July 6, 1954 T. S. HOLMES 2,682,957

CRANE WITH FOLDING BOOM

Filed March 28, 1950 2 Sheets-Sheet 1

Fig. 1.

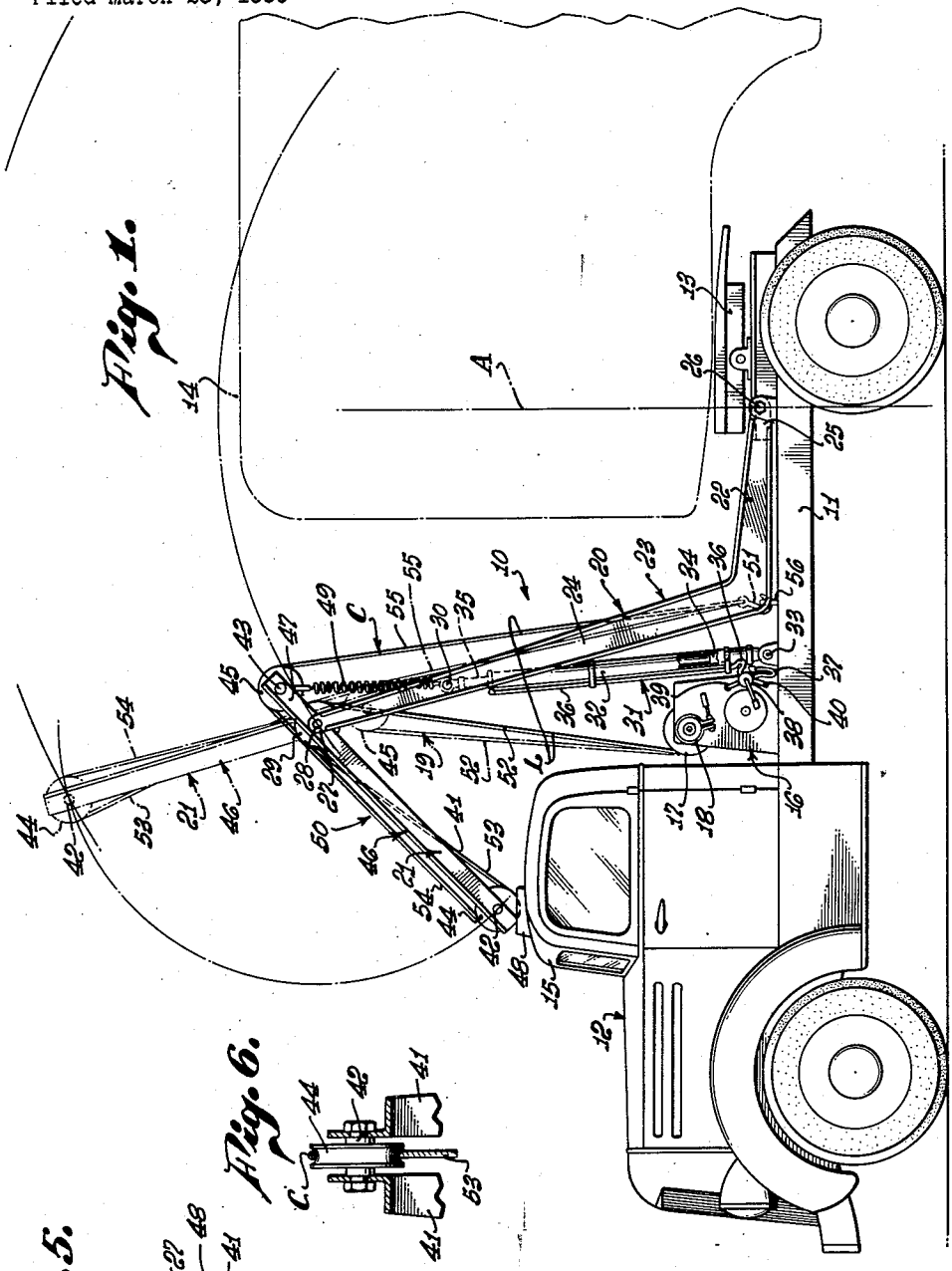
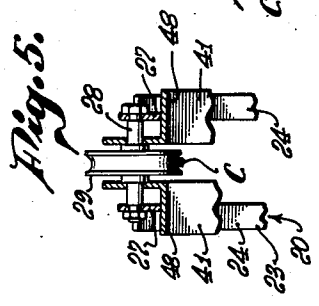


Fig. 6.

Fig. 5.



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Fig. 3.

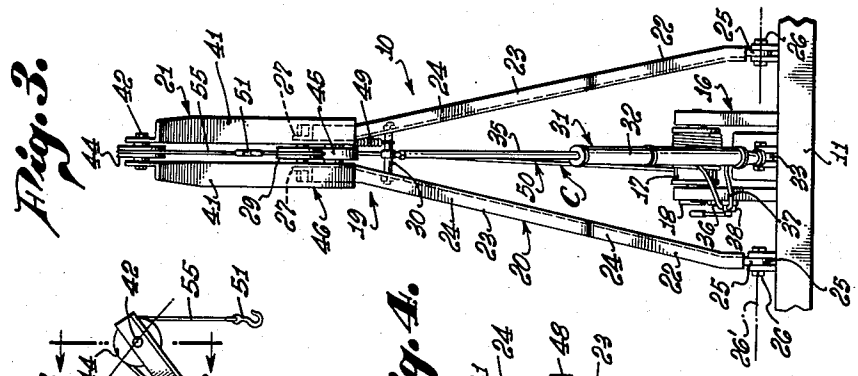


Fig. 4.

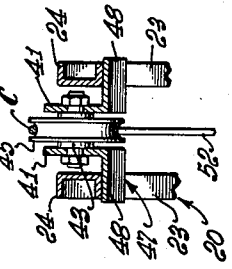
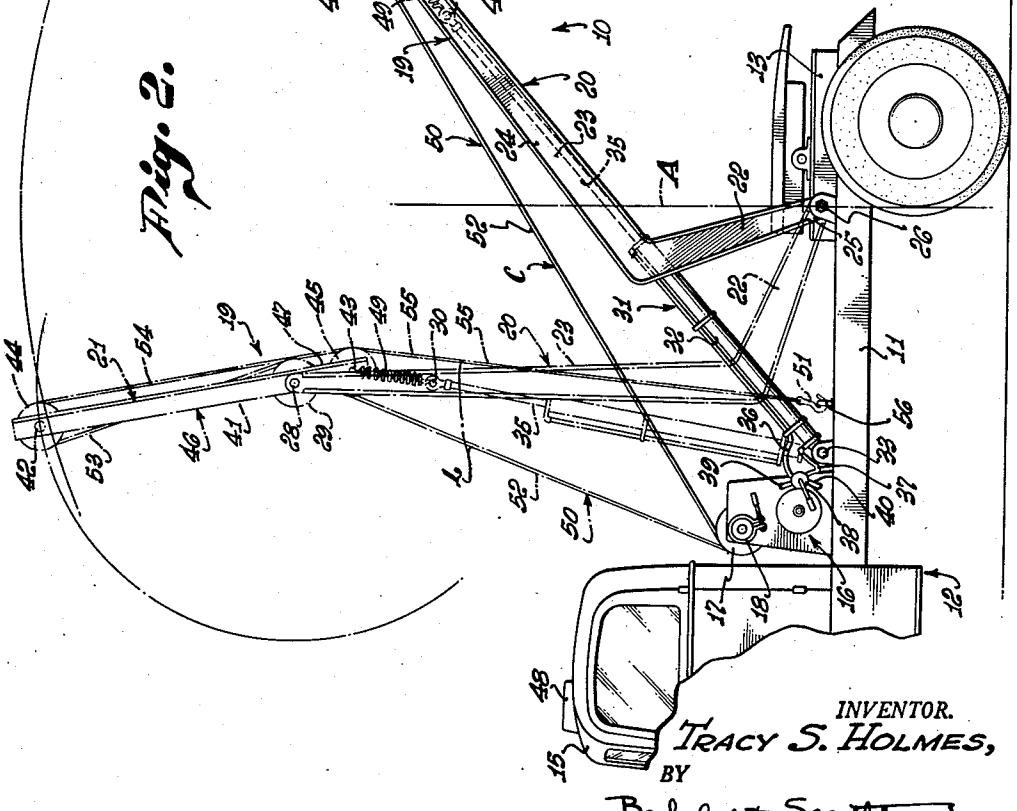


Fig. 2.



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CRANE WITH FOLDING BOOM

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5 Claims. (Cl. 212—8)

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This invention has to do generally with cranes and is more particularly concerned with cranes of the type wherein the boom may be folded to reduce its over-all length during periods of non-use.

While the crane is utilizable in any situation wherein its characteristics are beneficial, it is particularly well adapted for use as a mobile unit, that is, mounted on a vehicle as an integral part thereof, and thus easily transportable from place to place. Therefore I have shown and described my improved crane in this particular environment, but this is not to be considered as in any way limitative on the broader aspects of the invention. Furthermore, though the boom and its control system may obviously be mounted on the vehicle for swivelling or turntable movement, I have simplified the showing by illustrating only a stationary mounting for the boom—but this is not to be taken as excluding a turn-table mounting.

When the crane is embodied as a mobile unit, the foldability of the boom is of special significance and advantage, for, while the extended boom is of considerable length and gives decidedly good ranges of height, reach, and overhang, the folding of the boom reduces its overall length sufficiently to allow ample head-clearance when the vehicle, in transit, passes beneath wires, bridges, etc.

Further, the arrangement is such that, in transit, the folded boom does not overhang either the forward or rear ends of the truck. This is in spite of the fact that the horizontal axis about which the boom swings during hoisting operations may be quite close to the rear end of the vehicle, a feature which gives the extended boom a considerable working range rearwardly of the vehicle. As a special feature, the boom is of such character that, when fully folded, it leaves the bed of the vehicle clear to support loads which may be disposed thereon for transport.

I have devised an extremely effective, efficient and simple mechanism for unfolding and refolding the boom—a mechanism which preferably includes certain of the elements used for the normal hoisting control of the unfolded boom and the load, thus reducing to a minimum the total number of parts and the necessary operative manipulations thereof. The arrangement is such that it is possible, though not necessary, to effect or control the folding and unfolding of the boom by virtue of movement of the boom about its horizontal pivotal axis, a feature of obvious advantage.

The crane and its operating mechanism are of

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sturdy character and are well adapted to withstand the very severe service conditions to which devices of this type are almost universally exposed.

How all the above is accomplished, as well as further features and objects of the invention, will be made apparent in the following detailed description, reference being made to the accompanying drawings, in which:

Fig. 1 is a side elevation of my improved crane;

Fig. 2 is a view similar to Fig. 1 but showing the boom in changed position;

Fig. 3 is a fragmentary end elevation of Fig. 2, as viewed from the right thereof; and

Figs. 4, 5 and 6 are enlarged fragmentary sections on lines 4—4, 5—5, and 6—6, respectively, of Fig. 2.

As stated in the introduction, my crane may be applied to any suitable mount or support but it is particularly well adapted for application to a vehicle. Therefore I have illustrated my improved crane, generally indicated at 10, as mounted on a support represented by the bed 11 of vehicle 12. Though this is not limitative, the vehicle 12 may advantageously be in the nature of a tractor, the rear end of the bed being provided with a coupling-table, conventionally indicated at 13, for the detachable connection of the forward end 14 of a semi-trailer.

The vehicle cab is indicated at 15, and, mounted on bed 11 just to the rear of the cab, is a winch conventionally indicated at 16, though the placement is not limited to this particular location. Broadly speaking, the winch may be of any suitable character, that is, it may be of a type to be operated manually, mechanically or hydraulically, though it is obviously preferable that it be of a powered type, and that its power be taken from the vehicle engine through a suitable selective transmission. I have made no showing of a prime-mover or of a controllable drive connection to the winch drum 17, for such mechanisms are well known and their particularities play no part in the basic operation of the crane. However I have conventionally indicated a controllable brake 18 for drum 17, as the brake plays a part in certain of the manipulations of the boom over and beyond its usual manipulation for the purpose of hoisting or lowering the load-hook.

The foldable boom, generally indicated at 19, comprises a main boom member 20 and an extension member 21; member 20, as viewed from the side, preferably, though not necessarily, being of "dogleg" shape, the lower, shorter portion 22 being angularly offset from the upper, longer portion 23.

Preferably, though not necessarily, member 22 is made up of two channels 24 (Figs. 3, 4 and 5) the lower ends 25 of which are spread apart transversely and are pivotally connected to bed 11 at 26. From ends 25 the channels 24 converge, their distal ends 27 being connected by shaft 28, which shaft holds said ends spaced slightly apart to receive between them a sheave 29, which is rotatably mounted on said shaft. Channels 24 are also shown as connected by a cross-bar 30.

Boom member 20 is thus supported on bed 11 for pivotal movement about the horizontal axis 26' represented by alined mountings 25, to swing the distal end 27 of said member from a forward, inoperative position (Fig. 1) at one side of the vertical axial plane A to a rearward, operative position (full lines of Fig. 2) at the opposite side of said plane.

Any suitable controllable means may be provided for swinging the boom member 20 between and releasably holding it at these limits of pivotal movement, or holding it at any intermediate position of adjustment. I have conventionally illustrated a hydraulically operated ram device 31 for this purpose, but the showing is not to be considered as limitative, for obviously cable and winch means may be employed. Device 31 consists of a cylinder 32 pivotally connected at 33 to bed 11, mounting 33 being located well ahead of boom axis 26' and midway between the sides of bed 11 (Fig. 3). Piston 34 in cylinder 32 carries a piston rod 35 whose upper end is pivotally connected to cross-bar 30.

Pipes 36 and 37 lead from opposite ends of cylinder 32 to a conventionally illustrated control valve 38 which is connected by pipe 39 to a source (not shown) of fluid under pressure, pipe 40 being a return line from the valve. By manipulation of valve 38 actuating fluid may be selectively admitted to cylinder 32 at either side of piston 34 and released from the other side of the piston for the purpose of swinging boom member 20 in either direction, or controllably allowing it to swing under forces otherwise imposed, or the valve may be put in a holding position whereby the cylinder fluid at opposite sides of the piston is trapped to releasably hold the boom member in any position to which it has been adjusted. The controls for ram 31, as well as for the winch, may, of course, be located in any convenient place, as, for instance, within cab 15.

Boom extension 21 may, for instance, be made up of a pair of parallel angle irons 41 connected and held slightly spaced apart by shafts 42 and 43 at opposite ends thereof (Figs. 3, 4, 5 and 6). Extension 21 is pivotally connected at a point intermediate its ends to the distal ends 27 of main boom channels 24, as by mounting the extension on shaft 28 between the channels and so it is movable arcuately with respect to member 20 about an axis parallel to boom axis 26'. Mounted on shafts 42 and 43 are sheaves 44 and 45, respectively.

Extension 21 may be considered as made up of a relatively long, work-arm 46 at one side of shaft 28 and a relatively short lever arm 47 at the opposite side of said shaft. When the boom is folded, as in the full line position of Fig. 1, arm 46 extends at an acute angle with respect to boom member 20, sheave 44 resting in cradle 48 on the top of cab 15. The illustrated degree of angularity is not, of course, limitative. If desired, the sheave may be releasably strapped or otherwise held to the cradle during transit of vehicle 12. With arm 46 in this position, the relatively

short lever arm 47 extends upwardly and rearwardly from member 20, the over-all height of the folded boom being thus materially reduced below the over-all height of the extended boom.

Member 21 is movable arcuately in a clockwise direction about pivot shaft 28 from the folded, full line position of Fig. 1 to the unfolded, dotted line position of that figure. When arm 46 is in this extended or "working" position, it is substantially axially alined with main boom portion 23, the lever arm 47 and its sheave 45 being taken, with clearance, between channels 24. The horizontal flanges 49 of lever arm 47 engage the under sides of channels 24 to prevent further clockwise rotation of member 21, so when the boom is in the full-line position of Fig. 2, extension arm 46 is in a condition to take downbearing load at its distal end and therefore serve as an effective, rigid extension of boom member 20, thus considerably increasing the working range of the boom 19.

Were extension member 21 not restrained, it would freely swing by gravity from the dotted line position of Fig. 1 to the full line position of that figure, and, as will appear, gravity is depended upon to effect this folding movement. However, as will likewise appear, this movement may be controlled by manipulation of the hoisting line. In some cases it is also desirable to partially counterbalance the arm 46 so the blow on cradle 48 or other underlying structure will be decreased if the restraining cable breaks or is accidentally released. When such counterbalancing effect is desired, I may apply an extension spring 49 between the distal end of lever arm 47 and, for instance, the cross-bar 30. When arm 46 is in the dotted line position of Fig. 1, spring 49 exerts no counterbalancing effect, but, as the arm swings toward the full line position of that figure, the spring has progressively increasing counterbalancing effect, though never enough to prevent gravitation of the arm to said full-line position.

The cable system 50 whereby the extension is swung to unfolded position and is controlled in its swing to folded position, in extremely simple and, as a particular feature, makes use of the usual hoisting line and winch, thus holding the number of working parts to a minimum—with obvious advantage.

I will first describe the cable system as it appears when the boom is in the folded or full line condition of Fig. 1. Hoisting cable C leads from winch-drum 17 to the rearward side of pulley 29 and thence is reeved beneath sheave 44 and over 45. The free end of the cable carries a hoisting hook 51. For purposes of later reference the reach between drum 17 and sheave 29 is designated as reach 52; the reach from sheave 29 to sheave 44 is designated as reach 53; the reach between sheaves 44 and 45 is designated as reach 54, and the reach between sheave 45 and hook 51 is designated as reach 55.

The cable may be considered as making a loop L between drum 17 and hook 51, the loop confining the sheaves 45 and 44 within itself, while sheave 29 may be considered as externally engaging the loop at a point between sheaves 45 and 44.

For performing certain operations the loop terminals are selectively individually or collectively releasably dead-ended or anchored in positions of fixed relation with respect to the pivotal axis 26'. The braking of drum 17 in a manner to prevent its unreeling rotation serves as a means for releasably "dead-ending" reach 52

of cable C at one end of loop L. The releasable engagement of hoisting hook 51 with stationary structure of the vehicle, such as the eye 56 on vehicle bed 11, or on boom member 20—as at cross-bar 30—serves as a means for releasably "dead-ending" the reach 55 of cable C at the other end of loop L. It will be noted that when reach 55 is dead-ended on boom member 20, it remains at a fixed distance with respect to axis 26' throughout swinging movement of said member. In any event, the point of dead-ending reach 55 must be below the position occupied by pulley 45 when extension 46 is in the dotted line position of Fig. 1, and should normally be forwardly of pivotal axis 26'—though this latter position is not limitative, especially when the particularized geometrical relationships are varied over those illustrated by reason of different boom or extension lengths, different cab heights, different bed lengths, etc. It is to be understood that the relative positions of the winch and the "dead-end" of reach 55 may be varied within relatively wide limits without disturbing the generalities of operative performance.

It will be noted that when the crane is in the condition of Fig. 1 the general arrangement, including the "dog-legging" of boom member 20, is such that bed 11, rearwardly of winch 16, is kept clear for the reception of "loads" such as articles to be transported or the forward ends of semi-trailers.

Without at all inferring that they include all the possible sequences of operative steps, I will now describe several different procedures for folding and unfolding the boom. As a preliminary consideration it will be seen that if reach 52 is dead-ended by winch 16, a sustained pull on reach 55 would act through lever arm 47 in a manner to swing extension 21 to the dotted line position of Fig. 1. However, such practise is not ordinarily followed, and it is mentioned only to give a beginning picture of some of the principles of operation.

As one method of operation, the first unfolding step is to dead-end reach 55, as by engaging hook 51 with eye 56. Drum 17 is then operated to reel in reach 52. The resulting "shortening" of loop L acts through lever arm 47 in a manner to swing extension 21 to extended or unfolded position (dotted line position of Fig. 1). Then ram 31 is operated to swing boom member 20 to the full line position of Fig. 2, cable C being payed out from drum 17 by operating brake 18 in a manner to keep the loop taut and thus to retain the extension 21 in unfolded condition until the member 20 passes over center, the cable then being slacked off to allow the boom to lower under the control of ram 31.

Hook 51 is then disengaged from eye 56 and the hoisting cable C and boom 19 are subsequently winch-and-ram operated in the usual manner to lift and lower loads applied to hook 51.

In order to refold the boom, hook 51 is reengaged with eye 56, and winch 16 may then be operated to reel in cable C and thus swing the unfolded boom back towards the dotted line position of Fig. 1. As the boom passes over center the ram is operated as a dash pot to slowly lower the boom member 20 to its final position of rest (full lines of Fig. 1). Thereupon cable C is controllably payed out to allow arm 46 to gravitate to the full line position of Fig. 1.

As a special feature, the boom may be made to fold and unfold automatically by virtue of the swinging movement of boom member 20 about its axis 26'. For this operation, and starting with the boom in the folded, full line position of Fig. 1, both ends of loop L are dead-ended—that is, the winch brake 18 is operated to hold drum 17 against unreeling rotation, and hook 51 is engaged with eye 56 or its equivalent.

Ram 31 is now operated to swing member 20 in a clockwise direction. The reaction of dead-ended loop L to this movement is to tension the cable in a manner to cause clockwise swing of extension 21 towards extended position, the dotted-line-showing of the extension (Fig. 2) representing its position just before the articulated boom 19 has completely straightened out. The exact point at which the boom is fully straightened out depends upon the relative lengths of certain of the rigid members and the relative locations of the pivot points and dead-ending points. For instance, all other factors remaining as illustrated in the drawings, the effect of moving the dead-end of reach 55 toward the front end of the vehicle 12, is to cause greater angular movement of extension 21 with respect to boom member 20 per unit of angular movement of member 20 about pivotal axis 26'. Thus the various factors of the geometric system may be varied to give the relative speed of the angular movement of the extension 21 with relation to member 20 on the one hand, and the angular movement of member 20 about axis 26' on the other hand, which best fits the dimensions and the desired performance of a given installation.

As soon as the boom has fully straightened out or unfolded (and if this is not accomplished by the time the extension stands vertically erect, the extension will subsequently gravitate to a position of full extension during subsequent swinging movement of the boom) the hoisting line is slackened off to allow the boom to reach the full line position of Fig. 2 under the control of ram 31. Hook 51 is then disengaged from eye 56, and hoisting and lowering operations may be carried on by usual operations of winch 16 and ram 31.

When it is desired to refold the boom, hook 51 is reengaged with eye 56 and cable C is reeled on drum 17 to lift the entire boom as previously described. Just before the boom passes over center, it is put under the control of ram 31 and the cable is kept taut by reeling it in on drum 17. When the point is reached where the extension 21, unless otherwise restrained, would start to gravitate back to folded condition, winch 17 is braked in a manner to "dead-end" reach 52. Thereupon loop L, now anchored at both ends, reacts on the lever system in a manner to control the folding movement of the boom 19 as member 20 gravitates to the full line position of Fig. 1. The controlled folding movement will be just the reverse of the previously described, forced unfolding movement.

While I have shown and described a preferred embodiment of my invention, various changes in design, structure and arrangement may be made without departing from the spirit and scope of the appended claims.

I claim:

1. In a crane, a support, an elongated main boom member mounted on the support for pivotal movement about a horizontal axis from a position in which its distal end lies at one side of the vertical plane of said axis to a position in which its distal end lies at the other side of said

plane, an extension member pivotally connected at a point intermediate its ends to the main boom member near its distal end, the extension being movable arcuately about said point from a position in which one of its ends extends beyond the distal end of the main boom member in the general direction of the major axis of the main boom member to a position in which it forms an acute angle with the main boom member, coacting means on the members adapted to limit arcuate movement of the extension in one direction beyond the first named position, a pair of sheaves mounted on the extension, one at one side and the other at the opposite side of said point, a third sheave supported on one of the members at a point intermediate the two first-named sheaves, means on the support for controlling the pivotal movement of the main boom member, a brakable winch on the support, and a hoisting cable leading from the winch and, when the extension is in the second named position, extending therefrom over the third sheave and thence successively over the other two sheaves.

2. A crane as in claim 1; in which the axis of rotation of the third sheave is substantially coincident with the axis about which the extension moves arcuately.

3. A crane as in claim 1; in which the axis of rotation of the third sheave lies both in the common plane of the axes of rotation of the two first named sheaves when the extension is in the first named position and in substantial coincidence with the axis about which the extension moves arcuately.

4. A crane as in claim 1; including additionally releasable means for dead-ending the free-end of the cable.

5. A crane as in claim 1; including additionally releasable means for dead-ending the cable at the near side of the third sheave and at the far side of the particular one of the other two sheaves over which the cable last passes.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
970,773	Wylie	Sept. 20, 1910
1,411,090	Hankins	Mar. 28, 1922
1,920,370	Forsythe et al.	Aug. 1, 1933
2,394,217	Thom	Feb. 5, 1946
2,521,861	Mathias	Sept. 12, 1950
2,529,454	Marcantonio	Nov. 7, 1950

FOREIGN PATENTS

Number	Country	Date
262,317	Great Britain	Dec. 9, 1926
470,295	Great Britain	Aug. 12, 1937
520,182	Great Britain	Apr. 17, 1940