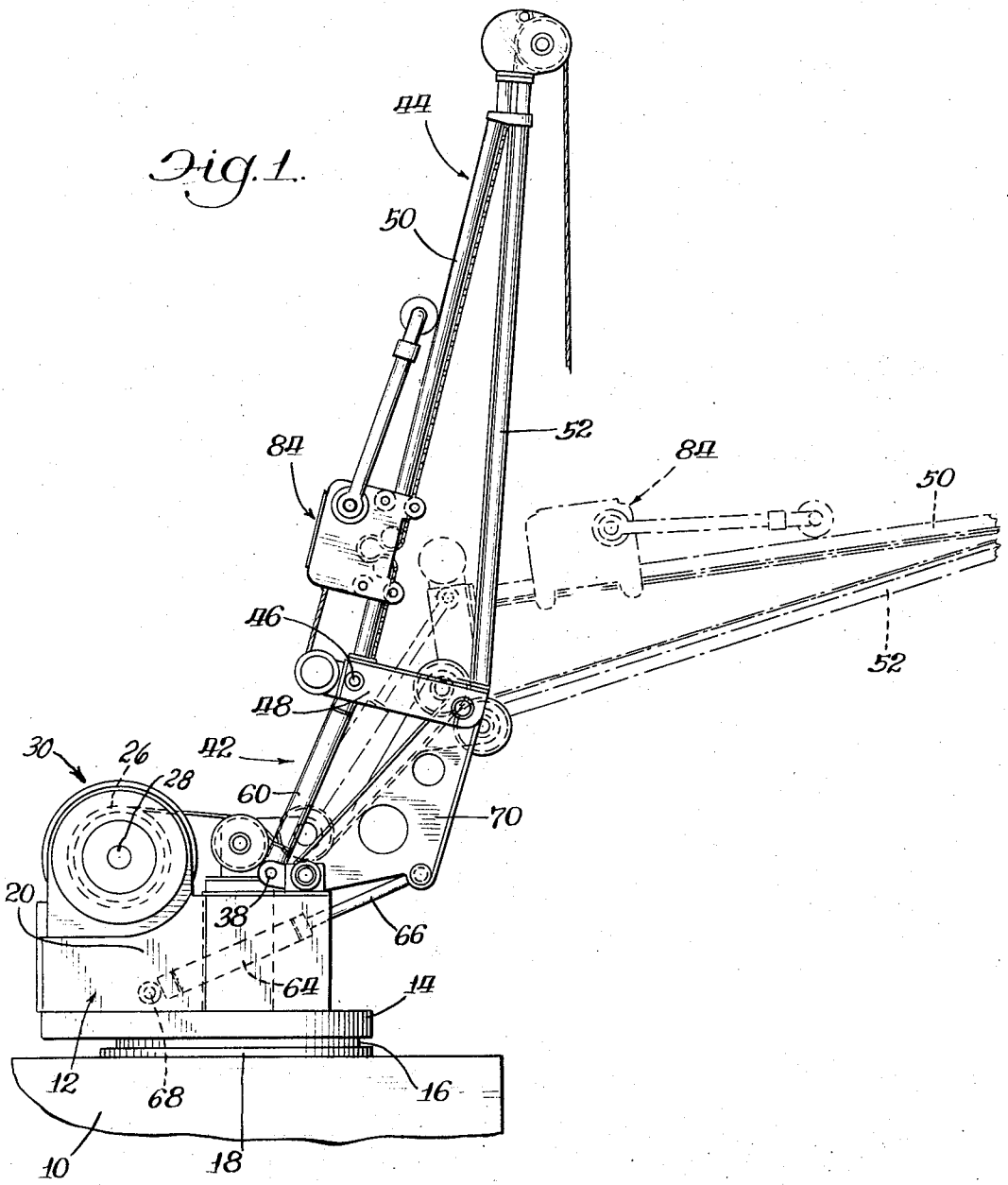
Oct. 24, 1967 C. G. WENNERSTROM ET AL 3,348,702

MULTIPURPOSE CRANE

Filed April 8, 1966 4 Sheets-Sheet 1

Fig. 1.



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MULTIPURPOSE CRANE

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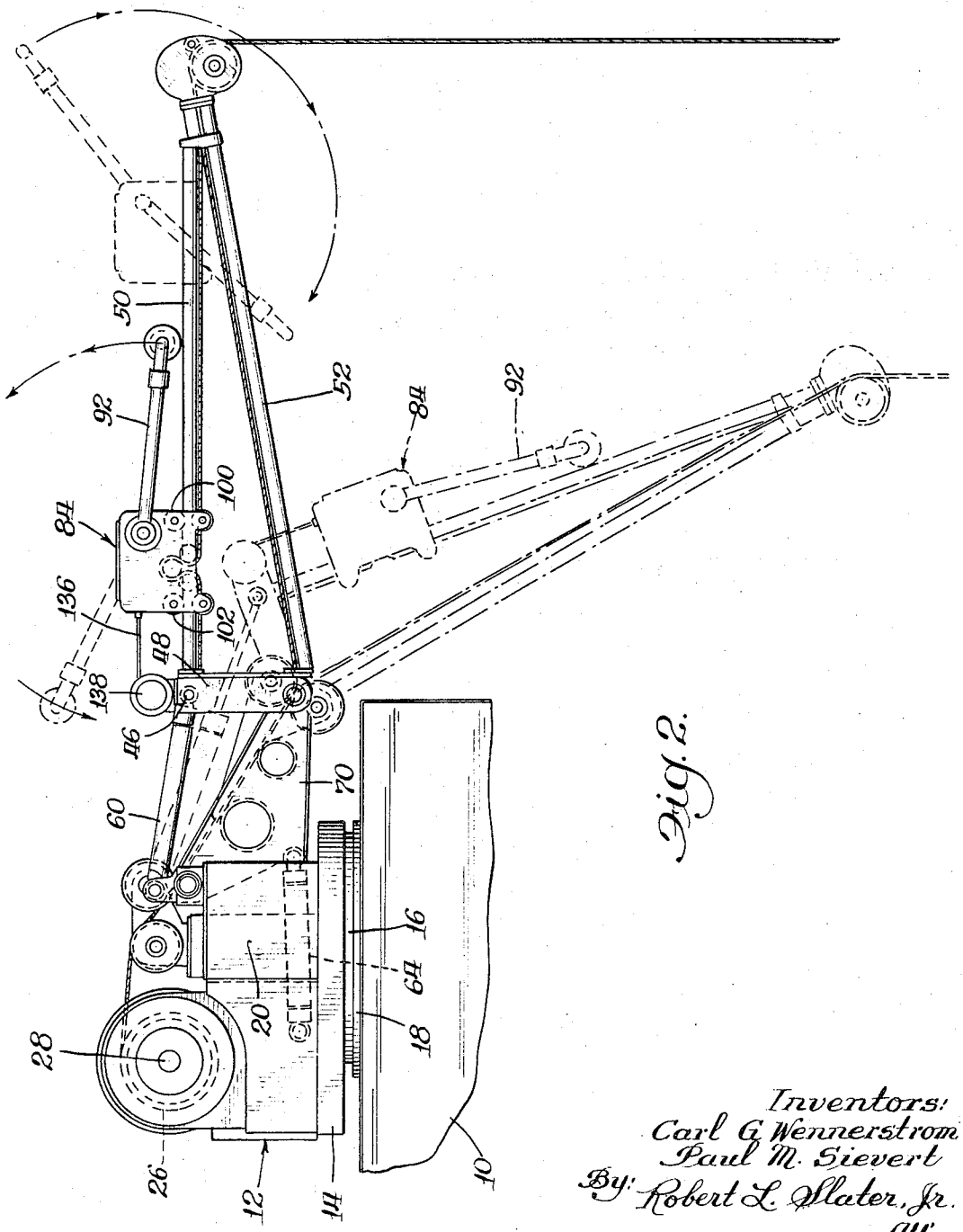


Fig. 2.

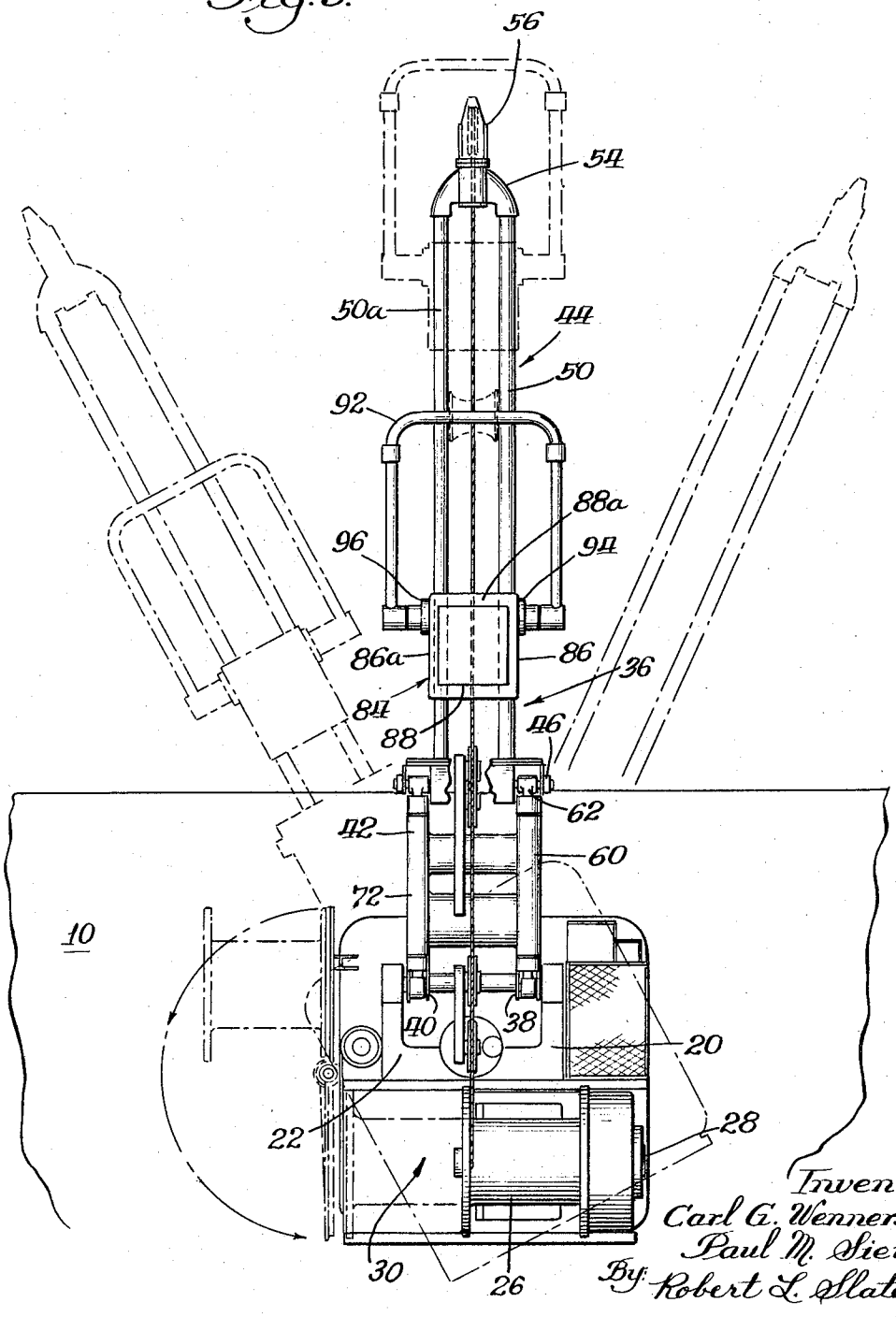
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MULTIPURPOSE CRANE

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Fig. 3.



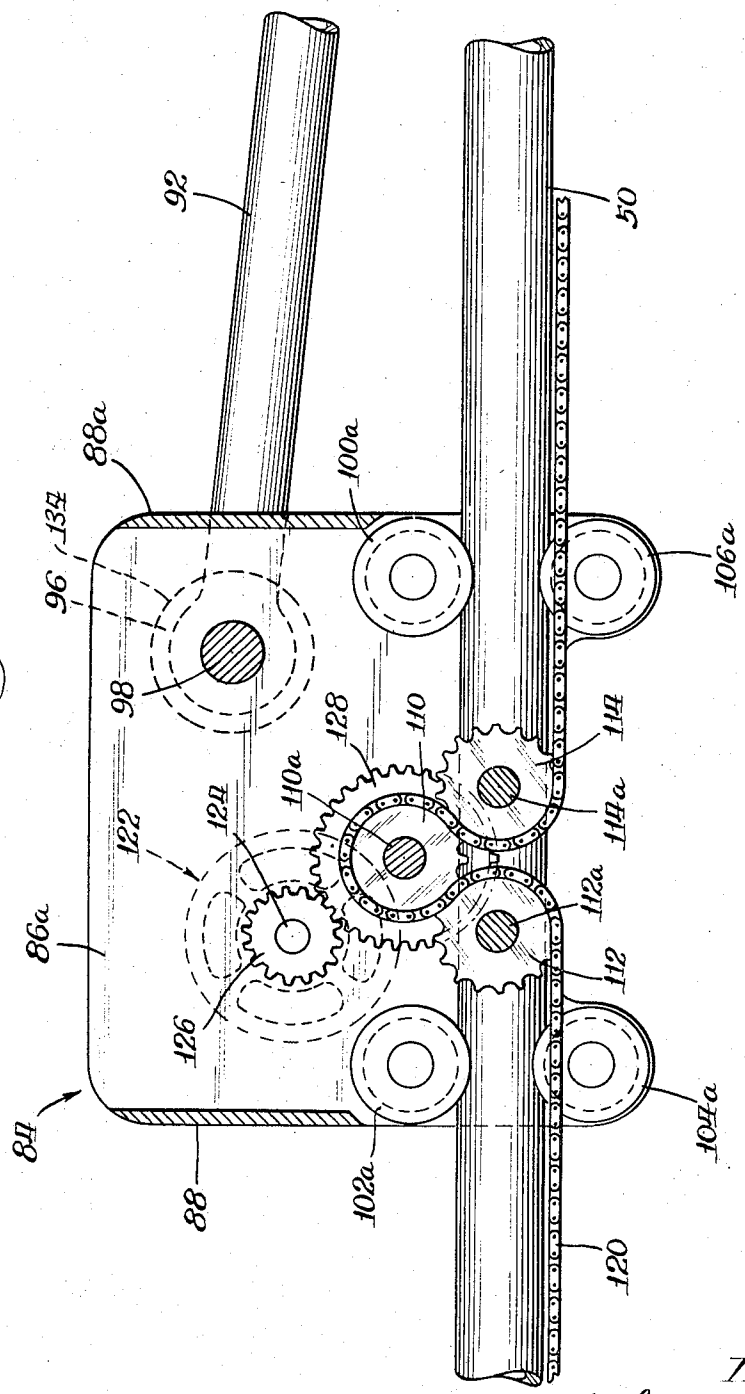
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MULTIPURPOSE CRANE

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Fig. 11.



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MULTIPURPOSE CRANE

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6 Claims. (Cl. 212—54)

The present invention relates generally to material handling equipment; more particularly, it relates to a novel crane for use during shipboard oceanographic work and for other marine equipment handling requirements.

Because of the depths of the oceans, oceanographic research involves reaching into environments observable only by means of remotely controlled instruments transported by ships and lowered by cranes. Oceanography is an interdiscipline science in which ever increasing sophistication is required for the very elaborate and very sensitive instruments prepared for use at great distances below the research vessels. Numerous characteristics of ocean water and ocean bottoms are subjects of scientific interest and are, therefore, subjects for observation and collection. For instance, bottom core samples, deep water samples, and measurements of temperature, salinity, density, turbidity, currents, turbulence and other properties of the oceans are being studied with much interest by scientists. Such observations and measurements far at sea require that sensitive, often large and elongated apparatus be lowered and retrieved over a ship's side.

During heavy seas and severe weather, there is great risk of costly damage to instruments and loss of samples due to the instrument load striking the ship's side. This risk is heightened during the retrieval operation. Moreover, the instrument retrieval work heretofore has required several persons working with a conventional shipboard crane to position the work object, raise it above the water, rotate the crane to position the work object over the ship's deck, then gently lower the work object onto the deck. With the elongated bottom coring devices, such a retrieval manipulation is well known to be slow and awkward. This operation immobilizes a large deck area and is hazardous to the crew, especially when conducted on a badly pitching and rolling vessel.

Because qualified oceanographic crew members for handling instruments on shipboard are always few in number, it is desirable to provide equipment for handling instrumentation that requires a minimum of manpower to utilize.

Aside from operations on oceanographic vessels, there are numerous other requirements for cranes which can be efficiently operated by one person and which are adapted to retrieve elongated, easily damaged objects. One example is the operation of a pleasure boat marina where it would be very useful to provide equipment operable by one person for lifting boats over a pier from the water and onto trailers and storage platforms. Pipeline and well drilling operations often require that elongated objects be retrieved by a crane and placed in horizontal temporary storage. Our novel crane is well adapted for convenient manipulation of the above described items.

Accordingly, one object of our invention is to provide an improved crane adapted for placing and retrieving elongated objects.

Another object of our invention is to provide a novel crane which one person may operate and adapted to handle elongated objects for placing them on an adjacent horizontal surface.

A further object of our invention is to provide a crane having a plurality of degrees of freedom adapted to retrieve elongated objects over a ship's side and position such objects horizontally on deck, even in conditions of heavy seas.

Still another object of our invention is to provide a crane for shipboard mounting adaptable to placing minimum stress on cables used for retrieving objects over the ship's side while at sea.

Another object of our invention is to provide a novel crane for retrieving objects and lifting such objects over a ship or pier side where such objects are subject to rough handling and possible breakage.

Anuother object of our invention is to provide a multipurpose shipboard crane requiring minimum deck space during storage, but being adapted to reach a sizable area of the deck during operation.

These and other objects and advantages of our invention will be apparent from the following illustrations, specification and claims.

FIGURE 1 is a side elevation view of a preferred embodiment of our invention.

FIGURE 2 is a side elevation view of the embodiment of our invention illustrated in FIGURE 1 showing the crane boom in extended position.

FIGURE 3 is a plane view of the embodiment of our invention illustrated in FIGURE 1.

FIGURE 4 is a cross section view of a fragment of the embodiment of our invention shown in FIGURE 1.

Referring now to the drawings, a fragment of a ship's deck **10** is shown as a typical mounting platform for our crane. A pier or a truck flat bed could be used equally well if desired. However, certain features of the illustrated embodiment of the subject invention are particularly well suited for shipboard use.

Our novel crane is rotatably mounted on a base **12** which is comprised of base platform **14** which rotates upon a pedestal **16**. The pedestal **16** is shown resting upon a deck plate or platform **18**. The base **12** is provided with vertical side members **20** and **22** which are rigidly attached along a lower edge, respectively, to the base **14** and which rotate with the base. The base side members which are most easily seen in FIGURE 3 are the flange projections of a U-shaped casting or fabricated frame.

A cable drum **26** is mounted on a shaft **28**. The axis of the shaft **28** is positioned parallel with and above the base platform **14**. In the embodiment shown, a level wind cable drum apparatus **30** is mounted to the base platform **14** and comprises the shaft **28** mounting. The level wind apparatus, **30** is of conventional design for a cable drum support which, moves coaxially with the shaft **28** and repositions the drum during each drum revolution one cable diameter to the right or left as viewed in FIGURE 3 depending upon the direction of movement of the cable wind apparatus.

Our novel crane can be embodied in models which do not include an even wind cable drum apparatus shown in the illustrated figures. In such a more simplified embodiment, the drum shaft **28** would be mounted between side panels such as **20** and **22** but would be adapted to provide stationary shaft bearing mounts.

The boom **36** is pivotally mounted on bearings **38** and **40** which are supported by the side members **20** and **22**, respectively. The boom **36** is comprised of a first pivotally mounted section **42** and a hinged section **44**. The hinge **46** is conveniently positioned approximately one-third of the distance between the boom pivot bearings **38** and **40** and the extreme point of the free end of the hinged boom section **44**.

The boom hinged section **44**, when viewed from the side, is comprised of a strut **48**, a lever arm **50**, and a brace **52**. The strut at a first end is rigidly attached at right angles to the lever arm **50**, and the brace **52** completes a triangular frame or truss, connecting between the free end of the hinged section and the second end of the strut. The above arrangement is readily visualized by reference to FIGURES 1 and 2.

Viewed from above, the hinged boom section **44** is comprised of two parallel lever arms **50** and **50***a* which are coupled in a bracket **54** at the free end of the boom. A swivel-mounted sheave **56** mounted on the bracket **54**. In shipboard cranes, the swivel rotation of the sheave reduces the sudden loading and stress on a cable passed over the sheave and connected to a load in the water, particularly during heavy seas.

The pivoted section of the boom **42** is, in the illustrated embodiment, comprised of four hydraulic means. Viewed from the side, a first hydraulic cylinder **60** having an extendable piston **62** connects between the side member **20** and bearing mount **38** and the boom hinge **46**. A second hydraulic cylinder **64** with extendable piston **66** connects between a bearing **68** mounted on the side member **20** and a frame plate **70**. The frame plate **70** is triangular in shape and pivotaly connects, at each respective corner, the boom pivot bearing **38**, the lower end of the strut **48** and the extreme end of the extendable piston **66**.

A parallel set of the aforesaid pivoted boom section parts is constructed in the embodiment shown and is indicated in the illustrations as hydraulic cylinders **72** and **76**, extendable pistons **74** and **78**, bearing **80**, and frame plate **82**. The position of the pivotally mounted boom section **42** and the angle of the hinged boom section **44** with respect to the pivoted boom section **42** are both controlled by the coordinated operation of the four hydraulic cylinders and four respective pistons. The hydraulic pistons **60** and **72** are always kept parallel, as are pistons **66** and **78**.

The phantom lines in the figures illustrate the motion of the boom sections **42** and **44** with respect to one another and with respect to the base platform **14**. For instance, the hinged boom section **44** may be raised vertically, as shown in FIGURE 1, and then positioned horizontally without altering the elevation of the pivoted boom section **42**. In FIGURE 2, the hinged boom section **44** is shown in phantom lines depressed below the horizontal, indicating the position of the boom for raising and object that has been reeled in close to the end of the boom.

A movably mounted positioner **84**, held in proper position by flanged rollers described below, is adapted to move along the boom lever arms **50** and **50***a*. The positioner **84** serves as support for a cradle hoop **92**. The hoop **92** is U-shaped and pivoted at each end on bearings **94** and **96**, which are mounted in the positioner **84**. The positioner **84** is a paneled rectangular frame having sides **86** and **86***a* and end members **88** and **88***a*. The positioner **84** moves along the lever arms **50** and **50***a* on four flanged rollers **100**, **100***a*, **102** and **102***a*. A second set of four flanged rollers, **104**, **104***a*, **106** and **106***a*, is adapted to coast or idle along the lower surfaces of the boom lever arms **50** and **50***a*, respectively, and restrain the positioner from transversely leaving the boom lever arms **50** and **50***a*. Translational movement and rigid positioning of the positioner along the lever arms **50** and **50***a* are controlled and regulated by three chain sprockets **110**, **112** and **114**, each of which is rigidly mounted on shafts **110***a*, **112***a* and **114***a*. The sprocket shafts **110***a*, **112***a* and **114***a* are in turn rotatably mounted at each respective end in bearings positioned within positioner sides **86** and **86***a*. A chain **120** is mounted parallel with and between lever arms **50** and **50***a*. The first end of the chain is firmly affixed to the bracket **54**, the second end being similarly affixed to a tie **48***c* which is mounted rigidly between struts **48** and **48***a*. The chain **120** is passed alternately under, over, then under the sprockets **112**, **110** and **114**, respectively. The above arrangement is most easily visualized by reference to FIGURE 4.

An electric motor **122** with high starting torque, having a shaft **124**, is mounted within the positioner **84**. The motor shaft **124** is juxtaposed and parallel to the sprocket shaft **110***a*. Gears **126** and **128**, mounted, respectively, upon the shafts **124** and **110***a*, transmit power from the motor **122** to the sprocket **110**. Rotation of the sprocket **110** propels the positioner **84** along the lever arms **50** and **50***a*. The sprocket **110**, interlocking with the chain **120** and restrained from rotation by the inertia and frictional resistance of the gears **126** and **128** and the motor **122**, provides an excellent brake for holding the positioner **84** in any desired position while it is under load.

The cradle hoop **92**, mounted on bearings **94** and **96**, is provided with a sturdy shaft **98** which serves a double purpose. The shaft **98** is rotatably mounted within the positioner **84** transversely between the sides **86** and **86***a* thereof. The second function of shaft **98** is that of being a drive motor shaft, as described below. The cradle hoop **92** is rigidly fastened to the shaft **98** and is rotated into the desired angle position with respect to the positioner **84** and the lever arms **50** and **50***a* by rotation of the shaft **98**. Shaft **98** is rotationally positioned by means of a direct current high torque motor **134** which is mounted concentrically with the rotational center of shaft **98**.

The power cable **136** carries separate power leads for motors **122** and **134**. At all times reel **138** functions to maintain a small tension on power and control cable **136** to prevent this cable from becoming fouled.

In practice, the crane shown would be provided with remote controls suitable for operation by one man. One or more motors would be provided in the space partially enclosed by the flanged base **14** or otherwise placed, for operation of the cable drum **26**, for the rotation of the base, and for the extension and retraction of the several hydraulic means. Means could be readily provided, if desired, by which lateral movement of the entire crane assemblage may be accomplished along an appropriate trackage system provided in the platform **18** to which the assemblage is rotatably mounted.

Many degrees of freedom would be present in the operation of such a crane. The entire assemblage may be rotated on pedestal **16**. Limited extension and retraction of the boom radius may be accomplished by coordinated extension and retraction of the several hydraulic means. The operating angle of the boom may be set by coordinated operation of the several hydraulic means. The extremes of such movement are suggested by the principal lines of FIGURE 1 and the phantom lines of FIGURE 2.

The operation of the cradle may readily be visualized. The configuration of cradle hoop **92** would be altered for particular applications. The U shape suggested by FIGURE 3 would be generally useful. Positioner **84** would be moved to a position near the free end of the boom by means of the sprocket drive described, as suggested by the principal lines of FIGURE 2. The elongated work object would be reeled close to the sheave **56** at the end of the boom. Then the cradle would be positioned by operation of motor **134**, as suggested by the phantom arc line of FIGURE 2. The work piece would thus be engaged and held by the cradle in general alignment with the boom, such that there would be greatly reduced hazard of the work object striking another object during further operation of the crane. When the work object would be unreeled, the motion of the cradle hoop reverses and the cradle hoop is positioned out of the way. Rapid movement of the cradle hoop would be generally avoided. When not in use, the cradle hoop would be positioned out of the way of the cable, as suggested by the principal lines of the respective figures.

A number of complex operations may be performed by means of such a crane. FIGURE 2 suggests the approximate horizontal angle of the boom at which an elongated work object, having been cradled as described, could be placed on a horizontal surface. The unfastened end of such a work object would be set on the surface. Then by coordinated movement of the boom and cradle, the cradle would be disengaged. Further lowering of the boom would place the work piece on the surface. The usefulness of such a technique is apparent.

This crane has been designed primarily for shipboard use. Its advantages in such an application are evident. However, it is clear that many other applications, including those earlier suggested, may be made for such a crane. It is not our intention to limit our invention to the embodiment herein described. Clearly technically equivalent elements can be substituted for elements of our invention without departing from the scope of our invention. And in various applications of our invention, certain modifications would likely be made to adapt the crane to decks of ships, beds of trucks, military support vehicles or other objects. Accordingly, the above-described and illustrated preferred embodiments of our invention are intended as merely illustrative of our invention, the scope of which is set forth in the following claims.

We claim:

1. A crane to be mounted to a platform for handling an elongated work object without hazard of the work object striking other objects, which crane comprises the combination of: a rotatable base mounted to the platform; a cable drum mounted by means of a shaft above the base; an articulate boom having one hinge, a free end, and an end pivotally mounted to the base; a hydraulic means, expansible in elongation, having a first end pivotally mounted to the base and a second end pivotally mounted to the hinged boom section, such that movement of the free end of the boom relative to the pivotally mounted end is responsive to expansion of the hydraulic means; a sheave mounted to the free end of the boom; a cable operatively positioned with respect to the cable drum and the sheave, and to which the work object is fastened; and a cradle means movably mounted to the hinged boom section and adapted to be operatively positioned with respect to the free end of the boom to engage the work object and to hold it in a relatively fixed position with respect to the hinged boom section, such position being responsive to translational movement of the cradle means along the hinged boom section; whereby the elongated work object may be positioned with respect to the hinged boom section in such position as may be appropriate for handling the elongated work object by relative movement of the crane elements without hazard of the work object striking another object.

2. The crane of claim 1 wherein the cradle means includes: a positioner movably mounted to the hinged section of the boom and adapted to travel longitudinally along the boom; and a cradle hoop pivotably mounted to the positioner and having a configuration suitable to engage an elongated object; whereby the elongated work object may be positioned with respect to the hinged boom section by winding the cable on the drum until the work object is positioned adjacent to the sheave, and then cradling the elongated work object in the cradle hoop, which is passed over the free end of the boom to engage the work object and is further passed to the position at which the elongated work piece may be handled by relative movements of the crane elements without hazard of the work object striking another object.

3. The crane of claim 1 wherein the hinged section of the boom comprises an assemblage of elements formed as a truss, and wherein the section of the boom pivotally mounted to the base comprises a second hydraulic means, expansible in elongation, having a first end pivotally mounted to the base and a second end pivotally mounted to the truss, such that relative operation of the respective hydraulic means operatively positions the free end of the boom.

4. The crane of claim 1 further characterized by means for laterally moving the base of the crane about the platform to which it is mounted.

5. The crane of claim 2 further characterized by means for laterally moving the base of the crane about the platform to which it is mounted.

6. The crane of claim 3 further characterized by means for laterally moving the base of the crane about the platform to which it is mounted.

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