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Wible et al.

[11] **3,805,681**

[45] **Apr. 23, 1974**

[54] **LIFT CYLINDER ASSEMBLY FOR LIFT TRUCK MAST AND CARRIAGE**

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[73] Assignee: **Towmotor Corporation,** Mentor, Ohio

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[52] **U.S. Cl.** **92/52**
[51] **Int. Cl.** **F01b 7/20**
[58] **Field of Search** 92/51, 52, 53

[56] **References Cited**

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2,887,092 5/1959 Brady ..... 92/51 X

FOREIGN PATENTS OR APPLICATIONS

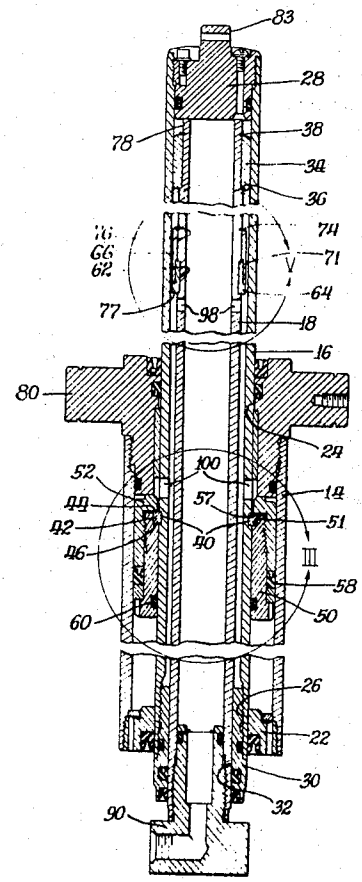
84,544 11/1957 Denmark 92/53

Primary Examiner—Edgar W. Geoghegan
Assistant Examiner—Abraham Hershkovitz
Attorney, Agent, or Firm—Fryer, Tjensvold, Phillips & Lempio

[57] **ABSTRACT**

A lift cylinder assembly has three tubular members, one inside the other, i.e., inner, intermediate, and outer tubular members. Stop means are associated with the outer and intermediate tubular members for determining the extreme positions of one relative to the other. Such means include a split ring disposed in a groove in the outer surface of the intermediate tubular member and the pair of partially overlapping, threadably connected sleeve members which retain the split ring in the groove. A pair of head members are threadably inserted in the ends of the outer tubular member, and contact between the sleeve members and each of these head members determines the extent of travel of the outer and intermediate tubular members relative to each other. Stop means are also associated with the intermediate and inner tubular members for determining the extreme positions of one relative to the other. Such means include a split ring disposed in a groove in the outer surface of the inner tubular member, a single sleeve member having a portion disposed around the split ring to retain it in the groove, and a snap ring positioned in a groove about the inner tubular member to retain the single sleeve member in position. A head member is threadably disposed in one end of the intermediate tubular member, and is positioned to contact the split ring to determine the extent of travel of the inner and intermediate tubular members relatively in one direction, and a head member is threadably disposed in the other end of the intermediate tubular member and is positioned to be contacted by an end of the inner tube to determine the extent of travel of the inner and intermediate tubular members relatively in the other direction.

13 Claims, 9 Drawing Figures



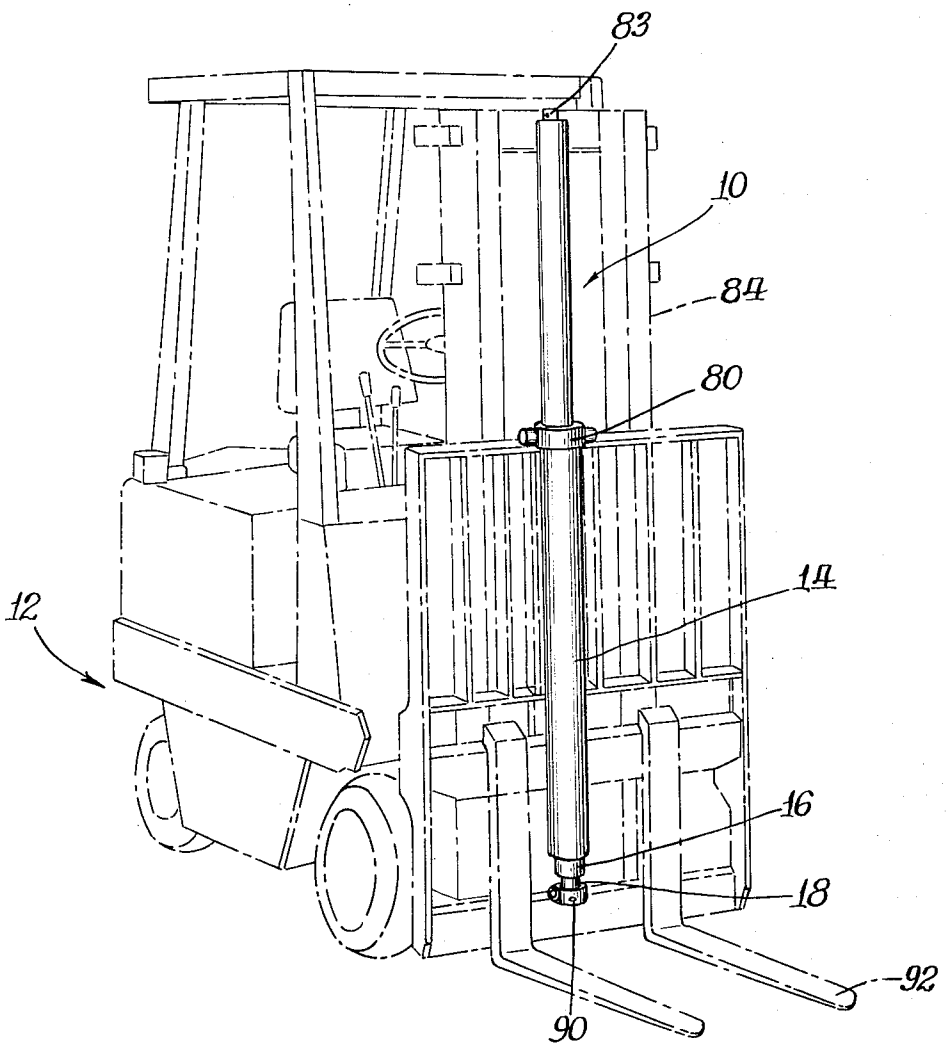


Fig_1_

Fig. 2

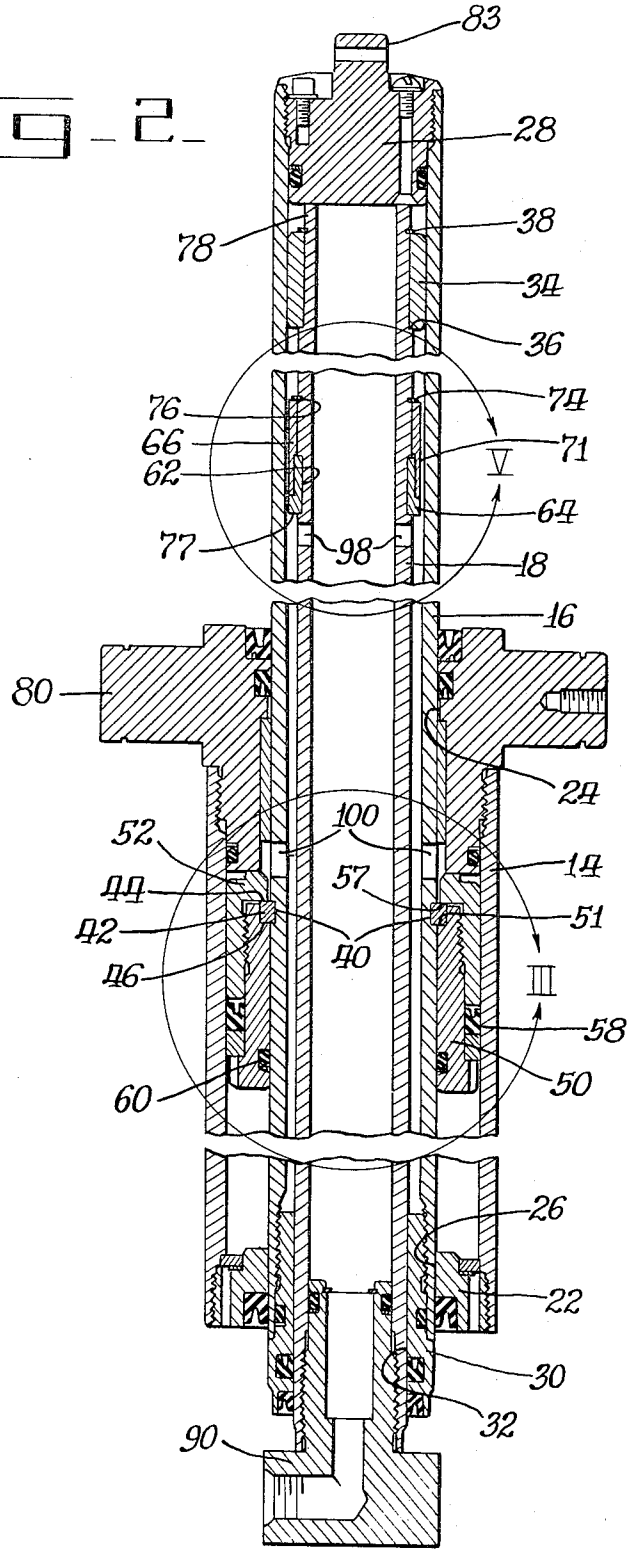

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Fig. 3

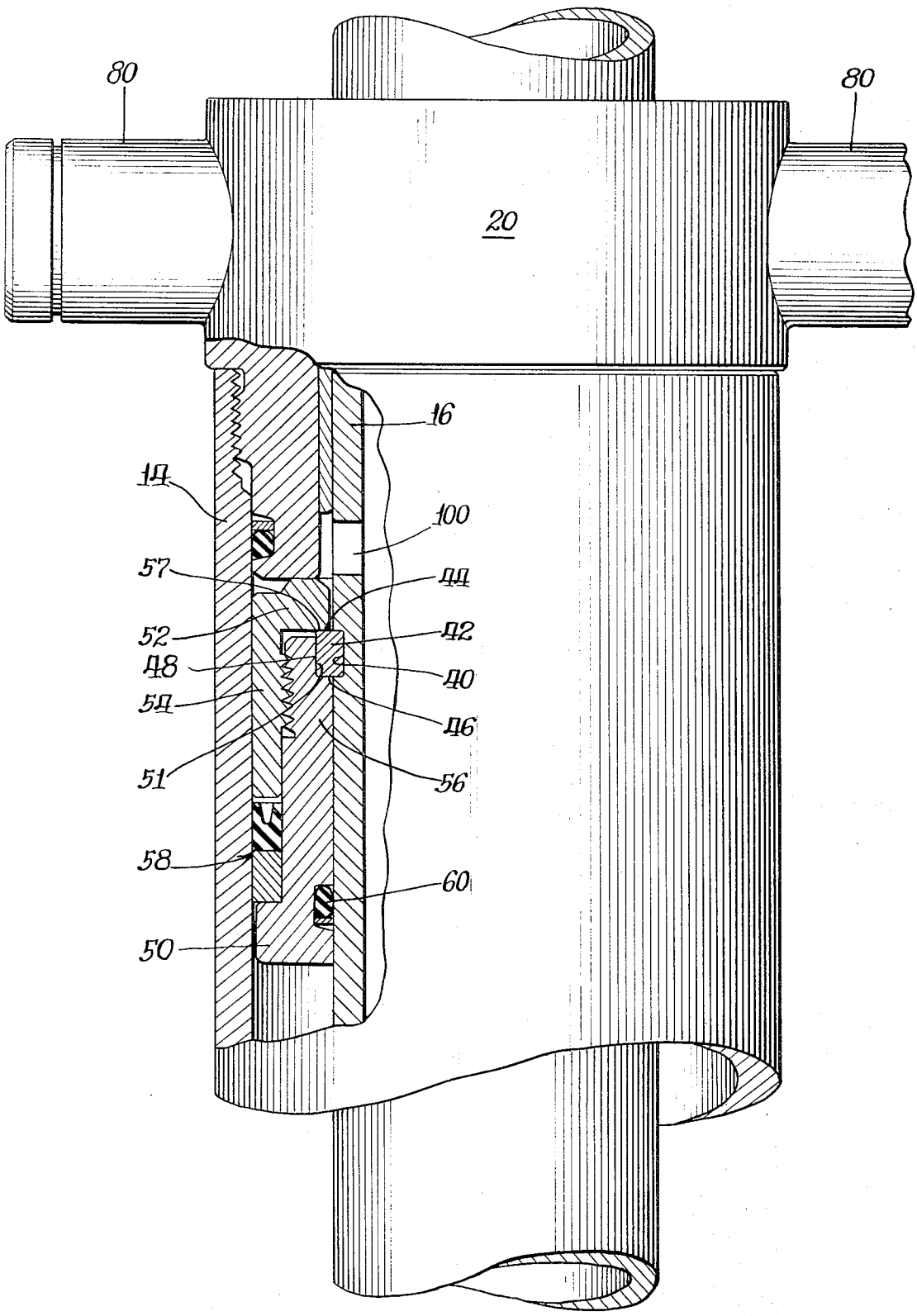


Fig 4

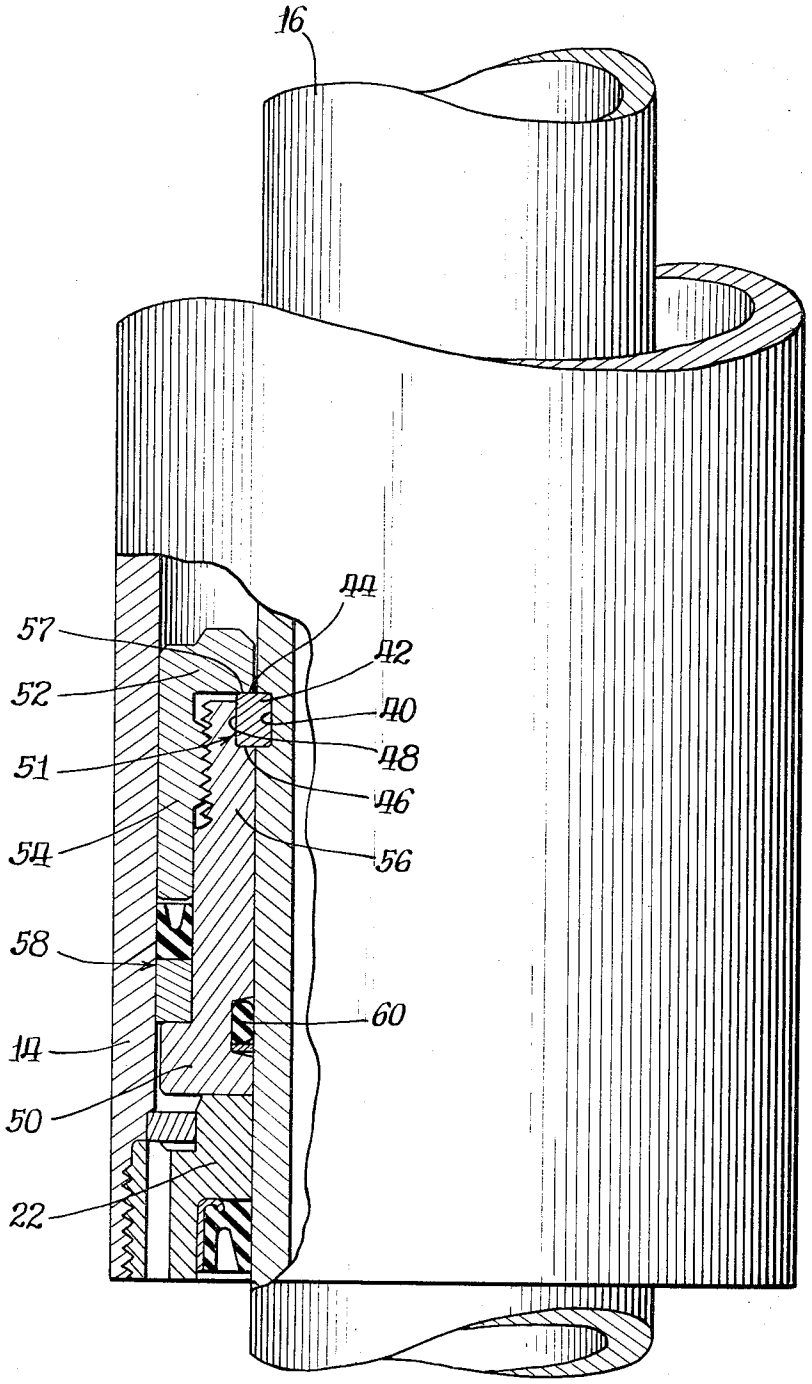


Fig. 5

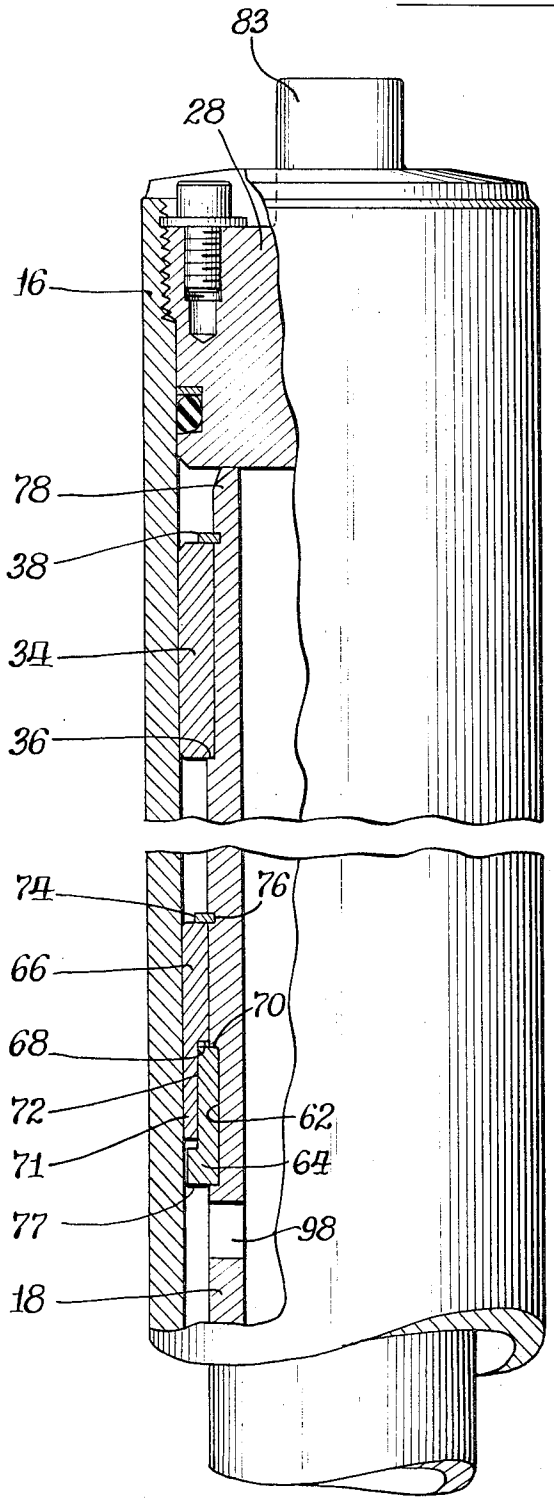
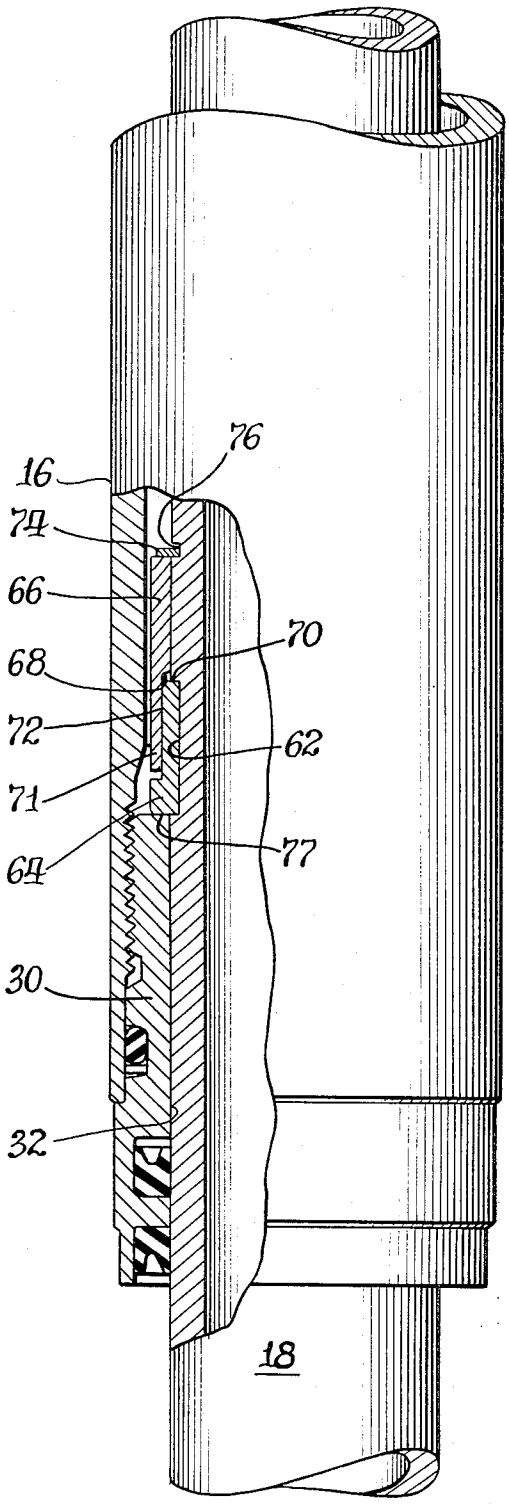


Fig. 6



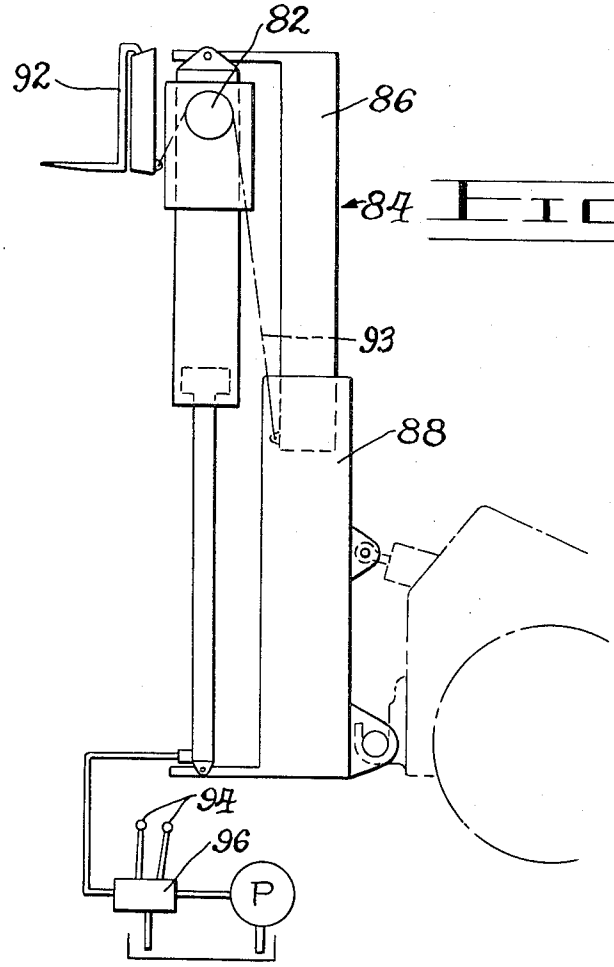


Fig. 9

Fig. 7

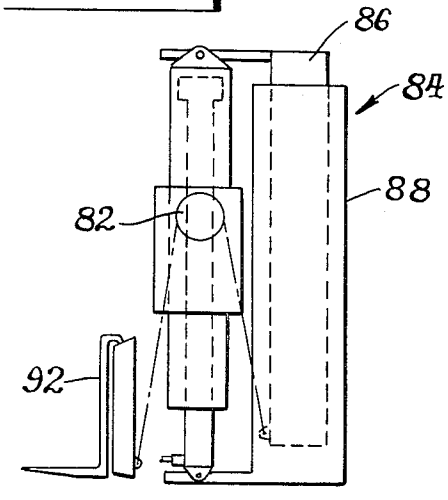
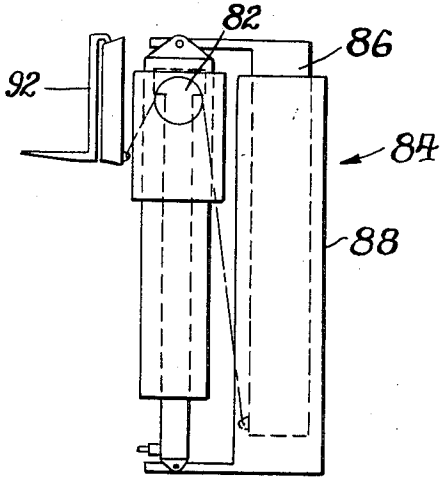


Fig. 8



LIFT CYLINDER ASSEMBLY FOR LIFT TRUCK MAST AND CARRIAGE

BACKGROUND OF THE INVENTION

This invention relates to cylinder assemblies, and more particularly, to a three-tube cylinder assembly and means for determining the extent of travel of a tube thereof relative to the others.

Generally, in a multiple cylinder assembly, i.e., one with tubular members disposed inside one another for telescoping action, means associated with adjacent tubular members are included for determining the extent of travel of one tubular member relative to another in either direction. Such means generally take the form of rings secured, generally by welding, to the inner surface of an outer tubular member and the outer surface of an inner tubular member, positioned to contact each other to so determine such positions. (See, for example, U.S. Pat. No. 2,670,811 to Shaffer, assigned to the assignee of this application, U.S. Pat. No. 2,783,744 to Tennis, U.S. Pat. No. 2,887,092 to Brady, and U.S. Pat. No. 3,136,223 to Evans et al.).

The fitting, positioning, and welding in place of such rings may be quite difficult and inconvenient, especially in the case of those to be fixed to the inner surface of the tubular member. In addition, the welding process can cause tubular member distortion. U.S. Pat. No. 3,279,755 to Notenboom et al. uses snap rings positioned in grooves as stop members. But, while this avoids the welding problem, it is well known that, in a relatively large cylinder assembly, such snap rings are not able to provide a stop of maximum strength and stability.

SUMMARY OF THE INVENTION

It is therefore an object of this invention to provide, in a cylinder assembly, stop means which may be easily and conveniently manufactured and assembled.

It is a further object of this invention to provide, in a cylinder assembly, stop means which, while fulfilling the above object, are extremely effective in determining stop positions, providing relatively great strength and stability.

It is a still further object of this invention to provide a cylinder assembly incorporating a stop system, the entire assembly being simple and lending itself to ease of manufacture.

Broadly stated, the invention is in combination with a cylinder assembly having a tubular member and an elongated member positioned within the tubular member for relative sliding movement therebetween, with the tubular member slidable relative to the elongated member in one and the other directions. Such invention comprises means for limiting said relative sliding movement in said one direction. Such invention comprises an annular groove defined by the outer surface of the elongated member. A split ring is positioned in the annular groove and extends outwardly of the outer surface of the elongated member. Means are disposed around the elongated member and within the tubular member and are positioned to contact the split ring on one side thereof and to retain the split ring in the annular groove. Stop means are associated with the tubular member and are positioned to cooperate with the split ring and means disposed around the elongated member to limit said relative sliding movement in said one direction.

BRIEF DESCRIPTION OF THE DRAWING

These and other objects of the invention will become apparent from the studying of the following specification and drawings, in which:

FIG. 1 is a perspective view of a lift truck incorporating the inventive cylinder assembly;

FIG. 2 is a vertical sectional view of the cylinder assembly;

FIG. 3 is an enlarged view of the area III shown in FIG. 2, showing tubular members thereof in one relative extreme position;

FIG. 4 is a view similar to that shown in FIG. 3, but showing the tubular members thereof in the other relative extreme position;

FIG. 5 is an enlarged view of the area V shown in FIG. 2, showing the tubular members thereof in one relative extreme position;

FIG. 6 is a view similar to that of FIG. 5, but showing the tubular members thereof in the other relative extreme position; and,

FIGS. 7–9 are schematic representations of the operating sequence of the cylinder assembly and its association with the lift mechanism of the lift truck.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Shown generally in FIG. 1 is the inventive lift cylinder assembly **10** as used in a lift truck **12.** The cylinder assembly **10** is shown in detail in FIGS. **2–6** and will now be described. The cylinder assembly **10** includes an elongated tubular member **14,** an elongated tubular member **16** positioned within tubular member **14,** and an elongated tubular member **18** positioned within tubular member **16.** The upper and lower ends of tubular member **14** have threadably fixed thereto respectively head members **20** and **22.** These head members **20** and **22** define internal bores **24,26** through which tubular member **16** is disposed, in intimate relation with the bores **24,26.** Through such means, relative sliding movement between tubular members **14,16** in either direction is allowed.

The upper and lower ends of tubular member **16** have threadably fixed thereto respectively head members **28,30.** Head member **30** defines an internal bore **32** through which tubular member **18** is disposed, in intimate relation with bore **32.** A guide ring **34** is disposed about the upper portion of the tubular member **18** and is positioned thereon by a shoulder **36** formed in the outer surface of the tubular member **18** and a snap ring **38.**

Through such means, relative sliding movement between tubular members **16,18** is allowed.

Suitable sealing or packing means are used in appropriate locations, as shown in FIG. **2.**

The outer surface of tubular member **16** defines an annular groove **40,** in which is positioned a split ring **42** as shown. Such split ring **42** extends outwardly of the outer surface of the tubular member **16,** and defines extending sides **44,46,** and an outer surface **48.** A sleeve member **50** is disposed around the tubular member **16** and has a notched portion **51** adapted to contact the side **46** of split ring **42,** and the outer surface **48** of split ring **42.** A sleeve member **52** is also disposed around the tubular member **16,** and has a portion **54** which is

disposed around a portion 56 of sleeve member 50 and in threaded engagement therewith. Such sleeve member 52 defines a shoulder 57 adapted to contact the side 44 of the split ring 42 when so positioned. Such assembly, comprising split ring 42, sleeve member 50, and sleeve member 52, is disposed within the tubular member 14, in the slidable relation therewith. Such assembly is positioned between head members 20,22. Through such sleeve members 50,52, split ring 42 is retained in annular groove 40.

The head members 20,22 actually function as stop means positioned to limit relative sliding movement between tubular members 14,16 in one and the other direction, by contacting sleeve member 52 or sleeve member 50 respectively, as will later be described in detail. Appropriate packing means 58 are associated with sleeve member 52 and the inner wall of tubular member 14. Similarly, appropriate packing means 60 are associated with sleeve member 50 and the outer wall of the tubular member 16.

Tubular member 18 has an annular groove 62 defined by the outer surface thereof, and a split ring 64 positioned in the annular groove 62 and extending outwardly of the outer surface of the tubular member 18. A sleeve member 66 is disposed around tubular member 18 and defines an inward shoulder portion 68, which is adapted to contact one side 70 of the split ring 64, and an extended portion 71 adapted to contact the outer surface 72 of the split ring 64. A snap ring 74 is positioned in an annular groove 76 defined by the outer surface of the tubular member 18, and is positioned adjacent sleeve member 66 to retain such sleeve member 66 in position to in turn retain the split ring 64 in the annular groove 62. The snap ring 74, however, is positioned to allow a certain clearance space between itself and the sleeve member 66. The entire assembly, made up of split ring 64, sleeve member 66, and snap ring 74, is positioned within the tubular member 16.

Head member 30 functions as stop means positioned to limit relative sliding movement between tubular members 16,18 in one direction by contacting the other side 77 of split ring 64. Head member 28 functions as stop means positioned to limit relative sliding movement between tubular members 16,18 in the other direction by contacting end 78 of tubular member 18, as will now be described in detail.

Head member 20 defines a cross head 80 to which are fixed chain sheaves 82 (FIGS. 7–9). Head member 28 defines an extended portion 83 which is fixed to the top portion of a mast assembly 84, made up of upper and lower members 86,88, as shown in FIG. 1 and FIGS. 7–9. In fact, extended portion 83 is fixed to the upper member 86 of said mast assembly 84. A head member 90 is threadably associated with the bottom end of tubular member 18 and is fixed to the lower member 88 of mast assembly 84. A raisable and lowerable fork carriage 92 is associated with the mast assembly 84, and chains 93 interconnect the fork carriage 92 and the bottom of the upper mast assembly member 86, passing over sheaves 82.

In the operation of the system, a control lever 94 is moved to a "raise" position, causing a control valve 96 to direct hydraulic oil under pressure through head member 90 and into tubular member 18. The oil then enters tubular member 16 through apertures 98, and from there enters tubular member 14 through apertures 100. Due to the greater pressure area (with respect to imposed loads) in the tubular member 14, such tubular member 14 will move first, upwardly relative to the tubular member 16. Upon such movement, fork carriage 92 is moved upwardly at twice the linear speed of a tubular member 14, through chains 93 and sheaves 82. Such movement continues until sleeve member 50 contacts head member 22 (FIGS. 3 & 8). Upon further introduction of oil into the cylinder assembly 10, tubular member 16 (with tubular member 14), moves upwardly relative to tubular member 18. Such movement continues until head member 30 contacts split rings 64 (FIGS. 6 & 9). In such state, fork carriage 92 is in its fully raised position.

In the lowering of the system, hydraulic oil is released from the cylinder assembly 10, allowing tubular member 16 (with tubular member 14) to move downwardly relative to tubular member 18. Such movement continues until head member 28 contacts end portion 78 of tubular member 18. Upon further release of oil from the cylinder assembly 10, tubular member 14 drops relative to tubular member 16. Such movement continues until sleeve member 52 contacts head member 20 (FIGS. 3 & 7) and the fork carriage 92 is in its fully lowered position.

It will be seen that the three-tube cylinder assembly 10 provided herein is extremely effective, meanwhile being quite simple. The stop means provided are quite effective for determining the relative extent of travel between tubular members, yet are extremely simple, requiring no welding, and only the simplest assembly steps. In fact, the entire cylinder assembly 10 is constructed without welding. All components, because of such unique design, can be centerless ground. In addition, no load is imposed on the snap ring involved, because a clearance space is provided between the snap ring and the sleeve member associated therewith.

What is claimed is:

1. In a cylinder assembly having a tubular member and a first elongated member positioned within the tubular member for relative sliding movement thereto, with the tubular member slidable relative to the first elongated member in one and the other directions, first means for limiting said relative sliding movement in one direction comprising:

a first split ring positioned in an annular groove defined by the outer surface of the first elongated member and extending outwardly of the outer surface of the first elongated member;

means separate from said first elongated member disposed around the elongated member and within the tubular member and positioned to contact the first split ring on one side thereof and to retain the first split ring in the annular groove; and,

first stop means associated with the tubular member and positioned to cooperate with the first split ring and means disposed around the first elongated member to limit relative sliding movement in said one direction.

2. The cylinder assembly of claim 1 wherein the first means disposed around the first elongated member contact the first split ring on both sides thereof, and wherein the first stop means contact said first means disposed around the first elongated member upon such relative sliding movement in said one direction to limit said relative sliding movement in said one direction.

3. The cylinder assembly of claim 2 wherein said first means disposed around the first elongated member

comprise a first sleeve member disposed around the first elongated member and adapted to contact one side of the first split ring, and a second sleeve member disposed around the first elongated member and having a portion which is disposed around a portion of the first sleeve member and in threaded engagement therewith, and adapted to contact the other side of first split ring.

4. The cylinder assembly of claim **3** wherein the first sleeve member is adapted to contact the outer surface of the first split ring.

5. The cylinder assembly of claim **4** wherein said first stop means comprise a head member threadably connected to the tubular member.

6. The cylinder assembly of claim **2** and further comprising second stop means associated with the tubular member and positioned to contact said first means disposed around the first elongated member upon such relative sliding movement in said other direction to limit such relative sliding movement in said other direction.

7. The cylinder assembly of claim **6** wherein said first-mentioned stop means comprise a first head member threadably connected to the tubular member, and said second stop means comprise a second head member threadably connected to the tubular member, the first means disposed around the first elongated member being between the first and second head members.

8. The cylinder assembly of claim **7** wherein said first means disposed around the first elongated member comprise a first sleeve member disposed around the first elongated member and adapted to contact one side of the first split ring, and a second sleeve member disposed around the first elongated member and having a portion disposed around a portion of the first sleeve member and in threaded engagement therewith, and adapted to contact the other side of the first split ring.

9. The cylinder assembly of claim **8** wherein the first sleeve member is adapted to contact the outer surface of the first split ring.

10. The cylinder assembly of claim **1** wherein a second means disposed around a second elongated member positioned inside said first elongated member comprise a third sleeve member disposed around the second elongated member and defining an inward shoulder portion and adapted to contact one side of a second split ring positioned in an annular groove defined by the outer surface of the second elongated member, and an extended portion adapted to contact the outer surface of the second split ring, and a snap ring positioned in a second annular groove defined by the outer surface of the second elongated member and positioned adjacent the third sleeve member to retain such third sleeve member in position to retain the second split ring in the first-mentioned annular groove, a third stop means being positioned to contact the other side of said second split ring upon relative sliding movement between the first and second elongated members in one direction to limit said relative sliding movement in said one direction.

11. The cylinder assembly of claim **10** wherein said third stop means comprise a head member threadably connected to the first elongated member.

12. The cylinder assembly of claim **11** and further comprising fourth stop means associated with the first elongated member and positioned to contact an end of the second elongated member upon such relative sliding movement in said other direction to limit such relative sliding movement in said other direction.

13. The cylinder assembly of claim **12** wherein said fourth stop means comprise a second head member threadably connected to the first elongated member.

* * * * *