June 3, 1952 R. J. ANDERSON 2,598,875

HYDRAULIC ASSEMBLY FOR ADJUSTABLE LADDER LEG EXTENSION

Filed April 9, 1951 2 SHEETS—SHEET 1

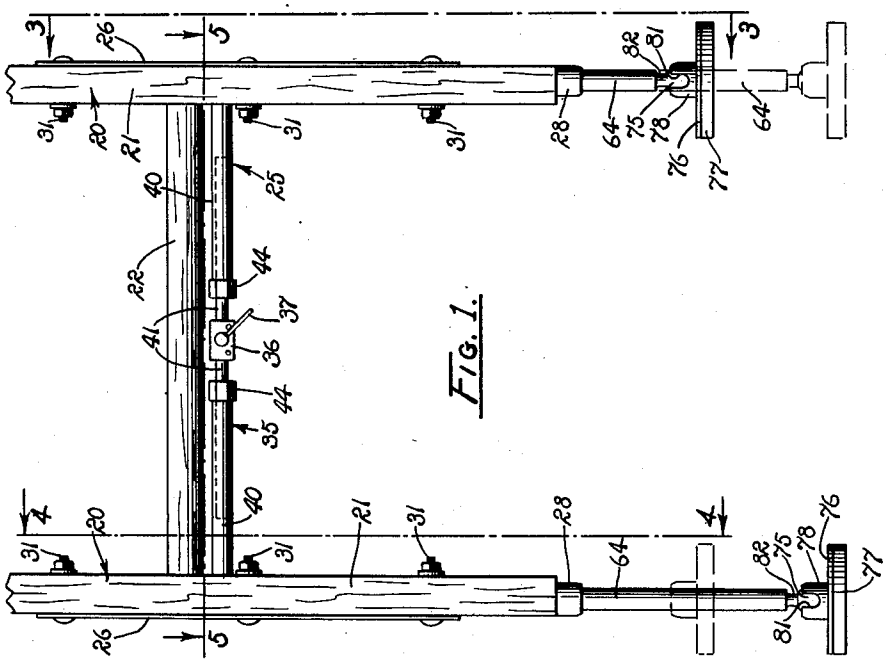


FIG. 1.

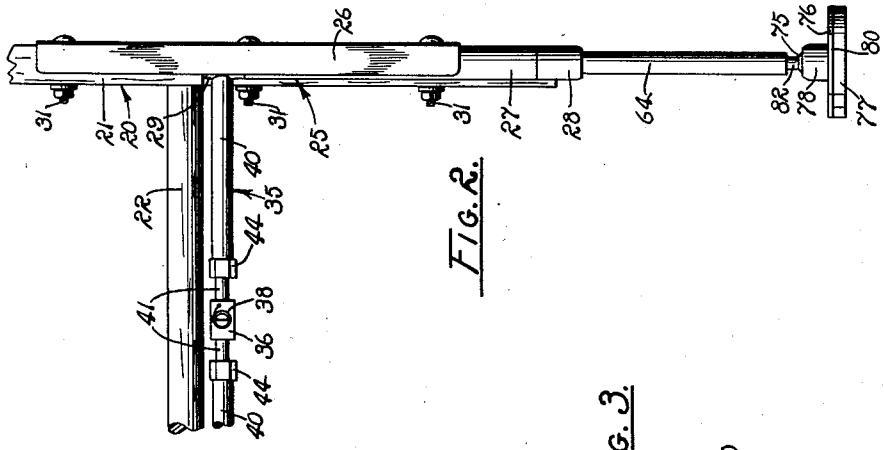


FIG. 2.

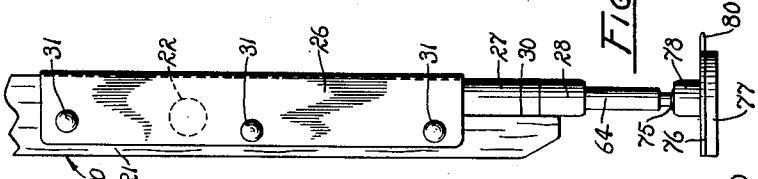


FIG. 3.

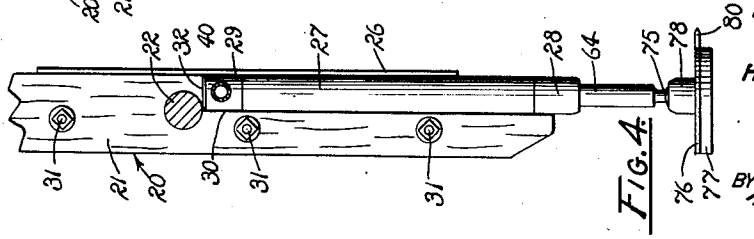


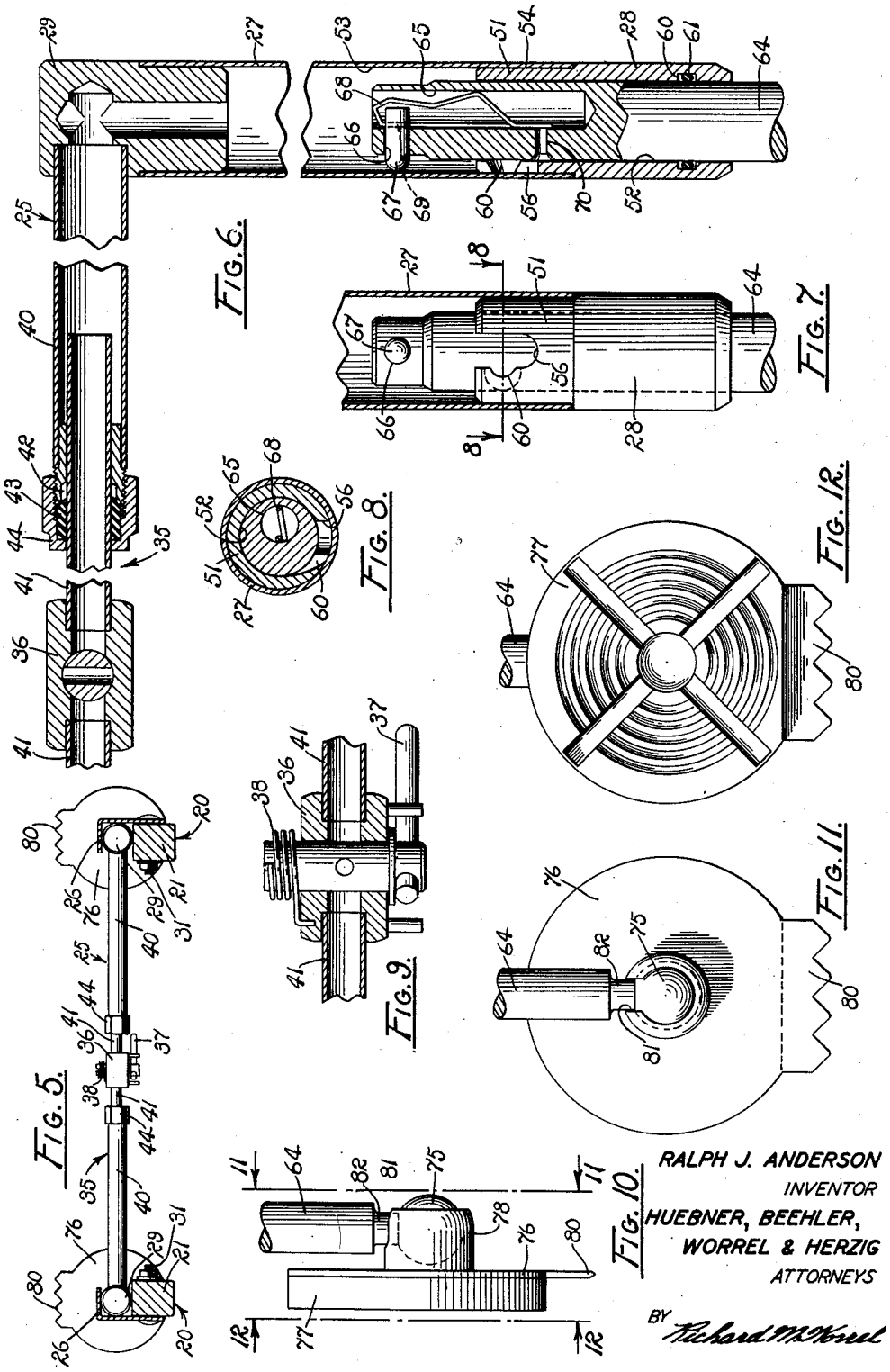
FIG. 4.

RALPH J. ANDERSON
INVENTOR
HUEBNER, BEEHLER,
WORREL & HERZIG
ATTORNEYS
BY Richard M. Worrel

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RALPH J. ANDERSON
INVENTOR
HUEBNER, BEEHLER,
WORREL & HERZIG
ATTORNEYS
BY Richard M. Worrel

Patented June 3, 1952 2,598,875

UNITED STATES PATENT OFFICE

2,598,875

HYDRAULIC ASSEMBLY FOR ADJUSTABLE LADDER LEG EXTENSION

Ralph J. Anderson, Tulare, Calif., assignor of one-half to Kenneth Billingsly, Tulare, Calif.

Application April 9, 1951, Serial No. 219,949

6 Claims. (Cl. 228—63)

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The present invention relates to hydraulic systems and more particularly to a system which for descriptive convenience is illustrated herein in connection with load equalizing devices for support legs such as that described in my copending U. S. patent application Serial No. 16,090 filed March 20, 1948, and has especial reference to an improved plunger and cylinder construction and association useable therein.

It is to be understood that the present invention is not necessarily restricted to employment in load equalizing devices for ladders and the like but may be utilized in any suitable operational environment without departing from the spirit or scope of the invention. For descriptive convenience, however, the invention is illustrated in connection with the support of ladders.

Various structures have been provided for utilizing loads supported on ladder legs and the telescopically adjustable characteristics of such legs to accommodate uneven terrain. In my copending application identified above, is described a load equalizing device which is also suitable for continuous compensation for elevational variations in a support surface on which the ladder is rested, such as an undulating platform, and which also automatically equalizes the loads supported on the ladder legs during displacement of the ladder from initial position by the imposition of independently extended forces thereon. Although my previous loading equalizing device has proved successful it has been subject to certain difficulties which the present invention seeks to overcome.

Originally, an excessive number of joints and connections were required to assemble the device. A closeable feed opening was necessitated for purposes of supplying hydraulic fluid and for bleeding air therefrom. Every joint, connection, closed opening and the like constitutes a potential area of leakage and increases production costs. The production costs increase precise requirements for close tolerances in associated elements and for skilled labor in the construction and assembly thereof. Further, the weight and cost of materials utilized has been found to have been greater than necessary and substantial reductions therein attainable by the practice of the present invention.

An object of the present invention is to provide an improved load equalizing support means for ladders and the like characterized by improved safety characteristics.

Another object is to provide an improved load equalizing support means for ladders and the like

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for automatically accommodating uneven terrain, compensating for varied support conditions, minimizing opportunities for inadvertent displacement, and adapted to provide stationary support in predetermined attitude even when rested on a continuously or successively tipped, tilted, undulated or otherwise displaced support surface.

Another object is to minimize joints and connections in hydraulic systems.

Another object is to obviate in hydraulic systems employing cylinders and plungers the previous necessity for filling and bleeding openings.

Another object is to reduce the cost of hydraulic systems by minimizing requirements for close tolerances in associated elements and requirements for skilled labor in construction and assembly.

Another object is to reduce the weight of hydraulic control systems without impairing the durability thereof and conversely to make possible a substantial increase in durability without materially increasing the weight.

Another object is to provide a hydraulic system including a plunger telescopically associated with a tubular member which system is automatically sealed by the slidable insertion of the plunger into the tubular member and which plunger is automatically locked against inadvertent disassociation from the tubular member by such insertion.

A further object is to provide improved elements and arrangements thereof in a device of the character and for the purposes set forth.

Further objects and advantages will become apparent in the subsequent description in the specification.

In the drawings:

Fig. 1 is a fragmentary front elevation of a straight ladder supported on a hydraulic load equalizing system embodying the principles of the present invention.

Fig. 2 is a fragmentary rear elevation of the structure shown in Fig. 1.

Fig. 3 is a fragmentary side elevation of the ladder and system shown in Fig. 1 taken along line 3—3 of Fig. 1.

Fig. 4 is a fragmentary side elevation of a ladder leg and portion of the support system mounted thereon, as taken on line 4—4 of Fig. 1.

Fig. 5 is a horizontal section taken on line 5—5 of Fig. 1.

Fig. 6 is a somewhat enlarged fragmentary vertical section of a load equalizing support system embodying the principles of the present invention taken on line 6—6 of Fig. 5.

Fig. 7 is a somewhat enlarged fragmentary side elevation of a tubular member and associated plunger.

Fig. 8 is a section taken on line 8—8 of Fig. 7.

Fig. 9 is a somewhat enlarged horizontal section illustrating a suitable valve structure optionally employed in the system.

Fig. 10 is a somewhat enlarged side elevation of the lower end of a plunger and associated foot positioned as employed to bring teeth thereof into downwardly disposed position.

Fig. 11 is an elevation of the structure shown in Fig. 10, as viewed in line 11—11.

Fig. 12 is a side elevation of the structure shown in Fig. 10 as taken on line 12—12.

Referring in greater detail to the drawings:

A straight ladder, fragmentarily illustrated in Figs. 1 to 4, is indicated generally at 20 consisting of a pair of elongated legs 21 interconnected in fixed spaced relation by rungs exemplified at 22. As is well known, the legs may be in parallel, divergent, or convergent relation as desired.

A load equalizing device for the legs 21 of the ladder 20 embodying the principles of the present invention is indicated generally at 25. The system is mounted on a pair of elongated angle brackets 26 for convenient attachment to the ladder legs or other objects to be supported. An elongated cylindrical tubular member 27 is weldably or otherwise secured longitudinally in each of the brackets in the inner corners defined by the angular cross-sectional form thereof. The tubular members each provide an open end portion 28 endwardly extended from the bracket on which the tubular member is mounted and an opposite closed end portion 29.

The ladder legs are notched, as shown at 30 in Fig. 4, to receive the tubular members 27 and the brackets bolted to the ladder legs, as at 31 in overlaying relation to the notches and tubular members. The notches further provide downwardly disposed shoulders 32 in rested relation on the closed ends 29 of the tubular members when the ladder is in an upwardly extended position.

The closed upper ends of the tubular members 27 are interconnected by a telescopically adjustable conduit 35 with the tubular members 27 in substantially parallel relation preferably of sufficiently malleable or flexible material to permit displacement of the brackets and tubular members from parallel relation subsequent to telescopic adjustment to accommodate ladders having divergent or convergent legs. The conduit 35 preferably is provided with a valve 36 therein intermediate the tubular members whereby fluid flow through the conduit may be restricted or precluded as well as opened for substantially unimpeded fluid flow therethrough. The valve preferably provides an operating handle 37 and may optionally incorporate a spring 38 resiliently to urge the valve into closed position.

The conduit is formed by welding outer tubes 40 to the upper end portions 29 of the tubular members 27 in communication with the hollow interiors thereof and laterally extended in juxtaposition inwardly from the legs 21 on which their respective tubular members are mounted. Inner tubes 41 are weldably or otherwise secured to the valve 36 and oppositely extended therefrom telescopically into the inwardly extended ends of the outer tubes 40. The inwardly extended ends of the outer tubes 40 are counterbored at 42 and peripherally screw-threaded. An annular packing ring 43 is nested within the counterbore 42 and a slip nut 44 slidably fitted to each of the inner tubes 41 and screw-threadably mounted on their adjacent outer tubes 40 and tightened to provide fluid-tight interconnection of the pipes.

As a production convenience, the open end portion 28 of each tubular member 27 is formed by a hollow cylindrical extension mounted in each of the tubular members 27. The extension provides a sleeve 51 fitted to its respective tubular member and weldably secured thereto. The extension simply provides a production expedient for providing each of the ground members with a bore 52 of predetermined diameter at the ends of the tubular members and a counterbore 53 of appreciably greater diameter.

The sleeve 51 has an exterior surface 54 tightly fitted to the counterbore 53 and an internal surface concentric thereto defining the bore 52. A slot 56 is formed radially through the sleeve longitudinally of the sleeve 51 from the inner end thereof providing a groove having a bottom defined by the inner surface of the counterbore portion 53. Each of the sleeves is also provided with an inwardly disposed camway 60 laterally extended from its longitudinal slot 56. Each of the camways has an end adjacent to the slot formed through the sleeve and is extended laterally from the slot in progressively decreased depth, eccentric to the longitudinal axes of the tubular member and sleeve on which it is formed to a point of disappearance at the inner surface of the sleeve in circumferentially spaced relation to the slot. The configuration of the camway and its relation to the slot are most clearly observable in Figs. 7 and 8.

It will be seen that the slot 56 has an outer end in spaced relation to the outer end of the sleeve 51. An inwardly disposed annular groove 60 is provided in the sleeve adjacent to the open end portion thereof in spaced relation to the slot and has an annular packing member 61, such as an O-ring packing of neoprene, rubber or other suitable material. An elongated plunger 64 is slidably fitted to each of the sleeves 51 and is extended therethrough into each sleeve's respective tubular member 27 inwardly of the sleeve. A bore 65 is formed longitudinally of each of the plungers from the inner end thereof for a distance approximately that of the spacing of the outer ends of the slots 56 from the packing members 61. An opening 66 is formed radially in the inner end of each of the plungers in communication with the bores 65. A detent 67 is mounted in each of the openings 66 for radial reciprocal movement and is urged radially outwardly by a leaf spring 68 inserted into the bore 65 and mounted in its detent as at 69 to limit outward movement thereof as well as to urge its detent radially outwardly to the fullest extent permitted by such connection. A bleeding port 70 is radially extended from the inner end portion of the bore 65 to the side of each plunger at a distance from its respective detent substantially equal to the spacing of the inner end of the slots 56 from the packing members 61 for purposes soon to become apparent.

The outer ends of the plungers 64 are provided with ball members 75. A substantially circular foot 76 having a downwardly disposed tread 77 of suitable slip resisting material is mounted for universal movement on each of the ball members by ball embracing cups 78. A serrated blade 80 is rigidly mounted on each of the feet in radially extended position. As demonstrated in Figs. 10, 11, and 12, the feet may be turned up-

wardly so as to support the ladder **20** on the serrated blade **80** as for resisting slipping on ice and the like. Such tipping is accommodated by a slot **81** formed in the cup adapted to receive a portion **82** of reduced diameter of its respective plunger **27** adjacent to the embraced ball member **75**. The slot is formed downwardly from the upper edge of the cup a distance sufficient to permit tipping from the normal position shown in Figs. 1 to 4 through an annular distance slightly greater than 90° to the positions shown in Figs. 10, 11, and 12 in which position the weight supported on the serrated blade **80** serves to maintain the foot in the upwardly tipped position for anti-skid support.

Operation

The utility of the device of the present invention is believed to be clearly apparent and is briefly summarized at this point. To install the attachment **25** on a ladder **20** the legs **21** thereof are preferably notched as described and the brackets **26** bolted in place as previously described. By loosening the nuts **44** the inner and outer tubes **41** and **40** are telescopically adjusted to accommodate the lateral spacing of the legs. So adjusted the nuts are tightened bringing the packing ring **43** into fluid-tight engagement with both the inner and outer tubes. With the tubular members **27** laterally spaced for appropriate bracket mounting on the legs, the telescopic conduit is radially bent or flexed to accommodate any normally encountered displacement of the legs **21** from precise parallel relation.

In order to fill the system with hydraulic fluid either before or after mounting the attachment **25** on a ladder or other object to be supported, the tubular members **27** are positioned with their open ends upwardly extended. One of the plungers **64** is shoved inwardly of its respective tubular member to the maximum amount of travel permitted. The other plunger is removed from its respective tubular member in an easily accomplished manner. To remove a plunger it is simply drawn outwardly until the detent **67** rides against the inner end of the sleeve **51** and rotated until the detent finds the slot **56**. Further outward movement of the plunger draws the detent outwardly along the slot. When the detent is aligned with the camway **60**, the plunger is rotated so that the detent is caused to travel along the camway and thus is forced into retracted position in its respective plunger. When the detent is retracted sufficiently to ride on the inner surface **52** of the sleeve, the plunger is radially withdrawn from its tubular member and sleeve.

Oil or other suitable hydraulic fluid is poured into the open end of the tubular member **27** from which the plunger **64** has been removed substantially filling the telescopic conduit **35**, including the valve **36**, and both of the tubular members **27** not occupied by the remaining plunger. As the system is thus filled with hydraulic fluid, the opposite plunger may be moved outwardly to facilitate filling as desired. When an adequate supply of fluid has been introduced, the removed plunger is simply slid inwardly through its respective sleeve and into its tubular member until the detent **66** passes the inner end of the sleeve **51** and snaps radially under the urging of the spring **68** to lock the plunger in tubular member engagement. To facilitate such insertion the inner ends of both plungers are preferably chamfered. It will be observed that the bore **65** and

the port **70** of the inserted plunger **64** permits exhaust of excess fluid from the system incident to insertion of the plunger and the emission of any air trapped therein.

As the plunger is thrust inwardly it is rotated and because of the described spacing of the detent **66** and port **70** relative to the outer end of the slot **56** and packing member **61**, the detent is thrust radially of the plunger into the camway **60** or the outer end of the slot concurrently with movement of the port inwardly past the packing member. Subsequently, the plunger is moved inwardly of the slot beyond the sleeve **51** and the device is ready for use. It will be obvious that the simple insertion of the removed plunger seals the entire system for operation.

If during filling, air is trapped in the tubular member **27** opposite from that into which the fluid is introduced, the opposite plunger is moved outwardly in its sleeve in the manner previously described a distance sufficient to uncover the port **70** and achieve the desired bleeding subsequent to which the plunger is returned to position.

So preconditioned for operation, the ladder **20** may be held in any desired operable attitude on level, sloped, or uneven terrain having elevational variations within the limits of the combined telescopic movements of the plungers in the tubular members and, with the valve **36** opened for a brief period, the weight of the ladder rested on the feet **76** automatically reciprocally adjusts the plunger-tubular member relationships for the support of substantially equal loads on the feet. When the valve is closed, the quantities of hydraulic fluid located on opposite sides thereof precludes movement of the plungers relative to their respective tubular members. In effect, this achieves a nearly instantaneous lengthening and shortening of the legs **21** in response to ladder attitude and type of terrain on which the ladder is supported making possible the use of ladders on floors, stairways, curbs, and the like with equal facility and prompt availability for use.

In some instances it is desirable to leave the valve **36** open during operation in which event the ladder is momentarily held in a working attitude desired to permit accommodation of the plungers **64** in the tubular members **27** to adjust to supporting terrain and the ladder inclined against a support wall or the like. With the valve open, the upper end of the ladder may be thrust laterally across the supporting wall even while supporting a workman with a resultant automatic accommodation of the plungers in their tubular members so that substantially equal weight is supported on each of the feet. Obviously, in such instances an operator supported on the ladder and working the upper end thereof laterally of a supporting wall must be careful to avoid displacing his weight and that of the ladder so far laterally that friction of the upper end of the ladder against the wall is inadequate to preclude falling.

Commercial units of the subject invention have been found to preclude loss of hydraulic fluid even when the ladders are weighted far beyond the maximum loads imposable thereon during use by workmen. No auxiliary filling and bleeding openings are required. A minimum of joints and connections are employed and of such joints, all but the plunger-tubular member association weldably secured or provided with dependable packing. The simple inward rotational thrusting of either plunger serves to seal the system and

to releasably lock the plunger for telescopic movement within its tubular member. The elimination of close tolerance requirements, the simplifying of the construction and the reduction of demands for skilled production labor has materially reduced production costs.

Although the invention has been herein shown and described in what is conceived to be the most practical and preferred method and embodiment, it is recognized that departures may be made therefrom within the scope of the invention, which is not to be limited to the details disclosed herein but is to be accorded the full scope of the claims so as to embrace any and all equivalent devices and systems.

Having described my invention, what I claim as new and desire to secure by Letters Patent is:

1. In a hydraulic system, the combination of a tubular member having an open end, a sleeve having an inner and an outer surface mounted in the open end of the tubular member and having an inwardly disposed camway formed radially therein with an end in communication with the tubular member at the outer surface and inner end of the sleeve and an opposite end at the inner surface of the sleeve; a plunger extended through the sleeve into the tubular member; and a spring-pressed detent radially extended from the plunger endwardly adjacent to the sleeve within the tubular member.

2. In a hydraulic control system, a cylinder having a longitudinal bore and a counterbore coaxial thereto, the cylinder having an inwardly disposed camway therein radially of the bore providing an end in communication with the counterbore having a bottom spaced from the axis of the bore and the counterbore a distance substantially equal to the radius of the counterbore and an opposite end having a bottom at the inner surface of the bore; a plunger slidably extended through the bore into the counterbore; and a spring-pressed detent laterally extended from the plunger within the counterbore.

3. In a hydraulic system, a member having an open-ended cylindrical opening therein, a sleeve mounted within the opening having an inner end provided with a slot longitudinally of the sleeve and an inwardly disposed camway having an end at the slot formed through the sleeve and laterally extended from the slot in progressively decreased depth to a point of disappearance at the inner surface of the sleeve in circumferentially spaced relation to the slot, a plunger extended inwardly through the sleeve axially thereof, and a spring-pressed detent laterally extended from the plunger inwardly of the sleeve.

4. In a hydraulic system, a cylinder having a bore longitudinally thereof, a sleeve mounted with an end within the bore of the cylinder having a slot longitudinally extended from its inner end and an inwardly disposed camway laterally extended from the slot formed eccentrically in the sleeve providing an end at the slot formed radially through the sleeve and an opposite end at the inner surface of the sleeve, a plunger extended through the sleeve into the bore of the cylinder, and a spring-pressed detent laterally extended from the plunger inwardly of the sleeve receivable by the slot and camway and retractable into the plunger.

5. In a hydraulic control system, a cylinder having a bore longitudinally thereof and a coaxial counterbore, the bore having an open outer end and the counterbore having an inner end connected to the hydraulic system, an inwardly disposed groove being provided longitudinally of the cylinder from the inner end of the bore to a depth radially spaced from the axis of the bore and the counterbore substantially equal to the radius of the counterbore, and an inwardly disposed camway in the cylinder radially of the bore having an end at the groove of substantially the same depth as the groove and laterally extended therefrom in progressively decreasing depth to an opposite end at the inner surface of the bore; a plunger slidably extended through the bore into the counterbore; and a spring-pressed detent laterally extended from the plunger within the counterbore receivable by the groove and the camway and retractable into the plunger.

6. In a hydraulic system, the combination of a tubular member having an open end; a sleeve having an inner and an outer surface mounted in the open end of the tubular member and having a slot longitudinally from the inner end thereof to a point in spaced relation to the open end of the sleeve, said sleeve also providing an inwardly disposed camway laterally extended from the slot having an end at the slot formed through the sleeve and an opposite end at the inner surface of the sleeve at a position circumferentially removed from the slot; an annnular seal mounted within the sleeve adjacent to the outer end thereof and in spaced relation to the outer end of the slot; a plunger slidably extended through the seal; and a spring-pressed detent laterally extended from the inner end of the plunger, said plunger having a bore formed longitudinally from the inner end thereof and ported to the side of the plunger at a position spaced from the detent a distance substantially equal to the spacing of the outer end of the slot from the annular seal.

RALPH J. ANDERSON.

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