Aug. 24, 1965 W. WILKENLOH ETAL 3,201,943

MINE ROOF SUPPORT

Filed Nov. 27, 1961 3 Sheets-Sheet 1

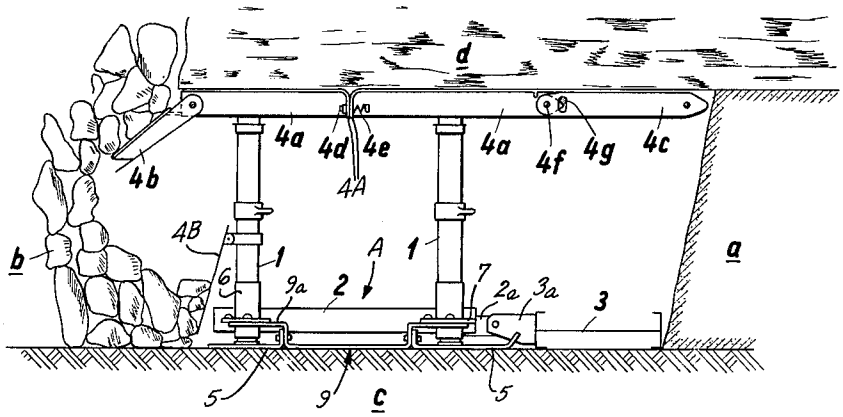


Fig. 1

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Fig. 2

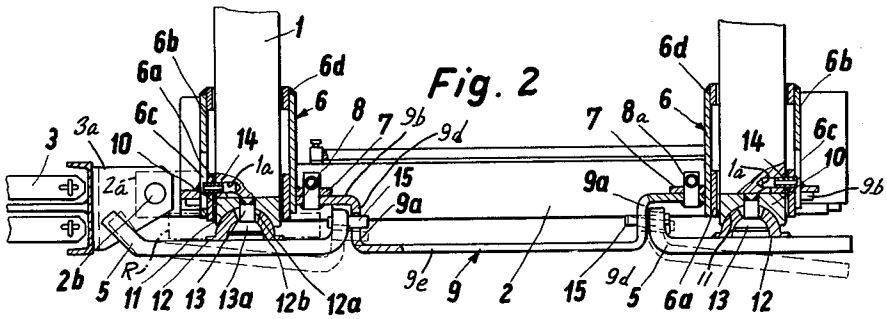


Fig. 3

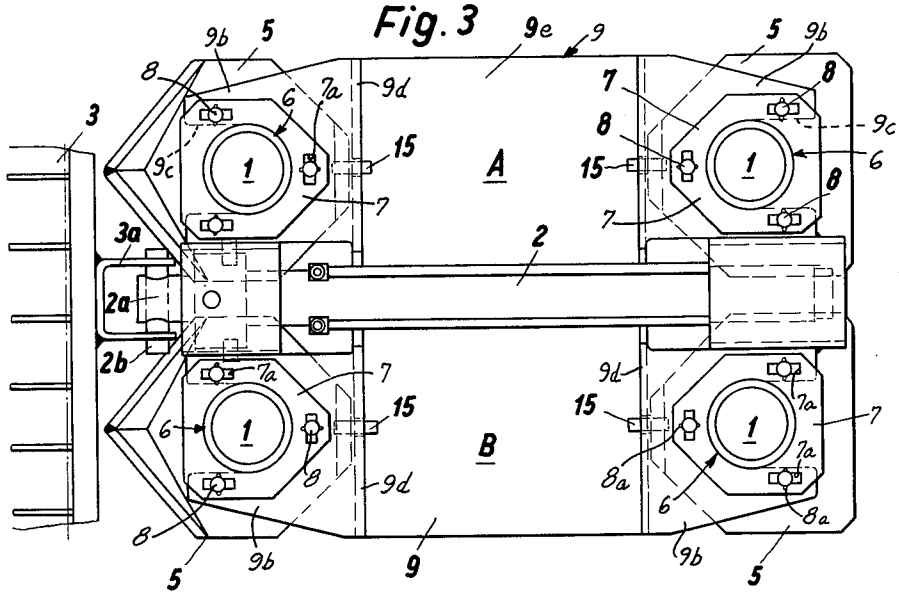
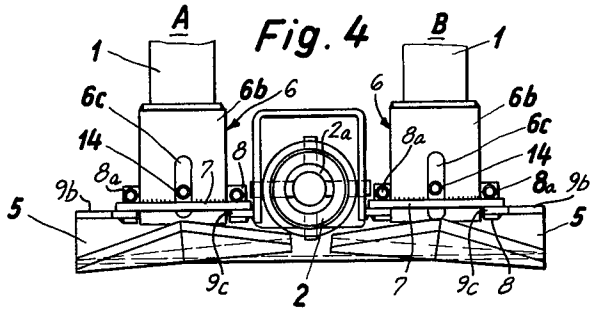


Fig. 4



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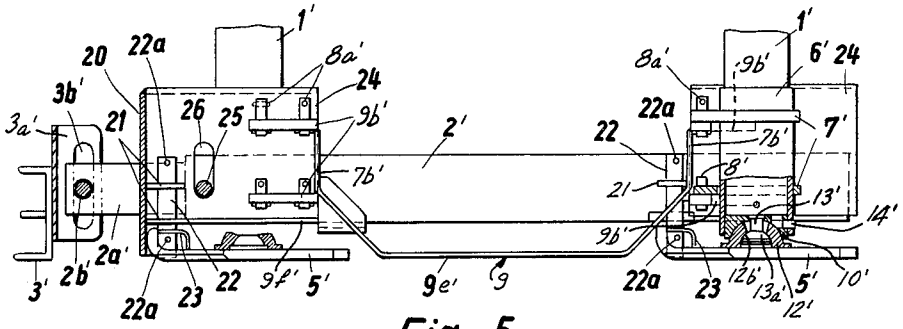


Fig. 5

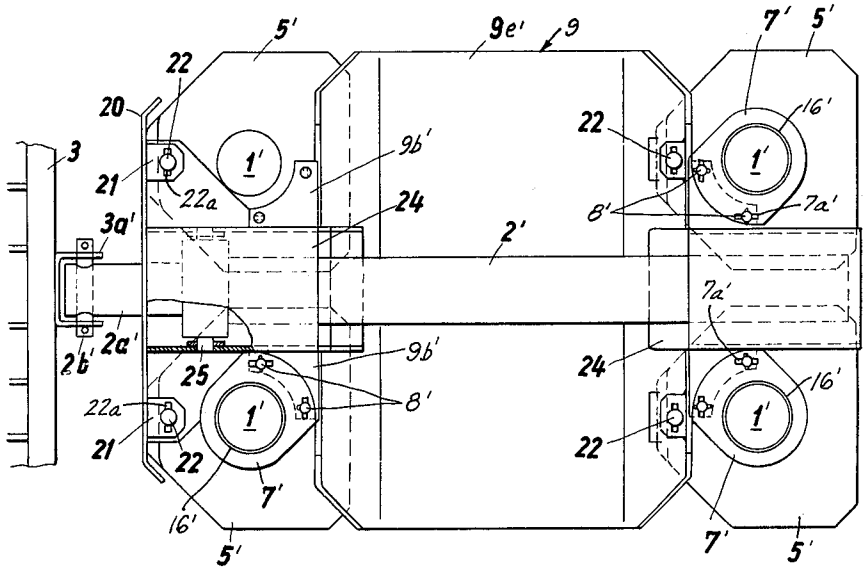


Fig. 6

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United States Patent Office 3,201,943 Patented Aug. 24, 1965

3,201,943

MINE ROOF SUPPORT

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Filed Nov. 27, 1961, Ser. No. 155,109
Claims priority, application Germany, Dec. 24, 1960, R 29,348
17 Claims. (Cl. 61—45)

The present invention relates to mining machinery in general, and more particularly to a multi-prop mine roof support whose props are articulately connected with their sole plates.

An important object of the invention is to provide a multi-prop mine roof support whose sole plates are universally movable with respect to their props even though the connections between these parts need not utilize rubber or like readily destructible substances.

Another object of the invention is to provide a mine roof support of the just outlined characteristics wherein the sole plates are movable not only with respect to the props but also with respect to the means which connects the props and the sole plates into an operative unit.

A further object of the invention is to provide a multi-prop mine roof support whose props are articulatable with respect to the aforementioned means which connects the props and the sole plates into an operative unit.

A further object of the invention is to provide a mine roof support of the above outlined type wherein the joints between the relatively movable parts are protected from rocks and other particulate matter, and wherein the connections, couplings and joints between the relatively movable parts can stand extensive wear without necessitating inspection, replacement or repair.

An additional object of the instant invention is to provide a mining apparatus of the above outlined characteristics which is constructed and assembled in such a way that it automatically assumes the requisite position with respect to the mine face and with respect to the customary coal or ore conveyor subseqeunt to each of its intermittent advances in an underground excavation and after having shifted the conveyor toward the mine face.

A concomitant object of the invention is to provide an improved articulate connection between a pit prop and its sole plate.

An additional object of the invention is to provide an improved articulate connection between the pit prop and its sole plate on the one hand, and the ground-contacting connecting plate of a multi-prop mine roof support on the other hand.

A further object of the invention is to provide a mine roof suport of the above outlined characteristics which is constructed and assembled in such a way that one or more of its component parts automatically pave the way for the sole plates in a direction toward the mine face when the mine roof support is moved to a new position in an underground excavation.

Another object of the invention is to provide a mine roof support wherein the articulate connection between each prop and its sole plate may operate without utilizing ruber or like materials regardless of whether the support comprises two relatively movable sections or whether all props of the support are movable simultaneously toward the mine face.

A more specific object of the invention is to provide a mine roof support whose parts are constructed and assembled in such a way that they may at least partially protect and conceal the customary cylinder which advances the support and the conveyor toward the mine face.

With the above objects in view, the invention resides in

the provision of a mine roof support which comprises at least two longitudinally and/or transversely aligned props, a ground contacting sole plate articulately connected to the lower end portion of each prop, a ground contacting connecting plate disposed between the sole plates, and means for vertically reciprocably coupling the props to the connecting plate.

Certain other features of the invention reside in the provision of means for articulately coupling the sole plates to the connecting plate preferably in such a way that the sole plates are dragged rather than pushed when advancing toward a mine face, in the provision of special rubber-free universal joints between the lower end portions of the props and the respective sole plates, in the provision of a specially constructed connecting plate which does not or overlaps only slightly the sole plates so that the articulate connections between the sole plates and the parts connected thereto cannot be clogged with rocks and other foreign matter, in the provision of special fillers which also serve as a means for preventing rocks and similar objects from reducing the mobility and articulateness of the sole plates, in the provision of special couplings between the props and the connecting plate, in the provision of a grader which may form a component part of the connecting plate and which serves as a means for paving the way for the sole plates in a direction toward the mine face, in such construction and configuration of the grader that it automatically adjusts the position of the mine roof support with respect to the conveyor when the apparatus is advanced toward the mine face, and in such configuration of the connecting plate that it may at least partially conceal the fluid-operated cylinder which is utilized for advancing the conveyor and the mine roof support toward the mine face.

The novel features which are considered as characteristic of 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 an advantages thereof, will be best understood from the following detailed description of certain specific embodiments with reference to the accompanying drawings, in which:

FIG. 1 is a vertical section through an underground excavation which accommodates a mine roof support embodying one form of our invention;

FIG. 2 is an enlarged fragmentary partly elevational and partly sectional view of the lower portion of the mine roof support shown in FIG. 1;

FIG. 3 is a top plan view of the structure shown in FIG. 2;

FIG. 4 is a front end view of the structure as seen from the left-hand side of FIGS. 2 or 3 with the conveyor omitted;

FIG. 5 is a fragmentary partly elevational and partly sectional view of a modified mine roof support; and

FIG. 6 is a top plan view of the structure shown in FIG. 5.

Referring now in greater detail to the illustrated embodiments, and first to FIG. 1, there is shown an underground excavation which is bounded at its front end by a mine face *a*, at its upper end by a mine roof *d*, at its lower end by a mine floor *c*, and at its rear end by a filling *b*, e.g., a pile of rocks, whose purpose is to fill up the excavation at a point rearwardly of a travelling multi-prop mine roof support which embodies our invention. In addition, the mine roof support shown in the excavation of FIG. 1 between the filling *b* and the mine face *a* serves as a means for advancing a horizontal conveyor 3 which extends along the mine face and which is utilized for removing ore, coal or other material which is being mined in the excavation, i.e., which is removed from the mine face *a* in any suitable way not forming part of this

invention. The conveyor 3 may be replaced by an articulated rail or by another type of material conveying means.

One embodiment of the improved mine roof support is shown in greater detail in FIGS. 2 to 4. It consists of two main sections A and B arranged side-by-side and secured to each other by a ground contacting connecting plate 9. Each section comprises a pair of hydraulic or pneumatic extensible and retractible pit props 1 which are aligned with each other in a direction perpendicular to the longitudinal direction of the conveyor 3. The upper end of each prop 1 is preferably articulately connected with a roof contacting bar or cap 4*a*, and the lower end of each prop is articulately connected with a ground or floor contacting sole plate or floor bar 5. Intermediate the sections A and B, there is provided a double-acting horizontal hydraulic or pneumatic cylinder 2 whose piston 2*a* is connected by a coupling pin 2*b* to the prongs of a forked bracket 3*a* provided on the conveyor 3. The piston 2*a* serves as a means for advancing the conveyor toward the mine face *a* when a layer of ore, coal or the like is removed from the mine face. As shown in FIG. 1, the caps 4*a* normally bear against the roof *d* and the sole plates 5 are supported on the mine floor *c* so as to prevent the roof from collapsing during a mining operation. The construction of the improved mine roof support is such that, when the piston 2*a* is expelled from the cylinder 2, it advances the conveyor 3 toward the mine face *a* while the sections A, B remain stationary and the caps 4*a* bear against the roof *d*. In the next step, the pressure fluid admitted to the oposite end of the cylinder 2 causes this cylinder to advance toward the mine face *a* and to entrain the sections A, B in the same direction. Of course, before the cylinder 2 can move the sections A, B toward the mine face, i.e., toward the forwardly shifted conveyor 3, the props 1 are shortened so that their respective caps 4*a* descend downwardly and away from engagement with the mine roof *d* and that the pressure fluid in the cylinder 2 must overcome only the friction between the sole plates 5 and the mine floor *c* in addition to the friction between the mine floor and the connecting plate 9 which articulately supports all four sole plates 5 and simultaneously permits substantially vertical reciprocatory movements of the props 1 and of the sole plates.

As is well known in the art, a large number of mine roof supports is utilized for supporting the roof in an underground excavation and for intermittently advancing a rail or a conveyor toward the mine face. Thus, the mine roof support shown in FIGS. 1 to 4 is but one of several supports which are used to advance the conveyor 3 toward the mine face *a*. However, since the other supports are of identical construction, it is sufficient to fully describe the construction and operation of a single support.

The rear ends of the caps 4*a* secured to the upper ends of the trailing props in sections A and B are articulately connected with upper shields 4*b* which may be adjusted in such position that they prevent the upper zone of the filling *b* from descending into the area occupied by the mine roof support. In addition, the trailing props 1 (i.e., the left-hand props as viewed in FIG. 1 or the right-hand props as viewed in FIGS. 2 and 3) are connected with lower shields 4B which prevent the lower zone of the filling *b* from advancing into the excavation and toward the mine face *a*. The forward ends of the caps 4*a* secured to the upper ends of both leading props 1 are articulately connected with front shields 4*c* which are adapted to support that portion of the mine roof *d* which extends above the conveyor 3. The caps 4*a* of the leading and trailing props 1 are connected with each other by bolts 4*d* which extend through vertical slots of abutting flanges 4A forming part of the caps 4*a* so as to permit the cap of a leading prop to be shifted vertically with respect to the cap of the respective trailing prop or vice versa. The bolts 4*d* are biased by springs 4*e* which permit the interconnected caps 4*a* to perform pivotal as well as limited translatory movements with respect to each other. Such more or less universal connection between the caps of the props forming part of the section A or B enables the caps to assume a position best suited for substantial face-to-face supporting engagement with the mine roof *d*. As indicated in FIG. 1, the springs 4*e* bear against the heads of the respective bolts 4*d* and against suitable projections provided on the caps of the leading props. It is sufficient if only one of the cooperating flanges 4*a* is provided with an elongated slot for the respective bolt 4*d*.

The front shields 4*c* are connected with the caps 4*a* of the respective leading props by pivot pins 4*f* and these front shields may be arrested in selected angular positions by wedges 4*g* inserted through vertical slots provided in the shields 4*c*, the wedges engaging in known manner with suitably configurated front end portions of the respective caps. If desired, the front shields 4*c* of the sections A and B may be articulately connected with each other.

Of course, the mine roof support of our invention may be modified by providing separate connecting plates 9 for the sections A and B, by connecting one of the sections with the piston 2*a* and by connecting the other section with the cylinder 2 so that the props of one section may engage the mine roof *d* when the other section advances with the cylinder and that the props of the other section engage the roof when the one section advances with the piston 2*a*. Such constructions are well known in the art and we selected to show a support with simultaneously movable props solely for the purpose of properly illustrating the basic purpose of the support since the invention may be embodied in mine roof supports with relatively movable as well as with rigidly interconnected sections. As will be readily understood upon full perusal of this description, the invention which resides in a novel connection between the props, their sole plates and the connecting plate or plates may be embodied in all types of mine roof supports, i.e., in those mentioned hereinabove as well as in those wherein the leading props are movable with respect to the trailing props or vice versa.

As shown in FIGS. 2 to 4, the front portion of each sole plate 5 is bent upwardly so as to form a runner which reduces friction with the mine floor and enables the sole plate to advance on uneven terrain. The lower end portion of each prop 1 extends into a tubular guide means in the form of an elongated outer sleeve 6 which is provided with an external collar 7 releasably coupled to a raised portion or supporting platform 9*b* of the connecting plate 9 by a series of bolts 8. As shown in FIG. 3, each collar 7 may be formed with three elongated slots 7*a* two of which are disposed at the opposite sides of the respective prop and are perpendicular to the longitudinal direction of the conveyor 3, and the third of which is parallel with the longitudinal direction of the conveyor. The platforms 9*b* are provided at each of the four corners of the connecting plate 9, and each platform is formed with an open recess 9*c* which receives the respective sleeve 6 so that the collars 7 are located above the respective platforms. Such arrangement renders it possible to rapidly detach the sleeves from the connecting plate merely by removing the coupling bolts 8 from the slots 7*a* and by thereupon moving the leading props in forward direction or the trailing props in rearward direction. The bolts 8 may but need not be welded or otherwise rigidly connected with the respective platforms 9*b*, and are retained in their slots 7*a* by transversely extending wedges, by cotter pins 8*a* or the like. As clearly shown in FIG. 3, the provision of elongated slots 7*a* for the coupling bolts 8 enables the sleeves 6 to perform limited angular movements with respect to the platforms.

Each outer sleeve 6 slidably receives in its lower end portion an inner sleeve 6*a* which is removably secured to the lower end portion of the respective prop 1 by a projection in the form of a radial slide pin 14, the latter extending into a vertical guide slot 6*c* provided in the lower portion of the respective outer sleeve 6. The upper end por-

tion 6b of each outer sleeve 6 receives a bushing 6d which slidably guides the respective prop in vertical direction and in a manner best shown in FIG. 2.

The underside of each prop 1 is secured to a short cylindrical bearing member or cup 10 which is received in the lower portion of the respective inner sleeve 6a and whose underside defines a concave seat 11 for the semi-spherical head of a hollow complementary bearing member 12 which is secured to and extends above the upper side of the respective sole plate 5. It will be noted that each pair of bearing members 10, 12 forms a so-called universal ball and cup joint which enables the respective sole plate to pivot in all directions with respect to its prop or vice versa. However, in order to prevent the lower end portions of the props from being uncoupled and lifted away from their respective sole plates and in order to compel the sole plates to participate in vertical movements of the respective props, each cup 10 is provided with a downwardly extending concentric stud 13 which extends through a radial aperture 12a of the respective ball 12 and is provided at its lower end with a spherical boss 13a which is received in a complementary concave seat 12b provided in the underside of the respective ball 12. The boss 13a prevents upward movements of the respective prop 1 from its sole plate 5, and the diameter of the aperture 12a determines the extent to which the sole plate may be pivoted with respect to its prop.

It will be seen that each prop may perform the following movements with respect to its sole plate and with respect to the connecting plate 9: The outer sleeve 6, its flange 7 and the prop may perform angular movements with respect to the associated platform 9b to the extent determined by the length and configuration of slots 7a, and the prop is vertically reciprocably coupled to the connecting plate in that is movable in its bushing 6d and in its outer sleeve 6 to the extent determined by the length of the guide slot 6c. In addition, the sole plate may be tilted from a horizontal position and with respect to its prop to the extent determined by the difference in diameters of the stud 13 and aperture 12a. Thus, the ball and cup joints 10, 12 enable the sole plates to be universally displaced with respect to their props so that they may assume positions in which they are in maximum face-to-face contact with the mine floor c even if the latter is bumpy or is inclined with respect to a horizontal plane. Furthermore, such universal tiltability of the sole plates protects the props against excessive stresses since the props may remain in vertical or substantially vertical position even if their sole plates are inclined to assume positions best suited to properly support the props on uneven terrain.

As shown in FIG. 2, the tapped radial bores 1a in the props 1 which receive the respective slide pins 14 are of such length that the pins may be fully accommodated therein in the event that an operator desires to uncouple a prop from its outer sleeve 6. This is of considerable advantage because the pins 14 cannot be lost or misplaced even if the props are disconnected from their respective sections. The pins 14 determine the extent of vertical reciprocatory movements of the props in their outer sleeves 6 in that they abut against the upper or lower end walls of their guide slots 6c when the props reach their upper or lower end positions. In addition, the pins 14 prevent the props from turning with respect to the outer sleeves because the width of each guide slot 6c is preferably just sufficient to slidably guide the respective pin 14 in vertical direction. Since the sole plates participate in all vertical movements of the props, their movements between uppermost and lowermost positions with respect to the sleeves 6 and the connecting plate 9 are also determined by the length of the guide slots 6c.

The rear end portions of the sole plates associated with the leading props are bent upwardly so as to extend along annodated webs 9d which connect the respective platforms 9b with the main body portions 9e of the plate 9. This main body portion 9e is coplanar with the main body portions of the sole plates 5 when the mine roof support of our invention is erected on a smooth horizontal floor, i.e. the main body portion 9e preferably extends into contact with the mine floor c. As best shown in FIG. 2, the upwardly bent rear end portions of the leading (left-hand) sole plates 5 are articulately coupled with the front webs 9d of the connecting plate 9 by means of coupling bolts 15 which extend through substantially vertical elongated guide slots 9a provided in the respective webs 9d. As shown in broken lines in FIG. 2, the leading sole plates 5 may perform limited pivotal movements with respect to the connecting plate 9, and the extent of such pivotal movements is determined by the length of the slots 9a. It will be noted that the bolts 15 are at least slightly spaced from the lower end portions of the respective props so as to insure that the props may reciprocate in their guide means 6 and that the sole plates may be angularly displaced with respect to the connecting plate within a reasonable range.

The trailing sole plates 5 are coupled with the respective annodated rear webs 9b in similar fashion so that they may also pivot between the broken-line and full-line positions shown in FIG. 2. However, it will be noted that the rear end portions of the trailing sole plates 5 need not be bent upwardly since their upwardly bent front end portions may extend into close proximity of the respective webs 9d and are coupled thereto by bolts 15 which extend into substantially vertical guide slots 9a of the webs.

FIG. 4 shows the leading sole plates in mutually inclined position, i.e. these sole plates are pivoted about the respective studs 13 to or nearly to the extent determined by the diameters of the apertures 12a.

Since its main body portion 9e extends into the contact with the mine floor c, the connecting plate 9 may take up substantial stresses and contributes to better stability of the mine roof support. Of course, the single connecting plate 9 of FIGS. 1 to 4 may be replaced by a pair of connecting plates, i.e. one for each of the sections A and B. The plate 9 is preferably slightly resilient, e.g. it may consist of elastic steel, so that it can be slightly deformed in response to stresses transmitted by the mine roof d or by the mine floor c. However, this connecting plate should be rigid enough to maintain the props 1 in upright position when the caps 4a are separated from the mine roof and the support is advanced toward the mine face. In other words, the connecting plate should prevent the props from swinging back and forth beyond a certain limit during forward movement of the mine roof support, that is, it should be rigid enough to reduce such swinging movements of the props to a safe minimum in order to prevent accidents or damage to the mining apparatus.

It will be readily understood that, for convenience of transportation, the connecting plate 9 may consist of several parts which are releasably connected with each other, e.g. by bolts or the like, so that the individual parts may be separated during transportation into an underground excavation and that they may be rapidly assembled at the locale of actual use.

The improved mine roof support preferably comprises elastically deformable filler means, such as rings, blocks or otherwise configurated bodies of foam rubber or like readily compressible material, which are inserted between relatively movable components of the apparatus in order to prevent penetration of rocks, stones or other hard substances such as could impede movements of the component parts with respect to each other. For example, FIG. 2 shows in phantom lines a ring R of foam rubber between the upper side of the leading sole plate 5 and the underside of the adjacent platform 9b. This ring protects the ball and cup joint 10, 12 and to a certain extent also the connection (bolt 15) between the read end portion of the leading sole plate and the adjacent web 9d. Additional filler means may be provided

about the bolts 15, about the bolts 8 and at certain other more sensitive points of the apparatus.

Referring to FIGS. 5 and 6, there is shown a modified multi-prop mine roof support which differs from the apparatus of FIGS. 1 to 4 in the manner in which its sole plates 5' are joined to the connecting plate 9', in the manner in which the cylinder 2' is supported by and coupled to the connecting plate, and in the manner in which the props 1' are assembled with the connecting plate.

The connection between a trailing (right-hand) prop 1' and its sole plate 5' is shown in FIG. 5. The lower end portion of the prop is received in and is rigidly fixed to a single sleeve 6' by means of one or more pins 14'. The pins 14' actually extend into the cup 10' which is secured to the underside of the prop and which cooperates with a ball 12' and with a stud 13' in the same manner as described in connection with FIGS. 2–4. Thus, the boss 13*a*' of the stud 13' is received in the concave seat 12*b*' at the underside of the ball 12' to prevent separation of the sleeve 6' and prop 1' from the sole plate 5'. The sleeve 6' is vertically movable in a pair of spaced annular guides in the form of rings 7' which, in turn, are releasably fixed to a pair of vertically spaced horizontal platforms 9*b*' forming part of the connecting plate 9'. The connection between the rings 7' and the respective platforms 9*b*' comprises two or more bolts 8' and transversely extending cotter pins 8*a*'. The bolts 8' may but need not be rigidly secured to the platform 9*b*' and are received in elongated slots 7*a*' of the respective ring 7'. It is preferred to provide stiffening or reinforcing elements 7*b*' which connect the vertically aligned rings 7' with each other. The stiffening elements 7*b*' may form part of the connecting plate 9'. The connections between the leading props and their sole plates, as well as between the leading props and the connecting plate 9' are of identical construction. A pair of horizontal supporting platforms or raised portions 9*b*' is provided at each of the four corners of the connecting plate 9'.

The forked bracket 3*a*'of the conveyer 3' is provided with vertical slots 3*b*' for the coupling pins 2*b*' at the forward end of the piston 2*a*', the latter reciprocable in a hydraulic or pneumatic cylinder 2'. The slots 3*b*' enables the conveyer to move vertically with respect to the mine roof support of FIGS. 5 and 6, or vice versa.

The upwardly bent front end portions of the sole plates 5' are vertically reciprocably and tiltably coupled with the connecting plate 9' so that the main body portions of the sole plates may rise above or that they may descend below the level of the main body portion 9*e*' of the connecting plate. The latter comprises a front portion 9*f*' which extends forwardly between the leading props 1' and carries a traverse in the form of a reinforcing plate 20 which is disposed in a substantially vertical plane and is located between the leading props and the conveyer 3'. At its rear side and at both sides of the front portion 9*f*', the traverse 20 carries pairwise arranged apertured supporting brackets 21 for vertical bolts 22 whose lower end portions are loosely received in the apertures of brackets 23 secured to and extending upwardly from the front end portions of the leading sole plates 5'. The brackets 21 extend above the upwardly bent front portions of the respective leading sole plates and are located above the respective lower brackets 23. The movements of the leading sole plates with respect to the adjacent portions of the traverse 20 are limited by stop pins 22*a* which extend transversely through the bolts 22 at the underside of the brackets 23 and above the upper brackets 21 to releasably retain the bolts in the respective apertures. The diameters of the apertures in the brackets 23 are larger than the diameters of the bolts 22 and the diameters of apertures in the brackets 21 so that the leading sole plates may pivot with respect to the connecting plate 9' to the extent determined by the ball and cup joints 10', 12', 13'. The pins 22*a* may assume the form of cotters, wedges or the like.

The connection between the upwardly bent front end portions of the trailing sole plates 5' and the rear portion of the connecting plate 9' is of identical design excepting that each rear bolt 22 extends through a single bracket 21 of the connecting plate. As shown in FIG. 5, the rear portion of the connecting plate 9' is bent upwardly and this upwardly bent rear portion carries not only the brackets 21 but also the rear platform 9*b*'. An important advantage of the connection between the plate 9' and the sole plates 5' as shown in FIGS. 5 and 6 is that all sole plates are dragged rather than pushed when the fluid-operated cylinder 2' advances the mine roof support toward the mine face. In the embodiment of FIGS. 1–4, the leading sole plate 5 are pushed toward the mine face *a* when the cylinder 2 moves toward the conveyor 3 because of the rear end portions of the sole plates 5 are connected with the plate 9. This could sometimes lead to undesirable tilting or blocking of the sole plates.

The lower edge portion of the traverse 20 preferably extends into close proximity of or into actual engagement with the ground, i.e., with the mine floor (see FIG. 5), and may serve as a grader by pushing the rocks, chips, stones and like particulate matter out of the way of the sole plates 5' when the modified mine roof support is advanced toward the conveyor 3'. In other words, this transversely extending reinforcing means 20 may smooth out the path for the sole plates and for the connecting plate so that the advancing parts 5' and 9' of the mine roof support meet less resistance while advancing toward the mine face.

The front portion 9*f*' of the connecting plate 9' which extends between the leading props 1' and is connected with the traverse 20 may form part of a box-like receptacle 24 (see FIG. 6) which surrounds the front end portion of the cylinder 2'. The vertical side walls of the receptacle 24 are formed with vertical guide slots 26 for a transversely extending pivot member 25 which is secured to the cylinder 2' so that the latter's front end portion is free to perform limited vertical reciprocatory movements with respect to the connecting plate 9'. A similar box-like receptacle 24 is preferably formed by the rear portion of the plate 9' between the trailing props 1' to at least partially surround and to thereby protect the rear end portion of the cylinder 2'.

FIG. 6 shows that the major portions of the sole plates 5' are not overlapped by the connecting plate 9'. This is of considerable advantage because any rocks or other solid particulate matter accumulating on the sole plates cannot reduce their mobility with respect to the connecting plate.

The traverse 20 is provided with a cutout (not shown) for the bracket 3*a*' so that the traverse may be moved into actual abutment with the rear side wall of the conveyor 3' when the cylinder 2' is caused to move toward the mine face. Thus, in the event that the mine roof support of FIGS. 5 and 6 assumes an inclined position with respect to the conveyor 3', the traverse 20 automatically returns the connecting plate of the support to requisite position in which the plane common to the axes of the leading and the respective trailing props 1' is perpendicular to the longitudinal direction of the conveyor. In other word, the traverse 20 may serve as a means for automatically adjusting the position of the connecting plate and of the mine roof support with respect to the conveyor 3'.

It will be noted that the construction of the mine roof support shown in FIGS. 5 and 6 is such that its component parts may be rapidly and conveniently separated from each other for the purpose of transportation to another locale of actual use and that they may be rapidly assembled in another underground excavation. All that is necessary is to remove the pins 22*a* and the bolts 22, to remove the coupling bolt 2*b*', to remove the cotters

8a' and to withdraw the bolts 8' from their slots 7a'. The props 1' may remain connected with the sleeves 6' and with the respective sole plates 5' and such assemblies of the parts 1', 5', 6' may be conveniently coupled to the plate 9' merely by introducing the sleeves 6' into the rings 7' and by turning the rings so that their slots 7a' may receive the respective bolts 8'. The rings 7' are preferably separable from the sleeves 6' and are secured to the platforms 9b' solely by the bolts 8' and cotters 8a'.

A very important advantage of articulate connections between the lower portions of the props 1 or 1' and the plates 5, 9 or 5', 9' is that they need not utilize any elastic materials such as rubber, deformable elastic plastic substances and the like. For example, British Patent 786,331 discloses bushes of rubber-like material which surround the lower end portions of the props so that the props are swingable in all directions with respect to the floor bars. The useful life of such bushes is extremely short when they are put to use in underground excavations so that all rubber like parts must be replaced at frequent intervals which results in higher maintenance cost and frequent idleness of the mine roof support. In addition, the restoring force of such rubber bushes is rather negligible when the props are swung only slightly from vertical position since such restoring force increases proportionally with increasing inclination of the props. Thus, when the props are disengaged from the mine roof, they are free to swing within a comparatively large area in response to minimal shocks which may be dangerous to workmen or may impede the forward movement of the support.

The mine roof support of our invention fully avoids such drawbacks of conventional supports by restorting to novel universal connections for the sole plates which need not utilize shortlived resilient bushes or the like and by providing such connections between the props and the connecting plate which always maintain the props in substantially vertical position even though the sole plates are free to assume such positions of inclination (if necessary) that they are subjected to minimal deforming stresses and always remain in substantial face-to-face contact with the mine floor.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic and specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be protected by Letters Patent is:

1. In a multi-prop mine roof support, in combination, at least two props each having a lower portion and an upper portion reciprocable relative to said lower portion to support said roof; a ground contacting sole plate for each prop; means for articulately coupling the ground contacting sole plates with the lower portions of the respective props; a ground contacting connecting plate arranged between the lower portions of adjacent props; and coupling means at both ends of said ground contacting connecting plate slidably engaging said lower portions of said adjacent props for sliding movement relative thereto.

2. In a multi-prop mine roof support, in combination, at least two props each having a lower portion and an upper portion reciprocable relative to said lower portion to support said roof; a ground contacting sole plate for each prop; means for articulately coupling the ground contacting sole plates with the lower portions of the respective props; a ground contacting connecting plate of at least slightly resilient elastic material arranged between the lower portions of adjacent props; coupling means at both ends of said ground contacting connecting plate slidably engaging said lower portions of said adjacent props for sliding movement relative thereto; and means for articulately coupling said sole plates to said connecting plate.

3. In a multi-prop mine roof support, in combination, at least two props each having a lower portion; and an upper portion telescopically movable relative to said lower portion to support said roof; a ground contacting sole plate for each prop; means for articulately coupling the ground contacting sole plates with the lower portions of the respective props; a ground contacting connecting plate extending between said ground contacting sole plates; and substantially vertical sleeve like guide means for said lower portion of each of said props, said guide means secured to said connecting plate and slidably receiving the respective lower portions of said props so that said lower portions of said props with said sole plates thereon are freely vertically displaceable with respect to the connecting plate.

4. In a multi-prop mine roof support, in combination, at least two props each having a lower portion; and an upper portion telescopically movable relative to said lower portion to support said roof; a ground contacting sole plate for each prop; ball and cup joints for articulately coupling the ground contacting sole plates to the lower portions of the respective props; a ground contacting connecting plate extending between said ground contacting sole plates; and means for coupling said lower portions of said props to said connecting plate, said coupling means comprising an inner sleeve disposed about and secured to the lower portion of each prop and an outer sleeve for each prop, said outer sleeves secured to said connecting plate and slidably receiving the inner sleeves of the respective props in a manner such that said lower portion of each prop having the respective ground contacting sole plate attached thereto is substantially vertically displaceable relative to said ground contacting connecting plate.

5. A combination as set forth in claim 3, including connecting means for releasably coupling said outer sleeves to said connecting plate.

6. A combination as set forth in claim 3, including connecting means for releasably connecting said guide means with said lower portions of the respective props so that said lower portions of the props have limited freedom of vertical movement in said guide means.

7. In a multi-prop mine roof support, in combination, at least two props each having a lower portion and an upper portion telescopically movable relative to said lower portion to support said roof, a ground contacting sole plate for each prop; means for articulately coupling said ground contacting sole plates with the lower portions of the respective props; a ground contacting connecting plate arranged between the lower portions of adjacent props and having a ground contacting body portion and a pair of raised portions extending above said sole plates; and coupling means at both ends of said ground contacting connecting plates slidably engaging said lower portions of said adjacent props for sliding movement relative thereto.

8. A combination as set forth in claim 9, wherein said connecting plate includes webs disposed between said body portion and said raised portions; additional coupling means being provided for articulately coupling said sole plates to the respective webs of said connecting plate.

9. A combination as set forth in claim 8, wherein said additional coupling means are at least slightly spaced from the lower portions of the respective props.

10. An apparatus as set forth in claim 1, further comprising readily deformable elastic filler means inserted between the relatively movable components of said mine roof support to prevent penetration of foreign matter.

11. A combination as set forth in claim 2, wherein at least the major portions of said sole plate extend beyond the confines of said connecting plate so that the latter overlies the remaining portions of said sole plates only.

12. In a multi-prop mine roof support, in combination, at least two props each having a lower portion and an

upper portion telescopically movable relative to said lower portion to support said roof; a ground contacting sole plate for each prop; means for articulately coupling said ground contacting sole plates with the lower portions of the respective props; a ground contacting connecting plate extending between said sole plates; means for articulately coupling said sole plates with said connecting plate; and means for coupling said lower portions of said props with said connecting plate, said last mentioned coupling means comprising at least one substantially vertically extending annular guide means for said lower portion of each prop, said guide means slidably receiving said lower portions of the respective props and secured to said connecting plate, whereby said lower portion of each prop having its ground contacting sole plate attached thereto is substantially vertically displaceable relative to said ground contacting connecting plate.

13. A combination as set forth in claim **12**, wherein at least one of said guide means comprises a plurality of vertically spaced concentric rings and means for releasably coupling said rings with said connecting plate.

14. In a mining apparatus for supporting the roof of an underground excavation and for advancing the material conveying means toward the mine face, in combination, a pair of leading props each having a lower portion and an upper portion telescopically movble relative to said lower portion to support said roof; a ground contacting sole plate for each of said props, each of said plates having an upwardly bent front portion; coupling means connected to each of the ground contacting sole plates and to the lower portion of the respective prop and articulately coupling the same to each other; a ground contacting connecting plate having a front portion extending between said props, and transverse reinforcing means carried by said last mentioned front portion and positioned to extend intermediate said props and the mine face; coupling means connecting the lower portion of each prop to said connecting plate for free substantially vertical movement between said lower portion together with the respective sole plate and said connecting plate; and additional coupling means connected to coupling the front portions of said sole plates and to said transverse reinforcing means articulately coupling the same.

15. A combination as set forth in claim **14**, further comprising a pair of trailing props each having a lower portion and an upper portion telescopically movable relative to said lower portion to support said roof and each aligned with one of said leading props; a pair of trailing ground contacting sole plates, one for each of said trailing props and each having an upwardly bent front portions; coupling means connected to each of the ground contacting trailing sole plates and to the lower portion of the respective trailing prop articulately coupling the same to each other; coupling means connecting the lower portion of each trailing prop to said connecting plate for free substantially vertical movement between said lower portion together with the respective sole plate and said connecting plate; coupling means connecting the front portions of said trailing sole plates with said connecting plates articulately coupling the same to each other; and means for advancing said connecting plate toward the mine face and for thereby dragging the sole plates in the same direction.

16. In a mining apparatus for supporting the roof of an underground excavation and for advancing the material conveying means toward the mine face, in combination, a pair of leading props each having a lower portion and an upper portion telescopically movable relative to said lower portion to support said roof; a ground contacting sole plate for each of said props, each of said plates having an upwardly bent front portion; coupling means connected to each of the ground contacting sole plates and to the lower portion of the respective prop and articulately coupling the same to each other; a ground contacting connecting plate having a front portion extending between said props and a substantially vertical plate like traverse positioned to extend intermediate said props and the mine face, said traverse having a lower edge portion extending at least into close proximity of the ground; coupling means connecting the lower portion of each prop to said connecting plate for free substantially vertical movement between said lower portion together with the respective sole plate and said connecting plate; means connected to the front portions of said sole plates and to said traverse and articulately coupling said front portion to said traverse; and means for advancing the connecting plate, the sole plates and the props toward the mine face so that the traverse clears the path for said sole plates.

17. In a mining apparatus for supporting the roof of an underground excavation and for advancing the material conveying means toward the mine face, in combination, a pair of leading props each having a lower portion and an upper portion telescopically movable relative to said lower portion to support said roof; a ground contacting sole plate for each of said props, each of said plates having an upwardly bent front portion; coupling means connected to each of the ground contacting sole plates and to the lower portion of the respective prop and articulately coupling the same to each other; a ground contacting connecting plate having a front portion extending between said props, and a substantially plate like traverse positioned to extend intermediate said props and the mine face; coupling means connecting the lower portion of each prop to said connecting plate for free substantially vertical movement between said lower portion together with the respective sole plate and said connecting plate; means connected to the front portions of said sole plates and to said traverse and articulately coupling said front portion to said traverse; conveyer means adapted to be disposed intermediate the mine face and said traverse; and means for advancing said connecting plate toward the mine face and for thereby shifting said conveyer means toward the mine face, the arrangement of said advancing means being such that said traverse is movable into abutment with said conveyer means to adjust the position of said connecting plate with respect to the conveyer means.

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