Oct. 21, 1958 J. A. W. MILLS ET AL 2,857,125

MINE ROOF SUPPORTS

Filed Feb. 24, 1954 4 Sheets-Sheet 1

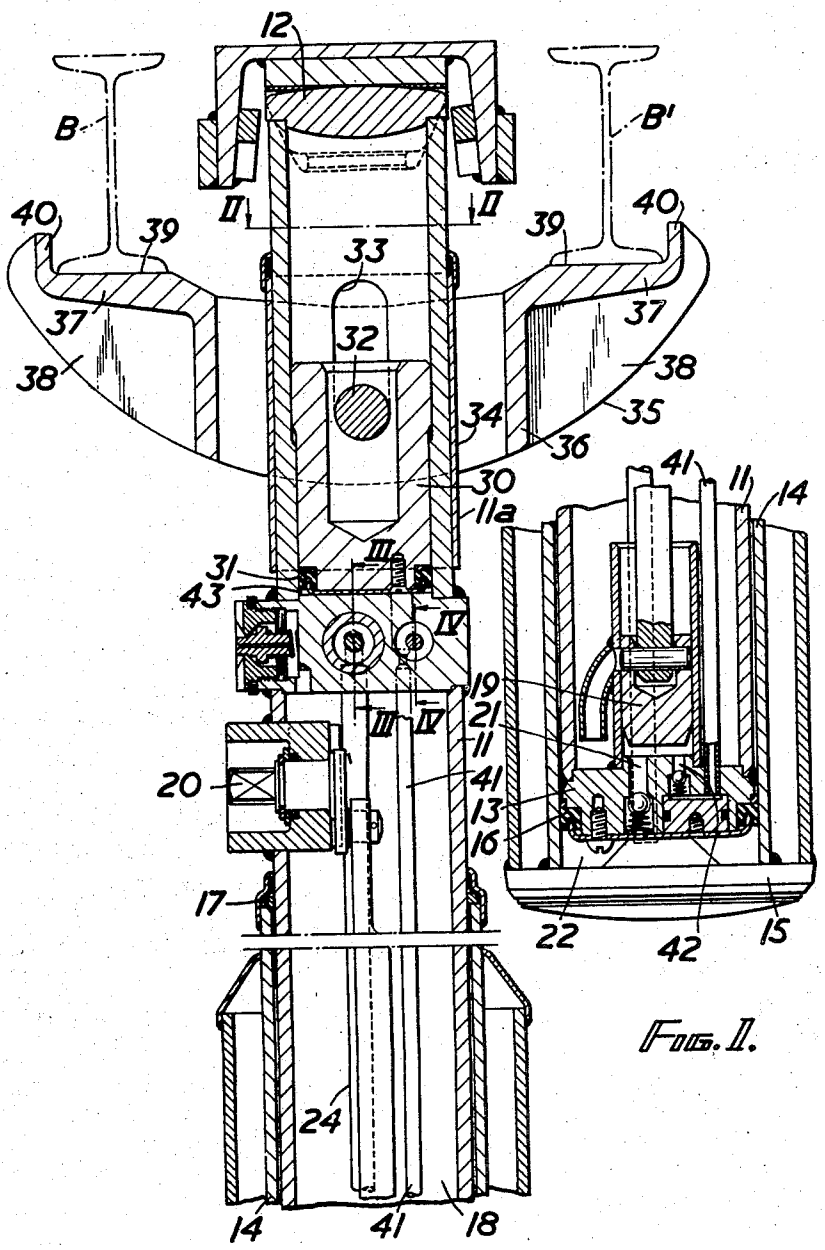

FIG. I.

INVENTORS
Joseph A. W. Mills
Hugh L. Holt
BY Reynolds, Beach & Christensen
ATTORNEYS

Oct. 21, 1958 J. A. W. MILLS ET AL 2,857,125

MINE ROOF SUPPORTS

Filed Feb. 24, 1954 4 Sheets-Sheet 2

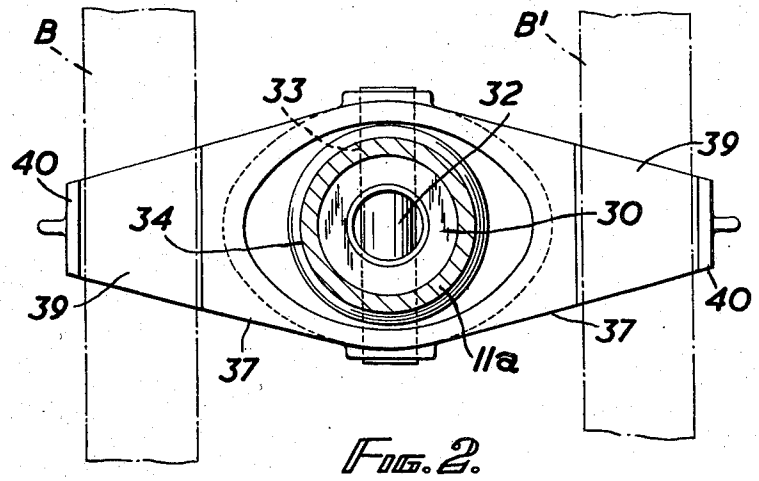

FIG. 2.

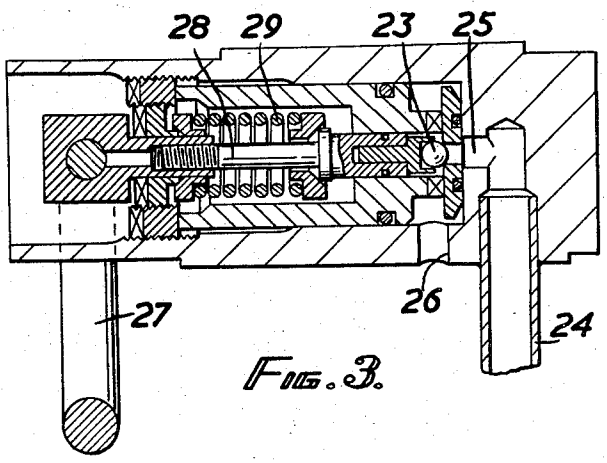

FIG. 3.

INVENTORS
Joseph A. W. Mills
Hugh L. Holt
BY Reynolds, Beach & Christensen
ATTORNEYS

Oct. 21, 1958 J. A. W. MILLS ET AL 2,857,125

MINE ROOF SUPPORTS

Filed Feb. 24, 1954 4 Sheets-Sheet 3

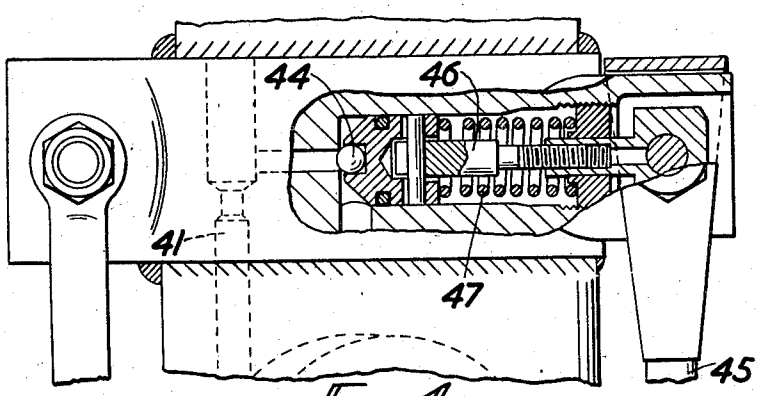

FIG. 4.

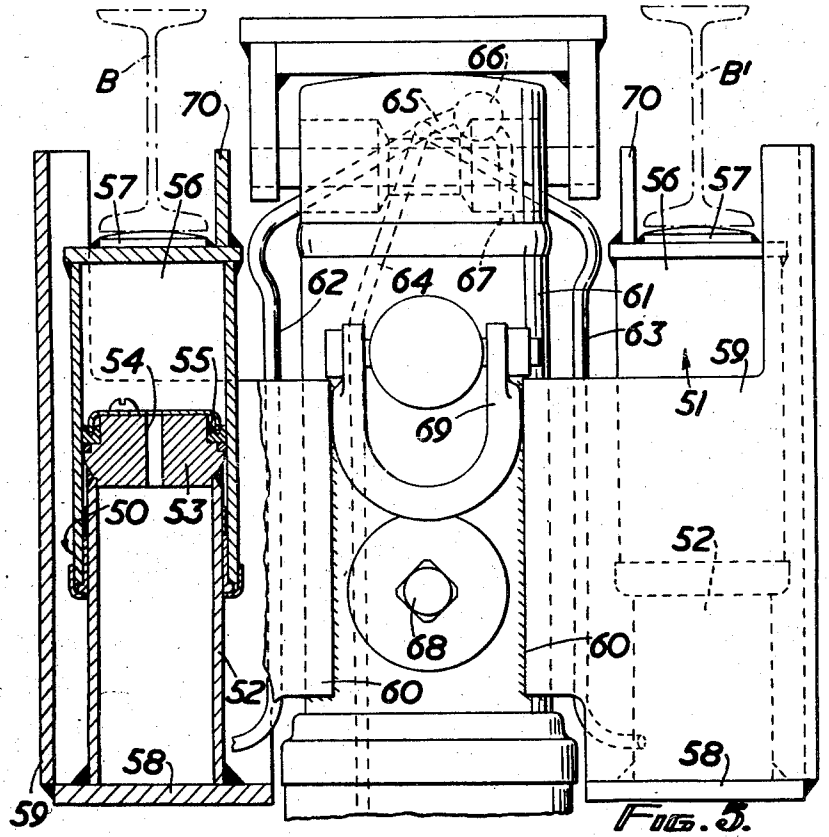

FIG. 5.

INVENTORS
Joseph A. W. Mills
Hugh L. Holt
BY Reynolds, Bard & Christensen
ATTORNEYS

Oct. 21, 1958 J. A. W. MILLS ET AL 2,857,125

MINE ROOF SUPPORTS

Filed Feb. 24, 1954 4 Sheets-Sheet 4

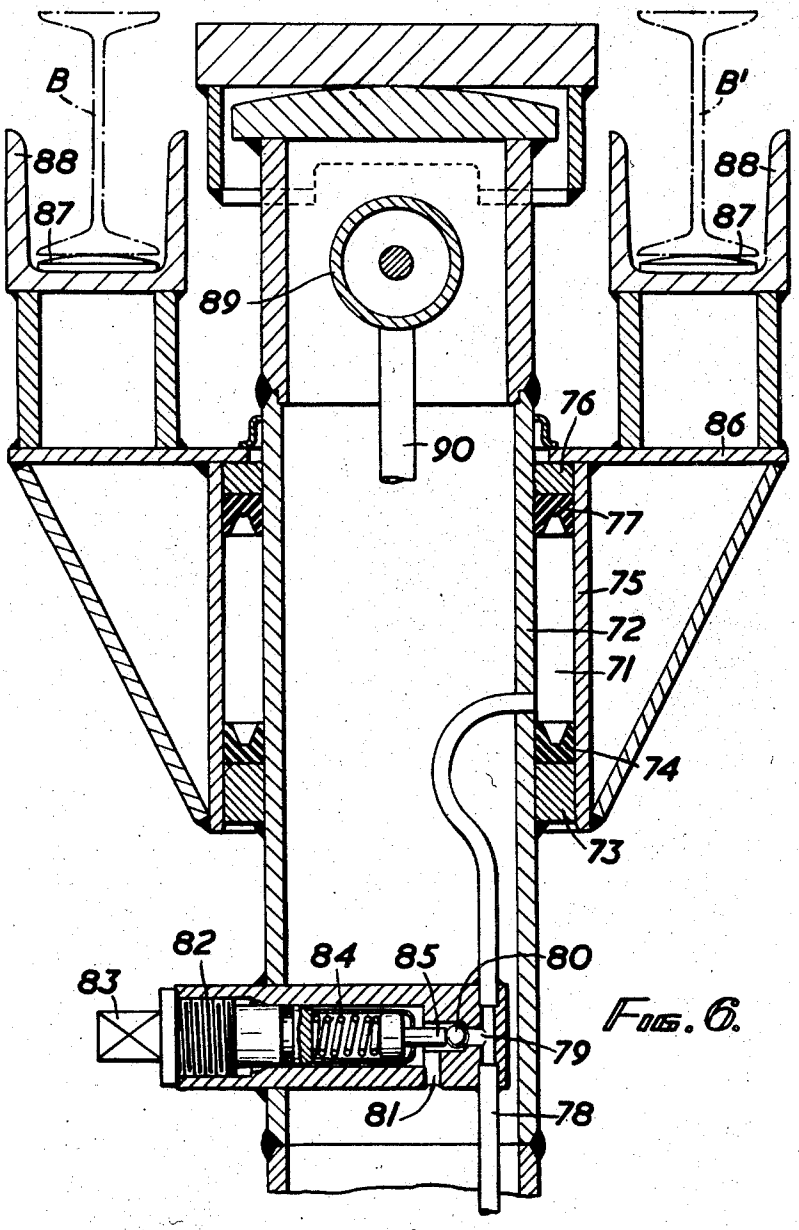

FIG. 6.

INVENTORS
Joseph A. W. Mills
Hugh L. Holt
BY Reynolds, Beard & Christensen
ATTORNEYS

United States Patent Office

2,857,125

Patented Oct. 21, 1958

2,857,125

MINE ROOF SUPPORTS

Joseph A. W. Mills, Leckhampton, and Hugh L. Holt, Bredon, near Tewkesbury, England, assignors to Dowty Hydraulic Units Limited

Application February 24, 1954, Serial No. 412,303

Claims priority, application Great Britain February 25, 1953

8 Claims. (Cl. 248—354)

There is in present use a system of mine roof support in which a number of rows of hydraulic or other pit props are arranged transversely of the working face, and in which for each row there is provided a roof bar which extends over the tops of the props and projects from the forward end of the row as a cantilever to support that part of the roof above the conveyor which runs along the working face. Each prop is provided with a head-piece which engages the top of the prop and straddles the roof bar to have direct engagement with the roof at each side of the bar. The bar is loaded into engagement with the roof by wedge members driven between the roof bar and the parts of the prop head-pieces directly below it. When the working face of the mine has receded, the wedges of the props are released row by row, to permit the roof bars to be moved forwardly beneath the part of the roof which has freshly been exposed. The wedges are replaced with the bars in their advanced positions. During the time the bars are released for forward movement, the props still support the roof by direct engagement through the sides of their head-pieces. After each bar has been advanced and the wedges re-set, the rearmost prop of each row is released and erected at the front, so that the row of props is thereby advanced. The head-pieces which straddle the roof bars form guides for the bars during their forward movements.

A modification of this system has been proposed in which rigid metal props of variable length are provided each with a head-piece adapted to be wedged between an undersurface thereof and the upper end of the prop so as to be loaded against the mine roof, said head-piece having lateral arms for extending beneath two roof bars disposed one at either side of the prop, which bars are loaded by wedges driven between them and the projecting arms. The bars can thus be freed without freeing the upper end of the prop so that they can be advanced as in the above described system relating to a single, centrally-disposed, bar.

The present invention has for an object to provide improved props for use in a roof-supporting system of the general type referred to and in which two roof bars are employed with a single row of props, and according to this invention, a telescopic prop of the hydraulically-actuated kind comprising a reservoir, a pressure chamber, pump means for transferring liquid under pressure from the reservoir into the chamber, and relief valve means in a return communication between the pressure chamber and reservoir, is provided with hydraulic thrust means adapted to engage and load a pair of roof bars disposed one at either side of the upper end of the prop, said hydraulic thrust means comprising a pressure chamber adapted to receive pressure liquid from the pump associated with the main pressure chamber of the prop, and to relieve into the prop reservoir independently of said main pressure chamber.

The pressure chamber of the hydraulic thrust means may be in two parts constituted by two hydraulic jack devices for association with the two roof bars respectively. Alternatively, a single pressure chamber which may be annular and surround the upper part of the prop, or which may be cylindrical and formed inside the upper part of the prop, may be arranged to load the two roof bars through a mechanical connection comprising two arms or equivalent members which are movable with the movable casing part of the pressure chamber.

The relief valve means associated with the main pressure chamber of the prop serves in known manner to limit chamber pressure automatically under increasing roof loading during use of the prop, and enables the pressure to be relieved at will under manual control. The relief valve means associated with the pressure chamber of the hydraulic thrust means will likewise serve to limit the pressure in the chamber automatically, and to relieve the pressure in the chamber under manual control.

Some hydraulic pit props embodying the invention will now be described with reference to the accompanying drawings, of which:

Figure 1 is a sectional side elevation of an arrangement wherein the pressure chamber of the hydraulic thrust means is cylindrical and situated inside the prop;

Figure 2 is a sectional view as seen on the line II—II in Figure 1;

Figure 3 is a sectional view taken on the line III—III in Figure 1 and showing the relief valve means associated with the main pressure chamber of the prop;

Figure 4 is a sectional view taken on the line IV—IV in Figure 1, and showing the relief valve means associated with the pressure chamber of the hydraulic thrust means;

Figure 5 is a side elevation partly in section showing the upper end of a prop embodying a modified arrangement wherein the pressure chamber of the hydraulic thrust means is constituted by two hydraulic jack devices, and

Figure 6 is a sectional side elevation showing the upper end of a prop embodying a further modified arrangement wherein the pressure chamber of the hydraulic thrust means is formed as a single annular chamber surrounding the prop.

Referring to Figures 1 to 4, the hydraulic prop comprises an upper tubular part indicated at **11** which has a head-piece **12** at its upper end and which is closed by a disc **13** at its lower end, and a lower tubular part **14** which is closed at its lower end by a foot piece **15** and which is sealed with respect to the upper part **11** by a high pressure sealing gland **16** carried by the disc **13**. The upper end of the tubular part **14** has a low pressure seal **17** engaging the outer surface of the tubular part **11** and serving to prevent dust and other foreign matter from passing down between the tubular parts **11** and **14**. The space inside the upper tubular part **11** forms a reservoir **18** for hydraulic liquid and accommodates a pump **19** the piston of which is adapted to be reciprocated from a rock shaft **20** to which a handle can be attached. The pump **19** withdraws liquid from the reservoir **18** and delivers through an outlet passage **21** into the main pressure chamber **22** of the prop. As liquid is pumped into the chamber **22**, the upper tubular part **11** of the prop is raised until the top of the prop engages the mine roof and the requisite setting pressure has been created in the pressure chamber **22**. When the prop is in use, the tendency for the mine roof to sag increases the load on the prop and raises the pressure in the chamber **22**. When this pressure reaches a predetermined maximum value, a relief valve **23** blows to open a return communication extending between the said pressure chamber and the reservoir **18**. For this purpose there extends upwardly from the lower end of

the disc 13 a conduit 24 which opens at its lower end into the pressure chamber 22 and which opens at its upper end into a bore 25 which is normally closed by the relief valve 23 but which, when the relief valve blows, communicates through a side port 26 with the reservoir 18. The relief valve 23 can also be withdrawn from its seating when release of pressure in the chamber 22 is desired, as when the prop is to be withdrawn from service or shifted to a new position of support. There is therefore provided a loop 27 situated externally of the prop and which is connected with a stem 28 against a shoulder on which bears the relief valve spring 29. When the loop is given an outward pull, usually by means of a cord or cable attached thereto, the force exerted by the spring 29 against the valve 23 is freed from the valve to permit the latter to unseat to relieve the pressure in the prop.

In accordance with the present invention, the upper end of the tubular part 11 embodies hydraulic thrust means adapted to engage a pair of roof bars disposed one at either side of the prop and indicated at B and B' in Figures 1 and 2. For this purpose, there is provided above the upper end of the reservoir 18 a tubular extension 11*a* forming part of the upper tubular part 11 of the prop. The inner cylindrical surface at the lower end of the tubular extension 11*a* forms the working cylindrical surface for a piston 30 which is sealed to the said surface by a sealing gland 31 secured to the piston. The piston 30 carries a cross pin 32 which extends out at opposite sides of the prop through vertically extending slots 33 formed in the tubular extension 11*a*, and the ends of which determine the limits of movement of the piston. The pin 32 also extends through closely fitting holes in a thin sleeve 34 surrounding and slidably fitting the tubular extension 11*a*. This sleeve 34 serves at all times to cover the otherwise exposed portions of the slots 33 and thus prevents dirt and other foreign matter from passing in through the slots 33. The outer ends of the pin 32 are in pivotal connection with a roof-bar-engaging member 35 which comprises an oval-shaped tubular portion 36 and a pair of oppositely extending arms 37 which are suitably strengthened by webs 38. The arms 37 present upper surfaces 39 for engagement with the underside of the roof bars B and B', and have upstanding end portions 40 which act as outward guides for said bars.

The space 43 inside the tubular extension 11*a* and situated below the piston 30 communicates with the outlet of the pump 19 through a tube 41. Thus when the pump 19 is operated, it not only delivers through the passage 21 into the main pressure chamber 22 of the prop but also delivers through a passage 42 and through the tube 41 into the pressure chamber 43, the top of which is constituted by the lower surface of the piston 30. The piston 30 and with it the pin 32, sleeve 34 and roof-bar-engaging member 35 thus move up when the pump is operated. This upward movement continues until the arms 37 press the roof bars B and B' against the mine roof and the requisite setting pressure is created in the pressure chamber 43. As with the main pressure chamber 22 of the prop, the maximum pressure in the chamber 43 is determined by a relief valve 44 controlling a return communication extending between the tube 41 and the reservoir 18. Also, the valve 44 can be permitted to unseat by an outward and upward pull on a hand lever 45 which, by its connection with a stem 46, frees the valve from the effect of its spring 47. The ability of the roof-bar-engaging member 35 to pivot on the pin 32 ensures an equal distribution of the loads on the roof bars B and B'.

A single hand pump therefore serves to supply pressure liquid into the main pressure chamber 22 to extend the prop into supporting engagement with the mine roof, and also serves to supply pressure liquid into the chamber 43 to give the necessary loading to the roof bars B and B'. The pressures in the two chambers are not interdependent, and either chamber can be relieved and released independently of the other.

Referring now to the modified arrangement shown in Figure 5, the pressure chamber of the hydraulic thrust means is formed in two parts constituted by two similar hydraulic jack devices 50 and 51. Each such device comprises a fixed lower cylindrical part 52 which carries at its upper end a piston 53 having a central opening 54. The piston 53 has a high pressure sealing gland 55 which seals the fixed cylindrical part 52 with respect to a movable upper cylindrical part 56 which is closed at its upper end by a head-piece 57 adapted to engage the undersurface of the corresponding roof bar. The fixed cylindrical parts 52 of the jacks 50 and 51 are mounted on platforms 58 secured at the lower ends of U-shaped casings 59 which are welded along edges 60 to the upper tubular part 61 of the prop. The pressure chambers within the jacks 50 and 51 communicate through conduits 62 and 63 respectively with the upper end of a conduit 64 which leads down to the outlet of the pump of the prop. The conduit 64 is thus the equivalent of the tube 41 of Figure 1. The conduits 62, 63 and 64 also communicate along a short conduit 65 with one side of a relief and release valve 66, the other side of which communicates through a conduit 67 with the reservoir of the prop. The valve 66 may function automatically as a relief valve to limit pressure in the jacks, and may be releasable under manual control to relieve pressure in the jacks when desired. The pump-actuating shaft is indicated at 68, and the manual control over the relief valve of the main pressure chamber of the prop is indicated at 69. The roof bars B and B' are loosely guided during advancement thereof between a part of the corresponding casing 59 and an upstanding rib 70 on the head-piece 57 of the corresponding jack.

In Figure 6, the roof bars B and B' are adapted to be loaded by hydraulic thrust means comprising a single pressure chamber 71 which is annular and surrounds the upper tube 72 of the prop. The inner boundary of the pressure chamber 71 is thus formed by the tube 72, and the lower boundary by a flange 73 on said tube. Above the flange 73 there is mounted a high pressure sealing gland 74. The outer boundary of the pressure chamber 71 is formed by a tube 75, and the upper boundary by a flange 76 on the tube 75. Below the flange 76 there is provided a further high pressure sealing gland 77. The tube 75, flange 76, and sealing gland 77 are slidable up and down on the tube 72. Pressure liquid is fed into the chamber 71 through a conduit 78 extending from the outlet of the pump of the prop. The tube 78 has a branch 79 leading to a valve 80 which controls communication between the branch 79 and a side port 81 communicating with the reservoir of the prop. The valve 80 operates automatically as a relief valve to limit the pressure in the chamber 71, and a manual control is provided whereby the pressure in the chamber 71 can be relieved at will. The manual control comprises a screw plug 82 which can be turned through a squared boss 83 to withdraw the spring 84 and plunger 85 away from the valve 80. A platform structure 86 of adequate strength is rigid with the tube 75 of the pressure chamber 71 and carries head-pieces 87 for engagement with the undersurfaces of the roof bars B and B'. Short lengths of channel section metal 88 form loose guides for the bars during advancing movements of the latter. In Figure 6, the relief and release valve assembly of the main pressure chamber of the prop is indicated generally at 89, said valve communicating with said main pressure chamber through a pipe line 90.

In each of the examples illustrated, the upper end of the prop which has direct engagement with the roof carries a short bar member capable of rocking movement relative to the prop. This distributes the load evenly over a suitable roof area.

We claim:

1. A hydraulic pit prop for use in mines, comprising inner and outer tubes closed at their outer ends and ar-

ranged in overlapping slidable sealing relationship, the outer end of the inner tube being adapted for direct engagement with the mine roof, a transverse wall in the inner tube, said wall enclosing a space in the inner tube forming a liquid reservoir and, in conjunction with the outer tube, defining a main pressure chamber of variable volume, a pump mounted in the inner tube and arranged for transferring liquid from the reservoir into the main pressure chamber, first valve means interposed between the pressure chamber and the reservoir, said first valve means being operative, automatically, to relieve and, manually, to release pressure of the liquid in the main pressure chamber, auxiliary hydraulic jack means consisting of two relatively movable parts together forming an auxiliary pressure chamber, separate from the main pressure chamber, one of said parts being fixed to the outer end portion of the inner tube and the other of said parts being movable axially of the prop, two thrust arms mounted upon and extending to opposite sides of said other movable part, adapted to engage a pair of roof bars disposed one at either side of the outer closed end of the inner tube, a liquid passageway extending from the delivery side of said pump to the auxiliary pressure chamber, and second valve means interposed between the auxiliary pressure chamber and said reservoir, said second valve means being operative independently of the first valve means manually to release pressure of the liquid in the auxiliary pressure chamber.

2. A hydraulic pit prop for use in mines, comprising inner and outer tubes closed at their outer ends and arranged in overlapping slidable sealing relationship, the outer end of the inner tube being adapted for direct engagement with the mine roof, a transverse wall in the inner tube, said wall enclosing a space in the inner tube forming a liquid reservoir and, in conjunction with the outer tube, defining a main pressure chamber of variable volume, a pump mounted in the inner tube and arranged for transferring liquid from the reservoir into the pressure chamber, first valve means interposed between the pressure chamber and the reservoir, said first valve means being operative, automatically, to relieve and, manually, to release pressure of the liquid in the main pressure chamber, auxiliary hydraulic jack means consisting of a cylinder formed by the outer end portion of the inner tube, a piston slidably fitting said cylinder and a transverse partition in the inner tube separating the jack cylinder from the liquid reservoir, a pin mounted transversely in said piston and projecting at opposite ends through longitudinally elongated slots formed in the inner tube, a roof-bar-engaging member disposed around the inner tube and mounted upon the opposite ends of the pin, said roof-bar-engaging member having laterally extending portions adapted to engage a pair of roof bars disposed one at either side of the outer closed end of the inner tube, a liquid passageway extending from the delivery side of said pump to the jack cylinder, and second valve means interposed between the jack cylinder and said reservoir, said second valve means being operative, automatically, to limit and, manually, to release pressure of the liquid in the jack cylinder.

3. A pit prop as in claim 2, wherein the laterally extending portions of the roof-bar-engaging member are disposed transversely of the axis of the pin, and said member is disposed around the inner tube with clearance to allow the member to rock about the axis of the pin for equalizing the loads on the roof bars.

4. A hydraulic pit prop for use in mines, comprising inner and outer tubes closed at their outer ends and arranged in overlapping slidable sealing relationship, the outer end of the inner tube being adapted for direct engagement with the mine roof, a transverse wall in the inner tube, said wall enclosing a space in the inner tube forming a liquid reservoir and, in conjunction with the outer tube, defining a main pressure chamber of variable volume, a pump mounted in the inner tube and arranged

for transferring liquid from the reservoir into the pressure chamber, first valve means interposed between the pressure chamber and the reservoir, said first valve means being operative, automatically, to relieve and, manually, to release pressure of the liquid in the main pressure chamber, two auxiliary hydraulic jacks secured one at each side to the inner tube at the outer end portion thereof and parallel thereto, the jacks being adapted to engage a pair of roof bars disposed one at either side of the outer closed end of the inner tube, a liquid passageway extending from the delivery side of said pump to the cylinder of each hydraulic jack, and second valve means interposed in common between said jack cylinders and the liquid reservoir, said second valve means being operative to release pressure of the liquid in the jack cylinder.

5. A hydraulic pit prop for use in mines, comprising inner and outer tubes closed at their outer ends and arranged in overlapping slidable sealing relationship, the outer end of the inner tube being adapted for direct engagement with the mine roof, a transverse wall in the inner tube, said wall enclosing a space in the inner tube forming a liquid reservoir and, in conjunction with the outer tube, defining a main pressure chamber of variable volume, a pump mounted in the inner tube and arranged for transferring liquid from the reservoir into the pressure chamber, first valve means interposed between the pressure chamber and the reservoir, said first valve means being operative, automatically, to relieve and, manually, to release pressure of the liquid in the main pressure chamber, an annular auxiliary jack surrounding the inner tube at the outer end portion of the latter, said jack consisting of two relatively movable parts together forming an auxiliary pressure chamber, one of said parts being secured to said inner tube, and the other of said parts being movable axially of the prop, thrust means connectively associated with said other movable part, said thrust means being offset to opposite sides of the inner tube and adapted to engage a pair of roof bars disposed one at either side of the outer closed end of the inner tube, a liquid passageway extending from the delivery side of said pump to the auxiliary pressure chamber, and second valve means interposed between the auxiliary pressure chamber and said reservoir, said second valve means being operative to release pressure of the liquid in the auxiliary pressure chamber.

6. A hydraulic pit prop of the character described, comprising a floor-engaging tubular member and a roof-engaging tubular member cooperating to define a vertically extensible mine roof support and an internal pressure chamber, and each formed at its outer end to provide a broad bearing area, the interior of one of said tubular members defining a hydraulic reservoir, pump means located within the mine roof support defined by said tubular members, and operatively interposed between said reservoir and said pressure chamber for delivering fluid from the reservoir under pressure into said pressure chamber to force said roof-engaging tubular member upwardly into supporting engagement with the roof, by reaction directly from said floor-engaging tubular member, a second roof-engaging member straddling said first-mentioned roof-engaging member and formed with two supporting arms at the respectively opposite sides of the latter, hydraulic piston and cylinder means carried the one by said roof-engaging tubular member and the other operatively connected to said two-armed roof-engaging member, to press the latter upwardly by reaction from the roof-engaging tubular member, conduit means connecting said pump with said piston and cylinder means for supply of hydraulic fluid under pressure to the latter from said reservoir, two separate valve means each connected for discharge of fluid to said reservoir, one being connected to said pressure chamber and operable for permitting lowering of the roof-engaging members conjointly, and the other being connected to said piston and cylinder means and operable for per-

mitting lowering of the two-armed roof-engaging member alone, and independent control devices for operating the respective valve means at will independently of each other.

7. A hydraulic pit prop for use in mines, comprising inner and outer tubes arranged in overlapping slidable sealing relationship, one of said tubes being adapted for direct engagement with the mine roof, said inner tube having longitudinally spaced transverse partition means enclosing a space in the inner tube forming a liquid reservoir, said outer tube having transverse partition means defining in conjunction with the inner tube a main pressure chamber of a volume variable by relative axial movement between the tubes, first valve means interposed between the pressure chamber and the reservoir, said first valve means being operative automatically to relieve and manually to release pressure of the liquid in the main pressure chamber, pump means mounted in the inner tube and arranged for transferring liquid from the reservoir into said main pressure chamber, auxiliary hydraulic jack means consisting of two relatively movable parts together forming an auxiliary pressure chamber separate from said main pressure chamber, one of said parts being mounted on that tube which is adapted to engage the mine roof, beyond the overlap of the other tube, and the other of said parts being movable parallel to the axis of the prop, two thrust means mounted on and extending transversely to opposite sides of said other movable part, adapted to engage a pair of roof bars disposed one at either side of the roof-engaging tube, a liquid passageway extending from the delivery side of said pump means to the auxiliary pressure chamber, and a connection and second valve means interposed in said connection, between the auxiliary pressure chamber and said reservoir, said second valve means being operative manually, independent of the first valve means, to release pressure of the liquid in the auxiliary pressure chamber while pressure is maintained in said main pressure chamber.

8. A hydraulic pit prop for use in mines, comprising inner and outer tubes arranged in overlapping slidable sealing relationship, one of said tubes being adapted for direct engagement with the mine roof, said inner and outer tubes having partition means defining a main pressure chamber of a volume variable by relative axial movement between the tubes, means forming a liquid reservoir, first valve means interposed between the pressure chamber and the reservoir, said first valve means being operative automatically to relieve and manually to release pressure of the liquid in the main pressure chamber, pump means arranged for transferring liquid from the reservoir into said main pressure chamber, auxiliary hydraulic jack means consisting of two relatively movable parts together forming an auxiliary pressure chamber separate from said main pressure chamber, one of said parts being mounted on that tube which is adapted to engage the mine roof, beyond the overlap of the other tube, and the other of said parts being movable parallel to the axis of the prop, two thrust means mounted on and extending transversely to opposite sides of said other movable part, adapted to engage a pair of roof bars disposed one at either side of the roof-engaging tube, a liquid passageway extending from the delivery side of said pump means to the auxiliary pressure chamber, and a connection and second valve means interposed in said connection, between the auxiliary pressure chamber and said reservoir, said second valve means being operative manually, independent of the first valve means, to release pressure of the liquid in the auxiliary pressure chamber while pressure is maintained in said main pressure chamber.

References Cited in the file of this patent

UNITED STATES PATENTS

2,641,906	Knights et al.	June 16, 1953

FOREIGN PATENTS

289,904	Germany	Jan. 25, 1916
636,568	Great Britain	May 3, 1950
1,009,955	France	Mar. 12, 1952