Jan. 31, 1967 G. DOMMANN ETAL 3,301,519

DOUBLE TELESCOPING HYDRAULIC PROP

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Fig. 1

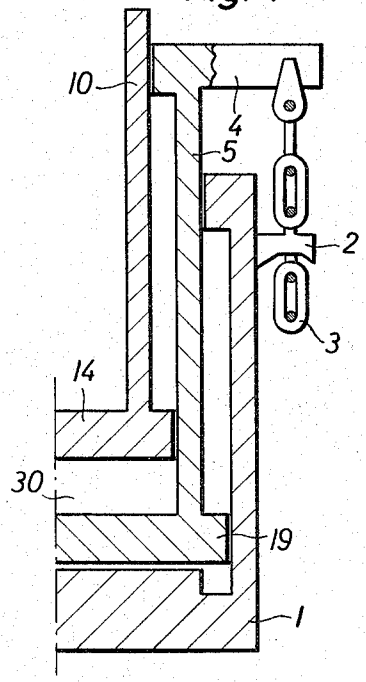

Fig. 2

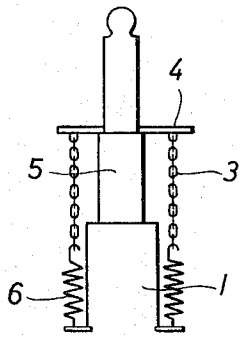

Fig. 3

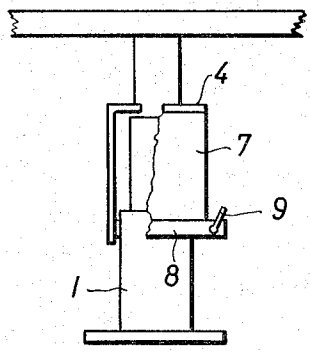

Fig. 3a

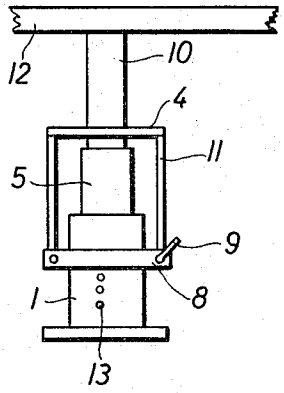

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Fig. 4

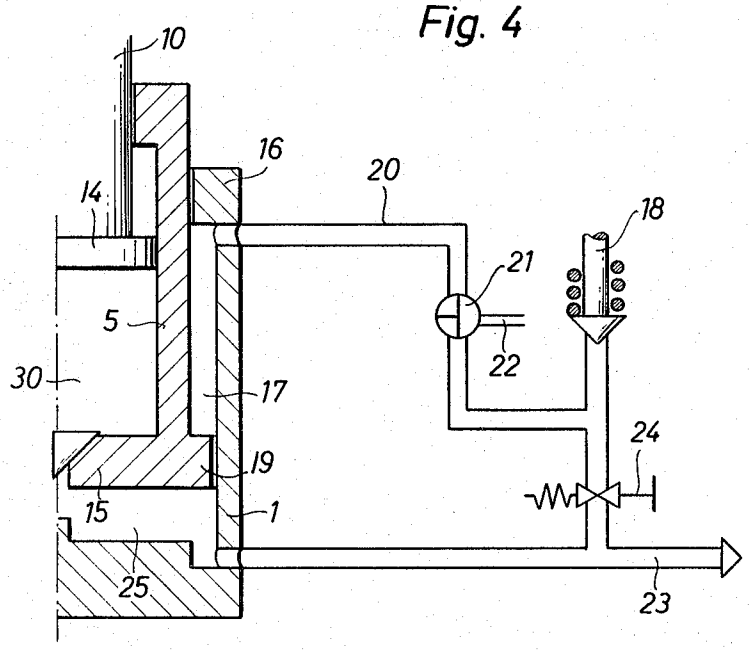

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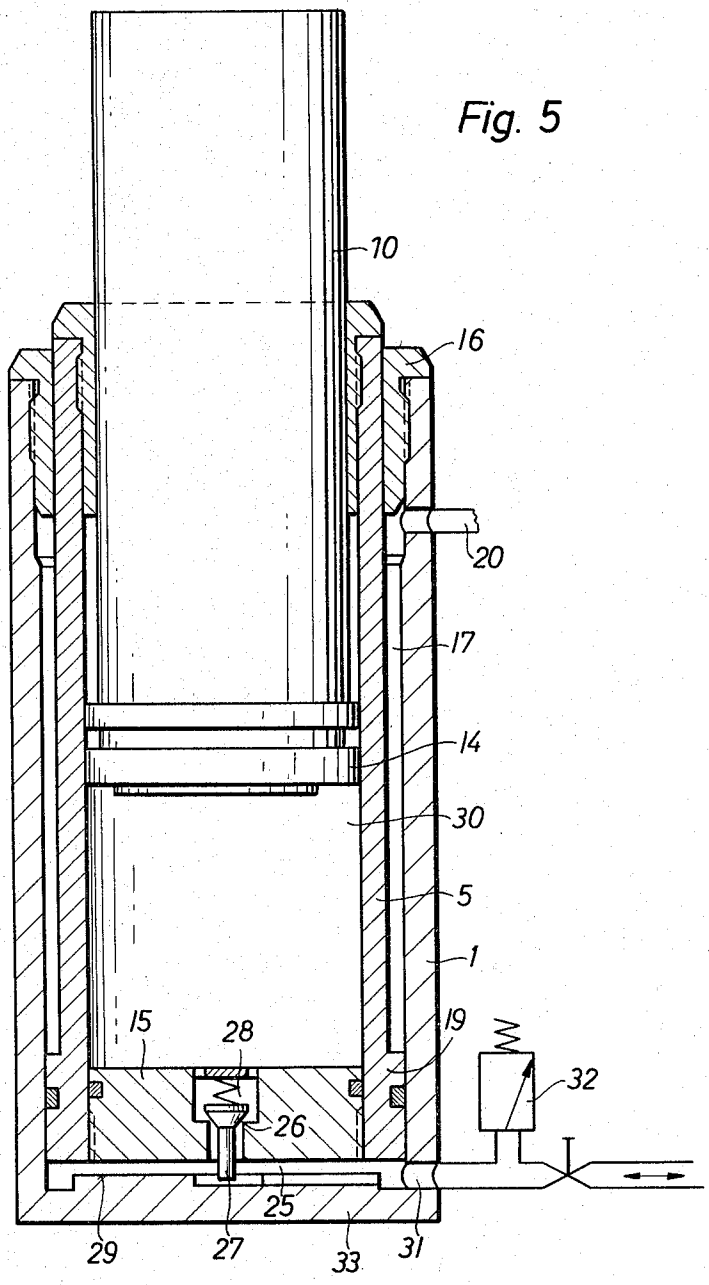
Fig. 5



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DOUBLE TELESCOPING HYDRAULIC PROP

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20 Claims. (Cl. 248—354)

This invention relates to double telescoping hydraulic props. It more particularly refers to such props which are more reliable and have greater constancy of operation than those of the prior art.

Double telescoping hydraulic props are well known. They are used extensively in mining operations to hold up the mine tunnel roof. In general these devices provide a cylinder housing two telescoping pistons arranged in such manner that both pistons are activated and moved from a single source by a single hydraulic fluid.

Because of the fact that the two pistons telescope, they present a different surface area to the pressurizing hydraulic fluid; the inside piston has a smaller working face surface area than does its surrounding outside piston. For ease of understanding, the outside piston may be hereinafter referred to as the "first stage" and the inside piston may be hereinafter referred to as the "second stage."

As generally noted above, the single hydraulic fluid is capable of acting on both the first and second stages at the same time. Since the first stage has a larger working surface, it will tend to be projected in preference to the second or inside stage.

Double telescoping hydraulic props are generally constructed in such a manner as to permit the first or outer stage to be hydraulically extended to a maximum point predetermined by means of a stop or shoulder extending inwardly from the top of the encasing cylinder a distance sufficient to engage a shoulder or flange which extends outwardly from the base of the first stage. When these two shoulders engage, the first stage is prevented from further extension without fracture of at least one of these two shoulders. Similarly, the top of the first stage has an inwardly extending shoulder to engage and mate with an outwardly extending shoulder of the base of the second stage for the same purpose. A space is defined by the combination of the inside cylinder wall, the outside of the first stage piston, the first stage base shoulder and the cylinder top shoulder; similarly a space is defined by the combination of the inside wall of the first stage piston, the outside wall of the second stage piston, the second stage base shoulder and the first stage top shoulder. Such spaces are known to the prior art and have been used to retract the pistons under positive hydraulic pressure as desired.

In the operation of prior art double telescoping hydraulic props, it was the practice to fully extend the first stage piston to the engagement of the first stage piston base shoulder with the cylinder top shoulder and thence to extend the second stage piston by continued hydraulic pressure until its top met and engaged the mine tunnel roof. Upon engagement with the roof, additional hydraulic pressure was provided to "set" the prop against the roof. Thus, the magnitude of the holding or setting force of the prop was determined by the pressure of the hydraulic fluid on the smaller (second stage) piston.

When it was required to move the prop to a different location, the hydraulic fluid pressure was relieved or released thus causing the piston assembly to retract from the roof and permit the total device to be moved. As will be apparent, upon relief or release of the pressure acting upon the pistons, the first stage piston was the first to retract with the relation between the first and second stage pistons remaining substantially constant until the first stage has been fully retracted.

In many instances, the piston assembly is not fully retracted since it is to be used very shortly and very near to the place where it was previously used. Thus, when the prop is now reused in a different location, hydraulic fluid pressure is again exerted on the double pistons and the outer stage is the first to extend until as before the cylinder and first stage shoulders engage. Now, if the new location of use offers a floor to roof dimension less than that of the old or prior location of use, the first stage will not extend fully to the shoulder engagement since the top of the second stage will have met the roof and will have become set through the additional hydraulic fluid pressure.

It should be noted at this point that the setting forces of the two installations just described are different even if the hydraulic fluid pressure is the same since in the first case the setting force was accomplished by action of the hydraulic fluid against the smaller second stage piston whereas in the latter case the setting force was accomplished by action of the hydraulic fluid against the larger first stage piston.

As can be appreciated, these same principles apply where more than two, e.g. three or more, stages are employed. It will also be appreciated that though the term cylinder has been employed, it is used in its generic functional sense and is not intended to be limited to any particular geometric shape.

It is an object of this invention to provide a multiple telescoping prop which is not subject to the disadvantages of prior art systems.

It is another object of this invention to provide a multiple telescoping prop system which will always provide the same setting force regardless of the floor to roof dimension of the space in which it is acting.

It is a further object of this invention to provide a multiple telescoping prop which will always provide a setting force determined by the largest piston face in the assembly.

It is still another object of this invention to provide a multiple telescoping prop which will always provide a setting force which is the maximum for the particular geometric configuration of the particular prop utilized.

Other and additional objects of this invention will be apparent from the consideration of this entire specification including the drawing and the claims.

In accord with and fulfilling these objects, this invention comprises a multiple telescoping hydraulic activated prop so arranged that the largest, and each succeeding smaller stage except the smallest, is physically prevented from extending to its maximum prior to its next smallest stage having extended to its maximum until the top of the smallest stage engages and contacts the roof to be supported by the prop and then providing the setting force to hold the top of the smallest stage against the roof by action of the hydraulic fluid pressure upon the largest stage piston.

This invention will be better understood with reference to the drawing in which:

FIG. 1 is a front elevation partially in section, with parts broken away, of a device according to this invention;

FIG. 2 is a front elevation of a slightly modified device according to this invention;

FIGS. 3 and 3*a* are similar to FIG. 2 showing further modified forms of this invention;

FIG. 4 is similar to FIG. 1 showing the hydraulic fluid circulation system of a device according to this invention; and

FIG. 5 is a full front elevation partially in section of the device shown in FIG. 4.

Referring now to the drawings and particularly to FIG. 5 thereof, a double telescoping hydraulic prop is shown having a cylinder 1 encasing a first stage piston 5 and a second stage piston 10. The first stage piston base 15 and the base of the cylinder 33 together with the inside walls of the cylinder define a space 25 into which hydraulic fluid can be pumped through an orifice 31.

A similar space 30 into which hydraulic fluid can be pumped to act upon a second stage piston 10 is defined by the inside walls of the first stage piston 5, the top of the first stage piston base 15 and the base 14 of the second stage piston 10. Hydraulic fluid will be admitted into this space 30 through a valve 26 in the first stage piston base 15.

Under normal (prior art) operation, when hydraulic fluid is admitted through the orifice 31 into the chamber 25 the first stage piston 5 would be extended until the shoulder 19 at the base thereof met the shoulder stop 16 at the top of the cylinder 1. Additional or continued hydraulic pressure would then cause the space 30 to fill thereby extending the second stage piston 10 until it engaged with the roof to be supported.

Upon release of hydraulic pressure, the hydraulic fluid will drain out of space 25 first thus causing the first and second stages to retract as a single unit. Upon complete retraction of this unit, the hydraulic fluid from the space 30 would then drain permitting the second stage to retract with reference to the first stage.

According to this invention however, physical means are provided to restrain the first stage from expanding to its maximum.

Referring now to FIG. 1, it can be seen that the first stage 5 can be prevented from extending to its maximum by providing a chain 3 or other extension device from a flange 4 on the first stage 5 to a flange or other extension 2 on the cylinder. A modification of this is shown in FIG. 2 where the chains 3 are attached to the cylinder 1 by means of springs 6 so as to prevent or at least reduce the tendency for the chains 3 to snap under the tension caused by the hydraulic pressure.

In FIGS. 3 and 3*a* a different arrangement is shown to accomplish the same purpose of preventing the first stage from extending to its maximum before extending the second stage. In this embodiment the flange 4 has a guard jacket 7 attached thereto. The bottom of the guard jacket 7 has a brake collar 8 thereon which is adjustable in its braking effect by means of lever 9 which may be a tensioning device, a set screw or the like. Thus the first stage piston is prevented from extending by means of this brake collar. In FIG. 3*a* the guard jacket 7 has been replaced by lead screws 11 which are adjustable to position the distance from the brake collar to the flange 4.

In employing any of the embodiments of this invention shown in FIGS. 1 through 3*a*, the first stage piston is prevented from extending to its maximum prior to the extension of the second stage piston. When the second stage piston extends sufficiently to have contacted the roof, the stopping device is either released, in the case of the chain 3 of FIG. 1 or the spring 6 of FIG. 2, or it may be overridden, as in the case of the brake collar 8 of FIGS. 3 and 3*a*.

Upon release or overriding of the stopping device, the hydraulic fluid pressure is then free to act upon the first stage causing it to extend slightly further and thereby exerting the setting force necessary to support the roof.

If desired, stops 13 can be provided on the cylinder to retard or prevent the downward sliding of the brake collar upon retraction of the first stage piston.

As utilized in the prior art and referred to above, an annular chamber 17 is formed between the cylinder 1, the first stage piston 2 and the shoulders 16 and 19.

This chamber or space can be utilized to aid in retraction or as a holding device as shown in FIG. 4. To this end the chamber 17 is shut off from the return line by means of an over pressure (pressure release) valve 18. A three way valve 21 is inserted into the line 20 leading from the chamber 17 which connects to the hydraulic system feed or return line 23 and to a drain line 22. In the position shown, the valve 21 permits the chamber 17 to exhaust only through the valve 18 (assuming valve 24 is closed) thereby maintaining the pressure in the chamber 17 at a value equal to the setting of the valve 18. The chamber 17 may be drained, thereby permitting retraction of the first stage piston 5 by turning the valve 21 90° clockwise.

By maintaining the valve 21 in the position shown, the first stage piston 5 is also prevented from extending further due to the pressure in the chamber 17. Thus the second stage piston 10 is now permitted to extend by means of hydraulic pressure despite the fact that the first stage piston 5 has not extended to its maximum. Upon contact of the top of the second stage piston 10 with the roof, the valve 21 can be turned 90° clockwise and the hydraulic fluid pressure permitted to extend the first stage piston 5 thus applying the required setting force.

Retraction of the first stage pistons can also be accomplished as shown in FIG. 4 by opening of the valve 24.

Referring once again to FIG. 5, the setting force for the prop can be predetermined by use of a pressure release valve 32 which is set to open at a certain pressure. After the two pistons have been extended to support the roof 12 (shown in FIG. 3*a*), pressure from the roof is transmitted back through the pistons to the hydraulic system through the valve 32.

The pistons are extended as heretofore mentioned by filling the chamber 25 first until the first stage piston has been extended as far as desired. The hydraulic fluid pressure then opens the check valve 26 by overcoming the pressure of the spring 28. The chamber 30 is then filled thereby extending the second stage piston 10 until it contacts the roof. Upon release of the mechanism restraining the first stage piston 5 the pressure in the chambers 25 and 30 equalizes permitting the valve 26 to close whereby the setting force is applied solely to the first stage piston 5 since the roof acting upon the second stage piston 10 maintains the valve 26 closed.

Upon retraction, the pressure in chamber 30 maintains the valve 26 closed while both pistons retract as a unit through draining of the chamber 25. The base of the cylinder 33 is provided with an elevation 29 and the valve 26 with an extension 27 so that as the base 15 of the first stage piston 5 comes to rest upon the elevation 29, its weight forces the valve 26 open permitting the chamber 30 to drain and retracting the second stage piston 10.

When the device is under pressure from above but still under hydraulic fluid pressure, the first stage piston will retract into the cylinder and cause the valve 26 to open whereby chamber 30 comes into communication with the pressure relief valve 32. Since the pressure in chamber 30 is less than the pressure in chamber 25, the valve 32 will permit the hydraulic system to increase the pressure into chamber 25. This will extend the first stage piston 5 and close the valve 26. During this the second stage piston 10 has retracted somewhat. With the valve 26 closed, the pressure on the second stage piston 10 will retract the entire piston assembly thus causing the valve 26 to open and so on repeating until the second stage piston is fully retracted. This cycling retraction mechanism maintains a quite smooth descent by extraordinarily simple means.

While the invention has been described in detail with reference to the specific embodiments shown, various changes and modifications which fall within the spirit of the invention and scope of the appended claims will

become apparent to the skilled artisan. The invention is, therefore, only intended to be limited by the appended claims or there equivalents wherein we have endeavored to claim all inherent novelty.

What is claimed is:

1. A multiple telescoping hydraulic prop having a single hydraulic fluid system to all telescoping pistons thereof wherein said prop contains means to restrain said largest piston from fully extending to its maximum prior to a smaller piston contacting a surface to be supported by said prop; and check valve means between two successive pistons operative to permit flow of hydraulic fluid therethrough from said hydraulic system into supporting relation with the smaller of said successive pistons and operative to permit flow of said hydraulic fluid from supporting relation with respect to said smaller piston to a source of said hydraulic fluid only when said larger piston is unsupported by hydraulic fluid.

2. A prop as claimed in claim 1 having a larger first stage and a smaller second stage piston; said first stage piston being restrained from extending to its maximum until said second stage piston contacts said surface.

3. A prop as claimed in claim 2 wherein said first stage piston is restrained by means of chains.

4. A prop as claimed in claim 2 wherein said first stage piston is restrained by means of springs.

5. A prop as claimed in claim 2 wherein said first stage piston is restrained by means of a brake collar.

6. A prop as claimed in claim 2 wherein said first stage piston is restrained by means of an hydraulic lock in the space between the exterior of said first stage piston and the interior of a cylinder in which said first stage piston is housed.

7. A prop as claimed in claim 6 wherein said space communicates through a valve to a hydraulic system which operates said prop, said valve being adjustable to isolate said space and to permit flow from said space to said system.

8. A prop as claimed in claim 2 wherein said first stage piston is restrained by means of both chain and spring.

9. A double telescoping hydraulic prop comprising a cylinder having walls, a base and inwardly projecting shoulders at the top thereof; a first stage piston having walls, a base, outwardly projecting shoulders at the base of said walls and inwardly projecting shoulders at the top thereof inside said cylinder; and a second stage piston having walls, a base and outwardly projecting shoulders at the base of said walls inside said first stage piston; said first stage piston base, said cylinder base and said cylinder walls defining a first chamber; said first stage piston base, said first stage piston walls and said second stage piston base forming a second chamber; a valve in said first stage piston base adapted to provide communication between said first and said second chambers; means to communicate said first chamber with a supply of hydraulic fluid; and means to restrain said first stage piston from extending to its maximum prior to said second stage piston contacting a surface to be supported by said prop.

10. A prop as claimed in claim 9 wherein said first stage piston base shoulder, said cylinder shoulder, said first stage piston walls and said cylinder walls define a third chamber.

11. A prop as claimed in claim 10 wherein said third chamber communicates with said hydraulic system through a valve means.

12. A prop as claimed in claim 9 wherein said valve between said first and second chambers is a check valve characterized by the ability thereof to maintain said second chamber sealed until said first stage piston is substantially completely retracted.

13. A prop as claimed in claim 9 wherein said restraining means is adjustable to permit extension of said first stage piston any predetermined amount less than to its maximum.

14. A prop as claimed in claim 11 wherein said valve means is operable externally from said prop.

15. A prop as claimed in claim 9 wherein said hydraulic system is connected to said prop through a pressure regulating valve.

16. A prop as claimed in claim 11 wherein said third chamber communicates with a return hydraulic line through a pressure relief valve.

17. Method of supporting a member by means of a multiple telescoping hydraulic prop wherein said prop has a single hydraulic fluid system to all telescoping pistons thereof wherein said prop contains means to restrain said largest piston from fully extending to its maximum prior to a smaller piston contacting a surface to be supported by said prop; and check valve means between two successive pistons operative to permit flow of hydraulic fluid therethrough from said hydraulic system into supporting relation with the smaller of said successive pistons and operative to permit flow of said hydraulic fluid from supporting relation with respect to said smaller piston to a source of said hydraulic fluid only when said larger piston is unsupported by hydraulic fluid, which method comprises exerting hydraulic pressure upon the largest piston to extend such until said restraining means prevents further extension; exerting hydraulic pressure on each successively smaller piston in turn until the extension of each is restrained; exerting hydraulic pressure upon the smallest piston until it contacts the member being supported; and exerting additional hydraulic pressure upon the assembly to set the assembly against the member.

18. The method claimed in claim 17 wherein said additional hydraulic pressure overrides said restraining means.

19. The method claimed in claim 18 wherein there are two pistons.

20. The method claimed in claim 17 wherein a valve means communicates between a first reservoir serving to exert hydraulic pressure on a larger piston and a second reservoir serving to exert hydraulic pressure on a next smaller piston; said valve means being within the base of said larger piston and containing a shaft operable to open said valve which extends beyond said base; said valve being opened by said larger piston base approaching its fully withdrawn position and said shaft making contact with the member against which said fully withdrawn larger piston rests.

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