

Aug. 18, 1970

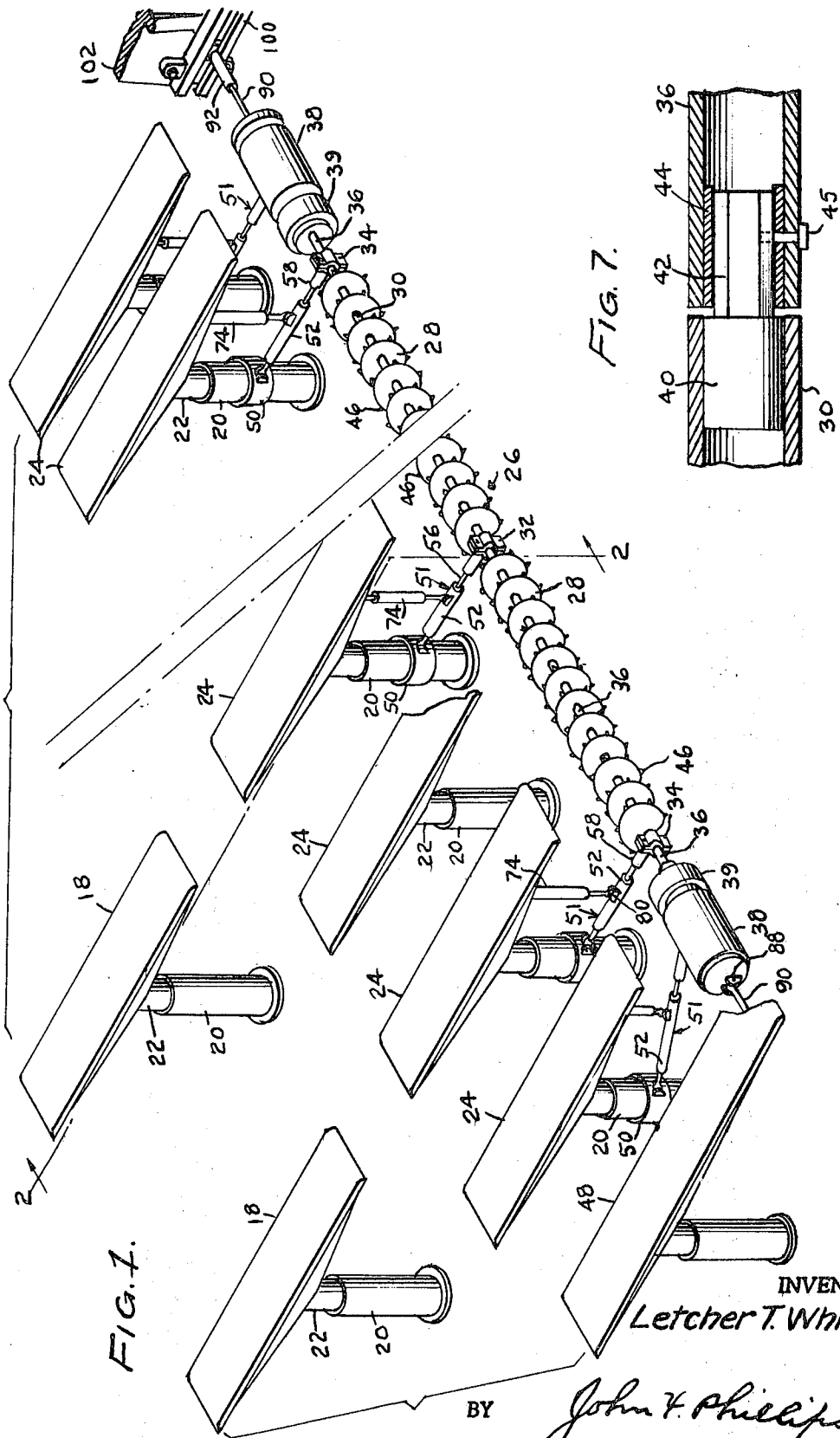
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MINING MACHINE HAVING SPIRAL CUTTERS WITH SCAVENGER BOARD

Filed Oct. 22, 1968

3 Sheets-Sheet 1



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FIG. 2.

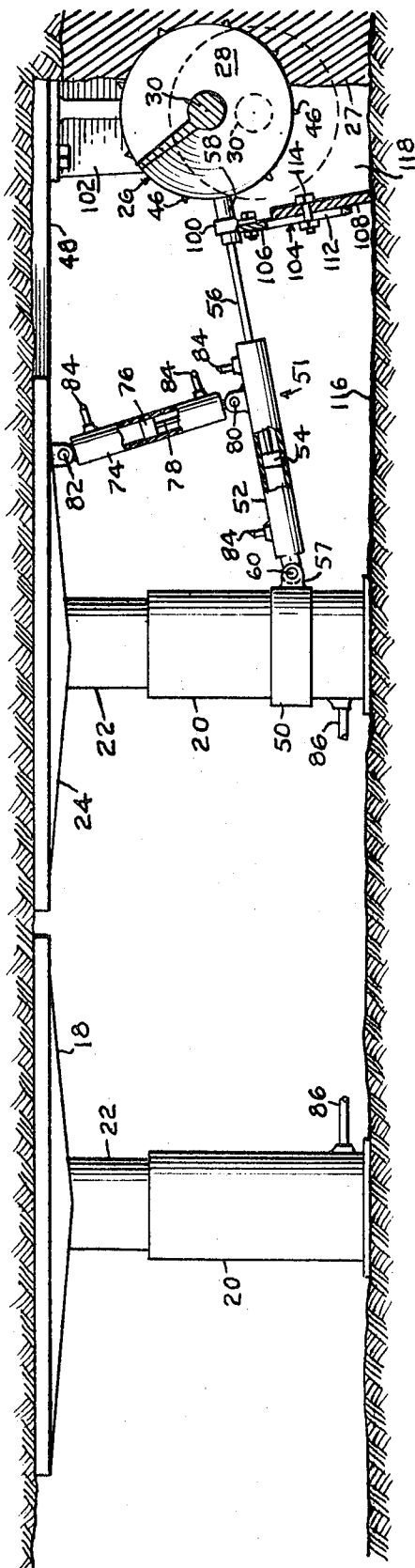
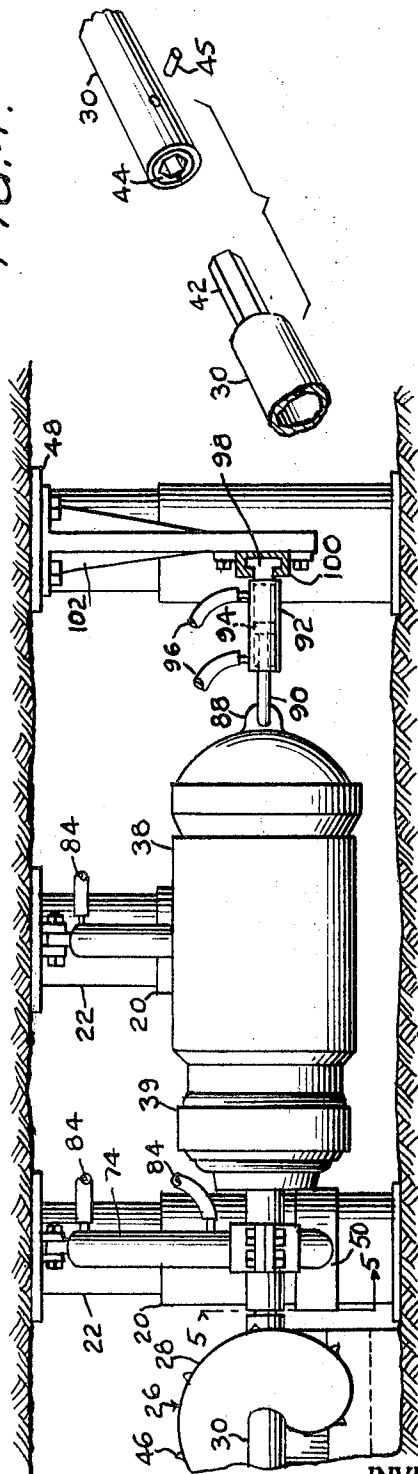


FIG. 3.



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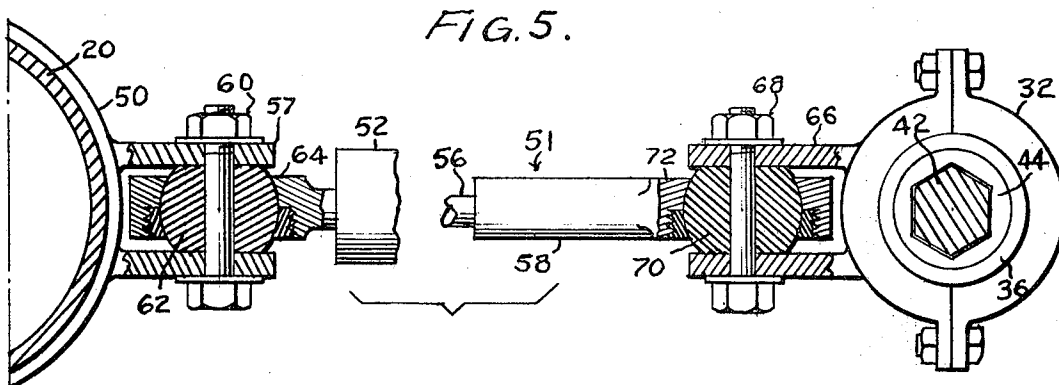
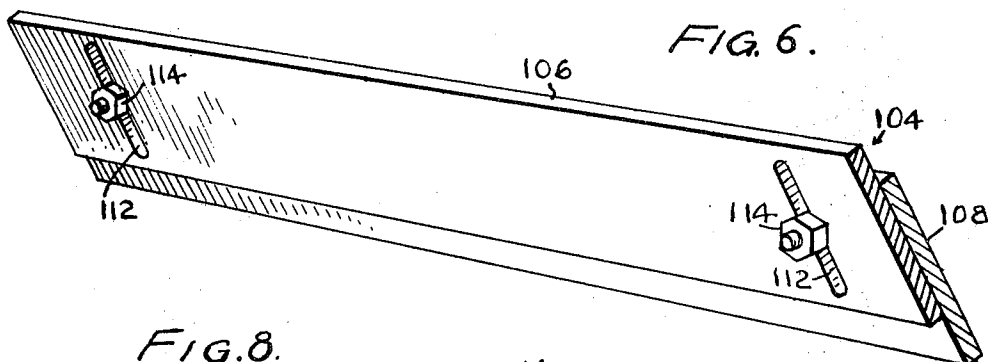
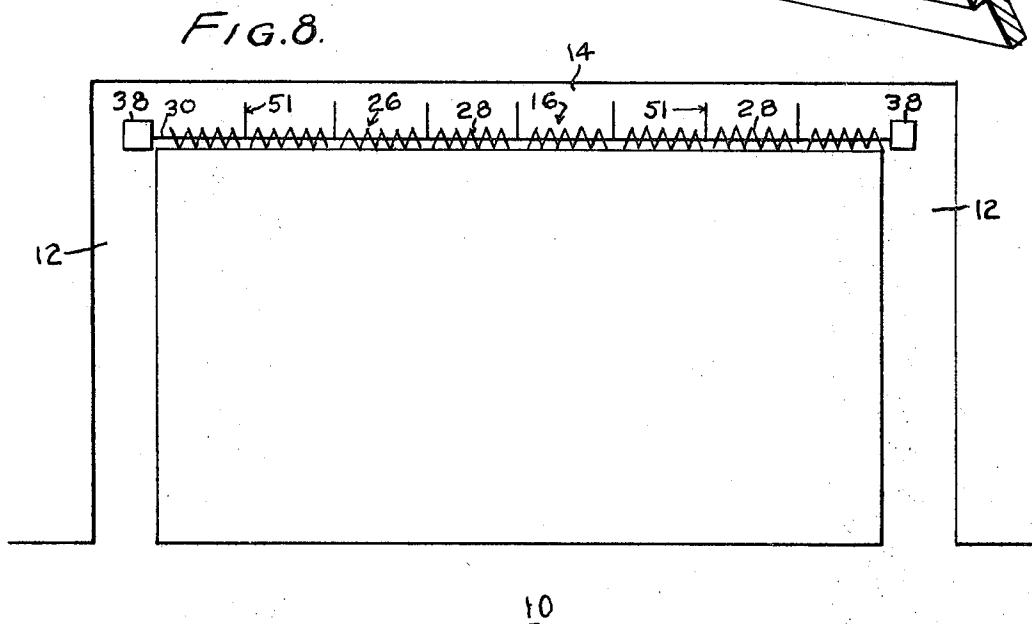
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13 Claims

ABSTRACT OF THE DISCLOSURE

A plurality of axially aligned augers, connected and driven from opposite ends thereof, are provided at spaced points along the helical edges of the augers with hardened cutting points to cut veins of coal. Pressure is applied to the augers laterally thereof at spaced points to gradually move the augers into a vein of coal to effect the cutting thereof. A rigid scavenger board is carried at the side of the augers opposite the vein of coal. During operation, the board, the mine floor and the vein of coal form a trough in which the augers act as a helical conveyor.

FIELD OF THE INVENTION

The invention relates to the field of coal mining, and has a particular reference to the cutting of coal in veins in a mine. A number of types of apparatus have been developed for this purpose but have been found to be relatively slow in cutting quantities of coal. For example, in one such apparatus, a spiral or helical member is fed axially into the coal, the outer end of the helix being rotated and the blades provided with cutting elements and the helix may be moved to a certain extent laterally of its axis to effect the cutting operation. Because the force is applied laterally against the free end of the helix, it is obvious that such a device cannot be of substantial length.

SUMMARY OF THE INVENTION

The invention comprises one or more, and preferably a plurality, of auger-like elements connected to each other axially for simultaneous rotation. The string of augers is driven from opposite ends by relatively large motors, and force is applied at spaced points along the augers to feed them laterally into the vein of coal.

More specifically, the cutting device comprises a plurality of relatively short large diameter auger sections connected to each other by means to be described and the ends of the shaft of each section are supported in a bearing. The motors at the end sections are also properly supported and each bearing and each motor is subject to the action of a hydraulic ram to feed it broadside into a vein of coal so that the cutting of the coal vein is accomplished by the hardened teeth carried by the edges of the several augers. Each hydraulic ram is backed up by engagement with a hydraulic jack supporting a roof support, and each such support is provided with a ram projecting substantially vertically downwardly therefrom and connected to the feeding rams which move the augers into the vein of coal. These rams connected to the roof supports act as supports for the other rams to hold the augers in the proper position to be fed straight into the vein of coal. The vertical roof support rams are subject to hydraulic pressure to move the entire assembly upwardly and downwardly within reasonable limits so that the augers will cut throughout the entire height of a vein of coal. The vertical or roof support rams attached to the feeding rams connected to the motors are similarly operable so that the motors may be raised or lowered with

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the augers as the feeding operation of the cutting augers into the vein of coal progresses. Each of the rams is universally connected at its ends to the respective elements by which they are carried to provide for endwise movement of the entire cutting assembly. This is accomplished by providing each motor at the remote ends of the augers with rams backed up by guides and the latter rams are subject to fluid pressure to move the entire assembly slowly axially, when desired, to change the rotative paths of the cutting elements carried by the augers. The axial rams connected to the motors are provided at their remote ends with crossheads operating in horizontal guides to permit them to slide forwardly and rearwardly in accordance with movement of the motors and helices toward and away from the vein of coal.

The adjacent ends of auger shaft sections and the remote ends of the auger shafts and the motor shafts are connected by slip joints which provide driving connections throughout the length of the apparatus. Such driving connections are in the form of a hexagonal element carried by one shaft, which is tubular, and slidable into a hexagonal socket in the adjacent shaft, there being very slight play between the hexagonal elements and sockets to permit very slight angular movement between the various shaft sections to accommodate for uneven cutting of the auger elements into the vein of coal. A pin extends through the slip joint connection referred to, to prevent excess endwise relative movement of these elements.

At the side of the augers opposite the vein of coal is arranged an elongated structure known as a "scavenger board" which is supported by the various ram assemblies which feed the augers into the vein of coal. This board, which may be made of two horizontal sections of overlapping metal relatively slideable laterally to each other, is arranged in contact with the bottom of the lateral or tunnel in which the apparatus is working to form with such bottom or floor and the vein of coal, a trough into which the chips of cut coal fall, thus preventing the coal from being thrown backwardly into the mine lateral. Moreover, the cut coal is maintained in proximity to and largely in engagement with the augers. These augers are preferably oppositely pitched from the center of the length of the assembly to the ends thereof so that the cut or chipped coal is fed endwise into an adjacent lateral to be collected and hauled away.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view showing the apparatus in conjunction with a plurality of mine roof supports;

FIG. 2 is a section on line 2—2 of FIG. 1, parts being broken away;

FIG. 3 is a face view of one end of the apparatus looking from the coal vein side thereof, a guide being shown in section;

FIG. 4 is a perspective view of one of the slip joint connections for the shaft elements;

FIG. 5 is a section on line 5—5 of FIG. 3;

FIG. 6 is a fragmentary perspective view of a portion of the scavenger board;

FIG. 7 is a longitudinal sectional view through one of the slip joints between the shaft sections; and

FIG. 8 is a diagrammatic view of a portion of a mine layout showing the position of the parts of the present apparatus when the operation begins.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 8, the numeral 10 designates the main gallery of a coal mine from which extend laterals

12, which may be, for example, twenty feet wide and as much as five hundred feet long. These laterals extend away from the main gallery 10 any desired distance which may be substantial, for example up to 1000 feet. The ends of the laterals remote from the main gallery are connected by a tunnel 14 parallel to the main gallery 10. It usually is in this tunnel 14 that the apparatus, indicated as a whole in FIG. 8 by the numeral 16, is arranged.

In accordance with the usual practice, the various galleries, laterals, etc., are provided with conventional roof supports, and a number of these supports, arranged in the tunnel 14, are shown in FIG. 1 and indicated by the numeral 18. Each of these supports has arranged therebeneath a hydraulic jack 20, having a piston 22 therein connected to the roof support. These jacks are maintained under pressure to properly support the roof of the mine as will be apparent.

A plurality of these roof supports, indicated in FIG. 1 by the numeral 24, are arranged in a line generally parallel to the vein of coal 27 (FIG. 2). Between the roof supports 24 and the vein of coal is arranged a cutting mechanism indicated as a whole by the numeral 26. This mechanism comprises a plurality of auger sections 28, each mounted on a shaft 30, the ends of which are connected by bearings 32. The remote ends of the shafts 30 are also supported by bearings 34, and these bearings also serve to support the shafts 36 of motors 38 of substantial size and horsepower. Each motor drives its associated shaft through a speed reduction gear 39. Thus, it will be apparent that the auger assembly is driven from opposite ends thereof by the two motors 38.

In FIG. 1 only two of the auger sections 28 have been shown, with the bearings 32 and 34 arranged a substantial distance apart. It will be understood in practice that substantially more bearings are employed, arranged relatively closer together than shown in FIG. 1. For example, each shaft 30 may have four, five or perhaps six helical turns of the auger thereon, thus a substantial number of helical shaft sections will be employed. These sections are connected to each other and to the motor shafts as shown in FIGS. 4, 5 and 7.

Referring to FIG. 7 it will be noted that the shaft sections are connected to each other to be simultaneously driven throughout the length of the auger sections. Each shaft is tubular as shown in FIG. 7, one adjacent shaft section being provided with an insert 40 having a hexagonal axial projection 42 slipping into a hexagonal socket 44 arranged in the adjacent shaft section. For example, the left-hand shaft section in FIG. 7 may be one of the shafts 30, while the other shaft section may be one of the motor shafts 36. As shown in FIG. 4, the hexagonal projection 42 has slight play relative to the socket 44 in which it is arranged. The purpose of this is to permit slight misalignment of the various shaft sections as may occur if one shaft section is moved forwardly slightly further than an adjacent section through the cutting action of the cutting elements carried thereby as referred to below. This play, while extremely slight, does permit a remote end of a shaft section to move an appreciable distance laterally of the axis of the shaft. A pin 45 (FIGS. 4 and 7) extends through one side of one shaft and partly through the other shaft to limit endwise movement of the shafts.

As shown in FIGS. 1, 2 and 3, the edge of each helix of each auger is provided with a plurality of spaced radially projecting cutting elements 46. These elements are formed of hardened carbon steel and their particular form and method of securing to the auger form no part per se of the present invention, these elements being known in the art.

Referring to FIG. 1, it will be noted that one of the roof supports and its jack 20 is arranged substantially opposite each bearing 32 and 34 and opposite each motor 38. In addition, one of the roof supports, indicated as a

whole by the numeral 48 (FIG. 1) is arranged beyond the end of each motor for a purpose to be described. Certain roof supports 24 are connected to the bearings 32 and 34 and to the motors 38 by struts 51. The jack cylinder 20 to which each strut is connected is provided with a relatively heavy band 50 to which is connected a ram 52, having a piston 54 therein (FIG. 2), and a piston rod 56 leads from each piston 54. This piston rod is provided at its end remote from the ram 20 with an enlarged rod 58, connected thereto, and this rod has its end connected to the adjacent bearing 32 or 34 or motor 38. The connection of this rod to its bearing and the connection of each ram 52 to its associated band 50 is shown in detail in FIG. 5. Each band 50 is provided with a pair of spaced ears 57 through which passes a bolt 60. Within these ears is arranged a ball element 62 engageable in a socket 64 connected to the adjacent ram cylinder 52. It will be apparent that this arrangement permits the ram 52 to partake of universal movement, being free to swing on the axis of the bolt 60 and to partake of the lateral movement relative thereto, for a purpose to be described. Similarly, each of the bearings 32 and 34 and each motor 38 is provided with a pair of spaced ears 66 having a bolt 68 passing therethrough and through a ball 70, arranged in a socket 72, carried by the rod 58. Accordingly, the rod 58 is free to partake of universal movement relative to the associated bearing or motor. It will be apparent that the admission of fluid pressure behind the pistons 54 of the rams moves the entire auger assembly toward the vein of coal (FIG. 2), to effect the cutting operation.

The vertical loads of the cutting apparatus and associated elements are supported by rams 74 (FIG. 2) each of which is provided with a piston 76, the piston rod 78 of which is connected at its lower end to the associated ram 52 as at 80. A similar connection 82 at the upper end of each ram 74 connects it to the associated roof support 24. The connections 80 and 82 are identical with the universal connections shown in FIG. 5 and need not be specifically illustrated. It will be apparent that these universal connections permit lateral swinging movement of the right-hand ends of the struts 51 as viewed in FIG. 2. Each of the rams 52 and 74 is provided with hydraulic pipes 84 for supplying hydraulic pressure to the rams to operate the pistons thereof for reasons which will become apparent. The source of hydraulic pressure is also connected to the jacks 20 by suitable pipes 86, these jacks being conventional, and accordingly, they need not be illustrated in detail. The remote ends of the two motors 38 are each universally connected as at 88 to a piston rod 90 of a ram 92, in which is arranged a piston 94, connected to the piston rod 90. Fluid pipes 96 are adapted to admit hydraulic pressure into either end of either cylinder 92, and this fluid pressure is adapted to effect a reasonable degree of axial movement of both motors and the cutting augers. The remote ends of the ram cylinders 92 are connected to the crossheads 98 (FIG. 3) operable in horizontal guides 100 carried by heavy depending brackets 102 secured at their upper ends to the roof supports 48.

Referring to FIGS. 2 and 6, the numeral 104 designates a "scavenger board" made up of a pair of plates 106 and 108, the former of which is connected by straps or any other suitable means 110 to the rods 58. One of the elements 106 or 108, which may be elongated metal plates, is provided with a plurality of spaced slots 112 in which is arranged a bolt 114 carried by the other plate. The assembly 104 is arranged at the side of the augers opposite the coal vein and combines with the vein and the floor 116 to form a trough 118 in which coal cut by the apparatus drops. If the rams 74 are energized to move the cutting apparatus upwardly, the plate 106 moves with its associated rods 58 while the plate 108 remains with its lower edge in contact with the floor 116. The augers may feed the coal in one direction, or they may be op-

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positely pitched from the centers thereof to feed the coal toward their ends, that is, the laterals 12 (FIG. 8). It will be noted in FIG. 8 that the motors 38 are arranged in the laterals 12, hence with the augers oppositely pitched from the centers thereof, the coal will be fed in opposite direction toward the laterals to be collected by any suitable means and hauled away.

In its simplest essence the invention comprises an auger, horizontally arranged, and provided with spaced points around the periphery thereof with cutting elements, and force is applied laterally to opposite ends of the auger to move it broadside into the vein of coal to perform the cutting operation. More specifically, a plurality of the augers is employed and arranged in axial alignment, end to end, and connected to each other to be simultaneously driven by motors at both of the remote ends of the auger assembly. Pressure for feeding the auger structure into the coal is provided by the rams 52, and the structure is supported by the rams 74. As the cutting progresses, fluid will be admitted to the rams 52 behind the pistons 54, thus feeding the cutting elements into the vein of coal so that the cutting operation proceeds.

The veins of coal in certain sections of the country are from four to six feet deep. Referring to FIG. 2, if the coal vein is higher than the diameter of the auger mechanism, and this diameter may be as much as four feet, it is desirable as the mechanism is fed into the coal vein to move it vertically. Under such conditions, fluid pressure is admitted to the upper ends of the rams 74, thus forcing the cutting assembly downwardly, for example as suggested in dotted lines in FIG. 2. Similarly, the admission of fluid pressure into the lower ends of the rams 74 will move the cutting elements upwardly.

Obviously, each cutting element 46 travels in a circular path, and the pitch of the augers therefore provides a cutting action at longitudinally spaced points along the augers. Under some conditions it may be desired to move the entire assembly axially to facilitate the cutting operation. Under such conditions, fluid pressure may be admitted to the outer ends of one of the arms 92 (FIG. 3) and to the inner end of the ram at the opposite end of the assembly. Therefore the motors structures and everything connected therebetween will be shifted to the left in FIG. 3. This operation may be reversed to move the assembly toward the right. This flexibility of the construction provides for the uniform cutting of the coal as will be understood.

Means (not shown) and forming no part per se of the present invention is employed for moving the apparatus forwardly as the cutting operation proceeds. For example, as each piston 54 approaches a point near the end of its stroke, suitable apparatus may be employed for moving the jacks 20 forwardly so that the operation can proceed almost uninterruptedly. It will be apparent, therefore, that the cutting operation may take place substantially continuously until the entire vein of coal has been cut from the tunnel 14 to the main gallery 10.

I claim:

1. A mining machine comprising a shaft having a helix thereon provided along the edge thereof at spaced points with cutting elements, means for driving said shaft, means for applying force laterally of said shaft at spaced points therealong to move it laterally into a vein of coal to cut the latter, a rigid scavenger board at the side of said helix opposite the vein of coal and longitudinally coextensive with said helix, and bearings for said shaft having mechanical connection with said scavenger board whereby the latter moves laterally with said shaft.

2. A mining machine according to claim 1 wherein said means for applying a lateral force to said shaft comprises a pair of hydraulic rams each anchored at one end and having its other end mechanically connected to said scavenger board and connected to one of said bearings.

3. A device according to claim 2 wherein each hydraulic ram is provided with a weight-supporting hy-

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draulic ram connected at one end directly thereto and having its upper end anchored whereby, the admission of hydraulic fluid to the same end of each weight-supporting ram will move said first-named rams to move said shaft vertically.

4. A mining machine according to claim 3 provided with means for effecting axial movement of said shaft to move the cutting paths of said cutting elements.

5. A mining apparatus comprising a plurality of end to end shafts having coupling means therebetween, a helix carried by each shaft and provided at spaced points along the edge thereof with cutting elements, means connected to one of the ends of said shaft for driving them, means for applying lateral force to said coupling means and to said driving means to move said cutting elements into a vein of coal to effect the cutting thereof, a scavenger board at the side of said helices opposite the vein of coal resting on the floor of the mine and extending longitudinally of and coextensive with said helices; said board, the mine floor and the vein of coal forming a trough in which said helices act as auger conveyors, and bearings connected to said scavenger board and supporting said shafts.

6. A mining machine according to claim 5 wherein each of said means for applying lateral force to said coupling means and to said power means comprises a hydraulic ram having mechanical connection with said scavenger board.

7. A mining machine according to claim 6 provided with a second hydraulic ram directly connected at one end to each of said first named rams and having its other end anchored whereby the admission of hydraulic pressure to the lower ends of said second rams supports the weight of said first named rams, said helices and said power means.

8. A mining machine according to claim 5 wherein said scavenger board comprises a pair of overlapping flat plates vertically slideably connected to each other, the upper of said plates being connected to said means for applying said lateral force and the slidably connection between said plates allowing the lower plate to remain in contact with the floor of the mine; said scavenger board, the bottom of said mine and the vein of coal forming a trough to receive the cut coal, said helices acting as auger conveyors to move the coal endwise of said trough to be recovered from the ends thereof.

9. A mining apparatus according to claim 8 provided with roof supports engaging the roof of the mine and provided with hydraulic supporting jacks, said means for applying said lateral force comprising rams each anchored at one end to one end of said jacks.

10. A mining apparatus according to claim 9 wherein each of said first named rams has universal connection at one end with one of said jacks and at its opposite end with the associated coupling or power means, and means for transmitting longitudinal force to said power means and to said shafts to change the circular cutting paths of said cutting elements.

11. A mining machine according to claim 10 provided with a plurality of hydraulic supporting rams each having universal connection at its lower end to one of said first named rams and at its upper end to one of said roof supports.

12. A mining machine comprising a shaft having a helix thereon provided along the edge thereof at spaced points with cutting elements, means for driving said shaft, means for applying force laterally to said shaft at spaced points therealong to move it laterally into a vein of coal to cut the latter, a scavenger board arranged at the side of said helix opposite the vein of coal, said scavenger board comprising a pair of overlapping flat plates vertically slidably connected to each other, the upper of said plates having mechanical connection with said shaft to move therewith as said helix advances into the vein of coal, said scavenger board forming with the floor of the mine and the vein of coal a trough in which said helix

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acts as an auger conveyor to move coal endwise of said trough.

13. A mining machine comprising a shaft having a helix thereon provided along the edge thereof at spaced points with cutting elements, means for driving said shaft, means for applying force laterally to said shaft at spaced points therealong to move it laterally into a vein of coal to cut the latter, and a scavenger board comprising relatively vertically movable elements and having a lower edge resting on the floor of the mine, said scavenger board, the floor of the mine and the vein of coal forming a trough in which said helix acts as an auger conveyor to move coal longitudinally of said trough, said scavenger board having mechanical connection with said shaft and with said means for applying lateral force to said shaft whereby said scavenger board will be moved with said shaft as the latter advances to cut into the vein of coal.

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References Cited

UNITED STATES PATENTS

1,336,440	4/1920	O'Toole	229—87	X
3,044,753	7/1962	Wilcox	299—87	X
3,088,718	5/1963	Lilly	299—87	X
3,291,533	12/1966	Rae	299—45	
3,445,139	5/1969	Von Hippel	299—87	

FOREIGN PATENTS

1,028,479	5/1966	Great Britain.
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U.S. Cl. X.R.

299—45, 87