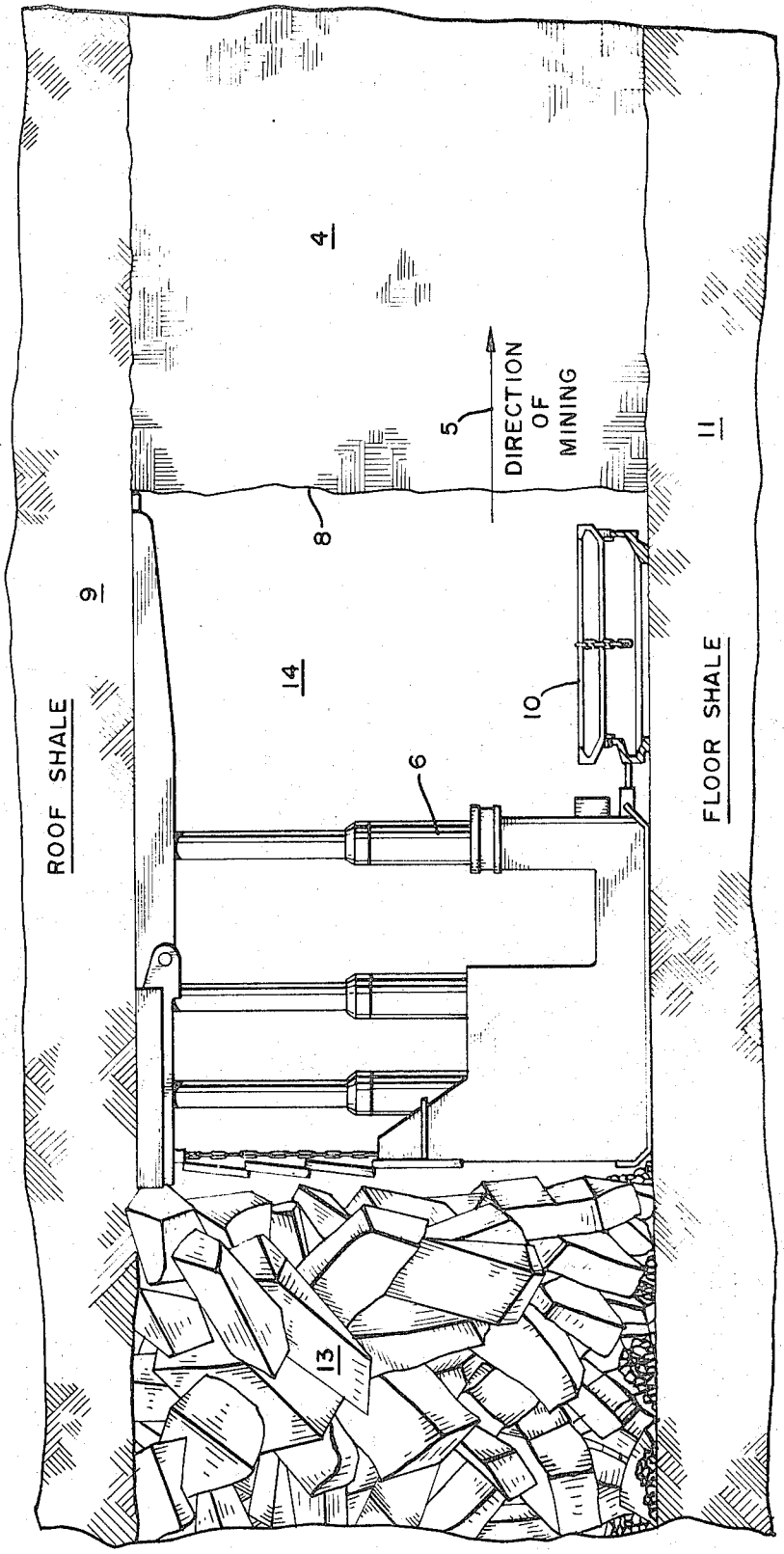

1A
1B
1C
1D
2
3
4
TRONA
5
DIRECTION OF MINING
6
7
8
12
15
2A
2B
2C
B
C
C'

FIG. 1

FIG. 2



TRONA MINING METHOD

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a method of mining trona which permits efficient removal of subterranean deposits of this naturally occurring ore.

Trona, having the formula Na_2CO_3 $NaHCO_3$ $2H_2O$, is presently mined in the United States from trona deposits located in Southwestern Wyoming. The underground deposits are in the form of horizontally extended beds having a thickness of from about 5 to about 15 feet, located at a depth of from about 800 to about 2,000 feet below the surface. A trona bed normally lies between two horizontally extending strata of shale. Both the overlying and underlying strata usually have compression strengths in the order of about 3,700 psi and are substantially weaker than the trona bed per se, which has a compression strength of about 7,500 psi. Furthermore, the tensile strength of the trona is greater than that of the underlying shale layers and of the overlying strata which is particularly low.

2. Description of the Prior Art

Because the surrounding geological formations are weaker than the trona bed, special techniques have been devised for mining trona to prevent caving of the roof into the mined cavity. One technique commonly used in mining trona is the room and pillar mining system. In this system, essentially rectangular tunnels are cut in the trona formation. These are termed "secondary entries." Substantially parallel rooms which are about 15 feet wide, spaced about 50 to 60 feet apart, are driven into the bed from the secondary entries, using a continuous mining machine. The pillars of trona which remain between the rooms are then extracted by driving tunnels called lifts through the pillars. The lifts are separated from the mined out area by a fender (wall) of trona on the order of 5 feet thick or less. When the lift is completed, the fender is removed by blasting and the resulting unsupported roof adjacent to the previously mined out area is caved. This sequence is repeated and upon completion of one lift, the fender is blasted and the next parallel lift is begun.

Another variation is the method of mining trona disclosed in U.S. Pat. No. 3,402,968, issued to William P. Fischer on Sept. 24, 1968. In this method, secondary supporting pillars are left of such size that they are gradually crushed by the weight of the overburden. The roof bends downwardly as an integral layer toward the previously mined areas, sloping away from the face of the main trona pillar being mined, until the roof has completely caved in on that portion of the mined area that contained the oldest and now completely crushed row of supporting pillars. In this manner, the main trona pillar can be extracted by rooms and cross-cuts to form additional rows of supporting pillars while the roof continues to bend downwardly toward the previously mined area away from the face of the main pillar being mined. A disadvantage of this mining method is that the trona comprising the secondary support pillar is lost.

It is an object of the present invention to provide for the continuous mining of trona by a process which not only eliminates the need for the blasting of fenders, but permits efficient and more complete removal of trona with minimum upset to the environment.

This and other objects are accomplished according to our invention which comprises driving substantially parallel entries into the trona formation, connecting said entries by at least one primary passage thereby defining the main trona pillar to be mined, supporting the roof of a primary passage by means of a roof supporting structure, mining the exposed face of the trona pillar under the protection of the roof supporting structure, removing the mined material and advancing the supporting structure so that it remains essentially adjacent and parallel to the mined face as it recedes, continuously advancing the roof supporting structure to incrementally effect spontaneous caving of the previously supported roof and continuing the mining of the exposed face of the trona pillar under the protection of the roof supporting structure, removing the mined material and advancing the supporting structure so that it remains essentially adjacent and parallel to the mined face as it recedes.

In general it is desirable to plan the placement of the entries and primary passages so that the face or longwall of the trona pillar to be mined is substantially parallel to the fracture pattern of the trona. Generally, the fracture pattern of the overlying shale is also parallel to that of the trona and when the direction of the shearer-loader or plow is parallel to these patterns, the best results are achieved and better control of caving is had.

BRIEF DESCRIPTION OF THE DRAWINGS

Referring now to the drawings which illustrate the preferred embodiment of the practice of the invention:

FIG. 1 is a plan view of a mine level, illustrating the application of the present invention in the extraction of a trona pillar or "panel" as mining progresses.

FIG. 2 is a sectional view on an enlarged scale along line 22 of FIG. 1, illustrating one method of supporting the overburden adjacent to the longwall. In the plan view illustrated in FIG. 1, two sets of parallel entries are shown; the first comprising interconnected passageways 1A and 1B, the second comprising the interconnected passageways 1C and 1D. These two sets of parallel entries are connected by primary entries shown as 2A, 2B, and 2C. These entries then define a pillar or panel of trona to be mined shown as numeral 4.

As illustrated in FIG. 1, when mining of this panel was initiated, entry 2C was complete for its full length and the roof of section BB was supported Beneath this support, the exposed longwall of trona CC representing one end of the trona panel 4, was mined along its entire face. The mining of the trona panel therefore proceeded in the direction of arrow 5 and the roof supports, beneath which the mining operation was carried out, were made to follow the receding longwall in direction 5, to thus continuously protect the mining area.

Because of the weakness of the overlying roof, the pressures and stresses to which it is subjected and the fracture patterns therein, the roof spontaneously caves, thus filling the area behind the roof support as it moves. Generally, this spontaneous collapse will occur when a roof support has been moved to expose no more than about 4 to 18 feet of unsupported roof. Preferably the incremental caving should occur in units of 10 feet or less. If a strip of unsupported roof having a width of more than about 18 feet has not caved, it is induced to do so.

In FIG. 1, the roof supporting members 6 have been moved from position CC to position C'C' and the en-

tire area 7 has spontaneously and progressively collapsed as the area has been mined and the roof supporting members 6 have been moved in the direction 5 to their position C'C'. As mining continues in the direction of 5, the entire trona pillar or panel 4 will be mined and the space will have been filled incrementally as a result of the progressive and spontaneous collapse of the roof.

In FIG. 2, which is an enlarged section through 22 of FIG. 1, one type of movable roof support is shown as FIG. 6. It has been moved against the exposed face 8 of trona, which is being mined. Numeral 4 represents the unmined trona and 9 and 11 represent the structurally weak overlying and underlying rock between which the trona strata is sandwiched. The mining operation is progressing in the direction of the arrow 5 and the supporting member 6 is made to follow the retreating wall 8. Numeral 10 represents a conveyor which moves parallel to the face or longwall of trona and is caused to remain adjacent to the face throughout the mining operation, to thus carry the mined trona out of the mining area. In FIG. 1, a conveyor, 12, is also shown as it moves out of entry 1B. In FIG. 2, numeral 13 represents the collapsed roof or "gob" behind the roof supporting member 6 as it is moved in direction 5.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In the preferred method of the present invention, the entryways are about 15 feet wide and substantially as high as the thickness of the bed of trona being mined. Commonly, this height is about 8 feet. Cross-cuts shown as 3 in FIG. 1 are made between the entryways to define roof supporting pillars shown as numeral 2, which are about 100 feet long and 100 feet deep. These entryways are preferably cut with a continuous mechanical miner. The entryways are used for ventilation, for routing the conveyor to and from the trona face being mined, and for the movement of men and equipment. The manway which is also the mining area is shown as numeral 14 in FIG. 2, and is at all times under the protection of the roof supporting member 6. Preferably, this roof supporting member may be a movable and adjustable hydraulic "chock" such as the Gullick Dobson rigid roof support unit marketed by B. Joy Manufacturing Co. A double drum shearer-loader is preferred for mining the trona longwall. Such a unit has two ranging rotary arms which can be positioned at the desired height during cutting. Such a device allows a full seam section cut in either direction of travel, thereby assuring rapid face advance. Eickhoff plows are also applicable to trona mining, particularly when the panel has been selected so that the longwall is substantially parallel to the fracture pattern of the trona. Both of these mining machines are also marketed by the Joy Manufacturing Co. In FIG. 1, the location of the shearer-loader or plow is represented as numeral 15. The aforementioned shearer-loader can remove the trona face to a depth of two feet in one pass. Since the structural strength of the roof largely depends on the thickness of the overhead trona layer retained during the mining operation, one way of controlling or inducing spontaneous caving of the roof is to reduce the thickness of this trona layer. This also has the advantage of enhacing the yield.

The method of the present invention offers several advantages over many of the mining methods now employed. By permitting spontaneous incremental caving of the roof, the hazards of a large roof fall are avoided. Furthermore, the need for roof bolts and the dangers inherent in their removal, and in the losses involved, are eliminated. All of the trona of the panel is recovered and no pillars or portions need to be left underground as in past practices. Methane gas which is generally released in large volumes with the collapse of a large roof area is released slowly with this method which permits the incremental spontaneous caving, and therefore, incremental gas release in amounts which can be readily handled by the ventilating system.

While we have described a preferred embodiment of our invention, it will be understood that various modifications and changes can be made in the mining plan described, without departing from the spirit of this invention or the scope of the following claims.

We claim:

1. A method of mining subsurface deposits of trona which comprises:
   a. driving substantially parallel entries into a trona formation and connecting said entries by at least one primary passage thereby defining the main trona panel to be mined;
   b. supporting the roof of the primary passage by means of movable roof supporting structures;
   c. mining the exposed longwall face of the trona panel under the protection of the roof supporting structures, said longwall face being substantially parallel to the facture pattern of the trona;
   d. removing the mined trona;
   e. advancing the supporting structures so that the support remains substantially adjacent and parallel to the mined face as it recedes;
   f. incrementally caving the previously supported roof; and
   g. advancing the supporting structures as the mining proceeds sufficiently to effect spontaneous incremental caving of the previously supported roof.

2. The method of claim 1 wherein incremental caving is effected before no more than 18 feet of unsupported roof is exposed by the movement of the supporting chocks.

3. The method of claim 1 wherein trona is removed from the roof in an amount sufficient to weaken the structure, to induce incremental spontaneous caving.

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