

[54] MULTI-SECTION HYDRAULIC RAM

[72] Inventor: Fu-Tien Sung, Waynesboro, Pa.

[73] Assignee: Walter Kidde & Company, Inc., Clifton, N.J.

[22] Filed: Sept. 28, 1970

[21] Appl. No.: 76,373

[52] U.S. Cl. 92/52

[51] Int. Cl. F01b 7/20

[58] Field of Search 92/51, 52, 53, 113

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Primary Examiner—Martin P. Schwadron

Assistant Examiner—Leslie J. Payne

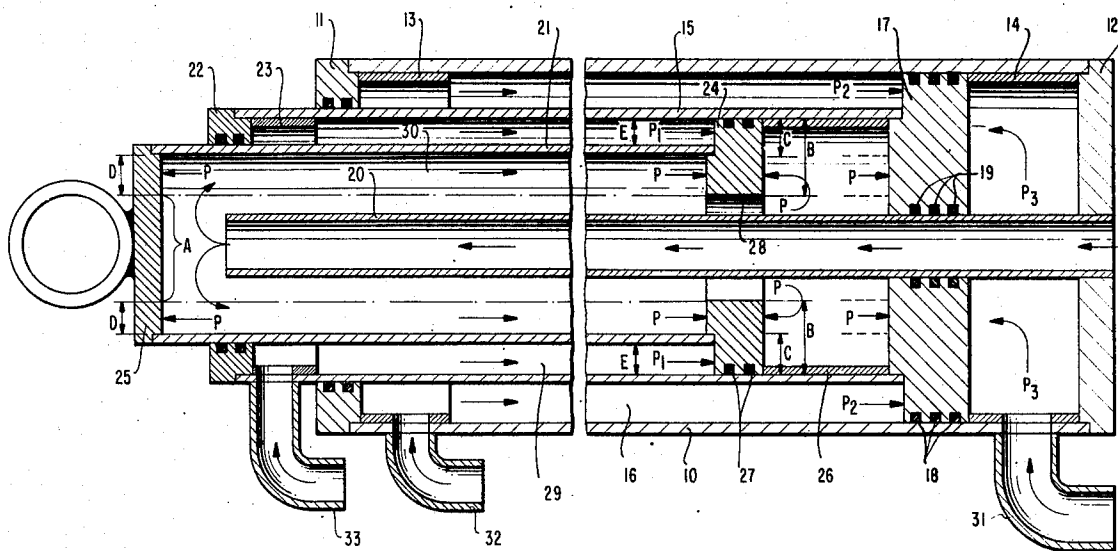
Attorney—Brady, O'Boyle & Gates

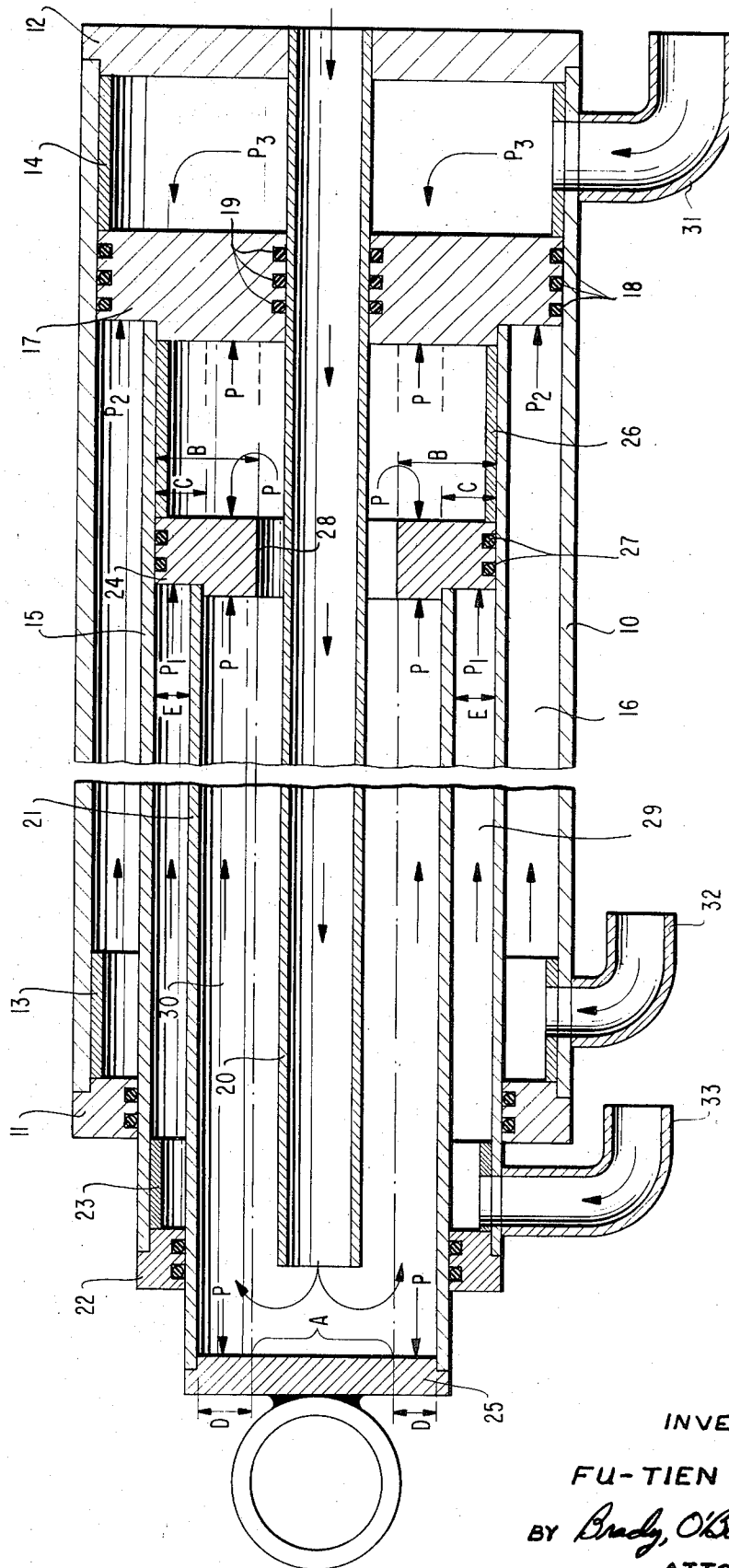
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ABSTRACT

A three section telescopic hydraulic ram features the ability to have its mid-section and interior or rod section independently actuated. Thus, the mid-section and rod section of the ram may be extended or retracted as a unit relative to the exterior base section, or the mid-section and rod section may move relative to each other in either direction while moving relative to the base section. This capability for individual control of the ram mid-section and rod section is achieved through a unique combination of fluid inlet porting and a divided piston construction for the interior or rod section of the ram.

9 Claims, 1 Drawing Figure





INVENTOR

FU-TIEN SUNG

BY *Brady, O'Boyle & Katz*
ATTORNEYS

MULTI-SECTION HYDRAULIC RAM

The objective of the invention is to provide a plural section fluid pressure operated telescopic ram for numerous applications, such as the operation and control of multi-section telescopic crane booms and the like. More particularly, the ram embodying the invention has fluid passage means and an effective piston arrangement which renders its mode of operation more flexible or versatile than known prior art structures for a similar purpose. In a three section ram incorporating the features of the invention, the mid-section and the interior section of the ram are fully independently operable under power, both with respect to extension and retraction. That is to say, one of these ram sections may be extending relative to the fixed base section while the other interior ram section is retracting. Also both interior sections may be extended or retracted in unison relative to the base section. The physical construction of the ram and its operating fluid circuitry is simplified, entirely practical and economical.

Other features and advantages of the invention will appear during the course of the following description.

BRIEF DESCRIPTION OF DRAWING

The drawing FIGURE is a central longitudinal vertical section through a three section ram embodying the invention.

DETAILED DESCRIPTION

Referring to the drawing in detail wherein like numerals designate like parts, the numeral 10 designates a base or exterior cylinder or ram section which is normally fixed during operation and connected with some stable structure. The base section 10 has end caps 11 and 12 secured to its opposite ends and closing such ends and preferably immediately inwardly of these caps spacer rings 13 and 14 are secured within the bore of the base section to serve as piston stop elements, as will be further described.

A ram mid-section 15 is disposed within the base section 10 concentrically and in spaced relation to the base section so as to form an annular fluid chamber 16 between the base and mid-sections. At its rearward end, the mid-section 15 carries a piston 17 rigid therewith having external seals 18 and internal seals 19, the latter engaging an interior relatively small diameter open-ended fluid inlet tube 20 having its rearward end anchored securely to the cap 12 of the ram base section. The tube 20 also assists somewhat in the guidance of the piston 17 of the ram mid-section. As will be further explained, the tube 20 delivers operating fluid to the piston head of the interior rod section of the ram to extend the same.

The interior rod section of the ram is designated by the numeral 21, and this rod section is disposed concentrically inside of the mid-section 15 in spaced relation. The rod section 21 is also concentrically spaced from the interior tube 20, the latter being centered on the longitudinal axis of the ram structure. The mid-section 15 has a forward end cap 22 through which the rod section 21 may slide during extension and retraction and a spacer ring 23 is disposed in the bore of the mid-section 15 immediately inwardly of the cap 22 to form a limit stop for the piston head 24 secured to the rear end of the rod section 21.

The piston head 24 forms a unique and important element of the ram in conjunction with a forward end closure cap 25 of the rod section 21 which lies ahead of the forward open end of the tube 20 when the ram is fully retracted, as shown in the drawing figure. Another spacer ring 26 is disposed within the bore of mid-section 15 immediately ahead of the piston 17 to serve as a retraction stop for the ram rod section 21 and its piston head 24.

The piston head 24 of rod section 21 slides in the bore of mid-section 15 and has external seals 27, as shown. The piston head 24 has a bore 28 which concentrically surrounds the tube 20 in spaced relation thereto. It may now be seen that additional working fluid chambers 29 and 30 are formed between the ram sections 15 and 21 and between the section 21 and tube 20.

A fitting 31 is connected in the base section 10 near the rear end cap 12 to admit working fluid to the extension side of the mid-section piston 17. A like fitting 32 connected in the base section 10 near its forward end admits fluid to the chamber 16 and the retraction side of the mid-section piston 17. Another fitting 33 connected into the mid-section 15 near its forward end ports fluid into the chamber 29 and the retraction side of rod section piston 24. As previously stated, the tube 20 from its rear end ports working fluid into the annular chamber 30 and to the extension side of the piston 24, as shown by the arrows in the drawing figure.

With respect to the operation of the rod section piston 24, the following should be explained, making reference to the letter designations in the drawing figure. The effective area of the rod section piston 24 is actually the sum of the areas (A) plus (B). The effect is the same as if the piston head 24 were a full solid piston head including the areas occupied by the tube 20 and the fluid passage through the bore 28. In effect, the working area of the piston head 24 is split or divided between the area (B) of the piston head and the downstream area (A) of the cap 25. This can be seen from the fact that the fluid pressure (P) is the same in all directions. The area (D) is equal to the area (B) - (C) on piston head 24. The forces acting on the area (B) - (C) on both sides of piston head 24 are equal and cancel each other. The fluid pressure acting on the area (D) at the rod section end will be equal to, but in opposite direction, to the pressure acting on the area (B) - (C) on piston 17. The net effect is, therefore, that the force acting on the rod end cap 25 is equal to the pressure (P) times the area (A) + (D). However, on the rear face of piston head 24, there is still the area (C) subject to fluid pressure (P). Therefore, if the fluid pressure (P_1) between ram sections 15 and 21 is equal to zero, then the actual force acting on the rod section is (P) times the total area (A) + (D) + (C). But if (P_1) is not zero, there will be a force (P_1) times (E) in the opposite direction. The net result will then be $P [(A) + (D) + (C)] - P_1 (E)$. By controlling the pressures (P), (P_1), (P_2) and (P_3) in conjunction with the various areas, one can either extend one section 15 or 21 of the ram at a time or extend both sections simultaneously. In the latter case, one can also control the relative speeds of extension of the sections 15 and 21. With the right combination, it is possible to extend the two sections at the same speed.

The structure permits varying of the volume and pressure of the working fluid entering the ports 31 and 20 to control the displacement of the ram mid-section 15 and the rod section 21 individually. Similarly, by varying the volume and pressure of the fluid entering ports 32 and 33, one can control the amount of retraction of the sections 15 and 21 individually. The pressure of the fluid entering the port or tube 20 can be made different from the pressure entering through the port 31 by using two different pump sections. This will provide better control, although by merely varying the fluid volume through a single pump and flow divider, will provide adequate control on the displacement of the ram sections 15 and 21.

From the above analysis, it may be seen that a three section hydraulic ram is provided wherein the two interior sections are individually controllable, both on their extension and retraction strokes. The piston head 24 of the interior rod section is bored out in the center to provide for the tube 20 and surrounding fluid chamber, but taking into account the downstream area (A) on the rod section the net effective area of the piston head 24 is the same as though it were a solid piston having the total of the areas (A) and (B).

The structure is simplified and practical to construct in all respects. The spacer elements 14 and 26 serve to positively limit retraction of the mid-section 15 and rod section 21, as shown. The spacers 13 and 23 in like manner will positively limit the extension stroke of these ram sections.

It is to be understood that the form of the invention herewith shown and described is to be taken as a preferred example of the same, and that various changes in the shape, size and arrangement of parts may be resorted to, without departing from the spirit of the invention or scope of the subjoined claims.

I claim:

1. A fluid operated extensible and retractable ram comprising a base section, a mid-section and an interior rod section arranged in telescopic interfitted relation, an annular piston on the mid-section adapted to reciprocate in the bore of the base section, an annular piston on the rod section adapted to reciprocate in the bore of the mid-section, a closure element on the end of the rod section distant from the rod section piston, a central fluid inlet tube fixed with relation to the base section and extending axially through the bores of said annular pistons and within the base section to a point close to the closure element when the ram is in a fully retracted condition, said annular mid-section piston having its bore in fluid sealing engagement with the exterior surface of said tube, the annular rod section piston having its bore spaced from said tube to provide a passageway for fluid therebetween, said tube delivering working fluid to the extension side of the rod section piston and to the face of said closure element, fluid passage means for delivering fluid to the retraction side of the rod section piston, and separate fluid passage means for delivering fluid to the extension and retraction sides of the mid-section piston, thereby enabling the mid-section and rod section to be independently

and individually operated.

2. The structure as defined in claim 1, and said tube having a length at least as great as the full stroke of the mid-section piston so that such piston always remains engaged with said tube.

3. The structure as defined in claim 2, and a closure cap for the rear end of the base section, and the rear end of said tube anchored to the closure cap and having its bore opening therethrough for the reception of fluid.

4. A fluid operated extensible and retractable ram comprising a base section, a mid-section and an interior rod section arranged in telescopic interfitted relation, an annular piston on the mid-section adapted to reciprocate in the bore of the base section, an annular piston on the rod section adapted to reciprocate in the bore of the mid-section, a closure element on the end of the rod section distant from the rod section piston, a central fluid inlet tube fixed with relation to the base section and extending axially through the bores of said annular pistons and within the base section to a point close to the closure element when the ram is in a fully retracted condition, the annular rod section piston having its bore spaced from said tube to provide a passageway for fluid therebetween, said tube delivering working fluid to the extension side of the rod section piston and to the face of said closure element, fluid passage means comprising a fitting connected in the side wall of said mid-section near the forward end thereof and forwardly of the base section when the ram is fully retracted for delivering fluid to the retraction side of the rod section piston, and separate fluid passage means for delivering fluid to the extension and retraction sides of the mid-section piston, thereby enabling the mid-section and rod section to be independently and individually operated.

5. The structure as defined in claim 4, and said separate fluid passage means comprising a pair of fittings connected in the side wall of the base section near opposite ends of the base section.

6. The structure as defined in claim 1, and said base, mid and rod sections of the ram being in substantially concentric spaced relation to provide fluid chambers therebetween, and said mid-section and rod section pistons having their peripheries extending radially beyond the tube members which constitute the mid-section and the rod section of the ram.

7. The structure as defined in claim 6, and spacer sleeves disposed within the bores of the base section and mid-section and engageable by the pistons of the mid-section and rod section to positively limit retraction and extension thereof.

8. The structure as defined in claim 1, and said interior rod section including a tubular body, said rod section piston secured to the rear end of the tubular body and extending radially inwardly and outwardly thereof.

9. The structure as defined in claim 1, and the total effective extension face of the rod section piston being a divided face and comprising the sum of the areas of the rear side of the rod section piston and that area of the the closure element which is encompassed by a projection of the bore of the rod section piston.

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