

Feb. 5, 1957

J. F. CORE ET AL
METHOD OF MINING COAL

2,780,448

Filed Sept. 23, 1953

8 Sheets-Sheet 1

FIG. 1.

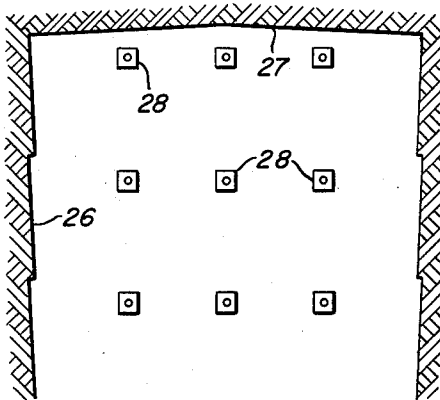


FIG. 2.

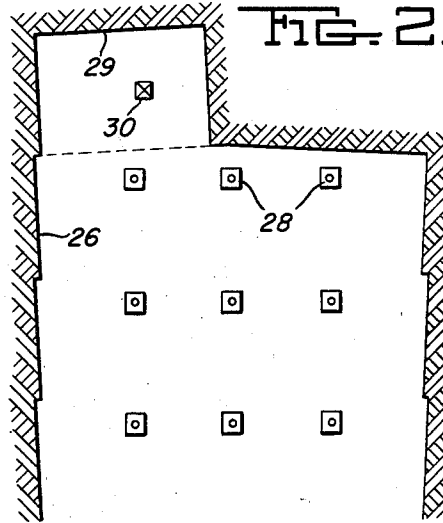


FIG. 3.

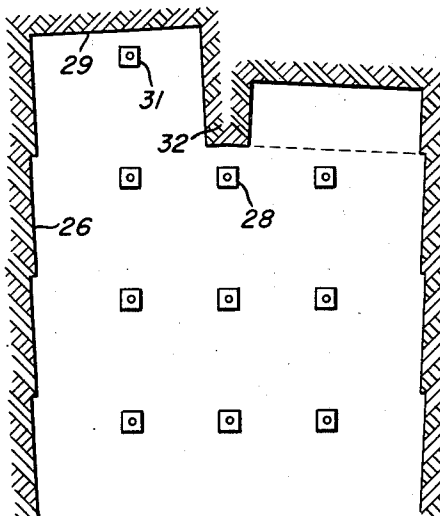
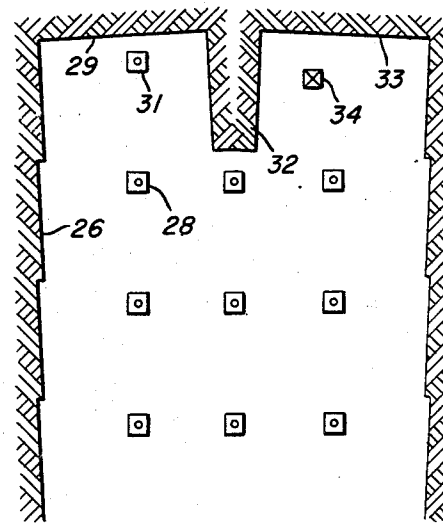


FIG. 4.



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8 Sheets-Sheet 2

FIG. 5.

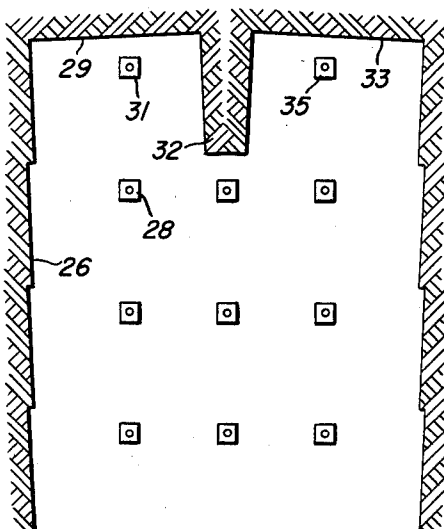


FIG. 6.

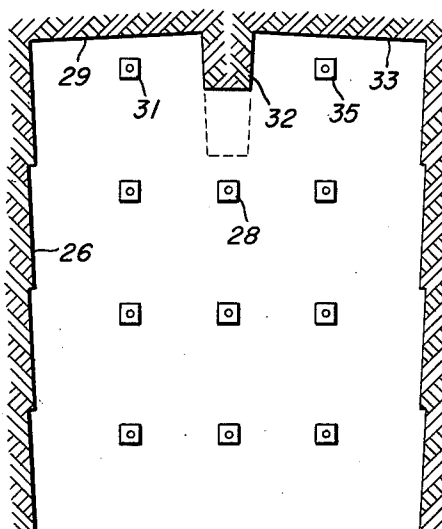


FIG. 7.

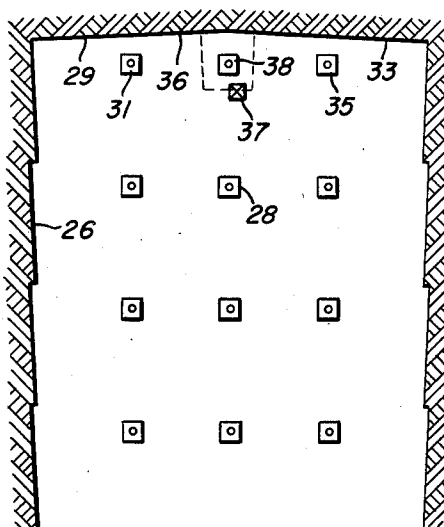
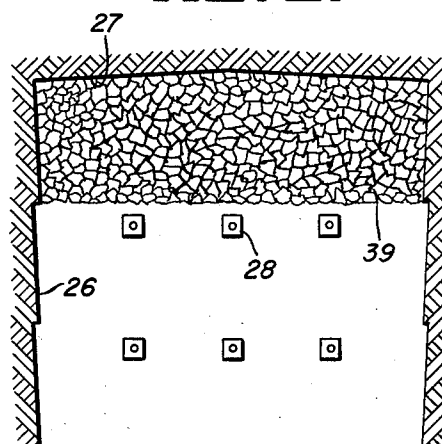


FIG. 8.



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8 Sheets-Sheet 3

FIG. 9.

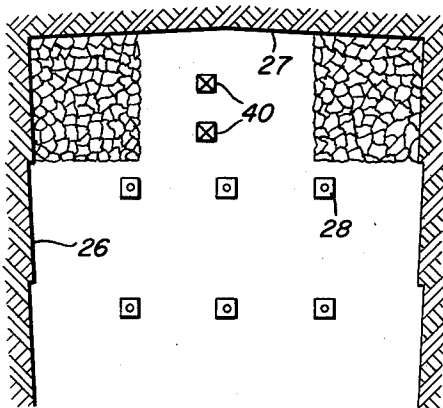


FIG. 10.

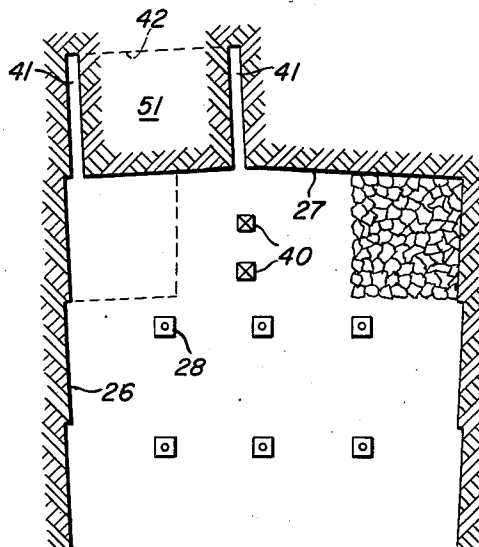


FIG. 11.

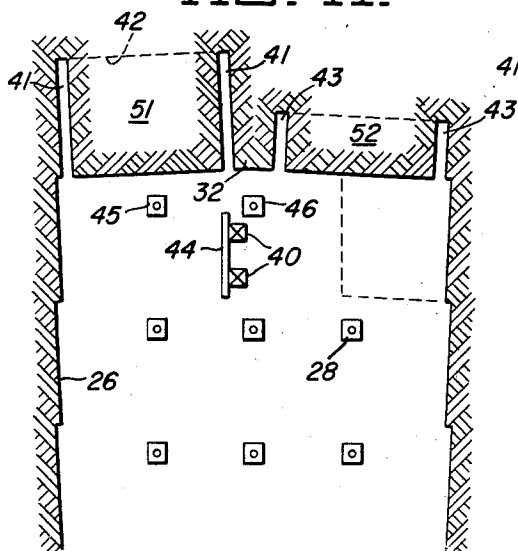
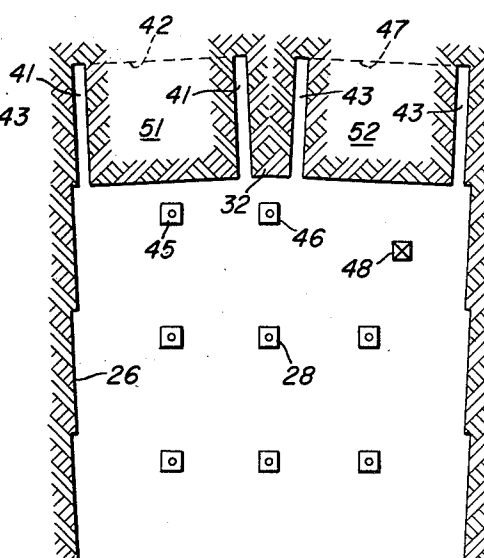


FIG. 12.



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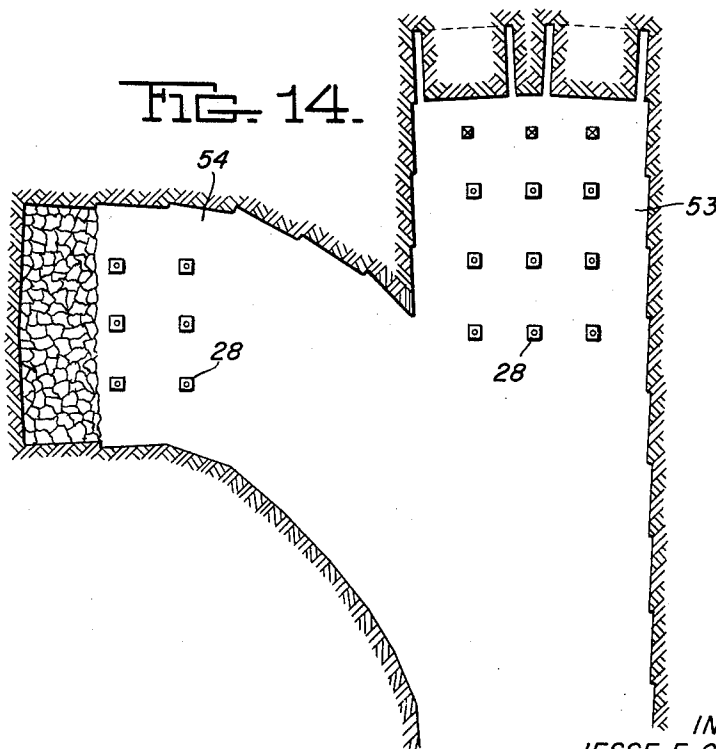
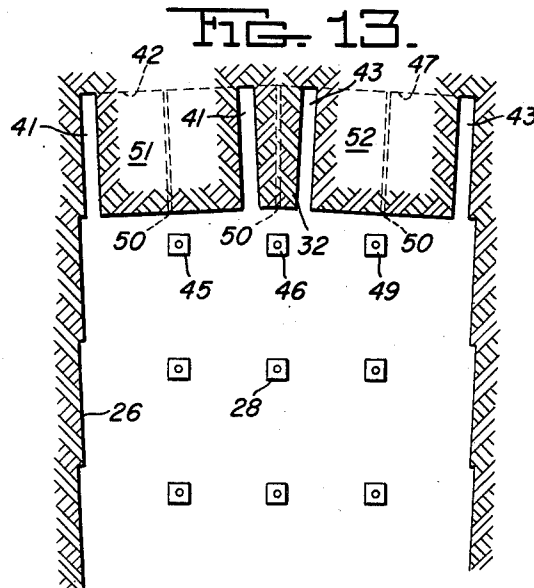
Feb. 5, 1957

J. F. CORE ET AL
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8 Sheets-Sheet 4



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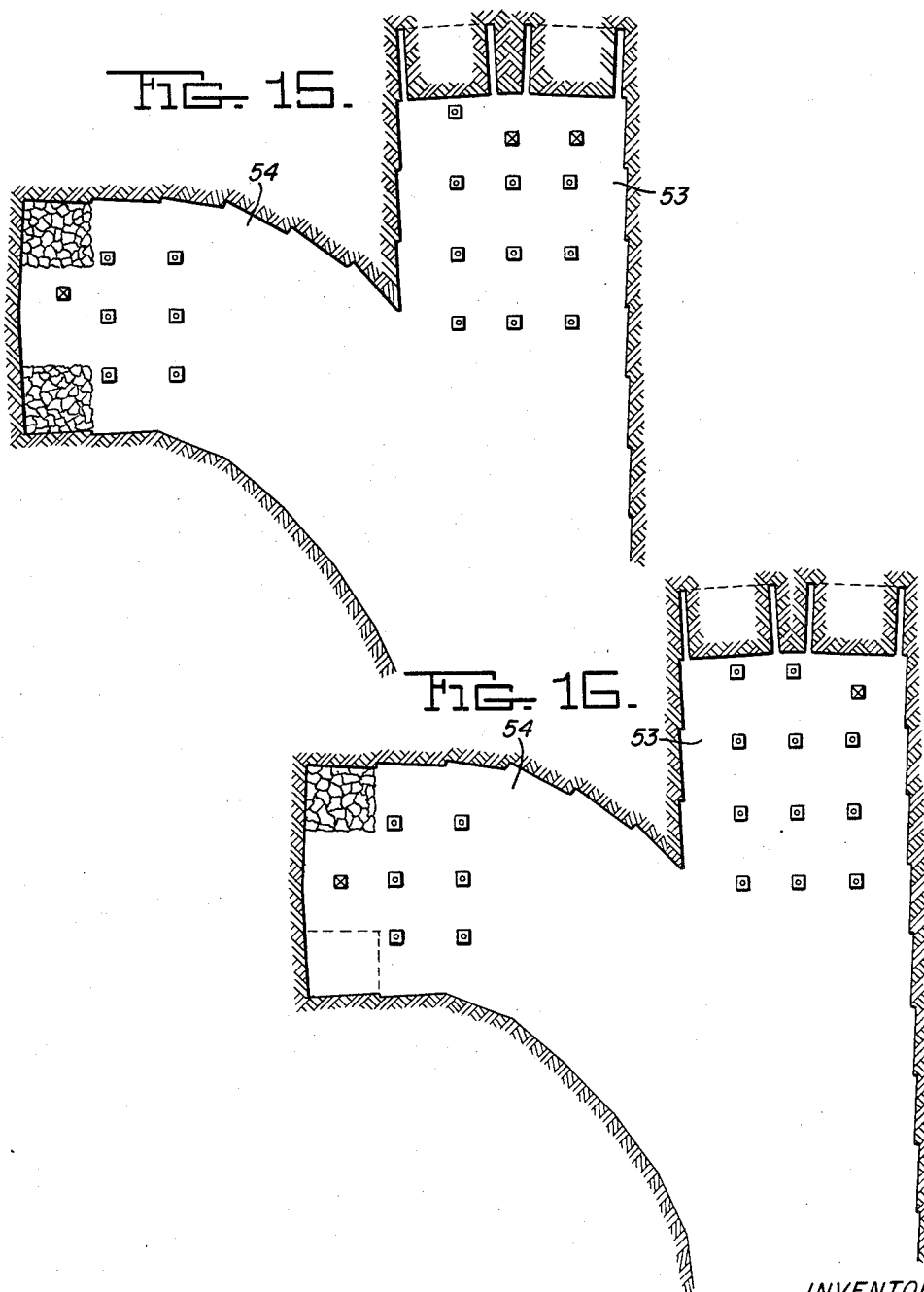
Feb. 5, 1957

J. F. CORE ET AL
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2,780,448

Filed Sept. 23, 1953

8 Sheets-Sheet 5



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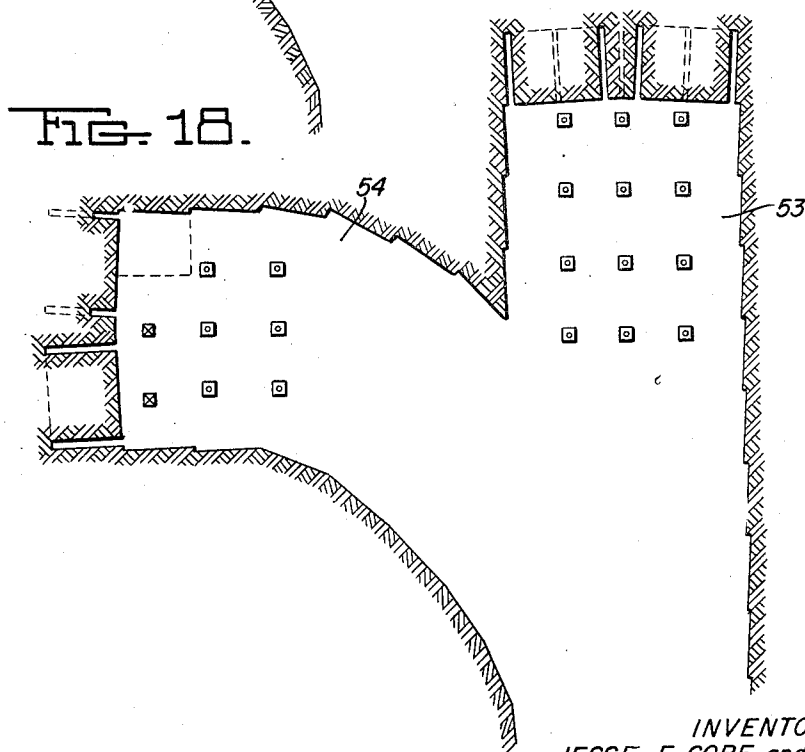
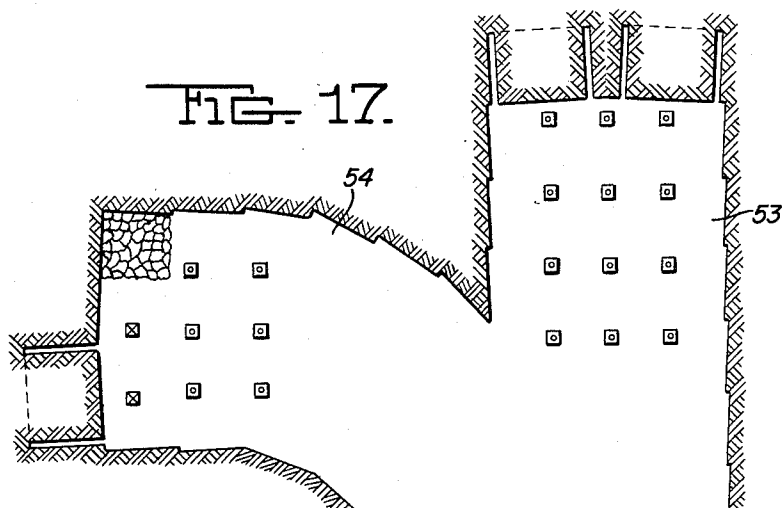
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J. F. CORE ET AL
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8 Sheets-Sheet 6



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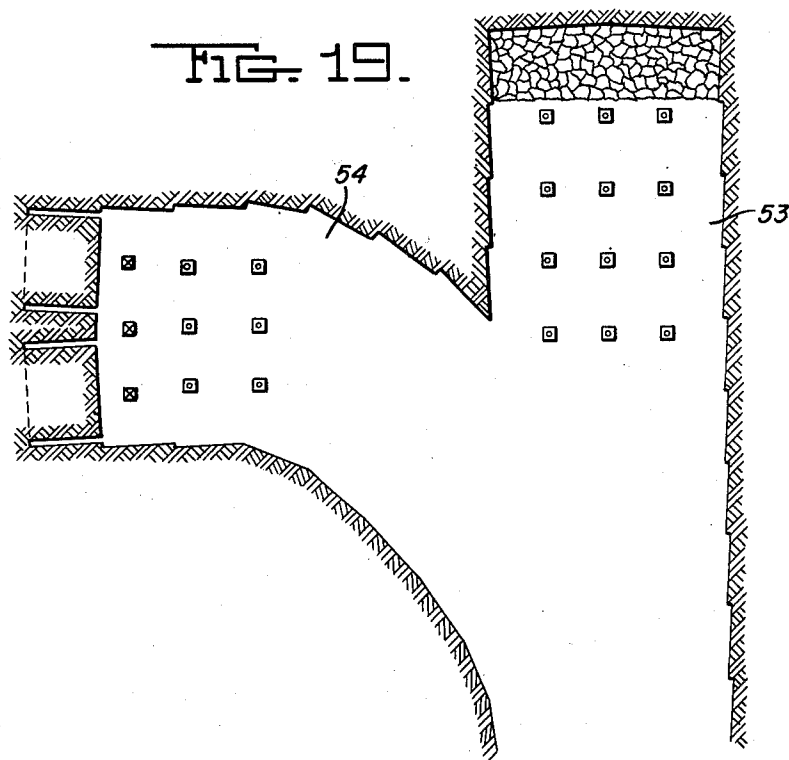
Feb. 5, 1957

J. F. CORE ET AL
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8 Sheets-Sheet 7



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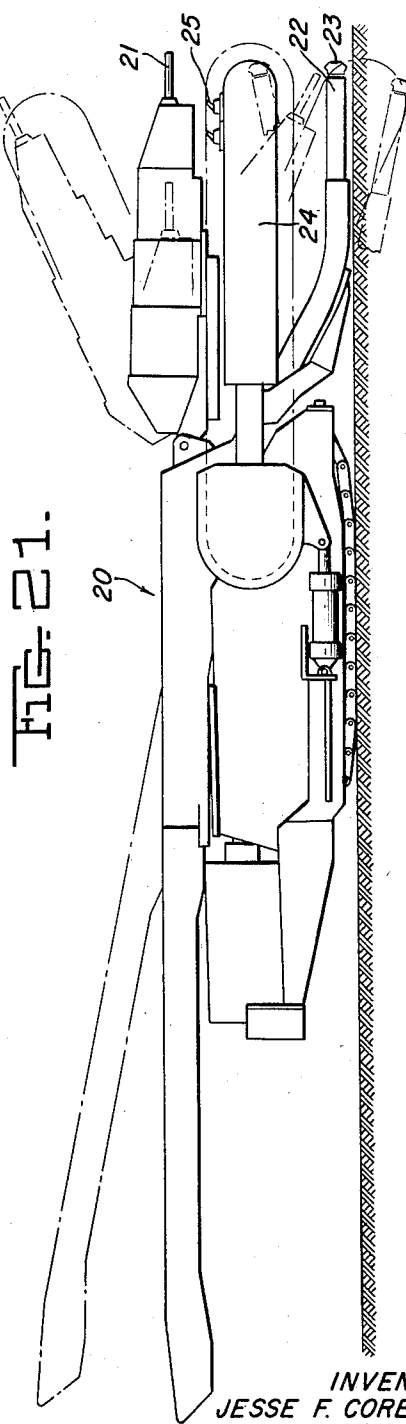
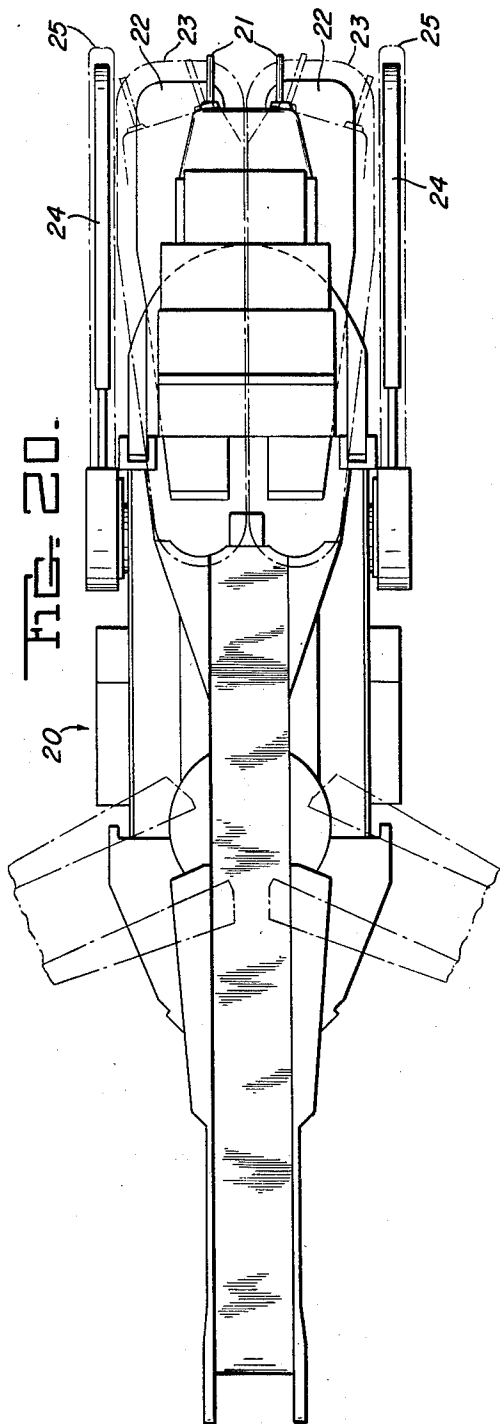
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8 Sheets-Sheet 8



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1

2,780,448

METHOD OF MINING COAL

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Application September 23, 1953, Serial No. 381,892

5 Claims. (Cl. 262—1)

This invention relates to a method of mining coal and, in particular, to a method utilizing so-called continuous or multiple-purpose mining machines.

Our invention has for its object a procedure whereby a working face in a coal seam, such as that of a heading or entry, may be rapidly advanced by making the most efficient use of a continuous mining machine. More particularly, it is the object of the invention to afford a method by which the least practical amount of unsupported roof area is opened up and roof supports are installed in such areas with a minimum of delay, thereby preventing the fall of the roof and maintaining a high quality in the mined coal.

Stated generally, our improved method consists in successively attacking a working face in a coal seam in adjacent portions of limited width and installing a roof support in each portion adjacent the fresh working face thus formed, promptly after the coal has been removed. The coal may be removed progressively by the machine or blocks thereof may be only partially severed from their native bed by the machine and subsequently broken up by light charges of explosive.

A complete understanding of our invention may be obtained from the following detailed description and explanation of preferred practices thereof, which refer to the accompanying drawings illustrating diagrammatically successive steps of such practices and, in outline only, a machine largely of known construction, by which the method may be readily performed. In the drawings,

Figures 1 through 7 are diagrammatic views illustrating the several steps of one practice of the invention;

Figures 8 through 13 are similar views showing the successive stages of a modified procedure;

Figures 14 through 19 are similar views showing the application of the method to a situation affording two working places reasonably close together;

Figure 20 is a plan view of one form of continuous mining machine which may be employed to carry out our method; and

Figure 21 is a side elevation thereof.

The invention is particularly adapted for development work, i. e., the driving of headings or entries but may also be applied to the actual mining operation in the room-and-pillar method including the robbing of pillars. The method is best practiced with the aid of a continuous or multiple-purpose mining machine, for example a modification of that disclosed in Konnerth Patent No. 2,308,517. This modification generally designated 20, is shown in outline in Figures 20 and 21 and includes, in addition to the vibratory hammers 21, the bottom kerf-cutting bars 22 and their chains 23 shown in the patent, a pair of spaced shear-cutter bars 24 tiltable about a transverse horizontal axis. Bars 24 are mounted one on each side of bars 22 and have their cutting chains 25 driven in any suitable manner from the same source of power as chains 23. They are conveniently spaced about six or seven feet apart and are tiltable independently of each other. With the aid of a machine of such construction, it is possible

2

to form a pair of spaced vertical shear cuts in the working face of a coal seam at the same time that a bottom kerf is being made between the shear cuts. The spacing of bars 24 is such, relative to the combined width of bars 22, that the bottom kerf cut by the latter substantially meets the shear cuts made by the former when they are completed.

In the following detailed explanation of one practice of our method, referring particularly to Figures 1 through 7, it is utilized to advance a heading or entry 26, which is about fifteen feet wide. Assuming that, at the beginning of a cycle of operations, the working face 27 is at the location shown in Figure 1 and that suspension bolts have been installed in the roof at points indicated at 28, the machine 20 is advanced toward face 27 at one side thereof, e. g., the left-hand side, with bars 22 horizontal and shear bars 24 raised to the proper height to leave the desired thickness of coal in the roof, and with chains 23 and 25 operating. The bars 24 form spaced vertical shear cuts and bars 22 form a bottom kerf or horizontal undercut between them. The machine is advanced as the cuts progress and hammers 21 are operated to trim any offsets in the roof which may have been left in front of face 27. Thereafter the hammers vibrate the coal at the face above the undercut thereby breaking it down by the method of the aforesaid patent. The coal dislodged is delivered by the conveyor of the machine to a shuttle car moved up behind it.

After the machine has advanced four or five feet to form spaced shear cuts and an undercut of that depth into the face, the bars 24 are tilted downwardly to complete the shear cuts so they substantially meet the undercut. Hammers 21 are then used to break coal from the face at increasingly higher elevations until the roof level is reached. When the coal between the shear cuts and above the undercut has all been removed to the full depth of the cuts in this manner, a fresh seam face 29 of limited width is exposed as shown in Figure 2. The machine is backed away from face 29 and a temporary roof support such as a post jack 30 is immediately set in place. The machine is then employed in making a similar attack on the right-hand side of face 27, an intermediate stage of which is shown in Figure 3. While this is going on, a roof bolt is installed at 31 and jack 30 is removed. A supporting pillar of coal 32 left in place temporarily protects the bolting crew from the machine.

Completion of the second step as illustrated in Figure 4 leaves a fresh face 33 approximately in line with face 29 and separated therefrom by pillar 32. Faces 29 and 32 are six or seven feet wide and four or five feet in advance of the starting face 27. The machine is then backed away from face 33, a post jack immediately placed at 34 and a roof bolt installed as promptly as possible at 35, as shown in Figure 5, after which jack 34 is removed. It will thus be apparent that the maximum roof span unsupported at any time is limited by the spacing between bars 24 and the depth of cut made into face 27, and that a permanent support is installed adjacent each fresh face and substantially centrally of its width within the least possible time. The machine necessarily remains idle while bolt 35 is being installed but this can usually be done while the shuttle car moves back to the adjacent haulage entry to transfer its load to a waiting train of cars.

When bolt 35 has been installed, the machine is advanced to attack pillar 32. In this step, only bars 22 and hammers 21 are employed since there is nothing for bars 24 to work on. Successive stages in the removal of the pillar are shown in Figures 6 and 7. Completion of this step forms a single fresh face 36 including, of course, the originally separate face portions 29 and 33. A post jack is immediately placed at 37 and a roof bolt is then

installed at 38 after which the jack is removed. This completes the cycle and restores the conditions shown in Figure 1 but at one step farther ahead in the advance of the heading or entry 26.

It will be observed that, as a result of the steps described, there is but little greater span of exposed roof left unsupported at any time than normally exists between adjacent roof bolts 28. It may be possible, however, when driving narrow entries, say twelve or thirteen feet in width or not more than twice the spacing between bars 24, that no center pillar 32 will be left. In such case, if the roof requires immediate support, the machine is backed up after attacking one side of the starting face and shut down while a bolt is installed in the fresh roof area thus exposed, before attacking the other side of the starting face.

The practice illustrated in Figures 1 through 7 is useful in seams where the coal is soft enough to permit it to be entirely broken down by the vibratory hammers 21. Where harder coal is encountered, a modified practice will be followed in which, after making the shear cuts and undercut as already described, the resulting blocks of coal are broken up with light charges of explosive. This modified practice is shown in Figures 8 through 13 and will now be explained in detail. Figure 8 shows heading 26 with roof bolts 28 therein, in the same condition as illustrated in Figure 1 except that the face 27 has just been disrupted by explosive to break the coal across the entire width as indicated at 39, after cutting and drilling in the manner now to be explained. In other words, adjacent blocks of coal are first partially severed from their native bed, broken up by explosive and then loaded out simultaneously with the severing of the next set of blocks and the setting of roof supports such as suspension bolts, close to them.

As shown in Figure 8, after firing the light disrupting charges, the starting face 27 is four or five feet ahead of the last row of roof bolts 28. Machine 10 is advanced approximately on the center line of the heading to remove the loose coal from the mid-portion of the face and trim down the roof as necessary by hammers 21. The machine is then backed away from the face and post jacks are installed at 40 as shown in Figure 9, to support the roof temporarily. The machine is then shifted toward one side of the entry, e. g., the left-hand side, and advanced toward face 27. Bars 22 gather up the loose coal and hammers 21 are operated to trim the roof. Shear bars 24 are tilted upwardly to the proper height to leave the desired thickness of roof coal and, when the bars 22 and 24 reach the face, they sump into it forming spaced shear cuts 41 and a bottom kerf 42, as shown in Figure 10. After an advance of four or five feet, bars 24 are tilted downwardly and the machine is backed away completing the cuts 41 so they substantially meet kerf 42.

The machine is then shifted to the right-hand side of heading 26 and the procedure just described is repeated, forming shear cuts 43, as shown in Figure 11. While this is going on, a guard barrier 44 is secured to jacks 40 to protect the bolting crew while they set a roof bolt at 45. A bolt is also installed at 46, preferably while the machine is shut down for a trip of the shuttle car to the haulage entry. This procedure leaves a central supporting pillar 32 between the partially severed blocks of coal 51 and 52 formed by the shear cuts and bottom kerf at each side of the entry as shown in Figure 12, the same as in Figure 4. When cuts 43 and a bottom kerf 47 therebetween are completed and the machine is again backed away from the face, a post jack is set at 48 and jacks 40 and barrier 44 are removed. A third roof bolt 49 is then placed and holes 50 are drilled between each pair of adjacent shear cuts as shown in Figure 13 and loaded with light charges of explosive or "pop shots." The charges are then fired one at a time, bringing down the blocks 51 and 52 and pillar 32 in the form of loose

coal, producing the condition shown in Figure 8, but with the face advanced four or five feet, whereupon the cycle is complete and is then repeated.

When a heading or entry narrower than fifteen feet is being driven, pillar 32 may be so narrow that it may be brought down by the vibrating hammers after shooting blocks 51 and 52. In that case, it is unnecessary to use explosive in the pillar. In any case, the pillar serves as a roof support until removed.

The efficiency of the procedure illustrated in Figures 8 through 13 can be materially improved by reducing the down time of the machine during drilling and shooting, if a second working place is fairly close by, say within fifty feet, so that the tramping time between the two places is less than the time needed for drilling and shooting. Such a condition exists when a crosscut is being turned off of an entry as shown in Figure 14. Assuming that cuts 41 and 43 and kerfs 42 and 47 have been completed in entry 53, and that blocks 51 and 52 and pillar 32 have just been broken up in crosscut 54, the machine is moved from the entry to the crosscut and then starts the loading and cutting stages of the cycle illustrated in Figures 8 through 13. At the same time, the bolting, drilling and firing stages are performed in the entry. The progress of these operations is shown in steps in Figures 15 through 19. After bringing down the coal in the entry, and completion of cutting in the crosscut, the machine is returned to the entry to resume its loading and cutting while bolting, drilling and firing proceed in the crosscut.

It will be apparent that the invention is characterized by important advantages. In the first place, it makes possible a high production rate by making most efficient use of the machine and this is reflected in a reduced cost of production. Secondly, the unprotected roof area is kept at a minimum and permanent roof supports are installed so quickly that fall of the roof is prevented. The formation of the shear cuts and bottom kerf, furthermore, permits the blocks of coal to be broken up by explosive when desired.

While we have disclosed in detail only the preferred practices of our invention, we intend to include such changes and alterations therein as are comprehended by the scope of the appended claims.

We claim:

1. In a method of advancing the working face of an entry or the like in a coal seam, the steps including removing coal to a predetermined depth from a portion of a starting face less than half its width at one side thereof, installing a roof support adjacent and substantially centrally of the portion of fresh face thus formed, repeating the aforesaid procedure at the other side of said starting face thereby leaving undisturbed a supporting pillar between the spaced portions of fresh face, then removing the pillar thereby reforming a continuous starting face substantially similar to the original starting face, and installing a roof support adjacent the reformed starting face and substantially centrally of the width of the pillar.

2. In a method of advancing the working face of an entry or the like in a coal seam, the steps including making a pair of shear cuts, one adjacent one side of the starting face and the other adjacent the center thereof, and a horizontal bottom cut connecting the shear cuts, repeating the aforesaid procedure at the other end of the starting face, thereby forming a pair of blocks partly severed from their native bed leaving undisturbed a supporting pillar therebetween, breaking up said blocks and pillar, then removing loose coal from the midportion of the fresh face thus formed and installing a roof support adjacent said face and substantially centrally thereof.

3. In a method of advancing the working face of an entry or the like in a coal seam, the steps including forming spaced pairs of shear cuts in a starting face and a bottom cut connecting the shear cuts of each pair, thereby partially severing from their native bed two spaced blocks

5

of coal and leaving undisturbed a supporting pillar therebetween, disrupting the blocks and pillar and installing roof supports adjacent the fresh face thus formed.

4. In a method of advancing the working face of an entry or the like in a coal seam, the steps including cutting the sides and bottom of a block of coal free from the seam at one side of said face, removing the coal in said block and installing a roof support substantially centrally of the fresh roof area thus exposed, repeating the aforesaid procedure at the other side of the face, leaving a central pillar of coal undisturbed between the adjacent sides of the blocks, and finally removing the pillar.

5. A method as defined by claim 4, characterized by setting said roof support centrally of the space formerly occupied by the first block while cutting the second, said support being a roof bolt.

6

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