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Welzel

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[54] **ROOF SUPPORT FRAME**

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[51] **Int. Cl.** **E21d 17/00**

[58] **Field of Search** .... 61/45 D, 45 C; 248/357; 287/99

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[57] **ABSTRACT**

A roof-support frame for use in mines comprising front and rear upright hydraulic props which support, at their upper ends, an articulated roof-support beam having two pivotally-connected beam parts which are thus able to swivel relatively to each other in a horizontal plane, there being a deformable arched blocking plate located in a space between the opposing ends of the two beam parts to limit the extent of relative swivelling movement between the latter parts in one direction.

4 Claims, 2 Drawing Figures

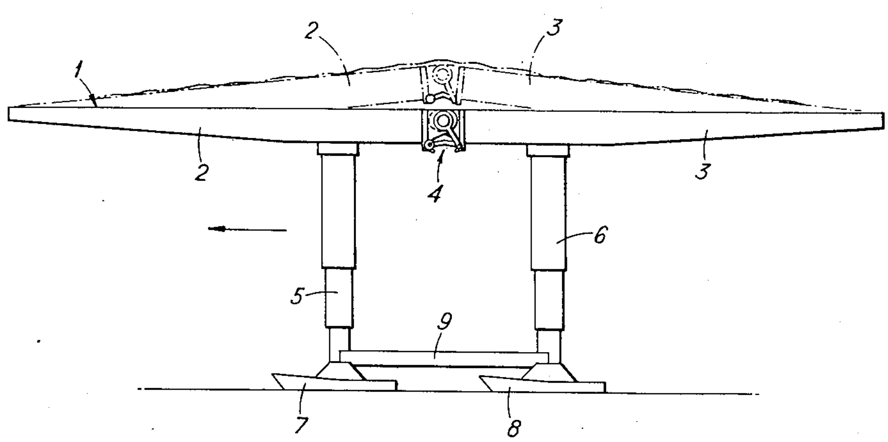

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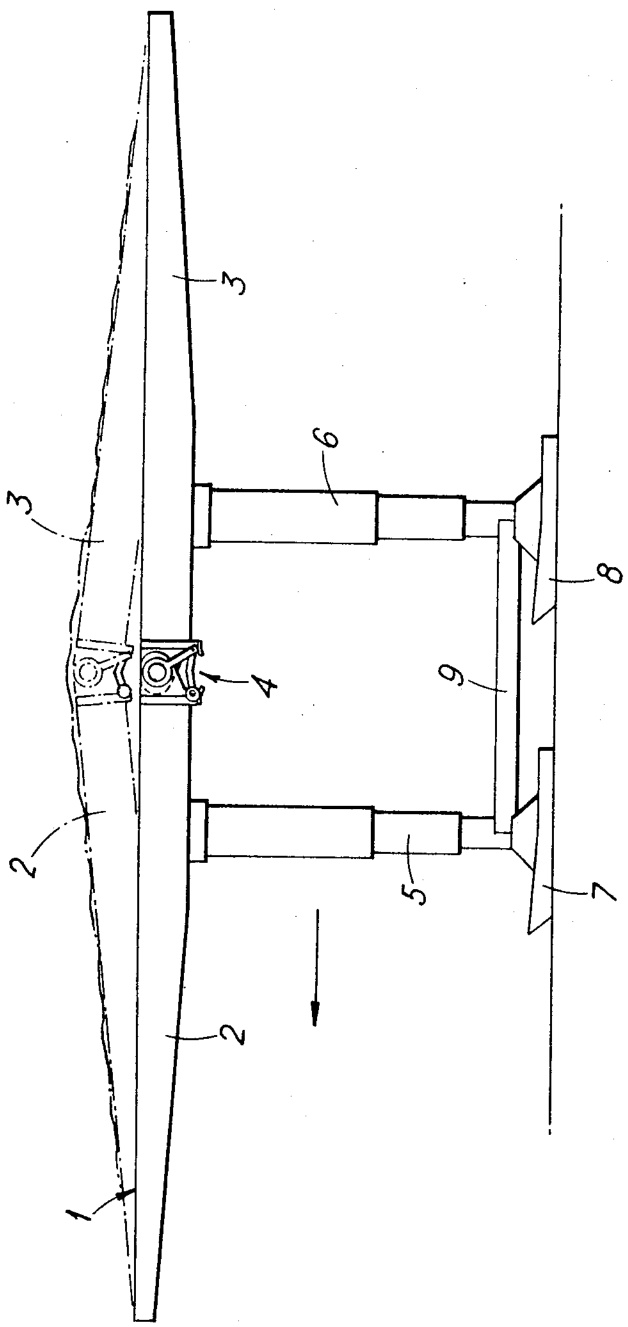
Fig.1



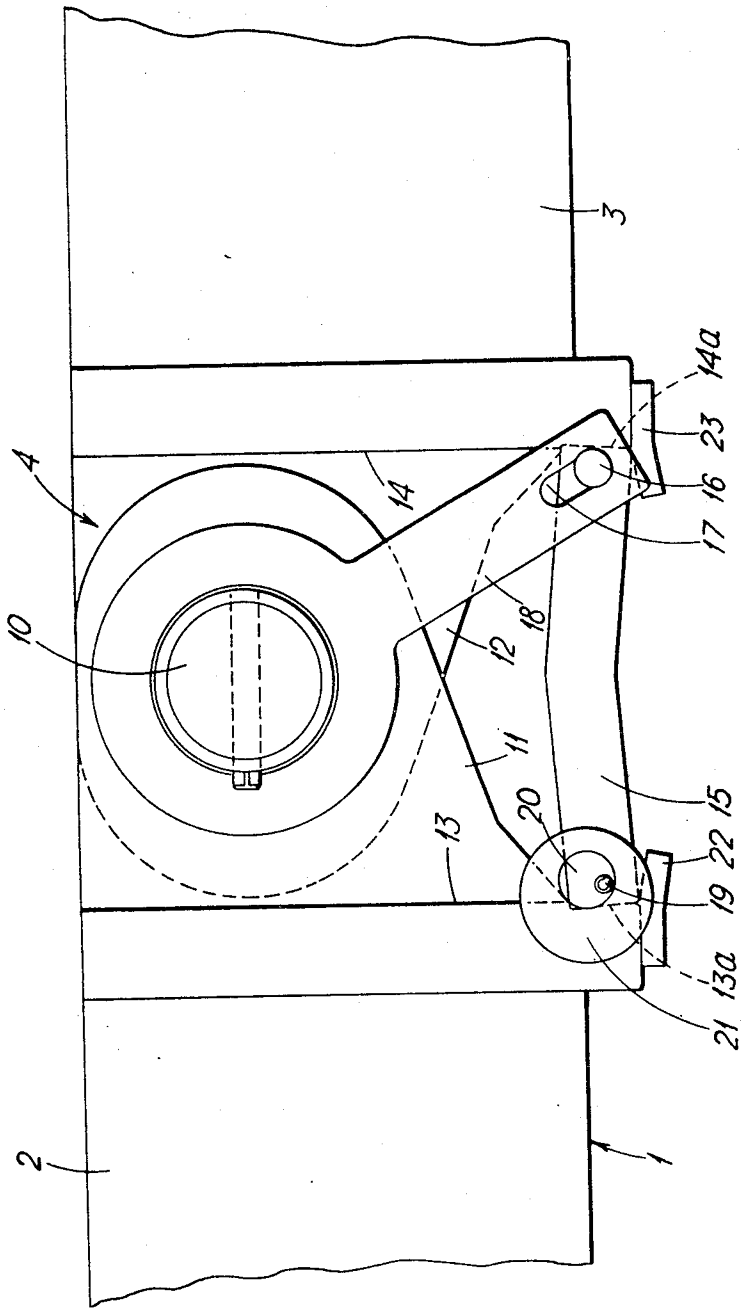


Fig. 2.

ROOF SUPPORT FRAME

This invention relates to the roof-support frames of so-called "walking" roof-support assemblies which are used in mines and other underground workings.

Walking roof-support assemblies are well known in the mining industry. They generally comprise two "frames" which are connected to different parts of a horizontally-disposed hydraulic ram so that, as the ram is expanded or retracted, relative movement takes place between the frames. In this way the frames can be advanced alternately, step by step. Each frame normally includes two upright hydraulic props, a front prop and a rear prop, joined together at their upper ends by a roof-support beam and supported at their lower ends on "shoes" or on a floor-beam which bears on the floor of the mine-working.

In recent years several proposals have been made for the roof-support beam of each frame (which beam extends parallel to the direction of advance of the assembly as a whole) to be of articulated construction so that it can adapt itself to the uneven contour of the mine roof. Thus, the beam can be in two parts which are joined end-to-end by a pivotal connection to permit the two parts of the beam to swivel relatively to each other in a vertical plane. Compared with rigid beams, such articulated beams offer several additional advantages: Thus, for example, because the rigid beams extend a substantial distance beyond the front and rear props of their respective frames, each beam receives the full supporting and bending forces from both these props and has to transmit these forces to the roof of the seam which is being worked. Owing to the fact therefore that these beams have to have a relatively high resistance to bending stresses, their vertical thickness is comparatively great. For this reason they are difficult to transport and, as they are also of considerable length, difficult to manipulate. In comparison, the bending stresses applied to articulated beams, which are divided into at least two parts by a pivotal connection lying between the two props of each frame so that each part is effectively supported by only one prop, are appreciably smaller than in the case of rigid beams. Articulated beams can, as a result, be made appreciably less thick and lighter than rigid beams.

In many of these articulated beams, a single horizontal swivel pin enables the two parts of each beam to be pivoted both upwardly and downwardly relatively to each other so that a large surface area of the beam will lie against the roof of the seam. The roof-supporting surfaces of the two parts are thus able to take up positions where they match irregularities in the surface of the roof of the seam. There is, however, one drawback of these composite beams. This is that any hollow space or spaces in the mine roof immediately above the pivotal connection between the two parts of the beam are not bridged over by a rigid surface as in the case of rigid beams. Instead, the two parts of the articulated beam are pressed by the props into the hollow space or spaces so that the beam takes up a shallow inverted V-shape resembling the gable or roof of a house. This means that the forward section of the front beam part and the end section of the rear beam part no longer lie against the roof of the mine or seam, with the result that the rock or mineral of which the roof is composed is unsupported in front of and to the rear of the hollow space or spaces. This occurs because the two parts of

the beam only support the edges of the hollow space over a small area of their surface and a small part of the hollow above the articulated joint. Such support of the mine roof is inadequate and unsatisfactory and, generally speaking, causes the hollow space to be enlarged.

It has already been proposed, with a view to preventing the beam parts from taking up the above-mentioned gable-like formation with its attendant drawbacks, to provide means for converting the pivotal connection between the beam parts into a rigid joint. The beams parts are thus prevented from pivoting up and down relatively to each other. This causes large surface areas at the remote ends of the beam parts to bear against and support the continuous or relatively even areas of the roof of the seam lying in front of and to the rear of any hollow space, the forces for thus supporting the roof of the seam being exerted by the props in the same way as in a rigid beam. This form of beam accordingly has the disadvantages of a rigid beam, except only that it can be split into two parts for transportation.

The present invention has as its object the elimination of the above-mentioned drawbacks associated with the use of articulated beams the pivotal connections of which are acted on so that the beam parts cannot move relatively to one another and the use of intrinsically rigid beams. With this object in view, the invention is directed to a roof-support frame comprising an articulated roof-support beam formed of a front beam part and a rear beam part articulated thereto, an upright front hydraulic prop supporting the front beam part at the upper end of the prop, an upright rear hydraulic prop supporting the rear beam part at the upper end of the rear prop, the said front and rear beam parts being disposed end to end but with a space between the adjacent ends of the beam parts, pivotal connection means connecting the adjacent ends of the front and rear beam parts to provide for relative pivotal movement in a vertical plane between the beam parts, and a blocking device to limit the extent of said relative pivotal movement between the beam parts in one direction, the blocking device comprising a deformable blocking element disposed in the space between the adjacent ends of the two beam parts below the pivotal connection means linking the said beam parts together.

An articulated beam of this construction has the advantage that, when a hollow space in the roof of the seam lies above the pivotal connection between the two parts of the beam, the space is bridged over or spanned by the beam in such a way that the forces exerted by the props of the frame will be transmitted with full effectiveness to the continuously unbroken or even portions of the roof of the seam lying in front of, and to the rear of, the hollow space without the beam having the disadvantages of the prior beams described above. Thus, an articulated beam according to the invention can be of thinner and lighter construction than rigid beams or beams where the pivotal connection between the beam parts is so controlled that it is rendered rigid and non-yielding. The new form of beam presents a completely rigid structure under normal working conditions but nevertheless ensures that the beam parts and the pivotal connection will not be destroyed when the conditions under which the beam bears against the roof of the seam are unusual. In this way the advantages of beams which present a continuous rigid structure are combined with those of articulated beams while, at the same time, the drawbacks previously encountered in such beams are avoided.

An example of a roof-support frame in accordance with the invention is shown in the accompanying drawings, in which:

FIG. 1 is a side view of the roof-support frame; and

FIG. 2 is an enlarged detailed view of part of FIG. 1.

As already indicated, walking roof-support assemblies for use in mines and other underground workings generally comprise two "frames" which can be advanced alternately by a horizontal hydraulic ram to which both frames are connected. Such assemblies are well known in the mining industry and will not therefore be described in detail. For the same reason, FIG. 1 does not shown a complete walking roof-support assembly but only one of the frames, the other frame in the assembly being identical to that illustrated.

The frame shown in FIG. 1 comprises an articulated, elongated, roof-support beam **1** formed of an elongated front part **2** and an elongated rear part **3**, the two parts **2** and **3** being joined together end-to-end by a pivotal connection **4** so that they can swivel relatively to each other in a vertical plane. The frame further includes a front hydraulic prop **5** and a rear hydraulic prop **6** which support the beam **1** at their upper ends, the force of the front prop **5** being applied mainly to the front part **2** of the beam and the force of the rear prop **6** being applied mainly to the rear part **3** of the beam. At their lower ends the two props **5** and **6** are supported by "shoes" **7** and **8** respectively which bear on the floor of the mine or seam. The lower portions of the props are also rigidly connected together, in this particular case by a longitudinally-extending bar or strut **9**.

FIG. 2 shows the pivotal connection **4** in greater detail. It includes a horizontal swivel pin **10** which passes through aligned holes in flanges or lugs **11, 12** formed on the opposing ends **13, 14** of the two beam parts **2** and **3**, the ends **13, 14** being spaced apart. Within this space, below the pin **10**, is a deformable blocking element **15** made of a material such as steel or iron whose strength is in keeping with the particular stresses and loads to which it will be subjected. This blocking element **15** takes the form of a metal plate or slab and is arched towards the swivel pin **10** so that it resembles, in its shape, a shallow gable of a house. In order to ensure that the ends of the blocking element **15** will lie flat against the opposed ends **13, 14** of the two beam parts **2, 3**, the ends **13, 14** of the latter are formed with recesses **13*a*, 14*a*** having downwardly-inclined surfaces with which the blocking element **15** is readily engageable. At one end of the blocking element **15** is a removable pin **16** which passes, with suitable clearance, through an elongated hole or slot **17** in a supporting arm **18** which is pivotally mounted on one end of the swivel pin **10**. The other end of the blocking element **15** has a smaller removable pin **19** which passes with even more clearance through a hole **20** in a disc **21** mounted on the end of the beam part **2**. Further support for the blocking element **15** is given by supporting brackets **22** and **23** welded or otherwise mounted on the lower portions of the ends **13** and **14** of the two beam parts **2** and **3**.

Because of the construction described above, the extent of relative angular motion between the two beam parts **2** and **3** about the swivel pin **10** is limited in one direction by the deformable blocking element **15** which is disposed between the spaced-apart ends of the beam parts and below the swivel pin **10** linking the said parts together. Thus, because the ends of the blocking element **15** are opposed by downwardly-inclined surfaces **13*a*, 14*a*** on the ends **13, 14** of the two beam parts **1, 2**, the ends of the blocking element will lie flat against the said surfaces **13*a*, 14*a*** when the beam parts **1** and **2** are in the positions shown in FIG. 2. The surfaces **13*a*, 14*a*** prevent the blocking element **15** from jumping out of position when, as explained below, it is being deformed.

The strength of the blocking element **15** is such that the load applied to the beam **1** by the props **5** and **6** will be fully transmitted, without deformation of the blocking element **15**, to the outer end portions **2*a*** and **3*a*** of the beam parts **2** and **3** where up to 70 percent of the total length of the two beam parts on either side of the swivel pin **10** is out of contact with the roof of the mine or seam. In other words, the pivotal connection **4** will remain resistant to bending stresses when only 30 percent of the total length of the beam parts **2** and **3** are in contact with the roof of the seam. If the proportion of the said length bearing against the roof of the seam falls below 30 percent, the blocking element will be deformed (assuming that the blocking element is not destroyed by the high stress applied to it from the roof of the seam). Owing to its intrinsic shape, and consequent upon this deformation, the blocking element **15** is then pressed upwards into the space between the opposing ends **13, 14** of the beam parts **1, 2**, whereupon the pivotal connection or articulated joint **4** as a whole yields to the force applied and enters the hollow space in the roof of the seam until it abuts against the rock or material bounding the hollow space as shown in broken lines in FIG. 1. Such is the strength of the blocking element **15** that the beam parts **2, 3** can take up an inclination of 30° with respect to the horizontal and can then again present a rigid structure for receiving the full supporting force exerted by the props **5, 6**. The blocking element **15** is so constructed and supported that, when it is being deformed, the holding disc **21** and the arm **18** are not simultaneously pulled in the same direction as, and in sympathy with, the deformation. After the frame has been further advanced by the hydraulic ram, the beam parts **2** and **3** return to their normal position. They are then comparable, in their operation, to a pair of freely-articulated parts until the deformed blocking element **15** has been replaced by a new blocking element.

Practical experience in using hydraulic advancing roof-support assemblies has shown that it is very improbable that more than 70 percent of the total length of the two beam parts **2** and **3** will ever be out of contact with the roof. Accordingly, the beam **1** as a whole can be relied upon to bridge over, as a rigid structure most hollow spaces which occur above the articulated joint **4**. When there is a hollow space in the roof of the seam above the forward portion **2*a*** of the front beam part **2** or above the end portion **3*a*** of the rear beam part **3**, the beam parts can pivot in the other direction relatively to one another about the swivel pin **10**. This is in contrast to roof-support beams which are either intrinsically rigid or which are made rigid by controlling a pivotal connection in the beam.

I claim:

1. A roof-support frame comprising an articulated roof-support beam formed of a front beam part and a rear beam part articulated thereto, an upright front hydraulic prop supporting the front beam part at the upper end of the prop, an upright rear hydraulic prop supporting the rear beam part at the upper end of the rear prop, the said front and rear beam parts being disposed end to end but with a space between opposed end surfaces on the said beam parts, pivotal connection means connecting the adjacent ends of the front and rear beam parts to provide for relative pivotal movement in a vertical plane of the beam parts, and a blocking element disposed between, and in engagement with, the said opposed end surfaces on the said beam parts at a location below the pivotal connection means to determine when relative pivotal movement of the beam parts in one direction shall be permitted, the said blocking element comprising an arched metal plate which is sufficiently rigid to prevent relative pivotal movement of the said beam parts in the said one direction under normal working loads on the roof-support beam but which deforms under abnormal working loads on the beam to permit such relative pivotal movement of the said beam parts.

2. A roof-support frame in accordance with claim **1**, wherein opposed recesses are formed in the adjacent ends of the two beam parts, the said recesses having downwardly-inclined surfaces to enable end surfaces on the blocking element to lie flat against the downwardly-inclined surfaces of these recesses.

3. A roof-support frame in accordance with claim **1**, wherein the blocking element is partially supported by a pin in an elongated hole of a supporting arm which is itself pivotally mounted on a part of the said pivotal connection means, the blocking element also being supported by another pin in a bore of a disc which is positioned against a lower portion of one of the adjacent ends of the two beams, the clearance between the two pins and the said hole and bore respectively being sufficient to allow the blocking element to move relatively to the said supporting arm and the said disc.

4. A roof-support frame according to claim **1**, wherein the blocking element is additionally supported by brackets on the lower portions of the adjacent ends of the two beam parts.

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