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TELESCOPIC HYDRAULIC PROPS

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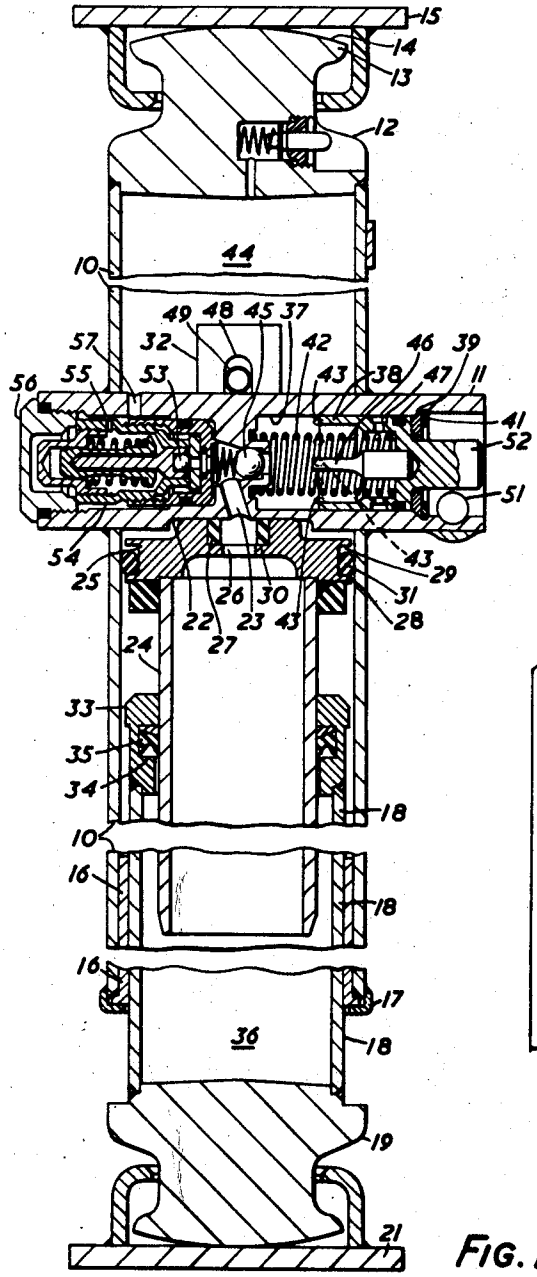


FIG. 1.

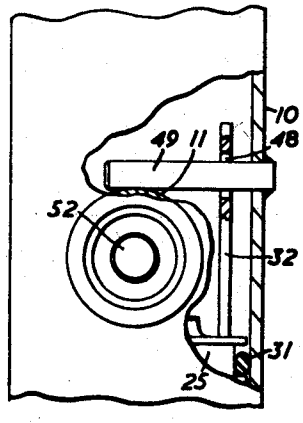


FIG. 2.

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TELESCOPIC HYDRAULIC PROPS

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This invention relates to hydraulic props of the kind having telescopic components together defining a variable volume chamber into which liquid is introduced during extension of the prop to enable the prop when extended to support an applied compression load. After such initial extension the prop may be set in load-supporting engagement by supplying liquid under pressure, for example by means of a pump, to the variable volume chamber, or the prop may be set by the use of wedges.

It is an advantage to be able to extend a prop rapidly to the point at which it can be set in load-supporting engagement, and for this purpose it is known to connect the variable volume chamber with a source of liquid supply through a valve which is opened while the prop is extended by manually lifting the upper component. In some prop constructions having a self-contained pump, the flow of liquid into the pressure chamber during manual extension of the prop may take place through the inlet and delivery valves of the pump. Extension of the prop will be resisted by the pressure drop across such valves. In other prop constructions the flow of liquid into the pressure chamber may take place through a pressure release valve provided between the variable volume chamber and a low pressure liquid supply. The release valve has to be operated during manual extension of the prop and this too may offer resistance to rapid extension.

The upper components of props may be heavy to lift particularly in the case of tall props for use in high coal seams, and it is desirable to reduce other causes of resistance to lifting, and resultant extension of the prop, to a minimum.

According to the present invention, a hydraulic prop comprises two telescopic components of which one is formed in two parts, one of the parts defining in part at least a reservoir for hydraulic liquid and the other of said parts together with the telescopic component defining a variable volume pressure chamber, wherein the two parts are relatively movable in the longitudinal direction of the prop and include valve means interposed directly between the reservoir and the pressure chamber for opening and closing movement upon opposite directions of relative movement of the two parts of the one component, the telescopic components being arranged to effect valve-opening movement of the two parts under manual extension of the prop whereby liquid flows directly and freely from the reservoir to the pressure chamber, and being arranged under a contraction load applied to the prop to effect valve-closing movement of the two parts whereby the pressure chamber is sealed from the reservoir, and can be supplied from the reservoir only by way of a pump means.

As a consequence of forming one of the telescopic components in two separate parts, one of said parts and the other telescopic component may be telescopically connected by a bearing which forms the main slide bearing of the prop, while the other part may be transversely adjustable within the said one part whereby it is subject only to longitudinal compression when the prop is in use. If therefore the prop is subject to a compression load which is offset from the central axis of the prop, the resulting bending moment is sustained by the main slide bearing

and is not transmitted to the other part of the divided telescopic component.

One construction of hydraulic prop in accordance with the invention is illustrated in the accompanying drawings, of which:

FIGURE 1 is a longitudinal section and FIGURE 2 is a detail view from the right hand side of FIGURE 1, broken away to show interior parts.

The prop, which in the form shown is intended particularly for use in high seams, comprises telescopic components of which that one which is uppermost in use is formed in part by an outer guide cylinder **10** with a cylindrical valve housing **11** fixed transversely in a position intermediate the ends of the cylinder **10**. The part of the guide cylinder **10** around and above the housing comprises a reservoir **44** containing hydraulic liquid with an air space above it enclosed by a head **12**. The head **12** has a flanged portion **13** and a upper domed surface **14** on which a roof-engaging cap **15** captively retained by the flange **13** can rock. The lower portion of the guide cylinder **10** has a slide bearing **16** inserted therein and retained by a flange ring **17**. The slide bearing **16** is substantially greater in length than its diameter to provide bearing support for a hydraulic cylinder **18**, slidably mounted therein. The lower end of the cylinder **18** is closed by a base **19** of similar form to the head **12** and is also provided with a floor-engaging cap **21**. The valve housing **11** has a flat seating face **22** on its lower side with a central valve port **23** therein. The other part of the uppermost telescopic component is formed as a hollow piston **24**. This hollow piston **24**, open at its lower end to a pressure chamber **36**, is closed at its upper end by a head **25** except as this head has a central opening **26** therein in register with valve port **23**. The piston head **25** has a substantially flat upper surface abutting the flat surface **22** of the valve housing, while a resilient packing ring **27** mounted in a recess **30** in the upper surface of the head **25** projects slightly above the head **25** to be capable of providing sealing engagement against the flat surface **22** in spite of slight angular misalignment of the guide cylinder **10** and the hollow piston **24** from a common axis. The packing ring **27** is of considerably smaller diameter than the piston **24**. The piston head **25** has outwardly projecting flanges such as **28**, having clearance within the bore of the guide cylinder **10**, defining a groove or recess **29** for a resilient O-ring **31** which seals compressively against the bore of the guide cylinder **10** to provide the lower limit of the reservoir **44**. The recess **29** is elongated axially to permit some degree of axial movement of the hollow piston **24** with rolling movement of the O-ring **31**. It may be observed that the prop is formed of two telescopic components, of which the first is the guide cylinder **18**, and the second is formed in two parts, **10** and **24**. The two parts **10** and **24** of the second component are interconnected, by a lost-motion connection that is about to be described, for limited movement of one part, **10**, relative to the other part, **24**, and then for conjoint movement in the direction longitudinally of the prop of the two parts conjointly relative to the first component **18**.

The lost-motion connection, in the form shown, includes a metal strip **32** secured at its lower end to the piston head **25**, and extending upwardly between the guide cylinder **10** and the valve housing **11**, see FIGURE 2. The upper portion of the strip **32** has a longitudinally elongated slot **48** therein through which a pin **49** extends with clearance from one side of the guide cylinder **10** and over the valve housing **11**. The pin **49** is inserted through the hole in the guide cylinder **10** and through the slot **48** after assembly of the piston **24** within the cylinder **10**, and the pin **49** is then secured in the cylinder **10** by

welding. The pin 49 and slot 48 form a lost-motion connection which permits limited axial movement between the piston head 25 and the valve housing 11. The upper end portion of the hydraulic cylinder 18 has a bearing ring 33 fixed thereto by welding. The bearing ring 33 slidably engages the outer surface of the hollow piston 24 and it has an internal recess 34 housing a sealing packing 35 which engages the hollow piston 24, whereby the piston 24 and hydraulic cylinder 18 together define the pressure chamber 36 of the prop. The sealing packing 35 has a frictional resistance against the piston 24 which exceeds the rolling resistance of the O-ring 31 between the piston head 25 and the guide cylinder 10. The axial length of the bearing surface of the ring 33 is small in relation to its diameter.

The valve housing 11 has a bore 37 from one end thereof in which a pump piston 38 slides, this piston being outwardly retained by a stop ring 39 and a circlip 41. When the piston is at its outermost end the restoring force of a spring 42, seated against the end of the bore 37, uncovers a pump inlet port 43 formed by a circular row of holes in the housing through which liquid in the reservoir 44 can enter the pump chamber. A spring-loaded pump outlet valve 45, forming an inlet valve to the pressure chamber 36, is interposed in the pump delivery passage 23.

The piston 38 carries a central stem 46 which in the innermost position of the piston 38 can unseat the valve 45 to permit escape of hydraulic liquid from the pressure chamber 36. The pump is not normally operated over its full stroke when extending the prop, but it can be depressed to the full extent when it is desired to release the prop. Escape of liquid takes place through ports 47 in the wall of the piston 38 when these ports are in register with the pump inlet port 43, in the innermost position of the piston. If the pump piston 38 is depressed slowly, the liquid trapped between the piston 38 and the outlet valve 45 can leak through the working clearance between the piston 38 and the bore 37 and through the inlet port holes 43 to the reservoir 44, without developing the full pressure of the chamber 36. Alternatively, the pump may include the known device of a spring-loaded check valve between the reservoir and pump bore 37 which closes under a pre-determined pressure generated by the pump piston 38. Operation of the pump is performed by a hand lever, not shown, which can be attached to a cross pin 51 offset from the axis of the housing 11 and having a lever arm to engage an externally projecting head 52 of the pump piston.

The port 23 also leads to a spring-loaded relief valve 53 enclosed in a capsule 54 which is inserted in a bore 55 at the opposite end of the housing 11, the capsule being retained therein by a screw plug 56. The discharge side of the relief valve is in communication with a port 57 in the housing 11 which opens into the reservoir 44.

When it is desired to extend the prop into engagement between the roof and floor of a mine this can be performed rapidly by extending the hydraulic cylinder 18 from the guide cylinder 10 for example by placing a foot against the floor-engaging cap 21 and lifting the guide cylinder 10. The guide cylinder 10 at this time exerts through the O-ring an upward drag on the piston head 25 and piston 24 which is resisted by friction of the sealing packing 35 carried by the cylinder 18. Since the friction of the sealing packing 35 is greater than the rolling resistance of the O-ring 31, the guide cylinder 10 will rise with respect to the piston 24 to the extent permitted by the lost-motion connection provided by the loose fit of the slotted strip 32 on the pin 49. The piston head 25 with its packing ring 27 and the flat seating surface constitute a valve which by-passes the pump outlet valve 45 and which is opened in consequence of lifting the guide cylinder 10 from the hydraulic cylinder 18 as described.

When the pin 49 engages the upper end of the slot 48, continued lifting of the guide cylinder 10 pulls the piston 24 out of the hydraulic cylinder 18 by means of the lost-motion connection, and opens port 26 directly to reservoir 44. So long as this by-pass valve is open hydraulic liquid from the reservoir 44 enters the pressure chamber 36 through the opening 26. If it were not for this by-pass valve, liquid would be compelled to enter the pressure chamber through the smaller opening of the valve 45 against the closing load of the spring acting thereon.

To set the prop against the mine roof, closure of the piston head 25 and packing ring 27 against the flat surface 22 is necessary to isolate the pressure chamber 36 from the reservoir 44. The weight of the guide cylinder 10 is normally sufficient for this purpose as the friction of the sealing packing 35, being greater than the rolling resistance of the O-ring 31, supports the piston 24 until the valve housing 11 moves downwardly against the piston head 25. Operation of the pump piston 38 will then transfer liquid under pressure from reservoir 44 into the pressure chamber 36, and since the area of the piston is greater than that of the packing ring 27 the pressure acting thereon will maintain the piston head 25 in sealing engagement with the flat surface 22 during upward movement of the piston 24.

When the prop is set under load any bending forces are sustained by the bearing at 16 between the guide cylinder 10 and the hydraulic cylinder 18. The piston head 25 is transversely adjustable on the seating face 22 and the piston 24 can tilt in the bearing 33 within the limits permitted by the bore of the guide cylinder without seizure of the sliding surfaces. The hydraulic piston 24 and cylinder 18 therefore only sustain an axial load between the valve housing 11 and the base 19.

To release liquid pressure from the pressure chamber 36, the pump piston is depressed fully so that the stem 46 unseats the pump outlet valve 45. Liquid from the pressure chamber 36 then escapes through the opening 26, valve port 23, past the valve 45, and through the registering ports 47 and 43 into the reservoir 44.

We claim as our invention:

1. A hydraulic prop comprising an outer cylinder closed at its upper end, a hydraulic cylinder closed at its lower end and extending slidably into the outer cylinder, a piston mounted in slidable sealing engagement with the hydraulic cylinder to enclose therewith a pressure chamber, the upper portion of the piston extending above the hydraulic cylinder having a sealing ring mounted therein to engage the bore of the outer cylinder and seal the lower end of a reservoir for liquid in the upper part of the outer cylinder, an apertured valve element in the upper part of the piston including passage means extending through the piston to afford liquid communication between the reservoir and the pressure chamber, a valve seating fixed in the outer cylinder at the lower end of the reservoir in position to enter into co-operative engagement with said apertured valve element whereby to seal the pressure chamber from the reservoir, and a lost-motion connection between said outer cylinder and said piston providing limits of relative axial movement within which said seating and apertured valve element are relatively movable into and out of sealing engagement.

2. A hydraulic prop according to claim 1, including a housing which is fixed in the outer cylinder, said valve seating being formed on said housing, and said housing including a pump having an inlet port extending through the housing from the reservoir, and a pump delivery passage extending through the housing to an opening at said valve seating in axial register with the apertured valve element.

3. A hydraulic prop according to claim 1, wherein said valve seating is formed with a seating face which is transverse to the longitudinal axis of the prop, and which extends radially beyond the apertured valve element to provide sealing engagement in spite of transverse displace-

ment of the upper end of said piston with respect to the seating face.

4. A hydraulic prop comprising a first telescopic component, a two-part second telescopic component slidably connected to the first telescopic component, one part of said second telescopic component being mounted in slidable sealing engagement with the first telescopic component to define therewith a variable volume pressure chamber and the other part of said second telescopic component constituting in part at least a reservoir for hydraulic liquid, normally closed valve means interposed between the reservoir and the variable volume pressure chamber, said valve means being provided by co-operable valve elements which are arranged on the two parts of the second telescopic component so as to close one against the other upon relative approach movement of said two parts and to separate one from the other upon relative separation movement of said two parts in the longitudinal direction of the prop, and a lost-motion connection between the two parts of the second telescopic component, said lost-motion connection being arranged to be operative upon pulling said other part of the second telescopic component away from the first telescopic component, first to afford separation movement of the two parts of the second telescopic component, thereby opening said valve means, and then movement of said two parts together during which said valve means affords flow of liquid from the reservoir to the pressure chamber, and said lost-motion connection also being operative upon pushing said other part of the second telescopic component towards the first telescopic component to afford relative approach movement of said two parts, into the normal valve-closed position.

5. A hydraulic prop comprising a first telescopic component, a two-part second telescopic component slidably connected to the first telescopic component, one part of said telescopic component being mounted in slidable engagement with the first telescopic component to define therewith a variable volume pressure chamber and the other part of said second telescopic component constituting in part at least a reservoir for hydraulic liquid, valve means interposed between the reservoir and the variable volume pressure chamber, said valve means being provide by co-operable valve elements which are arranged on the two parts of the second telescopic component so as to close one against the other upon relative approach movement of said two parts and to separate one from the other upon relative movement of said two parts in the longitudinal direction of the prop, a lost-motion connection between the two parts of the second telescopic component, sealing means interposed between said one part of the second telescopic component and the first telescopic component, said sealing means providing frictional resistance to relative movement of said one part and the first telescopic component, said lost-motion connection being arranged to be operative upon pulling said other part of the second telescopic component away from the first telescopic component, first to afford separation movement of said other part from said one part which, under the frictional resistance of said sealing means, tends to be retained in fixed position in the first telescopic component, which separation movement opens said valve means, and then to effect movement of said two parts together

after the frictional resistance of said sealing means has been overcome, during which latter movement said valve means affords flow of liquid from the reservoir to the pressure chamber, and said lost-motion connection also being arranged to be operative upon pushing said other part of the second telescopic component towards the first telescopic component to afford approach movement of said other part towards said one part which, under the frictional resistance of said sealing means, tends to be retained in fixed position in the first telescopic component, and by such approach movement closing said valve means.

6. A hydraulic prop according to claim 5, in which the first telescopic component is formed as a cylinder member within which said one part of the second telescopic component is slidable and exteriorly of which said other part is slidable, and in which the co-operable valve elements on said two parts are shaped to enter into sealing engagement in a mating plane transverse to the longitudinal axis of the prop, one of said valve elements comprising a sealing face of a size to afford sealing engagement with the other of said valve elements in spite of transverse misalignment of said valve elements.

7. A hydraulic prop comprising a first telescopic component, a second telescopic component slidably connected to the first telescopic component, said second telescopic component including two parts, of which a first part constitutes in part at least a reservoir for hydraulic liquid, and of which the second part is slidably connected to said first telescopic component to enclose therewith a variable volume pressure chamber, sealing means co-operating between the elements which enclose the pressure chamber, and tending to join said elements frictionally as the first part is moved relatively to the second part in the longitudinal direction of the prop, passage means for connecting said reservoir directly with the variable volume pressure chamber, normally closed valve means controlling said passage means and including cooperable valve elements connected to the respective parts of said second telescopic component for valve-opening movement upon prop-extension movement of said first part with respect to said second part and to the first telescopic component, as the second part and the first telescopic component are held together frictionally by said sealing means, and for valve-closing movement upon prop-contraction movement of said first part with respect to said second part and to the first telescopic component, and means to overcome the frictional resistance of said sealing means after limited movement of the two parts of the second telescopic component.

8. A hydraulic prop as in claim 7, including a sealing ring of lesser frictional effect than said sealing means, and cooperating between the two parts of the second telescopic component to define the lower limit of the liquid reservoir.

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