

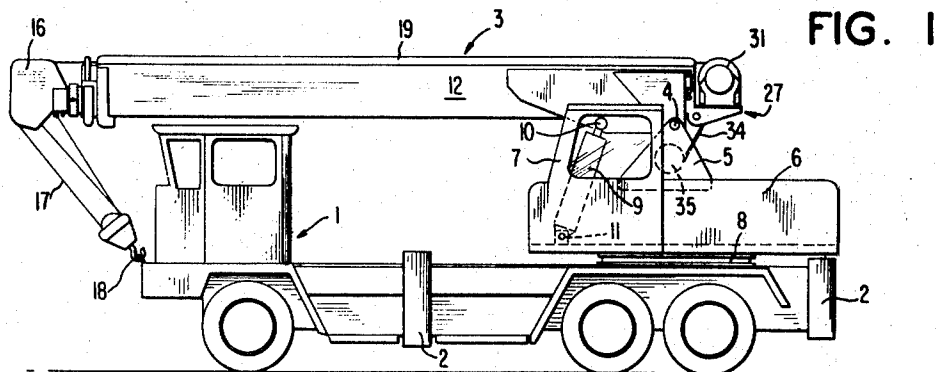
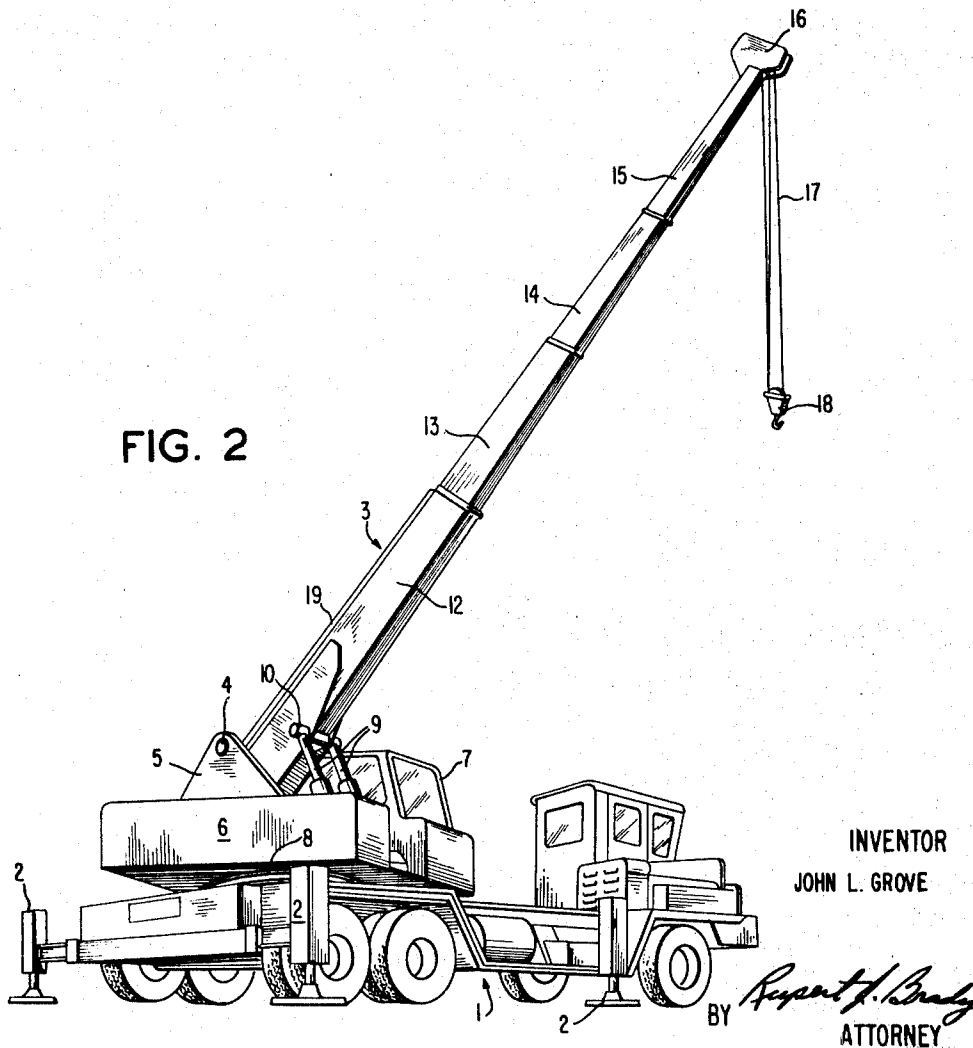
June 4, 1968

J. L. GROVE
METHOD OF AND APPARATUS FOR EXTENDING A
TELESCOPIC CRANE BOOM

3,386,594

Original Filed April 8, 1965

5 Sheets-Sheet 1



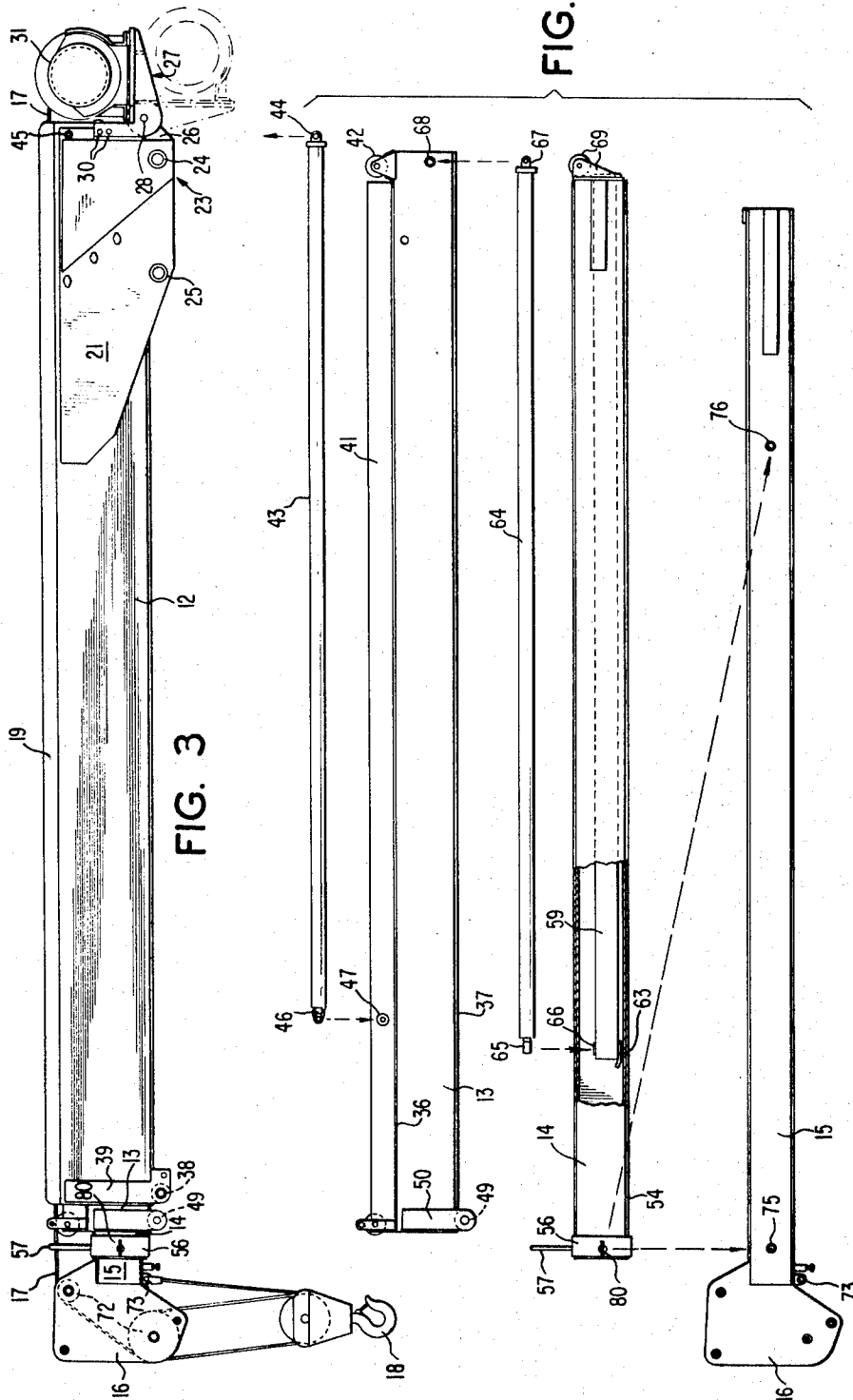
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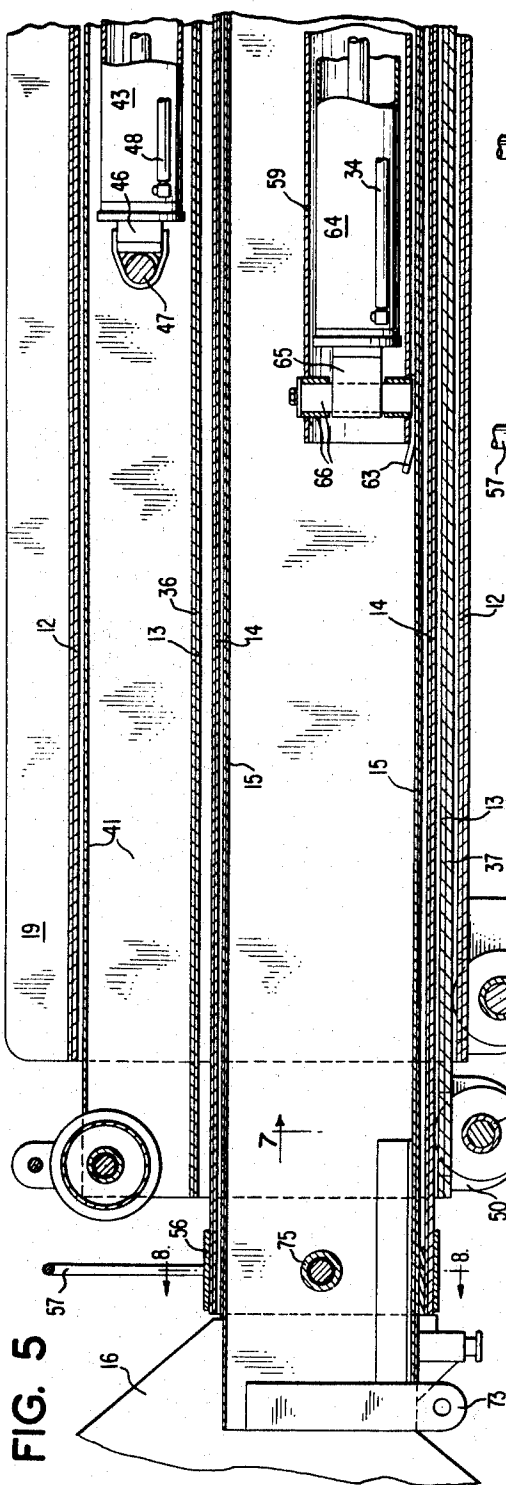


FIG. 5

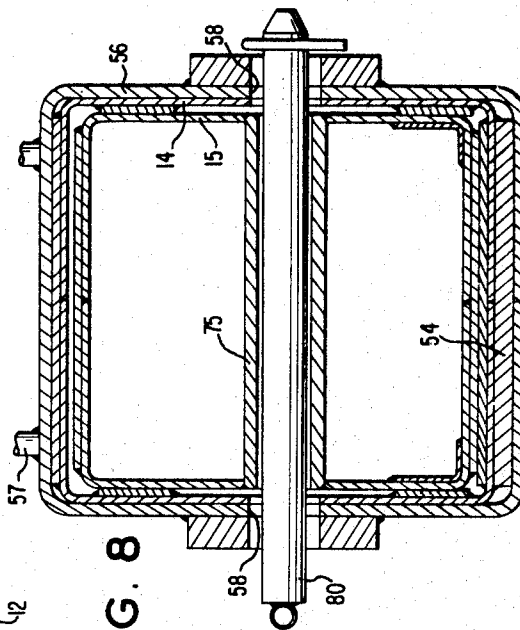


FIG. 8

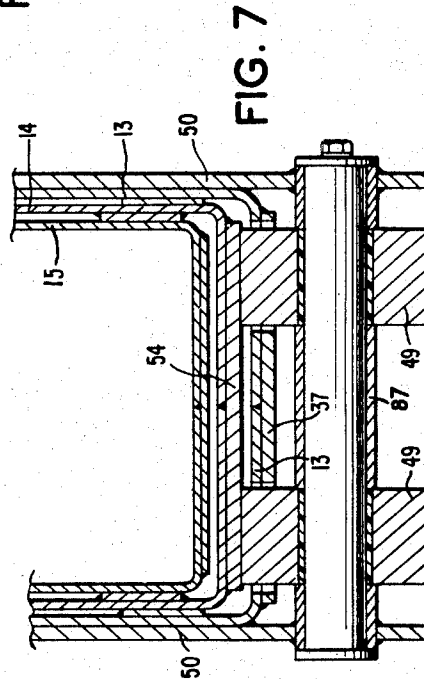


FIG. 7

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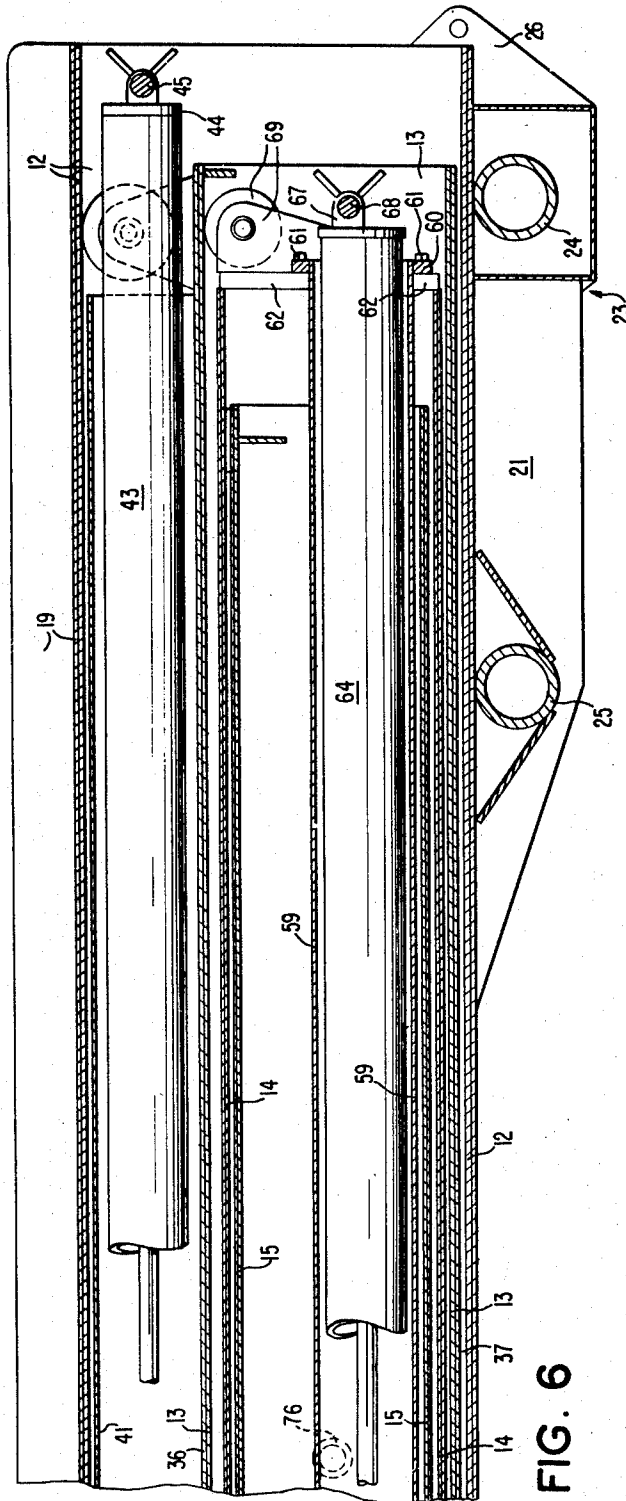


FIG. 6

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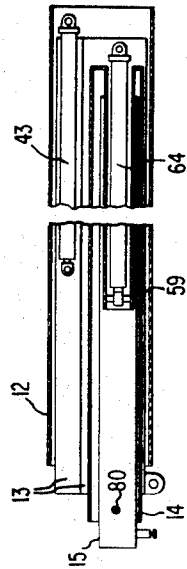


FIG. 9

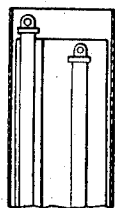


FIG. 10

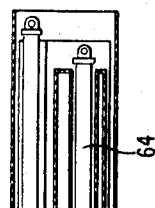


FIG. 11

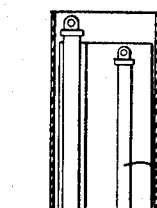


FIG. 12

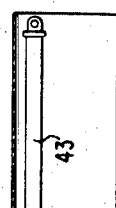


FIG. 13

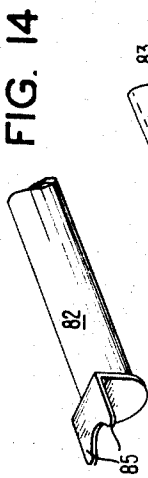


FIG. 14

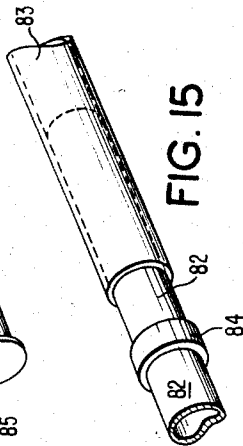


FIG. 15

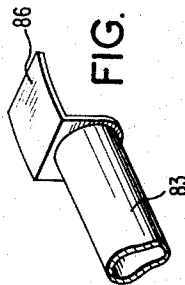


FIG. 16

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3,386,594

METHOD OF AND APPARATUS FOR EXTENDING A TELESCOPIC CRANE BOOM

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Continuation of application Ser. No. 521,329, Jan. 18, 1966, which is a division of application Ser. No. 446,602, Apr. 8, 1965, now Patent No. 3,243,052. This application May 8, 1967, Ser. No. 637,009

23 Claims. (Cl. 212—55)

ABSTRACT OF THE DISCLOSURE

A telescopic boom having at least three boom sections in which the outer two sections are selectively hydraulically extendible by a novel means and a single hydraulically extensible ram connected to the boom base section. The single hydraulic ram and novel means also provides a novel method for hydraulically extending a telescopic boom having at least three sections.

Cross-references to related application

This application is a continuation of my copending application Ser. No. 521,329, filed Jan. 18, 1966, now abandoned, which in turn is a division of application Ser. No. 446,602, filed Apr. 8, 1965, now Patent No. 3,243,052.

This invention relates broadly to crane booms and more particularly to a method of extending the boom sections of a multiple section, telescopic, hydraulically extensible boom relative to each other, and apparatus for extending the fly section of the boom.

Background of the invention

The telescoping crane booms to which the present invention is applicable are booms which are intended mainly for use on vehicles to provide mobile hydraulic truck cranes, but it is to be understood that the method and apparatus of the present invention is also applicable to booms mounted on stationary structures.

With present-day construction costs and techniques, the time involved in setting up a heavy duty long-reach crane at the job site is becoming increasingly more important. In the past, large heavy duty long-reach mobile cranes have required a separate boom truck, to carry sections of the boom, and the set-up time at the job has required considerable time usually in the range of several hours. Thus, heretofore, a mobile heavy duty crane has required approximately half a day for setup time and many times requires an expensive separate boom truck to stand by idly while it is in operation.

It is therefore the main object of the present invention to provide a method and apparatus for quickly setting up at a job site a heavy duty, long-reach, multi-section telescoping boom.

Another object of the invention is to provide a method of and apparatus for extending a heavy duty hydraulically extensible telescopic boom having a reach of approximately eighty feet in a period of less than five minutes.

Still a further object of the invention is to provide a novel method of and apparatus for extending telescopic boom sections relative to each other, and particularly a method of extending a manual boom section with the hydraulic cylinder connected for extending one of the other boom sections.

Other and further objects of the invention reside in the connecting rod apparatus for hydraulically extending the manual fly section of the boom, as well as other features which will become apparent to one skilled in the art by

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reference to the specification hereinafter following and the drawings, in which:

FIG. 1 is a side elevational view showing a mobile hydraulic crane with the crane boom shown in its retracted stored position;

FIG. 2 is a perspective view of the mobile hydraulic crane of FIG. 1, showing a four-section boom in its extended position;

FIG. 3 is a side elevational view of a four-section boom;

FIG. 4 is an exploded view showing the outer three boom sections of the four-section boom of FIG. 3, and the manner in which the hydraulic extension cylinders are connected therebetween;

FIG. 5 is an enlarged longitudinal sectional view of a fragmentary portion of the outer end of the boom of FIG. 3, showing the manner in which the boom sections are connected within each other;

FIG. 6 is an enlarged longitudinal sectional view of a fragmentary portion of the opposite end of the boom of FIG. 3;

FIG. 7 is an enlarged fragmentary cross sectional view taken substantially along line 7—7 of FIG. 5;

FIG. 8 is an enlarged cross sectional view taken substantially along line 8—8 of FIG. 5, and particularly showing the removable pin connection between the fly and outer mid-sections of the boom;

FIGS. 9, 10, 11, 12 and 13 are diagrammatic foreshortened views of the four-section boom showing the steps of extending the boom sections relative to each other from the retracted to the fully extended position according to the method of the invention;

FIG. 14 is an enlarged perspective view of the front portion of the extension rod assembly shown in FIGS. 10 and 11;

FIG. 15 is an enlarged fragmentary perspective view of the coupling of the extension rod assembly; and

FIG. 16 is an enlarged perspective view of the opposite end of the extension rod assembly from that shown in FIG. 14.

A four-section hydraulically extensible boom is shown in FIGS. 1 and 2 mounted on a vehicle, indicated generally at 1, adapted for travel over roads or rough terrain, to form a mobile hydraulic crane. The vehicle is equipped with hydraulically extensible outriggers 2 for stabilizing the vehicle frame on the supporting surface and removing the load from the vehicle wheels when the crane is set up for operation. The boom assembly 3 is pivotally mounted at 4 to a pair of boom supports 5 on housing 6 which includes an operator's cab 7 and the hydraulic control system for the boom. A pair of hydraulic cylinders 9 are pivotally connected between the boom assembly and housing 6 at 10 and 11 respectively for raising and lowering the boom assembly. The housing and cab 6 and 7 are connected to the vehicle through turntable 8, operable from the operator's cab which enables the boom assembly 3 to be continuously rotated through 360°. Although the boom assembly has been shown mounted on a mobile vehicle, it is to be understood that it can also be mounted on a stationary platform. In addition although a four-section boom has been shown the method and apparatus of the present invention is applicable to a boom having at least three telescopic sections.

Referring more particularly to FIGS. 3—13, the four-section, self-contained hydraulically extensible telescopic boom shown, includes a base section 12, an inner mid-section 13 telescopically disposed within base section 12, an outer mid-section 14 telescopically disposed within inner mid-section 13, and a fly section 15 telescopically disposed within outer mid-section 14 and having a boom nose assembly 16 connected to the outer end thereof for control of the hoist cable 17 and hook assembly 18.

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Base section 12 is of rectangular cross section with an upwardly opening channel 19 connected on the upper surface thereof and coextensive therewith to provide a guide for the hoist cable 17 which lays within the channel. The base end of the base section is provided with reinforcing side plates 21, securely connected thereto by welds and gusset plates which extend to form a box section, indicated generally at 23, beneath the end of the base section in which transversely extending boom pivot bushing 24 and lift cylinder bushing 25 are rigidly mounted. Bushing 24 provides a connection for the pivot connection 4 between the boom assembly and the pair of boom supports 5 while bushing 25 provides a connection for the pivot connection 10 between the pair of hydraulic raising and lowering cylinders 9 and the boom assembly. The box section 23 provides a pair of rearwardly extending supports 26 adjacent the terminating end of the bottom surface of the base structure to which a platform 27 is pivotally connected at 28, as shown particularly in FIG. 3. The sides of platform 27 are bolted at 30 to the sides of base section 12. A hydraulically powered winch 31 is connected on the platform at the end of the base section such that the hoist cable 17 extending from and controlled by the winch is positioned within channel 19. The pivot connecting member 28 also provides a mount for rotatable hose wheel (not shown) over which the hoses 34 from the movable hydraulic cylinder within the boom assembly extend and from which the hoses are guided onto spring-loaded hose reel 35, indicated in dotted lines in FIG. 1, for automatically taking up and extending the hydraulic hoses as the boom is retracted and extended, respectively. When access to the end of the boom assembly is desired for maintenance, or the like, the bolts 39 are removed from opposite sides of the platform 27 after cable 17 is slackened or retracted into the winch, and the winch platform is then pivoted downwardly about connection 28, as indicated in dotted lines in FIG. 3, moving the winch away from the end of the boom to expose the same and leave it clear of obstructions so that maintenance can be performed thereon.

Inner mid-section 13 of the boom assembly is generally rectangular in cross section and is provided with reinforcing plates 36 and 37, respectively, on the top and bottom surfaces thereof and coextensive with the length thereof, with the lower reinforcing plate 37 providing a bearing surface for roller bearings 38 rotatably connected to the reinforcing collar 39 rigidly connected on the outer end of base section 12. The roller bearings 38 extend through apertures adjacent the forward end of base section 12 and extend interior of the base section slightly above the lower surface thereof so that when inner mid-section 13 is telescopically disposed within the base section, reinforcing plate 37 is in bearing contact with the rollers.

An upper housing 41, comprising an inverted channel member, is securely connected by welding or the like to the top of inner mid-section 13, that is, the top of reinforcing plate 36, such that upper housing 41 is an integral part of mid-section 13 and telescopes within the base section since the overall height of the mid-section, including housing 41, is slightly less than the interior height of base section 12. Upper housing 41 is substantially coextensive with inner mid-section 13, as shown in FIG. 4, but terminates adjacent the inner end of the mid-section to provide connection space for a pair of roller bearing assemblies 42, FIG. 4, connected on the upper surface of the inner end of the inner mid-section. When inner mid-section 13 is telescoped within base section 12 roller bearing assemblies 42 roll upon the inner top surface of base section 12.

A telescopic hydraulic cylinder 43 is disposed within upper housing 41 with the base end 44 of the cylinder casing connected by pivot pin and bushing assembly 45, FIGS. 3, 4 and 6, to the top portion of the inner end of base section 12 while the end 46 of the piston rod, extend-

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ing from cylinder 43, is pivotally connected through pivot pin and bushing connection 47, FIGS. 4 and 5, to upper housing 41 of the inner mid-section 13, adjacent the outer end thereof. The pivot pin and bushing connections 45 and 47 by which telescopic cylinder 43 is connected between base section 12 and inner mid-section 13 extend transversely of the respective sections. The hydraulic lines 48 from opposite ends of the cylinder extend out of the rear of the boom assembly and to the hydraulic control system within housing 6 and cab 7.

A pair of roller bearings 49 are rotatably connected adjacent the outer edge of inner boom section 13 by side reinforcing members 50, such as to extend inwardly through apertures in the bottom surface of the boom section and terminate slightly above the inner bottom surface of the boom section as shown in FIG. 7.

Outer mid-section 14 of the boom assembly is of hollow rectangular cross section having length and width dimensions slightly smaller than the inner dimensions of the lower portions of inner boom section 13. A reinforcing plate 54 is provided on the lower surface of the boom section and being longitudinally coextensive therewith forming a bearing surface for roller bearings 49 of inner mid-section 13 as outer mid-section 14 is extended and retracted relative thereto. The outer end of the boom section is provided with a surrounding reinforcing collar 56 rigidly connected thereto. A guide loop 57 for guiding the hoist cable 17 is connected on the upper surface of collar 56 while transversely aligned apertures 58 are provided through the sides of the collar and outer mid-section as indicated in FIG. 8. The purpose of the aligned apertures is explained more fully hereinafter following.

A generally square cross-sectioned core or cylinder box housing 59, FIGS. 4, 5 and 6 is connected within outer mid-section 14 in spaced relation with the inner surfaces thereof by means of flange plate 60 rigidly connected to the inner end thereof and secured by bolts 61 to end flanges 62 rigidly connected to the inner end of outer mid-section 14. Cylinder box housing or core 59 and outer mid-section 14 are thus rigidly connected together as a unit at their inner ends with the outer end of core 59 terminating somewhat inwardly of the outer end of outer mid-section 14, as shown in FIGS. 4 and 5. Since core 59 is of substantial length a pair of support skids 63, FIGS. 4 and 5 are connected to the outer end of the core and are adapted to rest on the inner bottom surface of outer mid-section 14 when fly section 15 is not in place. When fly section 15 is telescoped within the outer mid-section, skids 63 will bear on the inner bottom surface thereof, as will be more fully understood later in the specification. Support skids 63 are curved upwardly and somewhat inwardly in converging relation on their outer ends to aid in sliding the fly section 15 in place if it is removed from the boom assembly.

Telescopic hydraulic cylinder 64 is disposed within core 59 with the end 65 of its piston rod pivotally connected to the outer end of core 59 by means of shaft and bushing connection 66, shown more particularly in FIG. 5. The base end 67 of hydraulic cylinder 64 is pivotally connected to shaft 68 connected transversely between the sides of inner mid-section 13 on the inner end thereof as shown in FIGS. 4 and 6. A pair of roller bearing assemblies 69 extending above the top surface of outer mid-section 14 are also connected to the inner end thereof to provide a rolling contact with the inner upper surface of inner boom section 13 as outer boom section 14 is extended and retracted therein.

The fly section 15 of the boom assembly is the outermost boom section and is of rectangular cross section with the cross-sectional dimensions being slightly smaller than the cross-sectional dimensions of outer mid-section 14, such that the fly section telescopes within the outer mid-section in close proximity to the inner walls thereof and is telescoped over core or cylinder box housing 59 such that the support skids 63 of the core slide on the inner

bottom surface of the fly section. A boom nose assembly 16 is securely connected to the outer end of the fly section, as indicated in FIG. 3, and carries a plurality of sheaves 72 about which the hoist cable 17 is threaded to support the hook assembly 18 therebeneath, which is raised and lowered by the hoist cable under control of winch 31. The end of hoist cable 17 is anchored to lug 73 on the outer end of the fly section. A downwardly extending extension lug 74 having a recess groove therein is securely anchored adjacent the outer end of the fly section substantially centrally of the lower surface thereof.

A bushing 75, shown particularly in FIGS. 4 and 8, is connected interior of the fly section adjacent the outer end thereof and transversely between the sides to form a transverse passage through the fly section. As shown in FIGS. 4 and 6, a pair of bushings 76 are disposed through opposite side walls of the fly section in registration with each other, spaced somewhat inwardly of the inner end thereof.

The fly section 15 is normally manually movable within outer mid-section 14 since there is no hydraulic cylinder connected thereto for hydraulic extension of the same, and the core 59 within the outer mid-section enables the difference in the cross section modulus, between the fly and outer mid-sections, to be a minimum. During transportation and when the fly section is not in use it is locked in its retracted position within outer mid-section 14 by manually removable pin 80 passing through apertures 58 in reinforcing collar 56 and the other end of outer mid-section 14 and hollow transverse bushing 75 in the outer end of fly section 15, which bushing is disposed in registration with apertures 58. The outer ends of the fly and outer mid-sections are thus normally locked to each other by pin 80. To extend the fly section, pin 80 is removed, the fly section is pulled out of outer mid-section 14 until the bushings 76 adjacent the inner end of the fly section move into registration with apertures 58 in the outer end of outer mid-section 14, and pin 80 is inserted through the apertures 58 and bushings 76 to lock the inner end of the fly section to the outer end of the outer mid-section.

The hydraulic hoses 34 from the front and rear ends of hydraulic cylinder 64 extend out through the inner end of the boom assembly over hose wheel 33 and onto the automatically retractible and extensible spring-load reel 35 so that the hydraulic hoses for the cylinder are automatically played out and retracted as inner mid-section 13, to which the cylinder is connected, is moved relative to base section 12.

Method

In the past, fly sections of a boom have normally been manually extended or connected to the outermost section of a hydraulic, telescopic boom. If the fly section is telescoped within the outer boom section this requires one or two men to pull the section out of the end of the boom to extend the same, and this is not an easy job because the section is rather heavy in a heavy duty boom assembly, since the sections are made of heavy gage steel. The present invention provides a novel method of extending the fly section 15 by use of a hydraulic cylinder connected between two other boom sections, which cylinder is not directly connected, but is operatively connected by novel means, to the fly section.

Referring to FIGS. 9-16, in practicing the method an extension rod assembly, shown generally at 81 is utilized. The extension rod assembly comprises a first rod section 82 adapted to be telescoped within a second rod section 83 until the stop collar 84 adjacent the end of first rod section 82 abuts the corresponding end of second rod section 83 as shown in FIGS. 10, 11 and 15. A locking clip 85 is connected on the forward end of first rod section 82 and is adapted for connection in the recess groove of extension lug 74 on the outer end of fly section 15. A connector clip 86 is connected to the inner end of second rod section 83 and is adapted to slide over bushing sleeve 87, FIGS. 7, 10 and 11, disposed between the pair of roller

bearings 49 connected beneath the outer edge of inner mid-section 13.

In FIG. 9 the four-section boom is diagrammatically illustrated in its fully retracted position with alternate boom sections shown in cross-hatched lines for purposes of ease in distinguishing between adjacent sections. The front of fly section 15 is locked with pin 80 to the front of outer mid-section 14 as shown in FIG. 9. Sections 15 and 14 are then extended relative to inner mid-section 13 by hydraulic cylinder 64 connected between sections 13 and 14. Pin 80 is removed to unlock the front of fly section 15 from the front of outer mid-section 14, and the first and second rod sections 82 and 83, which are normally carried at an appropriate place on the vehicle, are telescoped within each other to form an extension rod assembly 81. Clip 86 is placed over bushing sleeve 87 and the extension rod assembly is moved into the horizontal position, and then the first and second rod sections 82 and 83 are moved somewhat relative to each other, as indicated in FIG. 11 to slide locking clip 85 into the groove of lug 74. This entire procedure is being done while the boom assembly is in the horizontal position. Outer mid-section 14 is then telescopically retracted within inner mid-section 13 by means of hydraulic cylinder 64, and the inner end of fly section 15 is then locked to the other end of outer mid-section 14 by pin 80, FIG. 11.

Hydraulic cylinder 64 is again actuated to extend outer mid-section 14 relative to inner mid-section 13, but this time section 14 is carrying fly section 15 outwardly in an extended position rather than a retracted position. As section 14 moves relative to section 13 the distance between lug 74 and sleeve 87 increases and extension rod assembly 81 drops away. To extend the four-section boom to its entire length, hydraulic cylinder 43 is then actuated to extend inner mid-section 13 relative to base section 12. The manual fly section is thus semi-automatically extended by means of the hydraulic cylinder 64 connected between the mid-sections 13 and 14.

To retract the fly section pin 80 is removed to unlock the inner end of fly section 15 from the outer end of outer mid-section 14. Hydraulic winch 31 is actuated to draw hook assembly 18 tight against nose assembly 16 and by slowly winding hoist cable 17 onto the winch the cable pulls on the nose assembly 16 and slides fly section 15 inwardly to retract the same within outer mid-section 14. Pin 80 is then inserted to lock the front or outer edge of fly section 15 to the outer edge of outer mid-section 14. The remaining boom sections are then retracted with the hydraulic cylinders 43 and 64 in the usual manner.

By way of example, a four-section boom, having a base section 24 feet long, provides an overall boom assembly including the winch and nose assembly having a retracted length just short of 30 feet and an effective extended length of slightly over 80 feet.

While the method and apparatus of the invention has been shown and described in certain preferred embodiments it is realized that modifications can be made without departing from the essence of the invention, and it is to be understood that no limitations on the invention are intended other than those imposed by the scope of the appended claims.

I claim:

1. In a telescopic hydraulically extensible boom having at least three sections, including an inner section, a mid-section telescopically disposed in the inner section, a manual outer section telescopically disposed in said mid-section, power means connected at one end to said inner section and at the other end to said mid-section for moving said mid-section longitudinally relative to said inner section, the improvement comprising, a first connector means on the outer end of said manual outer section, a second connector means on the outer end of said inner section, and extension rod means connectable between said first and second connector means when said mid-section is extended longitudinally from said inner section by said

power means for longitudinally extending said manual outer section relative to said mid-section as said mid-section is longitudinally retracted in said inner section by said power means.

2. The method of extending a manual fly section relative to first and second hydraulically connected telescopic sections in an extendible boom structure having at least three telescopically disposed sections comprising the steps:

- (1) locking the fly section to the second section,
- (2) hydraulically extending the second section from the first section,
- (3) unlocking the fly section from the second section,
- (4) locking the fly section to the first section,
- (5) hydraulically retracting the second section in the first section,
- (6) locking the fly section to the second section, and
- (7) hydraulically extending the second section from the first section while unlocking the fly section from the first section, whereby the fly section is extended by the hydraulic means connected between the first and second sections.

3. The method as set forth in claim 2 wherein in step (4) the manual fly section is locked from retracting movement only.

4. The method as set forth in claim 2 wherein in step (7) the unlocking and extending steps are performed simultaneously.

5. The method as set forth in claim 2 wherein in step (1) the front of the fly section is locked to the front of the second section.

6. The method as set forth in claim 2 wherein in step (4) the front of the fly section is locked to the front of the first section.

7. The method as set forth in claim 2 wherein in step (6) the inner portion of the fly section is locked to the front of the second section.

8. The method as set forth in claim 2 wherein in the unlocking portion of step (7) the front of the fly section is unlocked from the front of the first section.

9. The method as set forth in claim 2 in which said extendible boom structure includes a winch and a winch cable extending outwardly of the telescopic sections the steps of retracting the manual fly section into said second section comprising:

- (1) unlocking the fly section from the second section,
- (2) connecting the winch cable to the fly section,
- (3) retracting the winch cable with said winch to retract the fly section into the second section, and
- (4) locking the fly section to the second section.

10. Apparatus for extending a multi-sectioned boom comprising:

a base section, a second section telescopically received within said base section, a third section telescopically received in said sections and said third section telescopically receiving a fly section,

a first hydraulic motor having one end pivotally secured to said base section and extending longitudinally of said boom in a chamber above said second section and pivotally connected at its other end to said second section for moving said section with respect to said base section, means for extending said third section outwardly with respect to said second section, said means including a second hydraulic motor having one end pivotally secured to said second section and lock means intermediate the length of the fly section and intermediate the length of said third section for selectively locking said fly section to said third section in an extended position whereby said means moves said fly section and third section as a unit when locked together.

11. The apparatus for extending the fly section of a boom as recited in claim 10 wherein said lock means is a removable pin receivable in aligned openings in said third and fly sections.

12. A telescopic hydraulically extensible boom for material handling apparatus comprising, a base tubular section, a telescoping mid-section movable outwardly from and retractible into the base section and nested in the base section in retracted position, a telescoping fly section extendible from and retractible into the mid-section and nested in the mid-section in retracted position, removable means receivable in alignable openings provided intermediate the length of the fly section and in the outer end of the mid-section when the fly section is in extendible position for locking the fly section in extendible position to the mid-section, a hydraulic motor means exerting a force axially of the fly section and having one end pivotally connected to the base section, and means connecting the outer end of the hydraulic motor means to the mid-section for moving said mid-section outwardly from and into the base section, said outer end of the hydraulic means being nested within the fly section when the latter is nested in the mid-section.

13. A telescopic hydraulically extensible boom for material handling apparatus comprising, a base tubular section; a telescoping mid-section movable outwardly from and retractible into the base section and nested in the base section in retracted position and a fly section; removable locking means receivable in alignable openings, provided intermediate the length of the inner end of the fly section and in the outer end of the mid-section when the fly section is in extendible position, for locking the fly section in extendible position to the mid-section; means for restraining movement of one of said movable sections during movement of the other to align the openings for receiving said removable locking means; hydraulic means positioned axially of the fly section and having one end pivotally connected to the base section; and means connecting the outer end of the hydraulic means to the mid-section for moving said mid-section outwardly from and into the base section, said outer end of the hydraulic means being nested within the fly section when the latter is nested in the mid-section.

14. The boom recited in claim 13 wherein said removable locking means is a pin having a diameter only slightly less than said aligned openings.

15. A telescopic hydraulically extensible boom for material handling apparatus comprising, a base tubular section, a telescoping mid-section movable outwardly from and retractible into the base section and nested in the base section in retracted position, a telescoping fly section extendible from and retractible into the mid-section in retracted position, a hydraulic jack having a line of expansion and contraction generally along the longitudinal axis of said fly section and having one end pivotally connected to the base section, and lock means connecting the outer end of the hydraulic jack to the mid-section and to said fly for moving said mid-section and fly outwardly in unison from the base section, a removable rod member extending between said fly and said base section when said mid-section and said fly have been moved outwardly from said base section, for restraining movement between said base section and said fly section as said hydraulic means retracts said mid-section into said base section.

16. A telescopic boom as set forth in claim 15 in which said removable rod member includes at least a pair of interfitting rod sections.

17. The method of extending a fly section of a hydraulic boom having a base section, mid-section means telescopically received in said base section and said fly section telescopically received in said mid-section means comprising the steps of restraining relative movement between said mid-section means and one of said other sections while extending said fly section, pinning an intermediate portion of said fly section to the outer end of said mid-section means and moving said mid-section means and fly sections as a unit outwardly with respect to said base section after removing the restraining force between said mid-section means and said one of said other sections.

18. A telescopic hydraulically extensible boom having at least a first section, a second section telescoped within said first section, and a third section telescoped within said second section, comprising hydraulic ram means connected with said first section and operatively connected to selectively extend said second and third sections, means operatively connectable between said third section and said hydraulic ram whereby said third section is extended relative to said second section by retraction of said hydraulic ram, locking means for connecting said third section to said second section in extended relation, and said hydraulic ram operatively connected with said second section to extend said second section relative to said first section upon a second extension of said ram.

19. A telescopic boom as set forth in claim 18 in which said means comprises a body portion less than the length of one boom section and extending longitudinally of said boom.

20. In a telescopic boom for material handling apparatus and the like, of the type having at least a base section, a mid-section telescoped within said base section, and a fly section telescoped within said mid-section, the said sections being of substantially the same length, the improvement comprising means including a single double action hydraulic cylinder and single piston member connected with said base section, mid-section and fly section for selectively extending and retracting said mid-section and said fly section for substantially the entire lengths thereof with said single hydraulic cylinder and single piston member, said single hydraulic cylinder and single piston member connected interior of said sections in the telescoped position, and said means disposed intermediate the length of said boom sections.

21. In a telescopic boom as set forth in claim 20 in which said means includes a body portion extending substantially parallel with the axis of said boom selectively connectable to the outer portion of said fly section and

operatively connected with said single hydraulic cylinder and single piston member for extending said fly section relative to said mid-section.

22. In a telescopic boom as set forth in claim 20 said fly section having apertures therethrough adjacent opposite ends thereof, and said means including member means connectable in said apertures for extending said fly and mid-sections.

23. The method of extending a hydraulically extensible telescopic boom having at least a base section, a mid-section and a fly section with a single piston hydraulic ram means connected to the base section, comprising,

- (1) hydraulically extending the fly section from the mid-section by operatively connecting the hydraulic ram to the fly section during a first reciprocation of the hydraulic ram, including operatively connecting the forward end of the hydraulic ram to the fly section during the outward operation of the hydraulic ram and operatively disconnecting the forward end of the hydraulic ram from the fly section during the retracting operation of the hydraulic ram,
- (2) locking the extended fly section to the mid-section, and
- (3) hydraulically extending the mid-section from the base section with a repetitious outward operation of the hydraulic ram whereby the fly section and mid-section are extended as a unit from the base section.

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