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(54) **METHOD OF MINING AND AN IMPROVED MINING MACHINE WITH A SHOVEL MOVEABLE RELATIVE TO A VEHICLE CHASSIS**

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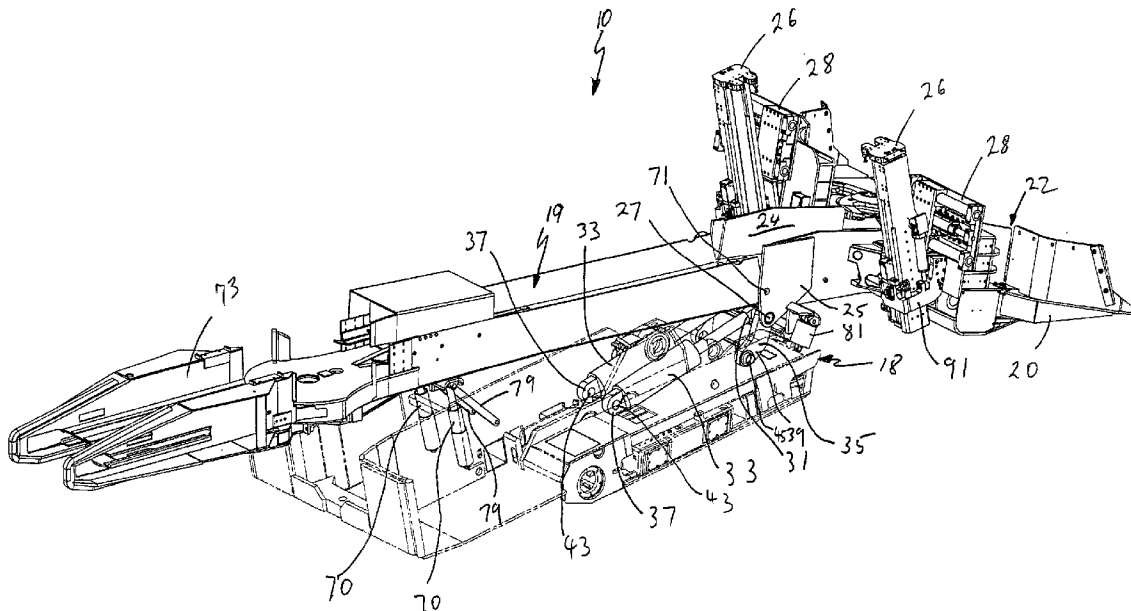
ABSTRACT

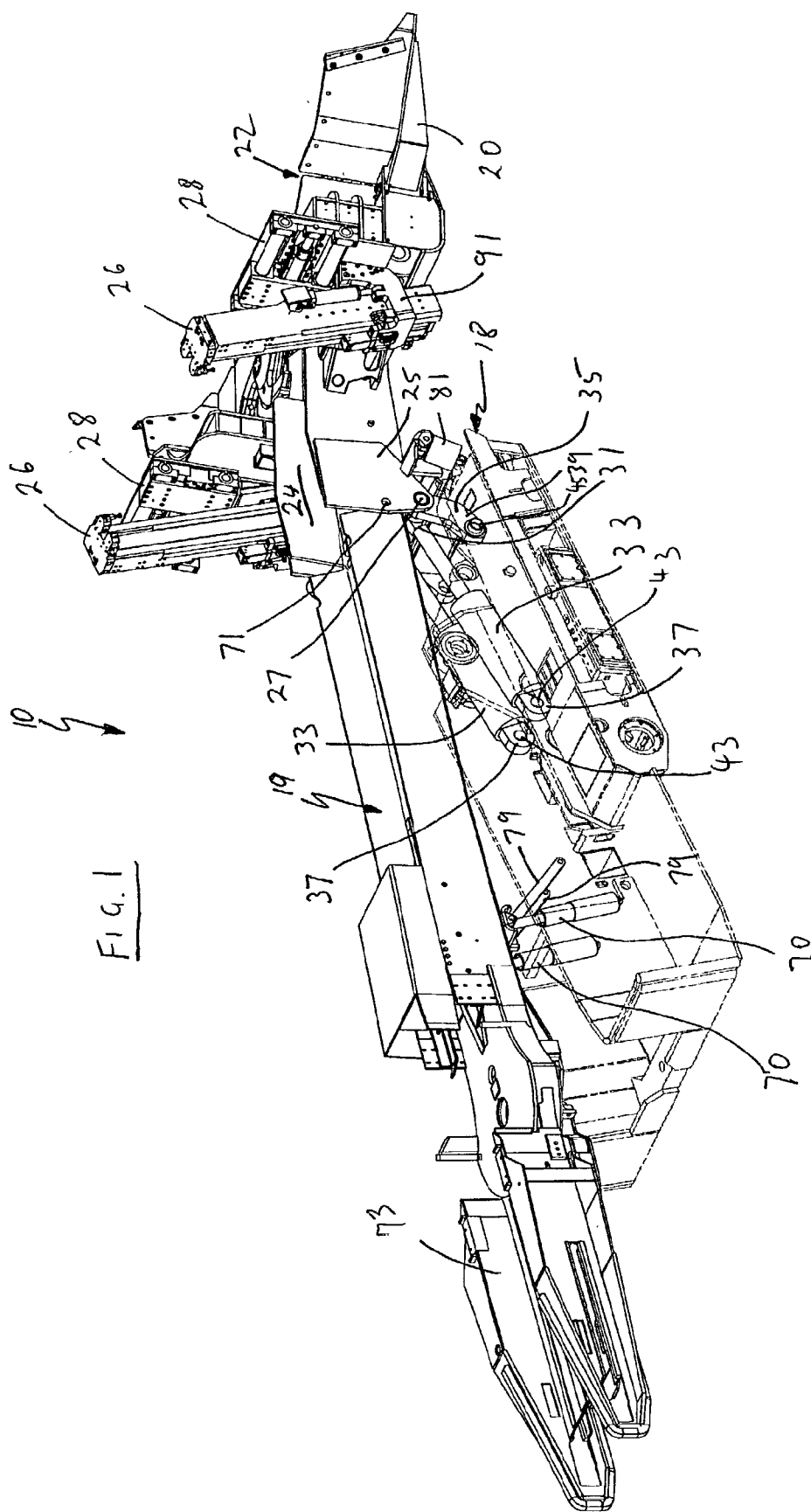
A continuous miner having a cutting head and a conveyor mounted on a moveable chassis, the miner including a shovel mounted on a supporting structure, the shovel being translatable relative to the miner, and means for translating the shovel relative to the moveable chassis so as to be able to be moved from a rearward location to a forward location relative to the moveable chassis.

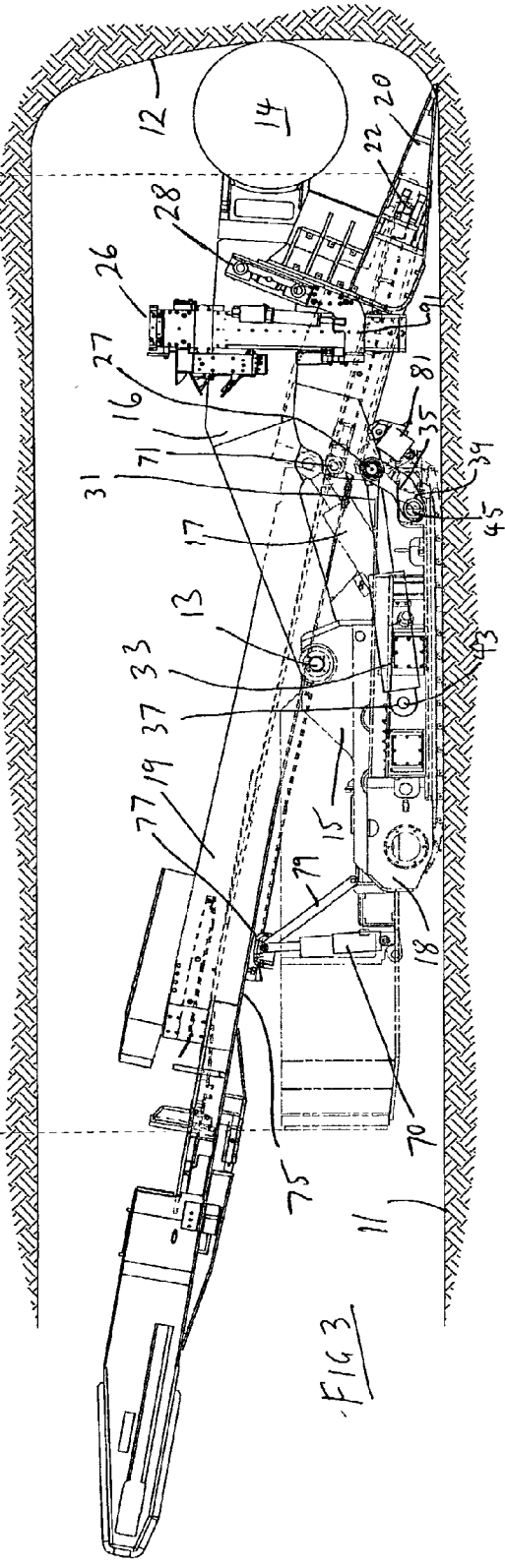
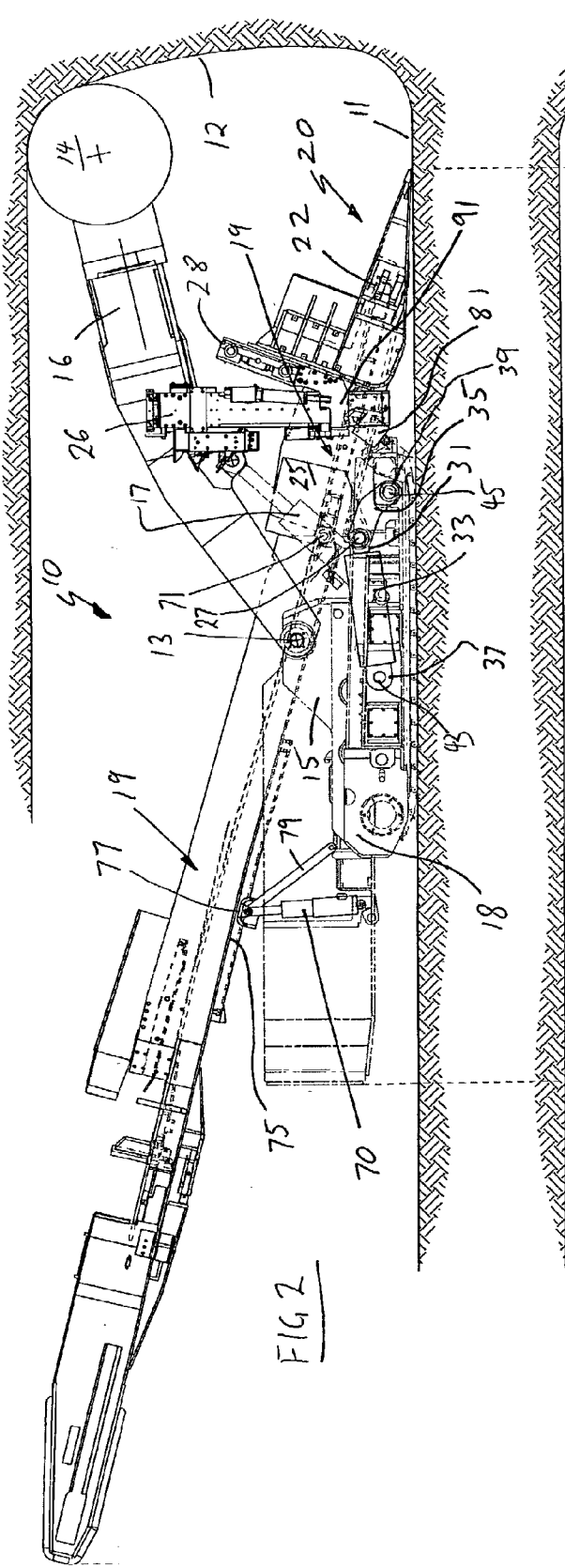
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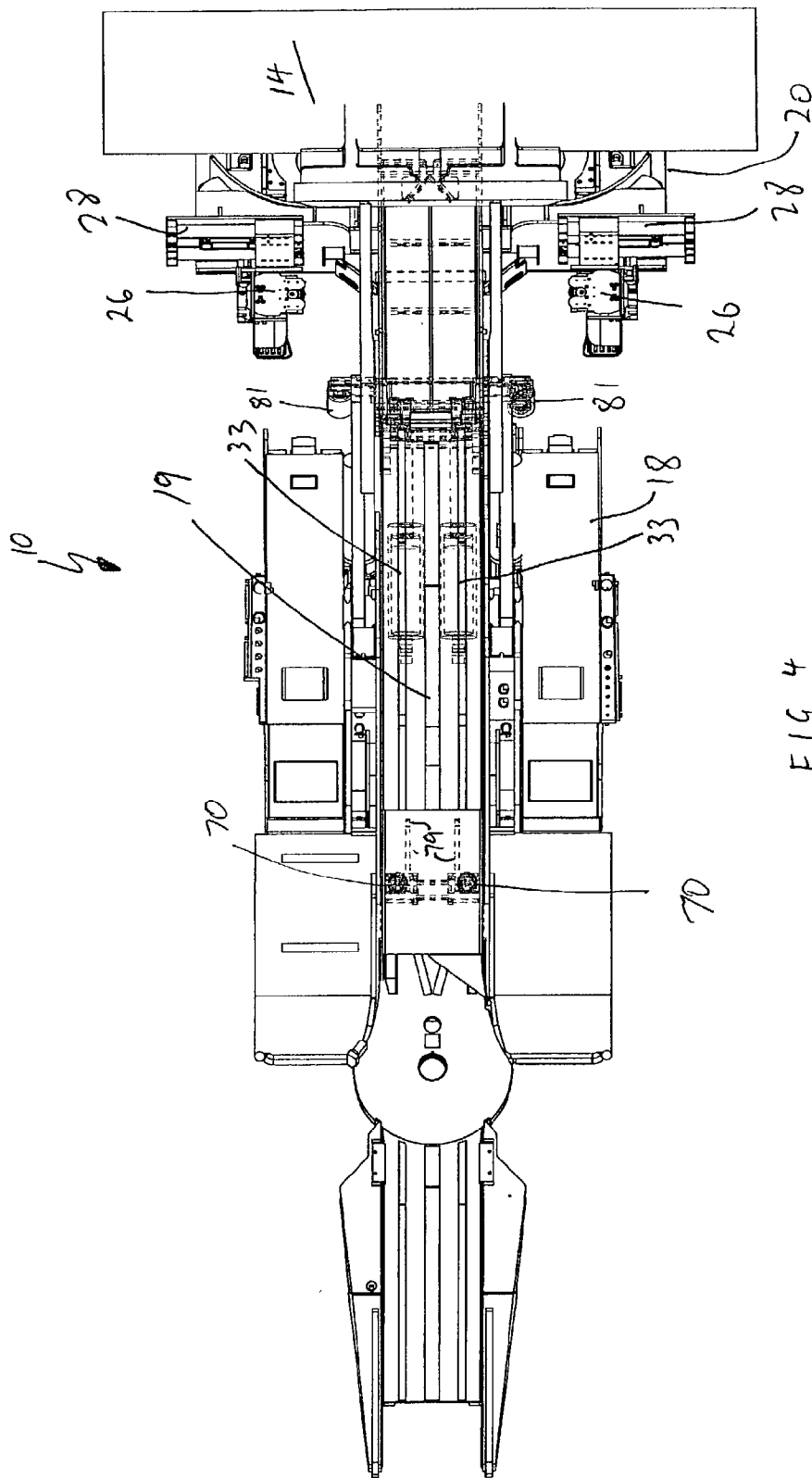
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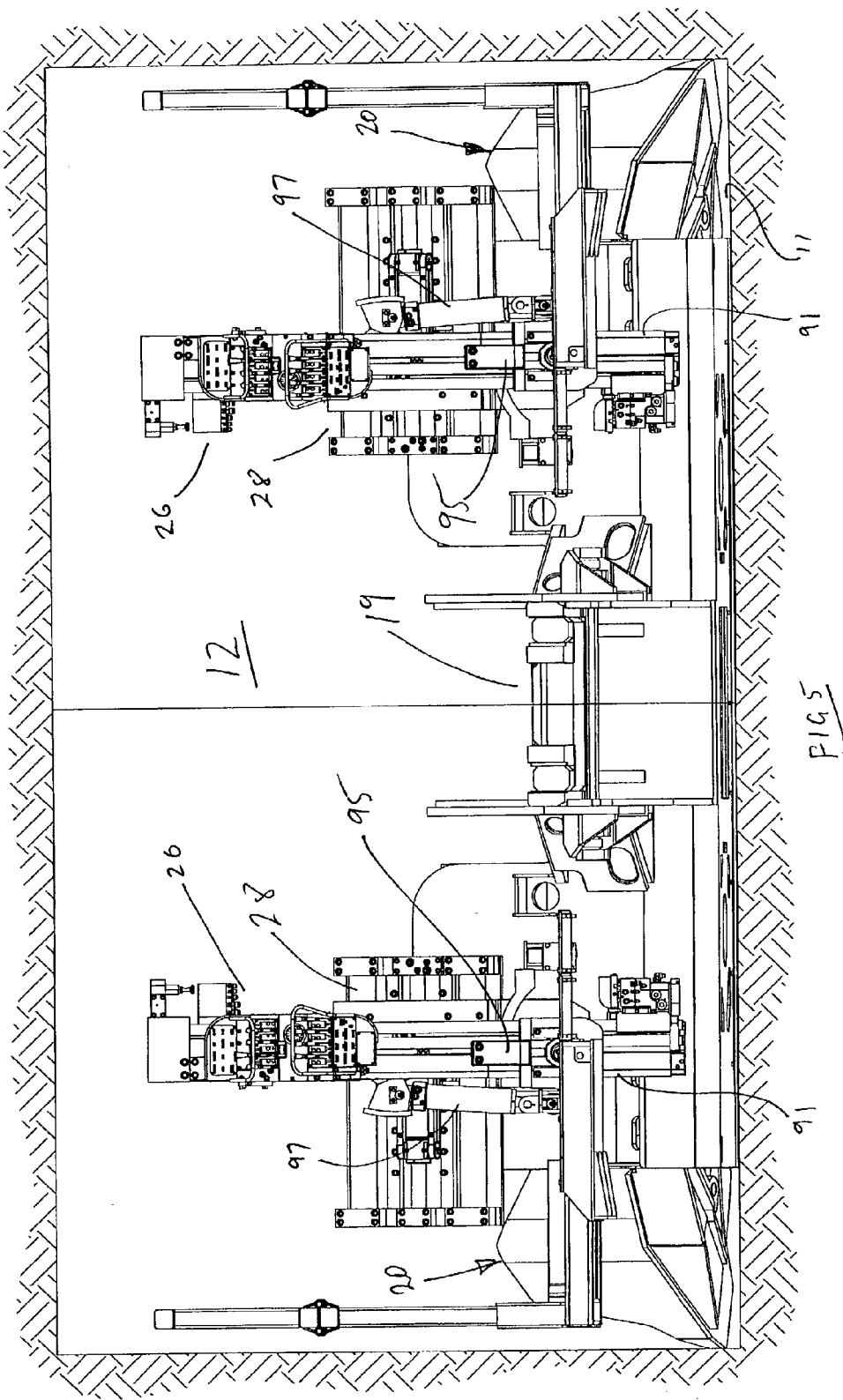
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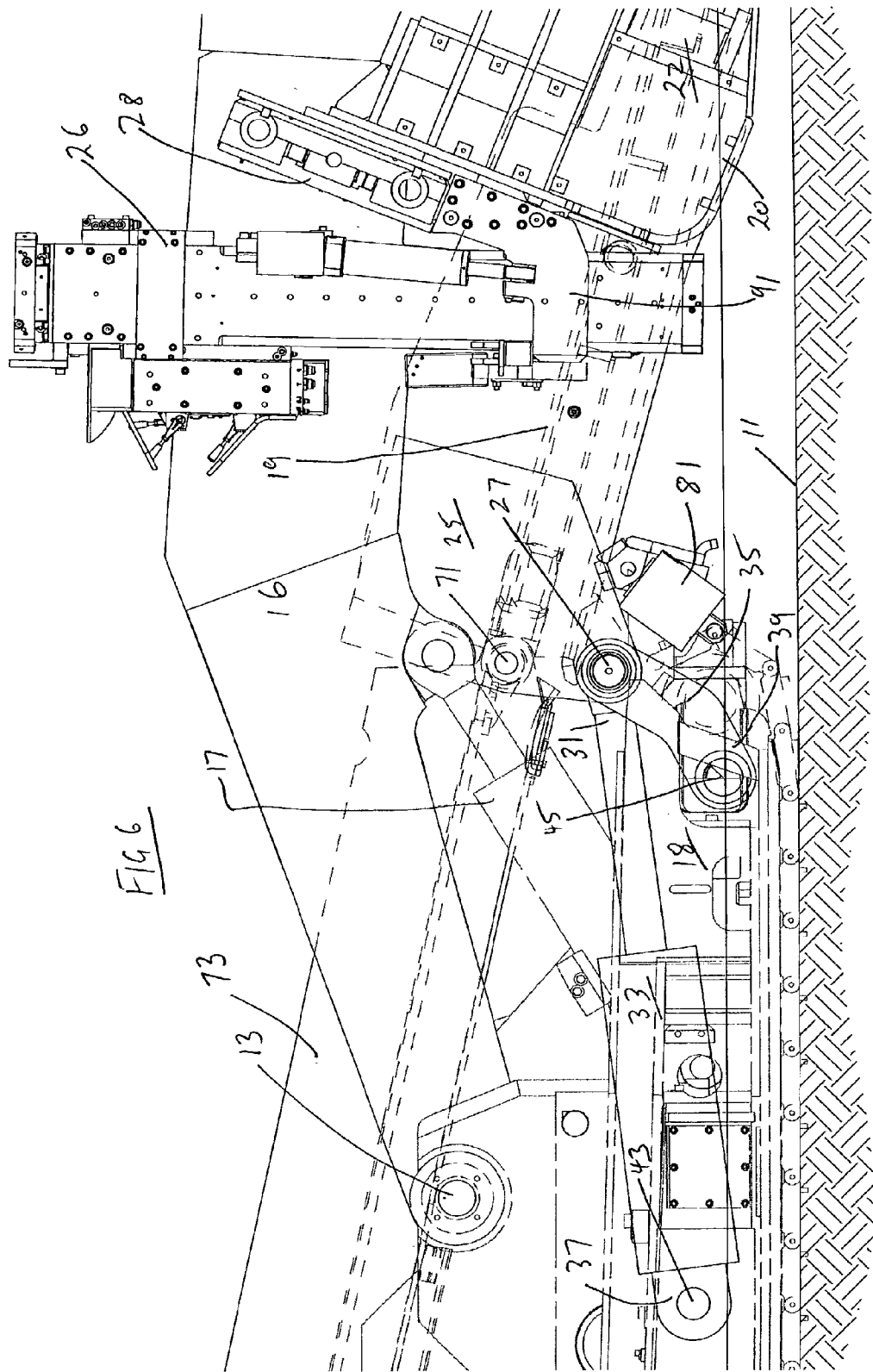


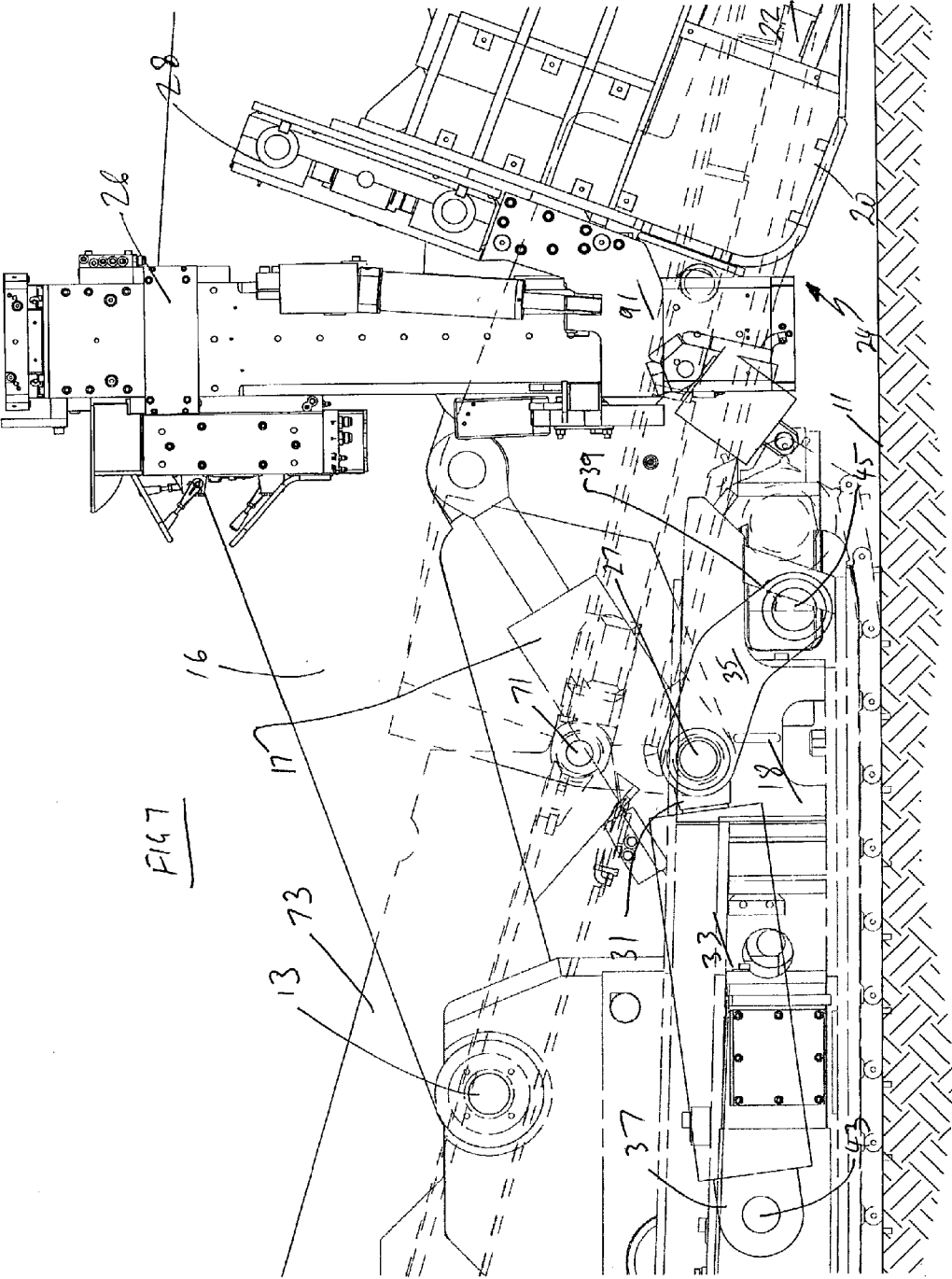


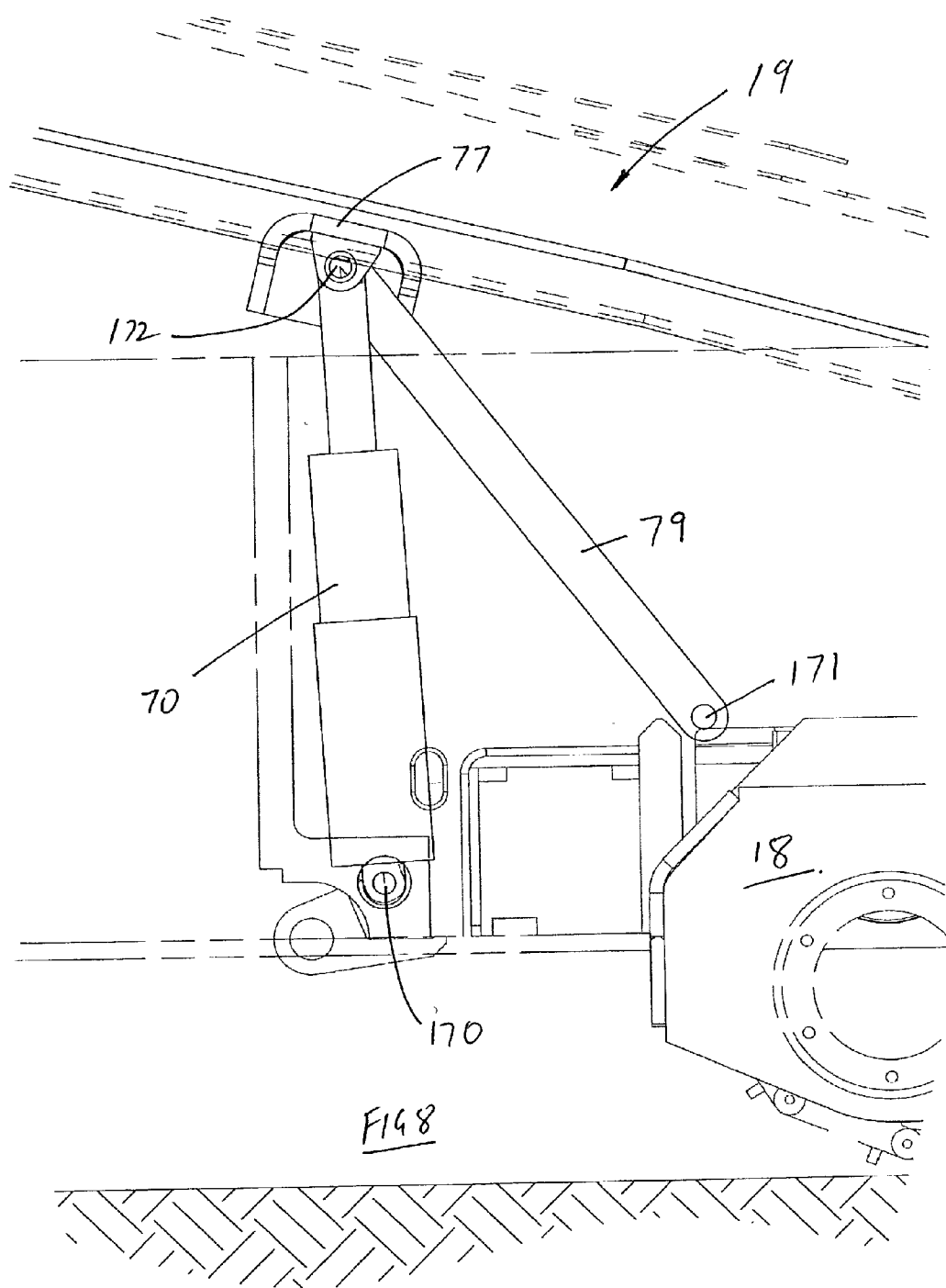


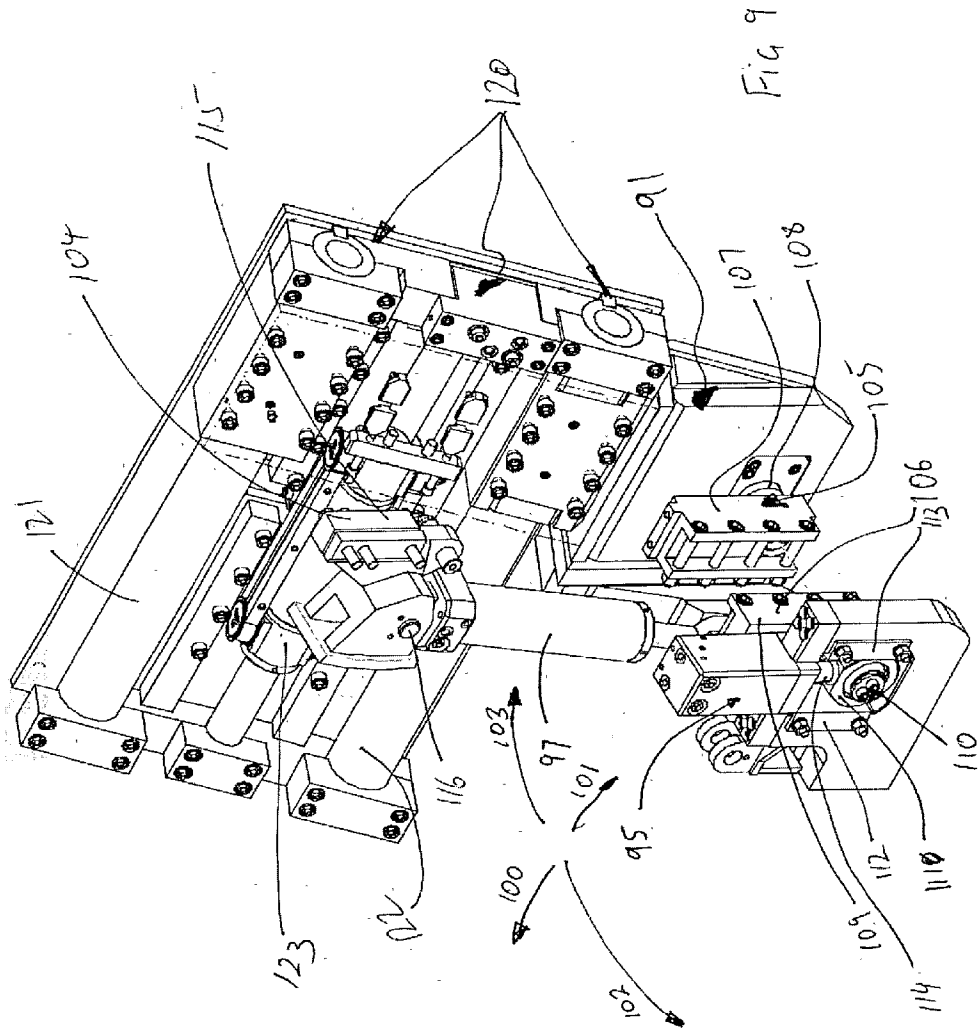


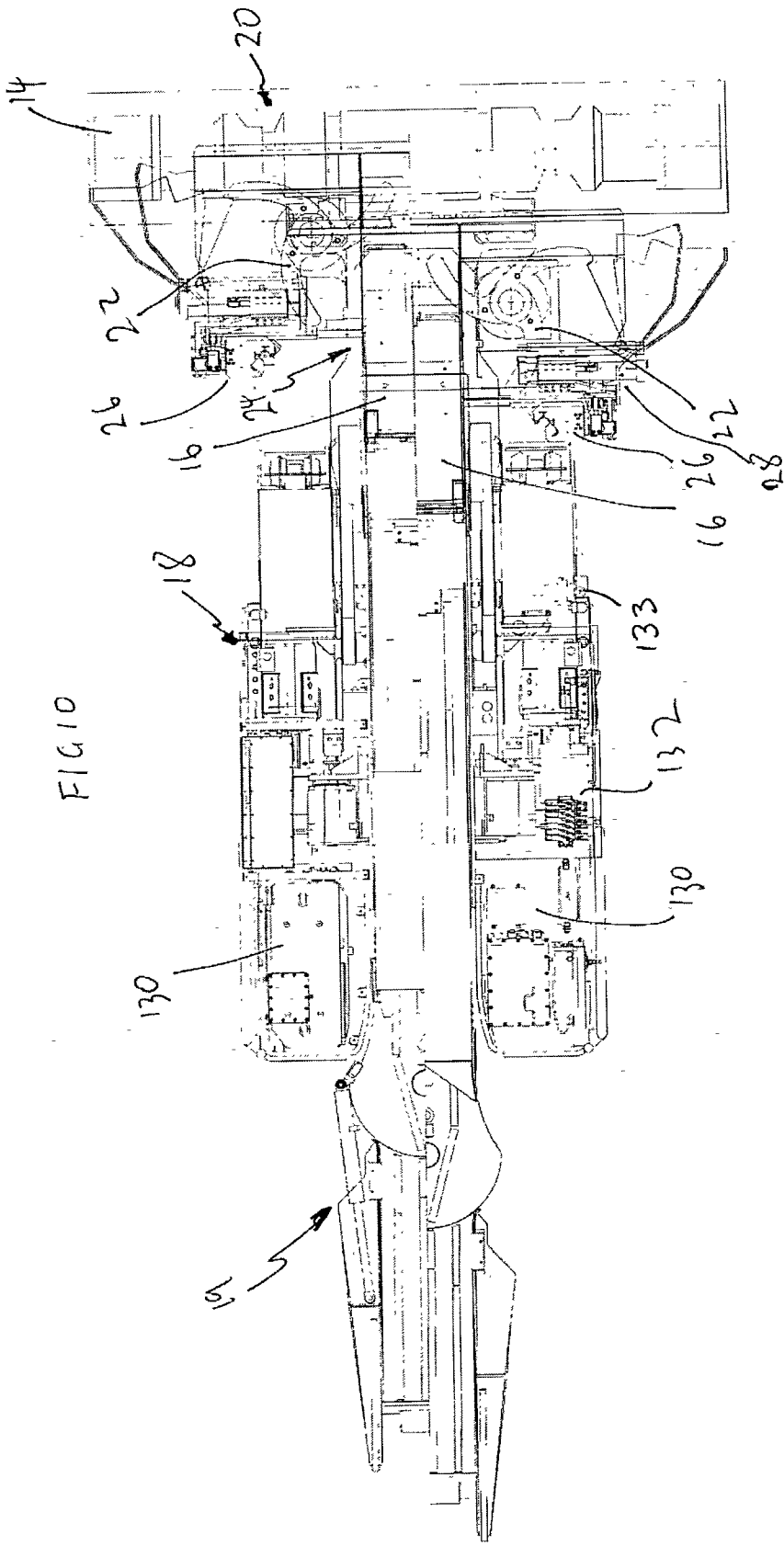












METHOD OF MINING AND AN IMPROVED MINING MACHINE WITH A SHOVEL MOVEABLE RELATIVE TO A VEHICLE CHASSIS

FIELD OF THE INVENTION

[0001] The present invention relates to continuous miners and improvements in relation thereto. The invention also relates to a method of mining particularly utilizing a continuous miner with the improvements described herein.

BACKGROUND OF THE INVENTION

[0002] Present continuous miners have a moveable chassis with a shovel fixed to the front end of a moveable chassis, coal loading arms, and a conveyor extending from the shovel to the rear of the moveable chassis. Some continuous miners also have roof bolters attached to the moveable chassis. The location of the roof bolters on the chassis of existing continuous miners leads to problems for the progression of the continuous miner through a mine entry, because by having the bolters at a fixed location relative to the moveable chassis prevents bolting close to the mine face.

SUMMARY OF THE INVENTION

[0003] The present invention provides a continuous miner comprising a cutting head and a conveyor mounted on a moveable chassis, the miner also including a shovel mounted on a supporting structure, the shovel being translatable relative to the miner, and means for translating the shovel relative to the moveable chassis so as to be able to be moved from a rearward location to a forward location relative to the moveable chassis.

[0004] More particularly, the shovel has mounted thereon at least one bolting apparatus, the shovel being translatable relative to the miner so as to be able to be moved from a rearward location to a forward location whereby the bolting apparatus can be operated in the forward location.

[0005] The shovel can be mounted on the miner by translation means to translate or move the supporting structure relative to the miner.

[0006] The supporting structure or shovel can be moved to a forward location, to create a work space for an operator of the bolter. The work space created can be between the shovel and the chassis.

[0007] A plurality of bolting apparatus can be located on the shovel. The bolting apparatus can be mounted on at least one cross slide which is in turn mounted to the shovel. The bolting apparatus can be able to attend to rib bolting or alternatively one or more rib bolting apparatus is provided on the miner.

[0008] Controls can be provided so that only when the cutting head is not operating the shovel can be moved to the forward position. The controls can also provide that only when the cutting head is located at an appropriate height above the shovel, that the shovel are moveable to a forward location, so as to prevent collision between the shovel and the cutting head.

[0009] The shovel can have at least one coal loading arm associated therewith. The conveyor can have a frame which

supports the conveyor belt, which frame has a portion pivotally mounted to the supporting structure by means of a pivot.

[0010] The supporting structure can include means to mount components associated with supporting the conveyor belt of the conveyor between the pivot and the shovel, and the conveyor can move with the shovel.

[0011] The rear of the conveyor can be able to be raised or lowered relative to the rear of the chassis. The conveyor also is raised or lowered by a lifting means which includes a three point linkage which will pass through an arc.

[0012] The translation means can include an arm pivotally connected to the supporting structure at one end and to the chassis at the other end, the arm being able to rotate between at least a first and a second position. The arm can be rotated by means of a hydraulic or pneumatic cylinder.

[0013] The present invention also provides a method of mining a mine entry with a continuous miner, the method including the steps of: mining the mine entry with a cutting head mounted on the miner and gathering the ore thus mined; moving bolting apparatus relative to the cutting head from a location occupied while the cutting head is mining to a forward location so that the bolting apparatus can perform bolting operations.

[0014] The method can include the step of moving the bolting apparatus relative to the cutting head being performed by translating a supporting structure on which the shovel is mounted from a location occupied while the cutting head is mining to a forward location. This step of moving the bolting apparatus relative to the cutting head can be performed while simultaneously moving the shovel, and a conveyor associated with the shovel, due to the bolting apparatus, the shovel and conveyor being connected.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] An embodiment of the present invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

[0016] **FIG. 1** illustrates a rear perspective view of a continuous miner with roof bolters mounted on the supporting structure of a shovel having its cutting head and associated structure removed;

[0017] **FIG. 2** illustrates a side elevation of the continuous miner of **FIG. 1** with the shovel retracted and cutting head elevated;

[0018] **FIG. 3** illustrates a side elevation of the continuous miner of **FIG. 1** with the shovel extended and cutting head raised to where it is clear of the shovel;

[0019] **FIG. 4** is a plan view of the continuous miner of **FIG. 1** with the shovel in a forward position;

[0020] **FIG. 5** illustrates a rear view of the continuous miner of **FIG. 1** showing the bolting apparatus;

[0021] **FIG. 6** illustrates a side elevation of the mechanism to move the shovel, bolters and conveyor of the miner of **FIG. 1** in the extended condition;

[0022] **FIG. 7** illustrates the mechanism of **FIG. 6** in a retracted position;

[0023] FIG. 8 illustrates a conveyor support mechanism;

[0024] FIG. 9 illustrates a perspective view of the attachment bracket and cross slides to carry a bolting apparatus which is not shown for the purpose of illustrating the features of the attachment bracket; and

[0025] FIG. 10 illustrates a plan view of the continuous miner with the shovel in the extended condition.

[0026] Before one embodiment of the invention is explained in detail, it is to be understood that the invention is not limited in its application to the details of the construction and the arrangements of components set forth in the following description or illustrated in the drawings. The invention is capable of other embodiments and of being practiced or being carried out in various ways. Also, it is to be understood that the phraseology and terminology used herein is for the purpose of description and should not be regarded as limiting. Use of "including" and "comprising" and variations thereof as used herein is meant to encompass the items listed thereafter and equivalents thereof as well as additional items. Use of "consisting of" and variations thereof as used herein is meant to encompass only the items listed thereafter and equivalents thereof. Further, it is to be understood that such terms as "forward", "rearward", "left", "right", "upward" and "downward", etc., are words of convenience and are not to be construed as limiting terms.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0027] Illustrated in FIGS. 2 to 4 is a continuous miner 10 which can engage a coal face 12 by means of a cutting head 14. The cutting head 14 is rotatably mounted and driven on a pivoting arm 16 which can be raised and lowered by hydraulic piston 17 so as to raise and lower the cutting head 14 between a position such as that shown in FIG. 3 to a higher position as shown in FIG. 2, which locates the cutter head approximately 4.5m above mine floor level 11, measured at the top of the cutter 14. The cutting head 14 can also be rotated to a location below ground level but this is not illustrated.

[0028] The arm 16 is pivotally mounted by pivots 13 to a chassis 15 of tracked vehicle 18, as is common in the art and will not be described in any particular detail here.

[0029] Underneath the cutting head 14 is a shovel 20 which includes coal loading arms 22 to assist with the loading of coal in the shovel 20 onto a central conveyor 19.

[0030] A central conveyor 19 passes through the centre of the vehicle 18 and extends from the shovel 20, through to the rear of the vehicle 18 as can be seen in FIG. 4. The front of the central conveyor 19 receives coal from the shovel 20, when in the position shown in FIG. 2 which is assisted by two rotating coal loading arms 22. The shovel 20 and the coal loading arms 22 are mounted on to a shovel carriage frame or supporting structure 24 which is constructed from plates which form a full boxed structure.

[0031] The supporting structure 24 is translatable, as later described, relative to the vehicle 18 so as to be able to move from a rearward position shown in FIG. 2 to a forward position shown in FIG. 3.

[0032] As shown in FIGS. 1, 6 and 7, the supporting structure 24 includes two pentagonal plates 25 through

which pass, and which support, pivots 27, at lower portions thereof. Also mounted to the pivots 27 are the distal ends 31 of pistons 33 and chevron shaped arms-35. The proximal ends 37 of the pistons 33 and the other ends 39 of arms 35 are all rotatably connected by pivots 43 and 45 respectively to the chassis 15 of the tracked vehicle 18.

[0033] The central conveyor 19, as illustrated in FIGS. 1 to 3, is in its raised orientation. This raised orientation occurs when the cylinders 70 are fully extended which causes the rear portion 73 of the conveyor 19 to pivot around forward pivots 71. These forward pivots 71 are also respectively mounted to the plates 25 above the pivots 27. As the cylinders 70 lower, irrespective of the position of the shovel 20, the base surfaces 75 of the frame (which supports the rollers that carries the conveyor belting) of conveyor 19 will slide over translating and rotating pivot bearings 77 (see FIG. 8). The rotating and translating pivoting bearings 77 accommodate a change in the distance between the bearings 77 and pivots 71 as the cylinders 70 extend or retract.

[0034] As is illustrated in FIG. 8, the raising and lowering mechanism of the conveyor 19 also includes struts 79 which rotate as the cylinders 70 extend or retract. The struts 79 are pivoted to the vehicle 18 by pivots 171, while the cylinders 70 are pivoted to the vehicle 18 by pivots 170. Third pivots 172 complete the mechanism, to which the bearings 171, distal ends of the pistons of cylinders 70, and the other ends of struts 79 are rotatably mounted.

[0035] To move the shovel 20, coal loading arms 22, bolters 26, supporting structure 24 and conveyor 19 from a retracted to an extended condition, the pistons 33 receive hydraulic pressure to rotate the arms 35 to the orientation of FIG. 6. This moves the conveyor 19 from left to right over the bearings 77 as the plates 25 are translated also from left to right. The shovel 20 follows an arcuate path with the tip or forward end of shovel 20 maintaining contact with the mine floor 11. The mine floor 11 will bear the weight of the shovel 20 until such time as the shovel 20 is fully retracted (by pistons 33 retracting to the position illustrated in FIG. 7) and pistons 81 are extended thus lifting the shovel 20 from the mine floor 11 and making the vehicle 18 ready for tramming.

[0036] Other mechanisms could be used for moving the supporting structure 24, such as slides or rails (not illustrated) which can include replaceable bronze bearings or hardened steel bearing plates. If desired other motivating mechanisms can be provided such as rack and pinion drives, power threads etc.

[0037] The central conveyor 19 is preferably driven by a motor and transmission (not shown) which is located on the support structure 24. The motor and transmission is also used to drive the coal loading arms 22. If desired, a separate motor and drive (not shown) can be provided for the coal loading arm 22 which can be mounted on the moveable support structure 24. In other embodiments, the central conveyor motor and transmission can be located at other locations along the conveyor, such as above the vehicle 18.

[0038] As can be seen from FIGS. 1 to 6, two bolting apparatus 26 are mounted on cross slides 28. While only two bolters 26 are indicated, a second bolter on each cross slide 28 can be added to provide four bolters 26 mounted on two forward cross slides 28. The cross slides 28 are attached to

the support structure 24 via an attachment bracket 91. The attachment bracket 91 allows the bolters 26 to be mounted via their bases or as close thereto as possible. As can be seen from FIG. 5, by so mounting the bolters 26 at their base, a greater useful range of indexing positions of the bolters 26 can be achieved. The indexing or positioning of the bolters 26 in the clockwise/anticlockwise directions in FIG. 5 (inboard and outboard directions) is controlled by the cylinders 97, while indexing into and out of the page of FIG. 5 (in-by and out-by directions) are controlled by cylinders 95. As illustrated in FIG. 9, the ability to rotate the bolter 26 in the inboard direction 100, outboard direction 101, in-by direction 102 and out-by direction 103 is a result of the three attachment points 104, 105 and 106.

[0039] Attachment point 105 consists of a channel cross section bracket 107 (to receive a forward portion of the bolter 26) which is mounted via a spherical bearing 108 to the attachment bracket 91. The spherical bearing 108 will allow rotation of the bracket 107 in each of the directions 100, 101, 102 and 103. The bearing 108 is housed in the bracket 91 and is not able to move translate relative to the bracket 91.

[0040] Attachment point 106 consists of a channel cross section bracket 109 (to receive a rearward portion of the bolter 26) which is connected to a spherical bearing 110. The spherical bearing 110 is mounted in a housing 111 which is attached to the end of a piston 114 which moves into and out of the cylinder 95 to control the movement in the in-by and out-by directions 102 and 103. The housing 111 is constrained to translate relative to the bracket 91 in the vertical direction only, and to guide and reduce friction vertically oriented bearing guides 112 and 113 are provided on either side of the housing 111. Attachment point 104 connects to a side, a front face or a rear face of the bolter 26 by means of a bracket 115. The bracket 115 is connected to the cylinder 97 by means of a pin 116. The pin 116 accommodates the rotation between the cylinder 97 and the bracket 115, when movement in the inboard and outboard directions 100 and 101 are performed.

[0041] The bracket 91 is mounted to a carriage 120 which in turn slidably engages cross slides 121 and 122. The carriage 120 is moved along the cross slides 121 and 122 by means of a hydraulic cylinder 123, which provides inboard and outboard translation capability to move the bolters 26, by means of bracket 91, across some of the width of the mine entry.

[0042] Illustrated in FIG. 10 is a plan view of the continuous miner 10, showing the location of the control boxes 130 which house the control systems and hydraulic valves to control the components described above. Banks of control valves 132 are also shown by which the operator can activate the levers of the valves to cause the components to move as desired. A rib bolter 133 is also attached to the side of the vehicle 18.

[0043] Thus, from the figures it can be seen that the forward movement of the shovel 20 and its supporting structure 24 also moves the cross slides 28 and thus the bolter 26 to a forward position.

[0044] This movement of the shovel 20 and its support structure 24 has three advantages over prior art continuous miners. One advantage is that when the miner 10 is mining

(that is the cutting head 14, conveyor 19 and coal loading arms 22 are functioning), the roof bolters 26, cross slides 28, shovel 20, supporting structure 24, and the coal loading arms 22 and associated drives are in a retracted position thus assisting in maintaining a centre of gravity which is conducive to the operation of the cutting head 14.

[0045] A second advantage of moving the shovel 20 and its supporting structure 24 to a forward location away from the vehicle 18, is that this creates or increases the amount of space available to an operator as a work area to operate the bolter 26.

[0046] Another advantage however is the ability to get the roof bolters 26 bolting at a location which is much closer to the face 12 of the mine entry and or closer to the cutting head than in the prior art.

[0047] If desired, a work platform (not shown) can be provided on the supporting structure 24 so that mine workers do not have to be on the mine floor 11 and to keep them clear of possible pinch points that may arise due to the movement of the shovel 20 and its supporting structure 24.

[0048] The controls of the miner 10, in addition to all the control facilities that are usually provided, can also provide:

[0049] 1. when the cutting head 14 and or the conveyor 19 is operational, then the shovel 20, its supporting structure 24 and all other components mounted thereon, cannot be moved out of the retracted condition.

[0050] 2. trip interlocks to ensure that the cutting head 14 is raised to a sufficient height before the shovel 20, its supporting structure 24 and all other components mounted thereon, are able to be moved from the retracted condition to the forward or extended location.

[0051] 3. that the cutting head 14 and the conveyor 19 can only be operated once the shovel 20, its supporting structure 24 and all other components mounted thereon, are in the fully retracted condition.

[0052] As can be seen from FIGS. 2 and 3 and its associated description, a method of mining a mine entry with a continuous miner is also provided, the method including the steps of mining said mine entry 12 with a cutting head 14 mounted on the miner 10. The ore thus mined can be gathered until the cutting head 14 can mine no more ore in that location. Then the roof bolting apparatus 26 can be moved relative to the cutting head 14 from their location occupied while the cutting head 14 is mining, to a forward location so that the said roof bolters 26 can perform roof bolting operations. These steps can be performed in any order. The step of moving the roof bolting apparatus 26 relative to said cutting head 14 is performed by translating the supporting structure 24 on which shovel 20 is mounted from a rearward location occupied while the cutting head 14 is mining, to a forward location.

[0053] While the embodiment illustrated in the figures has the conveyor 19 moving with the support structure 24 and shovel 20, if desired the continuous miner can be constructed so that the conveyor remains stationary, while the support structure 24, shovel 20 and bolting apparatus 26 moves forward and rearward. More particularly, the support structure 24 could have its own conveyor (not shown) with

a rearward portion that overlaps a conveyor (not shown) on the vehicle **18**, so that as the shovel **20** moves forward, the two conveyors continue to overlap so that the mined material will still be conveyed through the miner.

[0054] It will be understood that the invention disclosed and defined herein extends to all alternative combinations of two or more of the individual features mentioned or evident from the text or drawings. All of these different combinations constitute various alternative aspects of the invention.

[0055] The foregoing describes embodiments of the present invention and modifications obvious to those skilled in the art can be made thereto, without departing from the scope of the present invention.

1. A continuous miner comprising a cutting head and a conveyor mounted on a moveable chassis, said miner also including a shovel mounted on a supporting structure, said shovel having mounted thereon at least one bolting apparatus, said shovel being translatable relative to said miner, and means for translating said shovel relative to said moveable chassis from a rearward location to a forward location relative to said moveable chassis whereby said bolting apparatus can be operated in said forward location.

2. A continuous miner as claimed in claim 1 wherein when said shovel is moved to a forward location, a work space for an operator of said bolter is created.

3. A continuous miner as claimed in claim 2 wherein said bolting apparatus are mounted on at least one cross slide which is in turn mounted to said shovel.

4. A continuous miner as claimed in claim 3, wherein said work space is created between said shovel and said chassis.

5. A continuous miner as claimed in claim 1 wherein a plurality of bolting apparatus is located on said shovel.

6. A continuous miner as claimed in claim 5, wherein said bolting apparatus are mounted on at least one cross slide which is in turn mounted to said shovel.

7. A continuous miner as claimed in claim 1 wherein said bolting apparatus are mounted on at least one cross slide which is in turn mounted to said shovel.

8. A continuous miner as claimed in claim 1 wherein one or more rib bolting apparatus is provided on said miner.

9. A continuous miner as claimed in claim 1 wherein controls are provided so that only when said cutting head is not operating said shovel can be moved to said forward position.

10. A continuous miner as claimed in claim 1 wherein controls are provided so that only when the cutting head is located at an appropriate height above said shovel, that said shovel are moveable to a forward location, so as to prevent collision between said shovel and said cutting head.

11. A continuous miner as claimed in claim 1 wherein said shovel has at least one coal loading arm associated therewith.

12. A continuous miner as claimed in claim 1 wherein said conveyor has a frame which has a portion pivotally mounted to said supporting structure.

13. A continuous miner as claimed in claim 1, wherein said conveyor moves with said shovel.

14. A continuous miner as claimed in claim 1 wherein said conveyor is mounted above the rear of said moveable chassis and said conveyor and is able to be raised or lowered relative to the rear of said chassis.

15. A continuous miner as claimed in claim 14, wherein said conveyor is raised or lowered by a lifting means connected between said moveable chassis and said conveyor which includes a three point linkage which will pass through an arc.

16. A continuous miner as claimed in claim 15 wherein said lifting means includes a bearing which will engage the frame of said conveyor.

17. A continuous miner as claimed in claim 1 wherein said translation means includes an arm pivotally connected to said supporting structure at one end and to said chassis at the other end.

18. A continuous miner as claimed in claim 19, wherein said arm is rotated by means of a hydraulic cylinder.

19. A continuous miner comprising a cutting head and a conveyor mounted on a moveable chassis, said miner also including a shovel mounted on a supporting structure, said shovel being translatable relative to said miner, and means for translating said shovel relative to said moveable chassis so as to be able to be moved from a rearward location to a forward location relative to said moveable chassis.

20. A method of mining a mine entry with a continuous miner, said method including the steps of:

mining said mine entry with a cutting head mounted on said miner and gathering the ore thus mined; and

moving bolting apparatus relative to said cutting head from a location occupied while the cutting head is mining to a forward location so that said bolting apparatus can perform bolting operations.

21. A method as claimed in claim 20, wherein moving said bolting apparatus relative to said cutting head is performed by translating a supporting structure on which said shovel is mounted from a location occupied while the cutting head is mining to a forward location.

22. A method as claimed in claim 21, wherein said step of moving said bolting apparatus relative to said cutting head is performed while simultaneously moving said shovel, and a conveyor associated with said shovel.

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