United States Patent

Von Hippel

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[54] LONGWALL MINING APPARATUS

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[52] **U.S. Cl.** ..... **299/32**, 61/45 D

[51] **Int. Cl.** **E21c 35/14**

[58] **Field of Search** ..... 299/32, 33, 43; 61/45 D

[56] **References Cited**

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FOREIGN PATENTS OR APPLICATIONS

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[57] **ABSTRACT**

An underground excavating apparatus having a conveyor for removing material from the face of an underground excavation. The conveyor removes the material in a predetermined direction. An elongated cap is movable into engagement with the roof of the excavation above the conveyor extending transversely to the face and the direction in which the conveyor removes the material. A set of props including first props extending upwardly above the conveyor from one side thereof and of the predetermined direction, and second props extending upwardly above the conveyor from the other side of the latter and of the predetermined direction. The props are thus mutually inclined, meeting above the conveyor and engaging and maintaining the cap means in position above the conveyor.

10 Claims, 4 Drawing Figures

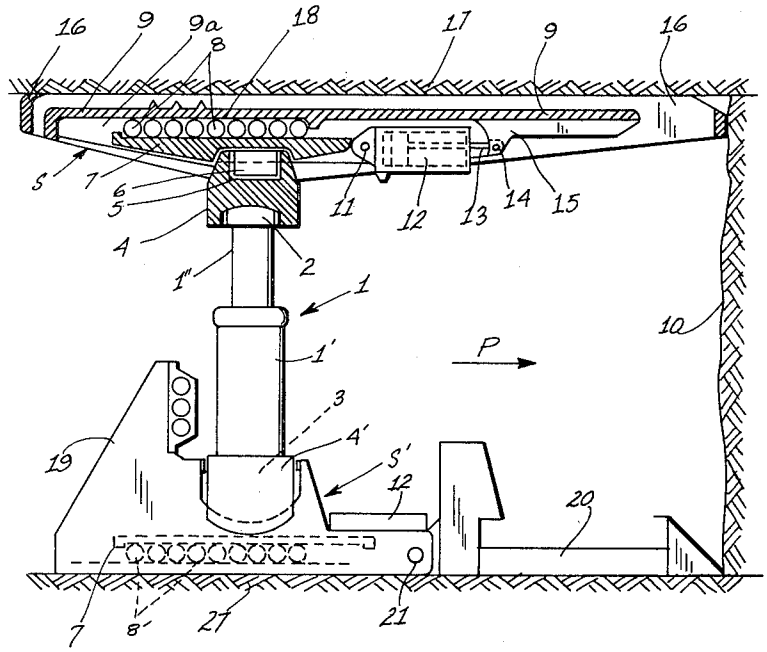
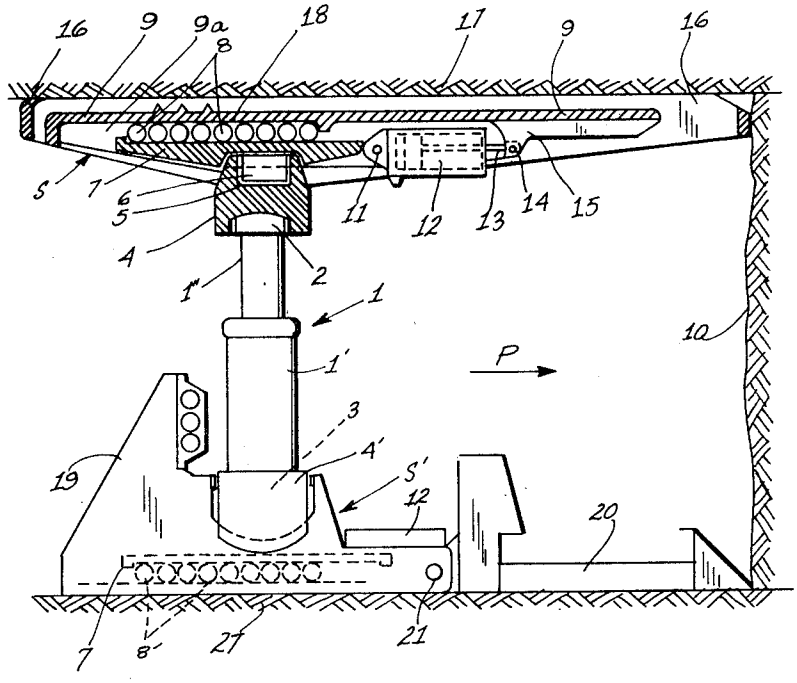


Fig. 1



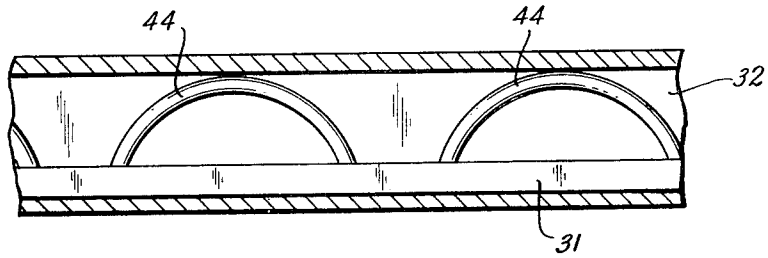


Fig. 4

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Fig. 3

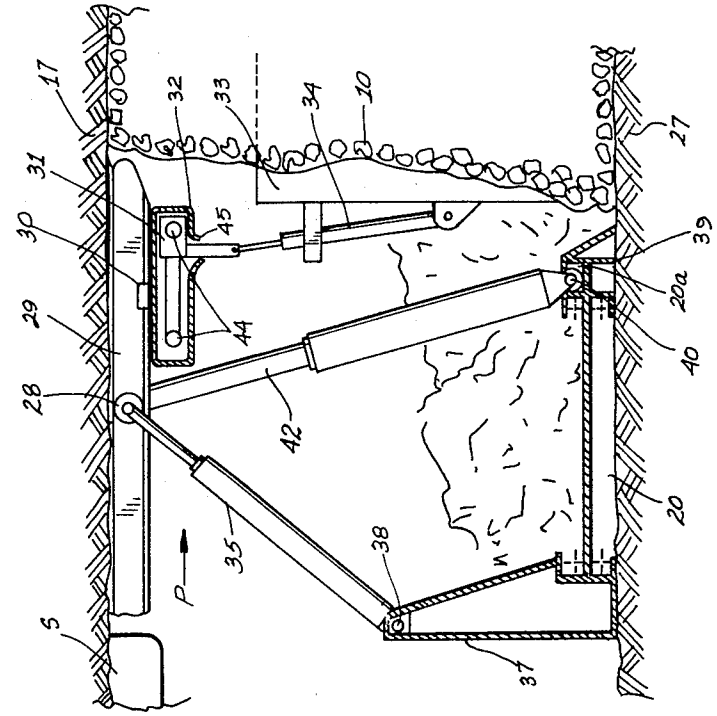
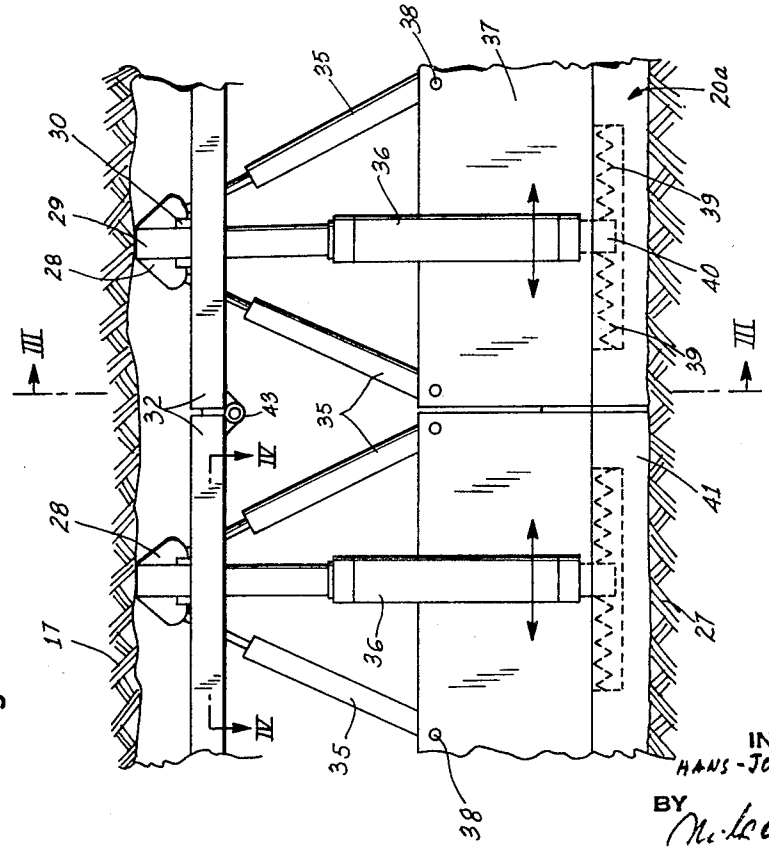


Fig. 2



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LONGWALL MINING APPARATUS

BACKGROUND OF THE INVENTION

The present invention relates to apparatus for underground excavations, and more particularly to apparatus for supporting the roofs of mining galleries and similar underground excavations. Still more specifically the invention relates to improvements in so-called walking mine roof supports which are movable stepwise toward the mine face in an underground excavation.

Apparatus of this type is already known. It is, for instance, described in detail in my U.S. Pat. No. 3,372,551 to which reference may be had for a detailed background of walking mine roof support apparatus. Generally speaking, such apparatus includes cap means which engages the roof of the excavation to prevent it from collapse, and prop means which props the cap means against the roof. In accordance with my aforementioned United States patent this apparatus is constructed so as to be capable of advancing, i.e., "walking," stepwise towards the mine face from which material is being taken for removal out of the underground excavation.

In the nature of the operations involved the apparatus comprises equipment which removes material from the mine face, such as coal or whatever material is to be removed, and a conveyor which conveys the thus-separated material away from the mine face towards another location of the excavation for eventual removal from the underground excavation. In order to protect this apparatus which removes material from the mine face, and also the conveyor, against collapse of the roof above them, walking mine roof supports are usually provided with advance caps which project to the mine face ahead of the main gaps and serve to prevent the roof of the excavation adjacent the mine face from collapsing. Such advance caps are supported by props which are located at opposite sides of the conveyor, the latter extending along the mine face, with some of the props being located between the conveyor and the mine face and others being located at the side of the conveyor which is directed away from the mine face. The problem with these arrangements is the fact that the positioning of the props intermediate the conveyor and the mine face poses certain difficulties, not only because they make it more awkward to channel the removed material onto the conveyor but also because they interfere with the electrical cables which are needed to supply energy to the usually electrically operated device which removes material from the mine face.

SUMMARY OF THE INVENTION

It is, accordingly, an object of the present invention to overcome the aforementioned disadvantages.

More particularly it is an object of the present invention to provide an apparatus wherein the props for the advance cap no longer interfere with the supply of removed material onto the conveyor, and no longer interfere with the electrical cables which supply electrical energy to the apparatus removing material from the mine face.

In pursuance of the above objects, and others which will become apparent hereafter, one feature of my invention resides in an underground excavating apparatus, of a combination which briefly stated comprises first means for removing material from the face of an underground excavation, conveyor means extending along said face for conveying the removed material away from such face in predetermined direction, and elongated cap means movable into engagement with the roof of the excavation above said first means and conveyor means and extending transversely to said face and said direction, for preventing collapse of said roof. Further in accordance with the invention I provide sets of prop means, including at least one first prop extending upwardly into supporting engagement with the cap means from a side of the conveyor means closer to the mine face, and at least one second prop extending upwardly into supporting engagement with the cap means from a side of the conveyor means farther from the mine face, with the props of each set being inclined towards one another and having upper end portions engaging the cap means above the conveyor means.

This inclination of the two props of each set, which are thus in effect astride the conveyor, assures that there exists an angle between the prop closer to the mine face and the latter which increases upwardly towards the roof. Because the other prop located at the other side of the conveyor is inclined towards the mine face, this prop can serve to advance the advance cap in direction towards the mine face while simultaneously elastically reducing the load on the prop which is located intermediate the conveyor and the mine face. Furthermore, I can now arrange auxiliary components in the angle between the mine face, the prop located between the mine face and the conveyor, and the advance cap, and can thus guide electricity supply cables in this space. The cable or cables are provided in form of a loop because the apparatus of course moves along the mine face and the loop serves to provide the apparatus with freedom of such movement, and because the loop can now be arranged substantially horizontally rather than vertically as herebefore and the height of the construction can therefore be rather low, which is desirable in underground excavations.

In accordance with a further concept of my invention I recognize that the prop located between the mine face and the conveyor is usually in danger of having its lower end portion deflected in direction of movement of the material, partly by the apparatus removing material from the mine face and partly because of the stream of material which advances on the conveyor and frequently impacts upon the lower end portion of the prop of props in question. According to the invention and according to a further embodiment thereof, the lower end portions of these particular props are therefore mounted in such a manner as to be capable of elastically yielding in the direction of movement of the material, to be restored by suitable biasing means to their starting position.

Conversely, I arrange the lower end portions of the other props, that is those located at the side of the conveyor spaced from the mine face, at a level above the conveyor and provide them in pairs, thereby avoiding the possibility that material moving on the conveyor can impact against them and inclining these props more strongly toward the horizontal so that their action upon the advance cap in the sense moving the same stepwise towards the mine face, is correspondingly stronger than would otherwise be the case.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a schematic side elevational view of a known mine roof support of a walking mine roof support apparatus;

FIG. 2 is a fragmentary elevational view as seen from the right-hand side of FIG. 1, illustrating an embodiment of my invention;

FIG. 3 is a section taken on the line III—III of FIG. 2; and

FIG. 4 is an enlarged section taken on line IV—IV of FIG. 2.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Discussing firstly FIG. 1 it is emphasized that this illustrates essentially a known walking mine roof support apparatus of the type set forth in U.S. Pat. No. 3,372,551. This illustration is included herein in order to show more clearly the relationship of the present invention with respect to the remainder of such apparatus with which it is ordinarily employed.

The walking mine roof support in FIG. 1 comprises a hydraulic pit prop 1 including a lower tube 1' and an upper tube 1'' which latter is reciprocably telescoped into the lower tube 1' so that the prop can be extended and contracted. The

tubes 1', 1'' are respectively provided with cooperating cylinder and piston means to extend or contract the prop in response to controlled admission or evacuation of a hydraulic fluid. The upper end portion 2 of the tube 1'' constitutes a male coupling member which extends into a socket provided in an operating cylinder 4. The lower end portion 3 of the lower tube 1' extends into a socket provided in an operating cylinder 4'.

The operating cylinders 4', 4' respectively form part of two advancing units S, S' which cause the mine roof support to "walk" along the mine floor 27 towards or away from the mine face 10 and to shift an evacuating conveyor 20 which extends transversely of the mine roof support along the front part of the mine floor 27 and which serves to evacuate material being removed from the mine face.

The advancing unit S comprises the aforementioned operating cylinder 4 which may be rigidly or tiltably secured to the upper end portion 2 of the tube 1'' and defines a cylinder chamber 5 for a plunger or ram 6 which is rigid with a slide or runner 7. The slide 7 can travel lengthwise along a track constituted by rolls or analogous friction-reducing elements 8 installed in a first roof-engaging member or cap 9. In the illustrated embodiment the elements 8 are rolls accommodated in a cage including a first portion constituted by the slide 7 and a second portion constituted by the lower part 9*a* of the cap 9. The latter extends lengthwise of the mine roof support at right angles to the mine face 10. The downwardly extending flanges of the cap 9 form the sidewalls of the cage portion 9*a* and shield the elements 8 against debris falling off the mine roof 17.

A shifting device of the upper advancing unit S comprises a double-acting hydraulic cylinder 12 articulately connected to the front end portion of the runner 7 by a horizontal pin 11 and which accommodates a reciprocable piston whose rod 13 is connected with a downwardly extending bracket 15 of the cap 9 by a horizontal pivot pin 14. The shifting device including the cylinder 12 and piston rod 13 can move the cap 9 with reference to the runner 7, or vice versa. This shifting device is protected by cap 9 by being mounted between the downwardly extending flanges bounding the sides of the cage portion 9*a*.

In addition, the advancing unit S comprises a second roof-engaging cap including two elongated I-beams 16 fixedly secured to the operating cylinder 4 at the opposite sides of the cap 9.

The upper side of cap 9 is preferably provided with teeth 18 or analogous protuberances which can bite into the material of the mine roof 17 to prevent sliding of cap 9 when the latter bears against the mine roof 17.

The lower advancing unit S' comprises the aforementioned operating cylinder 4' which if fixedly connected with a floor-engaging cap composed of two spaced parallel I-beams. The nonillustrated chamber of cylinder 4' contains a vertically operable plunger which can reciprocate and displace a U-shaped cap corresponding to the cap 9 and movable into and from firm engagement with the mine floor 27. This cap extends lengthwise between the I-beams and its front end portion is articulately connected with the double-acting cylinder 12' of a hydraulic shifting device serving to move the cap with reference to the beams or vice versa. A horizontal pivot pin 21 connects the front end portion of the beams with the evacuating conveyor 20 which is slidable sideways along the mine floor 27. The rollers 8' are disposed between cap and a slide 7' which is connected with the ram in the operating cylinder 4'.

The cap and the beams are respectively shorter than the cap 9 and beams 16 to provide room for the evacuating conveyor 20. A shield on the rear end portions of beams protects the operating cylinder 4' from filling which is used to fill up the gallery rearwardly of the mine roof support. The evacuating conveyor 20 usually comprises two endless chains which are driven to travel in a direction at right angles to the plane of FIG. 2. Details concerning the hydraulic system of this unit are fully disclosed in U.S. Pat. No. 3,372,551 and reference may be had thereto.

Coming now to the present invention, as illustrated in the exemplary embodiment of FIGS. 2 and 3, it will be seen that instead of having the unit S extend all the way to the mine face 10, there is provided forwardly of the unit S–between the same and the mine face 10–an advance cap 29. This is movable towards the mine face 10 at right angles thereto, in the same manner as and substantially in unison with the unit S, the direction of movement being indicated by the arrow P.

The conveyor 20 is, accordingly, located forwardly of the unit S below the advance cap 29 by which it is protected against collapse of the mine roof 17. In accordance with my invention, the conveyor 20 is provided on the side facing the mine face 10 with guides 20*a* extending lengthwise of the conveyor 20 and in which the lower end portions 40 of the props 36 are mounted for yielding movement in lengthwise direction of the conveyor 20, as indicated by the double-headed arrows in FIG. 2.

This is accomplished by providing suitably dimensioned springs or analogous biasing members 39 located in the respective guides 20*a* at opposite sides of the lower end portions 40, as shown in FIG. 2, so that if the props 36 are deflected in one or the other direction of the double-headed arrows in FIG. 2, by impingement of material carried on the conveyor 20 against the props 36, or by contact with the material-removing apparatus 23, they will return to their intended original position as seen in FIG. 2, as soon as the impinging force is released.

The props 36 have portions 42 which engage the advance cap 29 substantially centrally thereof as seen with respect to its longitudinal extension. Both the connection between the upper portions 42 and that between the lower end portions 40 and the guides 20*a* is effected by a ball joint or similar means for enabling lateral tilting in the sense just discussed, as well as to enable the inclined positioning evident from FIG. 3.

The conveyor 20 is further provided with a shield 37 located at that side which faces away from the mine face 10 (compare FIG. 3). This shield, extending upwardly above the level of the conveyor 20, prevents material which is being conveyed from falling off the conveyor and moving rearwardly into the area of the remainder of the apparatus, as discussed above with respect to FIG. 1. In accordance with one aspect of the present invention, the lower end portions of the props 35 are secured to the upper region of the shield 37 via ball joints 38 or analogous means. Each of the props 36 is associated with two of the props 35 which are inclined towards one another in the manner illustrated in FIG. 2, with their lower end portions being spaced from one another in longitudinal direction of the conveyor 20. The upper end portions of the props 35 are secured via ball joints or the like at opposite sides of the advance cap 29 to lateral extensions 28 of the latter.

Arranged below the advance cap 29, in the space defined between the mine face 10, the advance cap 29 and the upper portions 42 of the props 36, is a cable loop guide which is arranged in a box-shaped conduit 32 secured via the clamps 30 movable with the advance cap 29. As shown in FIG. 2, this box-shaped conduit 32 is composed of individual sections which are connected with one another via joints or hinges 43. Arranged in the interior of the conduit 32 (see FIG. 4) is a cable 44 which is arranged in form of a loop in well known manner, the free end of the loop being secured to a carriage 31 or analogous means which is guided by the material-removing machine 33–whose construction forms no part of the invention and is not of importance for purposes of this explanation–via an extensible arm 34. A slot 45 is provided in the conduit 32 through which the cable 44 extends to the arm 34 and thence to the apparatus 33.

It will be appreciated that by providing suitable hydraulic control means, for instance of the type set forth in my aforementioned U.S. Pat. No. 3,372,551, the advance cap 29 can be moved towards the mine face 10 in stepwise manner independently of the main apparatus shown in FIG. 1, whose upper advancing unit S is just visible in FIG. 3. However, it is also possible to coordinate the movement of the main apparatus with that of the apparatus shown in FIGS. 2 and 3 so that they

advance in unison. Furthermore, it is also possible to have the advancing unit S extend forwardly laterally of the advance cap **29** so that it serves to provide additional protection against collapse of the mine roof **17**. In this case it would then for instance be possible to retain the unit S in position while the advance cap **29** is moved forwardly, whereupon the unit S would then be moved forwardly until it would be again laterally of the advance cap **29**.

Of course, in addition to or in place of the conduit **32** with its associated components, other auxiliary equipment–for instance relating to the apparatus **33**–can also be accommodated in the space defined between the underside of the advance cap **29**, the upper section **42** of the props **36** and the mine face **10**. When the arrangement is such as illustrated in FIGS. **2** and **3**, the fact that the cable loop is arranged horizontally and does not have to hang vertically as is customary, the entire construction can be very low which is of course very desirable in underground excavations.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of constructions differing from the types described above.

While the invention has been illustrated and described as embodied in an underground excavating apparatus, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

I claim:

1. In an underground excavating apparatus, in combination, first means for removing material from the face of an underground excavation; conveyor means extending along said face for conveying the removed material away from such face in predetermined direction; elongated cap means movable into engagement with the roof of the excavation above said first means and conveyor means and extending transversely to said face and said direction, for preventing collapse of said roof; and mutually inclined sets of prop means, including at least one first prop extending upwardly into supporting engagement with said cap means from a side of said conveyor means closer to said face, and at least two second props extending upwardly into supporting engagement with said cap means from a side of said conveyor means farther from said face and inclined with reference to one another in said predetermined direction, said props of each set having upper end portions engaging said cap means above said conveyor means.

2. In an apparatus as defined in claim **1**, wherein said props have lower ends mounted on said conveyor means.

3. In an apparatus as defined in claim **1**, wherein said second props each have lower end portions spaced in said predetermined direction, and wherein said upper end portions of said second props engage said cap means at least substantially proximal to one another.

4. In an apparatus as defined in claim **1**, wherein said upper end portions engage said cap means at spaced locations.

5. In an apparatus as defined in claim **1**, said cap means being movable towards said face transversely to said direction for advancement in response to receding of said face resulting from removal of the material being excavated.

6. In an apparatus as defined in claim **1**, wherein said props all have lower end portions, and wherein the lower end portions of said second props are located at a level above that of the lower end portions of said first props.

7. In an apparatus as defined in claim **1**, said props all having lower end portions; and further comprising mounting means mounting said lower end portions of said first props for resilient yielding movement in said direction.

8. In an apparatus as defined in claim **1**, said first props having upper end portions adjacent said cap means and defining therewith a predetermined angle; and auxiliary means associated with said first means and being mounted below said cap means in a space defined by said angle.

9. In an apparatus as defined in claim **1**, said first means being electrically operated, and said first props having upper end portions adjacent said cap means and defining therewith a predetermined angle; and elongated looped conductor means for supplying electric energy to said first means, arranged in the space defined by said angle between said cap means and upper end portions of said second props.

10. In an apparatus as defined in claim **9**, wherein said space is elongated, and extends substantially horizontally in said direction, and wherein said conductor means comprises at least one elongated loop extending longitudinally of said space.

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