Aug. 27, 1968 H. K. NANSEL 3,398,645

MULTIPLE EXTENSION APPARATUS

Filed Nov. 30, 1966 2 Sheets-Sheet 1

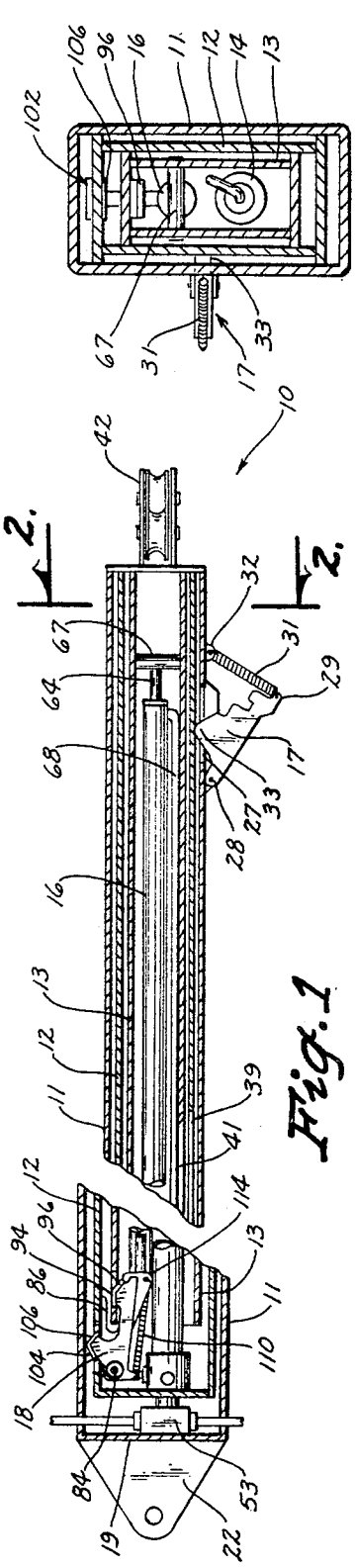


Fig. 1

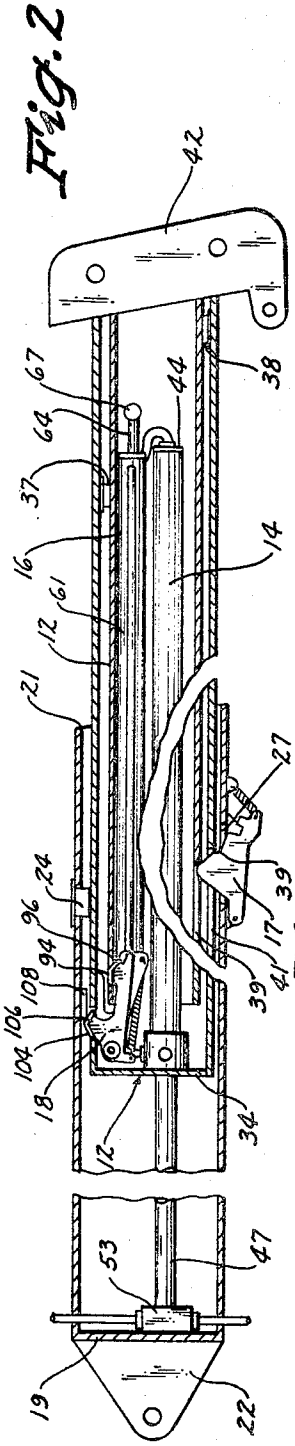


Fig. 2

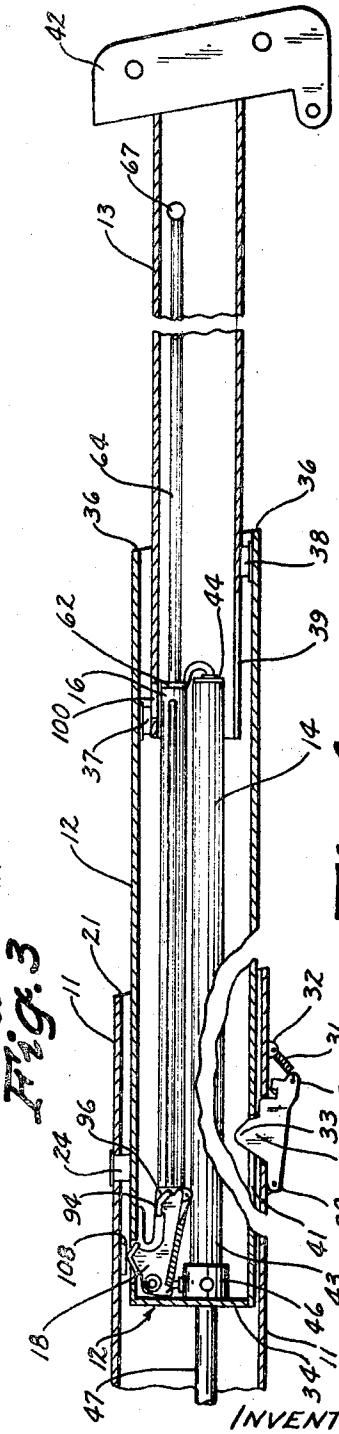


Fig. 3

Fig. 4

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MULTIPLE EXTENSION APPARATUS

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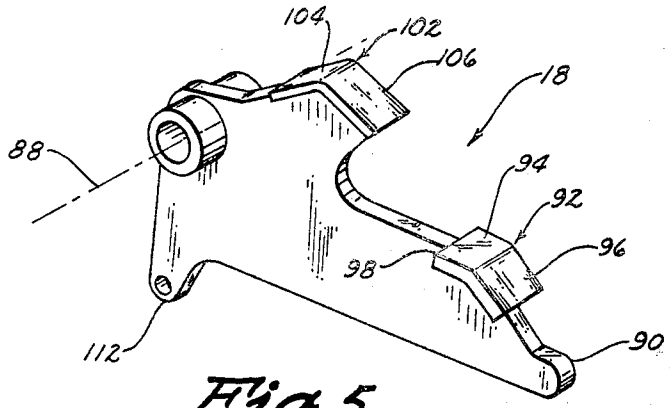


Fig. 5

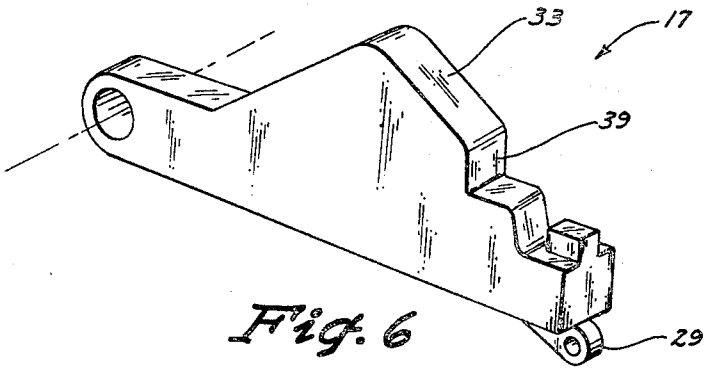


Fig. 6

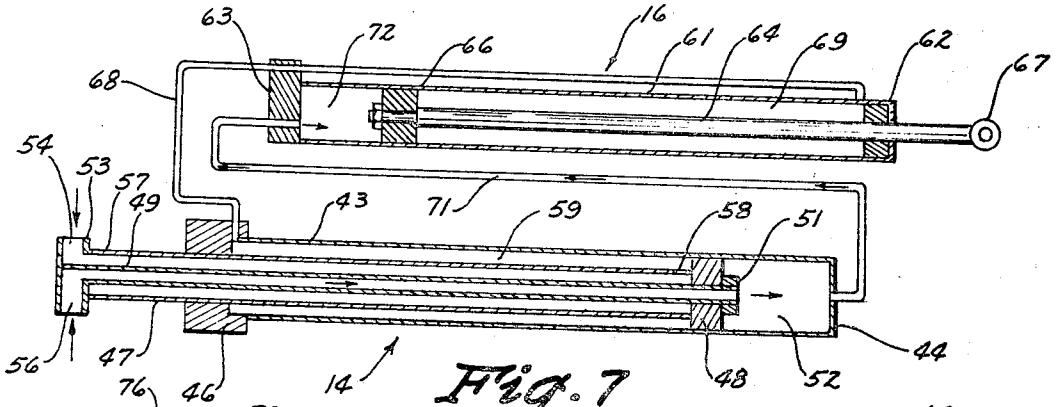


Fig. 7

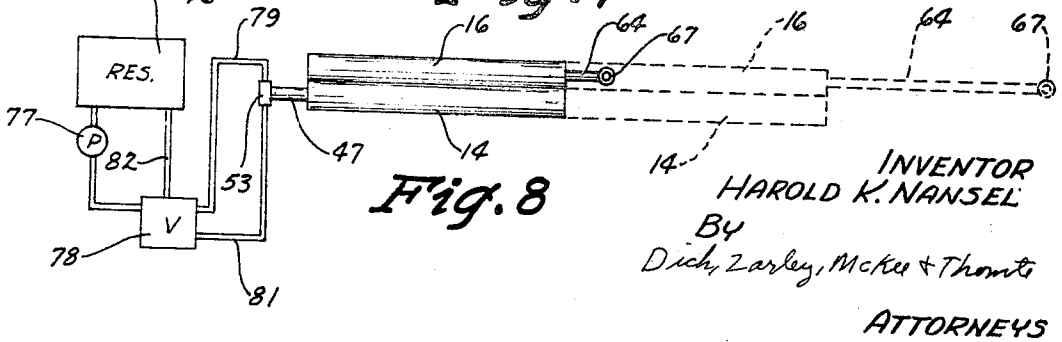


Fig. 8

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MULTIPLE EXTENSION APPARATUS

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8 Claims. (Cl. 91—173)

An apparatus having telescoping sections powered by hydraulic cylinders. Mechanical latches are used to limit extension and retraction of the sections.

The field of art to which this invention pertains is expansible chamber-type motors wherein the extension of the unit is controlled by separate working chambers which equal the sum of the individual chamber extensions.

The relevant prior art to this invention includes applicant's Patent No. 3,250,182, May 10, 1966, entitled, Multiple Extension Apparatus. The unit in this patent required the use of check valves to control the extension and retraction of the multiple sections. The power required to operate the extensions through the check valves was substantially greater than that required by the present invention using locking latches between the cooperating sections.

This invention may be summarized as including a multiple extension apparatus having a first section in which a second section is slidably mounted and a third section being slidably mounted in the second section. Fluid actuated power means is provided to extend and retract the first and second sections relative to each other and a second fluid actuator power means is provided to extend and retract the second and third sections relative to each other. A mechanical latch is included which limits extension of the second and third sections until the first and second sections have been fully extended. A second mechanical latch is provided to assure that the third section is retracted first and then is automatically actuated to permit the first and second sections to be retracted relative to each other.

These and other features and advantages of this invention will become readily apparent to those skilled in the art upon reference to the following description when taken into consideration with the accompanying drawings, wherein:

FIG. 1 is a fragmentary longitudinal cross-sectional view of the multiple extension apparatus wherein the right end fragmentary portion has been rotated 90 degrees relative to the left end fragmentary portion for the purpose of illustrating both mechanical latches;

FIG. 2 is a cross-sectional view taken along line 2—2 in FIG. 1;

FIG. 3 is a cross-sectional view showing the multiple extension apparatus with its sections in a position ready for the third section to be unlatched and extended; the fragmentary portion of the multiple extension apparatus has been rotated 90 degrees for the purpose of illustrating both of the latches in the same figure;

FIG. 4 is a cross-sectional view of the multiple extension apparatus illustrating the three sections fully extended and in particular the outer latch locking the first and second sections in their extended positions; the fragmentary portion in this view is rotated 90 degrees for the purpose of illustrating both of the latches in the same figure;

FIG. 5 is a perspective view of the inner lower latch employed in the multiple extension apparatus;

FIG. 6 is a perspective view of the outer latch employed in the multiple extension apparatus;

FIG. 7 is a sectional view of the cylinder units arranged in hydraulic schematic; and

FIG. 8 is a schematic of the hydraulic elements for the apparatus.

Referring now to the drawings the multiple extension apparatus of this invention is referred to generally by the reference numeral 10 in FIG. 1, and it comprises basically a first section 11, a second section 12, a third section 13, a second section cylinder unit 14, a third section cylinder unit 16, a third section extension limiting latch device 18, and a second section retraction limiting latch 17.

The first section 11 is elongated and rectangular in cross-section and closed at one end 19 and open at the other end 21. The closed end 19 has a tongue 22 secured thereto which can be pivotally connected to any structure stationary or movable as desired. A pair of longitudinally spaced, diametrically opposed supporting blocks 24 (others not shown) are provided with the first section 11, and an elongated opening 27 is formed in one side thereof.

The opening 27 is provided for the latch device 17, pivotally connected at one end 28 to the first section 11, and having the other end 29 connected by a spring 31 to an ear 32 secured to the first section. The latch device 17 has a projection 33 convex in shape adapted to extend through the opening 27 and into the first section, due to the bias of the spring 31. The detailed purposes for the latch 17 will be described in greater detail hereinafter.

The second section 12 is also rectangular in cross-section, being of a size adapting its telescopic movement within the first section 11, having a closed end 34 and an open end 36. The section 12 is also provided with a pair of longitudinally spaced, diametrically opposed supporting blocks 37 and 38 for the third section 13. An opening 39 is formed in the wall of the second section 12 and is adapted, upon movement of the second section 12 to a retracted position, to be aligned with the opening 27.

The third section 13 is elongated and rectangular in cross-section and of a size adapting its telescopic mounting within the second section 12. The inner end 41 of the third section embraces the two cylinder units 14 and 16, and at the outer end of the third section a pulley unit lifting head 42 is mounted. The head 42 is not a part of this invention and the invention is not to be so limited.

The second section cylinder unit 14 comprises an elongated tubular cylinder 43 closed at its forward end 44 and having a packing gland 46 at its rear end which is secured to the end 34 of the second section 12. A tubular shaft 47, having a piston 48 on its inner end is reciprocally mounted internally of the cylinder 43, and which shaft 47 has a tube 49 mounted concentrically therein.

The forward end 51 of the tube 49 is in fluid communication with the expansible chamber 52 between the piston 48 and the forward end 44 of the second section cylinder. The rear end 53 of the tube 49 is of a T-shape having a pair of fluid passages 54 and 56, and which end 53 is secured to the end 19 of the first section 11. The passage 54 is in fluid communication with an annular chamber 57 between the tube 49 and the shaft 47, and the passage 56 is in fluid communication with the interior of the tube 49. It will be noted that a port 58 places the chamber 57 in fluid communication with an annular chamber 59 formed between the shaft 47 and the wall of the cylinder 43.

The third section cylinder unit 16 includes a housing 61 secured to the cylinder unit 14, and having a packing gland 62 at the forward end and a closed rear end 63. A shaft 64 is reciprocally inserted in said housing 61 with a piston 66 at the inner end and a crossbar 67 at the outer end which is secured to the third section 13.

The housing 43 of the cylinder unit 14 is fluidly connected to the housing 61 of the cylinder unit 16 by a conduit 68, fluid communicating with the chamber 59 and with a chamber 69 between the piston 66 and the packing 62. Another conduit 71 connects the chamber 52 to a

chamber 72 between the piston 66 and the rear end 63. The fluid flows through the conduit 71 in the direction of the arrows.

A reservoir 76 for the fluid is provided and a pump 77 is connected to the reservoir for pumping fluid through a control valve 78 for transmission through a line 79 to the passage 54, or for transmission through a line 81 to the passage 56. A by-pass line 82 is provided.

The latch 18 is carried in the second section 12 adjacent its inner closed end 34 and is pivotally connected by a shaft 84 to a bracket 86 secured to the section 12. As seen in FIG. 5, the latch plate 18 pivots about the axis 88. An outer free end 90 is provided and a first latch portion 92 formed from plate material is mounted on the latch plate 18 and includes a generally vertical surface 94 as seen in FIGS. 1, 3 and 4 which merges into a sloping surface 96. The lower end of the surface 94 terminates in a shoulder 98 which is adapted to engage the lower end of an opening 100 formed in the section 13. The sloping surface 96 may move against the opposite end of the opening 100 as the latch portion 92 moves into and out of the opening 100.

A second latch plate portion 102 is provided and includes diverging sloping surfaces 104 and 106 which are adapted to slide against a bearing plate 108 mounted on the inner side wall of the section 11 as seen in FIGS. 3 and 4. A spring 110 extends from an ear 112 to the bracket 86 at its end 114 (FIG. 1) and biases the latch 18 outwardly for the latch plate portion 92 to move into the opening 100 in the section 13 and the latch plate portion 102 against the bearing plate 108.

With the apparatus 10 in the position of FIG. 1, operation to extend the sections is as follows. Fluid is pumped through line 81 and passage 56 to the tube 49, whereupon the fluid enters the chamber 52. Fluid pressure therein forces the cylinder 43 away from the stationary piston 47 until the section 12 attains its substantially extended position of FIG. 3. It will be noted that in this position, the latch 18 through the latch portion 92 with its shoulder 98 engaging the lower end of the opening 100 in the section 13 prevents extension of the section 13 relative to the section 12. However, as seen in FIG. 3, the bearing plate 108 is ready to engage latch plate portion surface 106 thereby pivoting the latch plate 18 to the right as viewed in FIG. 3 and consequently moving the latch plate portion 92 out of the opening 100 and thereby permitting the extension of the section 13 as additional fluid is pumped through the cylinders.

During the extension process, fluid in the chambers 59, 57 and 69 is forced out thereof due to the diminishing size of the chambers, the fluid passing outwardly through the passage 54 and the line 79 for transmission to the reservoir 76. To retract the sections, fluid is redirected through the line 79 and passage 54, and into the chambers 57 and 59. As the cylinders 43 cannot move relative to the shaft 47, due to the cylinder 43 being locked to the section 11, the fluid continues to flow through the conduit 68 into the chamber 69. This forces the piston 66 rearwardly, pulling the shaft 64 and the third section 13 back to the substantial position of FIG. 3. The fluid in the chamber 72 escapes out through the conduit 71 into the chamber 52. From the chamber 52, the fluid returns to the reservoir through the tube 29.

As the third section 13 engages the latch 17 and removes it from its locking position, the fluid within the chamber 59 moves the piston 48 and affects a retraction of the shaft 47 into the chamber 52, thus completing the retraction process. It is particularly noted that the latch plate 17 holds the sections 11 and 12 in their extended positions until the section 13 is retracted. To provide the maximum strength in the boom at all times it is important that the stronger sections be extended first and the weaker sections retracted first. Thus, latch plate 18 assures that section 12 is extended first and latch plate 17 assures that section 13 is retracted first.

The operation of this multiple extension apparatus has been found to be substantially automatic and fool-proof and a substantial improvement over applicant's earlier check valve controlled unit discosed in Patent No. 3,250,-182.

In summation, the multiple extension apparatus described and disclosed which provides a certain, positive, and sequential movement of the second section and third section out of the first section as a unit, and of the third section out of the second section, the retraction being the exact reverse of the extension operation.

Some changes may be made in the construction and arrangement of my multiple extension apparatus without departing from the real spirit and purpose of my invention, and it is my intention to cover by my claims, any modified forms of structure or use of mechanical equivalents which may be reasonably included within their scope.

I claim:

1. A multiple extension apparatus comprising, in combination,
   - a first hollow section one end of which is adapted to be secured to a structure,
   - a second hollow section slidably mounted in said first section,
   - a third hollow section slidably mounted in said second section,
   - first fluid actuated means operably connected to said first and second sections and operable to move said first and second sections longitudinally relative to each other,
   - second fluid actuated means operably connected to said second and third sections and operable to move said second and third sections longitudinally of each other,
   - control means for directing fluid under pressure to said first and second means; wherein the improvement comprises,
   - latch means for releasably locking said second and third sections in a retracted position, and
   - actuating means on said first section for engaging said latch means when said second section is in its extended position to permit extension of said third section relative to said second section.

2. The structure of claim 1 wherein said latch means is secured in said second section and includes a first portion for releasably locking said second and third sections in a retracted position and a second portion for engaging said actuating means when said second section is in its extended position.

3. The structure of claim 2 wherein said latch means is further defined as being pivotally secured within said second section, said third section having an opening to receive said first portion, said actuating means being positioned inside said first section outwardly of said second section and in the line of travel of said second portion as said first and second sections are moved relative to each other, spring means normally biasing said first portion into said opening in said third section and said second portion to a position for engagement with said actuating means, said first portion being pivoted out of said opening upon said second portion being pivoted by engaging said actuating means.

4. The structure of claim 3 wherein said third section has an inner end edge, said opening in said third section is formed in the side wall of said third section adjacent said inner end edge and has an outer and an inner end, said first portion has a tapered outer surface for engagement with the inner end edge as said third section is retracted, and said first portion has a shoulder inwardly of said tapered outer surface for engagement with the inner end of said opening when said third section is retracted thereby preventing extension of said third section.

5. The structure of claim 1 and a second latch means for releasably locking said second section to said first sec-

tion in an extended position of said second section, actuating means on said third section for engaging said second latch means when said third section is in its retracted position within said second section to release said second latch means from locking engagement between said first and second sections.

6. The structure of claim 1 and said first and second sections having openings formed therein being alignable upon said second section attaining an extended position, second latch means on the exterior of said first section and movable into said openings when aligned to releasably lock said first and second sections against relative movement, actuating means on said third section for engaging said second latch means when said third section is in its retracted position within said second section to release said second latch means from locking engagement between said first and second sections.

7. The structure of claim 6 wherein said second latch

means includes further a resilient element biasing said second latch toward said openings.

8. The structure of claim 7 wherein said second latch when positioned in said aligned openings is in the line of travel of said third section and upon said third section being retracted said third section engages said second latch to move it in said aligned openings out of a position locking said first and second sections against relative movement whereby said second section may be retracted into said first section.

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