United States Patent

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[54] **TELESCOPIC HOIST**
7 Claims, 5 Drawing Figs.

[52] **U.S. Cl.** **91/168,** 91/401, 91/450, 91/468
[51] **Int. Cl.** **F15b 11/18,** F15b 11/22
[50] **Field of Search** ..... 91/168(Cursory), 450(Cursory), 449, 401(Cursory), 167(Cursory), 443, 454, 168(Cursory)

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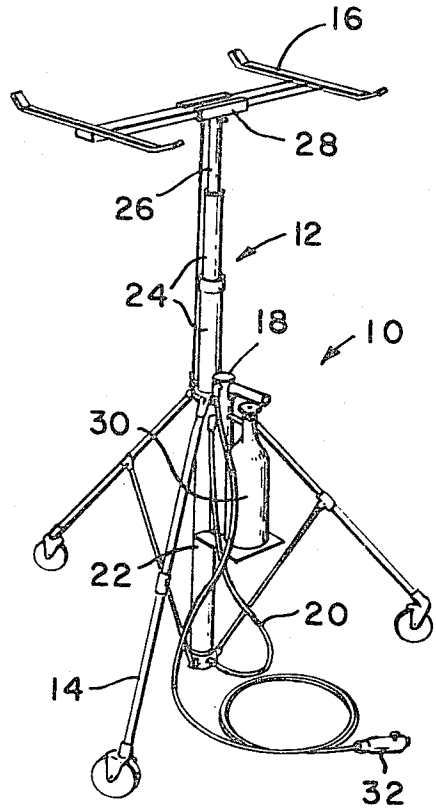
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ABSTRACT: The concentric tubular sections of a telescopic fluid-operated hoist are provided with internal valves adapted to cause the hoist lift cylinder assembly to retract from the base rather than from the top. The hoist may also be provided with a release valve assembly adapted to limit the extended length of the hoist and to permit rapid retraction of the hoist.



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FIG. 2

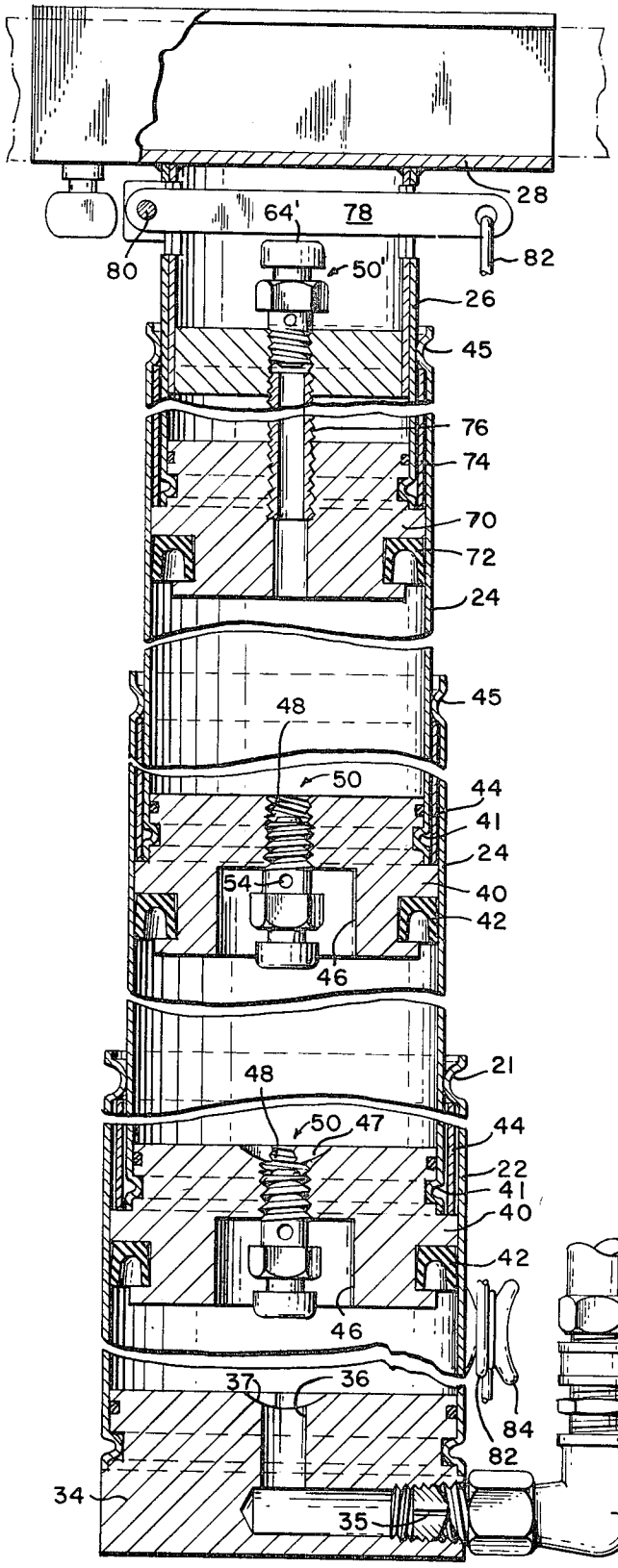


FIG. 3

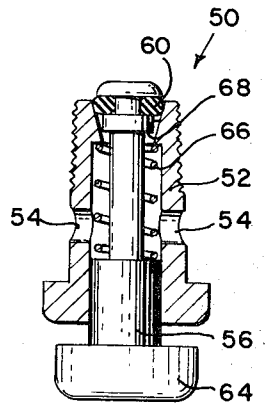
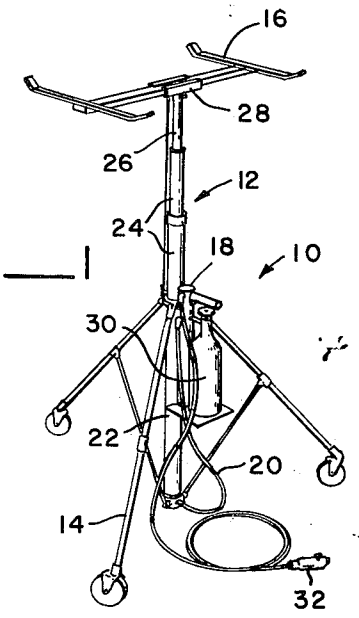


FIG. 1



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FIG. 4

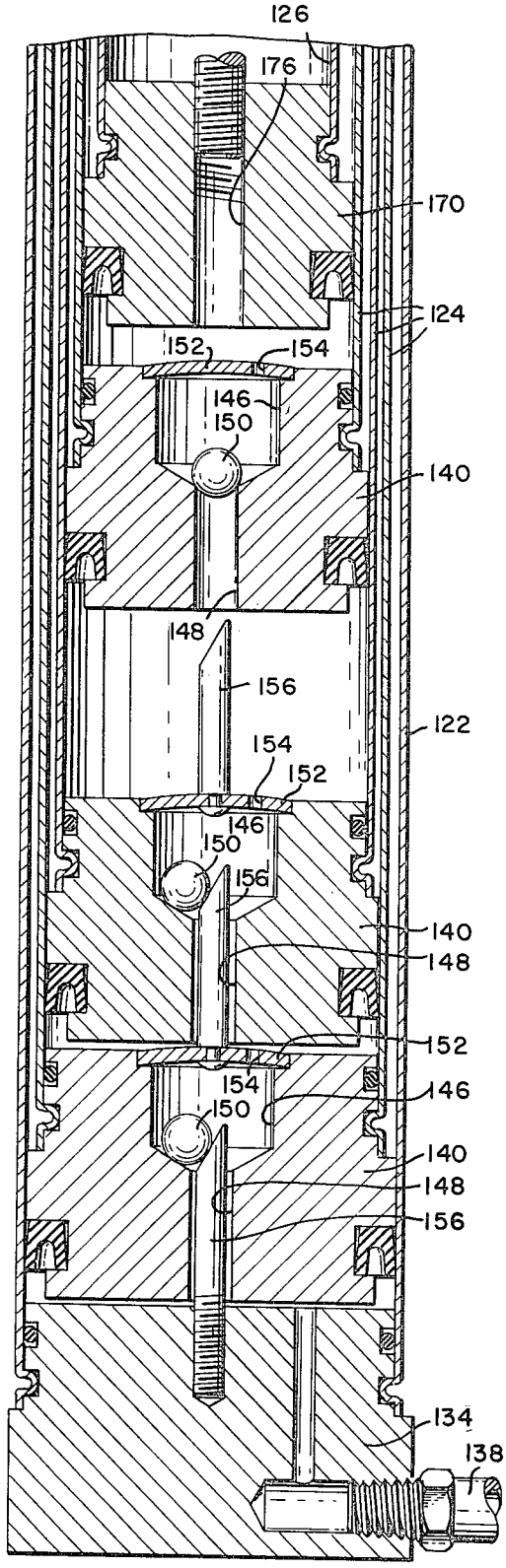
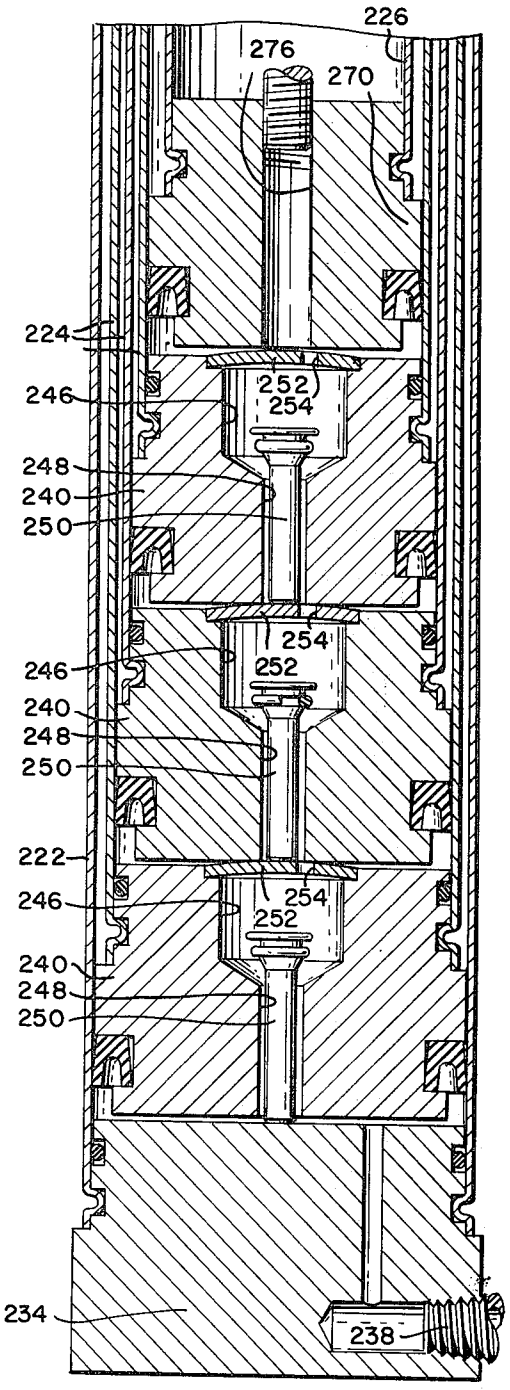


FIG. 5



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TELESCOPIC HOIST

This invention relates to pressurized, compressible fluid-operated hoists. More particularly, this invention relates to hoists designed to telescopically extend and retract to raise and lower loads.

Hoists of the above-described type typically employ telescopic lift cylinder assemblies so constructed that the outermost of the telescopic concentric tubular sections is the most susceptible of extension and the innermost to retraction when compressible fluid is transferred to or from the assembly. In one form, annular pistons are provided on the inner ends of each of the tubular sections and are sized such that the outermost tubular section extends first and then the other tubular sections in sequence proceeding to the innermost. The innermost tubular section will retract before the other tubular sections when fluid is withdrawn. Thus, height adjustment of the lift cylinder assembly in an extended condition can only be effected by the extension or retraction of the innermost tubular section of the lift cylinder assembly. Since the innermost tubular section is the smallest, only relatively insensitive height adjustment can be made vis-a-vis the sensitive height adjustment that could be made by extension and retraction of the larger outermost tubular section.

Hoists of the above-described type are also undesirably sensitive to the compressibility of the fluid. For example when the lift cylinder assembly of such a hoist is telescopically retracted by exhausting the compressible fluid therefrom, the tubular sections will retract erratically and cause the fluid to be alternately compressed and expanded such that the tubular sections will begin to oscillate as they are retracted. At best this oscillation is a nuisance but it can render the hoist inoperable, as would be the case when the hoist is to be only partially collapsed and used. In this case, the hoist could not be used until the tubular section oscillations ceased, which could require several minutes.

Such hoists are further undesirably sensitive to load changes. For example when a load is removed from an extended lift cylinder assembly, the load compensating fluid pressure will cause a sudden extension of the lift cylinder assembly. The degree of this sudden extension will depend upon the weight of the load and the extent to which the lift cylinder is extended at the time the load is removed, of course.

A primary object of the present invention is to provide a hoist having a telescoping lift cylinder assembly so constructed that height adjustment is effected by extension and retraction of a tubular section other than the smaller, innermost tubular section. Another object is to provide such a lift cylinder assembly with internal valve means adapted to effect sequential extension of concentric tubular sections from the outermost to the innermost and sequential retraction from the outermost to the innermost, with height adjustment being effected by retraction and extension of the outermost extended tubular section.

Other objects and advantages will become apparent from the following description taken in conjunction with the accompanying drawings; in which:

FIG. **1** is a perspective view of a compressed gas-operated hoist embodiment of this invention;

FIG. **2** is a vertical elevation view in partial cross section through the lift cylinder assembly of a hoist;

FIG. **3** is a vertical elevation view in partial cross section of one form of the internal valve elements of the lift cylinder assembly;

FIG. **4** is a vertical elevation in cross section of another lift cylinder assembly employing another type of valve element; and

FIG. **5** is a vertical elevation in cross section of still another lift cylinder assembly employing still another type of valve element.

It is to be understood the word "hoist" as herein employed refers to a variety of structures wherein a load is acted upon, including jacks, extensible levers, and the like, as well as the vertical load lifting structure described in detail herein. As thus employed, the "hoist" may be fixed in place, either pivotally or otherwise, or it may be portable as is the preferred embodiment.

In brief, the invention comprises a fluid-operated hoist, the principal feature of which is a multistage lift cylinder assembly. The lift cylinder assembly comprises a plurality of telescopically extendable and retractable concentric tubular sections including an outermost or base section, at least one intermediate section, and an innermost or upper section. The base section is provided with fluid inlet and outlet means for transferring fluid preferably air into and out of interior of the lift cylinder assembly. The intermediate and upper sections are provided with interiorly mounted piston means that divide the lift cylinder assembly into stages, one stage per telescopically movable tubular section. The piston areas are sized such that their relative areas correspond to the relative diameters of the tubular sections to which they are connected. Each intermediate section piston means also is provided with valve means adapted to permit fluid flow between the base section and the telescopic stages. Each valve means is open when the tubular section with which it is associated —(1) is essentially completely retracted to exhaust fluid from the next adjacent inner cylinder; or (2) is extended to permit fluid transfer into the next adjacent inner cylinder. Each such valve means closes when its tubular section is stopped from extending to close the interior of its tubular section from the interior of the next adjacent outer section. By this combination of relative piston areas and the closable valve means, the larger or outer tubular sections will telescopically extend and retract before the next adjacent inner tubular sections. Consequently height adjustments are made with the largest possible tubular section and are therefore more sensitive.

Referring to the FIGS., a preferred, compressible fluid operated hoist **10** comprises a lift cylinder assembly **12**, a tripod assembly **14** mounting the lift cylinder assembly, a load-supporting assembly **16** mounted atop the lift cylinder assembly, and a power source **18** communicating with the interior of the lift cylinder assembly through a hose **20**. The lift cylinder assembly comprises an elongated tubular base section **22**, at least one elongated tubular intermediate section **24** (two such concentric intermediate sections being shown, the smaller of the two being telescopically contained within the larger and the larger being telescopically contained with the base section), and an elongated tubular upper section **26** (telescopically contained within the smaller of the two intermediate sections). The tripod assembly is applied to the lift cylinder assembly base section, and the load-supporting assembly is applied to the lift cylinder assembly by means of a mounting bracket **28** attached to the outer end of the lift cylinder assembly upper section. The self-contained power source is detachably carried on a mounting bracket and preferably comprises a pressurized container **30** of fluid such as CO_2, suitable pressure regulators and gauges, a manifold designed to transfer fluid to and from the lift cylinder assembly through a hand-held manually operable flow control valve assembly **32**.

The base section **22** is capped at its lower end by a block **34** which contains a suitable porting **36**, including a flow control orifice **35**, to permit fluid to be transferred to and from the interior of the base section through a quick-disconnect coupling **38**. The upper end of the base section is roll-formed to provide an annular crimp or rib at **21** as a guide bearing and to retain the larger of the two intermediate sections.

The two intermediate tubular sections are constructed similarly except for diameter, and each is capped at the lower end by a disk piston **40** having a peripheral sealing gasket **42** in sliding contact with the inner wall of the outer adjacently concentric lower section. Each such intermediate tubular section is attached to its respective disk piston by a roll-formed inwardly extending annulus **41** fitted into a groove in the piston. A spacer sleeve **44** encircles each tubular section **24** and extends upward from the piston **40** to limit the degree of extension from the outer adjacently concentric lower section by

abutment against the latter's roll formed upper end **45**. As shown in the drawing, each such sleeve is formed independently of the tubular section and floats between a shoulder on piston **40** and the crimp **21** on the next outer tubular section. The bottom portion of each intermediate section piston is provided with a recessed cavity **46** from which a threaded passage **48** extends upward through the piston.

A typical valve assembly **50** is shown in FIG. **3** threadedly secured in each such passage **48**. The valve assembly shown comprises an externally threaded hollow housing **52** having one or more ports **54** through the shank thereof providing communication to the housing interior. A plunger-type valve element **56** extends axially through the housing and is provided with an O-ring seal **60** at its upper shank end, (the lower O-ring seal contacting the inner surface of the housing **52** below the ports **54**), and with an enlarged actuating head **64** at its lower end. The valve element may be surface, thereby opening the valve, before the piston itself is contacted from below.

The upper tube section **26** is capped at its lower end by a disk piston **70** having a peripheral sealing gasket **72** in sliding contact with the inner wall surface of the smaller of the two intermediate sections by abutment against the latter's roll-formed upper end **45**. An exhaust tube **76** extends upwardly from the disk piston **70** and is closed at its upper end by a limit and quick exhaust valve assembly **50'** which is identical to the aforementioned valve assemblies **50** but inverted as shown. An actuating lever **78** is pivotally connected to the upper end of the upper section at **80** and extends therethrough adjacent to the valve element head **64'** of the valve assembly **50'**. The end of the actuating lever **78** opposite pivot point **80** is adapted to have a height limiting and release cord **82** attached thereto and extended downward to a suitable connector **84** mounted on the outer section **22**.

With the lift cylinder assembly in the extended and stopped position depicted in FIG. **2**, the intermediate section valve means **50** and the relief valve **50'** are closed. Consequently, any final positioning height adjustment must be made by transferring air from or to the base section **22** so as to telescopically lower or raise the lowermost movable tubular section (*i.e.* the larger of the two intermediate sections), the remaining movable sections being raised and lowered as a unit locked into their extended positions by reason of the closed valve means.

When the tubular section containing the lowermost valve means has been lowered to a substantially fully retracted position, that valve means will be opened by upward movement of its plunger upon contact with either the base cap of the base section **22** or a projection therefrom. The base cap portion **36** is provided with a countersunk slot **37** so that the valve head **64** does not seal the porting upon contact with the base cap. Upon opening of this valve means, the next lower tubular section (*i.e.* the smaller of the two intermediate sections) can be telescopically raised and lowered with the remaining movable sections being raised and lowered as a unit. The porting in the lower intermediate section piston is also provided with a countersunk slot **47** to prevent the overhead valve head from sealing the porting on contact therewith.

To raise the lift cylinder assembly from a fully retracted condition, compressed CO_2 is transferred to the base cylinder through the coupling **38** flow control orifice **35** and porting **36**. At this time all of the piston valves will be held open. Consequently, gas will first flow through all of the piston ports to fill the cylinder assembly until the pressure on the largest and lowest piston is sufficiently great to support the weight of the assembly above it. At that time the lowest piston will be moved upward so that its valve will close and prevent further supply of gas to the tubular sections above the lowest piston. The pressure of the gas in the sealed base cylinder will extend the lowermost intermediate section to its full extent at which time the increase in gas pressure within the base cylinder will lift the valve element in the lowermost intermediate tubular section piston off its seat to permit additional fluid transfer therethrough to the next adjacent intermediate cylinder. Such additional fluid will be supplied at a pressure higher than that initially supplied to the base cylinder. Such pressure will be sufficiently greater as to produce a force on the piston received in the lowermost intermediate tubular section to raise such piston and the portion of the hoist mechanism above it. Such upward movement will enable the valve in the piston of the next adjacent intermediate cylinder to close so that the pressure acting on such piston will extend its intermediate tubular section, and so forth until the desired extension of the lift cylinder assembly is attained. When the desired lift cylinder extension is reached, fluid transfer to the base cylinder is terminated whereupon the valve elements in the intermediate section pistons which are not held open will settle onto their seats to close off the adjacent stages from one another.

At this point, upward height adjustment can be made by transferring fluid to the base cylinder whereupon the outermost nonfully extended section will be telescopically adjusted, the valve elements in the pistons of the lower fully extended sections being lifted off their respective seats. Height adjustment downward is made by exhausting fluid from the base section whereupon the lowermost intermediate section will telescopically retract.

Thus in the present invention, all extension and retraction normally occurs by telescopic movement of the section having the largest piston area which will be the section that is not physically restrained against movement in the desired direction which has the lowest piston. Normally, no tubular section can be retracted until all of the larger concentric tubular sections have been fully retracted so as to displace the latter's valve elements. No tubular section can be extended until all of the larger concentric tubular sections have been fully extended such that continued transfer of fluid into the base cylinder will unseat the latter's valve elements.

When the lift cylinder assembly is to be extended to a predetermined height, the release cord **82** can be tied to connector **84** such that the lever **78** will pivot to open the release valve **50'** when the desired height is reached. Opening of the valve **50'** will permit excess fluid to be exhausted therethrough to prevent further extension of the lift cylinder assembly. When fluid transfer to the base section is terminated, the valve **50'** will be spring biased closed and the lift cylinder assembly maintained at the desired height.

If the load carried by the lift cylinder assembly is substantial, the fluid pressure within the assembly will be substantial enough that removal of the load will tend to cause the assembly to suddenly extend further. By attaching the release cord **82** to the connector **84**, however, any such extension will pivot lever **78** to open valve **50'** thereby exhausting the excess fluid to the degree necessary to prevent the extension.

The flow control orifice restriction **35** is sufficiently large to permit reasonably rapid extension and retraction of the lift cylinder assembly. However, it is sufficiently small that any break in the fluid supply line will not result in the outright collapse of a loaded and extended lift cylinder assembly.

If it is desired to retract the lift cylinder assembly more rapidly than can be done by exhausting CO_2 through orifice **35**, the release valve **50'** can be opened by pulling the cord **82**, thereby quickly exhausting CO_2 out through the top of the lift cylinder assembly. This, of course, will cause the upper section **26** to telescopically retract first, just the reverse of the above-described normal mode of operation.

The release valve **50'** or its equivalent can be located top or bottom of the lift cylinder assembly and either internally or externally thereof. Thus, the release valve **50'** alternately can be externally mounted to the top of the upper section **26** in communication with the interior thereof, in which case the release cord **82** could be directly connected to the valve. As a second alternative, the release valve **50'** could be mounted to the base section **22** in communication with the interior thereof as by suitable porting through the base block **34**, in which case the release cord **82** could be directly connected thereto and extend upwardly to an opposite end connecting point, or it could

be connected to a lever assembly similar to actuating lever **78**. If the release valve **50'** were mounted in communication with the interior of the base section **22**, for example as in the case of the above-mentioned second alternative, retraction of the lift cylinder assembly by gas exhaust through valve **50'** would proceed in the above-described normal mode.

FIG. **4** depicts another valve assembly embodiment as applied to a lift cylinder assembly having three intermediate tubular sections. Each of the intermediate section pistons **140** is axially bored to provide a recessed cavity **146** in the upper portion from which a passage **148** extends downwardly through the lower portion. A ball **150** of slightly larger diameter than the passage **148** resides in each cavity **146** and normally seats over the upper end of passage **148**. Each ball is retained by a disk-type expansion plug **152** fitted across the top of the cavity **146** and provided with an offcenter fluid passage **154** therethrough. The expansion plugs of all but the uppermost intermediate section piston axially mount actuating rods or tubes **156** of sufficient length to extend through the passage of the next adjacent upper piston to dislodge the ball from the top of such passage when the next adjacent upper intermediate section is retracted. The upper end of each of these rods is tapered to facilitate ball dislodgement. The base cap **134** is also axially provided with a similar rod to dislodge the ball in the lowermost intermediate section piston.

The above-described FIG. **4** valve arrangement functions in the same manner as the FIG. **2** arrangement. Thus when the lift cylinder assembly is extending, the lowermost intermediate cylinder extends first, due to its larger piston area. When the lowermost intermediate cylinder has fully extended, fluid passes through its passage **148**, dislodges its ball **150** from its seat, and flows through the passage **154** in its plug **152** to extend the next lower intermediate cylinder, and so forth until the desired height is reached. When the lift cylinder assembly has reached the desired height and fluid transfer is terminated, the balls **150** return to their seats and close off the adjacent stages from one another. When the lift cylinder assembly is retracted, the lowermost unretracted section telescopically retracts first and the upper sections do not telescopically retract until the next lower section is fully retracted and its ball dislodged from its seat.

FIG. **5** depicts still another valve assembly embodiment as applied to a lift cylinder assembly having three intermediate tubular sections. Each of the intermediate section pistons **240** are ported as in the FIG. **4** embodiment with upper recessed cavities **246** and lower passages **248**, the cavities being closed by expansion plugs **252** with offcenter passages **254** therethrough. The valve element **250** in this FIG. **5** embodiment is a plunger type having an elongated stem that extends through its respective passage **248** and having an enlarged head with an encircling O-ring seal adapted to normally seat over the upper ends of the respective passages **248**. The valve element stem is sufficiently long to protrude below its respective passage **248** such that it can be contacted from below to dislodge the valve element head from its seat when the intermediate section containing it is substantially fully retracted. This embodiment also functions similarly to the FIG. **2** embodiment.

It is believed that the invention will have been clearly understood from the foregoing detailed description. Changes in the details of construction may be resorted to without departing from the spirit of the invention and it is accordingly my intention that no limitations be implied and that the hereto annexed claims be given the broadest interpretation to which the employed language fairly admits.

I claim:

1. A compressible fluid-operated, multistage hoist comprising a telescopically extendable and retractable lift cylinder assembly composed of a plurality of concentric elongated tubular sections including a base section of relatively large cross section, at least one intermediate section of intermediate cross section and a top section of relatively small cross section, a plurality of piston means in superposed relationship provided, respectively, in the intermediate and top sections, and valve means in the lowest piston means including a hollow valve housing carried by such piston means, having an open upper end providing fluid communication between the tubular cylinder sections above and below such lowered piston means, said housing including a ported side wall affording communication between the tubular section below said housing and the interior of said housing, and a valve plunger movable in said housing to open a passage through the upper portion thereof.

2. A compressible fluid-operated, multistage hoist comprising a telescopically extendable and retractable lift cylinder assembly composed of a plurality of concentric elongated tubular sections including a base section of relatively large cross section, at least one intermediate section of intermediate cross section and a top section of relatively small cross section, a plurality of piston means in superposed relationship provided, respectively, in the intermediate and top sections, normally closed limit valve means mounted on said lift cylinder assembly for communication with the interior thereof, and a lever pivotally mounted on said lift cylinder assembly in a position to contact and open said limit valve means to exhaust fluid therethrough when said lift cylinder assembly is extended a predetermined amount to prevent further extension of said lift cylinder assembly.

3. A compressible fluid-operated, multistage hoist comprising a telescopically extendable and retractable lift cylinder assembly composed of a plurality of concentric elongated tubular sections including a base section of relatively large cross section, at least one intermediate section of intermediate cross section and a top section of relatively small cross section, a plurality of piston means in superposed relationship provided, respectively in the intermediate and top sections, means for extending and retracting said lift cylinder assembly including means for supplying fluid under pressure to said lift cylinder assembly and restricted passage means through which fluid is discharged from the interior of said lift cylinder assembly for limiting the speed of retracting movement of such assembly, and quick-exhaust valve means mounted on said lift cylinder assembly for communication with the interior thereof, bypassing said restricted passage means and adapted to be opened for rapid retraction of said lift cylinder assembly.

4. A compressible fluid-operated multistage hoist comprising a telescopically extendable and retractable lift cylinder assembly composed of a plurality of concentric elongated tubular sections including a base section of relatively large cross section, at least one intermediate section of intermediate cross section and a top section of relatively small cross section, a plurality of piston means in superposed relationship provided, respectively, in the intermediate and top sections, the exterior of each tubular section being substantially smaller than the interior of the next larger tubular section in which it is received telescopically, the upper end portion of each tubular section having an inwardly projecting annular rib engageable by the interior of the next smaller tubular section for guiding such next smaller tubular section for lengthwise movement relative to the section having said rib, and a sleeve between each tubular section and the next smaller tubular section received telescopically within it and formed independently of both tubular sections between which it is disposed, the upper edge of said spacer sleeve being engageable with the inwardly projecting rib of the tubular section next outwardly of it, and the lower edge of said spacer sleeve being engageable with the piston means of such next smaller tubular section for limiting relative extension movement of the tubular sections between which said spacer sleeve is disposed.

5. The hoist defined in claim **4**, in which the spacer sleeve is detached from and floats between the tubular section next outwardly from it and the tubular section next inwardly from it.

6. A compressible fluid-operated multistage hoist comprising a telescopically extendable and retractable lift cylinder assembly composed of a plurality of concentric elongated tubular sections including a base section of relatively large cross

section, at least one intermediate section of intermediate cross section and a top section of relatively small cross section, a plurality of piston means in superposed relationship provided, respectively, in the intermediate and top sections, means for extending and retracting said lift cylinder assembly including control valve means for successively supplying fluid under pressure to the undersides of said piston means, for moving said tubular sections successively from a collapsed relation to an extended relation, starting with the intermediate tubular section having the largest piston means, and for exhausting fluid from the lift cylinder assembly for collapsing said lift cylinder assembly from an extended condition starting with the intermediate section having the largest piston means, and a restricted passage means through which fluid is exhausted from said lift cylinder assembly for retracting it, which passage its sufficiently restricted to damp contracting movement of said lift cylinder assembly effected by the weight of its structure, and quick-exhaust valve means mounted on said lift cylinder assembly for communication with the interior thereof, bypassing said restricted passage means and adapted to be opened for rapid contraction of said lift cylinder assembly.

7. The hoist defined in claim **6**, in which the restricted passage is in the base section of the lift cylinder assembly and the quick-exhaust valve means are in the base section of the lift cylinder assembly.