

Feb. 24, 1959

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2,874,945

MINING SYSTEMS OF THE ROOM AND PILLAR TYPE

Filed Dec. 24, 1956

6 Sheets-Sheet 1

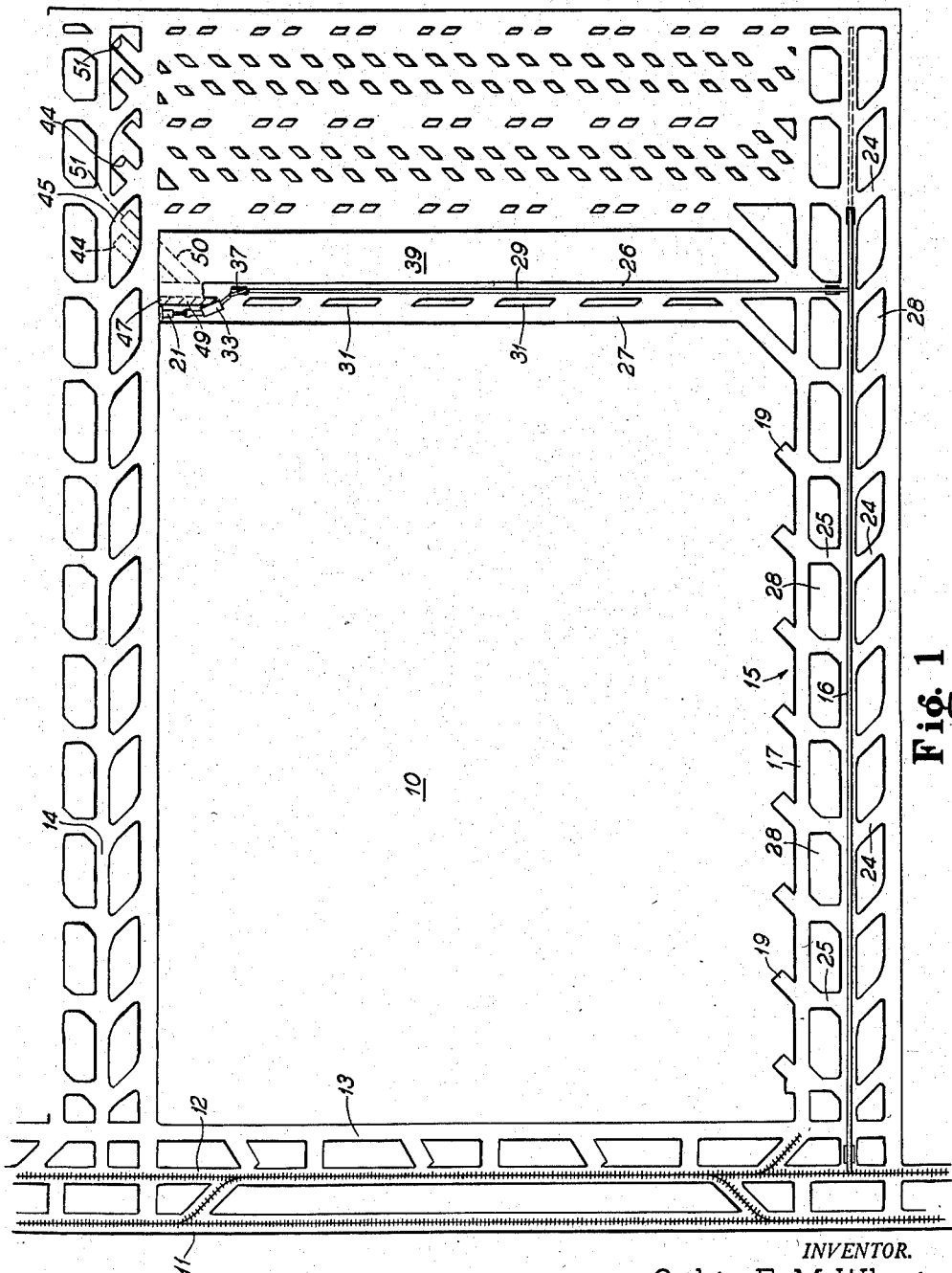


Fig. 1

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6 Sheets-Sheet 2

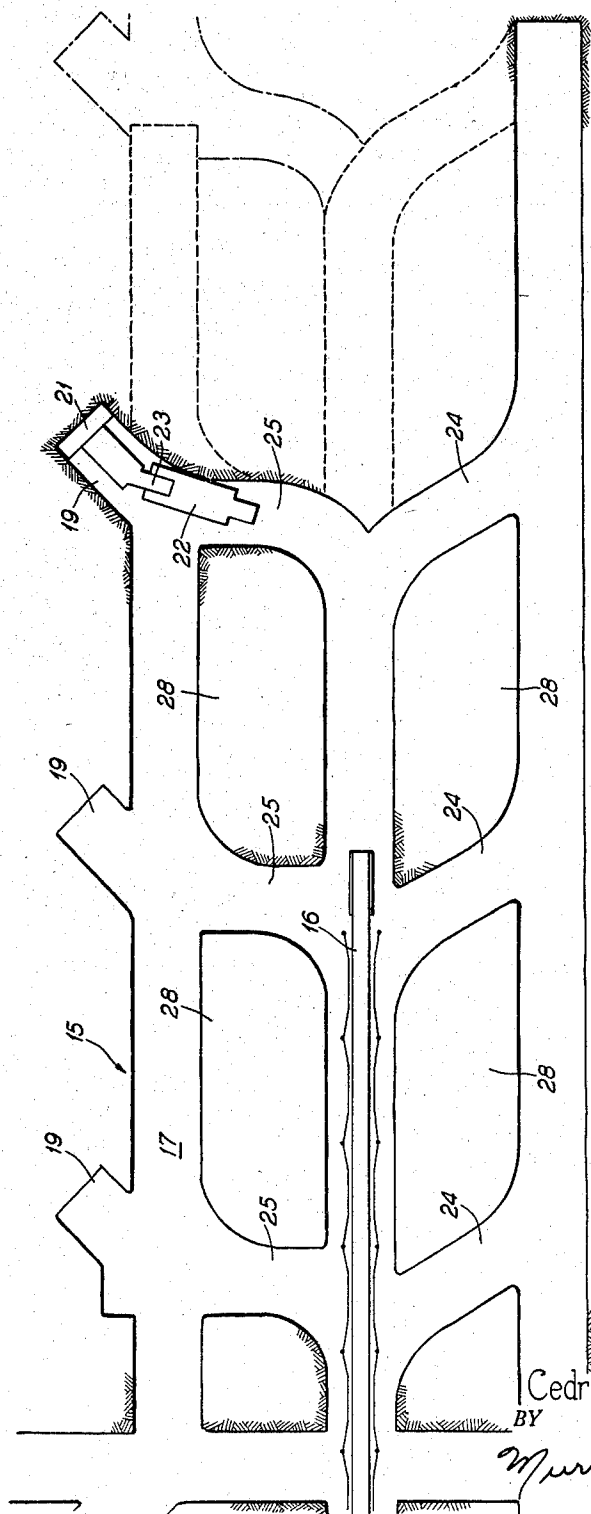


Fig. 2

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6 Sheets-Sheet 3

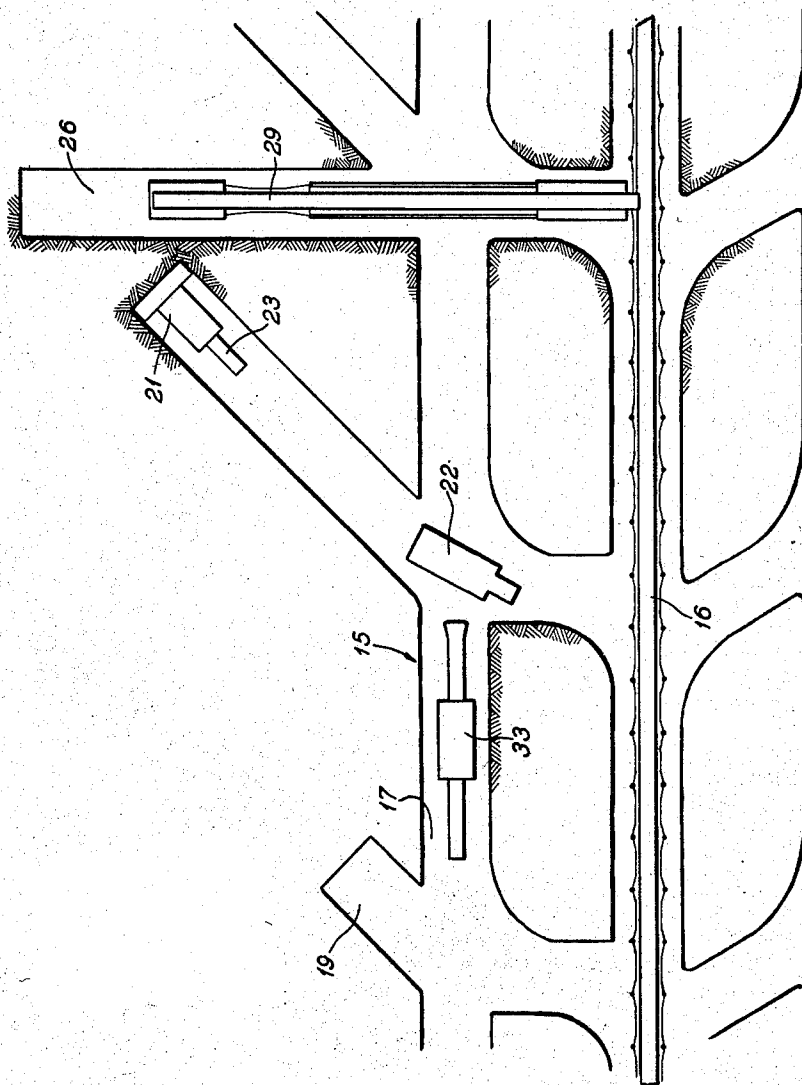


Fig. 3

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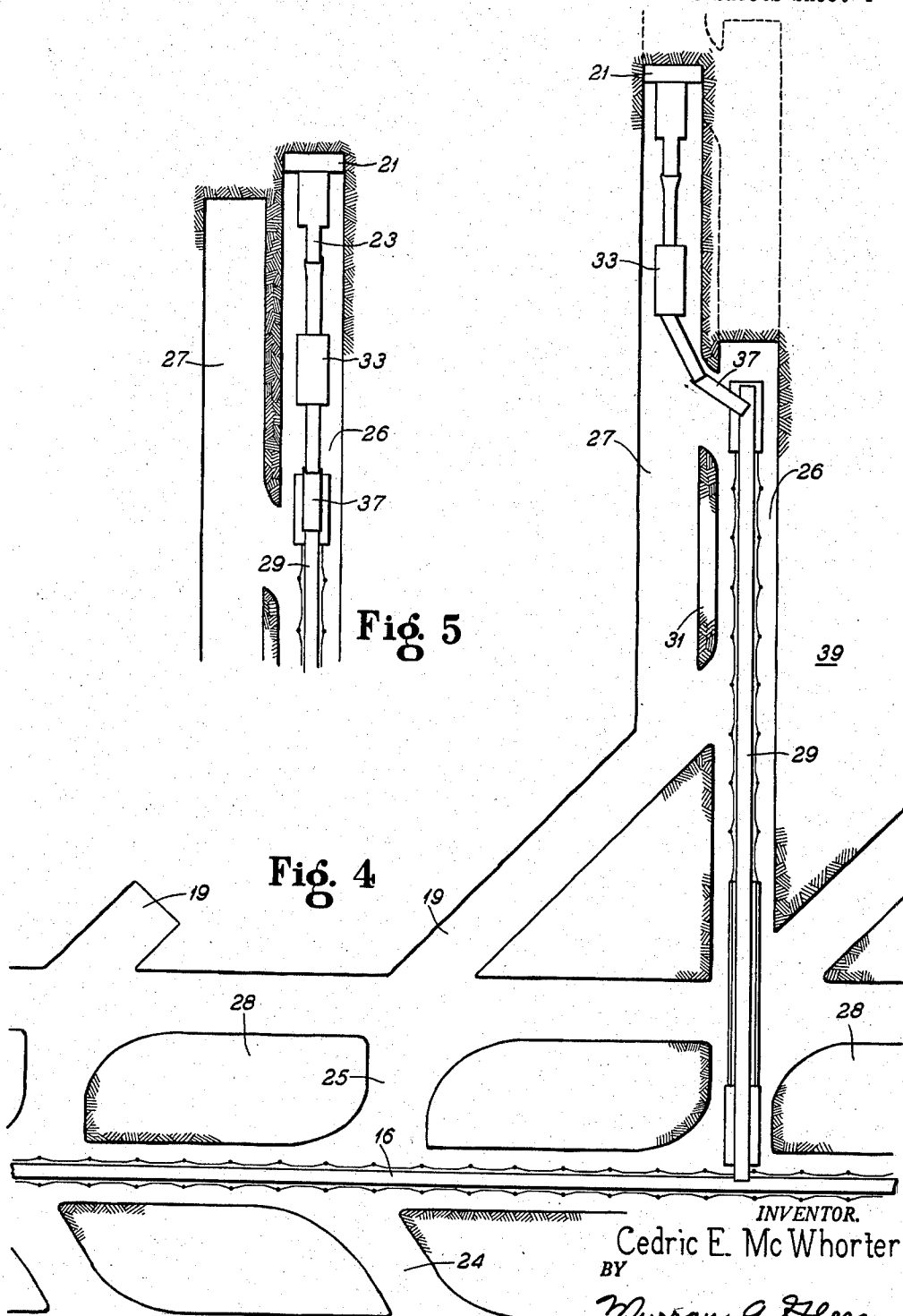
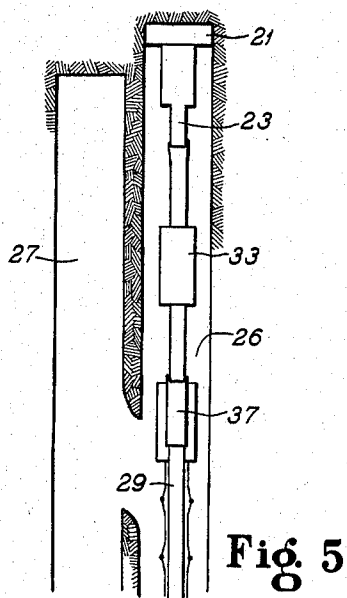
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MINING SYSTEMS OF THE ROOM AND PILLAR TYPE

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6 Sheets-Sheet 4



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MINING SYSTEMS OF THE ROOM AND PILLAR TYPE

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6 Sheets-Sheet 6

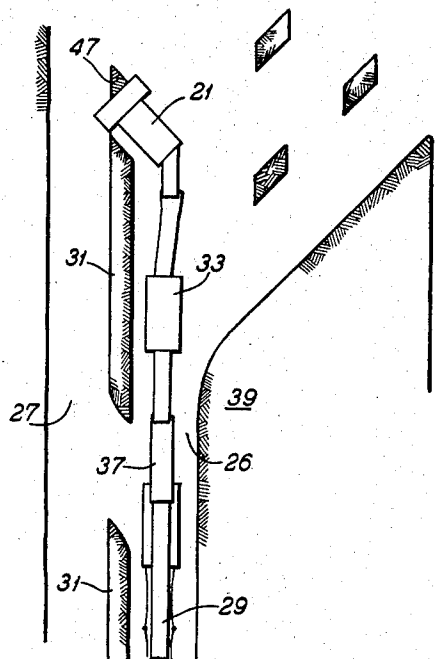


Fig. 10

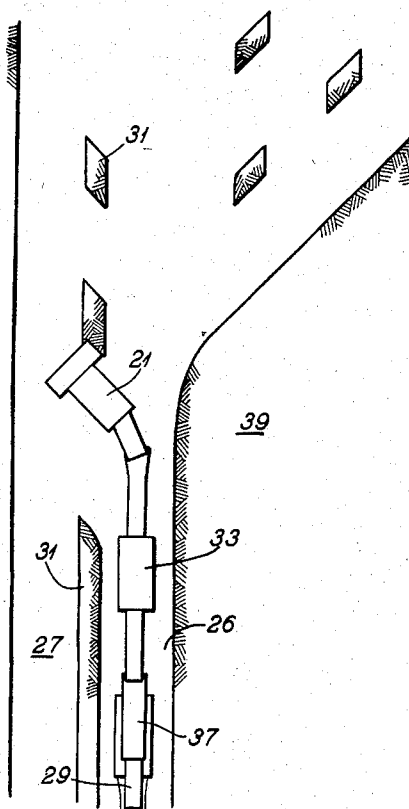


Fig. 11

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## MINING SYSTEMS OF THE ROOM AND PILLAR TYPE

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Application December 24, 1956, Serial No. 630,342

3 Claims. (Cl. 262—1)

This invention relates to improvements in mining systems and more particularly relates to a mining system of the room and pillar type for coal and the like, in which the coal is mined, loaded and transported from the working face in a continuous operation.

In mining coal underground, separate rooms are usually individually driven off of separate cross or butt entries, leaving pillars between the rooms for supporting the roof and periodically driving a break-through through the pillar between the rooms as the working face advances, to facilitate the circulation of air at the working face of the room. After a panel of rooms has been driven, the pillars are then mined, retreating from the face to the entry and leaving sufficient coal in the pillars to hold the roof during the mining operation and to allow the roof to gradually settle as the pillars are mined or drawn.

In such mining systems it has never been possible to recover more than 65% of the coal in the area being mined. The recovery, however, is usually much lower than this even with the use of continuous mining and loading machines due to the inability to transport the coal away from the machine as fast as it is mined, and thereby unduly lengthening the process of mining out a coal seam and making it necessary to leave larger pillars than would be necessary with a faster system of mining, so as to leave sufficient support to hold up the roof.

A principal object of the present invention is to improve upon the systems heretofore used to recover coal from a coal seam underground by advancing a pair of parallel rooms and mining the supporting pillars while retreating and by providing a continuous mining, loading and conveying chain from the coal face to the entry operable both during the advancing of the working face and the mining of the pillars while retreating from the coal face.

Another object of the invention is to provide an improved mining and loading system so arranged as to speed up the mining of an area of coal, and thereby recover a larger proportion of coal from a coal seam than has heretofore been considered possible.

Still another object of the invention is to provide an improved form of mining system in which a pair of rooms are advanced in parallel by operation of a single continuous mining machine alternately advancing one room and then the other by driving a communicating break-through to effect the advance of the other room and leaving a barrier pillar to one side of one room, repeating the alternate room advancing and break-through driving operations, and then retreating and mining the barrier pillar and supporting pillars between the rooms in a continuous retreating operation while maintaining a continuous mining and loading material transferring and conveying chain extensible and retractible during the advancing and retreating operations to afford a continuous flow of coal from the working face with a minimum of interruptions.

These and other objects of the invention will appear

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from time to time as the following specification proceeds and with reference to the accompanying drawings wherein:

Figure 1 is a diagrammatic plan view of a section of a mine, illustrating one form in which the mining system of the invention may be carried out;

Figure 2 is a diagrammatic plan view of a section of the mine, illustrating the steps of driving a cross or butt entry;

Figure 3 is an enlarged diagrammatic plan view showing the initial stages in the driving of a pair of parallel rooms in accordance with the mining system of the invention;

Figure 4 is a view somewhat similar to Figure 2 and showing an advance stage in the mining of a pair of parallel rooms;

Figure 5 is a detail plan view illustrating a still further advance stage in the driving of a pair of parallel rooms in accordance with the mining system of the invention; and

Figures 6, 7, 8, 9, 10 and 11 are diagrammatic plan views illustrating the sequence of operations in mining the barrier pillar and supporting chain pillars between the rooms during the operation of retreating from the coal face.

In the embodiment of the invention illustrated in the drawings, I have shown in Figure 1 a section of a mine map in which an area or block of coal 10 has been partially mined in accordance with the system of the invention. The area of coal 10 is shown as being bounded on one side by a main entry having two parallel entries 11 and 12 having tracks laid therein for mine cars hauled by locomotives (not shown) for transporting the coal to the outside of the mine and having a third parallel entry 13 extending along one side of the area of coal, which may be used for trackless equipment, such as shuttle cars, mobile conveyors, continuous mining machines and other mobile equipment.

A butt entry 14, which may be adjacent a mined out area, extends along one side of the area of coal, while a butt entry 15 having a conveyor 16 extending therealong extends along the opposite side of the area of coal. The butt entry 15 is used as a working entry and is shown as comprising three parallel entries having an entry 17 extending along the block of coal having a plurality of spaced diagonal stub entries 19 driven into the block of coal and providing storage places for supplies and trackless equipment used in carrying out the mining operation.

The butt entry 15 may be driven by a continuous mining and loading machine 21, which may be a multiple boring machine commonly known as a McKinley type mining machine, in which two radial boring members cut overlapping bores in advance of the machine, and an auxiliary cutter chain serves to cut-off the upstanding and depending cusps left at the floor and roof, respectively, between the two main bores, such as is shown and described in Patent No. 2,711,890 which issued to James S. Robbins and Carl A. Wilms on June 28, 1955, and no part of the present invention so not herein shown or described further.

In driving the butt entry, a trackless haulage vehicle, such as, a shuttle car 22 of a well known form may be used to carry the mined coal from the continuous mining machine 21, for discharge into mine cars (not shown) in the entry 12 prior to setting up the conveyor 16. As the mining operation progresses and the conveyor 16 is set up in the entry, the shuttle car 22 may load the mined coal into the conveyor.

The conveyor 16 may preferably be a rope type of belt conveyor in which the conveyor idlers are supported on

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flexible strands and the support shafts therefor are connected together by an articulated connection, to accommodate the idlers to conform to the form of the belt and also to accommodate ready removal and replacement of the idlers during extension and retraction of the belt, as shown in application Serial No. 600,418, filed July 27, 1956, by Joseph Craggs and Keith McCann and entitled "Conveyor Having Flexible Strand Side Frame and Thoroughing Roller Assembly Therefor," now Patent No. 2,773,257. The particular conveyor shown and described in the foregoing application may be extended in increments in length of 155 feet, in a manner well known to those skilled in the art and no part of the present invention so not herein shown or described further. The shuttle car 22 thus bridges the gap between the continuous miner and the conveyor 16 as the continuous mining machine advances.

In driving the butt entry 15 three parallel stub entries may first be turned off the main entry, at right angles thereto by operation of the continuous mining machine 21 previously mentioned, as shown in Figure 2. When the three stub entries are completed, the center entry may be driven for at least the length of a supporting pillar therefor, by operation of the continuous mining machine 21 and during this driving operation the mined coal may be loaded onto the shuttle car 22 by a conveyor 23 of the continuous mining machine and transported by the shuttle car to the main entry and discharged into mine cars in the main entry in a well known manner.

Upon the completion of the driving of the stub entries, the miner may be turned to drive a break-through 24, in a direction, which in Figure 1 is shown as being to the right. Upon completing the driving of the break-through, the miner 21 may then be turned to drive the right hand entry for a distance determined by the length of its supporting pillar.

It should here be understood that the continuous miner 21 is capable of cutting laterally as well as forwardly and may thereby be turned while cutting in a straight line to make an angular bore or cut.

Upon driving the right hand entry to the required distance the miner 21 may be withdrawn and turned to drive a break-through 25 to the left. During this driving operation, operation of the continuous mining machine may be continued, to drive the angular stub entry 19, herein shown as extending at 45° to the butt entry 17. At the termination of driving the stub entry 19 the continuous mining machine may be retracted and turned to drive the entry 17 for a distance determined by the length of a supporting pillar 28. The continuous mining machine may then be retracted and may be advanced to drive the central entry for a distance determined by the length of a pillar and then be turned to the right, to drive another break-through and continue to drive the right hand or outer parallel entry for a distance determined by the length of a pillar. The miner may then be withdrawn and drive a second break-through 25 to the left and continue the driving operation to drive a second angular stub entry 19. The miner may then be withdrawn from the stub entry 19 and then continue to drive the inner entry 17. The foregoing driving operations may be repeated for the entire length of the entry which may extend for the full length of the area being mined out.

It should here be understood that as soon as the entry has been driven to the required length that the conveyor 16 is laid in the center entry with its head end in material discharge relation with respect to the mine cars (not shown) on the track in the entry 12, and that the mined coal is then loaded directly from the shuttle car onto the tail or inby end of the conveyor 16 as the faces of the individual entries are advanced.

As the entries are advanced distances slightly greater than the increments in length in which the conveyor may be extended, the conveyor 16 may again be extended

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until it has been extended for the full length of the entry, it being understood that the conveyor is withdrawn as an area is mined out.

When the entry has been completed, a pair of parallel rooms may be turned off the entry and driven at right angles to the entry until they intersect the butt entry 14. In driving the rooms the continuous mining machine 21 may first drive the room 26 at right angles to the butt entry 15 a distance sufficient to enable an extensible rope belt conveyor 29 to be set up in the room, with its head or outby end in material discharge relation with respect to the conveyor 16. As the room 26 is advanced a distance greater than the distance required to accommodate the extensible belt conveyor 29, the continuous mining machine may be withdrawn along the room and entry 17 and positioned to extend the stub entry 19 to intersect the room 26.

During extension of the stub entry 19, the extensible conveyor 29 is set up in the room 26 to a position adjacent the point of intersection of the entry 19 with the room as shown in Figure 3. The conveyor 29 is shown as being an extensible rope conveyor known to the trade as a "Ropex" conveyor in which the belt is stored in a mobile head section for the conveyor and in which the supporting ropes for the belt idlers are paid off from a mobile tail section of the conveyor, as shown and described in application Serial No. 548,622, filed by Joseph Craggs and Keith McCann on November 23, 1955, and entitled "Extensible Conveyor," now Patent No. 2,822,913, and no part of the present invention, so not herein shown or described further. During the operation of extending the stub entry 19 by the continuous mining machine 21 the shuttle car 22 affords a means for transporting the coal from the continuous mining machine 21 to the conveyor 16.

As the stub entry 19 is driven to intersect the room 26, the continuous mining machine 21 is withdrawn a distance sufficient to enable it to be turned to drive the room 27 parallel to the room 26. The continuous mining machine 21 may then start the operation of driving the room 27, leaving a pillar 31 between the rooms 26 and 27 to form a roof support therefor as required in room and pillar mining operations. During the initial operation of driving the room 27, the shuttle car 22 may be used to transport coal from the continuous mining machine 21 to the conveyor 16. As soon, however, as the room 27 has been driven far enough to enable an articulated conveyor 33 to follow the continuous mining machine in material receiving relation with respect to the conveyor 23 and to convey the material for discharge onto the extensible belt conveyor 29, the shuttle car 22 may be withdrawn and stored in an adjacent stub entry 19 or used to haul supplies to the working face as required. The articulated conveyor 33, stored in the entry 17 or in a stub entry 19 may then be moved along the extended stub-entry 19 to the conveyor 23 of the continuous mining machine. The receiving end of the conveyor 33 may then be maintained in cuttings receiving relation with respect to the conveyor 23 of continuous mining machine, by the operation of said conveyor.

The articulated conveyor may be a well known form of mobile conveyor propelled about the mine on continuous traction tread devices (not shown) and having forward and rear end portions laterally flexible to opposite sides of the longitudinal center thereof, as shown and described in Patent No. 2,677,453 which issued to John R. Madeira on May 4, 1954, so not herein shown or described in more detail. The conveyor 33 is commonly termed a "worm" due to its ability to twist or flex its receiving and discharge end portions to opposite sides of center as selected by the operator of the machine. As shown in Figure 4, a bridge conveyor 37 which may be like the conveyor shown in Patent No. 2,604,201 which issued to Murray A. Gleeson on July 22, 1952, is mounted on the tail end section of the articulated con-

veyor or worm 33 in material receiving relation with respect thereto to be extended in material discharge relation with respect to the inby or tail end section of the extensible conveyor 29.

When the articulated conveyor 33 and bridge conveyor 37 are in position behind the continuous mining machine 21, to convey the coal mined thereby to the extensible conveyor 29, the driving of the room 27 may be continued, the articulated conveyor moving along the break-through into the room 27 and following the continuous mining machine 21. The bridge conveyor 37 will in turn move along the extensible conveyor 29 toward the receiving end thereof until the room has been driven a distance slightly greater than the length of a supporting pillar, which may be equal to the length of the supporting pillar plus the width of the next break-through to be driven from the room 26.

It should here be understood that since the head and tail sections of the extensible conveyor 29 are mobile that extensible and retractible movement of the conveyor is a relatively simple and fast operation and consists merely in taking the surplus idlers from the supporting ropes and taking in on the ropes and belt, and then paying off on the ropes and belt, as the inby or tail section of the conveyor 29 is extended, and during the paying of the ropes and belt, replacing the idler assemblies where necessary.

With the discharge end of the articulated conveyor 33 supporting the bridge conveyor 37 in material discharge relation with respect to the extensible conveyor, the driving of the room 26 may be advanced for a distance slightly greater than the length of a supporting pillar between the rooms 26 and 27. The machine may then be retracted and a second break-through may then be turned by operation of the continuous mining machine to intersect the room 27. The continuous mining machine may then be turned to continue the driving of the room 27 for the length of a supporting pillar plus a distance slightly greater than the width of a break-through between the supporting pillars. During this room driving operation the articulated conveyor 33 and bridge conveyor 37 follow the continuous miner through the break-through, the bridge conveyor moving along the extensible conveyor 29 and supplying a continuous flow of coal thereto. As necessary, the extensible conveyor 29 may be extended to follow the bridge conveyor 37. At the termination of the second operation of driving the room 27, the extensible conveyor 29 may then be retracted to accommodate the withdrawing of the articulated conveyor 33 and continuous miner 21 into the first room 26. The room 26 may then be advanced a next successive stage and during the advance of said room the extensible conveyor 29 may be advanced therewith. A next successive break-through may then be turned from the room 26 and the room 27 may be advanced as previously described.

The successive operations of first driving the room 26 turning a break-through to the room 27 and then extending the room 27 and then retractibly moving the continuous mining machine, the articulated conveyor 33 and bridge conveyor 37, and the extensible conveyor 29, to then continue the operation of driving the room 26 with the extension of the extensible conveyor 29 to follow the continuous mining machine 21, articulated conveyor 33 and bridge conveyor 37, may be continued until the rooms 26 and 27 intersect the butt entry 14.

In Figure 1 the continuous mining machine 21 is shown as first completing the driving of the room 27. It may then be retractibly moved together with retractible movement of the articulated conveyor 33, bridge conveyor 37 and extensible conveyor 29, to complete the driving of the room 26 to intersect the butt entry 14.

It should here be noted with reference to Figure 1 that during the entire operation of advancing the parallel rooms 26 and 27 that a barrier pillar 39 between

the room 26 and the mined out area of the block of coal is left along the opposite rib of the room 26 from the pillars 31.

As the room 26 is advanced to intersect the entry 14, the continuous mining machine 21 may be turned at an angle and be advanced to mine or bore a section 44 of a supporting pillar 45 in the butt entry 14. During this operation the continuous mining machine conveyor 23, articulated conveyor 33, bridge conveyor 37 and extensible conveyor 29 are all maintained in material receiving relation with respect to each other. The continuous mining machine 21, articulated conveyor 33, bridge conveyor 37 and extensible conveyor 29 may then be withdrawn within the room 26 and the continuous mining machine 21 may be turned to the left, to cut an end of a supporting pillar 31, as indicated by reference character 47 in Figure 1.

The continuous mining machine 21, articulated conveyor 33 and bridge conveyor 37 may then be withdrawn a further distance and a second section 49 may be mined in the adjacent supporting pillar 31. The continuous mining machine 21 may then again be withdrawn and turned to the right, to mine a diagonal section or passageway through the barrier pillar 39, the continuous mining machine being advanced beyond the barrier pillar to mine a similar diagonal section 51 in the pillar 45. The continuous mining machine 21, articulated conveyor 33 and bridge conveyor 37 may then withdraw into the room 26, the extensible conveyor 29 being retractibly moved therewith. A cut or swath is then mined to the left to mine out the rear end of the advance supporting pillar 31. The continuous mining machine 21, articulated conveyor 33 and bridge conveyor 37 may then retractibly move in position to mine a second diagonal swath or bore 52 through the barrier pillar 39. At the termination of this mining operation the continuous miner 21 may be turned to mine out the end of the pillar between the two diagonal cuts 50 and 52, as shown in Figure 7. The continuous mining machine may then be withdrawn along with the articulated conveyor 33 and bridge conveyor 37 to make a second cut through the pillar between the two diagonal cuts as shown in Figure 8, and may then be further withdrawn to make a third cut through the same pillar as shown in Figure 9. The continuous miner 21 may then be withdrawn into the room 26 and turned diagonally to the left in position to mine off the end of the next adjacent supporting or chain pillar 31 as shown in Figure 10. The continuous mining machine 21 may then be retractibly moved together with the articulated conveyor 33, bridge conveyor 37 and extensible conveyor 29 and may then be advanced to mine an intermediate section in the same pillar 31 and then may be further retractibly moved and advanced to mine out the end of the same pillar, as shown in Figure 11.

Another diagonal section may then be mined through the barrier pillar 39 parallel to the diagonal sections 50 and 52 and the continuous miner may then be withdrawn and mine an intermediate section through pillar between this diagonal section and the next adjacent diagonal section. The machine may then back out of the diagonal section after mining out the inner end of the same pillar and then mine out the advance end of the next adjacent supporting pillar 31.

The retreating mining and loading operation of the barrier pillar and the supporting pillars between the rooms 26 and 27, as just described is continued substantially to the entry 17, mining out a large proportion of both the barrier pillar and the supporting chain pillars between the rooms 26 and 27 and continuously loading onto the extensible conveyor during the entire mining operation. At the termination of the mining of the barrier pillar 39 and the last chain pillar 31, the continuous mining machine is withdrawn to the entry 17 while the articulated conveyor 33 is stored in said entry. A next succeeding room 26 may be initially driven in the manner

previously described to initiate the mining out of a next adjacent area in the coal seam.

As an area of coal is mined out, the supporting coal left in the form of pillars is just sufficient to support the roof until the retreating mining of the barrier and chain pillars has been completed and all equipment has been withdrawn from the area. The roof will then commence to settle, but the area will be practically mined out as may be seen in looking at the mined out area shown in Figure 1, recoveries of 87% of the coal being possible which is far higher than has heretofore been attained with previous mining systems utilizing continuous mining machines.

It should here be understood that the recoveries of coal obtainable with the present system of mining of my invention are possible because of the speed with which the parallel rooms may be advanced and the pillars may be mined during the retreating operation, and that this relatively high speed of mining is not only attained by operation of the continuous mining machine 21, which both cuts and loads the coal from the working face, but also by the use of the articulated conveyor 33, in which both ends are laterally flexible to opposite sides of center making it possible for the continuous miner to mine one room turn a break-through and mine a parallel room all while continuously loading on to the extensible conveyor 29, and also to make the diagonal cuts in the barrier pillar 39, and then turn and mine out a large proportion of the coal left in the barrier pillar and the chain pillars, all during the retreating operation, with little if any interruption in the flow of coal to the entry.

It should here be understood that while I have referred to certain types of equipment, that various other types of equipment may be used as well, and that the operation may be carried with any type of continuous mining machine and extensible conveying equipment with the use of a laterally flexible mobile conveyor connecting the continuous mining machine with the extensible conveying equipment.

It will further be understood that while I have herein shown and described one form in which my invention may be embodied, that various modifications and variations of the invention may be effected without departing from the spirit and scope of the novel concepts thereof.

I claim as my invention:

1. A room and pillar system for mining coal and the like, the steps of alternately advancing two rooms of a pair of parallel rooms along one side of a barrier pillar between two parallel butt entries, by first driving a first room at right angles to one butt entry, one rib of which forms a face of the barrier pillar, then withdrawing to the butt entry and driving a diagonal stub entry a distance sufficient to intersect the first room and turning a second parallel room from the diagonal stub entry and extending said room for substantially the length of a supporting chain pillar between said rooms, then withdrawing from the second room and advancing through the stub entry to the first room and continuing the driving of the first room for substantially the length of the supporting pillar, then driving a break-through to the second room and turning the break-through and continuing the driving of the second room for substantially the length of a supporting pillar, then withdrawing through the break-through to the first room and continuing the driving of the first room all while maintaining a continuous conveying chain from the face being driven, effecting the flow of coal along the first room from the face during the advancing of the two rooms, at the intersection of the second butt entry in the operations of advancing each room, retreating from the second butt entry and successively driving a series of spaced diagonal cuts through one rib of the first room and a barrier pillar therefor and

then through the opposite rib of the first room and the supporting pillar therefor, and at the termination of each diagonal mining operation through a barrier pillar, withdrawing from the barrier pillar and mining the advance pillar in a series of mining operations of the coal remaining in the pillar, and maintaining the continuous conveying chain effecting the continuous flow of mined coal along the first room away from the working places during the entire retreating operation.

2. A method of mining coal comprising the steps of advancing at least two parallel rooms between two butt entries having supporting pillars between the rooms, in a continuous mining and loading operation and leaving a barrier pillar along one of the rooms during the operation of advancing said rooms, then mining in a retreating operation and during the retreating operation mining a series of spaced diagonal cuts in the solid barrier pillar from the rib of the adjacent room in a series of continuous mining and loading operations, withdrawing from each diagonal cut and mining a series of spaced diagonal cuts in the supporting pillars between the rooms in the opposite rib from the barrier pillar in a series continuous mining and loading operations and during the operation of advancing the rooms and during the retreating mining operations maintaining a conveyor in one room and loading onto the conveyor during the entire advancing and retreating operations and extending and retracting the conveyor in accordance with the advancing and retreating mining operations, to thereby maintain a substantially continuous flow of mined coal away from the coal face for delivery through a communicating butt entry.

3. In a room and pillar system for mining coal and the like, the steps of successively advancing two parallel rooms from a first butt entry to a parallel second butt entry in a series of step by step mining operations, loading the mined coal during the advancing operations and maintaining a flow of mined coal along one room to the first butt entry, at the termination of the operation of advancing one room for one step, driving a break-through to a next adjacent room and then advancing the next adjacent room for a next succeeding step in a continuous mining and loading operation, withdrawing from the next adjacent room through the break-through to the first room upon the completion of driving a step of the first room, continuing the advance of the first room for a next succeeding step, and repeating the successive advancing break-through driving and withdrawing operations of the two rooms in step by step relation, to intersect a second butt entry, and during the room advancing and break-through driving operations loading the mined coal and maintaining a continuous conveying chain, maintaining the flow of coal from the room being advanced along the one room to the first butt entry, and upon the intersection of the second butt entry by the two rooms, retreating toward the first butt entry and during retreating alternately mining a series of spaced diagonal cuts through the opposite ribs of said one room and during this mining operation maintaining the continuous conveying chain effecting the flow of coal along said one room away from the working places to the first butt entry during the retreating operation.

#### References Cited in the file of this patent

##### UNITED STATES PATENTS

2,651,513 Ramsay ----- Sept. 8, 1953

##### OTHER REFERENCES

"Mechanical Loading of Coal Underground," by Ivan A. Given, McGraw-Hill Book Co., 1943, pp. 148, 149 and 188.

"Mining Congress Journal," August 1952, pp. 105-07.