Aug. 28, 1951 B. JOHNSTON ET AL 2,565,730

CYLINDER ASSEMBLY WITH MOVABLE LINER

Filed April 23, 1949 3 Sheets-Sheet 1

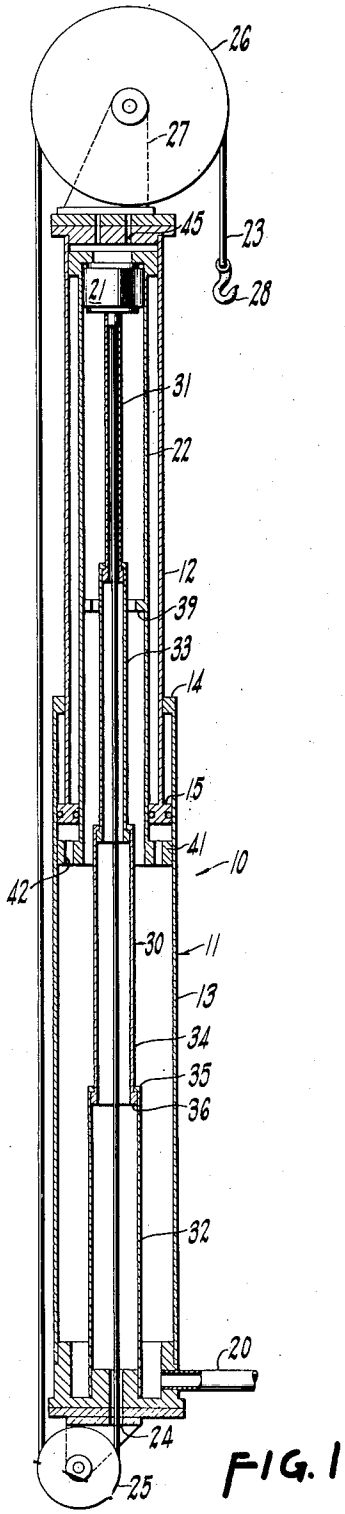


FIG. 1

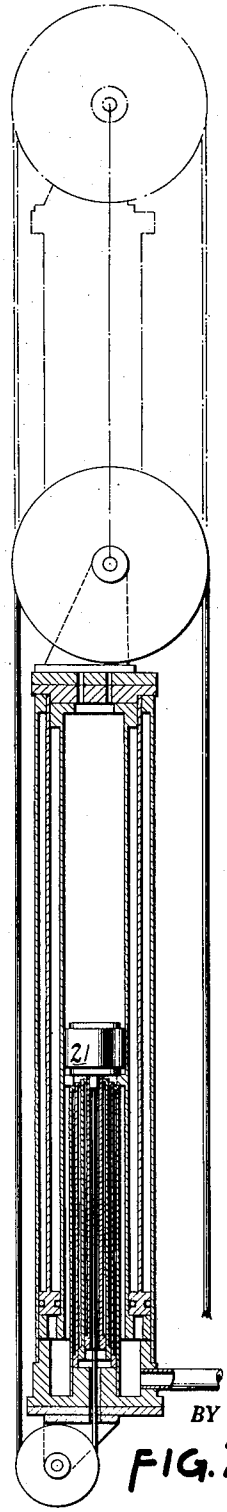
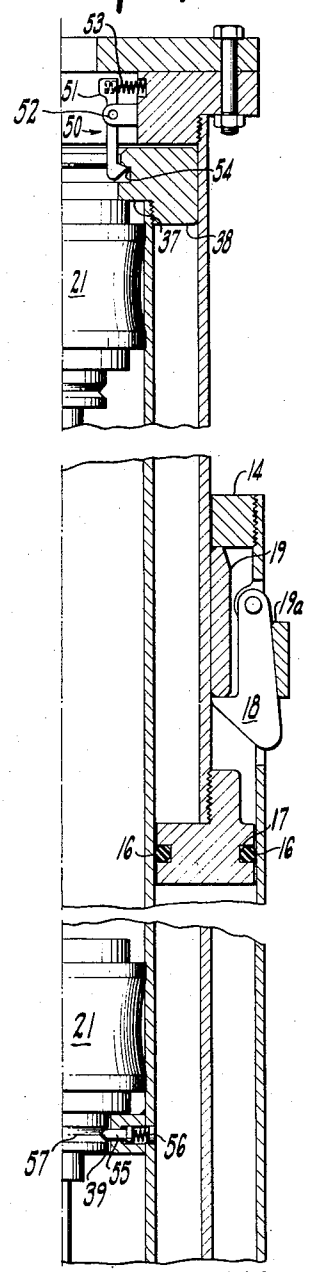


FIG. 2

FIG. 3



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CYLINDER ASSEMBLY WITH MOVABLE LINER

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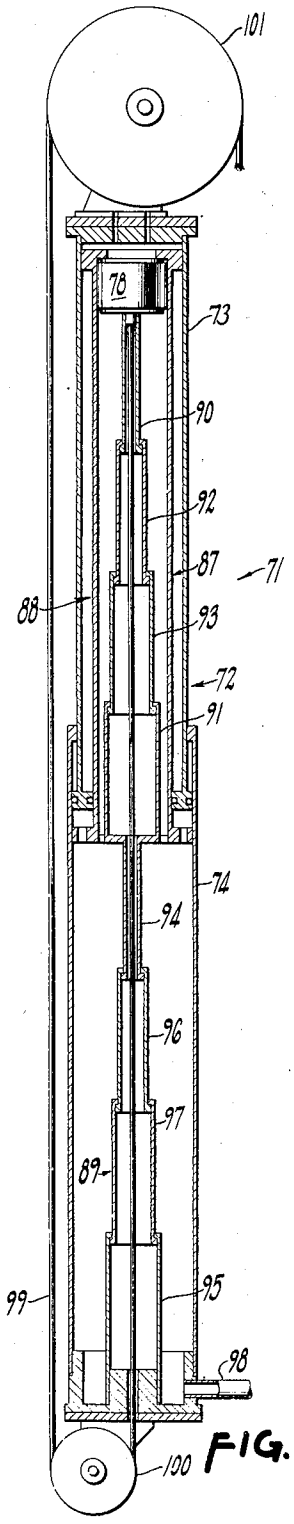


FIG. 4

FIG. 5

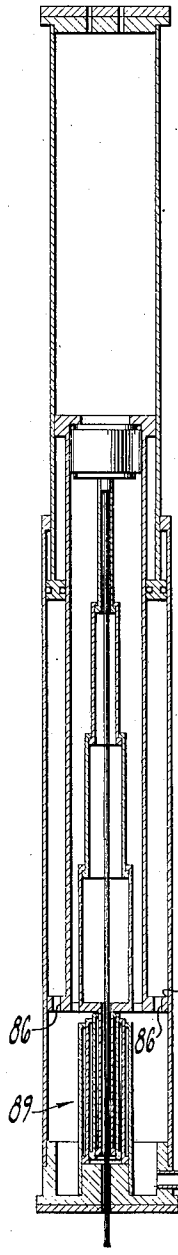
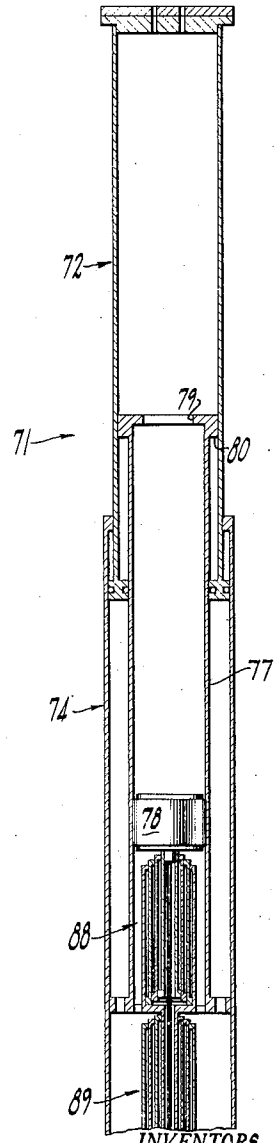


FIG. 6



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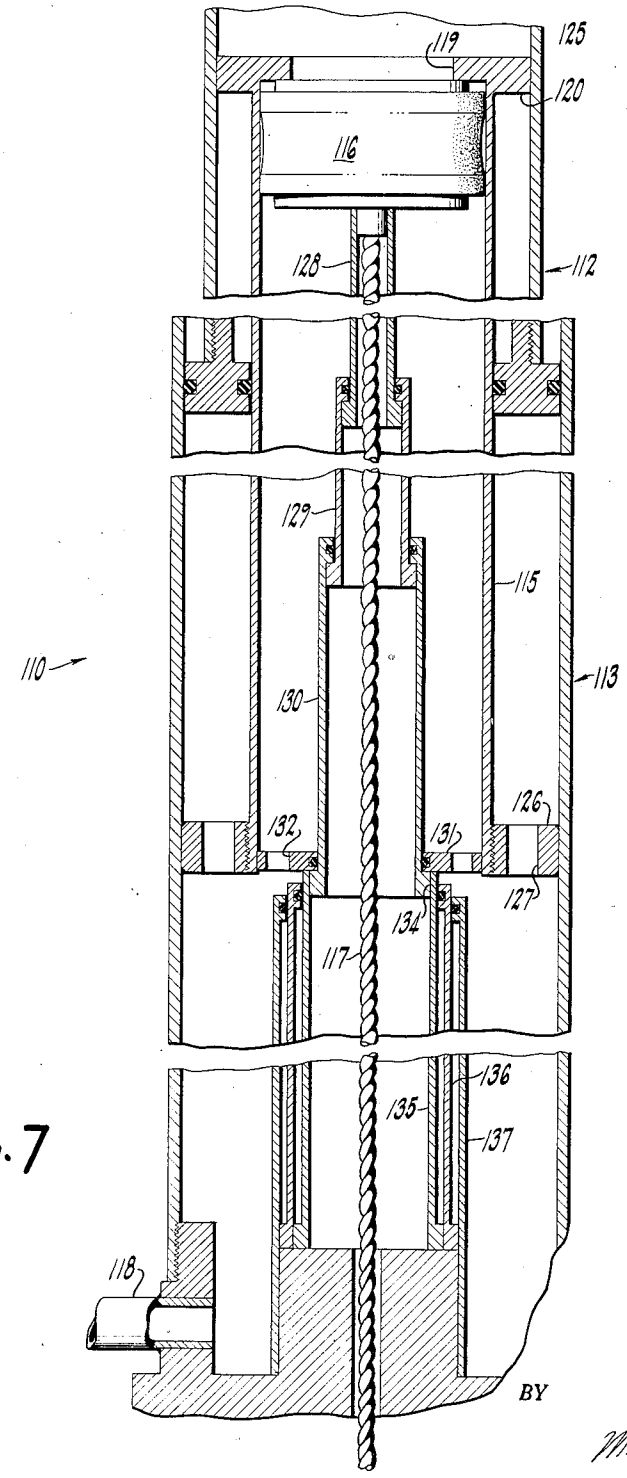


FIG. 7

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CYLINDER ASSEMBLY WITH MOVABLE LINER

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Application April 23, 1949, Serial No. 89,324

9 Claims. (Cl. 121—46)

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This invention relates to an hydraulically operable device comprising a cylinder, a piston reciprocable therein, a wire line or cable operated by the piston, means for sheathing and sealing the wire line, and a movable liner for the piston.

As set forth in Mason United States Patent No. 2,340,794, granted May 6, 1941, entitled "Drilling Lift," an hydraulically operable lifting device having utility in drilling, servicing and operating an oil well is provided by means of one or more upright cylinders. A piston is disposed reciprocably within each of the cylinders, and a wire line or cable is operated by the piston. To seal the wire line as it passes through one end of the cylinder, a plurality of nestable or telescoping tubes are provided, one of which is fixed to the piston and another to one end of the cylinder.

As set forth in copending application of Mac J. Kinsey, et al., Serial No. 89,322, filed April 23, 1949, entitled "Portable Drilling Rig," an hydraulically operable device of the character described is advantageously provided with a tubular liner disposed concentrically of and spaced from the cylinder. Such a liner has several advantages. For example, as set forth in the above-mentioned application, Serial No. 89,322, drilling lifts or rigs of the character described may employ cylinders of great height, e. g. about 100 feet, and a piston stroke of the same magnitude. Obviously, inasmuch as the piston is in sliding, sealing engagement with the cylinder, the inner surface of the cylinder must be accurately machined.

Machining a large cylinder of the character described is an expensive and cumbersome operation. Furthermore, if the cylinder is damaged, operation of the piston will be impaired. As set forth in the above-mentioned copending application, by providing a liner and disposing the same concentrically within and spacing it from the cylinder, these and other difficulties are in great measure obviated. Thus, the liner may be made of relatively light section and of a light alloy, and it is more easily machined than the outer cylinder. Moreover, damage to the cylinder does not necessarily result in damage to the liner. Also, in an upright cylinder of great height, the provision of an annular space between the outer cylinder and the liner simplifies the hydraulic supply system. Thus, hydraulic pressure may be introduced into the annular space at the bottom of the cylinder and flow up and into the upper end of the liner.

A disadvantage still exists in the case of an

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hydraulically operable device of the character described, including an upright cylinder, a liner disposed concentrically therein and spaced therefrom, and a piston reciprocable within the liner for operating a wire line. Thus, in prior designs of this character, a fixed liner has been provided extending from the bottom of the cylinder nearly to its upper end. Although such a liner is more easily constructed and machined than the outer cylinder, nevertheless difficulty is encountered in manipulating and machining an object of such great length and diameter.

It is therefore an object of the present invention to provide an improved form of hydraulic device of the character described, including a cylinder, a liner disposed concentrically therein, and a piston reciprocable in the liner for operating a wire line.

It is a particular object of the invention to provide an hydraulically operable device of the character described, including a liner of the character described and a piston reciprocable therein, such liner being of considerably shorter length than the cylinder, yet allowing a maximum stroke of the piston.

These and other objects of the invention will be apparent from the ensuing description and the appended claims.

Certain forms which the invention may assume are exemplified in the following description and illustrated by way of example in the accompanying drawings, in which:

Fig. 1 is a more or less diagrammatic view showing the hydraulic device of the invention in vertical section and also showing the sheathing tubes in their extended positions and the piston at the end of its upstroke.

Fig. 2 is a similar view showing the sheathing tubes in collapsed position and the piston at the end of its downstroke.

Fig. 3 is a fragmentary, vertical sectional view on a larger scale than that of Figs. 1 and 2, taken through the upper and intermediate portions of the cylinder showing means for latching the liner and the upper section of the cylinder in their up positions.

Fig. 4 is a diagrammatic, vertical sectional view as in Fig. 1, but illustrating a different embodiment of the invention and showing the sheathing tubes in their extended position and the piston at the end of its upstroke.

Fig. 5 is a view similar to that of Fig. 4, but with certain parts omitted and showing the piston at an intermediate position and one set of tubes in collapsed position.

Fig. 6 is a view similar to that of Fig. 4, but showing the piston at the end of its downstroke and the tubes completely collapsed.

Fig. 7 is a fragmentary, sectional view of yet another embodiment of the invention.

Referring now to the drawings and more particularly to Figs. 1 to 3, the device of the invention is shown in one of its forms and is generally designated as 10. The device comprises an upright cylinder 11 including an upper section 12 and a lower section 13. As illustrated, the upper and lower sections 12 and 13 are telescopically arranged, upper section 12 being of lesser diameter than and being received in the lower section 13. Lower section 13 is provided at its upper end with an internal flange 14 and upper section 12 is provided at its lower end with a flange 15 which is in slidable, sealing engagement with both the lower section 13 and a liner 22 by means of O rings 16 seated in annular recesses 17. As shown in Fig. 3, the upper section 12 is latched in its extended position by means of any desired number of latch pawls 18 (of which only one is shown) pivotally supported on the lower section 13 above the flange 15, and a fixed annular latch member 19 fixed to the upper section 12. To secure the pawls 18 in latched position an annular wedge 19a is provided which is driven downwardly into firm engagement with the pawls 18.

A supply conduit 20 communicates with the cylinder at its lower end and a piston 21 is provided which is reciprocable within a movable liner 22. A wire line or cable 23 is fixed at one end to the piston 21, passes through the lower end of the cylinder through a passage 24 and is led over a bottom sheave 25 and a crown sheave 26 journaled in a crown block 27. A hook 28 is fixed to the other end of the wire line 23.

Also illustrated is a plurality of nestable tubes generally designated as 30, which function to sheath the wire line 23. The tubes 30 include an innermost tube 31 fixed to the piston 21, an outermost tube 32 fixed to the bottom of the cylinder and any desired number of intermediate tubes 33, 34, etc., of which only two are shown for purposes of illustration. Each of the intermediate tubes 33 and 34 and the outermost tube 32 is provided at its upper end with an internal flange 35, and the innermost tube 31 and each of the intermediate tubes 33 and 34 is provided with an external flange 36 at its lower end. As is well known, the internal and external flanges 35 and 36 serve as sealing members and also as limit members to limit movement of the tubes 30 on the upstroke of piston 21.

The liner 22 is provided at its upper end with an internal flange 37 and with an external flange 38. At an intermediate position the liner 22 is provided with radially spaced lugs 39, and at its lower end the liner is provided with an external flange 41 having vertical passages 42 formed therethrough. The top and bottom flanges 38 and 41 are in slidable engagement with the upper and lower sections 12 and 13, respectively, of the cylinder 11. At its upper end the cylinder 11 is provided with air bleed passages 45.

Referring now more particularly to Fig. 3 in which the piston 21 is shown in two different positions, a top latch 50 is provided, such latch comprising a pawl 51 pivotal about a fixed axis 52. The pawl 51 is urged counterclockwise as viewed in Fig. 3 by means of a spring 53 so as to seat in a recess 54 formed in the flange 37 when the liner is in its upper position. The lugs 39 are provided with any desired number of latch pins 55 (of which only one is shown), each of which is urged inwardly by a spring 56 so as to seat in a groove 57 formed in the piston 21 when the latter abuts the flange 39.

The device operates as follows. Assume that the cylinder 11 and tubes 30 are in the collapsed position and that the piston 21 is in its down position as illustrated in Fig. 2. Hydraulic pressure is admitted through the conduit 20, causing pressure to bear against flange 15 of upper cylinder section 12 and against piston 21. Section 12 and piston 21 will move upwardly together until annular member 19 limits against flange 14. The cylinder is now in its extended position and it will be latched in such position by means of pawls 18 and wedge 19a. Continued application of pressure will disengage piston 21 from pins 55, thus unlatching it, and it will travel to the top of the cylinder as shown in Fig. 1. On striking flange 37 at the upper end of liner 22, piston 21 will carry the liner upwardly until it also reaches the top of the cylinder and is latched in its up position by means of pawls 51.

When it is desired to lower the hook 28 and a load suspended therefrom, pressure is bled through conduit 20. The load on hook 28 will pull downwardly on piston 21, causing it to travel down the liner 22. On striking lugs 39, the piston will rock pawl 51 (which has a slanting nose, as illustrated) and will disengage it. Thereafter, liner 22 will travel downwardly with the piston to the position shown in Fig. 2 (except, of course, that the upper cylinder section 12 will remain in its up position).

When it is desired to lift a load, pressure is admitted through conduit 20, and piston 21 and liner 22 will undergo the sequence described above with reference to erection of the cylinder.

Meanwhile, as piston 21 moves up or down, the nestable tubes 30 will extend or retract to provide at all times a sheathing for the wire line 23.

Referring now to Figs. 4, 5 and 6, there is shown another embodiment of the invention which is generally designated as 71 and which comprises a cylinder 72. The cylinder 72 includes an upper section 73 and a lower section 74 which are of sectional, telescoping construction as in the case of the cylinder of Figs. 1, 2 and 3, and are provided with similar means (not shown) for latching them in the extended position. A liner 77 is provided in which a piston 78 is reciprocable. The liner 77 is provided at its upper end with an internal flange 79 and an external flange 80 and at its lower end it is provided with an external flange 85 having passages 86 formed therethrough. A plurality of nestable tubes collectively designated as 87 are provided, comprising an upper set of tubes 88 and a lower set of tubes 89. The upper set of tubes 88 comprises an innermost tube 90 fixed to the piston, an outermost tube 91 fixed to the lower end of the liner 77 and intermediate tubes 92 and 93. The lower set of tubes 89 comprises an innermost tube 94 fixed to the lower end of the liner 77 and to the tube 91, an outermost tube 95 fixed to the bottom of the cylinder and intermediate tubes 96 and 97. These tubes are provided with flanges as illustrated and in the same manner as the tubes illustrated in Figs. 1 and 2, for the purpose of providing a sealing engagement between the tubes and to limit their axial movement. The cylinder 72 is provided at its lower end with a supply conduit 98, and a wire line 99 is fixed at one end to the piston 78 and is led over a bottom sheave 100

and a crown sheave 101 and is operated by the piston.

In operation, this embodiment of the invention functions as follows: In Fig. 6 the piston is shown in its down position and the upper and lower sets of tubes 88 and 89 are shown in their collapsed or telescoped condition. Also, the liner 77 is shown in its down position. When fluid under pressure is admitted to the cylinders through the conduit 98, the piston 78 is pushed upwardly to the top of the liner 77, thus extending the upper set of tubes 88 as illustrated in Fig. 5. Thereafter, further upward travel of the piston will carry with it the liner 77 to the top of the cylinder, thereby extending the lower set of nestable tubes 89, as illustrated in Fig. 5.

It will be noted that the liner 77 is floating and is at all times free to move relatively to the piston except when the piston is at the end of a stroke. Thus, the liner is not provided with a mechanical latch for latching it in either its up or down position as in the case of the device of Figs. 1 and 2.

Ordinarily, this freedom of movement of the liner would be objectionable. Thus, in moving the piston 78 between two predetermined positions in the cylinder 72, it is desirable that a predetermined, constant quantity of fluid be delivered to or drained from the cylinder. Since the liner 77 is free to move, this is obviously impossible without the provision of means to compensate for the displacement or void created by movement of the liner. Such compensating means is provided by the nestable tube arrangement illustrated in the drawings and described hereinabove. Thus, assume that while the piston 78 moves from its bottom position, as shown in Fig. 6, to its intermediate position, as shown in Fig. 5, the liner 77 also moves upwardly. Such movement of the liner tends to create a void, but such movement will also extend the lower set of nestable tubes 89. The extension of these nestable tubes will displace liquid while the upwardly moving liner is creating a void, and by simple calculations based upon the dimensions of the liner and of the nestable tubes 89, it is possible to design and provide tubes which will displace an amount of liquid equal in volume to the void created by the liner. Similarly, when the piston 78 moves downwardly from its top position, as shown in Fig. 4, should the liner also move downwardly before the upper set of tubes 88 are completely collapsed, the liner will of course displace fluid in the lower part of the cylinder 72. However, in so moving, the liner will cause the lower set of tubes 89 to collapse, thus creating a void equal to the volume of liquid displaced by the liner.

Referring now to Fig. 7, there is shown still another embodiment of the invention which is generally designated as 110 and which comprises a sectional, telescoping cylinder including an upper section 112 and a lower section 113 provided with latch means (not shown) as in the case of the cylinders described above and with a liner 115. A piston 116 is reciprocable in the liner and operates a wire line 117. A supply conduit 118 communicates with the lower end of the cylinder 111. The liner 115 is formed at its upper end with an internal flange 119 and with an external flange 120, and at its lower end the liner is formed with an external flange 126 having passages 127 formed therethrough. A plurality of nestable tubes are provided for sealing the wire line 117, such tubes comprising an innermost tube 128 fixed to the piston, an intermediate tube 129 in slidable, sealing engagement with the tube 128 and a tube 130 in slidable, sealing engagement with the tube 129. The tube 130 is in slidable, sealing engagement with a flange or collar 131 fixed to the lower end of the liner and having passages 132 formed therethrough. At its lower end, the tube 130 is provided with an external flange 134 which is in slidable, sealing engagement with a tube 135 which is fixed to the collar 131. The tube 135 is slidable in an intermediate tube 136. The tube 136 is, in turn, in slidable, sealing engagement with an outermost tube 137 fixed to the bottom of the cylinder.

This embodiment of the invention operates similarly to that illustrated in Figs. 4, 5 and 6. That is to say, the liner 115 is of the floating type and is not latched mechanically in either its up or down position. Thus, the liner 115 is free to move relatively to the piston 116 and to displace fluid or to create a void. However, as in the case of the device of Figs. 4, 5 and 6, the nestable tube arrangement is such as to compensate for liquid displacement or the voids resulting from movement of the liner 115.

Thus, it will be apparent that an hydraulically operable device has been provided including a cylinder, a liner disposed concentrically within and spaced from the cylinder, a piston reciprocable in the liner, a wire line operated by the piston, and sealing means comprising nestable tubes for sealing the wire lines. Such device is operable to permit a long stroke of the piston, yet the liner is of considerably smaller length than the cylinder; in fact, it is only about half the length thereof. It will be apparent that a considerable saving of material is effected. Of even greater importance, a saving in manufacturing costs is effected owing to the fact that the short liner is much easier to manipulate and machine. Several forms of the device are provided, one of which includes mechanical latch means for latching the liner in its up position until it is disengaged therefrom by means of the piston, thereafter traveling with the piston either upwardly or downwardly within the cylinder. In other forms of the invention, the liner is free to float or move relatively to the piston but means is provided for compensating for displacement of liquid or the creation of voids resulting from movement of the liner. In all forms of the invention, provision is also made for telescoping the cylinder. Thus when the device is to be stored or transported, it may be collapsed into a relatively small, compact form.

While we have shown the preferred form of our invention, it is to be understood that various changes may be made in its construction by those skilled in the art without departing from the spirit of the invention as defined in the appended claims.

Having thus described our invention, what we claim and desire to secure by Letters Patent is:

1. A device of the character described comprising a cylinder, a liner reciprocable therein and of substantially lesser length than the cylinder, a piston reciprocable within the liner for operating a wire line fixed thereto and passing through one end of the cylinder, latch means at one end of the cylinder for latching the liner at said end of the cylinder, and abutment means for engaging said piston to cause the piston and liner to travel together in both directions, said abutment means including a first abutment member nearer said latch means and a second abutment member spaced farther from said latch means, said latch means being yieldable so as to unlatch the liner

when the piston strikes said second abutment member.

2. A fluid pressure operated device comprising a cylinder having a fluid pressure inlet and outlet, a liner reciprocable within and of substantially shorter length than the cylinder, a piston reciprocable within the liner, and means actuated by the liner operable to compensate for movement of the liner relative to the piston and thereby maintain a constant fluid capacity in the cylinder for a given position of the piston with respect to the cylinder.

3. A fluid pressure operated device comprising a cylinder having a fluid pressure inlet and outlet, a liner reciprocable within and of substantially shorter length than the cylinder, a piston reciprocable within the liner, and means actuated by the liner operable to compensate for movement of the liner relative to the piston and thereby maintain a constant fluid capacity in the cylinder for a given position of the piston with respect to the cylinder, said means comprising a group of nestable tubes fixed at one end to the cylinder and at the other end to the liner, said tubes being extended or collapsed by movement of the liner to thereby create a displacement or a void to compensate for a void or displacement caused by movement of the liner.

4. A fluid pressure operated device comprising a cylinder having a fluid pressure inlet and outlet, a liner reciprocable within and of substantially shorter length than the cylinder, a piston reciprocable within the liner, a first set of nestable tubes including a tube fixed to one end of the cylinder and a tube fixed to one end of the liner, and a second set of nestable tubes including a tube fixed to said end of the liner and a tube fixed to said piston, said tubes being such as to displace liquid when extended and to create a void when collapsed to compensate for variations in fluid capacity of the cylinder resulting from movement of the liner.

5. A fluid pressure operated device comprising a cylinder having a fluid pressure inlet and outlet, a liner reciprocable within and of substantially shorter length than the cylinder, a piston reciprocable within the liner, and a plurality of nestable tubes including a tube fixed to the piston, a tube fixed to one end of the cylinder, and an intermediate tube fixed to one end of said liner, said tubes being such as to displace liquid when extended and create a void when collapsed to compensate for variations in fluid capacity of the cylinder resulting from movement of the liner.

6. A collapsible hydraulic device comprising a master cylinder constructed of sections including a first section of greater diameter and a second section of lesser diameter telescopic within the first section, means for clamping said sections in end-to-end relation and in axial alignment, a piston, and means providing a cylinder to circumscribe said piston and define a path of travel therefor, said means comprising a tubular liner telescopic within said second section and of substantially lesser length than the total length of the cylinder, said liner being provided with axially spaced abutment means to engage the piston so that the liner will be carried by the piston from end to end of the cylinder.

7. A collapsible hydraulic device comprising an outer cylinder of sectional, telescopic construction including a first section of greater diameter and a second section of lesser diameter telescopic within the first section, means for clamping said sections in coaxial, end-to-end relationship, a piston and tubular liner for the piston movable axially within the cylinder, said liner being provided with axially spaced abutment means for engaging the piston so that piston will carry the liner from end to end of the cylinder.

8. A collapsible hydraulic device comprising an outer cylinder of sectional, telescopic construction including a first section of greater diameter and a second section of lesser diameter telescopic within the first section, means for clamping said sections in coaxial, end-to-end relationship, a piston and tubular liner for the piston movable axially within the cylinder, said liner being provided with axially spaced abutment means for engaging the pistons so that piston will carry the liner from end to end of the cylinder, a cable fixed to the piston and passing through one end of the cylinder and a plurality of telescoping tubes for sheathing the cable comprising a tube fixed to the piston and a tube fixed to said end of the cylinder.

9. A collapsible hydraulic device comprising a cylinder including top and bottom sections, said top section being of lesser diameter than and telescopic within said lower section, means for clamping said sections in end-to-end, coaxial relationship, a tubular liner disposed coaxially of and slidable in said upper section, said liner being of substantially lesser length than said cylinder, and being provided with guide means at its upper and lower ends for guiding and centering it in said upper and lower sections, respectively, abutment members disposed within and spaced axially of said liner, a piston reciprocable within said liner between said abutment members, a wire line fixed to said piston and passing through one end of said cylinder, and a plurality of telescoping tubes for sheathing said wire line including a tube fixed to said piston and a tube fixed to said cylinder.

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