(12) UK Patent Application (19) GB (11) 2 197 679 (13) A

(43) Application published 25 May 1988

(21) Application No 8727060

(22) Date of filing 19 Nov 1987

(30) Priority data
(31) 8627652 (32) 19 Nov 1986 (33) GB

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(51) INT CL⁴
E21D 23/00

(52) Domestic classification (Edition J):
E1P 2E5J 2E5W 2E7

(56) Documents cited
None

(58) Field of search
E1P
Selected US specifications from IPC sub-class
E21D

(54) Mine roof supports with lifting toe on base

(57) A mine roof support assembly which comprises:
- a floor engaging unit with two toe portions 12, 13;
- an advancing mechanism 9 adapted to act between the floor engaging unit and an associated mining conveyor 10; and
- a lifting mechanism 14, 15 associated with each tip portion.

The lifting mechanism applies a lifting force to the tip region of the toe portion to allow the roof support assembly to be advanced and is separately operable. Each lifting mechanism comprises a lever 21, 27, 28 pivotally connected to the tip region, and an actuator 14, 15 which operates to pivot the lever 28 against a bearing surface of the advancing mechanism to apply the necessary lifting force.

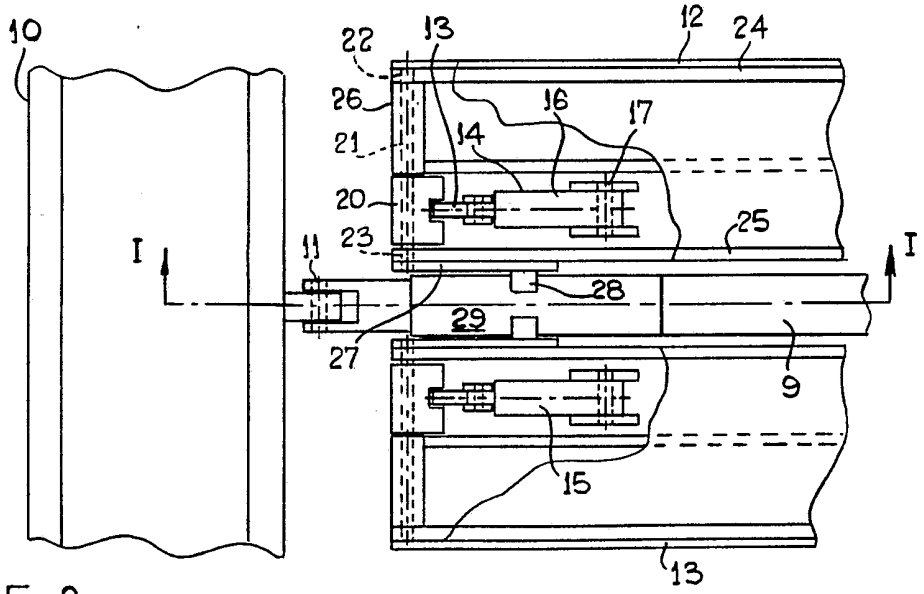

Fig.2

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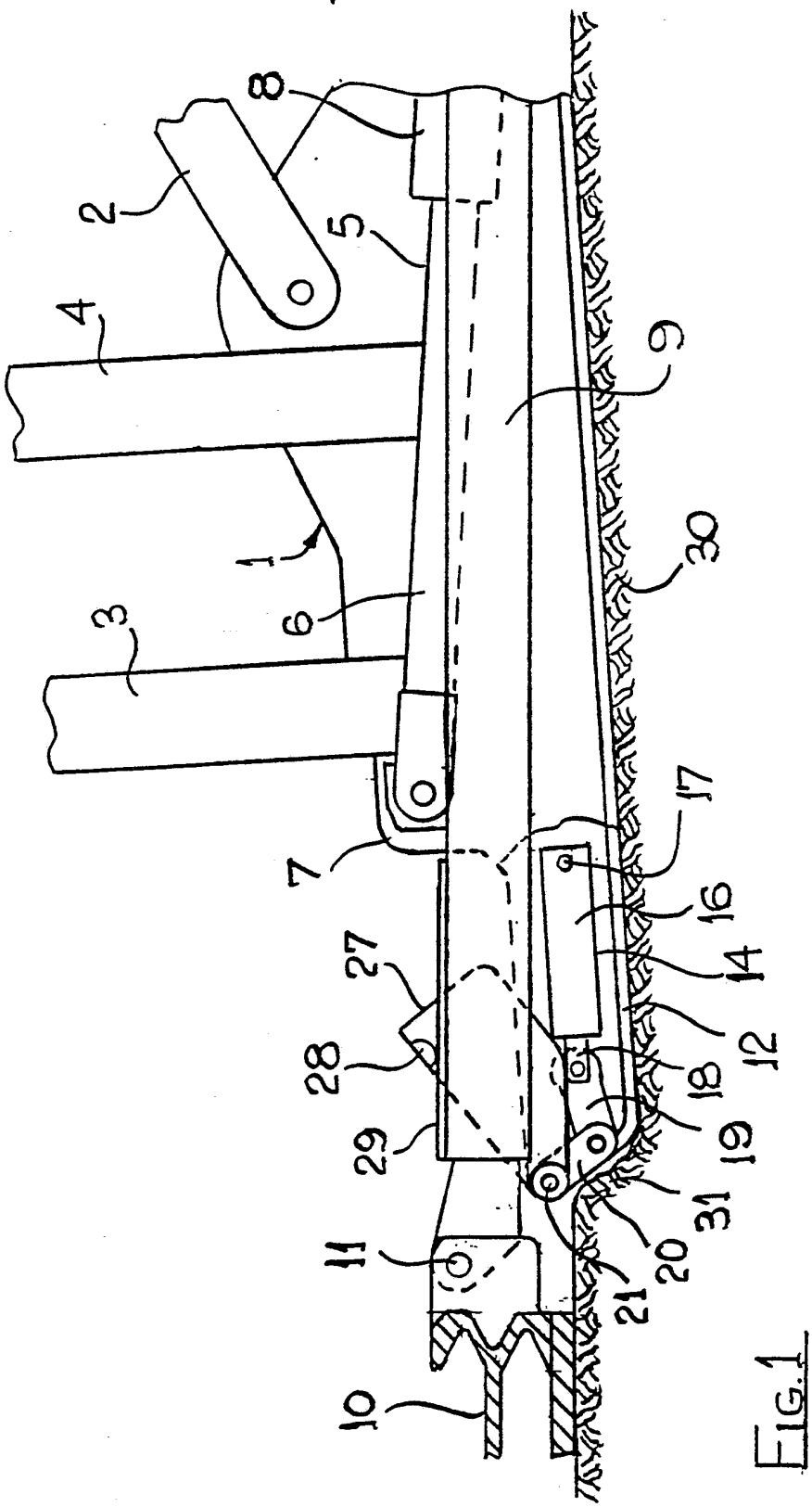

FIG.1

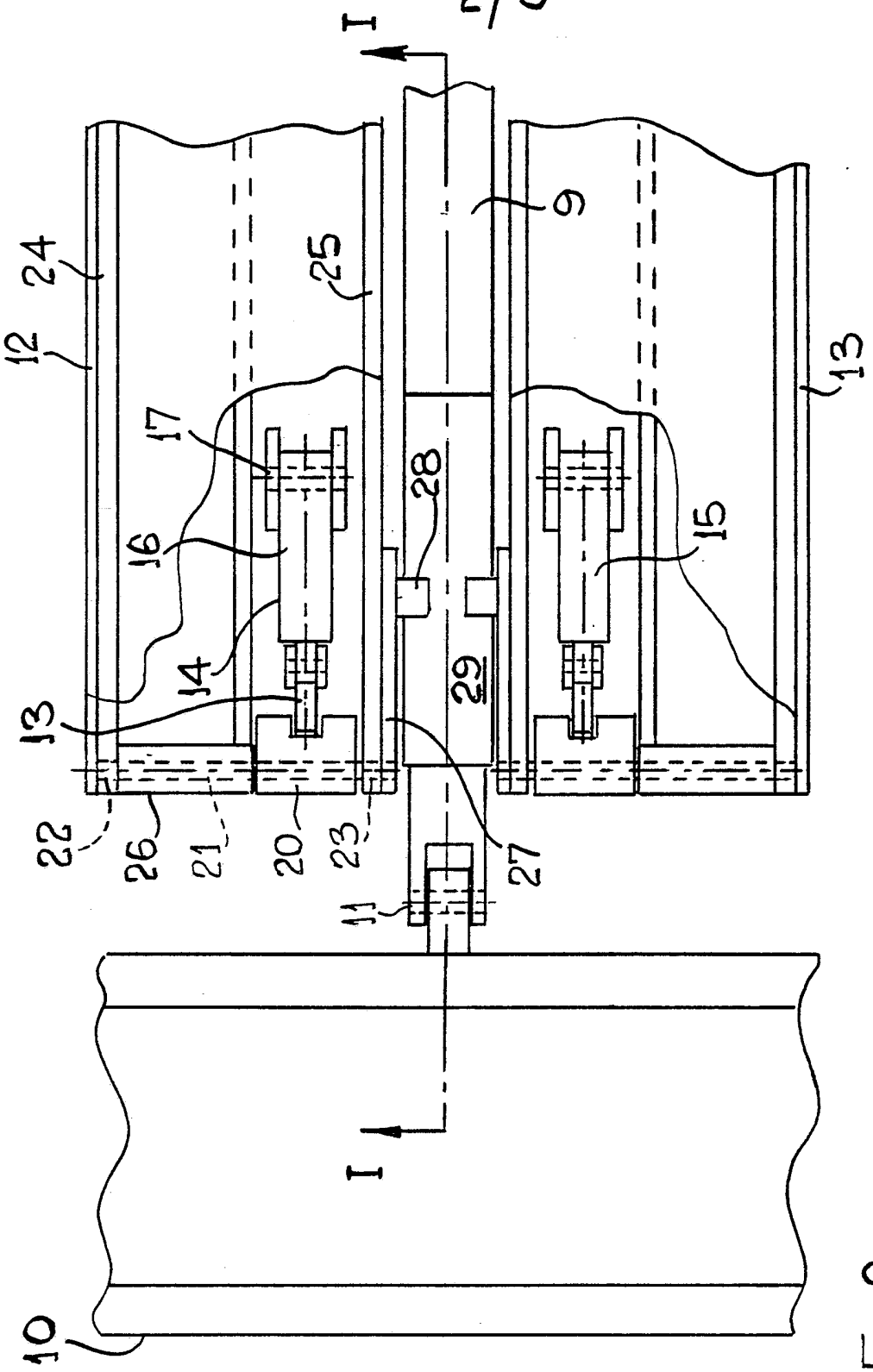

FIG.2

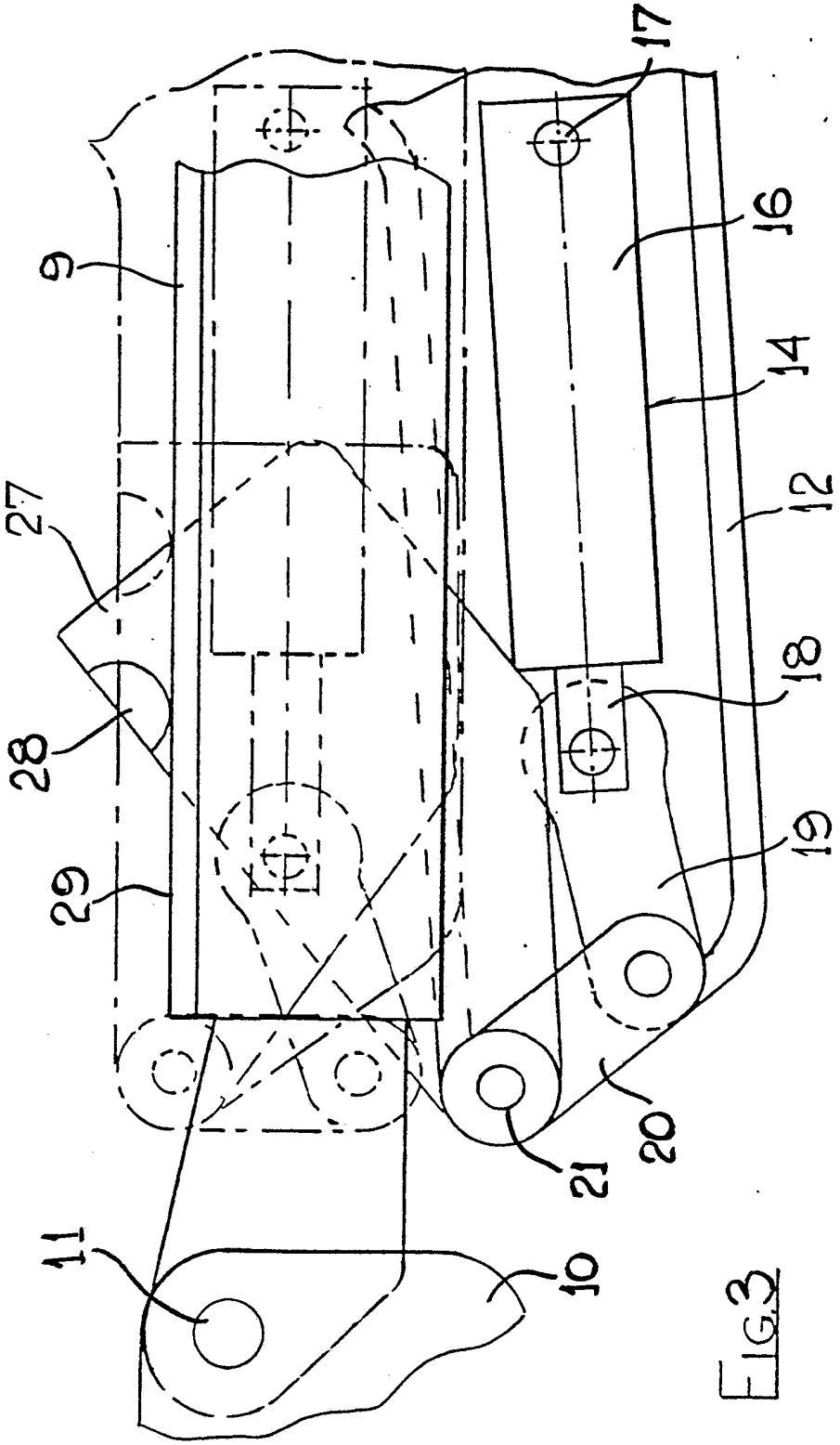

FIG.3

"Mine Roof Support Assemblies"

This invention relates to mine roof support assemblies.

As is well known, a typical mining installation includes a mining conveyor extending along the length of the mine face, a series of mine roof support assemblies spaced along the goaf side of the conveyor, and advancing jacks extending between the roof support assemblies and the adjacent sections of the conveyor. A mining machine runs along the conveyor to cut mineral from the face which is then carried away by the conveyor. From time to time it is necessary to advance the conveyor and the roof support assemblies towards the mineral face. This is done by first advancing the conveyor sections relative to the roof support assemblies by operating the advancing jacks, and by subsequently releasing the roof support assemblies from their original support positions and advancing them towards the conveyor, again by operating the advancing jacks, to new positions in which they are reactivated to support the

roof above these new positions.

Typically a mine roof support assembly incorporates a floor-engaging unit, a roof-engaging unit pivotally connected to the floor-engaging unit, and hydraulically-operated telescopic props by means of which the floor-engaging and roof-engaging units are urged into engagement with the floor and roof respectively. The floor-engaging unit generally incorporates two forwardly projecting toe portions which extend one on each side of the advancing jack. When the mine roof support assembly is to be advanced towards the conveyor the roof-engaging unit is released from engagement with the mine roof by appropriate operation of the props and the roof support assembly is moved towards the conveyor by operating the advancing jack. However, due to the weight of the roof support assembly, such movement may be rendered difficult due to the tendency of the front ends of the toe portions to dig into the floor or due to the inability of these portions to ride over uneven parts of the floor.

Various arrangements have been tried with a view to overcoming this problem by applying a lifting force to the toe portions of the floor-engaging unit during advance of the roof support assembly. For example, one such arrangement comprises a bridge linking the two toe portions and spanning the advancing jack, and a hydraulic lifting ram arranged between a flat

upper surface of the hydraulic jack and the bridge so as to enable the toe portions to be lifted relative to the advancing jack. The main disadvantage of such an arrangement and of other similar arrangements is that they cannot accommodate independent vertical movement of the toe portions relative to one another as is preferred during such advancing movement. Whilst several proposals have made for applying separate lifting mechanisms to the toe portions which are operable independently of one another, these proposals are not entirely satisfactory for a number of reasons. For example, one such proposal includes a respective hydraulic lifting ram associated with each toe portion and acting between the associated toe portion and either the mine floor or guide rods which extend between the floor-engaging unit and the conveyor for guiding advancing movement of the conveyor. However, this arrangement suffers from the fact that the hydraulic lifting rams are set back from the front of the floor-engaging unit so as not to obstruct the space above the front of the floor-engaging unit, and this means that the rams do not apply their lifting forces at the tips of the toe portions with the result that the lifting efficiency is prejudiced.

It is an object of this invention to provide a mine roof support assembly incorporating a lifting mechanism which is particularly well adapted to conditions encountered in use.

According to the present invention, there is provided a mine roof support assembly comprising a floor-engaging unit having two forwardly projecting, laterally spaced toe portions, an advancing mechanism acting between the floor-engaging unit and a part of a mining conveyor and serving for relative advancing movement of the floor-engaging unit and the conveyor part, the advancing mechanism being pivotally connected to the floor-engaging unit and projecting forwardly between the toe portions, and a respective lifting mechanism associated with each toe portion for applying a lifting force to a tip region of that toe portion when the floor-engaging unit is to be advanced relative to the conveyor part, wherein each lifting mechanism is separately operable and comprises a lever pivotally connected to the tip region of the associated toe portion, and an actuator operable to pivot the lever so as to urge a portion thereof against an upwardly facing bearing surface of the advancing mechanism resulting in application of a lifting force to the tip region of the associated toe portion.

When such a roof support assembly is to be advanced towards the conveyor, the actuators of the lifting mechanisms associated with the two toe portions of the floor-engaging unit may be operated to urge the levers against their associated bearing surfaces to lift the toe portions with respect to the advancing mechanism. Since the advancing mechanism is pivotally

connected to the floor-engaging unit, the resulting reaction force acting on the advancing mechanism will not be transmitted back to the floor-engaging unit, but instead will tend to be transmitted to the conveyor which will spread the load over a large floor area. Furthermore, since each lever is pivotally connected to the tip region of the associated toe portion, the lifting forces will act on the tip regions of the toe portions and will thus apply optimum leverage to the front of the floor-engaging unit. Of course, since each lifting mechanism is separately operable, the assembly can accommodate independent vertical movements of the toe portions as required to meet varying local floor conditions in the vicinity of each toe portion.

In a preferred embodiment of the invention the advancing mechanism includes an advancing jack having one end thereof pivotally connected to a front portion of the floor-engaging unit and extending towards the rear of the floor-engaging unit, and a relay bar having a rear end pivotally connected to the other end of the advancing jack and a front end adapted for connection to the associated conveyor part, the relay bar incorporating the bearing surfaces against which portions of the levers of the lifting mechanisms are urged by the actuators. Such an arrangement enables the reaction forces to be taken up by a relay bar of relatively rigid construction.

It is also preferred that the actuator of each lifting mechanism is accommodated within the confines of the associated toe portion. In this manner it is ensured that the actuators do not obstruct the space above the toe portions which is required for access by operating personnel.

Conveniently the actuator of each lifting mechanism comprises a hydraulic ram having its longitudinal axis extending substantially along the direction of conveyor advance, being connected at one end to the floor-engaging unit and being coupled at its other end to the associated lever.

The actuator of each lifting mechanism may be coupled to the associated lever by way of a link which is pivotally connected both to the actuator and to the lever.

Furthermore the lever of each lifting mechanism may incorporate a vertical pivot plate disposed between an inner wall of the associated toe portion and the advancing mechanism, and preferably having a portion projecting from an inner face of the plate for engaging the associated bearing surface of the advancing mechanism.

In this case the pivot plate of each lifting mechanism may be pivotally connected to the associated toe portion by way of a pivot pin extending through a hole in the inner wall of the toe portion and being fixedly connected on one side of said inner wall to the

pivot plate and on the other side of said inner wall to an arm forming a part of the lever.

In order that the invention may be more fully understood, a preferred mine roof support assembly in accordance with the invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a side elevation of part of the assembly, partly broken away and taken along the line I-I in Figure 2;

Figure 2 is a plan view of part of the assembly, partly broken away; and

Figure 3 is a side view of a detail of the assembly.

Referring to Figures 1 and 2, the illustrated mine roof support assembly includes a floor-engaging unit 1, a roof-engaging unit (not shown), links 2 interconnecting these two units and hydraulically-operated telescopic props 3 and 4 by means of which the roof-engaging unit can be moved with respect to the floor-engaging unit 1.

The assembly also includes an advancing jack 5 having a piston rod 6 pivotally connected to a front portion 7 of the floor-engaging unit 1, and a cylinder 8 pivotally connected (at a point not shown in the drawings) to the rearward end of a relay bar 9. The forward end of the relay bar 9 is pivotally connected to a conveyor part 10 at a pivot point 11.

The floor-engaging unit 1 includes two forwardly projecting, laterally spaced toe portions 12 and 13 positioned one on each side of the relay bar 9 and each of which is constituted by a substantially box-section member. A respective hydraulic lifting ram 14 or 15 is accommodated within each toe portion 12 or 13, the toe portions 12 and 13 being broken away in Figures 1 and 2 in order to show these rams 14 and 15. The cylinder 16 of each ram 14 or 15 is pivotally connected to the associated toe portion 12 or 13 at 17. Furthermore the piston rod 18 of each ram 14 or 15 is pivotally connected to a link 19 which is in turn pivotally connected to an arm 20. The arm 20 is fixedly connected to a pivot pin 21 which is rotatably supported within bearings 22 and 23 in side walls 24 and 25 of the toe portion 12 or 13 and which also extends through a front wall 26. The front wall 26 and the arm 20 together form an inclined surface at the tip of the toe portion 12 or 13.

The pivot pin 21 extends beyond the inner side wall 25 of the toe portion 12 or 13, and a pivot plate 27 lying immediately adjacent and parallel to the inner side wall 25 is fixedly connected to the part of the pivot pin 21 which extends beyond the inner side wall 25, so that the arm 20, the pivot pin 21 and the pivot plate 27 together form a lever pivotal about the pivot axis of the pivot pin 21. A tab 28 of generally

semicircular cross-section projects from the inside surface of the pivot plate 27 adjacent an edge thereof and engages a bearing surface 29 on the top of the relay bar 9.

When the mine roof support assembly is to be advanced towards the conveyor, the props 3 and 4 are operated to release the roof-engaging unit from the mine roof, and the advancing jack 5 is extended to tend to move the complete roof support assembly forward. At the same time hydraulic pressure may be supplied to the lifting rams 14 to lift the toe portions 12 and 13 whilst allowing independent vertical movements of the toe portions 12 and 13 relative to one another. The floor-engaging unit 1 is shown in Figure 1 as having sunk into the mine floor 30 so that, in order for the floor-engaging unit 1 to move forward, it is necessary for it to surmount a step 31. To surmount such a step 31 the lifting mechanisms of the toe portions 12 and 13 are operated in a manner which will be described below with reference to Figure 3.

Figure 3 shows the lifting mechanism of the toe portion 12 as illustrated in Figure 1, but on a larger scale. The initial position of the lifting mechanism is shown in solid lines in Figure 3, whereas the final, lifted position of the mechanism is shown in broken lines in that figure. As will be appreciated from that figure application of lifting pressure to the ram 14 will result in forward extension of the piston

rod 18 resulting in application of a moment to the arm 20 by way of the link 19 so as to pivot the arm 20 clockwise about the pivot axis of the pivot pin 21. This results in corresponding pivoting of the pivot plate 27 causing the tab 28 to be urged against the bearing surface 29 of the relay bar 9. When the resulting reaction force exceeds a certain value the complete lifting mechanism and the associated toe portion are caused to be lifted relative to the relay bar 9 and to take up a position as shown in broken lines in Figure 3.

In this manner lifting forces may be applied directly to the tip of each toe portion, and the resulting load may be applied to the rigid relay bar 9 and hence to the conveyor part 10, rather than being applied directly to the floor as in certain previous arrangements. Furthermore the installation of the necessary lifting mechanisms in the toe portions of the floor-engaging unit will not weaken the toe portions since each mechanism can be assembled without breaking the top or bottom surface of the toe portion. It will further be appreciated that the only part of each lifting mechanism which extends above the upper surface of the relay bar 9 is the upper part of the pivot plate 27 incorporating the tab 28, so that the space above the relay bar 9 is substantially unobstructed by this mechanism.

Various modifications of the above described arrangement are possible within the scope of the invention. For example, the arm 20 may be set back relative to the front wall 26 of the toe portion 12 or 13 so that the arm 20 does not project forwardly of the front wall 26 at any time during lifting operation. Furthermore the two tabs 28 projecting from the pivot plates 27 of the lifting mechanisms may be joined together by an arrangement allowing limited relative movement of the tabs 28 vertically and in directions parallel to the direction of conveyor advance, whilst tending to retain the tabs 28 against lateral outward movement.

Whilst in the arrangement described with reference to the drawings the lifting load is taken up by a bearing surface 29 on the top of the relay bar 9 with which the tabs 28 engage, it should be understood that an alternative arrangement is possible in which the lifting load is taken up by a bearing surface on the top of a specially provided bearing bar coupled to the conveyor, or by two such bearing bars provided one on each side of the floor-engaging unit (but not necessarily being coupled to the floor-engaging unit).

Whilst it is preferred that the two lifting rams are operated by supply of hydraulic fluid at the same pressure to both rams, it is also possible to arrange for the pressure of hydraulic fluid supplied to

each ram to be variable under user control independently of the hydraulic pressure applied to the other ram.

According to another aspect of the present invention, there is provided a mine roof support assembly comprising a floor-engaging unit having two forwardly projecting, laterally spaced toe portions, an advancing mechanism acting between the floor-engaging unit and a part of a mining conveyor and serving for relative advancing movement of the floor-engaging unit and the conveyor part, and a respective lifting mechanism associated with each toe portion for applying a lifting force to that toe portion when the floor-engaging unit is to be advanced relative to the conveyor and allowing limited independent vertical movement of the toe portions, wherein each lifting mechanism comprises a lever pivotally connected to the associated toe portion, and an elongate actuator arranged with its longitudinal axis substantially horizontal and operable to pivot the lever so as to urge a portion thereof against an upwardly facing bearing surface of a part coupled to the conveyor resulting in application of a lifting force to the associated toe portion.

CLAIMS

1. A mine roof support assembly comprising a floor-engaging unit having two forwardly projecting, laterally spaced toe portions, an advancing mechanism acting between the floor-engaging unit and a part of a mining conveyor and serving for relative advancing movement of the floor-engaging unit and the conveyor part, the advancing mechanism being pivotally connected to the floor-engaging unit and projecting forwardly between the toe portions, and a respective lifting mechanism associated with each toe portion for applying a lifting force to a tip region of that toe portion when the floor-engaging unit is to be advanced relative to the conveyor part, wherein each lifting mechanism is separately operable and comprises a lever pivotally connected to the tip region of the associated toe portion, and an actuator operable to pivot the lever so as to urge a portion thereof against an upwardly facing bearing surface of the advancing mechanism resulting in application of a lifting force to the tip region of the associated toe portion.

2. A mine roof support assembly as claimed in claim 1, wherein when the roof support assembly is

to be advanced towards the conveyor, the actuators of the lifting mechanisms associated with the two toe portions of the floor-engaging unit are operated to urge the levers against their associated bearing surfaces to lift the toe portions with respect to the advancing mechanism.

3. A mine roof support assembly as claimed in claim 1 or claim 2, wherein the advancing mechanism includes an advancing jack having one end thereof pivotally connected to a front portion of the floor-engaging unit and extending towards the rear of the floor-engaging unit, and a relay bar having a rear end pivotally connected to the other end of the advancing jack and a front end adapted for connection to the associated conveyor part, the relay bar incorporating the bearing surfaces against which portions of the levers of the lifting mechanisms are urged by the actuators.

4. A mine roof support assembly as claimed in any one of claims 1 to 3, wherein the actuator of each lifting mechanism is accommodated within the confines of the associated toe portion.

5. A mine roof support assembly as claimed in any one of claims 1 to 4 wherein the actuator is

an hydraulic ram.

6. A mine roof support assembly as claimed in any one of the preceding claims, in which the actuator of each lifting mechanism comprises a hydraulic ram having its longitudinal axis extending substantially along the direction of conveyor advance, being connected at one end to the floor-engaging unit and being coupled at its other end to the associated lever.

7. A mine roof support assembly as claimed in any one of the preceding claims, wherein the actuator of each lifting mechanism is coupled to the associated lever by way of a link which is pivotally connected both to the actuator and to the lever.

8. A mine roof support assembly as claimed in any one of the preceding claims wherein the lever of each lifting mechanism may incorporate a vertical pivot plate disposed between an inner wall of the associated toe portion and the advancing mechanism, and preferably having a portion projecting from an inner face of the plate for engaging the associated bearing surface of the advancing mechanism.

9. A mine roof support assembly as claimed in claim 8, wherein the pivot plate of each lifting mechanism may be pivotally connected to the associated toe portion by way of a pivot pin extending through a hole in the inner wall of the toe portion and being fixedly connected on one side of said inner wall to the pivot plate and on the other side of said inner wall to an arm forming a part of the lever.

10. A mine roof support assembly substantially as hereinbefore defined with reference to the accompanying drawings.