

Filed July 16, 1958

MATERIAL HANDLING APPARATUS

2 Sheets-Sheet 1

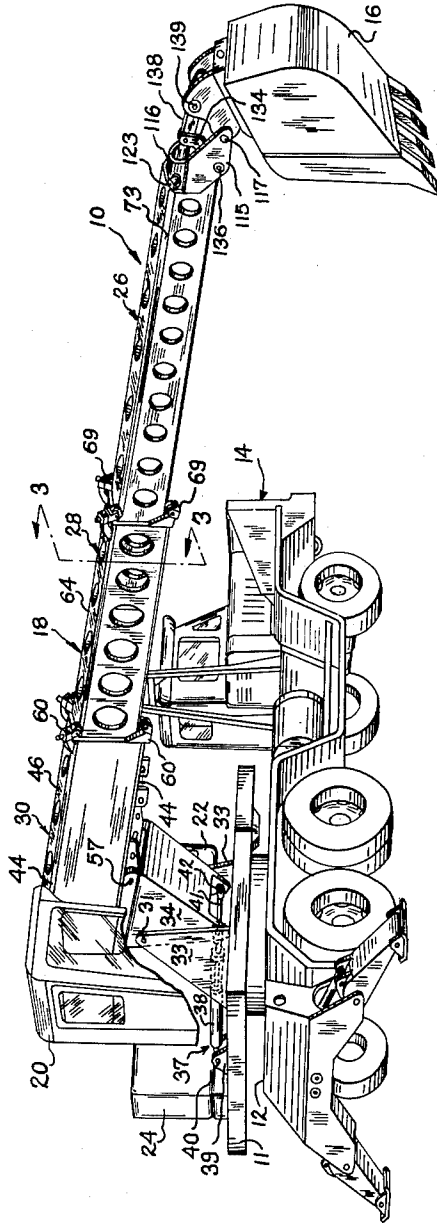


FIG. 1

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MATERIAL HANDLING APPARATUS

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2 Sheets-Sheet 2

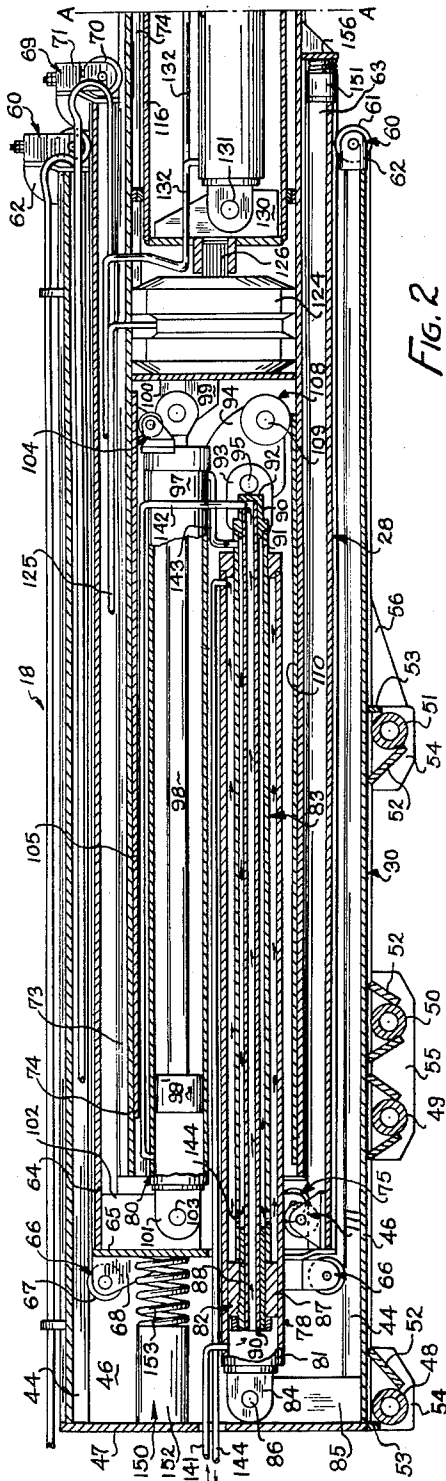


FIG. 2

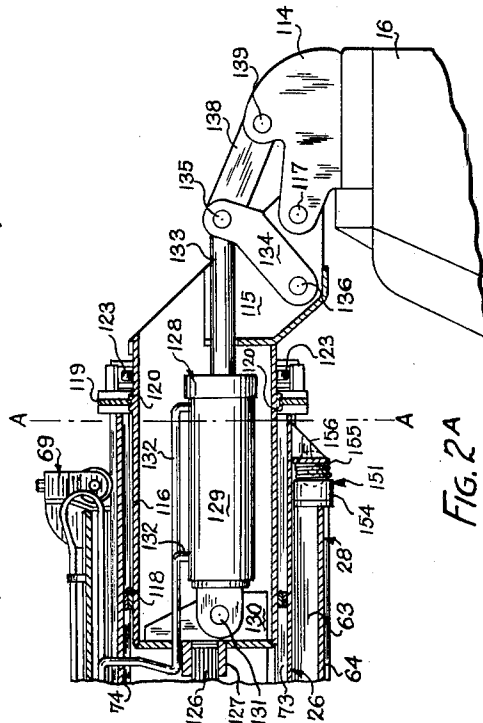


FIG. 2A

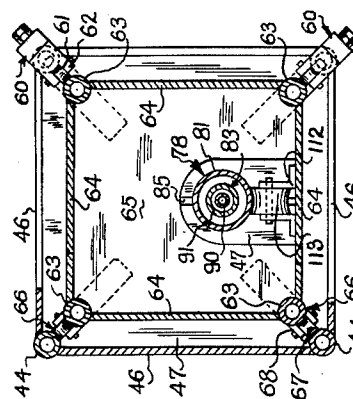


FIG. 3

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MATERIAL HANDLING APPARATUS

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Filed July 16, 1958, Ser. No. 748,908

9 Claims. (Cl. 214-141)

The present invention relates to material handling apparatus and, more particularly, to a power operated, extensible, telescoping boom for use with a material handling apparatus.

One of the principal objects of the present invention is to provide a new and improved telescopic boom for use in a material handling apparatus.

Another object is to provide a novel telescopic boom, for material handling apparatus and machines, having a greater reach when extended, a higher load carrying capacity, and a minimum length when retracted for ease of transporting the same.

A further object of the present invention is to provide a material handling apparatus having a new and improved telescopic boom of the above character, which is durable and efficient in use, simple and easy to manufacture, and can be placed upon the market at a reasonable cost.

A still further object of the invention is the provision of a new and improved boom having three substantially frictionless telescoping sections comprising a base section, an intermediate section, and an outer load or tool carrying section, with a first double acting hydraulic motor or power cylinder adapted to extend and retract the intermediate section disposed within and pivotally connected to the base section, and a second double acting hydraulic or power cylinder adapted to extend and retract the outer end section disposed within and pivotally connected to the intermediate section.

Another object of the present invention is to provide an extensible boom as set forth in the preceding object, wherein the fluid motor means are comprised of a pair of removable and/or replaceable, double acting fluid motor units, which are pivotally connected to each other with one of the fluid motor units serving to extend and retract the intermediate section in the base section, and the other fluid motor serving to extend the outer end section in the intermediate section prior to the extension of the latter and retract the outer end section after the retraction of the intermediate section, the extensible boom sections being slidably movable on rollers for the frictionless extension and retraction of the boom.

The invention further resides in certain novel features of construction, combinations and arrangements of parts, and further objects and advantages of the invention will be apparent to those skilled in the art to which it pertains from the following description of the preferred embodiment thereof described with reference to the accompanying drawings forming a part of the application and wherein the same reference characters represent corresponding parts throughout the several views, and in which:

Fig. 1 is a pictorial view of an apparatus including an extensible boom embodying the present invention, the boom being shown completely extended and in a declined position with a part of the extensible boom operator's cab broken away to show part of the boom lift fluid motor apparatus used to vary the angle of inclination or elevation of the extensible boom;

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Figs. 2 and 2a are longitudinal sectional views of the boom of the apparatus of Fig. 1 detached from the apparatus and in a retracted position, and

Fig. 3 is a fragmentary and partial section of the boom substantially along line 3-3 of Fig. 1, especially broken away to show the roller arrangement.

It is to be understood that the invention is not limited to the details of construction and arrangements of parts shown in the drawings and hereinafter described in detail, but is capable of being otherwise embodied and of being practiced or carried out in various ways. It is to be further understood that the phraseology or terminology employed herein is for the purpose of description and there is no intention to herein limit the invention beyond the requirements of the prior art.

Referring to Fig. 1, a material handling and moving apparatus indicated generally by the reference numeral 10 is mounted at its base upon a rotatable turntable 11, the turntable being mounted for swinging movement upon a bed 12 of the motor vehicle 14. However, it is to be understood that the invention could be mounted on other apparatus.

The material moving apparatus 10, for purposes of describing and illustrating a specific embodiment of the present invention, is shown having an earth digging tool 16, mounted on the outer end of an extensible telescopic boom 18 which is mounted on the turntable 11 for pivotal movement in a vertical plane. A boom operator's cab 20 is mounted beside the extensible boom 18 on the turntable 11 and adjacent a power unit 22 having a fuel tank 24.

The boom 18 is comprised of an outer end section 26, an intermediate section 28, and a base section 30 that is pivotally mounted for up and down movement in a vertical plane upon a transverse pivot shaft 31, which passes through a pair of triangular gusset plates 33 near the upper apices thereof. The gusset plates 33 are rigidly secured to the turntable 11, and a pair of interconnected triangular mounting plates 34 are rigidly secured to the underside of base section 30 of the boom 18.

A pair of parallelly arranged boom lift fluid motors 37 are each comprised of a cylinder 38 having one end pivotally secured to a vertical flange 39 by means of a pivot pin 40, the flange 39 being rigidly secured to turntable 11. The boom lift motors 37 each have a conventional piston, not shown, in the corresponding cylinder 38 and a piston rod 41 extending therefrom. Each piston rod 41 is pivotally connected at its outer end with the adjacent apex portion of a respective one of the triangular mounting plates 34 by a respective transversely extending, horizontal pivot pin 42. Upon the piston rods 41 being moved outwardly of their cylinders 38 the mounting plates 34 are urged in a counterclockwise direction about the pivot pin 31 for raising the boom 18. Alternatively, upon moving the pistons and piston rods 41 into the cylinders 38, the boom 18 and the mounting plates 34 are caused to be moved in a clockwise direction around pivot pin 31 for lowering the boom 18.

More particularly, the base section 30 of the boom 18 is preferably constructed with four tubular and longitudinally extending parallel corner members or beams 44 of circular cross section interconnected by spacing members 46, preferably welded to the peripheries thereof, so as to form a boom section of substantially rectangular cross section. An end panel 47 is rigidly fastened to the inner or base end of the boom section 30 formed by the beams 44 and spacing members 46.

Referring to Fig. 2, the bottom side of the base section 30 is provided with means for adjustably connecting it to the mounting plates 34 in the form of two pairs or sets of transversely disposed parallel tubular bushings 48,

49 and 50, 51. The bushings are rigidly secured to the bottom of base section 30 by means of long narrow strips of transversely disposed and inclined plates 52 and vertically arranged cross plates 53 welded to the bushings and to the juxtaposed bottom spacing member 46.

The rearwardmost positioned bushing 48 has one side in juxtaposition with one of the cross plates 53 secured to the lower edge of the end panel 47 and to the bushing 48 on one lateral side thereof. The other lateral side of bushing 48 is rigidly supported with one of the inclined support strips 52. An end plate 54 is secured over each of the ends of the bushing 48, strip 52 and cross plate 53, so that openings formed therein correspond with the opening in the tubular bushing 48.

The bushings 49 and 50 are supported with inclined strips 52 welded to either side thereof and to the bottom spacing member 46. A pair of end plates 55 are secured over the ends of bushings 49, 50 and supporting strips 52. Openings are formed in the end plates 55 to correspond to openings in the bushings 49, 50.

The tubular bushing 51 is also secured to the underside of the boom section 30 by means of an elongated strip 52 and a cross plate 53, which are rigidly secured, preferably by welding, to the bushing 51 and to the bottom of the base section 30. Two of the end plates 54 are rigidly secured to the ends of the tubular bushing 51, strips 52, and cross plate 53 with openings in the end plates 54 corresponding with the longitudinal opening in the tubular bushing 51. A pair of gusset plates 56 additionally reinforce bushing 51.

The end plates 54, 55 function as bearing plates for the mounting plates 34 which are secured thereto by conventional means such as two bolts 57 and two nuts, with the bolts 57 passing through one of the two sets of bushings 48, 49 and 50, 51 depending upon the wishes of the operator so that the boom can be mounted in either of two different positions. Fig. 1 shows the boom section 30 attached at bushings 48 and 49 and thereby extending the total reach of the boom 18 by a predetermined amount.

A roller assembly 60 is mounted on each of the four corners of the free end of the base section 30. Each roller assembly 60 comprises a roller 61, having a concave tread of semicircular cross-section, rotatively journaled in parallel support brackets 62, which are welded to the beam ends of the base section 30. The brackets of the upper and lower roller assemblies 60 are shown as different in configuration, and it is to be understood that other bracket configurations can be substituted.

The roller assemblies 60 are canted to an approximately 45° angle with respect to the horizontal for rolling upon the intermediate section 28 of boom 18 and, more particularly, to roll upon the exposed outer arcuate surfaces of the four longitudinal tubular beams 63, forming the corners of the intermediate section 28 and interconnected by longitudinally extending spacing members 64 so as to form a boom section similar in configuration to the base section 30, but sufficiently reduced in size to be slidable within the section 30. The inner end of the intermediate boom section 28 is provided with an end panel 65. It is to be noted that the members 64 are connected to the beams 63 in such a manner that sufficient beam surface is left exposed both inside and outside of the beam to form longitudinal tracks.

Four canted roller assemblies 66, somewhat similar to roller assemblies 60, are each comprised of a roller 67 journaled in a support bracket 68. A support bracket 68 is rigidly secured to the end panel 65 at each corner thereof. Each roller 67 has a concave tread of arcuate transverse section and is adapted to roll upon the juxtaposed edges of the downwardly facing portions of the arcuate surfaces of the two upper beams 44 and upon the two upwardly facing arcuate surfaces of the two lower beams 44 in base section 30.

The outer end of the intermediate section 28 is pro-

vided with four roller assemblies 69 canted to an angle of approximately 45° with the horizontal. The roller assemblies 69 are each comprised of a roller 70 having a semicircular and concave tread section, and a support bracket 71 with the upper and lower brackets 71 respectively having configurations similar to the corresponding brackets 60. Each support bracket 71 is rigidly secured at each of the corners of the outer end of the intermediate boom section 28 and the rollers 70 roll along the outside arcuate surfaces or tracks of four beams 73 of section 26.

The outer or tool carrying end of the boom section 26 is comprised of four tubular corner beams 73 of round cross section secured together by four longitudinally extending spacer members 74 so as to form a boom section of substantially rectangular configuration similar in shape to the cross sections of base section 30 and intermediate section 28, but of reduced size and adapted to telescope into the intermediate section 28.

The inner end of boom section 26 is provided with four roller assemblies 75 comprised of rollers and brackets very similar to the corresponding rollers 67 and brackets 68 of the assemblies 66, but of reduced size. The rollers of roller assemblies 75 are adapted to roll upon the juxtaposed arcuate peripheral surfaces of the two upper beams 63 and the two upwardly facing arcuate surfaces of the two lower beams 63 of the section 28.

Fluid motors

A pair of fluid motors 78 and 80 are pivotally mounted inside the boom 18 for self-alignment purposes. Moreover, the motors 78, 80 are adapted to outwardly project the outer end boom section 26 before the intermediate boom section 28 is extended and to retract the outer end section 26 after the intermediate boom section 28 is retracted.

Fluid motor 78, which is connected to extend and retract the intermediate boom section 28, is comprised of a cylinder 81, Fig. 2, having a piston 82 with a piston rod 83 rigidly secured thereto. The inner end of the hydraulic cylinder 81 is formed with a longitudinally rearwardly extending ear 84 pivotally connected to a vertically upstanding flange 85 rigidly secured to the inner end panel 47. The pivotal connection between ear 84 and flange 85 is effected with a transverse and substantially horizontal pivot pin 86 and aids in aligning the fluid motor within the boom 16.

The piston 82 consists of a cylindrical body or piston 87 and a tubular bushing 88 passed through a central opening in piston 87 and secured with a locking nut. A central and inner tubing 90 extends through the bushing 88 and forms a part of the piston rod 83. The piston rod 83 further comprises an outer tubular conduit 91 which has one end pressed over an end of the bushing 88 which extends through the body 87, and its other end rigidly secured to an end plug or closure member 92. The inner and outer conduits 90 and 91 terminate in the closure member 92 which is provided with a longitudinally outwardly extending lug 93 which is pivotally secured to a connecting plate 94 by means of a pivot pin 95. The outer end of the central inner tubing 90 extends beyond the outer terminal end of the outer conduit 91 and is press fitted or otherwise rigidly secured within a central bore in the plug member 92.

The connecting plate 94 is rigidly secured to the underside of the outermost end portion of a cylinder 97 forming a part of the fluid motor 80 which extends the outer boom section 26, the piston rod 83 extending the cylinder 97 outwardly. A piston rod 98, having a piston 981 on the inner end thereof, is slidably disposed in the cylinder 97. The outer end of the piston rod 98 is pivotally connected to a rearwardly extending vertical flange 99, which is rigidly secured to a vertical transverse partition 100. The partition 100 is rigidly secured within the outer end boom section 26 intermediate the ends thereof, but spaced

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more closely to the outer end of the boom section 26. A rearwardly projecting lug 101 on the inner end of cylinder 97 is pivotally connected to a downwardly extending rectangular flange plate 102 by means of a pivot pin 103. The downwardly extending flange plate 102 is rigidly secured to the outer face of end panel 65 and the inside of the top spacing member 64.

A roller assembly 104 holds the cylinder 97 at its outer end in spaced apart relationship with the boom section 26 and consists of a roller journaled in a bracket which is rigidly secured to an outer end of the cylinder 97 in which the piston rod 98 is slidably disposed. The roller 104 is adapted to bear upwardly against the underside of an elongated reinforcing plate member 105 secured in juxtaposition with the uppermost spacing member 74.

A large dolly roller 108 supports and guides the outer end of piston rod 83 in boom section 26 and is journaled in the forward end of the connecting plate 94 by means of a pin 109 and bears upon the upper surface of an elongated reinforcing plate member 110 secured to the lowermost spacing member 74 so that the boom section 26 is guided relative to the fluid motors 78 and 80 which are supported therein. A smaller dolly roller assembly 111 is comprised of a support bracket 112 rigidly secured to bottom spacing member 64 and a roller 113 journaled therein having a tread of concave, semicircular transverse section adapted to support and roll on the underside of the cylinder 81.

Referring to Fig. 1, the material moving tool and more particularly a bucket 16, mounted on the outer end section 26 of extensible boom 18, is disconnectably secured to a rocker member 114. The rocker 114 is pivotally secured to a pair of spaced, longitudinally extending parallel support plates 115 of a rotatable sleeve 116 by means of a transverse pin 117. The rotatable sleeve 116 is mounted for rotation in the outer end of boom section 26 and supported at its innermost portion upon an annular bearing ring 118 and at its outermost portion upon a flat radially extending annular guide flange 119. The annular flange 119 is rigidly secured to the outer end of the boom section 26 by suitable means, such as welding.

A pair of axially spaced, peripherally extending guide flanges 120 rigidly secured to the sleeve 116 straddle the inner periphery of the flange 119 for preventing relative longitudinal movement of the rotatable sleeve 116. Four rollers 123 are secured to the end of the annular flange 119 and roll upon the sleeve 116.

A fluid motor 124 is adapted to tilt the tool 16 about a longitudinal axis of the boom 18 and is preferably of a vane type and having fluid supply line means 125. The motor 124 is rigidly secured within the boom section 26 in juxtaposition with the outer surface of the partition 100, and is provided with a drive shaft 126 connected to a hub portion 127 of the rotatable sleeve 116. A double acting fluid motor 128 is comprised of a cylinder 129 with its inner end pivotally connected to a vertical support plate 130 by means of a transverse pivot pin 131. The support plate 130 is rigidly secured to the hub portion 127 of the rotatable sleeve 116. Hydraulic fluid is supplied to the cylinder 129 by either of the two lines 132 in a conventional manner. The fluid motor 128, in addition, comprises a piston having a piston rod 133, which piston is slidably disposed in the hydraulic cylinder 129 of the motor 128. The outer end of the piston rod 133 is pivotally secured to an upper end of a guiding or radius lever 134 by means of a pivot pin 135, the other end of the radius lever 134 being pivotally secured to the support plates 115 by means of a pivot pin 136. An additional lever 134 can be provided if desired.

The bucket 16 is connected to the outer end of the piston rod 133 by means of a link member 138 which is pivotally secured to the rod 133 by means of the pivot pin 135 and pivotally secured to the bucket 16 by means of a pin 139. Upon the piston rod 133 being forced out-

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wardly of its cylinder 129, the bucket 16 is urged in a clockwise direction about the pivot pin 117 via the link 138, with the radius lever 134 also being moved in a clockwise direction about its pivot 136. Upon movement of the piston rod 133 inwardly of its cylinder 129, the bucket 16 moves in a counterclockwise direction about its pivot pin 117 and accordingly, the radius lever 134 is moved in a corresponding direction about its pivot pin 136.

Operation

In order to extend the boom sections 26 and 28, hydraulic fluid is introduced into the cylinder 81 via a line 141 and through inner conduit 90 of the piston rod 83, the end plug member 92, and into the cylinder 97 of the motor 80 via a line 142, as shown by the arrows in Fig. 2, for forcing the piston 98¹ and piston rod 98 outwardly of the cylinder 97 and projecting boom section 26.

Accordingly, due to the hydraulic forces and the relative area sizes of the pistons 82 and 98¹ in the motors 78 and 80, respectively, the end boom section 26 is extended, followed by the extension of intermediate section 28 until both are fully extended.

Moreover, as the boom 18 is extended, fluid is forced out of the cylinder 97 back of the piston 98¹ through a line 143 into an elongated annular chamber formed between the conduits 90, 91 of the piston rod 83. Fluid is forced out of the conduit 91 through a plurality of radial ports 144 in the wall thereof adjacent the piston 82 and into an outer elongated annular chamber formed by the concentric walls of the cylinder 81 and the tubing 91 into a line 144. The line 144 is connected to a sump by a control valve in a conventional hydraulic system, not shown, from which the fluid is drawn by a pumping apparatus.

When it is desired to retract the boom sections 26 and 28 into the position shown in Fig. 2, the direction of fluid flow in the motors 78 and 80 is reversed and the outer boom section 26 is first retracted and then the section 28 is retracted. A conventional control valve apparatus, not shown, can be provided for controlling the direction of fluid flow in the motors and does not form a part of the invention.

Additionally, bumper assemblies, such as bumper assemblies 150 and 151, can be provided for cushioning and braking the intermediate boom section 28 and the end boom section 26 at the end of the retraction movement thereof. More particularly, the bumper assembly 150, comprised of a cylindrical block 152 with a helical spring 153 on the outer end thereof, is rigidly secured to the outer face of end panel 47 of base section 30 for cushioning and braking the inward movement of the intermediate section 28. The bumper assembly 151, Figs. 2 and 2A, also comprised of a block 154 and a helical spring 155 is rigidly secured to the outer, lower end of intermediate section 28 in such a manner that a reinforced stop plate 156, rigidly secured to the underside of the outer end of boom section 26, will abut and compress the spring 155. It is to be understood that other bumper or cushion assemblies can be provided or substituted where desired.

While I have shown and described a specific embodiment in accordance with my invention, it is understood that the same is susceptible of many changes and modifications, as known to a person skilled in the art, and I intend to cover all such changes and modifications coming within the scope of the appended claims.

Having thus described my invention, I claim:

1. In an extensible boom, a longitudinally extending hollow base section, a longitudinally extending hollow second section of said boom telescopically disposed in said base section, a longitudinally extending hollow third section of said boom telescopically disposed in said second section, first fluid motor means pivotally disposed within and connected to said base section and said second section for moving said second section inwardly and

outwardly of said base section, second fluid motor means pivotally disposed in and connected to said second section and said third section for moving said third section inwardly and outwardly of said second section, said first fluid motor means extending into said third section when said sections are fully telescoped into each other.

2. In an extensible boom as set forth in claim 1, wherein said first and second fluid motor means comprise a pair of individually removable double acting fluid motors.

3. In a material handling apparatus, an extensible boom comprised of a hollow base section having a base end and an outer end, a hollow intermediate section telescoped into said base section and having an inner end disposed in said base section, a hollow outer section telescoped into said intermediate section and having an inner end disposed in said intermediate section, a first piston-cylinder actuator within said boom and extending from adjacent said base end of said base section through said inner ends into said outer section when said sections are telescoped, a second piston-cylinder actuator disposed in said intermediate section and extending through the inner end of said outer section into said outer section, means connecting one end of said second actuator to said intermediate section adjacent its inner end and to said outer section, and means connecting said first actuator to said base section adjacent its base end and to a part movable with said intermediate section.

4. In a material handling apparatus, the structure as defined in claim 3 wherein said second actuator is disposed substantially alongside said first actuator when said sections are telescoped.

5. In a material handling apparatus, the structure as defined in claim 3 wherein said second actuator is connected to said outer section at the central portion thereof and is disposed substantially alongside of said first actuator when said sections are telescoped and a plurality of material manipulating motors are disposed within said outer section outwardly of said second actuator.

6. In a material handling apparatus, the structure as defined in claim 3 wherein said first actuator extends approximately to the central portion of said intermediate section and wherein means is provided to connect the end of said first actuator in said intermediate section to said intermediate section adjacent its inner end, the last-said means extending axially of said boom from the end of said first actuator in said intermediate section to the inner end of the latter.

7. In a material handling apparatus, an extensible boom comprised of a hollow base section having a base end and an outer end, a hollow intermediate section telescoped into said base section and extending outwardly from the outer end thereof and having an inner end re-

ceived by said base section, a hollow outer section telescoped into said intermediate section and having an inner end disposed in said intermediate section, a first piston-cylinder actuator within said boom and extending from adjacent the base end of said base section through said inner ends into said outer section when said sections are telescoped, said actuator including relatively movable telescoping first and second elements and each element having an outer end to be connected to a respective one of said base and intermediate sections, means connecting said outer end of said first element to said base section adjacent the base end thereof, said second element extending axially of the boom from said first element and having an outer end disposed in said intermediate section and said outer section when said sections are telescoped, a second piston-cylinder actuator including relatively movable telescoping first and second elements, each of said first and second elements of said second piston-cylinder actuator having an outer end to be connected to a respective one of said intermediate and outer sections, means connecting said outer end of said first element of said second actuator to said intermediate section adjacent the inner end thereof and the other end of the first element of said second actuator to said outer end of said second element of said first actuator, and means connecting said outer end of the second element of said second actuator to said outer section at a point intermediate its ends.

8. In a material handling apparatus, the structure as defined in claim 7 wherein said second element of said first actuator is disposed substantially within said intermediate section and is substantially coextensive in said intermediate section with the first element of said second actuator.

9. In a material handling apparatus, the structure as defined in claim 8 wherein said outer end of the second element of said second actuator is connected to the central portion of said outer section and a plurality of material manipulating motors are disposed in said outer section outwardly of said second actuator.

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