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Bull

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[54] **HYDRAULIC PIT PROP**

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[51] **Int. Cl.** **F01b 15/00**

[58] **Field of Search** ..... 91/196, 422, 216 R, 91/216 A, 217; 92/117 A

[56] **References Cited**

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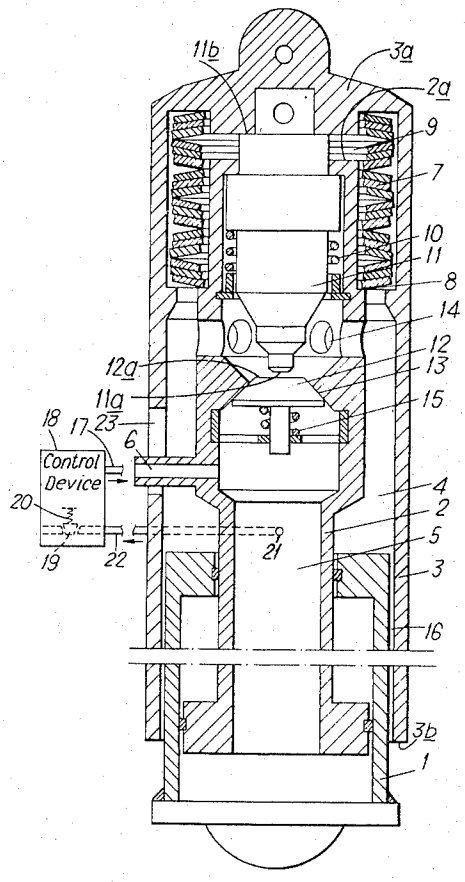
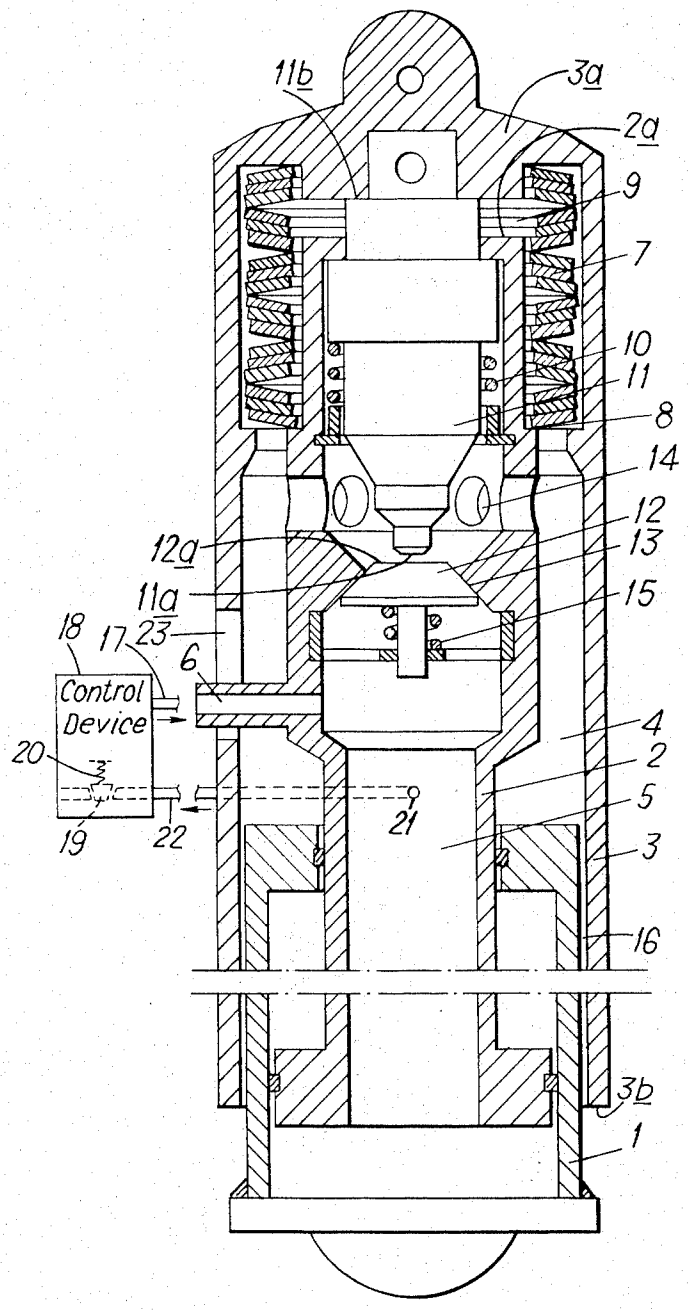
[57] **ABSTRACT**

An hydraulic prop having a relatively movable piston and cylinder which are surrounded by an outer guide tube provided with a closed end which is normally spaced away from an opposing end of the piston by spring means but which moves telescopically in relation to the piston if excess loads are applied to the prop, such relative movement between the piston and the outer guide tube causing the latter to actuate and move a plunger which, in turn, acts on a valve member in the piston so that liquid under pressure in a pressure chamber of the piston can flow out rapidly past the valve member and thus quickly relieve the prop of transitory excess loads such as those caused by rock falls or a partial collapse of the seam being worked.

6 Claims, 1 Drawing Figure




11b
3a
2a
9
7
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11
8
14
12
13
15
12a
11a
23
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17
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Control Device
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19
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21
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16
3b
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HYDRAULIC PIT PROP

This invention relates to hydraulic pip props for use in seams which are liable to be endangered by rock falls or the partial collapse of the seam.

Hydraulic pit props or chocks are generally protected from excessive loads imposed on them by rock pressure by at least one valve which may, if desired, be located in a control device disposed outside the prop. These valves are so set that, when the pressure on the prop exceeds a predetermined value, a tapered surface on a movable valve member which is normally biased by a mechanical spring into a closed position is raised for a short period of time away from a seat for the valve member, the spring force being overcome by the excess pressure. Liquid under pressure then flows out of a pressure chamber in the prop so as to allow the latter to yield. The valve remains in its open condition until pressure equilibrium is attained, whereupon the valve closes under the biasing force of its spring.

When the prop has to sustain heavy loads and to exert heavy pressures of up to 480 kp/cm^2, the cross-section of the valve opening is made relatively small so as to keep the pressure per unit area at the sealing surfaces of the prop within a permissible range. This has the drawback that the pressure in the prop can increase abruptly to an inadmissible extent through the occurrence of heavy transitory loads applied to the prop - for example by a rock fall or a partial collapse of the roof or wall of the seam being worked. The abrupt increase in pressure in the prop results directly from the cross-section of the valve opening not being large enough to allow a sufficient quantity of liquid to be discharged rapidly from the pressure chamber in order to obtain a condition of pressure equilibrium. Quite apart from the fact that this may have dangerous consequences for mining personnel, there is also the danger that the prop will be destroyed through this abrupt increase in pressure.

The aim of the present invention, accordingly, is to so construct an hydraulic prop, and, in particular, the hydraulic means for protecting it against excess pressures, that, on the occurrence of an abrupt and substantial increase in pressure in the prop such as results from a rock fall or partial collapse of the seam, the cross-section of openings and passages for the flow of liquid will be sufficiently large to enable liquid under pressure to be discharged rapidly from the pressure chamber to relieve the prop of excess pressure.

With this aim in view, the invention is directed to an hydraulic prop comprising a cylinder, a tubular piston arranged partially in the cylinder for axial sliding movement relatively thereto, a pressure chamber in the piston for liquid under pressure, a valve opening of large size in the piston for the rapid passage therethrough of liquid under pressure from the pressure chamber, a valve member arranged to close the valve opening, an outer guide tube, closed at one end and open at the other end, surrounding the cylinder and the piston, an end surface on the piston spaced away from and opposing the closed end of the outer guide tube, spring means disposed between the closed end of the outer guide tube and a part of the piston to maintain said spacing between the said end surface of the piston and the closed end of the outer guide tube under normal loads on the prop, an axially movable plunger in the piston, an end surface on the plunger opposing the valve member, and at least one large liquid-discharge opening in the piston on the downstream side of the valve opening therein, the outer guide tube and the piston being axially movable relatively to each other against the action of the spring means on the application of excess loads to the prop whereby the closed end of the outer guide tube actuates and moves the plunger in an axial direction and causes the said end surface on the plunger to contact and move the valve member away from its seat to provide a liquid flow-path of large cross-section from the pressure chamber.

When the prop is subjected to loads the magnitude of which is below or no greater than the load at which the prop is set to yield, the pressure acting to maintain the valve closed increases with increasing pressure within the pressure chamber of the prop. If and when the load to which the prop is subjected reaches the yielding load for which the prop has been set, pressure equilibrium is established by way of a pressure-relief valve which preferably lies outside the prop. When a rock fall or a partial collapse of the seam occurs, the excess load on the prop will cause the above-mentioned spring means to be compressed due to their disposition between the outer guide tube and the piston of the prop which move telescopically relatively to each other. The plunger thus pushes the valve member open so that large quantities of liquid under pressure can flow rapidly out of the pressure chamber through the wide valve opening, thereby ensuring that a further increase in pressure in the prop will not occur. When the excess load has been removed, the valve is once again closed, preferably by a valve spring and by the liquid under pressure remaining in the pressure chamber of the prop. The prop can now again carry its full load.

An example of an hydraulic prop in accordance with the invention is shown in longitudinal cross-section in the accompanying drawing and will now be described.

The prop comprises a cylinder **1** and a tubular piston **2** which are surrounded by an outer guide tube **3** having a closed upper end **3***a* and an open lower end **3***b*. The closed upper end of the tube **3** opposes the upper end **3***a* of the piston **2**, while the lower part of the tube **3** surrounds the cylinder **1** concentrically with the provision of an annular clearance **16** between them. Between the piston **2** and the guide tube **3** there is defined an annular space **4** which is not sealed off and which lies radially outwardly of a pressure chamber **5** in the piston **2.** Liquid under pressure is fed into the said pressure chamber **5** of the prop through a duct **6** and a pipeline **17** from a control device **18** which lies outside the prop. This control device **18** accommodates a pressure-relief valve **19** loaded by a spring **20,** which serves to protect the prop against excessive pressures or loads. Thus, when the load applied to the prop exceeds a predetermined value at which the pressure-relief valve **19** has been set to yield or open against the pressure of its spring **20,** the opening of the valve **19** allows liquid under pressure to be discharged from the pressure chamber **5** of the prop through a discharge opening **21** into a return duct or pipe **22** which is free of pressure and which contains the pressure-relief valve **19.**

The outer guide tube **3** is supported at its closed upper end **3***a* by sets of superposed frustoconical washer-type springs **7** from a shoulder **8** on the upper portion of the piston **2** of the prop. Under normal circumstances of use, the number of springs **7** provided, as well as their combined strength, will ensure that a gap

9 is formed between the upper end 2*a* of the piston 2 and the opposing surface of the outer guide tube 3. The size of the gap 9 can therefore be varied by telescoping movements between the piston 2 and the outer guide tube 3. The number and strength of the springs 7 are so selected that the spring force exerted by them exceeds by a predetermined amount the magnitude of the load at which the pressure-relief valve 19 is set to open or yield. Thus, relative telescoping movement between the guide tube 3 and the piston 2 of the hydraulic prop in such a direction as to compress the springs 7 can only take place when the prop is subjected to pressures or loads which exceed those at which the prop has been set to yield. In practice, only pressures or loads such as occur on the occasion of a rock fall or seam collapse will be great enough to cause the relative telescoping movement between the guide tube 3 and the prop piston 2 and consequent compression of the springs 7.

If and when relative telescopic movement between the guide tube 3 and the piston 2 takes place, the lower end 11*a* of a downwardly-tapering plunger 11 will come into contact with the upper surface 12*a* of a frusto-conical valve member 12. This results from downward movement of the plunger 11, against the action of a spring 10, due to the upper end 11*b* of the plunger abutting against the closed end 3*a* of the guide tube 3. The valve member 12 has a large surface area in comparison with the size of the prop and is located in the upper portion of the piston 2. The conical surface of the valve member 12 bears against a valve seat 13 which is formed as a frusto-conical surface on a shoulder projecting from the inner wall of the piston 2.

When the lower end 11*a* of the plunger 11 presses against the valve member 12, the latter is moved off its seat 13 so as to allow the flow of liquid under pressure from the pressure chamber 5 of the prop into the outer annular space 4 through the outlet openings 14 which are of large diameter. From the space 4, the liquid can flow to th outside of the prop through the clearance 16 or through a slot 23 in the outer guide tube 3 for the duct 6.

It will thus be seen that, when the valve member 12 is pressed downward off its seat 13, a liquid flow path of large cross-section is formed from the pressure chamber 5 to the outside of the prop. A large quantity of liquid under pressure can therefore flow out of the pressure chamber 5 in a short time, the effective length of the prop thereby being rapidly shortened. The prop is accordingly relieved of some of the load acting on it without the pressure-relief valve 19 being used. As soon as the transitory increase in pressure caused by the rock fall or partial collapse of the seam has ceased, the set of springs 7 will expand and cease to be compressed, and the frusto-conical valve member 12 will seat again on the valve seat 13 as a result of the biasing force of the spring 15 and the pressure of the liquid remaining in the prop. The prop will then be once again in a condition to sustain the load which it is required to carry.

I claim:

1. An hydraulic prop comprising a cylinder, a tubular piston arrange partially in the cylinder for axial sliding movement relatively thereto, a pressure chamber in the piston for liquid under pressure, a valve opening of large size in the piston for the rapid passage therethrough of liquid under pressure from the pressure chamber, a valve member arranged to close the valve opening, an outer guide tube, closed at one end and open at the other end, surrounding the cylinder and the piston, an end surface on the piston spaced away from and opposing the closed end of the outer guide tube, spring means disposed between the closed end of the outer guide tube and a part of the piston to maintain said spacing between the said end surface of the piston and the closed end of the outer guide tube under normal loads on the prop, an axially-movable plunger in the piston, an end surface on the plunger opposing the valve member, and at least one large liquid-discharge opening in the piston on the downstream side of the valve opening therein, the outer guide tube and the piston being axially movable relatively to each other against the action of the spring means on the application of excess loads to the prop whereby the closed end of the outer guide tube actuates and moves the plunger in an axial direction and causes the said end surface on the plunger to contact and move the valve member away from its seat to provide a liquid flow-path of large cross-section from the pressure chamber.

2. An hydraulic prop according to claim 1 wherein the outer guide tube surrounds the cylinder with annular clearance therebetween, and wherein the valve member is positioned in the upper portion of the piston and has a frusto-conical valve surface of large area.

3. An hydraulic prop according to claim 1 wherein the valve member is biased into sealing contact with the valve seat by a valve spring and the pressure of liquid in the pressure chamber, the valve seat being formed on a shoulder projecting from the inner wall of the piston.

4. An hydraulic prop according to claim 1 wherein the spring means comprise a seat of superposed washer-type springs having a biasing force which exceeds the load at which the prop is normally set to yield.

5. An hydraulic prop according to claim 1 wherein the plunger has a downwardly-tapering end portion which normally lies a short distance above the valve member and is biased by a plunger spring towards the closed end of the outer guide tube.

6. An hydraulic prop according to claim 1 wherein the tubular piston is provided with at least two liquid discharge openings leading to a space, outside the piston, which is in communication with the outside of the prop.

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