July 26, 1955 D. G. SUTTON 2,713,773

HYDRAULIC PIT PROP OR JACK

Filed Sept. 20, 1954 2 Sheets-Sheet 1

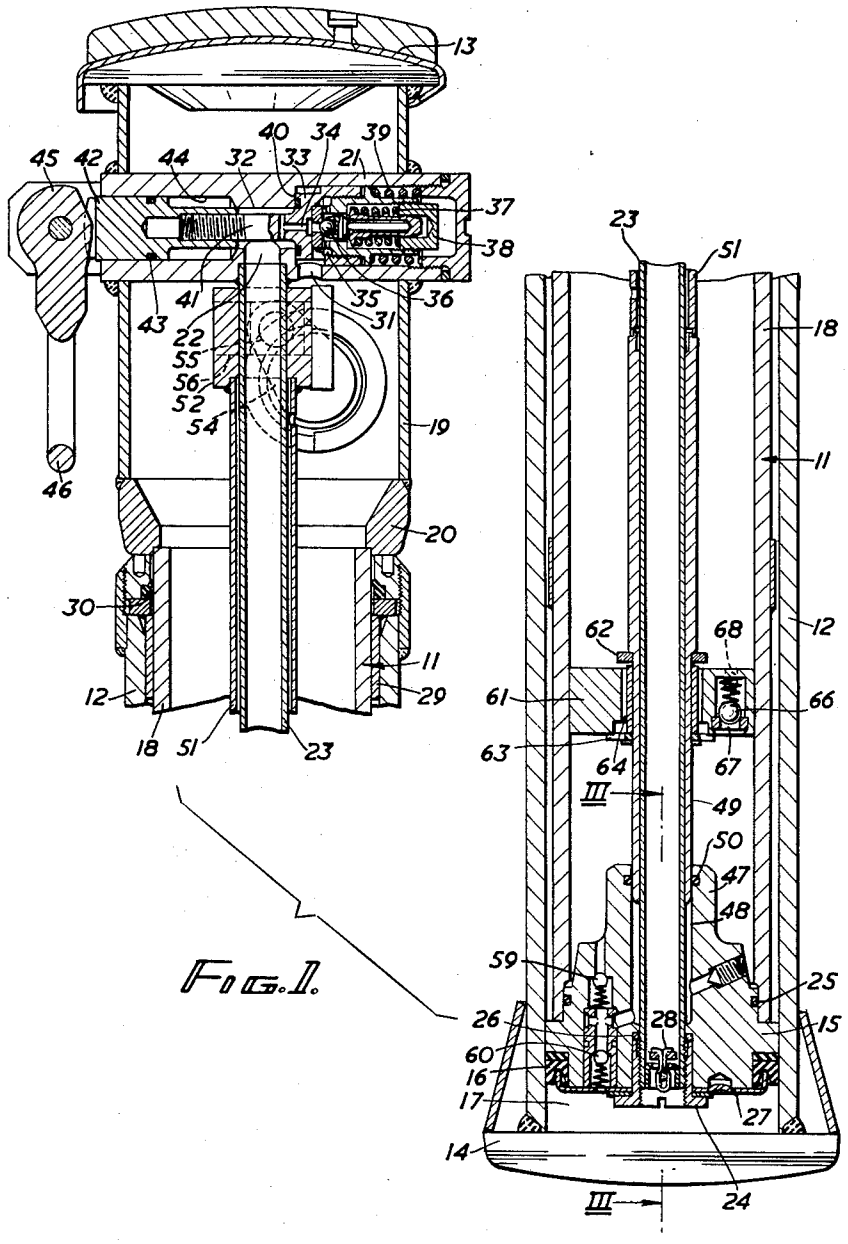

FIG. 1.

INVENTOR
DUDLEY G. SUTTON

BY Reynolds, Beach & Christensen
ATTORNEYS

July 26, 1955 D. G. SUTTON 2,713,773

HYDRAULIC PIT PROP OR JACK

Filed Sept. 20, 1954 2 Sheets-Sheet 2

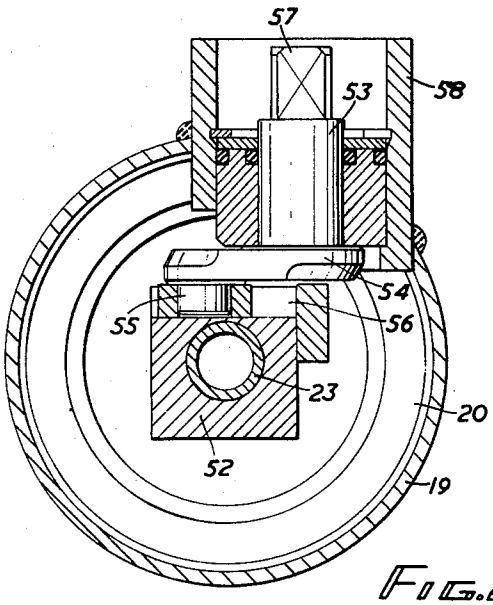

FIG. 2.

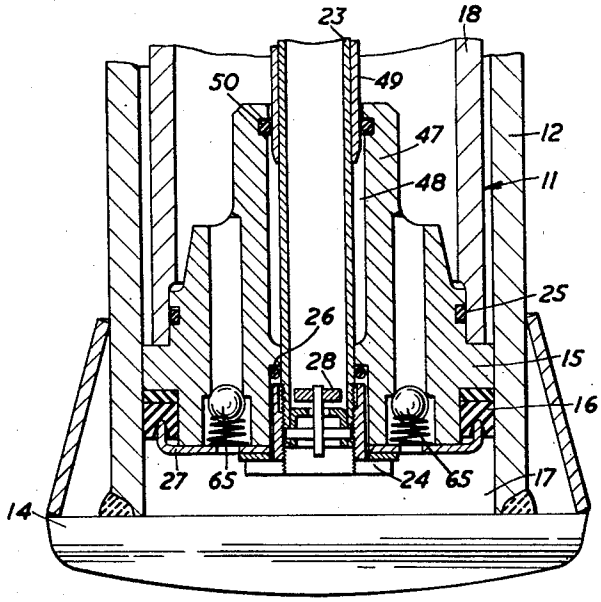

FIG. 3.

INVENTOR
DUDLEY G. SUTTON

BY Reynolds, Brooks & Christensen
ATTORNEYS

United States Patent Office 2,713,773 Patented July 26, 1955

2,713,773

HYDRAULIC PIT PROP OR JACK

Dudley G. Sutton, Cheltenham, England, assignor to Dowty Auto Units Limited, Cheltenham, England

Application September 20, 1954, Serial No. 457,097

Claims priority, application Great Britain September 24, 1953

4 Claims. (Cl. 60—52)

This invention relates to hydraulic jacks of a special type and for use in mine pits, termed pit props, in which a hollow cylindrical ram, intended to be upright when the prop is in use, constitutes a reservoir for hydraulic liquid and is slidable telescopically with respect to an external cylinder so that extension of the prop can be effected by operation of a pump situated in the ram to cause liquid to pass from the reservoir into the pressure chamber formed by the cylinder space beyond the inner end of the ram, and contraction of the prop can be effected when desired under the control of an externally operable release valve in a return communication between the pressure chamber and the reservoir. The invention, moreover, relates to hydraulic pit props in which the release valve is situated adjacent the outer end of the ram and communicates with the cylinder space along a conduit which extends down from the valve and through the inner end of the ram, as disclosed in U. S. A. patent specification No. 2,621,631. Such pit props are hereinafter referred to as hydraulic pit props of the kind hereinbefore specified.

The object of the present invention is to provide an improved construction of hydraulic pit prop of the kind hereinbefore specified, and to this end and in accordance with the invention, the conduit which extends between the cylinder space beyond the inner end of the ram and the release valve situated adjacent the outer end of the ram is disposed co-axially of the tube of the ram, and the pump comprises large and small area pistons arranged concentrically between the valve conduit and the ram tube, and means for rendering said large area piston ineffective upon the attainment of a predetermined pressure in the cylinder space.

The valve conduit preferably forms a guide stem for a tube which fits at its inner end into a cylinder upstanding from the closure member at the inner end of the ram and which constitutes the small area piston of the pump. The large area piston of the pump is preferably in sliding engagement with the inner surface of the tube of the ram and has clearance around the tube of the small area piston and operates between shoulders on said tube. Both pistons are preferably reciprocable by a tubular driving member extending around the valve conduit to a slide block at the upper end of said conduit, said slide block being in pin-and-slot driving connection with a rotary crank arm.

A hydraulic pit prop in accordance with the preferred embodiment of the invention will now be described with reference to the accompanying drawings, of which:

Figure 1 shows the prop in longitudinal sectional elevation;

Figure 2 is a transverse sectional view of a detail of Figure 1; and

Figure 3 is a fragmentary sectional view taken on the line III—III of Figure 1.

The pit prop comprises two main parts, namely an upper part or ram indicated generally at **11**, and a lower

part or cylinder **12** into which the ram **11** telescopes in sealed relation with the cylinder **12**. The ram **11** is closed at its upper end by a head piece **13** for engagement with the mine roof, and the cylinder **12** is closed at its lower end by a foot piece **14** for engagement with the floor of the mine. The ram **11** has an end closure member **15** which operates as a piston in the cylinder **12** and which carries a sealing gland **16** around its periphery. The ram **11** constitutes a reservoir for hydraulic liquid and incorporates a pump, to be described, by which liquid can be transferred from the reservoir into the cylinder space **17** beyond the inner end of the ram to bring about extension of the prop. When the prop is to be withdrawn from service, contraction of the prop is brought about by the opening of a release valve in a return communication between the cylinder space **17** and reservoir, also to be described.

The ram **11** comprises a tubular part **18** and a tubular part **19** of larger diameter than the tubular part **18**, and an annular shoulder **20** joining the two parts **18** and **19** together in co-axial relationship. The enlarged size of the tubular part **19** gives a useful added volumetric capacity to the reservoir space in the ram **11**.

A valve housing **21** extends transversely through the ram **11** adjacent the upper end of the tubular part **19** to which said housing is permanently secured. The housing **21** has a radial port **22** disposed centrally of the ram and communicating with the cylinder space **17** beyond the inner end of the ram by a tube **23** which is secured at its upper end to the housing **21** and which extends through the end closure member **15** of the ram **11**. The tube **23** is co-axial with respect to the tubular parts **18** and **19**. The closure member **15** is secured at the inner end of the ram **11** by a nut **24** screwed on to the end of the tube **23**, and has sealing rings **25** and **26** by which it is sealed to the tubular part **18** and tube **23** respectively. The nut **24** also serves to retain a flanged end plate **27** which holds the sealing gland **16** on the closure member **15**. A non-return valve **28** is provided in the inner end of the tube **23** and operates to prevent flow from said tube into the cylinder space **17**. The tubular part **18** of the ram **11** is a sliding fit in a bearing bush **29** secured in the upper end of the cylinder **12**. Above the bearing bush **29**, the cylinder **12** is fitted with a wiper ring **30** for preventing dust and moisture from passing down around the ram **11**.

The valve housing **21** also has a radial port **31** opening into the reservoir space in the ram **11**, and communication between the housing ports **22** and **31** is by way of a central passage **32** in said housing under the control of a release valve **33**, or by way of said passage **32** and additional passages **34** and **35** under the control of a relief valve **36**. The relief valve **36** is loaded by a spring **37** in a casing **38** to determine the blow-off pressure of the valve and thus to limit the pressure which can be built up in the cylinder space **17**. The release valve **33** constituted by the casing **38** is loaded by a spring **39** which normally holds the release valve **33** in sealed engagement with the step **40** in the valve housing **21**. The casing **38** housing the relief valve **36** and constituting the release valve **33** has a central threaded extension **41** screwed into a plunger member **42** which is sealed at **43** with respect to a bore **44** in the housing **21**. The plunger member **42** is adapted to be engaged by a manually operable external cam member **45** fast with a loop **46**. When the loop is swung out and up from the position shown in Figure 1, the cam **45** engages the plunger member **42** to displace the release valve **33** and establish communication between the ports **22** and **31** of the valve housing. This will place the cylinder space **17** in communication with the reservoir regardless of the pressure prevailing in said cylinder space. The spring

39 need not be particularly strong and need not be related to the strength of the spring 37 because the pressure acting in the central passage 32 and tending to unseat the release valve 33 also acts oppositely on the slightly larger area of the plunger member 42 and tending to hold the release valve in the closed position. The action of the pressure liquid therefore biases the release valve 33 in the closing sense. Although not shown, an air breather valve may be provided in the upper end of the ram 11 above the level of liquid therein.

The pumping means by which liquid is transferred from the reservoir into the cylinder space 17 will now be described. The closure member 15 at the inner end of the ram 11 has an upstanding cylindrical wall 47 forming an annular cylinder space 48 around the lower end of the tube 23. The lower end of a tube 49 surrounding the tube 23 and guided by the latter projects into the cylinder space 48. A sealing ring 50 serves to prevent escape of liquid from the cylinder space 48 between the upstanding cylinder 47 and the tube 49. The tube 49 has an extension 51 somewhat spaced around the tube 23 and secured to a slide block 52 on the upper end of the tube 23. The slide block 52 and with it the tubes 51 and 49 are adapted to be reciprocated from a crankshaft 53 having a crank arm 54 and a crank pin 55 operating in a transverse slot 56 in the slide block 52, see Figure 2 in which the crank arm is seen in the dead centre position. The crankshaft 53 has a squared end 57 for driving engagement with a suitable handle. The shaft end 57 is surrounded by a protecting shroud 58. The cylinder space 48 forms a high pressure pumping chamber by virtue of non-return valves 59 and 60. When the tube 49 is raised in the cylinder space 48, liquid enters said space from the reservoir across the non-return valve 59, and when the tube 49 is lowered into the cylinder space 48, the liquid in said space is forced out across the non-return valve 60 into the cylinder space 17. This pump will transfer a small quantity of liquid from the reservoir into the cylinder space 17 for each stroke of the pump handle, and is capable of being operated up to the desired setting pressure in the prop.

In order that extension of the prop into engagement with the mine roof may be effected rapidly, there is provided also a large diameter pump capable of transferring a large quantity of liquid at low pressure for each stroke of the pump handle. For this purpose, there is provided an annular piston 61 which fits within the tubular part 18 of the ram 11 and operates as a clack valve between shoulders 62 and 63 on the tube 49. The distance between the shoulders 62 and 63 slightly exceeds the axial dimension of the piston 61, and the piston 61 has an annular clearance space 64 around the tube 49. When the tube 49 is moved in a downward direction, the shoulder 62 engages the upper side of the piston 61 and closes the annular space 64 so that liquid in the ram 11 and below the piston 61 will be transferred through non-return valves 65 in the closure member 15, see Figure 3, and into the cylinder space 17. During upward movement of the tube 49, the shoulder 62 moves away from the piston 61 so that there is now a passage for liquid across the piston 61 and over parts of the shoulder 63 to enable liquid to charge the space below the piston 61 and also the cylinder space 48. The piston 61 is fitted with a relief valve 66 which limits pressure below said piston, the valve 66 controlling communication between an inlet opening 67 and spaced outlet openings, one of which is indicated at 68.

The prop is used in the following manner. Operation of the pumping means by the handle will bring about a rapid extension of the prop by means of the piston 61 which is designed to give a large flow at low pressure. When the head piece 13 of the prop meets the resistance of the mine roof, the pressure in the cylinder space 17 and below the piston 61 will rise until the relief valve 67 blows to render the piston 61 of the pump ineffective. The high pressure piston constituted by the lower end of the tube 49 continues to pump small quantities of liquid until the necessary setting pressure has been created in the cylinder space 17. After this and during the time the prop is serving as a roof support, there is a tendency for the roof weight to increase and place a greater loading on the prop. This loading is limited by the action of the relief valve 36 in the return communication between the cylinder space 17 and the reservoir. It will be appreciated that the space inside the tube 23 forms part of the pressure chamber of the prop. The prop therefore gradually shortens in a controlled manner with increasing roof loading.

When the prop is to be withdrawn from service, a cord or cable is attached to the loop 46 so that an operator standing a safe distance away from the point of support can, by pulling on said cord or cable, unseat the release valve 33 to open the cylinder space 17 to the reservoir to allow the prop to shorten and thereafter, by continuing to pull on the cord or cable, cause the prop to topple over and be dragged endwise towards him. Any tendency for air in the upper part of the reservoir to pass down through the tube 23 into the cylinder space 17 during the withdrawal of the prop is countered by the closing of the non-return valve 28 in said tube.

The construction of the pit prop above described enables the release valve to be situated conveniently at the upper end of the prop, and makes provision for the employment of a double-area pump of the two-stage type giving the maximum rate of prop extension. The features of the tube 23 and double-area pump 61, 49 are thus combined in a simple and efficient manner.

I claim as my invention:

1. A hydraulic pit prop comprising an outer cylinder, a ram tube slidable in said outer cylinder, a closure member fixed to the inner end of the ram tube, said closure member defining in conjunction with the ram tube a low pressure reservoir for hydraulic liquid and in conjunction with the outer cylinder a variable volume pressure chamber, a conduit disposed co-axially within the ram tube, said conduit opening from the pressure chamber and extending towards the outer end of the ram, release valve means situated adjacent the outer end of the ram, said release valve means controlling return flow from said conduit to the reservoir, and pump means mounted in the ram tube for transferring liquid under pressure from the reservoir to the chamber, said pump means comprising large and small area annular pistons disposed concentrically between the conduit and the ram tube, reciprocating drive mechanism operative in common upon said large and small area pistons, and pressure-responsive means adapted to terminate the pumping action of the large area piston upon the attainment of a predetermined pressure in the pressure chamber.

2. A hydraulic pit prop comprising an outer cylinder, a ram tube slidable in said outer cylinder, a closure member fixed to the inner end of the ram tube, said closure member defining in conjunction with the ram tube a low pressure reservoir for hydraulic liquid and in conjunction with the outer cylinder a variable volume pressure chamber, a conduit disposed co-axially within the ram tube, said conduit opening from the pressure chamber and extending towards the outer end of the ram, release valve means situated adjacent the outer end of the ram, said release valve means controlling return flow from said conduit to the reservoir, and pump means mounted in the ram tube for transferring liquid under pressure from the reservoir to the chamber, said pump means comprising a small area piston of tubular form mounted slidably on the conduit, a cylinder for said small area piston formed in the ram tube closure member, a large area annular piston slidably fitting the bore of the ram tube, reciprocating drive mechanism operative in common upon said large and small area pistons, and pressure-responsive means adapted to terminate the

pumping action of the large area piston upon the attainment of a predetermined pressure in the pressure chamber.

3. A hydraulic pit prop as in claim 2, wherein the reciprocating drive mechanism comprises a slide block mounted on the conduit adjacent its outer end, means for reciprocating said slide block on the conduit, a connecting tube disposed around the conduit, said tube forming a drive connection between the slide block and the small area piston.

4. A hydraulic pit prop as in claim 3, comprising also a lost-motion drive mounting for said large area piston

provided by axially spaced shoulders formed on said connecting tube, an inlet passage extending from one side of said large area piston to the other, one of said shoulders forming in conjunction with said large area piston a clack valve which is operative to close said inlet passage upon the working stroke of the pump.

References Cited in the file of this patent

UNITED STATES PATENTS

2,621,631 Dowty ---------- Dec. 16, 1952