United States Patent [19]

Grove

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[54] **TELESCOPIC CRANE BOOM WITH CHAIN ACTUATION OF FLY SECTION**

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[52] **U.S. Cl.** **212/55**

[51] **Int. Cl.** **B66c 23/06**

[58] **Field of Search** 212/55

[56] **References Cited**

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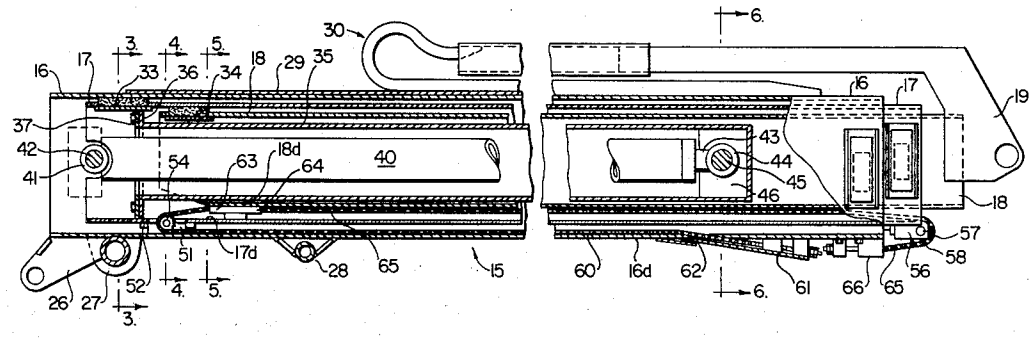
[57] **ABSTRACT**

A telescopic crane boom having a base section, a mid section telescopically received in the base section and a fly section telescopically received in the mid section, a hydraulic cylinder for moving the mid section relative to the base section and chains connected to the base and fly section for extending and retracting the fly section upon actuation of the hydraulic cylinder to extend and retract the mid section. The chains are trained on front and rear sprockets supported by the mid section; the axes of the sprockets are below the bottom of the mid section, the chains are anchored to the bottom of the base section and one chain passes rearwardly through an aperture rearwardly of the anchor. Plural front and plural rear sockets are provided, with a chain for each.

2 Claims, 6 Drawing Figures



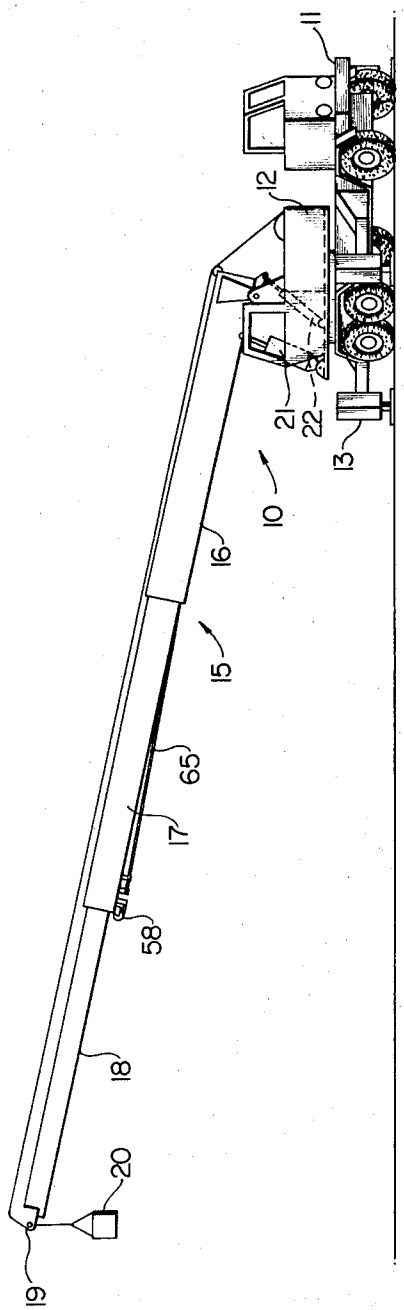

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FIG. 1

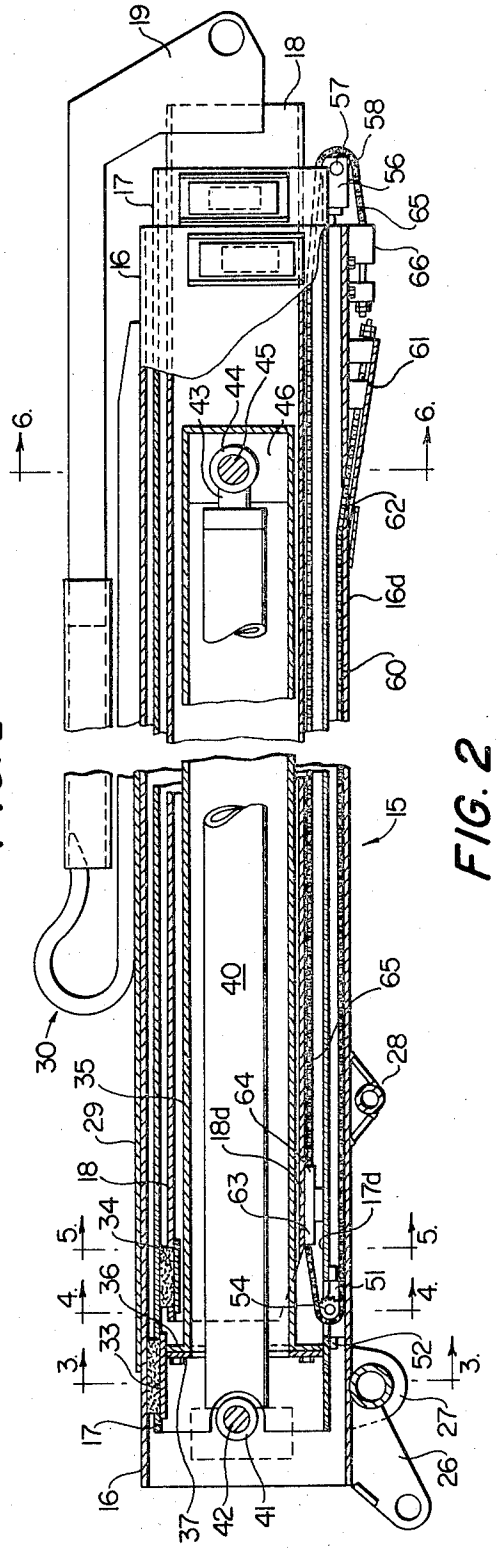
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FIG. 2

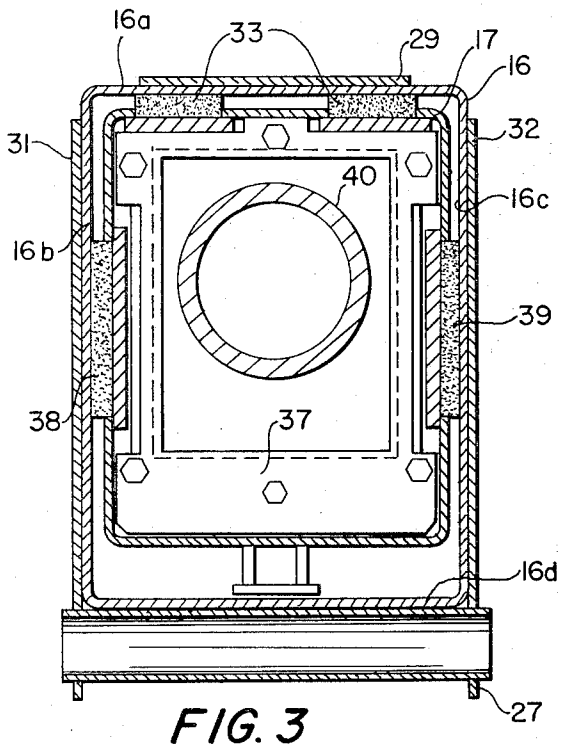

FIG. 3

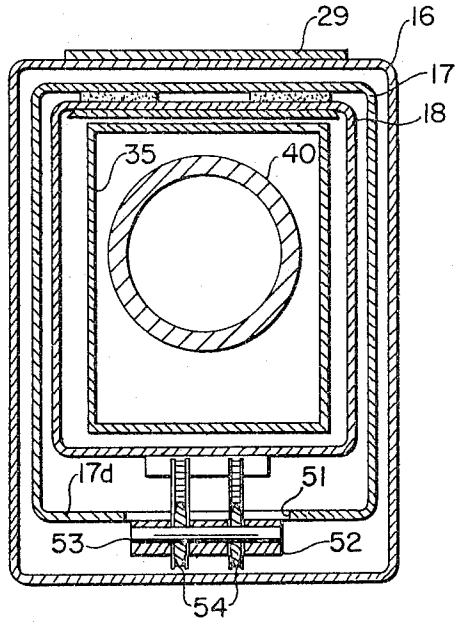

FIG. 4

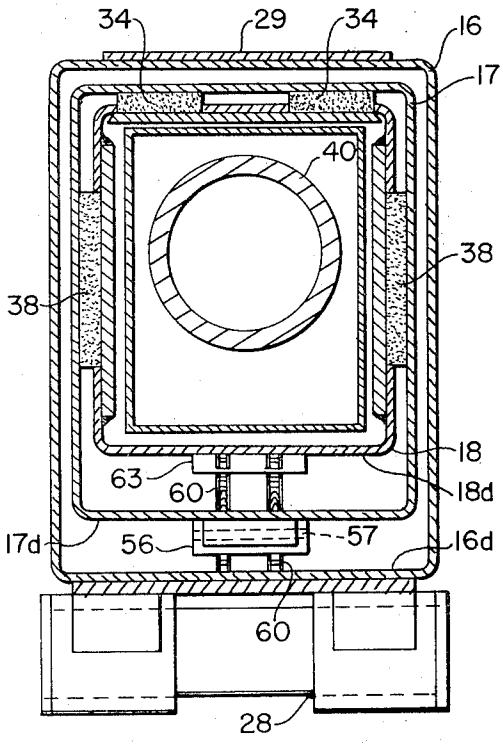

FIG. 5

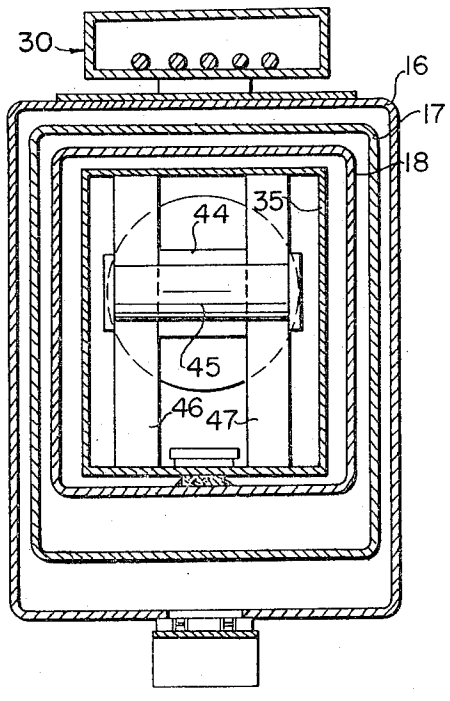

FIG. 6

TELESCOPIC CRANE BOOM WITH CHAIN ACTUATION OF FLY SECTION

BACKGROUND OF THE INVENTION

The present invention relates to telescopic crane booms for lifting and moving loads, such as a person and/or supplies.

There have long been used various types of cranes, for lifting inert loads and for lifting humans. Where cranes are used primarily for lifting humans, they are often referred to as "aerial platforms." Telescopic cranes for both purposes have been used for years, and in the early days of the development of telescopic cranes, the various telescopic sections were caused to move by supple links connected to two adjacent sections; such supple links included ropes, wire cables and chains. These constructions were somewhat unweildy, and often required that the entire extending movement of the telescopic crane sections be in response to a force applied through a single element, such as the shaft of a crank or winch. This required very strong elements and very strong mountings, which resulted in costly and heavy apparatus which was generally too slow and cumbersome, and which was not easily controlled. In particular, the control of such cranes when of the aerial platform type would be most difficult.

Supplanting the supple link operators of the telescopic sections, in more recent times, were fluid motors in the form of double acting hydraulic cylinders. Hydraulic cylinders replaced the supple links when they had reached the stage of development where they were sufficiently strong and reliable, and had adequate pumps and valves to respectively power and control them. Typically, where there was a three section telescopic crane boom, a first hydraulic cylinder was connected so as to move the second section relative to the first section, and a second hydraulic cylinder was connected to move the third section relative to the second section. Thus, in the prior art booms, there were provided one fewer hydraulic cylinders than there were sections, and suitable controls were provided.

The controls of the hydraulic cylinders which were conventionally provided were in the form of valves to admit fluid under pressure to the cylinders, there being provided a control handle or control lever for controlling each of the cylinders so that operation of a handle in one direction caused a boom section to extend, and in the opposite direction caused a boom section to retract. Independent handles or levers were provided for the control valves of each of the cylinders. As a result, the operator was required to be trained and instructed not to extend an outer boom section, of smaller cross section, unless it was necessary and unless the desired reach of the crane could not be obtained by a previous extension of an inner boom section of larger cross section. However, despite such training and instruction, from time to time an operator, through either lack of skill or inadvertence, would extend for example the third or fly section of a three section boom, while the second or mid section was still fully retracted: as a result, the fly section would be overloaded, and damage to the boom would result.

There was formerly proposed a system for preventing such fly or third section operation, which involved a complex and expensive hydraulic control system, requiring the full extension of a cylinder controlling the mid section prior to the supplying of fluid to the cylinder which extends the fly section. That solution has not been found to be entirely satisfactory because of the complexity of the hydraulic equipment, and because of the increased expense occurring because of this greater complexity of the hydraulic system.

There have also been provided telescopic booms in which a motor was connected to the base section and mid-section of a three section telescopic boom, with a chain system for extending the fly section, the chain extending from an anchor at the outer end of the base section around a sprocket at the rear of the mid-section having its axis above (or at) the bottom of the mid-section, and anchored to the rear of the fly section, and a second part of the chain system extending from the rear of the fly section forwardly around a sprocket at the forward end of the mid-section and thence to an anchor at the outer end of the base section. Such a construction gives rise to interference between the boom section(s) and the chain.

Another consideration pertinent to the construction of telescopic booms for cranes is the weight of the sections and of the parts associated with them, particularly the hydraulic cylinders. In a three section boom, a first hydraulic cylinder will be connected to the first and second sections, to extend and retract the latter, the cylinder part of the hydraulic cylinder remaining housed in the first section. Similarly, a second hydraulic cylinder will be connected to the second and third sections to extend and retract the latter, and will typically be housed within the second section. Thus, when the second section is extended, the second hydraulic cylinder moves outwardly from the crane pivotal axis, and thus adds its weight to the weight of the second crane boom section at the increased distance from the crane boom pivotal axis. In a typical installation of a 45 foot boom having three sections of substantially 15 feet each, the hydraulic cylinder may have a weight of approximately 500 pounds, and have its center of gravity approximately 22 feet from the pivotal axis, when the boom is in horizontal position. Thus, the hydraulic cylinder for extending the third section will be seen to add considerably to the weight and moment factors of the crane boom.

SUMMARY OF THE INVENTION

The present invention provides a telescopic crane boom, which may be of three sections, a first or base section, a second or mid section and a third or fly section, the base section being pivotally connected to a support for raising and lowering movement of the boom about a horizontal axis. The boom sections are each longitudinally extending, and have generally hollow rectangular transverse sections, the base section being of the largest transverse section and receiving telescopically therein the mid section, which in turn receives therein the fly section. A fluid motor in the form of a double acting hydraulic cylinder is provided, being connected to the base section and the mid section in known fashion to extend and retract the latter. The third or fly section is moved by mechanical linkage in response to movement of the second or mid section, the energy for the movement of the fly section being supplied by the hydraulic system including a conventional pump which supplies the noted hydraulic cylinder. This mechanical linkage is in the form of supple links, specifically chains, there being a first chain and a second chain; the second or mid section is provided

with arcuate guide surfaces for engagement by the supple link, these specifically being sprockets on which the chains are trained. A front or outer sprocket is positioned adjacent the outer end of the mid section, being supported on the bottom plate of the mid section when it is of the above noted generally hollow transverse rectangular section. A rear or inner sprocket is supported by the mid section near its inner end, and the axes of both of the sprockets are positioned below the level of the bottom plate of the mid section. The first chain extends from an anchor connecting it with the bottom side of the bottom plate of the base section through an aperture at the base section bottom plate and thence rearwardly in the space between the base and mid section bottom plates, around the noted rear sprocket, and having its other end connected to the bottom plate of the fly section near its inner end. The connection is by an anchor, and adjacent to that anchor is another anchor to which the second chain is connected, the second chain extending in the space between the bottom plates of the mid section and fly section, and extending forwardly, being trained around the front or outer sprocket, and connected by an anchor to the bottom surface of the base section bottom plate, adjacent the first mentioned anchor. When fluid is supplied to the hydraulic cylinder to extend the mid section, the outer sprocket will move outwardly, and pull on the second chain, thereby pulling the fly section and causing it concurrently to extend. Upon reverse operation of the hydraulic cylinder, the mid section will be caused to retract, and the inner sprocket will pull on the first chain, causing it to pull and retract, concurrently, the fly section with the mid section.

Among the objects of the present invention are to provide a telescopic crane boom of comparatively lighter weight and of the same strength as previous booms. Another object of this invention is the provision of a crane boom having extension and retraction equipment of lighter weight than heretofore. Still another object of the present invention is to provide a telescopic boom for a crane in which supple links are provided for extending and retracting one section in response to extension and retraction of another section, with provision of guides for the supple links positioned to avoid interference of the movement thereof.

Other objects and many of the attendant advantages of the present invention will be readily understood from the following specification and drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an elevational view of a mobile crane with telescopic boom in accordance with the present invention.

FIG. 2 is an enlarged longitudinal view with parts in section of the boom shown in FIG. 1.

FIG. 3 is an enlarged cross sectional view taken on the line 3—3 of FIG. 2.

FIG. 4 is an enlarged cross sectional view taken on the line 4—4 of FIG. 2.

FIG. 5 is an enlarged cross sectional view taken on the line 5—5 of FIG. 2.

FIG. 6 is an enlarged cross sectional view taken on the line 6—6 of FIG. 2.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, wherein like or corresponding numerals are used to designate like or corresponding parts throughout the several views, there is shown in FIG. 1 a crane generally designated **10**, crane **10** being illustrated as a mobile or vehicle-mounted crane, including a vehicle **11**, a turn table **12** and outriggers **13**. The telescopic and extensible crane boom is generally designated **15**, and comprises a first or base section **16**, a second or mid section **17** and a third or fly section **18**. The outer end of the fly section **18** is provided with a supporting nose **19**, to which is attached a basket aerial platform **20**. Controls are preferably provided in the aerial platform **20** for controlling the extension and retraction of the sections **17** and **18**, and other controls may be provided as is well known to those skilled in the art, as for raising and lowering the boom **15** and for rotating the entire boom including the turn table **12**. By way of illustration, raising and lowering cylinders **21** and **22** may be seen connected to the turn table **12** and to the base section **16** of boom **15**.

Referring now to FIG. **2**, the telescopic boom **15** is shown in cross section, and in its retracted position. Thus, each of the hollow boom sections of lesser strength and of similar transverse hollow cross sectional dimensions is telescopically received in the next boom section of larger cross section and of higher strength. The base section **16** is provided with depending ears, such as **26**, for connection to a first cylinder for causing raising and lowering of the boom **15**, a second ear **27** being provided for receiving a pivot pin (not shown) on which the boom **15** may be raised and lowered, and a third ear and axle construction **28** for connection with a lift cylinder, such as the lift cylinder **21** shown in FIG. **1**. On its top, the base section **16** is shown provided with a reinforcing plate **29**, and lying thereon is a conduit group **30** which can provide for suitable electrical and/or hydraulic conduits extending from the aerial platform **20** to the various elements to be controlled. As may be seen in FIG. **3**, base section **16** is provided with side reinforcing plates **31** and **32**. The transverse cross sectional shape of base section **16** may also be seen in FIG. **3**, and comprising a generally hollow rectangular cross section which includes a top plate **16***a*, side plates **16***b* and **16***c* and a bottom plate **16**d.

Referring again to FIG. **2**, within base section **16** there may be seen the mid section **17**, which is provided at its inner end with a wear pad **33** positioned between the sections **16** and **17**; in FIG. **3**, it may be seen that two such wear-pads **33** are provided. The fly section **18** is positioned inwardly of the mid section **17**, and a wear-pad **34** is provided between them. Inwardly of the fly section **18** there is a hollow housing **35**. Hollow housing **35** is provided with a flange **36** at its inner end, to the left as shown in FIG. **2**, which flange **36** is secured to a housing mounting plate **37** that is in turn secured to the mid section **17** adjacent its inner or rear end. The hollow housing mounting plate **37** may be seen in FIG. **3** to be generally in the shape of an open rectangle, there also being seen in FIG. **3** a plurality of bolts which serve to secure together the flange **36** and mounting plate **37**. A fluid motor **40**, specifically in the form of a double acting hydraulic cylinder, is also shown in FIGS. **2** and **3**, passing through the mounting plate **37**. Also shown in FIG. **3** are additional wear plates **38** and **39** provided between the base section **16** and the mid section **17**.

At its rear end, fluid motor **40** is provided with a transverse tube **41** within which is a pivot pin **42**; pivot pin **42** is connected to the base section at the inner or rear end thereof.

The fluid motor **40** at its outer end has an extending rod **43** on which is a tube **44**, a pin **45** being received in the tube **44** and being supported, as shown in FIG. **6**, by a pair of spaced apart support plates **46** and **47**. The support plates **46** and **47** are fixed to the hollow housing **35** at its outer end. Hence, actuation of fluid motor **40** will cause the mid section **17** to be linearly moved relative to base section **16**, through the connection provided by the hollow housing **35**, flange **36** and mounting plate **37**.

A mechanical linkage system is provided for extending the fly section **18** concurrently with extension of the mid section **17**, and for retracting fly section **18** concurrently with mid section **17**, the noted linear movement of fly section **18** being effected by the mid section **17** actuating mechanical linkage. Thus, as shown in FIGS. **2** and **4**, the mid section **17** has at its bottom plate **17d** an aperture **51** which is adjacent to its inner end, just outwardly or forwardly of the mounting plate **37**. The aperture **51** has mounted beneath it a sprocket mounting assembly **52**, generally secured to the bottom of the bottom plate **17d**. Mounting assembly **52** has journalled therein a sprocket shaft **53** which carries a pair of rear or inner sprockets **54** in transversely spaced relationship. At its outer end, the mid section **17** is provided with a mounting assembly **56** suitably secured to the bottom plate *17d* (see FIG. **5**), there being a sprocket shaft **57** therein, and having a pair of spaced outer or forward sprockets **58** journalled therein. The sprockets **54** and **56** serve as guides, and it will be seen that they revolve about shafts **53** and **57** which have their axes below the level of the bottom plate *17d* of mid section **17**. This placement of the sprocket shafts **53** and **57** is important to avoid interference between the chains and the fixed boom elements, to thereby insure long operation of the boom, without excessive deterioration or wear.

The base section **16** near its outer end is provided with a first anchor **61** on the bottom surface of the bottom plate *16d* thereof. Inwardly or to the rear of anchor **61**, bottom plate *16d* has an aperture **62**, and a pair of chains **60** extend from the anchor **61** through the aperture **62** and thence rearwardly, in the space between the bottom *16d* of base section **16** and the bottom plate *17d* of mid section **17**, to the sprockets **54**, shown in FIGS. **2** and **4**. The chains **60** are trained on the sprockets **54** and pass therearound, and thence forwardly to an anchor **63** fastened to the bottom of the bottom plate *18d* of fly section **18**. Just forwardly of the anchor **63** is an anchor **64**, similarly connected to the bottom of the bottom plate **18d**, and connected to the anchor **64** are a pair of chains **65** which extend forwardly from the anchor **64** in the space between bottom plates *18d* and *17d*, and to the sprockets **58**, the chains **65** extending around sprockets **58** and being connected by an anchor **66** to the bottom surface of the bottom plate *16d* of base section **16**. As may be seen, the anchors **61** and **66** are in adjacent relationship, anchor **66** being closer to the outer end of base section **16** than anchor **61**, and both are in a position such that the ends of the chains are accessible, to permit adjustment.

Referring again to FIG. **5**, the above referenced wear-pads **34** may be seen, as well as additional wear-pads **38**. All wear-pads are of generally known construction, and preferably of a suitable material to permit relative sliding movement between the various boom sections, while being long lasting in use.

In operation, a pump will supply fluid under pressure to the fluid motor **40** through a suitable control valve, to thereby actuate it. In the present instance, since fluid motor **40** is in the form of a double acting hydraulic cylinder, the piston therein will be caused to move, thereby increasing the space between the pins **42** and **45** to which the fluid motor **40** is connected, thereby linearly extending the mid section **17**, due to the aforementioned connection from pin **45** to the hollow housing **35** and thence to the mid section **17**, pin **42** being anchored to base section **16**. As mid section **17** is extended, the sprockets **58** will move with it, away from the base section **16**. This movement of the sprockets **58** will exert a pull on the chain **65**, which will function as a supple link. Since one end of the chain **65** is immovably fixed by the anchor **66**, the upper run of chain **65** as shown in FIG. **2** will exert a force on anchor **64**, and through it the fly section **18**, causing fly section **18** to be linearly extended concurrently with the linearly extending movement of mid section **17**. Such extension in a concurrent manner by the mid section **17** in fly section **18** may continue to the limit of the physical dimensions of the apparatus, which thereby determines the full extension of the boom **15**. Upon operation of the fluid motor **40** in the opposite direction, through suitable control valve means, forces applied to the pins **42** and **45** will cause linear retraction of mid section **17**, thereby causing inward movement of the sprockets **54** toward the inner end of base section **16**, and the supple link formed by the chains **60** will be acted upon, thereby exerting a pull on the anchor **63** and causing the fly section **18** to be concurrently retracted with the retracting motion of mid section **17**.

It will be understood that during extension of the boom sections **17** and **18**, the sprockets **54** will be caused to move outwardly, and a portion of the chain **60** will thereby pass around the sprocket, from the space between lower plates *17d* and *16d* to the space between lower plates **18d** and *17d*. Conversely, upon retracting movement of the boom sections **17** and **18**, a portion of the chains **65** will be caused to move from the bottom of bottom plates *16d* into the space between bottom plates *18d* and *17d*.

The telescopic crane boom herein disclosed is provided with but a single fluid motor, which causes concurrent extension and retraction of both the mid section **17** and fly section **18**, due to its connection to base section **16** and mid section **17**, and due to mechanical linkage which is connected to the fly section **18**, and which mechanical linkage moves in response to and is actuated by movement of the mid section **17**. Thus, there has been provided a telescopic crane boom which cannot be over stressed due to extension of the lighter weight and smaller cross section fly section while the stronger and larger cross section boom mid section is in the retracted position.

It will be obvious to those skilled in the art that various changes may be made without departing from the spirit of the invention and therefore the invention is not limited to what is shown in the drawings and described in the specification but only as indicated in the appended claims.

What is claimed is:

1. A boom for a crane comprising:

a first section telescopically receiving a second section, said second section telescopically receiving a third section, said sections being longitudinally extending and having hollow transverse cross sections,

fluid motor means connected to said first and second sections for extending and retracting said second section,

front and rear sprocket means carried by said second section adjacent the outer and inner ends thereof respectively with their axes transverse to said boom sections and lower than the bottom of said second section,

first chain means, means for anchoring one end of said first chain means to said first section adjacent the outer end thereof, said first chain means extending around said rear sprocket means, means anchoring the other end of said first chain means to said third section adjacent the inner end thereof,

second chain means, means for anchoring one end of said second chain means to said first section adjacent the outer end thereof, said second chain means extending around said front sprocket means, means anchoring the other end of said second chain means to said third section adjacent the inner end thereof,

and an aperture in said first section adjacent the outer end thereof rearwardly of said anchors of said first and second chain means, said anchors on said first section being on the lower surface of the bottom of said first boom section and said first chain means extending through said aperture, whereby the ends of said chain means are accessible.

2. The boom of claim 1, wherein each said chain means and sprocket means comprises plural chains and plural sprockets.

* * * * *