Sept. 24, 1968 W. G. FISCHER 3,402,968

METHOD FOR MINING TRONA

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FIG. 2.

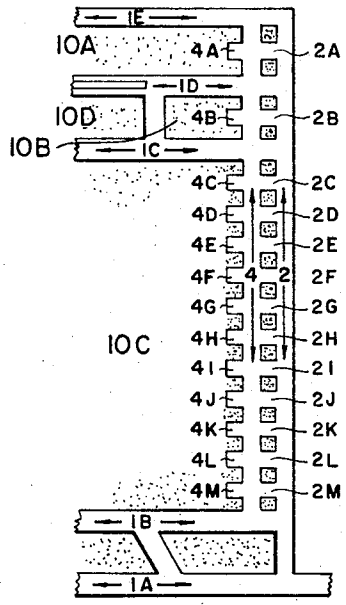


FIG. 1.

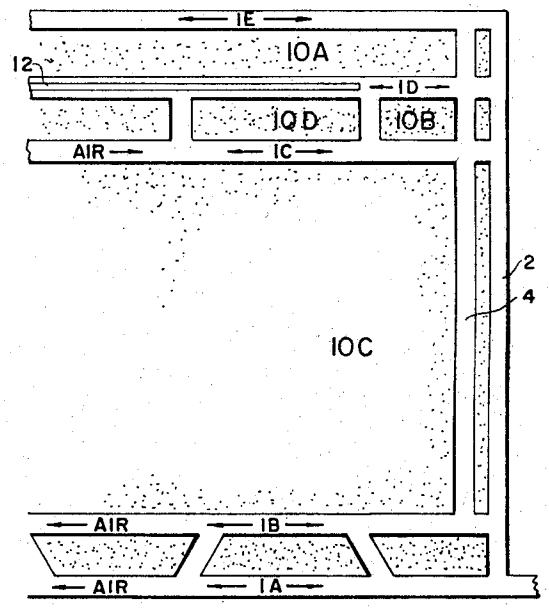


FIG. 3

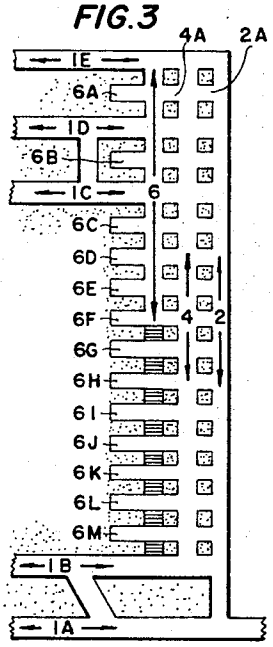
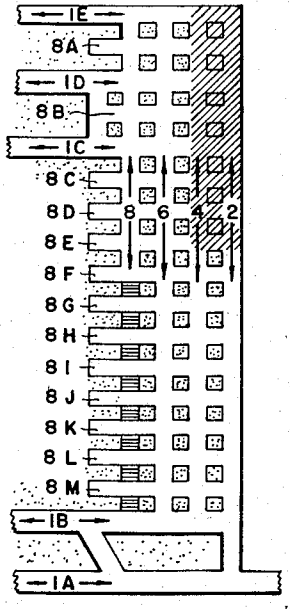


FIG. 4



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METHOD FOR MINING TRONA

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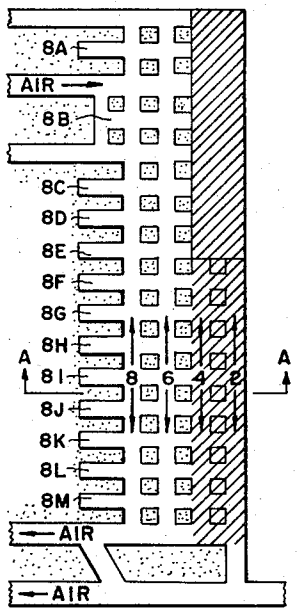
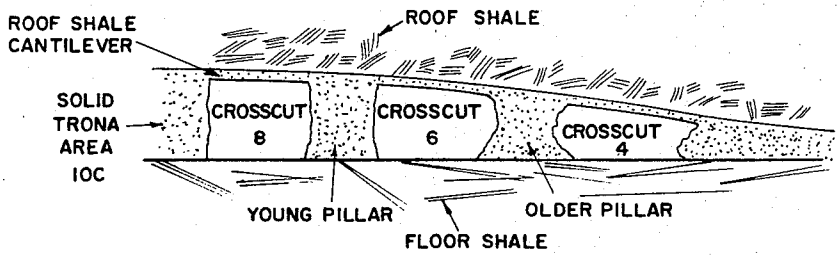


FIG. 5.

FIG. 6.



DIRECTION OF MINING

SECTION A A

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METHOD FOR MINING TRONA

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ABSTRACT OF THE DISCLOSURE

In the mining of a horizontal bed of trona located between earth formations that are not as strong as the trona, roof supporting pillars of trona are left behind, which gradually yield, as a function of time and load, and eventually crush out. This allows the mine roof to bend downward as an integral layer towards the previously mined areas and finally to completely cave the previously mined areas in a controlled manner without localized caving of the roof of the mine.

Background of the invention

(A) *Field of the invention.*—The invention relates to the method of mining trona mineral in order to obtain gradual, controlled bending of the mine roof, as an integral layer, in the mined areas until these areas are completely caved in.

(B) *Description of the prior art.*—Trona mineral, having the formula $Na_2CO_3 \cdot NaHCO_3 \cdot 2H_2O$, is presently mined in the United States from trona deposits located in southwestern Wyoming. The underground deposits are in the form of horizontally extending beds having a thickness of from about 7 to about 13 feet located at a depth of from about 900 to about 1800 feet below the ground. A trona bed normally lies between two horizontal extending strata of shale. Both the overlaying and the underlaying strata of shale have compression strengths on the order of about 3700 p.s.i. and are substantially weaker than the trona bed per se which has a compression strength of about 7500 p.s.i. Because the surrounding formations are weaker than the trona bed per se, special techniques have been devised for mining trona to prevent caving of the roof and buckling of the floor into the mining 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. 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 narrow fender of trona on the order of 5 feet or less. When the lift is completed, the fender is removed by blasting and the resulting unsupported roof adjacent the previously mined out area is caved. This caving of the mined out area relieves some of the roof and floor pressure adjacent these areas. This sequence is repeated, and upon completion of one lift the fender is blasted and the next parallel lift is begun.

One refinement in this technique which has been developed is that described in U.S. Patent 3,097,830 issued to Robert F. Love et al. on July 16, 1963. In this technique a first room is driven between a second room used for mining a pillar of trona and the still unmined areas; the first room is then deliberately collapsed next to the second room in which mining is to be conducted. In this way pressure over limited areas to be mined is relieved.

While the above patented process is a material improvement in the conventional room and pillar technique for mining, it still does not solve the basic problem of relieving the pressure over the mined areas of the trona bed. The basic room and pillar technique nevertheless requires the blasting of fenders and the complete collapse of designated portions of the mined out area to relieve the overburden pressure. This is undesirable because the roof collapse or caving takes place all at once and requires carefully supervised blasting techniques. This introduces an element of hazard since the extent of caving is sometimes difficult to control.

As a result, there is a need for a mining technique which will relieve such pressure, without resorting to sporadic, complete cave-ins.

Summary of the invention

A method for mining trona has been found that relieves the overburden pressures created in the mine by gradual, controlled bending of the mine roof, comprising, driving substantially parallel entries into a trona formation and connecting the entries by at least one primary passage, thereby defining a main trona pillar to be mined, located between said entries and said passage, driving a series of rooms into the face of the main trona pillar and leaving secondary pillars between said rooms, driving cross-cuts through said secondary pillars and forming an initial row of trona supporting pillars of predetermined size, continuing to drive rooms into the face of the main trona pillar, thereby forming additional secondary pillars and continuing to drive crosscuts through the additional secondary pillars to form additional rows of trona supporting pillars, said trona support pillars being of a predetermined size that will allow them to be gradually compressed by the weight of the roof so that the roof bends downward, as an integral layer, towards previously mined areas with increasing pitch way from the face of the main trona pillar being mined, until the oldest row of support pillars have been crushed and the roof has caved in on that portion of the mined area that contained the oldest row of supporting pillars. In this manner, the main trona pillar can continue to be extracted by rooms and crosscuts to form additional rows of support pillars while the roof continues to bend downward with increasing pitch towards the previously mined area away from the face of the main pillar being mined.

Brief description of the drawings

In the drawings:

FIGURE 1 is a plan view of a mine level illustrating the application of the present invention;

FIGURE 2 and FIGURE 3 illustrate the mine level as mining progresses;

FIGURE 4 and FIGURE 5 show collapsing of a portion of the mine under controlled conditions after increased mining beyond the stage shown by FIGURES 1 through 3.

FIGURE 6 is a sectional view on an enlarged scale along the lines A—A of FIGURE 5.

Description of the invention and the preferred embodiments

The present invention utilizes a mining technique in which supporting pillars of trona left behind are of a size that is predetermined so that they gradually yield as a function of time and load and eventually are crushed. This allows the mine roof to be bent slowly downward, as an integral layer, towards previously mined areas and permits the slow downward deflection of the mine roof in the mined out areas without the need of constant blasting and sometimes uncontrollable caving. The controlled caving permits the overburden pressure to be relieved

over a greater portion of the mined area and eliminates or minimizes localized cavings.

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

In FIGURE 1, a 4-entry secondary development made up of entries **1***a*, **1***b*, **1***c*, and **1***d* are joined together by two passages, **2** and **4** connecting the entries together. Entry **1***e* is the lower entry of a previous 4-entry secondary development. The entries and the passages are preferably cut using a continuous miner such as described in U.S. Patent 3,111,306 issued to Robert F. Love et al. on Nov. 19, 1963. The mining operation then begins as shown in FIGURE 2.

As shown in FIGURE 2, the pillar lying between passages **2** and **4** is mined by cutting rooms through the pillar at locations **2***a*, **2***b* etc. to **2***m*. This leaves an initial row of supporting pillars of a size predetermined in accordance with the discussion hereinafter. Mining of the pillar **10***a*, **10***b* and main pillar **10***c* is then commenced by cutting rooms into the face of these pillars as shown in FIGURE 2 at locations **4***a*, **4***b*, **4***c* etc. to **4***m* and leaving secondary pillars between the rooms. Turning now to FIGURE 3, after the rooms are of sufficient depth, a crosscut **6** is cut through the secondary pillars, between the rooms, leaving support pillars, e.g. the support pillars between **4***c* and **4***d* and between **4***d* and **4***e*, etc. FIGURE 3 shows crosscut **6** being cut through these secondary pillars leaving a second row of supporting columns of trona. Additional rooms **6***a*, **6***b*, **6***c* etc. to **6***m* are then continued to be cut into the face of the trona pillars.

The term "rooms" is used herein to denote the initial cuts made into trona pillars during the mining operation. The term "crosscuts" refers to the cavities driven at essentially right angles to the rooms to extract the trona present in the pillars remaining between the rooms.

As the faces of the pillars continue to be mined the trona support columns which remain to support the ceiling commence to gradually yield, the extent of yielding increasing with the age of the support pillar. Accordingly, the roof of the mine, beginning at the mining face, commences to slope downward towards passage **2** (passage **2** and **4** can be considered initial crosscuts, if desired, because they are parallel to the subsequent crosscuts). When sufficient amounts of the trona pillars have been mined, the roof continues to lower as the older pillars continue to yield and finally are crushed. When this occurs the roof of the mine collapses completely onto the floor of the mined out areas located at passages (or crosscuts) **2** and **4**.

This is illustrated in FIGURE 4, in which the mined out area, i.e. the area in which collapse of the ceiling finally takes place, is shown by cross hatching. FIGURE 4 also shows the result of additional mining of the pillars **10***a* (all of **10***b*), **10***c* and **10***d*. An additional cross cut **8** is also shown driven to room **8***f*.

Turning to FIGURE 5, mining is then continued into the face of pillars **10***a*, **10***c*, and **10***d* and crosscut **8** is then driven through the secondary pillars between the rooms until it cuts through the pillar bounded by room **8***m* and entry **1***b*. When this occurs the roof of the mine finally lowers to a point where the pillars between the crosscuts **2** and **4** in areas **2***g* to **2***m* eventually are crushed and the mine roof collapses onto the floor. This is shown in FIGURE 5, wherein the collapsed area is shown by cross hatching.

FIGURE 6, which is a sectional view on an enlarged scale along the line A—A of FIGURE 5, illustrates the lowering of the roof and the gradual yielding of the pillars with age until finally the oldest pillars crush out and the roof caves in. It should be noted that the roof lowers towards the worked out portion of the mine in a cantilever style and lowers uniformly over the entire mined area without individual breakthroughs or cavings.

In the operation of this process the rooms can be cut in sizes of from about 15 to 12 feet and the crosscuts on the order of about 15 feet, leaving support pillars of from about 11 to 15 feet thick with about 12 feet being preferred. Where rectangular supporting pillars are utilized, the rooms can be driven on 25 foot centers about 12 feet wide leaving pillars about 13 feet thick and the crosscuts can be spaced on 37 foot centers leaving support pillars of trona 22 feet long. The remaining supporting pillars of trona, 13 by 22 feet, become reduced to a size of about 10 by 18 feet by natural rib sloughing or by spalling of trona from the pillars. This size supporting pillar, namely 10 by 18 feet, has been found to yield at a rate which permits effective mining of the remaining trona pillars. Obviously the exact dimension of the pillars will vary depending on the depth of the mine, the strength of the rock strata, and the rate at which it is desired to have the supporting pillars yield.

Local conditions sometimes make it necessary to adjust pillar sizes relative to the mined area by eliminating a room or changing the center to center distance between crosscuts. This can be done most conveniently by mining the most recent crosscuts flush with the advancing room faces and marking off the rooms at the new width and spacing on the face of the large trona pillar being mined.

In the preferred embodiment set forth in the drawings, the rooms are cut in a direction parallel to the entries into the main trona pillar while the crosscuts are cut through in a direction perpendicular to the entries. However, it should be understood that any face of the main trona pillar can be mined in substantially the same way regardless of whether the rooms are parallel to the main entries or perpendicular thereto.

Ventilation of the working area is carried out through entries **1***a*, **1***b*, **1***c* and **1***d*, and through the crosscuts that connect the entries in the manner shown on the drawings. Because there is always a crosscut which connects the entries at the face of the pillar being mined, good circulation of air is obtained. The movement of machines, supplies and personnel, and the removal of trona are accomplished through the entries. A belt conveyor **12** is normally employed to remove trona and is situated along a substantial length of one of the entries **1***d*.

Pursuant to the requirements of the patent statutes, the principle of this invention has been explained and exemplified in a manner so that it can be readily practiced by those skilled in the art, such exemplification including what is considered to represent the best embodiment of the invention. However, it should be clearly understood that, within the scope of the appended claims, the invention may be practiced by those skilled in the art, and having the benefit of this disclosure otherwise than as specifically described and exemplified herein.

What is claimed is:

1. A method of mining trona and relieving overburden pressures by gradual, controlled bending of the roof of a mine which comprises, driving substantially parallel entries into a trona formation and connecting said entries by at least one primary passage thereby defining a main trona pillar to be mined located between said entries and said passage, driving a series of rooms into the face of the main trona pillar and leaving secondary pillars between said rooms, driving crosscuts through said secondary pillars and forming an initial row of trona supporting pillars of predetermined size, continuing to drive rooms into the face of said main trona pillar thereby forming additional secondary pillars and driving crosscuts through said additional secondary pillars to form addditional rows of trona supporting pillars, all of said trona support pillars being of a size sufficient to be gradually compressed by the weight of the roof so that the roof bends downward, as an integral layer, towards previously mined areas with increasing pitch away from the face of the main trona pillar being mined until the oldest row of support pillars have been crushed and the roof has caved in on that portion of the mined area that contained the oldest row of support pillars, and continuing

to extract the face of the main trona pillar by rooms and crosscuts to form additional rows of support pillars while the roof continues to bend with increasing pitch away from the face of the main pillar being mined and towards previously mined areas.

2. Method of claim 1 wherein said supporting trona pillars are substantially square and have sides of from about 11 to about 15 feet.

3. Method of claim 1 wherein said supporting trona pillars are substantially rectangular and are from 18 to 22 feet long and 10 to 13 feet thick.

References Cited

UNITED STATES PATENTS

2,155,415	4/1939	Fletcher	299—19 X
2,874,945	2/1959	McWhorter	299—11
3,111,306	11/1963	Love et al.	299—11

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