Nov. 18, 1969 R. E. STAUFFER 3,478,894

EXTENSIBLE AND RETRACTABLE BOOM CONSTRUCTION FOR CRANES

Filed Nov. 27, 1967 3 Sheets-Sheet 1

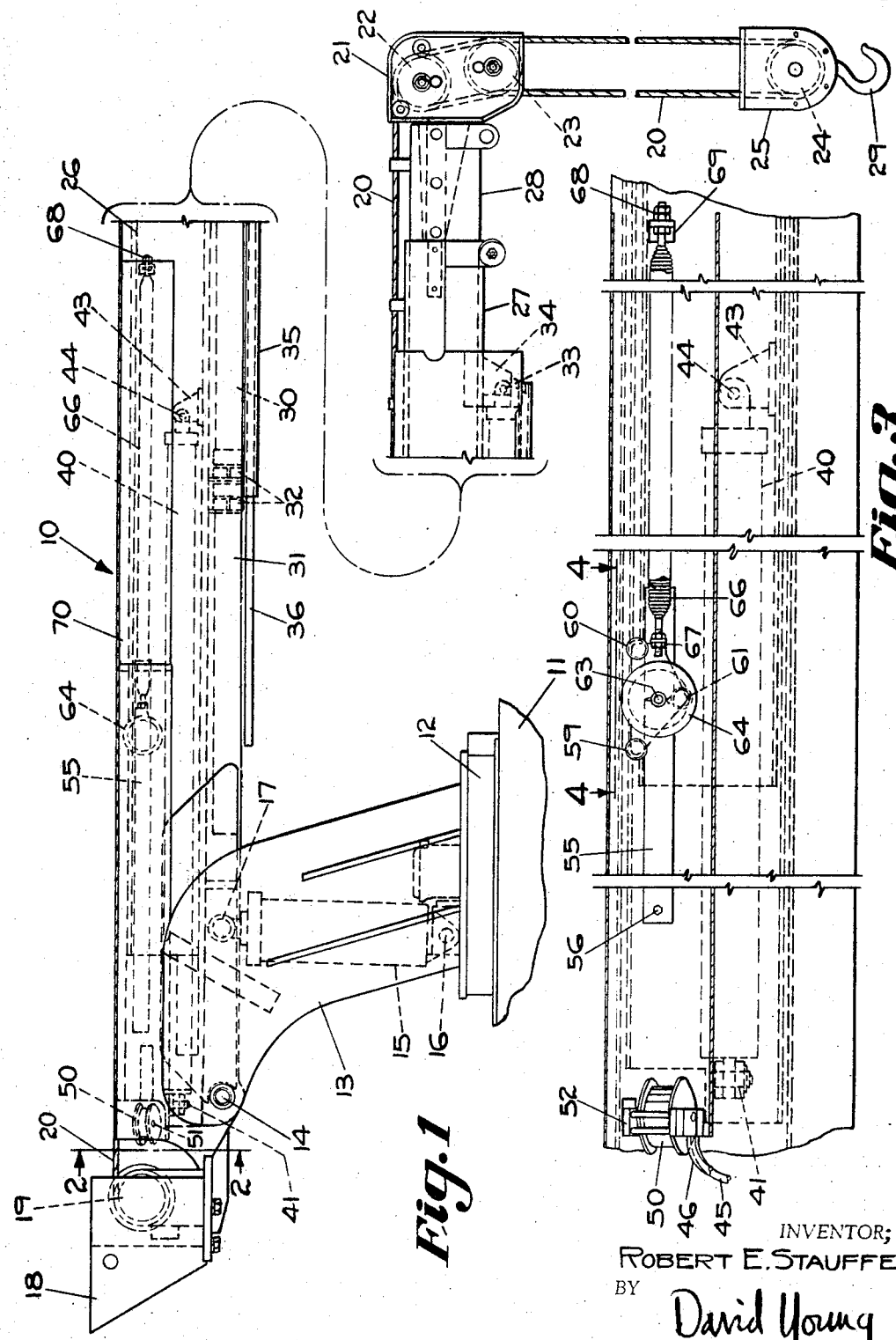


Fig. 1

Fig. 3

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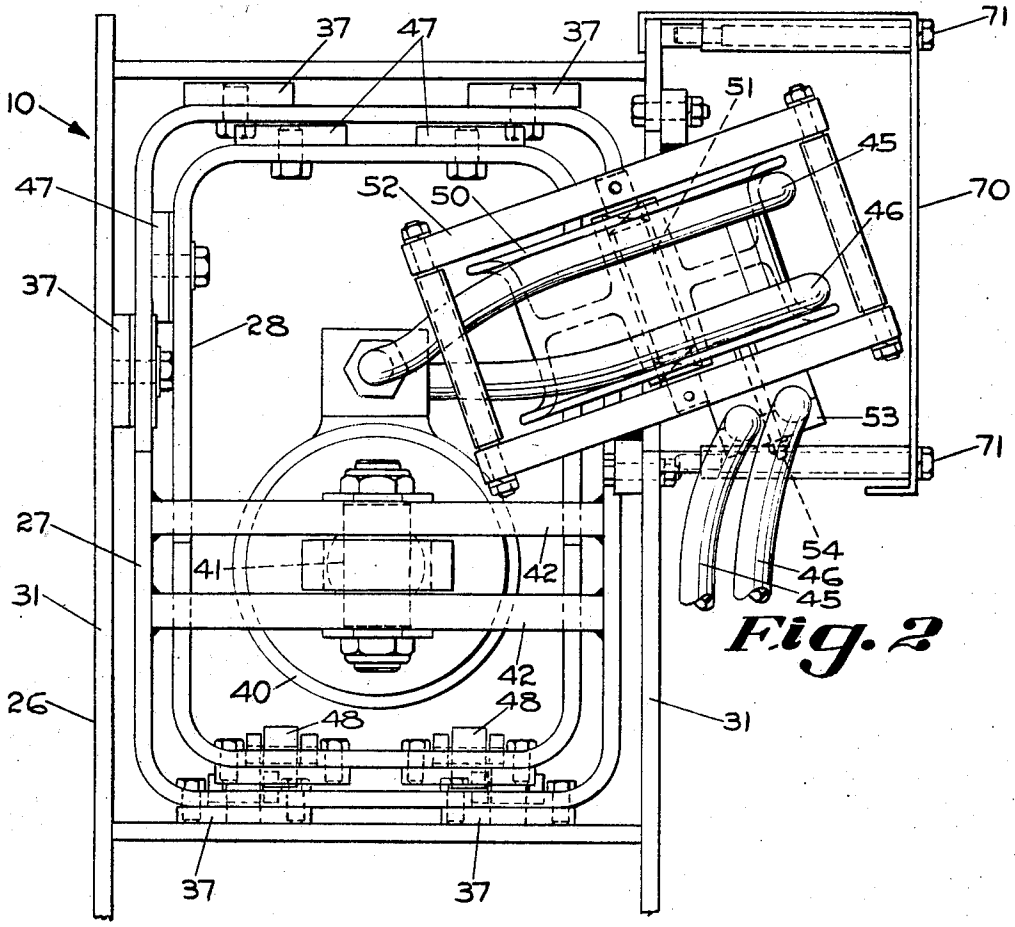


Fig. 2

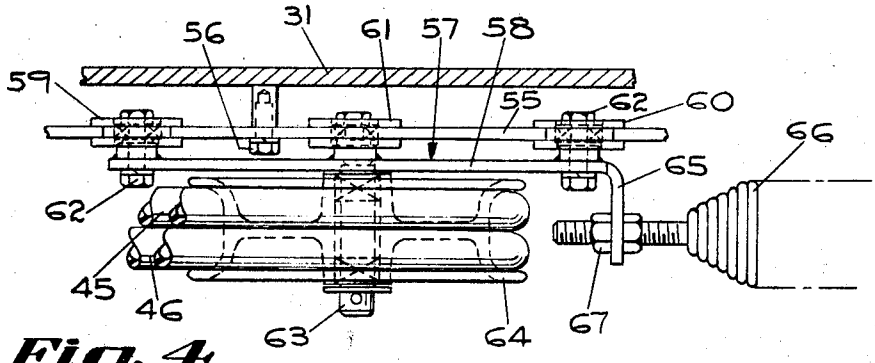


Fig. 4

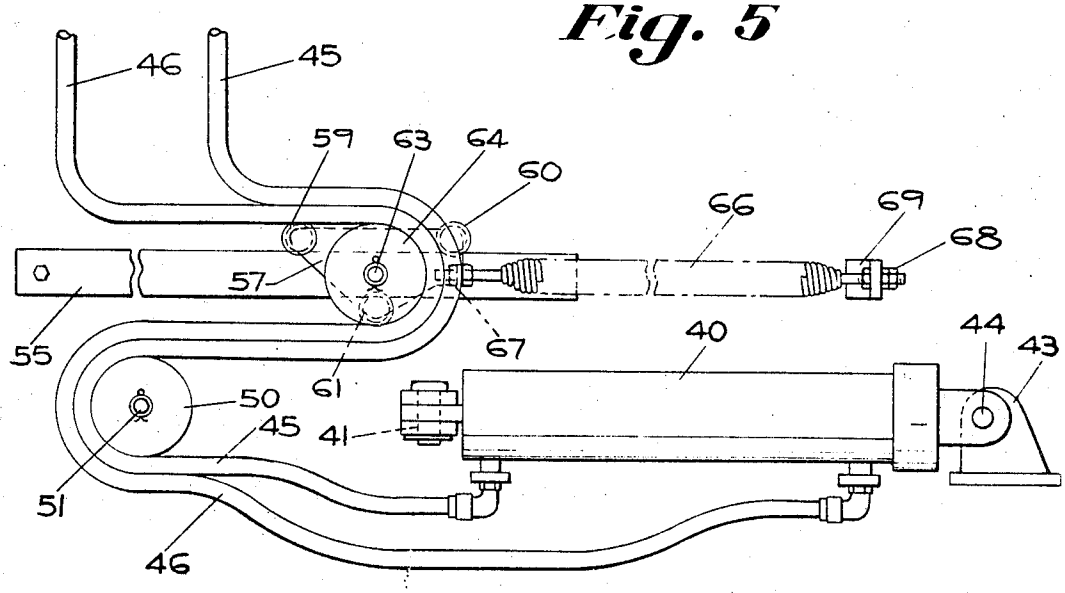
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Fig. 5



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EXTENSIBLE AND RETRACTABLE BOOM CONSTRUCTION FOR CRANES

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U.S. Cl. 212—55 8 Claims

ABSTRACT OF THE DISCLOSURE

A crane with a boom that has three boom sections. The second and third boom sections are extensible and retractable relatively to the first boom section and relatively to each other. There is a hydraulic cylinder to extend and to retract the third boom section relatively to the second boom section. The hydraulic cylinder travels with the second and third boom sections. A storage length of hydraulic hose may be drawn out and returned to maintain the hydraulic fluid connections to the cylinder as it travels.

The instant invention relates to cranes, and more particularly to an improved construction for an extensible and retractable boom for such cranes.

There are many applications for cranes for lifting and moving loads of various sizes and descriptions. The usefulness of the cranes stems from the ability to reach any place in a wide area with the crane boom. The crane boom is customarily mounted on a turntable base which permits the boom to swing to any position in a circle. The support for the boom also includes means for raising and lowering the boom, which permits the boom to reach to any elevation within its operating range. Further, the boom is constructed of several extensible and retractable sections, which gives the boom the ability to reach out in a radial direction to different distances within its circle of operation.

The reach of the crane boom in the radial direction is increased by increasing the number of telescoping sections of the crane boom. There may be only two boom sections, in which the one boom section is extended and retracted relatively to the other boom section. In such a boom construction the radial reach of the boom is determined by the extent to which the one boom section may be extended and retracted relatively to the other boom section which remains fixed. The radial reach of such a crane boom is increased by adding another boom section which may be extended and retracted. In such a boom construction the radial reach of the boom is determined by the extension and retraction of two boom sections, which are extended and retracted relatively to the fixed boom section, and also, the outer one of the boom sections is extended and retracted relatively to the second boom section.

Hydraulic power cylinders are customarily utilized to extend and to retract the boom sections relatively to each other. In the boom construction in which there is a third boom section that is extended and retracted relatively to a second boom section, the hydraulic cylinder is disposed within the second and third boom sections. When the second and third boom sections are extended or retracted relatively to the first boom section the hydraulic cylinder travels or moves with the boom sections. It is necessary to maintain the hydraulic hose connections to the hydraulic cylinder in any position of the latter. This is accomplished by providing a length of the hydraulic hose which is stored along the first boom section. As the hydraulic cylinder moves it draws the hydraulic hose out from the stored length thereof, and in this manner communication is maintained for the hydraulic fluid to the hydraulic cylinder.

It is an object of this invention to provide an improved boom construction in which there are second and third boom sections that are extended and retracted to increase the range of the radial reach of the boom..

It is another object of this invention to provide an improved boom construction that has second and third boom sections with a hydraulic cylinder for extending and retracting the third boom section relatively to the second boom section, and means for maintaining connection to the hydraulic cylinder to supply hydraulic operating fluid to the latter.

It is another object of this invention to provide an improved boom construction with second and third boom sections that are extended and retracted relatively to each other by a hydraulic cylinder in which there is a stored length of hydraulic hose that is drawn out and returned as the hydraulic cylinder travels out and returns with the second and third boom sections.

Other objects of the invention will appear hereinafter, the novel features and combinations being set forth in the appended claims.

In the drawings:

FIG. 1 is a side elevational view of a crane boom which is constructed in accordance with this invention;

FIG. 2 is a sectional view of the crane boom, taken on the line 2—2 in FIG. 1;

FIG. 3 is a side elevational view of the movable sheave and trolley for the hydraulic hose;

FIG. 4 is a plan view of the movable sheave and trolley, as seen on the line 4—4 in FIG. 3;

FIG. 5 is a schematic view showing the looping of the hydraulic hoses around the sheaves.

In FIG. 1 there is illustrated a crane boom **10** that is mounted on a suitable platform **11**, which may be the chassis or frame of a truck, as in the case of a mobile crane. There is a turntable base **12** on which the crane boom **10** may be swung laterally, usually to any position within a circle. A pedestal **13** stands on the turntable base **12**, and extends upwardly and rearwardly to provide a support for a lateral pivot pin **14**, by which the crane boom **10** is pivotally mounted on the pedestal **13** to swing upwardly and downwardly to reach to different elevations within the range of operation of the boom **10**. There is a lift cylinder **15** which has its base end pivotally connected to the turntable base **12** by a pivot pin **16**, and its piston rod end is connected to the boom **10** by a pivot pin **17**. The boom **10** is swung upwardly and downwardly on its pivot pin **14** by extension and retraction, respectively, of the lift cylinder **15**.

The boom **10** extends forwardly from the pedestal **13** as a cantilever beam construction. At the rear end of the boom **10** there is a counterweight **18** to counterbalance the overhanging weight of the boom **10**. A winch **19** is also at the rear of the boom **10**. A cable **20** extends from the winch over the top of the boom **10** to a head block **21**, in which the cable **20** is reeved around the sheaves **22**, **23**, and then around the sheave **24** of the hook block **25**. The winch **19** is operated to pay out and to take up the cable **20** which lowers and raises the hook block **25** to lower and raise any load that may be carried by the hook **29** of the hook block **25**.

The boom **10** has a lower or first boom section **26** to which the pivot pin **14** of the pedestal **13** is connected. The counterweight **18** and the winch **19** are secured to the first boom section **26**. Also the lift cylinder **15** is secured to the first boom section **26**. Thus, the first boom section **26** may be moved upwardly and downwardly on the pivot pin **14** by means of the cylinder **15**, but it can-

not be extended and retracted, and in this respect it is fixed.

There is an upper or second boom section **27** which is telescopically received within the first boom section **26**, and an extension boom section or third boom section **28**, which is telescopically received within the second boom section **27**. The second boom section **27** may be extended and retracted relatively to te first boom section **26**, and the third boom section **28** is carried with the second boom section **27** as the latter is extended and retracted. The third boom section **28** may be extended and retracted relatively to the second boom section **27**.

There is a first cylinder **30** which is placed below the first boom section **26** and between its depending side plates **31, 31**. The cylinder **30** is connected to the first boom section **26** by a plurality of flexible or yieldable mounting elements **32** at about the mid-length of the cylinder **30**. The piston rod end of the cylinder **30** is connected to the second boom section **27** by a pin **33** which connects to a depending leg **34** on the underside of the second boom section **27**. The cylinder **30** is connected to the first boom section **26** at its mid-length in order to avoid excessive bending of the latter, which would cause binding of the piston and piston rod. The cylinder **30** is double acting to extend and to retract the second boom section **27** relatively to the first boom section **26**, and the extent of extension is determined by the stroke of the cylinder **30**. Below the cylinder **30** there is a fixed guard **35** with a movable part **36** that travels with the second boom section **27** as it is extended and retracted.

The first boom section **26** is of a hollow walled construction, and the second boom section **27** is also of a hollow walled construction, as seen in FIG. 2. A plurality of wear plates **37** are secured to the walls of the second boom section **27** to bear against the inner surfaces of the walls of the first boom section **26**, and to facilitate the movement of the second boom section **27** relatively to the first boom section **26**.

The cylinder **30** is double acting, and accordingly, there are hydraulic hose connections to the cylinder **30** at the opposite ends of the latter for the supply and return flow of hydraulic fluid. The cylinder **30** is fixed on the first boom section **26**, and the hydraulic lines or hoses are connected to the cylinder **30** in the customary manner. The hydraulic hoses are not illustrated in order to maintain clarity of the drawings.

A second hydraulic cylinder **40** is connected to the second boom section **27** and to the third boom section **28**. The cylinder end of the hydraulic cylinder **40** is connected to the second boom section **27** by an upright pin **41** which is secured to the lateral bars **42, 42** in the second boom section **27**, as seen in FIG. 2. The piston rod end of the cylinder **40** is connected to the third boom section **28** on an upstanding post **43** by a lateral pin **44**. The cylinder **40** is double acting to extend and to retract the third boom section **28** relatively to the second boom section **27**, with the length of extension being determined by the stroke of the cylinder **40**.

A plurality of wear plates **47** are secured to the third boom section **28** and are directed outwardly therefrom to bear against the inner surfaces of the walls of the second boom section **27** to facilitate the movement of the third boom section **28** relatively to the second boom section **27**. At the bottom of the third boom section **28** there are rollers **48**, which are adapted to ride on the inside of the second boom section **27**, also to facilitate relative movement of the second and third boom sections **27, 28**.

Since both the second boom section **27** and the third boom section **28** are extended or move together relatively to the first boom section **26**, the cylinder **40** travels relatively to the first boom section **26** with the second and third boom sections **27, 28**. Therefore, it is necessary to maintain the connections of the hydraulic lines or hoses to the cylinder **40** in all portions of the latter as it travels with the second and third boom sections **27, 28**.

At the rear end of the first boom section **26** there is a fixed sheave **50**, which is rotatably mounted on an upright pin **51** that is secured in a supporting frame **52** on the side wall **31** of the first boom section **26**. Below the supporting frame **52** there is a dual hose clamp **53** for receiving hydraulic hoses **45, 46** and for securing the latter by a nut and bolt **54**. The hydraulic hoses **45, 46** are led up through the hose clamp **53** and secured by the latter.

At the side of the first boom section **26**, on the side wall **31**, there is a rail or track **55**, which extends along the first boom section **26** and is secured to the side wall **31** of the latter by a plurality of screws **56**. A trolley **57** rides along the rail **55**. Such trolley **57** has a back plate **58** of a somewhat triangular configuration. At the two upper corners of the back plate **58** there are flanged wheels **59, 60**, which are rotatably mounted and which engage on the upper surface of the rail **55**. Another flanged wheel **61** is rotatably mounted on the lower corner of the back plate **58** and engages the bottom surface of the rail **55**. Each flanged wheel is secured to the back plate **58** by nut and bolt means **62**, with suitable bearing means for free rotation of the flanged wheels **59, 60, 61**. The trolley **57** may ride back and forth along the rail **55**. A short shaft **63** is secured to the back plate **58** and projects laterally to rotatably support a movable sheave **64**.

The hydraulic hoses **45, 46** are led forwardly from the hose clamp **53** to the movable sheave **64** and wound around the latter in a bight to extend rearwardly therefrom to the fixed sheave **50**. The hydraulic hoses **45, 46** are led around the sheave **50** and then forwardly therefrom to extend into the second boom section **27** and the third boom section **28** to the cylinder **40**, and are connected to opposite ends of the latter by suitable hydraulic fittings.

When the second boom section **27** is in its retracted position relatively to the first boom section **26**, the cylinder **40** is in its innermost position, as seen in FIG. 1. In this position of the cylinder **40**, the trolley **57** and the movable sheave **64** are in their forwardmost position on the rail **55**, also as seen in FIG. 1. In this position of the movable sheave **64**, the hydraulic hoses **45, 46** are withdrawn from the second boom section **27** and the third boom section **28**, and extend around the fixed sheave **50** and the movable sheave **64**.

The back plate **58** of the trolley **57** has a lateral leg **65** to which there is secured one end of a long coil spring **66** by screw and nut means **67**. The other end of the coil spring **66** is secured to the first boom section **26** by screw and nut means **68** on a bracket **69**. The coil spring **66** urges the trolley **57** to its forwardmost position on the rail **55**. When the hydraulic hoses **45, 46** are drawn into the second boom section **27** and the third boom section **28**, they are pulled out over the fixed sheave **50** and the movable sheave **64**, in opposition to the force of the coil spring **66** as the trolley **57** travels to the rear. The hoses **45, 46** are withdrawn from the second boom section **27** and the third boom section **28** by the force of the coil spring **66** acting on the trolley **57** to cause it and the movable sheave **64** to travel forwardly along the rail **55**. There is a cover **70** for the fixed sheave **50**, the rail **55**, the trolley **57**, and the coil spring **66** that extends along the first boom section **26** and is secured to the latter on its side wall **31** by a plurality of screws **71**.

There is a storage length of the hydraulic hoses **45, 46** which is disposed along the crane boom **10** in a bight around the movable sheave **64**. Such stored length of the hoses **45, 46** is about twice as long as the rail **55** on which the trolley **57** rides. The hydraulic hoses **45, 46** are readily pulled out from the storage length thereof or returned, according to the travel of the hydraulic cylinder **40** with the second and third boom sections **27, 28** thereby to maintain the connections of the hydraulic hoses **45, 46** to the cylinder **40** in all positions of travel of the latter.

Obviously those skilled in the art may make various changes in the details and arrangement of parts.

Having thus described and shown an embodiment of the invention, what it is desired to secure by Letters Patent of the United States is:

1. An extensible and retractable boom construction comprising, a first hollow walled boom section, a second hollow walled boom section, a third hollow walled boom section, each of said first, second and third boom sections being elongated members, said second boom section being telescopically received within said first boom section and said third boom section being telescopically received within said second boom section, means to extend and to retract said second boom section and said third boom section relatively to said first boom section, double acting hydraulic cylinder means disposed within and connected to said second boom section and to said third boom section to extend and to retract said third boom section relatively to said second boom section, first and second hydraulic lines connected to said hydraulic cylinder means for supply flow and for return flow of hydraulic fluid to the hydraulic cylinder, a first guide element mounted on the inner end of said first boom section on a wall of the first boom section, said first guide element overlapping said wall of the first boom section, said hydraulic lines being led from outside said wall of the first boom section over said first guide element to change the direction of the hydraulic lines to extend into the first boom section at the inner end thereof for connection of said hydraulic lines to said hydraulic cylinder means, a movable guide element for said hydraulic lines in which the hydraulic lines are led around the movable guide element to change the direction of the hydraulic lines to lead the hydraulic lines to said first guide element, and means on said first boom section to support said movable guide element for movement along said first boom section to pay out said hydraulic lines in one direction of movement of the movable guide element towards said first guide element and to take up said hydraulic lines in the opposite direction of movement of said movable guide element away from the first guide element.

2. An extensible and retractable boom construction as recited in claim 1 in which said first guide element comprises a sheave mounted on an upright pivot pin on said wall of said first boom section to lead the hydraulic lines into the first boom section, said support means comprises a track secured to said wall of said first boom section in proximity to the wall and extending along the first boom section in the longitudinal direction to said first guide element sheave, and said movable guide element comprises a sheave and movable means engaged with said track to move the movable guide element sheave back and forth along said track.

3. An extensible and retractable boom construction as recited in claim 2 including elongated spring return means for said movable sheave, said elongated spring return means being attached to said movable means and to said first boom section and disposed in longitudinal alignment with said track to take up said hydraulic lines when said second and third boom sections are retracted relatively to said first boom section.

4. An extensible and retractable boom construction comprising, a first boom section, a second boom section, a third boom section, said second boom section being telescopically received within said first boom section and said third boom section being telescopically received within said second boom section, means to extend and to retract said second boom section and said third boom section relatively to said first boom section, a hydraulic cylinder disposed within and connected to said second boom section and to said third boom section to extend and to retract said third boom section relatively to said second boom section, a hydraulic line connected to said hydraulic cylinder for hydraulic fluid for the hydraulic cylinder, a first guide element fixedly mounted on the inner end of said first boom section, a rail secured to said first boom section and extending along the first boom section in the longitudinal direction from said first guide element, a second guide element mounted on said rail to be movable along the rail back and forth in the longitudinal direction of said first boom section, said hydraulic line being led around said second guide element and along said first boom section and then around said first guide element and into the inner end of said first boom section and connected to said hydraulic cylinder, resilient means to urge said second guide element to one end of said rail that is remote from the inner end of said first boom section and the second guide element moving toward the inner end of said first boom section as the second and the third boom sections are extended relatively to the first boom section and the hydraulic line is pulled around the second guide element and around the first guide element and into and through the first boom section.

5. An extensible and retractable boom construction as recited in claim 4 in which said first guide element comprises a rotatable sheave, said second guide element comprises a rotatable sheave, a trolley for said second guide element, wheels for said trolley to engage said rail and to ride back and forth on the rail with the second guide element, and said resilient means comprising a spring secured to the trolley and to said first boom section.

6. An extensible and retractable boom construction as recited in claim 5 in which said hydraulic cylinder is a double acting cylinder and there are two hydraulic lines connected to the double acting cylinder within said second and third boom sections, and two hydraulic lines being led through said first boom section around said first sheave guide element and then along the first boom section and around said second sheave guide element to draw the two hydraulic lines into the first boom section as the second and third boom sections are extended and to withdraw the two hydraulic lines from the first boom section as the second and third boom sections are retracted.

7. An extensible and retractable boom construction as recited in claim 5 in which said rail is secured to a side wall of said first boom section in proximity to the side wall, said first sheave guide element is secured to said side wall of said first boom section on an upright pivot pin to be rotatable on the pivot pin about an upright axis, said second sheave guide element is mounted on a lateral shaft to be rotatable on the shaft about a lateral axis, said hydraulic line being led around said second sheave guide element to said first sheave guide element and around the first sheave guide element to change the direction of the hydraulic line and to lead the hydraulic line around the inner end of said side wall of the first boom section and into the first boom section to said hydraulic cylinder.

8. An extensible and retractable boom construction as recited in claim 5 in which said rail is secured to a side wall of said first boom section in proximity to the side wall, said trolley wheels are disposed above and below said rail in engagement with the rail to hold the trolley on the rail as it rides back and forth, said spring is disposed in alignment with said rail and extends along said side wall of the first boom section in a longitudinally forward direction from the rail, the forwardmost end of said spring being secured to said side wall of the first boom section.

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U.S. Cl. X.R.

214—141