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(54) Improvements relating to arch setting.

(57) A three sectioned arch is set in an underground passage by mounting an arch crown section (9) in a fixture (23) and positioning the fixture on a platform (20) of a monorail transport device (16). The platform (20) is raised and lowered through a linkage mechanism (21) to position the crown section while it is fixed in position.

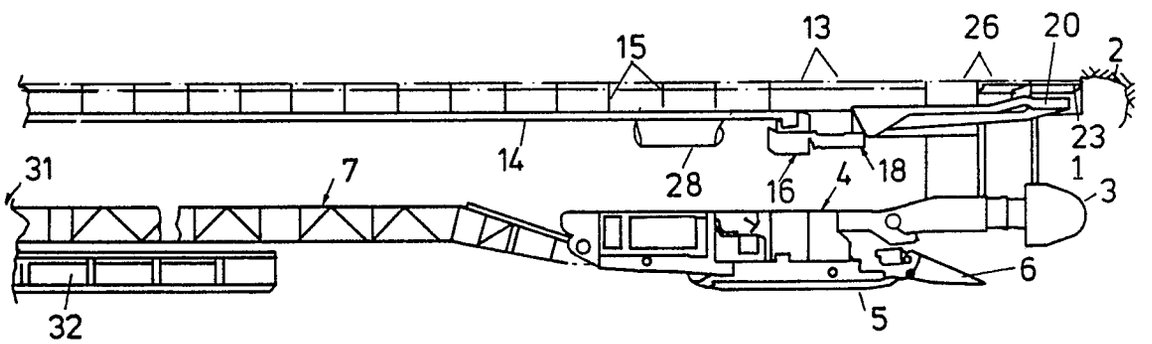

FIG. 1.

EP 0 383 456 A2

IMPROVEMENTS RELATING TO ARCH SETTING

This invention relates to a method and apparatus for setting an arch in an underground passage in which the arch is constituted by a plurality of components secured together, the components comprising an arch crown section and a plurality of arch sections forming in use leg supports.

In passages formed in underground workings such as coal mines the passages or roadways as they are often called are formed by a heading machine which cuts at the head of the passage and extracts material from the face. This material is then carried away from the face and the freshly excavated roof is supported by arches which have to be set against the roof and the walls of the newly created part of the passage.

Alternatively the face of the passage is excavated by shot firing where holes are drilled into the face and explosive is placed in these holes. The explosive is then detonated bringing about a fall of material at the face end of the passage and this fall in material is first removed, usually by a mechanical excavator with manual assistance, before the arches can be set to support the newly exposed roof and sides.

As soon as excavation or shot firing has taken place the unsupported area of the passage becomes a very dangerous place for personnel to work in. The strata surrounding the newly exposed area is subject to unbalanced forces and falls of the material can occur. It is thus essential to provide the maximum amount of protective cover for personnel who have to work in this area and to reduce where possible the number of personnel working. It is also essential to ensure that arches are set as soon as possible so that no fall from the newly exposed area takes place.

In order to set the arches, platforms can be erected on which arch setters can stand while the arches are raised into position first against the roof of the newly exposed passage area and against the walls. The arch components are secured together, struts are placed to secure the newly set arch to the adjacent arch and if necessary lagging boards or sheets are placed behind the struts. While this is taking place the personnel concerned are exposed to the risk of falls from the roof.

In order to minimize these risks mechanical means have been suggested which include platforms which can be carried on the end of excavating or roadway clearing machines and some of these include a temporary form of canopy which can extend over the operator. However, the operator is always at some risk since he must at some stage be in a vulnerable position outside the canopy while the physical connections are made to the various sections of the arch.

Furthermore, the use of arch setting platforms carried on mining machinery does cause problems in itself, in as much as platforms may have to be stored in the passageway away from the heading face during work on the heading face, and the excavating machinery is therefore limited in its useful excavating time whilst manoeuvring of the platform takes place.

One method of overcoming these problems has been proposed in our co-pending U.K. Application No. 88 22364.9 where it is proposed that for an arch constituted by a plurality of components secured together, the components consisting of a first plurality of arch sections forming in use the crown of the arch and a second plurality of arch sections forming in use leg supports, the method comprises the steps of forming the first plurality of sections into a distorted arch configuration such as to pass readily within the passage, advancing the configuration to a forward location in the passage on an overhead monorail, raising the configuration to the roof of the passage at the location and adjusting the sections to the profile of the roof of the passage to form an arch, securing the sections to retain this profile and subsequently securing the second plurality of arch sections to provide leg supports.

This method has proved successful for use with arch designs where the arch crown is made of a plurality of sections hinged together so as to collapse into a gothic arch formation during movement to its final location from an assembly site (eg 4 piece arches). It is not very suitable, however, for use with the design of arches which have a single arch crown supported by leg sections, (eg 3 piece arches).

It is an object of the present invention to provide an improved method and apparatus of setting a single arch crown section type of arch which does not interfere in a mining or excavating situation with the normal excavating process and which does not require removal of equipment during arch setting and therefore enables arch setting to be speeded up.

According to a first aspect of the present invention a method of setting an arch in an underground passage is provided in which the arch is constituted by a plurality of components secured together, the components comprising an arch crown section and a plurality of arch sections forming in use leg supports, and comprises the steps of positioning the arch crown section on a fixture on a support platform carried by an overhead rail device, raising the platform and fixture with the

arch crown section to pass readily over any equipment in the underground passage, advancing the arch crown section to a forward location in the passage, raising the arch crown section to the roof of the passage at the location and positioning it relative to a previously set arch crown section and securing it and the fixture thereto, securing the plurality of sections to provide leg support, and subsequently removing the platform from the fixture.

Preferably, subsequent to the positioning and securing of the arch crown and fixture and arch legs, the platform is retracted from the fixture and located below the previously set arch crown section, raised to engage the fixture thereof, the fixture is then released from the previously set arch crown and withdrawn from the arch on the support platform along the rail device. The fixture may then be loaded with the next arch crown section for the process to be repeated.

The arch crown section is preferably secured to the fixture with quick release means such as clips, and lagging sheets may also be applied to the arch crown section and transferred by the platform so as to provide a canopy over the arch section when it is positioned. When raised the lagging sheet may trap and secure a previously positioned sheet or sheets. The lagging sheets may be secured to the arch crown by suitable lagging clips and the fixture may be designed to contain struts for securing the arch crown sections. Struts may be loosely placed into recesses in the fixture so that they are correctly positioned. The fixture is raised to position the arch crown sections.

The plurality of arch sections forming the leg supports may conveniently be secured to the arch crown section or fixture prior to positioning the arch crown section to the roof. Preferably the arch leg sections will comprise only one leg section on each side of the arch crown section and these leg sections may be folded under the arch crown section for transportation over the equipment in the passage or, if the equipment is suitably positioned, they may be loosely connected and dragged forward with the arch crown section. When the arch crown section is in position the leg sections can be secured by suitable means such as fishplates.

The overhead rail device is preferably a monorail and as the arch crown sections are successively set, further sections may be added to the monorail to extend it. These further sections are set under the safety of the support given by the recently set arches, or the support for the monorail may be attached to the arch crown prior to the crown being loaded onto the fixture.

According to another aspect of the present invention apparatus for use with the method thereof includes a transport device arranged to be mounted and propelled along a monorail, the transport device including a hydraulically controlled linkage mechanism carrying at one end a platform adapted to be raised and lowered in a general horizontal plane, the platform having locating holes adapted to be engaged by spigots in an arch lifting fixture carried by the fixture platform and the fixture itself having a locating recess for receiving the arch crown section and recesses for receiving struts.

The monorail device is to be driven by a tug element which may be either electrically or hydraulically powered.

In order that the invention may be readily understood one example of arch setting apparatus using the method of the invention will now be described with reference to the six figures of the accompanying drawings. In the drawings Figure 1 is a side view of a machine positioned within an underground passageway showing the apparatus of the invention in the setting position. Figure 2 is a plan view of the excavating machine of Figure 1 but showing schematically part of the arch setting apparatus in a withdrawn position. Figure 3 is the sectional view through the passageway showing schematically the arches in a folded position and Figure 4 is a similar view to Figure 3 but showing the arches lifted to position. Figure 5 is a scrap view of part of the apparatus in plan view and Figure 6 is a side view of the apparatus of Figure 5.

Referring now to the drawings an underground passageway is of a general D configuration which is easily seen from Figures 3 and 4. The face of the passageway (1) is indicated at (2) and this face is cut by the cutting head (3) of an excavating machine (4) mounted on self propelling crawler tracks (5). Material cut by the cutting head (3) is collected at the front of the machine (4) by gathering arms (6) and transported through the machine and away from the face by a conveyor structure (7) which extends to a delivery point (31) onto a roadway conveyor (32). The passage (1) as it is formed is supported against caving by rings or arches (8) which are each made up of three sections, an arch crown section (9) and two leg support sections (10) and (11). These sections are bolted together in position by the use of fishplates (12) and the sections are spaced apart and secured by struts (13) which extend between adjacent sections along the length of the passage (1).

A monorail (14) is suspended by hangers (15) from the arches and the monorail carries a transport device indicated generally at (16) which includes a tug unit (17) and an arch setting unit (18).

The arch setting unit is comprised basically of a platform (20) which is supported at the end of a linkage mechanism (21) which is able to operate to keep the platform (20) level. The linkage mecha-

nism is controlled through a hydraulic cylinder arrangement (22) which raises and lowers the platform (20).

A fixture (23) is located on the platform (20) by means of spigot locations (24) and the fixture (23) has a recess area (29) into which an arch crown section (9) can be located. The fixture (23) is curved to the same configuration as the arch crown section (9).

The fixture (23) also has longitudinally extending recesses (25) into which fixing struts (13) can be located.

In order to provide adequate cover for personnel working within the passageway the passageway has lagging sheets (26) fixed behind the arches. The lagging sheets over the crown are fixed when the crown is loaded onto the fixture. The rest of the lagging sheets are fixed after the arch legs have been secured. Materials are supplied to the heading along suitable rails (27) and ventilation to the heading is supplied through a ventilation duct (28).

In use the arch setting apparatus is first moved along the monorail (14) to a position behind the heading machine (4) and with the fixture (23) in a lowered position an arch crown section (9) is located in the slot (29) of the fixture (23). Struts (13) are then positioned in the recesses (25). The arch section is clipped to the fixture by quick releasable clips and a lagging sheet or series of sheets (26) are laid on top of the section and located in position, possibly by clips.

The hydraulic system cylinder arrangement (22) is then operated and the linkage raises the platform (20) with the fixture (23) to a position where it will pass freely over the machine (4). The tug (17) then propels the apparatus along the monorail (14) to a forward position where the platform (20) is located immediately in advance of the last set arch and below newly exposed roof. The hydraulic means (22) is then operated further to lift, through the linkage mechanism (21), the platform (20) and the fixture (23) to the position as shown in Figure 1. In this position the arch section (9) carried on the fixture traps its own lagging sheets (26) under the forward end of the lagging sheets (26) of the previously set arch crown section. The struts (13) which are loosely connected to the previous section are now secured to the arch crown section on the fixture and tightened up. This secures the new arch crown section temporarily in position while leg sections are set. The platform (1) is now lowered and this leaves the fixture (23) clipped to the arch section (9) as the spigot locations (24) remove from the fixture. The apparatus is withdrawn a short distance so that the platform (20) is positioned under the previously set arch and fixture. The platform is then raised to engage this previously set fixture and the clips are released so that the fixture settles back onto the platform (20) with the fixture spigots engaging in the platform (20) for correct location.

The platform is now lowered beneath the level of the monorail and the apparatus is withdrawn by the tug (17) to a position to the rear of the machine (4) where the fixture can be reloaded. The leg sections are preferably carried forward with the arch crown section so that separate transport is not necessary around the area of the machine. The leg sections may be folded up over the machine under the fixture or, preferably, they can be loosely connected to the fixture or crown section when it is loaded on to the fixture and then dragged along by the fixture spanning the machine as the apparatus (16) progresses. When the crown section is in position the joints to the leg sections can then be secured correctly by fishplates.

It will be appreciated that there may be a number of variations to the apparatus without departing from the scope of the invention. For example the link mechanism (21) need not necessarily be hydraulically operated but may be operated by any convenient form of power device such as an electrical motor.

The apparatus (16) may be operated by a power pack which is itself monorail mounted or alternatively floor mounted or a power take off from the heading machine.

A bridge unit may be situated either over the main part of the conveyor structure (7) or over the roadway conveyor (32). This will enable the heading machine to continue working while the fixture is loaded. A typical position for the bridge is as indicated by the position of the fixture in Figure 2.

If it is necessary to provide extra cover to the equipment and personnel working on it while arch setting is taking place, then hinged extensions such as those shown dotted in Figure 3 may be secured to the fixture (23) so as to give an umbrella type of cover. The extension pieces can be supported by props and are preferably hydraulically operated.

Claims

1. A method of setting an arch in an underground passage (1) in which the arch (8) is constituted by a plurality of components (9, 10, 11) secured together, the components comprising an arch crown section (9) and a plurality of arch sections (10, 11) forming in use leg supports, the method being characterised by the steps of positioning the arch crown section (9) on a fixture (23) on a support platform (20) carried by an overhead rail device (14), raising the platform (20) and fixture (23) with the arch crown section (9) to pass readily

over any equipment (4) in the underground passage (1), advancing the arch crown section (9) to a forward location in the passage (1), raising the arch crown section (9) to the roof of the passage (1) at the location and positioning it relative to a previously set arch crown section (9) and securing it and the fixture (23) thereto, securing the plurality of sections to provide leg supports (10, 11) and subsequently removing the platform (20) from the fixture (23).

2. A method according to Claim 1 characterised by the step that, subsequent to positioning and securing the arch crown section (9) and the fixture (23), the platform (20) is retracted from the fixture (23) and the arch crown section (9) and then located below the previously set arch crown section (9), raised to engage the fixture (23) thereof, securing the platform (20) to the fixture (23) and releasing the fixture (23) from the previously said arch crown section (9) and withdrawing the fixture (23) from the arch (8) on the platform (20) along the rail device (14).

3. A method according to Claim 1 or Claim 2 characterised by the step of securing the arch crown section (9) to the fixture (23) with quick release means.

4. A method according to Claim 3 characterised in that the quick release means are clips.

5. A method according to any preceding claim characterised by the step of securing a lagging sheet or sheets (26) to the arch crown section (9) and transferring the lagging sheets (26) with the arch crown section (9) when moved by the platform (20) and trapping and securing the previously lagging sheets (26) as the arch crown section (9) is secured in position.

6. A method according to any preceding claim characterised by additionally supporting the fixture (23) and the arch (9) by mechanical struts.

7. A method according to any preceding claim characterised by the step of securing the arch leg sections (10, 11) to the arch crown section (9) prior to setting the said section.

8. A method according to Claim 7 characterised by the step of folding the leg sections (10, 11) of the arch (8) to clear any obstructions in the passageway (1) during transportation.

9. A method according to Claim 7 characterised in that the leg sections (10, 11) are dragged along by the crown section (9) or fixture (23).

10. A method according to any preceding claim characterised in that the rail device is a monorail (14) and by the step of securing further monorail sections to the arch crown sections (9) as the arches (8) are progressively set.

11. A method of setting an arch in an underground passage substantially as hereinbefore described with reference to the accompanying drawings.

12. Apparatus for use with the method according to any preceding claim characterised by a transport device (16) arranged to be mounted and propelled along a monorail (14), the transport device (16) including a hydraulically controlled linkage mechanism (21) carrying at one end a platform (20), adapted to be raised and lowered in a general horizontal plane, the platform (20) having locating holes adapted to be engaged by spigots (24) in an arch lifting fixture (23), carried by the platform (20) and the fixture (23) having a locating recess (29) for the arch crown section (9) and recesses (25) for receiving struts (13).

13. Apparatus according to Claim (12) characterised by motorised means (17) for driving the transport device (16) along the monorail (14).

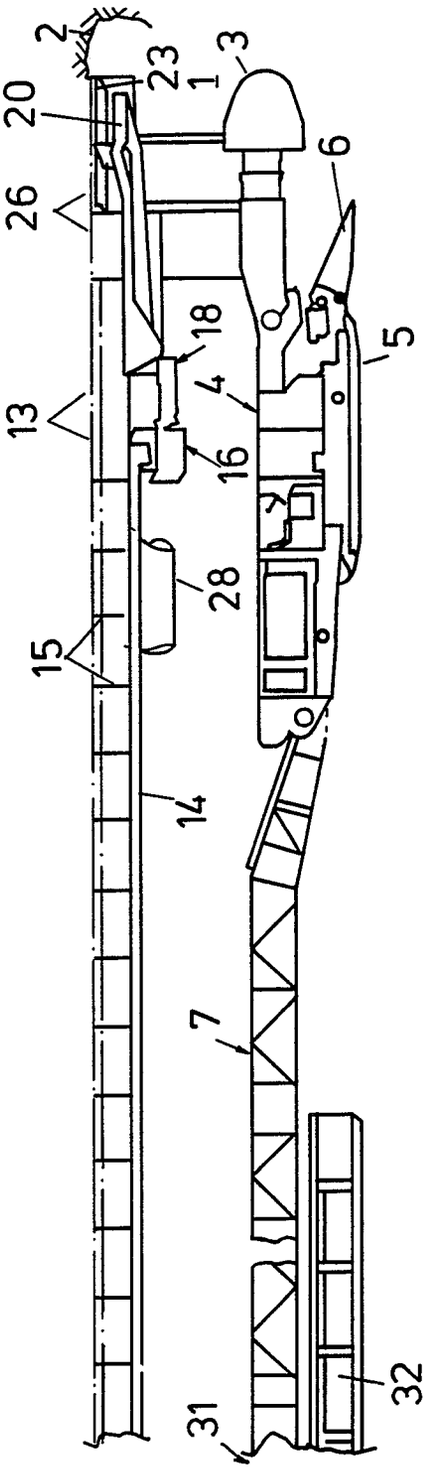

FIG. 1.

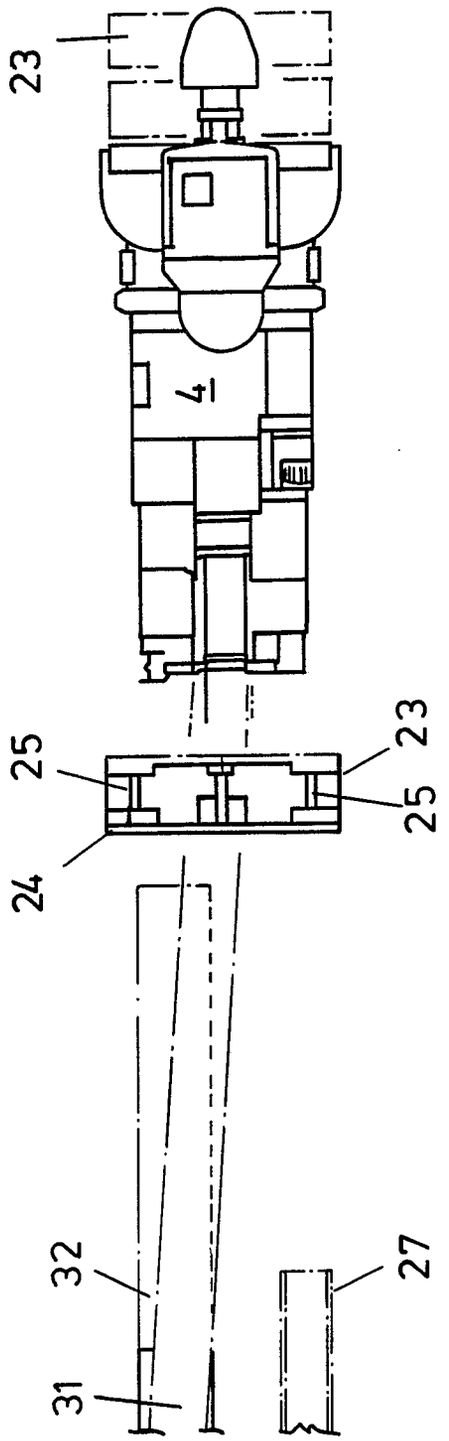

FIG. 2.

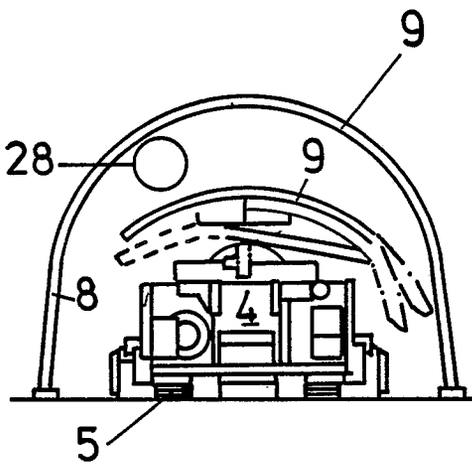

FIG. 3.

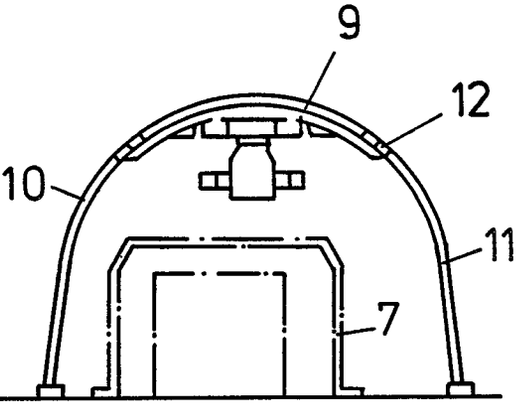

FIG. 4.

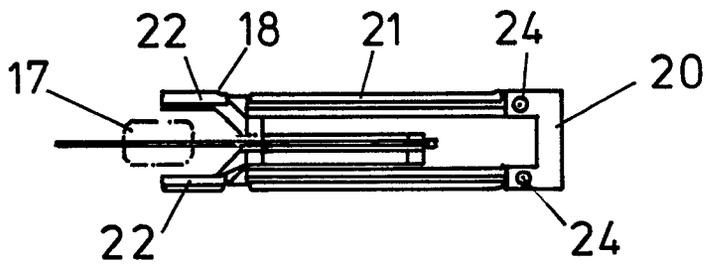

FIG. 5.

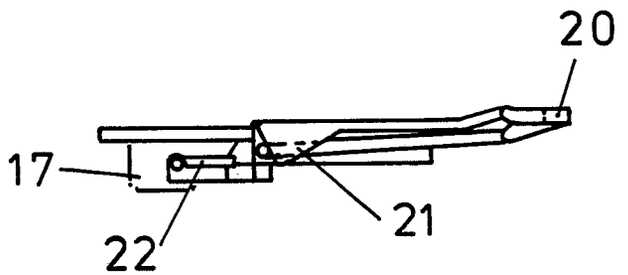

FIG. 6.