March 20, 1962 R. F. LOVE 3,026,096

METHODS FOR CONTROLLING UNDERGROUND WATER

Filed April 12, 1960 2 Sheets-Sheet 1

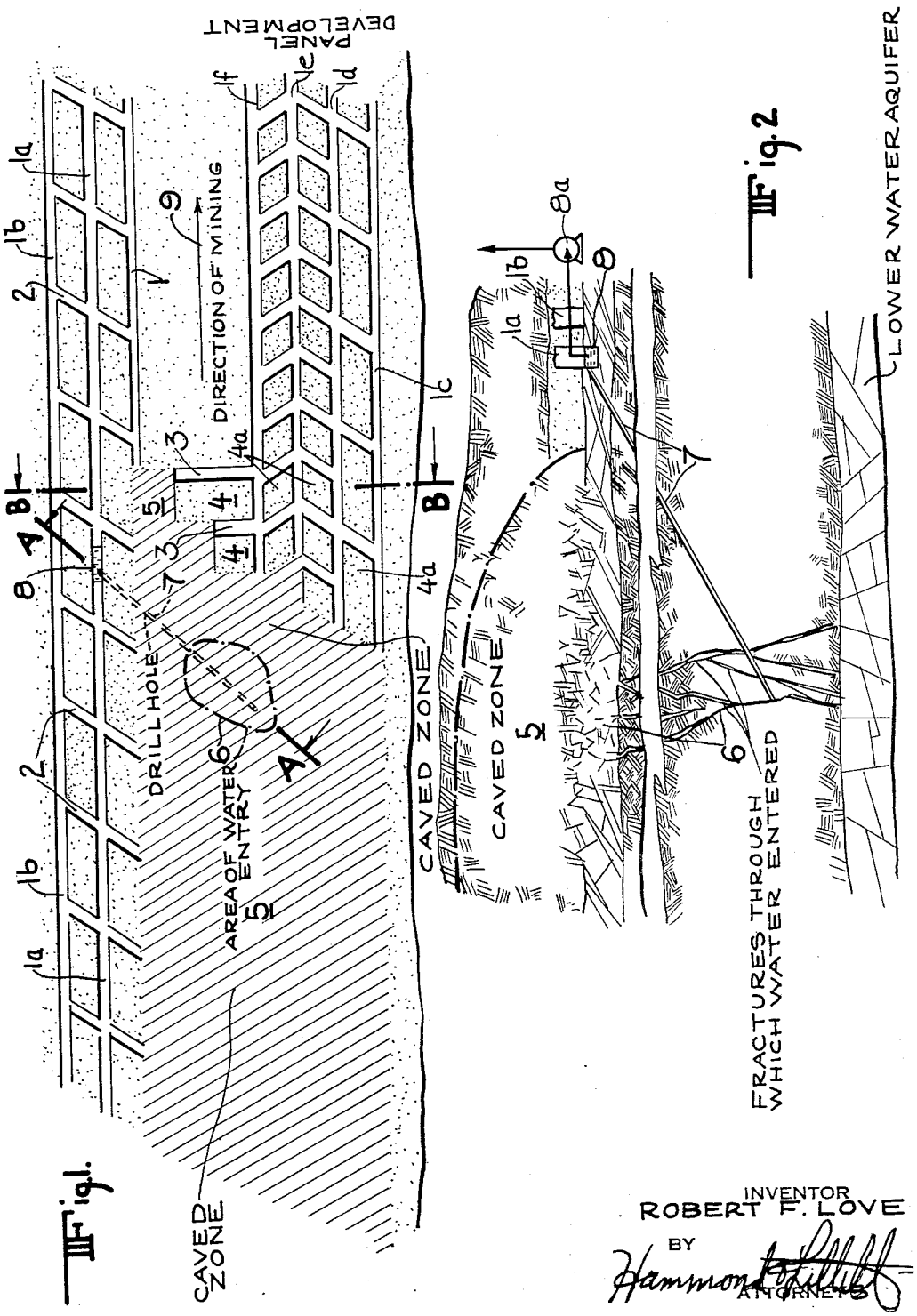


Fig. 1.

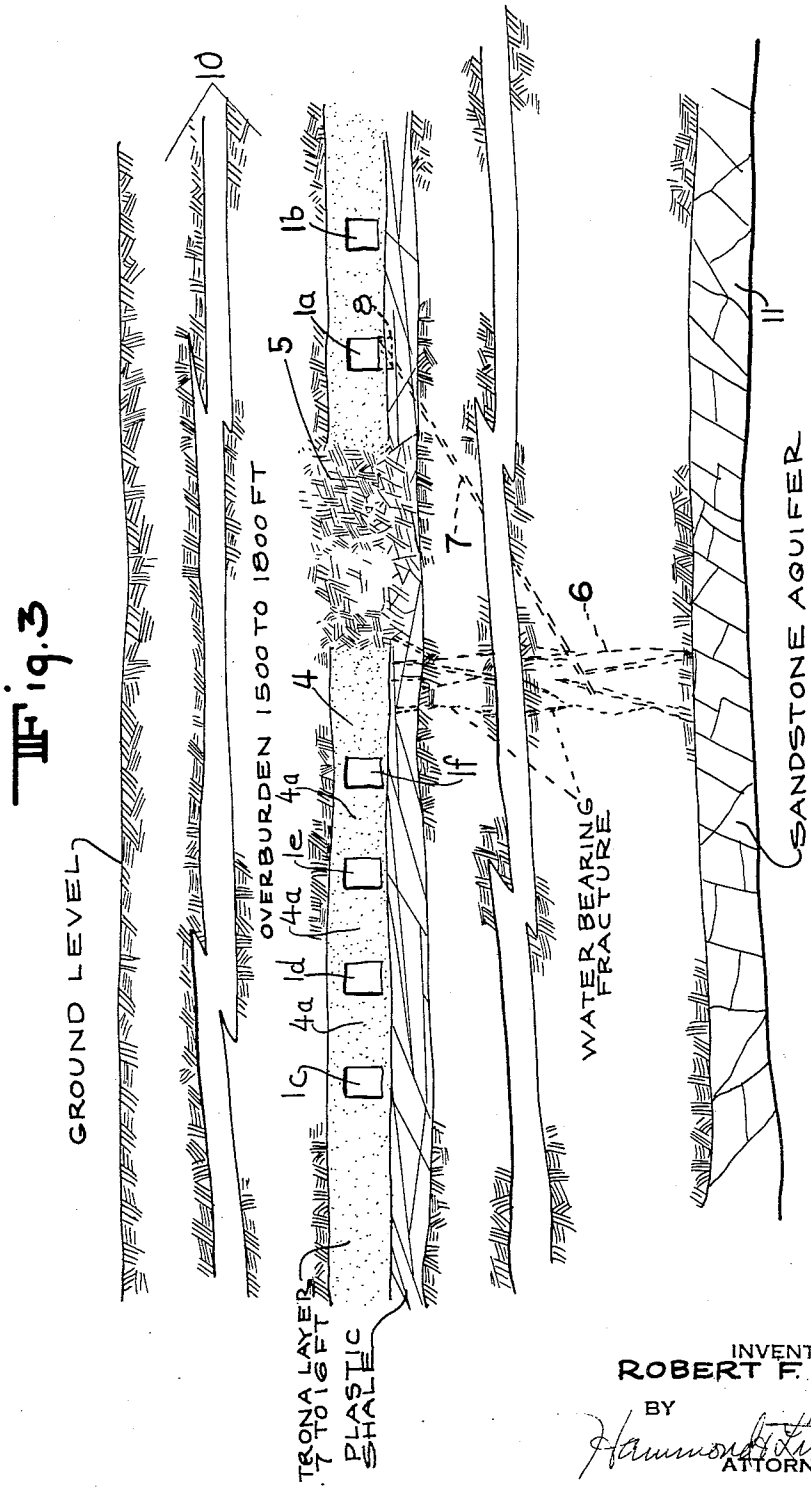
Fig. 2

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METHODS FOR CONTROLLING UNDERGROUND WATER

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METHODS FOR CONTROLLING UNDERGROUND WATER

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This invention relates to a method of controlling water in trona mining operations.

In Sweetwater County and adjacent counties in southwestern Wyoming large deposits of trona

$$(Na_2Co_3NaHCO_32H_2O)$$

have been found, which are mined by methods similar to those used in coal mining operations. The mined trona is processed to produce soda ash. These trona deposits lie in beds of varying thickness up to about 16 feet thick, averaging more nearly 7 to 13 feet, and are at a depth of about 1500 to 1800 feet underground.

The main trona beds lie substantially horizontal. The overlying strata are also horizontal in attitude and are chiefly composed of unconsolidated shales and fine grained sandstones. The 400 feet of strata immediately above the main trona bed are mainly weak, laminated grey shales and oil shale and an approximately 8 foot bed of somewhat plastic oil shale lies immediately below the main trona bed. About 200 feet below the main trona bed and separated from the main trona bed by normally impervious shale layers there is a porous sandstone aquifer approximately 200 feet thick carrying water under artesian pressure of about 1200 p.s.i. at the top level of the aquifer.

During the mining operations the roof of the mined out areas is caved into the mined out cavity to relieve the overburden pressure and the lower shale layers are sometimes disturbed or broken forming communicating fissures from the lower aquifer into the trona bed so that water penetrates the shale floor of the mine from the lower aquifer and enters the mine. The water may enter through pre-existing cracks or fractures or may enter through fractures caused by the pressure differential between the aquifer and the sometimes stress relieved floor of the mine or through cracks due to blasting or caving in the mine.

Regardless of how the water enters, it appears in the mine flowing from under the caved ground in the active working areas where the pillar extraction or other mining operations are being carried out. It is essential that this water be collected and not allowed to flow throughout the mine because of the water soluble characteristic of trona and the possible weakening of pillars, which would result. Because the trona bed and the mine workings are nearly horizontal, the control of this water and subsequent removal, however, becomes very difficult and costly. Ditching and innumerable sumps and pump installations are normally required.

One of the objects of this invention is to provide a method of controlling water penetration into a trona mine which will alleviate the conditions described above.

Another object is to provide a method of tapping and draining off water below the mine floor before it reaches the active mining areas.

Various other objects and advantages of the invention will appear as this description proceeds.

The method which I have found effective to secure these objectives is to drill holes or bores from a mine entry into the area of suspected water inflow, about 50 to 100 feet below the mine floor and in advance of the active mine working area and to drain the water through these holes into a sump from which it can be

pumped out of the mine so as to prevent the water entering the active mining area through the mine floor. Thus the use of ditches and numerous sumps and pumps is avoided.

Referring now to the drawings which show diagrammatically an illustrative embodiment of the practice of my invention—

FIG. 1 is a plan view of a typical mining operation in a trona mine.

FIG. 2 is a cross section along the line A—A of FIG. 1, and

FIG. 3 is a diagrammatic cross section through the formation along the line B—B of FIG. 1.

In the drawings **1**, **1***a* and **1***b* illustrate part of the entry tunnels through which men and supplies are brought into the mine and the mined trona is removed from the mine. Cross haulage ways from the mining areas are indicated at **2** and rooms **3** and pillars **4** are shown in the mining area. To the left of the mining area a caved zone **5** is indicated from which all the pillars have been mined and the roof caved. Another panel development having entries **1***c*, **1***d*, **1***e* and **1***f* and pillars **4***a* is indicated toward the bottom of FIG. 1. The pillars **4***a* toward the left of this panel development are drawn as the mining progresses in the direction of the arrow **9** and the roof is caved as indicated at **5**. The specific arrangement and number of the entries and cross haulage ways is not material to the invention herein described.

Below the floor of the caved area **5** an area of water entry is indicated at **6**. This may be water-bearing fractures through the shale floor of the mine or a water pocket under artesian pressure. Normally water from the fracture will flow into the mine from numerous small cracks in the shale floor of the mine under the caved ground where it is very difficult to control. Because the mine floor is substantially horizontal, ditching and innumerable sumps and pumps are required to keep the working areas dry and prevent weakening of the supporting pillars due to dissolution of the trona.

I have found, however, that the control of this water is greatly simplified and the use of extensive ditching and extensive sump and pump installations is avoided by drilling one or more small diameter holes from a previously selected sump area, preferably in one of the entry tunnels **1***a* or **1***b* so as to intersect the water-bearing fractures some distance below the mine floor and direct the water flow into the preselected sump areas.

One such hole, indicated at **7**, has been drilled from the sump **8** in entry **1***a* in a diagonal direction rearwardly and downwardly approximately 30° below the horizontal level of the mine floor to intersect the suspected area of water entry **6** approximately 50 to 100 feet below the mine floor. In practice the holes **7** are drilled from beyond the pillar extraction area on a flat lying angle usually between 10° and 30° below the horizontal, to intersect the suspected area of water entry below the mine floor and beyond the active pillar extraction area. I prefer to drill 2½ inch diameter holes and to case the holes with 2 inch pipes after they contact the water-bearing fractures, although the diameter of the holes and of the casing is not critical, providing the holes are large enough that water flows through the drill holes with less resistance than the resistance of the cracks adjacent the mine floor. Intersection of the diagonally drilled hole with the water-bearing fractures is indicated by the flow of water from the drill hole into the sump and by the reduction of flow of water from under the caved ground into the active mining area.

I have drilled such holes over 200 feet long to intersect the water entry areas at distances of 50 to 100 feet below the mine floor.

After the holes 7 are drilled, the water flows into the sump 8 from below the mine floor and is pumped by pump 8*a* to the surface, and substantially no water flows into the active pillar extraction areas. The reason the water flows through the drilled holes rather than continuing through the fractures to the mine is believed to be because of less resistance in the holes than in the fractures in the shale above the holes. It is also possible that relief of the artesian water pressure through the holes 7 permits some of the fractures in the shale above the holes 7 to seal under the weight of the overburden pressure to still further retard water flow through these fractures into the mine floor.

Removal of water from the sump 8 can be continued and dry mining conditions maintained after the active mining area has advanced considerably in the direction indicated by the arrow 9. If additional water flow is encountered, as the mining advances in the direction indicated, additional holes 7 may be drilled in the new area of water entry and sumps 8 installed to take care of the additional water flow.

FIG. 3 illustrates diagrammatically the general nature of the formation in which the trona beds occur. The overburden is indicated at 10, the trona layer with the various mining tunnels 1*a*, 1*b*, 1*c*, etc., therein is indicated at 4*a*, the caved area along section B—B at 5, the water-bearing fractures at 6, the diagonal drain hole at 7, the sump at 8 and the water-bearing sandstone aquifer at 11.

While I have described a specific embodiment of my invention as applied to the mining of trona, it will be understood that various modifications and changes may be made in applying it to specific mining conditions and that it is applicable to other mining operations where similar formations and water flow conditions are encountered.

I claim:

1. The method of controlling water inflow into a trona mine having a shale floor and located above a water aquifer under artesian pressure from which water enters the mine through fractures in the shale floor, which comprises drilling a diagonal hole from a mine entry to intersect said water-bearing fractures below the mine floor and in advance of the active mining area, casing said hole after it has contacted the water-bearing fractures and utilizing the artesian water pressure and the overburden pressure to drain water from said fractures into a sump in the mine entry and pumping said water out of the mine.

2. The method of protecting a soluble trona mining area having a shale floor and located above a water aquifer under artesian pressure from which water enters the mine through fractures in the shale floor, from dissolution by water flowing into said mine, and of keeping said mine dry, which comprises drilling diagonal holes from a mining area into the area from which the water-flow into the mine originataes, at a point in advance of the active mining face, utilizing the artesian water pressure to force water through said diagonal holes to drain water from the water-flow area into sumps adjacent the mining area and pumping the water from said sumps out of the mine, whereby water-flow into the mining area is reduced and dissolution of trona pillars and walls in the active mining area is retarded.

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