Aug. 23, 1966 W. G. KEGEL 3,268,258

CONVEYING AND ROOF BOLTING METHOD AND APPARATUS

Filed Sept. 21, 1962 2 Sheets-Sheet 1

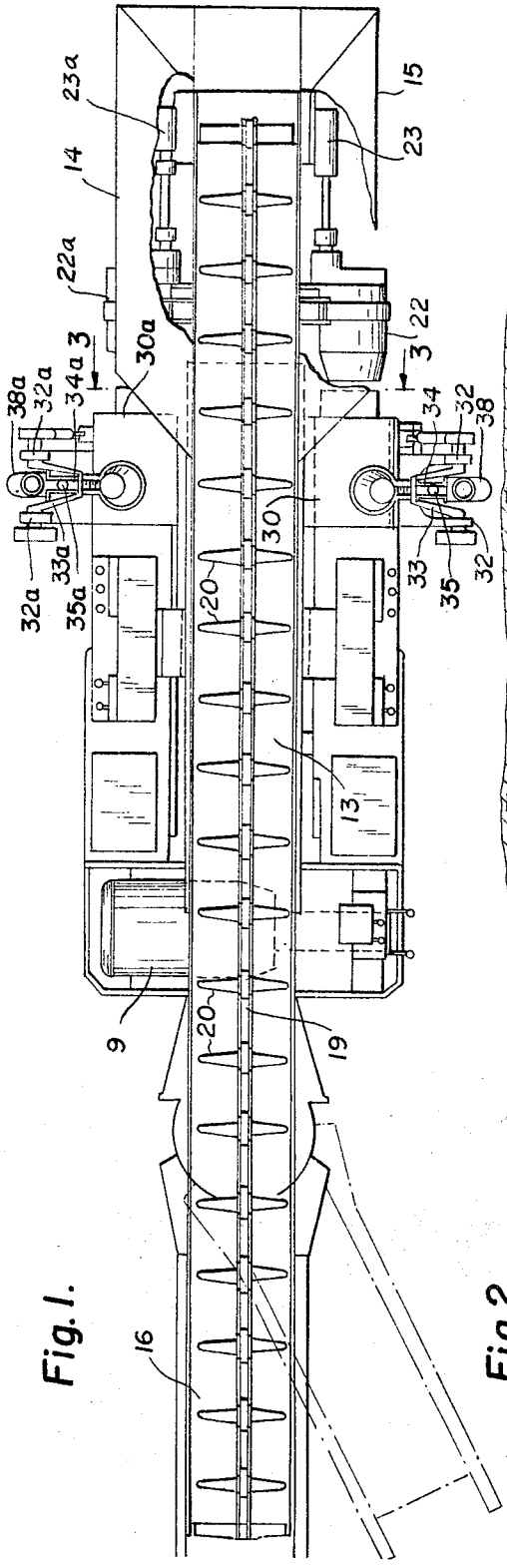


Fig. 1.

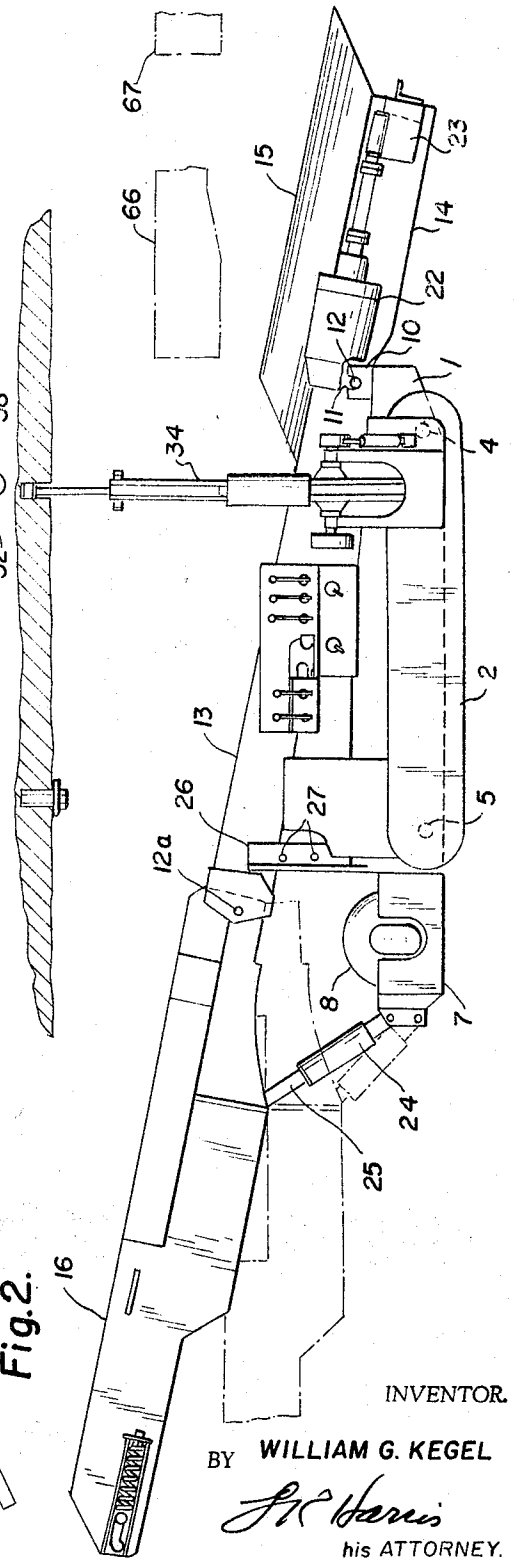


Fig. 2.

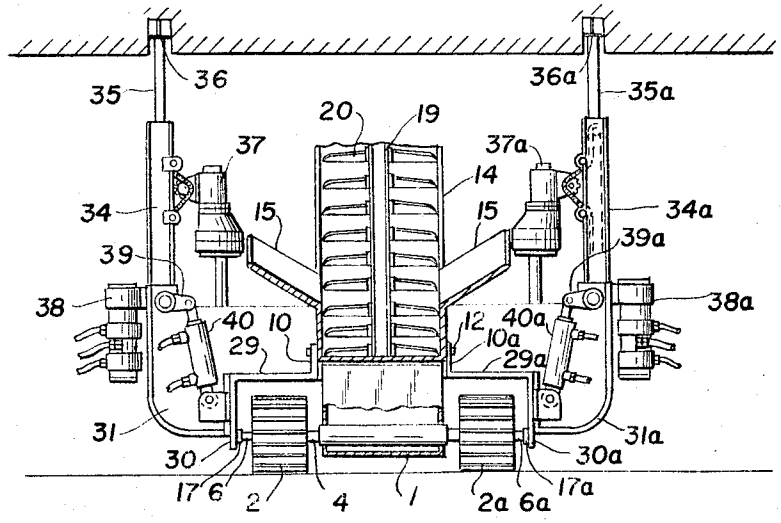
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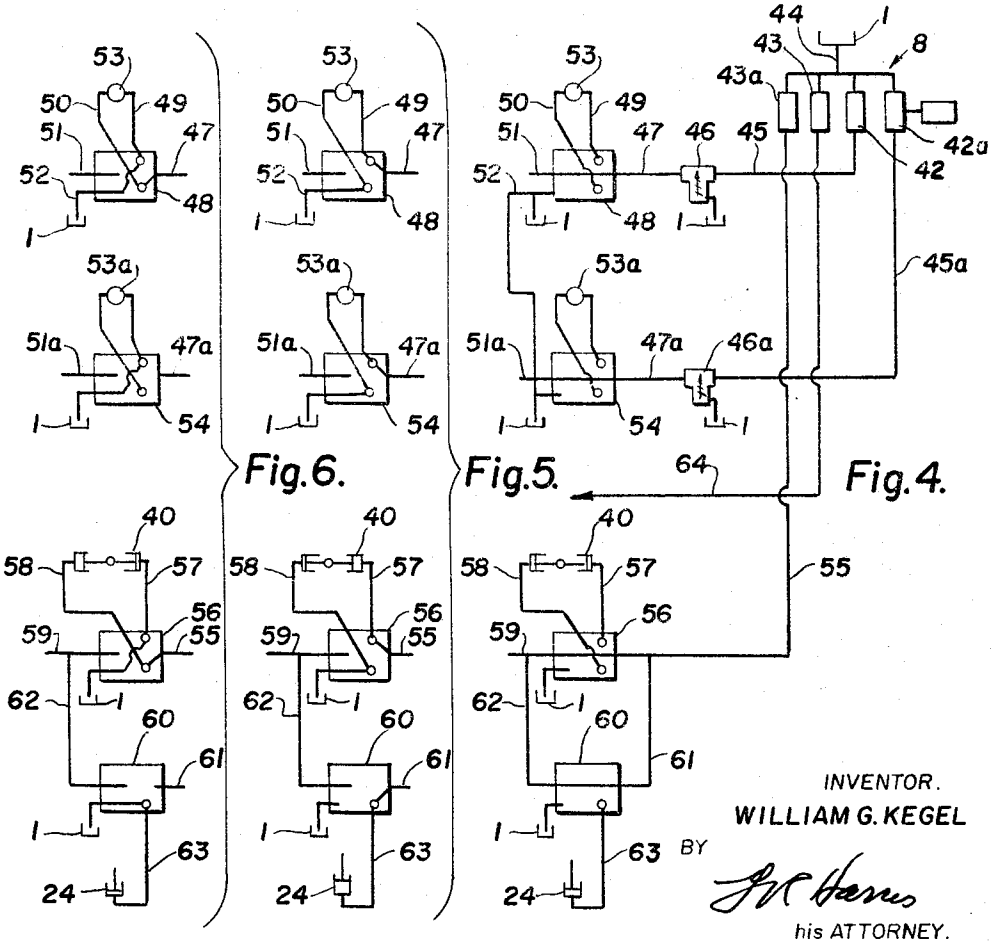
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Fig.3.





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CONVEYING AND ROOF BOLTING METHOD AND APPARATUS

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5 Claims. (Cl. 299—18)

This invention relates to the continuous underground mining and carrying away from the face of minerals such as coal. It is more particularly concerned with a method of continuously mining a mineral and providing permanent roof support immediately behind the face, and apparatus suitable for that purpose.

Underground mining of coal and the like is quite commonly carried out by the use of mining machines. One well known type of mining machine continuously advances toward the coal face and continuously mines and dislodges material from that face. The dislodged material is automatically directed into a conveyor mounted on the mining machine which lifts the material and transfers it along the length of the mining machine. That conveyor overhangs the rear end of the mining machine and discharges material into cars or onto a second conveyor which is positioned beneath it.

The advance of the mining machine cuts out an entry, the roof of which normally requires support. In recent years it has become common to support mine roofs in coal mines by suspension bolts. These bolts, which may be from three to five feet long, require that holes be drilled in the mine roof through the exposed roof portion and well into the over-burden. The bolts are known as expansion types that wedge into the hole. A steel plate of suitable size provided with a hole is placed over the bolt so as to be forced firmly against the roof when the bolt is screwed home.

This method of roof support makes it necessary to drill holes at intervals in the mine roof as the mining machine advances and heretofore it has been necessary to interrupt the continuous discharge of material from the mine face at intervals to permit the roof drilling and bolting operation to be carried out. These periodic interruptions reduce the capacity of continuously advancing mining machines, and are therefore undesirable.

It is an object of my invention, therefore, to provide a method of continuously conveying away from the mining face minerals dislodged by a continuously advancing mining machine, and intermittently to furnish roof support immediately behind the mine face without interrupting the mining or carrying away of the mined mineral. It is another object to provide separate transfer apparatus adapted to receive mined material from a continuously advancing mining machine and also adapted to perform roof drilling and bolting operations without interrupting the conveying away of the minerals. It is another object to provide such apparatus having improved construction and improved operating characteristics. Other objects of my invention will appear in the course of the following description thereof.

An embodiment of the apparatus of my invention presently preferred by me is illustrated in the attached figures to which reference is now made.

FIGURE 1 is a plan, partly broken away, of transfer apparatus of my invention.

FIGURE 2 is an elevation of the transfer apparatus of FIGURE 1.

FIGURE 3 is a section of the same apparatus on the plane 3—3 of FIGURE 1.

FIGURE 4 is a schematic of a portion of the hydraulic control system of my transfer apparatus.

FIGURE 5 is a schematic of the valves of FIGURE 4 in another position.

FIGURE 6 is a schematic of the valves of FIGURE 4 in still another position.

My apparatus utilizes as its frame an elongated liquid-tight tank 1 which is mounted between a pair of like endless treads 2 and 2*a*. In this specification the letter "*a*" following a reference character indicates an element which is identical with that of the reference character alone, but on the left hand side of the machine, viewed from its discharge end. The element identified by the reference character alone is mounted on the right side of the machine. Endless treads 2 and 2*a* are driven by separate hydraulic drive motors 53 and 53*a* which are shown schematically in FIGURES 4, 5 and 6. The driving elements of the endless tread are mounted on front axle 4 and rear axle 5 which extend transversely through tank 1. Front axle 4 is provided at either end with extended portions 6 and 6*a* for a purpose to be described. At the rear end of tank 1 is affixed a bracket 7 in which is mounted a pump 8 and its driving motor 9. On the upper surface of the front end of tank 1 are mounted a pair of brackets 10 and 10*a* each of which is provided with a U-shaped recess 11 which receives a cross-shaft 12. This cross-shaft 12 is the forward support for an elongated conveyor indicated generally by reference character 13 which is mounted above tank 1 and parallel to its long axis. Conveyor 13 has a front portion 14 which extends a substantial distance in front of tank 1 and is provided with a material-receiving hopper 15 which is considerably wider than the conveyor and which slopes downwardly toward the conveyor at the front and both sides so as to direct mined material onto it. The rear section 16 of the conveyor extends a substantial distance beyond bracket 7 and is movable about a vertical pivot, not shown, through an angle each side of center into positions shown by the broken lines is FIGURE 1. An endless chain 19 extends the entire length of conveyor 13 and travels around and beneath the conveyor in its return flight. Chain 19 is provided at spaced intervals with cross members 20—20 which extend substantially the width of the conveyor. Chain 19 is driven by motors 22 and 22*a* and gear arrangements 23 and 23*a* which are attached to conveyor section 14.

Hydraulic cylinder 24 is pivotally attached at one end to bracket 7. The piston rod 25 is pivotally attached to the underside of conveyor section 16 so that the conveyor section can be raised or lowered, tilting the whole conveyor 13, about cross-shaft 12. Upright bracket 26 which is attached at its lower end to tank 1 is provided with a plurality of holes 27—27, so that conveyor 13 can be fixed by bolts or the like in any one of several positions.

A cross member 29 attached to tank 1 near its front end is provided with down-turned ends 30 and 30*a*, which extend on each side below and outside endless threads 2 and 2*a*. Fastened to down-turned end 30 is upright bracket 31 having U-shaped vertical portion provided with aligned bearings 32—32 at its upper ends. In bearings 32—32 is journaled a crank 33; attached to the offset of crank 33 is boom 34, which is normally in the upright position shown in FIGURE 2. Attached to the inside of end 30 is a collar 17 dimensioned to receive the extended end 6 of front axle 4. Identical elements are found on the left side of my apparatus.

Boom 34 is a hollow box section within which is positioned a drill shaft 35 so that it can move axially thereof. Drill shaft 35 carries a drill bit 36 at its upper end. Alternatively, bit 36 can be replaced by a socket wrench or the like. My roof drilling and bolting mechanism is conventional and will not be described in detail here. It includes a hydraulic motor driven mechanism 37 for feeding drill shaft 35 in or out relative to boom 34, and a hydraulic motor driven mechanism 38 for rotat-

ing drill shaft 35. An arm 39 at one end of crank 33 is connected to a double-ended hydraulic cylinder 40 so that boom 34 can be swung in either direction from the vertical about the axis of crank 33.

A portion of the hydraulic control system of my apparatus is shown diagrammatically in FIGURE 4. Pump 8 is a four stage pump having two identical high volume stages 42 and 42*a*, and two identical low volume stages 43 and 43*a*. One high volume stage 42 drives endless tread 2 or corresponding drill mechanism 38 on the right side of my apparatus in a manner to be described, and the other high volume stage 42*a* drives identical mechanisms on the left side. One low volume stage 43 drives the right hand drill feed mechanism 37. The other low volume stage 43*a* drives hydraulic cylinders 40 and 40*a* and hydraulic cylinder 24, or the left hand drill feed mechanism 37*a* in a manner to be described.

High volume stages 42 and 42*a* are connected to tank 1 through a suction manifold 44. From high volume stage 42 delivery line 45 is connected to relief valve 46 and from that valve line 47 goes to control valve 48. Valve 48 is a three-way valve and in FIGURE 4 is shown in neutral or number 2 position. It is shown in position 1 in FIGURE 5 and in position 3 in FIGURE 6. In FIGURE 4, valve 48 connects line 47 to line 51 which goes to right hand drill rotating motor 38. Right hand endless tread drive motor 53 is unconnected from pump 42.

In its position shown in FIGURE 5 valve 48 connects line 47 to line 49 which leads to endless tread drive motor 53. Valve 48 also connects line 50 coming from motor 53 to line 52 which discharges to tank 1. In this position of valve 48 motor 53 rotates in the direction to move my apparatus forward. When valve 48 is moved into the position shown in FIGURE 6, line 47 is connected to line 50 and line 49 to line 52. In this position of valve 48 motor 53 rotates in the direction to move my apparatus backward.

Valve 54 shown immediately below valve 48 in FIGURE 4 controls left hand endless tread drive motor 53*a* in exactly the same way, and in its position shown in FIGURE 4 allows fluid from a high volume stage 42*a* to pass to left hand drill rotating motor 38*a* through line 51*a*.

Valve 56 shown immediately below valve 54 controls swing cylinders 40 and 40*a* and left hand feed mechanism 37*a*. Line 55 connects low volume stage 43*a* to valve 56. In the position of valve 56 shown in FIGURE 4 line 55 is connected to line 59 which carries fluid to left hand feed mechanism 37*a*. In its position shown in FIGURE 5 valve 56 connects line 55 to line 57 which, in turn, is connected to one end of the double ended cylinders 40 and 40*a*. The other end of those cylinders is connected through line 58 to tank 1. In its position shown in FIGURE 6 valve 56 connects line 55 to line 58 and line 57 to the tank.

Valve 60 shown immediately below valve 56 controls single-ended conveyor elevating cylinder 24. Valve 60 in its position shown in FIGURE 4 connects line 61, which leads from line 55 to line 62 which, in turn, leads to line 59. Valve 60 thus bypasses valve 56 in supplying fluid to left hand feed mechanism 37*a*. In its position shown in FIGURE 5, valve 60 connects line 61 to line 63 which is attached to hydraulic cylinder 24. In its position shown in FIGURE 6 valve 60 connects line 63 to the tank 1.

Valves 48, 54, 56 and 60 are individually controlled. In addition, my apparatus is provided with other control valves which are conventional and so are not shown. Fluid lines 51 and 51*a* lead to drill rotating motors 38 and 38*a* as has been mentioned, and fluid line 59 leads to left hand drill feed mechanism 37*a*. A fluid line 64 leads from low volume stage 43 of pump 8 to right hand drill feed mechanism 37. Each motor 37, 37*a* and 38, 38*a* is also connected to tank 1, and each is provided with a conventional reversing valve which starts, stops or reverses its associated motor in conventional fashion.

My apparatus operates in conjunction with a continuously advancing coal mining machine provided with an overhanging discharge conveyor at its rear end. In FIGURE 2 the end of that discharge conveyor, indicated by reference character 66, is shown in its position of maximum overhang or overlap with respect to my apparatus. Reference character 67 indicates the end of the same discharge conveyor in its position of minimum overhang or overlap with respect to my apparatus. Although I have described the mining machine conveyor as overlapping my apparatus, I can equally well describe my apparatus as underlapping that conveyor.

My apparatus is put into operation by moving it up behind a mining machine until hopper 15 underlaps the mining machine conveyor 66. Motor 9, connected to a source of electrical energy not shown, operates pump 8. Tank 1 is filled with oil. The high volume stages 42 and 42*a* pump oil from tank 1 through valves 48 and 54, moved to the positions of FIGURE 5, into endless tread drive motors 53 and 53*a*. These move the apparatus forward. Low volume stage 43*a* pumps oil to valves 56 and 60. Conveyor 13 is tilted around shaft 12 so as to raise or lower its discharge end 16 by admitting oil into cylinder 24, or allowing the oil to run back into tank 1, in which case the weight of conveyor 13 causes its end 16 to fall. Valve 60 is moved to its position in FIGURE 5 to elevated end 16, and to its position in FIGURE 6 to allow end 16 to fall. Chain 19 is set in motion by connecting motors 22 and 22*a* to a source of electrical energy, not shown.

As coal or other mineral mined is discharged from mining machine conveyor 66 into hopper 15 of my apparatus, cross members 20—20 are pulled along by chain 19 carrying the coal along conveyor 13 up over its discharge end 16 onto another conveyor or mine cars not shown. My apparatus is caused to follow the mining machine by actuating endless tread drive motors 53 and 53*a* as may be necessary.

When a roof bolting operation must be performed, my apparatus is moved up behind the mining machine until hopper 15 underlaps the mining machine conveyor 66 the maximum amount, and the endless tread drive motors 53 and 53*a* are then stopped by moving valves 48 and 54 respectively to the positions shown in FIGURE 4. In that position the valves allow fluid to flow through lines 51 and 51*a* to drill motors 38 and 38*a*. Conveyor drive motor 22 is allowed to run so as to maintain movement of conveyor chain 19 and cross members 20—20.

Boom 34 is brought into the desired position for roof drilling by admitting oil to one end or the other of cylinder 40. This is accomplished by moving valve 56 to the position of FIGURE 5 or FIGURE 6. Drill shaft 35 is then fed out by admitting oil to feed motor 37. This is effected for the left hand feed motor 37*a* by moving valve 56 to its position shown in FIGURE 4, and for the right hand feed motor 37 by a conventional valve in line 64 not shown, but previously mentioned. Right hand drill shaft 35 is caused to rotate by admitting fluid into drill rotating motor 38 through a control valve not shown, and left hand drill shaft 35*a* is caused to rotate by admitting fluid to drill rotating motor 38*a* through a control valve not shown.

During the drilling operation the reactive force from drill 35 is transmitted through bracket 31 and collar 17 to end 6 of axle 4 and through that axle and endless tread 2 to the mine floor. When holes of the desired depth have been drilled in the mine entry roof, the drills are backed out and expansion bolts are inserted in the holes. The drill bit 36 on drill shaft 35 is then replaced by a socket wrench which fits the bolt head, and the roof drilling mechanism is used to screw the bolt tight. All during this entire operation of drilling roof holes and bolting them, my apparatus is stationary, but the mining machine

continues to advance. The position of its discharge conveyor with respect to hopper **15** of my apparatus changes from that indicated by reference character **67**. When the roof bolting operation is completed, my apparatus is made to move forward by operating valves **48** and **54** to allow fluid to enter endless tread motors **53** and **53***a*. With the valves mentioned in position to operate the endless tread motors, no fluid can pass to the drill motors.

I claim:

1. Apparatus for operating in cascade with a continuously advancing mining machine having elongated material discharge means overhanging its rear end comprising an elongated mobile transfer unit having a longitudinally extending conveyor with elongated material receiving means adapted to be positioned beneath the material discharge means of the mining machine, and roof drilling and bolting means mounted on the transfer unit, the material receiving means being dimensioned to underlap the mining machine discharge means throughout a range of advance of the mining machine sufficient for the roof drilling and bolting means to perform a roof drilling and bolting operation while the transfer unit is stationary without interrupting the advance of the mining machine or the discharge of material therefrom, whereby the transfer unit provides roof bolting support immediately behind the mining machine.

2. Apparatus of claim **1** including as a part of the mobile transfer unit a transverse axle extending outwardly of that unit and a mounting bracket for the roof drilling and bolting means positioned to bear against the outside end of the axle and transmit thrust from the roof drilling and bolting means to the axle.

3. An elongated mobile transfer unit for operating in cascade with a continuously advancing mining machine having elongated material discharge means overhanging its rear end comprising a pair of laterally spaced endless treads, a closed elongated tank positioned between them, an elongated conveyor positioned above the tank and extending beyond it at either end, roof drilling and bolting means attached to the tank, a power driven pump having a fluid connection with the tank, separate hydraulic drive motors for the endless treads and for the roof drilling and bolting means, fluid connections between the pump and the separate motors, and fluid connections between the separate motors and the tank.

4. The apparatus of claim **3** including valve means in the fluid connections between the pump and the separate motors adapted to connect the separate motors for the roof drilling and bolting means with the pump and simultaneously disconnect the separate motors for the endless treads from the pump.

5. The method of driving a continuously advancing mine face and intermittently providing roof support immediately behind the face comprising cutting and discharging material from the mine face in a continuously advancing operation, transferring the mined material to a continuously advancing first conveyor, continuously discharging the mined material from the first conveyor onto a second movable conveyor, halting the second conveyor and performing a roof drilling and bolting operation therefrom without interrupting the discharge of material thereon from the first conveyor, and then advancing the second conveyor toward the mine face.

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