

Feb. 2, 1943.

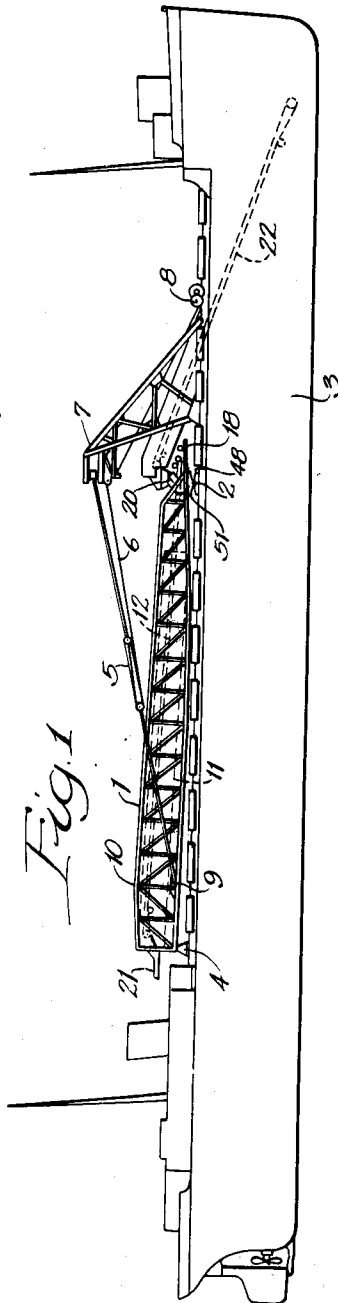
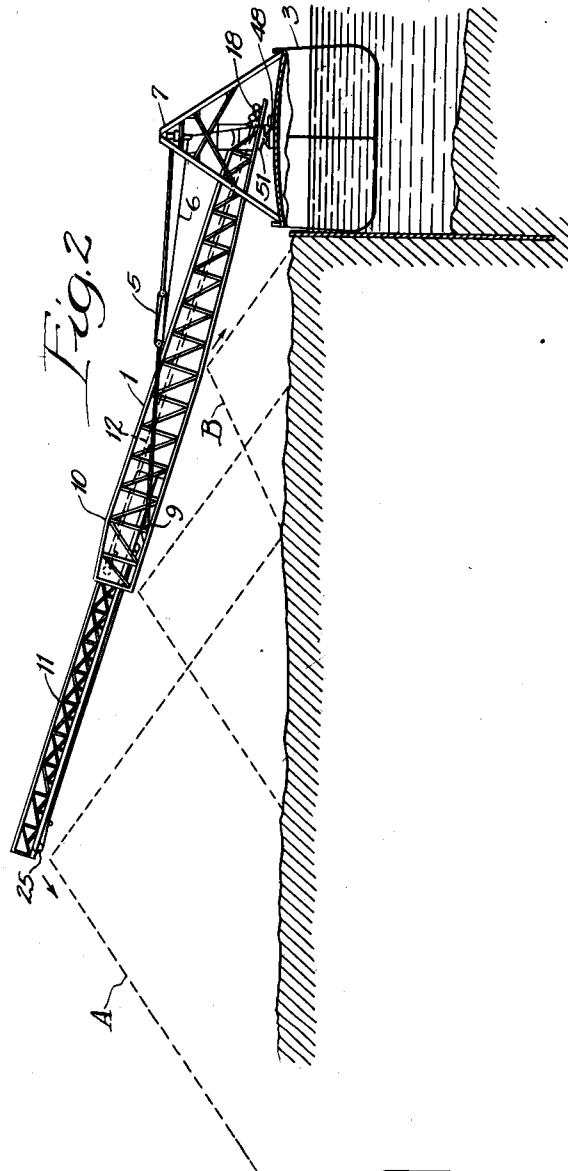
C. M. RUDOW

2,309,715

MARINE BULK-CARGO UNLOADING BOOM

Filed Jan. 3, 1939

3 Sheets-Sheet 1



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2,309,715

MARINE BULK-CARGO UNLOADING BOOM

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3 Sheets-Sheet 2

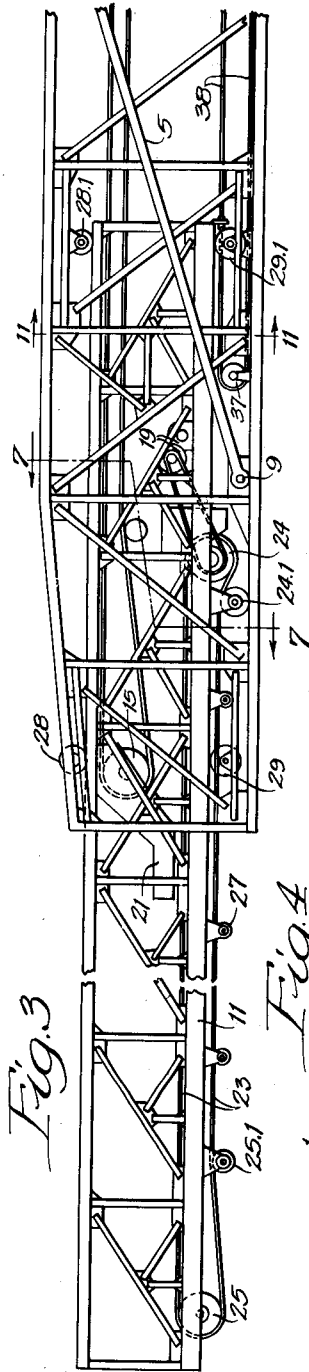


Fig. 3

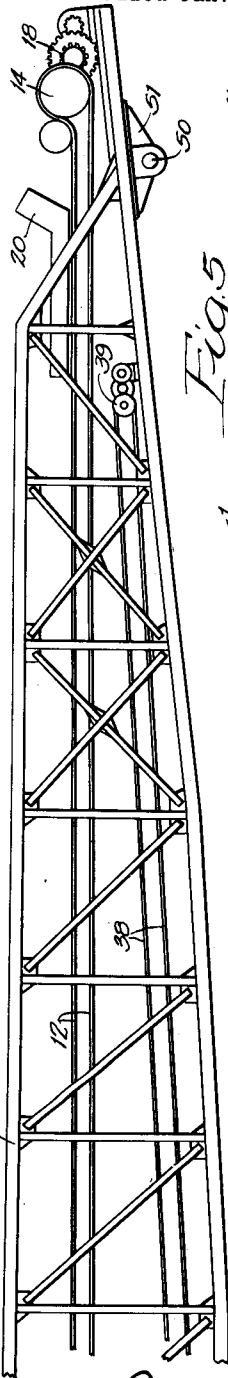


Fig. 4

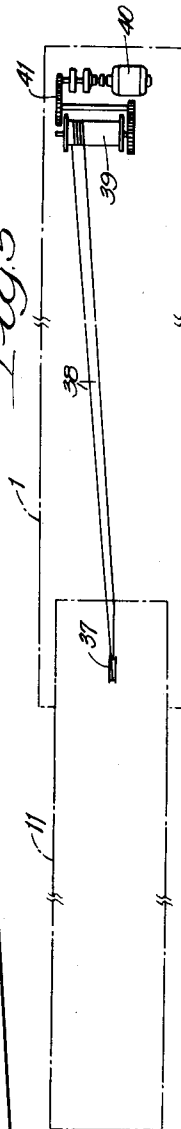
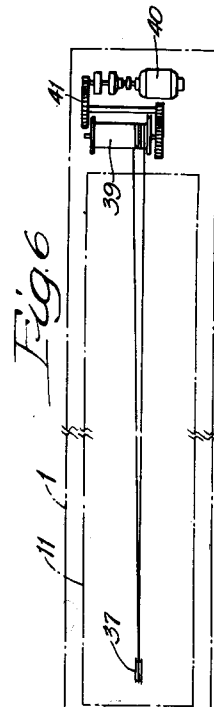


Fig. 5

Fig. 6

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3 Sheets-Sheet 3

Fig. 7

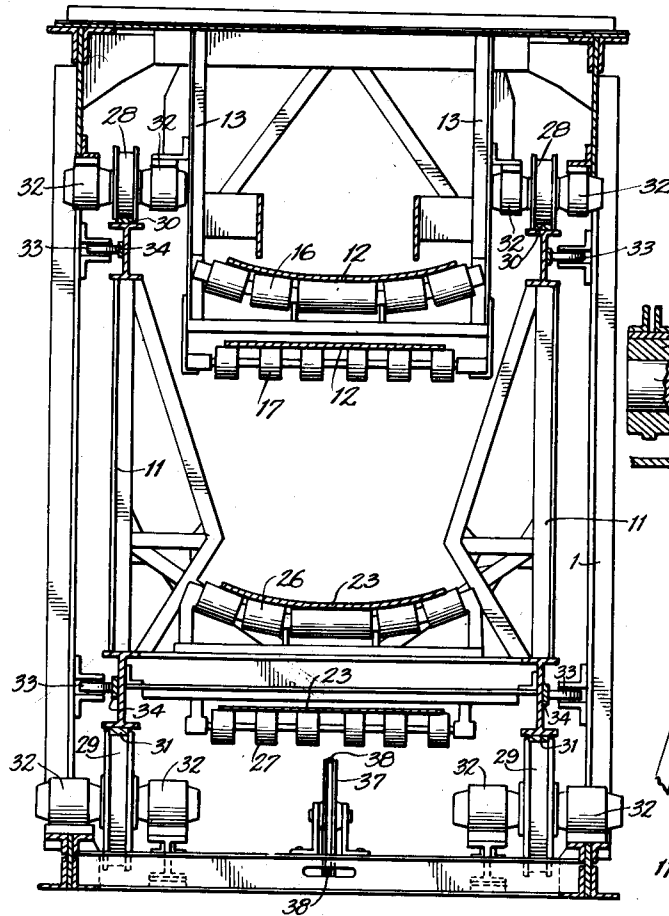


Fig. 10

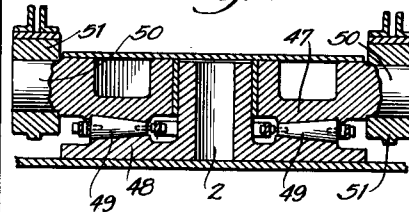


Fig. 11

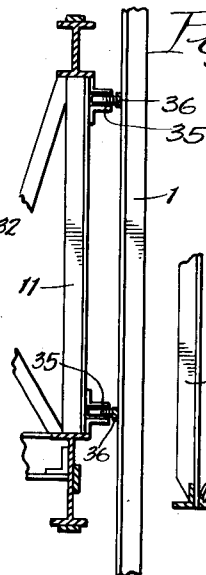


Fig. 9

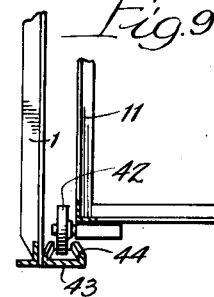
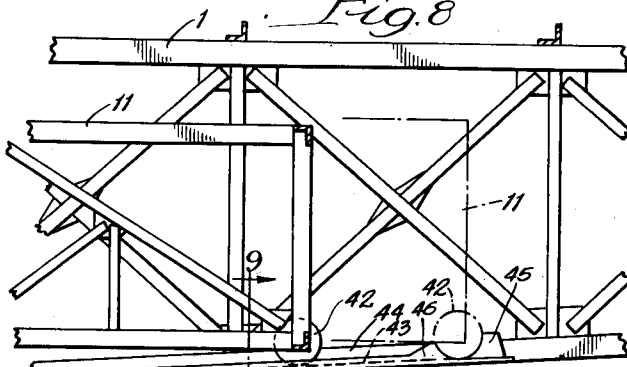


Fig. 8



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UNITED STATES PATENT OFFICE

2,309,715

MARINE BULK-CARGO UNLOADING BOOM

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Application January 3, 1939, Serial No. 248,919

5 Claims. (Cl. 214—14)

This invention relates to bulk-cargo unloaders for ships and other vessels, and particularly to boom-conveyors used for discharging cargo from a ship to a point beyond the sides thereof or for shifting the location of bulk cargo within a ship.

Such devices heretofore used comprised a trussed boom carrying a belt conveyor of fixed length, the boom being pivotally supported at one end and generally on the longitudinal axis of the ship or vessel, and arranged for vertical angular motion about the pivot provided by any of several well-known means, usually a system of hoisting tackle extending from some point on the boom to an A-frame centering over the pivot support and thence to driven drums located at any convenient place. Such booms are also arranged for horizontal angular motion usually provided by swing tackle hitched to the boom and the deck of the ship, thus permitting the boom to be inclined to substantially any vertical angle and swung to any horizontal angle within clearance limitations on the ship and in accordance with the conditions at a given unloading site.

The length of such booms and conveyors is, however, limited and fixed, thus limiting the locus of discharge or unloading points, and at times necessitating awkward handling or docking of the vessel, which is not always convenient and often requires long delays before docking space of suitable size is available.

The main objects of this invention are to provide structural and economical improvements in bulk cargo unloading boom conveyors for lake, river or ocean vessels; to provide an improved arrangement of boom elevating tackle whereby weight and cost of boom, tackle and A-frame can be reduced; to provide a device for increasing the operating length of a boom conveyor beyond its stowed length by varying amounts readily and at will; and to provide a device for reducing the operating length of a boom conveyor below its stowed length by varying amounts readily and at will.

Other objects of the invention are to provide a device permitting the building of a higher pile of material at a given shore site than would be possible otherwise; to provide a device permitting the deposit of material on shore at points more remote from the vessel than would be possible otherwise; to provide a device permitting the distribution of cargo on the shore over large areas or along railroad spurs or service roads without changing the position of the vessel; to

provide such a device permitting a vessel greatly increased latitude in utilizing anchorages that would otherwise be unfavorable or impossible, and to provide an unloading device which, in permitting the gradual building up of piles to increased heights without movement of the vessel minimizes the degradation of cargo due to breakage.

Further objects of the invention are to provide an improved unloading device which makes the boom unloader principle valuable to small vessels or vessels of limited clear deck space for which it would otherwise have little or no economic value; to provide such a device which corresponding enhances the value of the boom unloader principle on vessels having greater clear deck space; and to provide such a device which reduces difficulties and hazards incidental to the necessity of swinging the boom outward while taking on cargo; namely, the possible delays and the certain legal risks arising from the obstruction of traffic and the labor and expense of correcting list of the vessel so induced.

A specific embodiment of the invention is shown in the accompanying drawings in which:

Figure 1 is a side elevation of a ship embodying an improved unloader boom.

Fig. 2 is a view showing a vessel in end elevation with the improved unloader boom in extended position to illustrate the range of bulk-cargo discharging points beyond the side of the vessel.

Fig. 3 is a detailed view showing the outboard end of the fixed portion of the boom and the arrangement of a shuttle extension therefor.

Fig. 4 is a view in elevation showing the arrangement of the inboard end of the main boom.

Figs. 5 and 6 are diagrammatic illustrations in plan showing one manner of operating the boom extension.

Fig. 7 is a sectional view in vertical elevation of the fixed boom and shuttle, showing their mechanical arrangement and inter-relation.

Fig. 8 is a fragmentary view in side elevation showing the manner of supporting the inboard end of the shuttle boom when the same is in retracted position.

Fig. 9 is a fragmentary sectional view as taken on line 9—9 of Fig. 8.

Fig. 10 is a sectional view in elevation showing the arrangement of the inboard end support of the main boom for both vertical and horizontal pivotal movement, and,

Fig. 11 is a fragmentary sectional view of the

main boom and shuttle showing the arrangement of lateral guide wheels on the shuttle.

As shown in the drawings, my invention makes use of a main conveyor boom of such length as can be stowed on a ship deck in the usual manner, the conveyor carried by the boom being of a continuous belt type in the arrangement shown. A shuttle extension boom is carried by the main boom and, as shown, telescopes within the same, running on tracks incorporated within the structures and being actuated by means of cables or other appropriate means whereby the shuttle may be run out to and held at the desired length within limits, as determined by the length of the main boom.

The shuttle, as shown, carries a second belt conveyor arranged below the conveyor on the main boom; the latter, receiving its load in any of the usual manners, discharges the load over its head or outward end onto the shuttle conveyor, which, in turn, carries the load over the extended distance and discharges it to the shore.

The direction of travel of the shuttle conveyor is reversible; thus, from a given anchorage, the shuttle not only extends the unloading radius through all parts of a zone determined by its own working length beyond the working radius of the main boom, but also permits unloading through substantially all parts of the zone within the radius of the main boom.

Referring specifically to the drawings, a typical illustration is shown in Fig. 1, wherein the main boom 1 is shown in stowed position, the main boom taking up all the available clear length of the vessel deck and being supported at one end by a pivot support 2 mounted on a horizontal turntable on the deck of the ship 3, and at the opposite end by a supporting means 4, which helps to carry the weight of the boom when the hoisting tackle 5 is not in use.

As shown in Fig. 1, cable 6 of the hoisting tackle runs to suitable sheaves on an A-frame 7, and thence to a hoisting drum 8 driven by any suitable means such as an electric or gasoline motor, and the outer or remote end of the tackle is attached at 9 to the lower chord of the main boom truss structure adjacent to its outer end. This arrangement of the hoisting tackle is an important feature of my invention.

In the conventional design the hoisting tackle is attached to some point as at 10, on the top chord of the main boom 1, necessarily at an acute angle with it, and the acuteness of this angle necessitates a heavy tension in the tackle and a correspondingly heavy compression in the top chord of the boom in order to carry the boom weight. The top chord compression must in such case, follow an indirect path to the reaction point, which is the pivot 2, located below the line of the top chord and quite close to the bottom chord.

Thus in such conventional design the top chord compression or the balancing force between the weight supported and the tackle tension in following this indirect path to the reaction point sets up stresses in the truss framing for which the latter need not otherwise be designed. These stresses in the truss framing will generally be of opposite sign or character to those otherwise obtaining and of many times greater magnitude. The result is the necessity of a considerable increase in truss weight which my design makes unnecessary, this extra weight being high above the center of gravity of the vessel at an elevation where elimination of weight is of great value in conserving stability.

By connecting the tackle to a point on the lower chord, as in my improved design, the compressive stress on the boom is transmitted quite directly along the bottom chord to the pivot and this permits the lighter construction of the boom without sacrifice of strength.

As shown in the drawings and particularly in Figs. 2, 3, 4, and 7 thereof, my improved unloading boom construction is generally rectangular in cross section and comprises a hollow frame made up of spaced parallel elongated vertically disposed trusses, within which a generally U-shaped shuttle boom 11 is telescopically housed, the shuttle boom likewise being of hollow rectangular trussed frame construction.

As shown, the main boom 1 also carries an endless belt conveyor 12 supported on suitably spaced hangars 13, as shown in Fig. 7. The conveyor 12 is of fixed length and runs from adjacent to one end of the main boom 1 to the opposite end, passing over suitable pulleys 14 and 15 at the inboard and outboard ends of the main boom respectively and also passing over suitable spaced supporting or idler rollers 16 and 17, the whole being supported on framework carried by hangars 13.

As shown in Figs. 1, 2 and 4, the main boom conveyor 12 is driven by a suitable motor, or other power medium, and gearing 18 usually located at the inboard end of the main boom. A suitable loading chute 20 is provided at the inboard end of the main boom conveyor 12 in the usual manner to properly guide the material being handled onto the same, and a suitable discharge chute 21 is provided at the opposite end of the main boom to guide the conveyed material onto the conveyor of the shuttle boom 11, as will be hereafter described. Thus, material taken from the hold of the ship by any suitable means, such as an elevator 22, is delivered onto the conveyor 12, carried the length of the main boom 1, and deposited onto the conveyor 23 of the shuttle 11.

As shown in Figs. 3 and 7, the shuttle boom 11, which in the form shown telescopes into the main boom 1, carries a conveyor 23 which extends over substantially its whole length and is supported on tail pulley 24, head pulley 25, snub pulley 24.1, bend pulley 25.1 and suitable spaced intermediate idlers 26 and 27, the several pulleys and idlers being suitably mounted on the shuttle framing. Also as shown, this conveyor is driven by a suitable motor or other power means 19, located near the inboard or tail end of the shuttle and having driving connections with the tail pulley 24.

As before mentioned, the drive for the shuttle boom conveyor 23 is reversible so that the conveyor may travel in either direction to carry material delivered onto the same either toward the inboard or the outboard end of the shuttle boom. Thus, with the conveyor 12 of the main boom extending along the upper part thereof above the shuttle boom 11, material may be delivered onto the shuttle boom conveyor 23 regardless of the position of the shuttle boom with respect to the outboard end of the main boom 1, and wholly independently of the direction of travel of the shuttle boom conveyor.

It will be seen that with this arrangement the shuttle boom will serve either as a means for transporting the conveyed material to a point beyond the outboard end of the fixed or main boom or to carry the conveyed material backwards from the outboard end of the main boom

to substantially any point intermediate the ends thereof, thus providing delivery to any point within an arcuate zone extending from the side of the ship to a distance substantially equivalent to the sum of the lengths of the main boom 1 and the shuttle 11 and making the actual delivery or discharge point independent of the length of the main boom.

Another important advantage gained by my improved conveyor boom arrangement is that cargo may be taken from one part of the ship's hold and deposited in another part in a single operation, thus obviating the necessity, as in the usual case, of first discharging the cargo to the shore and then reloading the same.

As shown in the drawings, the shuttle boom 11 together with its conveyor 23 is advanced or retracted by movement of the shuttle boom along the axis of the main boom, the shuttle boom being so constructed as to run over a plurality of guide wheels on which it is supported for telescoping movement relative to the main boom. As shown in Figs. 2 and 7, upper and lower guide wheels 28 and 29, respectively, are supported on the main boom structure adjacent the outer end of the same, a pair of upper guide wheels 28 and a pair of lower guide wheels 29 being located at or near the outer end of the main boom, and pairs of upper and lower guide wheels 28.1 and 29.1 respectively being located inwardly of the end of the main boom at or near the point of farthest outward travel of the inner end of the shuttle boom. Thus in any extreme operating position the weight of the shuttle is carried by one pair of lower guide wheels acting as a fulcrum against the reaction of the remote pair of upper guide wheels. In any intermediate position in which the center of weight lies between the inner and outer pairs of wheels the shuttle is carried by two pairs of lower wheels.

As shown, the guide wheels 28, 28.1, 29 and 29.1 are flanged and arranged to engage tracks 30 and 31 extending along the upper and lower chords of the shuttle trusses. Thus the shuttle is stably supported in all working positions, the guide wheels being mounted on shafts, not shown, journaled in suitable bearings 32, fixedly mounted on the main boom structure.

In order to provide lateral stability fixed side guide rollers 33 located at or near the outer end of the main boom and arranged to engage tracks 34 on the upper and lower chords of the shuttle boom trusses are provided, and moving guide rollers 35 are mounted on the shuttle at or near the inner end thereof as shown in Fig. 11, the guide rollers 35 travelling with the shuttle 11 and contacting tracks 36 suitably positioned and extending along the trusses of the main boom 1. These guide rollers assure freedom from jamming in changing of the length of the unloader boom and serve to carry wind and other lateral loads from the lateral bracing system of the shuttle truss to that of the main boom.

Since shuttle motion in either direction and control of the same must be possible at any vertical inclination which might be used, a cable system of fixed length for actuating the shuttle boom is provided. As shown in the drawings, with particular reference to Figs. 5 and 6, this cable system comprises a sheave 37 fixed to the main boom at a point near the outer end thereof on the bottom lateral truss system and arranged so as to be aligned with the longitudinal center line of the shuttle; a cable 38 having a fixed attachment to the inner end of the shuttle and

passing around the sheave 37; and a winding drum 39 around which the cable 38 is wrapped, mounted at the inner end of the main boom. The cable 38 makes several turns around the drum 39 and then runs back to the inner end of the shuttle boom 11. At this point both ends of the cable are attached to the shuttle boom.

As indicated in the drawings, the winding drum 39 may be driven in either rotative direction by any suitable motive power such as an electric motor 40 operating through speed reduction gearing 41. As will be readily understood, the diameter and grooving of the drum 39 must be proper for the cable used, and the length of the drum must be sufficient for the number of turns of the cable, which would equate in length to the maximum distance of shuttle travel plus at least four additional turns for friction anchorage. Thus the cable being endless, the anchorage turns travel back and forth the length of the drum according to the shuttle movement. It will also be understood that the shuttle operating mechanism includes besides the motor 40 and speed reduction gearing 41 suitable brake and clutch mechanism not specifically shown, as half of the shuttle operation will consist of brake action against closing of the shuttle by gravity when the main boom is in upwardly inclined position.

It will be seen that when the shuttle is in retracted position most of its length becomes a cantilever supported on the relatively short anchor span between the outer and inner sets of guide wheels 28 and 29.1 on the main boom and since it is undesirable to subject such a long cantilever to the abuse which it would receive from motion of the ship while the shuttle is in stowed position, means are provided adjacent to the inner end of the main boom to anchor the inner end of the shuttle when the same is in stowed position. Such means are illustrated in Figs. 8 and 9 of the drawings and as shown, comprise a straight-faced wheel or tail guide 42 mounted on the bottom chord of each of the shuttle trusses and guideways or runways 43 mounted on supports in the plane of the bottom chord of the main boom in alignment with the tail guides 42.

As shown, the guideways 43 are inclined upwardly in the rearward direction so that as the inner end of the shuttle approaches the stowed position the tail guides 42 will contact the guideway 43 and elevate the inner end of the shuttle a sufficient amount to take up the computed elastic dead load deformation of the cantilever when the end of inward travel of the same is reached. Preferably the vertical inclination of the guideway 43 is slightly in excess of the computed cantilever deformation to assure easy making and breaking of contact with the tail guide 42. Also the side guides 44 of the guideways 43 are flared outwardly in the forward direction of the main boom to insure easy entry of the tail guide onto the runway under all conditions of lateral distortion of the shuttle. At the end of shuttle travel, however, the space between the side guides 44 is narrowed to working clearance of the tail guide, thus providing a lateral anchorage which will be firm while the vessel is in motion. Wheel stops 45 are also provided to prevent over travel of the shuttle in the closing or retracting movement of the same and it will be understood that suitable known means will be provided for automatically shutting off the motor drive of the shuttle operating mechanism when the tail guide wheels 42 contact the stops 45 or when they pass

some predetermined point short thereof. Also suitable locking means, such as the wheel locks 46, may be provided which will operate automatically to hold the shuttle in the retracted position; and suitable means, either manually or automatically operated, or both, may be provided for opening or removing the locking means when it is desired to extend the shuttle.

As shown, in Fig. 10, the pivot support 2 for the inboard end of the main boom 1 comprises a turntable 47 pivotally mounted on the vertical axis of a base plate 48, suitable roller bearings 49 being disposed between the turntable and the base plate. Also, as shown, the turntable 47 is provided with opposed laterally-projecting trunnions 50 on which suitable supporting bearings 51 attached to the inner end of the main boom are journaled. This construction is well known and provides ample efficient support for the main boom under all conditions of horizontal or vertical angular movement of the same.

In the operation of my improved unloader boom the device is elevated to the desired vertical angular position by means of the hoisting tackle 5 running from the A-frame 7 centering over the pivoted or supported end of the boom; and lateral angular motion of the boom is effected by means of suitable swing tackle, not shown, but of established conventional design. When the main boom has been swung to its desired position and vertical angle, the shuttle is then run out or extended to the desired amount by means of the shuttle drive 40—41 and the endless cable and drum 33 and 39, respectively. The main boom conveyor 12 and the shuttle boom conveyor 23 are then actuated by their respective drives which are arranged for remote control. The bulk-cargo of the vessel is then taken from the hold by any suitable cargo-handling means and deposited on the main boom conveyor 12 through the chute 20. The cargo is then carried to the chute 21 where it is delivered onto the shuttle conveyor 23, which in turn, discharges the cargo to a shore pile.

When the shore pile location is beyond the end of the main boom, as at A in Fig. 2, the shuttle boom conveyor will travel in the outward direction and discharge the cargo over the outward end of the shuttle boom. When the shore pile is desired to be located at a point between the end of the main boom and the ship, as at B in Fig. 2, the shuttle conveyor is run in the reverse or rearward direction so as to discharge the cargo over the rearward or innermost end of the shuttle. It will thus be seen that latitude as to location, size and shaping of piles of cargo as deposited on the shore by this device is much greater than would be possible with unloader booms of conventional design, in which unloading is confined to a single fixed and relatively short radius.

It is to be understood that though the conveyors herein shown and described are of the continuous belt type my invention is not to be construed as being limited thereto; and that any suitable kind or type of conveyor may be employed.

The chief advantage of my invention is the increment of working reach over that possible with an unloader boom of fixed length subject to the same limitation of stowed space. A second advantage is the facility for varying the working reach throughout substantially the whole length of the elongated boom.

The usefulness of these advantages can be

illustrated by considering the example of a vessel having a clear deck space to stow a boom 100 feet long. Without my invention such a boom would carry a conveyor about 100 feet long. Bulk commodities can be carried by such a conveyor up inclines of 15° to 25°, the angle depending upon the material carried. Thus, assuming an 18° incline, this conveyor will deposit a maximum pile 31 feet high measured from the top of the delivery pulley of the conveyor, or about 35 feet high measured from the deck of the vessel, on a fixed radius of 95 feet from the center of horizontal rotation usually on the center line of the vessel.

For the same 100 feet stowed length my invention would afford operating lengths variable at will from a maximum of about 170 feet to a minimum of about 30 feet. Under the same operating conditions my improved conveyor boom would deposit a maximum pile about 56 feet higher than the deck of the vessel on a radius of approximately 161 feet from the axis of horizontal rotation. It would also deposit a pile on any lesser radius down to the 30 foot minimum, the height of the pile varying with the radius.

With such an advantage a vessel can discharge cargo over a greatly increased land area and to a greatly increased average depth. In addition to this increase in the use of shore space my invention also permits increased freedom and convenience of handling. Thus a ship of deep draft can discharge a cargo from a more remote anchorage if water at the dock line is too shallow or it can on occasion discharge cargo without waiting for another ship to vacate the berth which it would have to use without such equipment.

My invention also offers a number of advantages in the use of shore storage. A storage site otherwise valueless may be made usable by the increased reach of the boom conveyor extension and the capacity of any established cargo site is greatly increased. Cargoes can also be disposed adjacent to service roads or railroad spurs more advantageously without additional cost and the ability to discharge different materials to separate piles without reberthing the ship is increased several hundred per cent.

The dealer in commodities so handled profits, in addition to such gains as the foregoing may ultimately give him, in the improved condition in which the material reaches him. The high lift afforded by the extension results in the building up of fewer and larger piles. Further, there is less casual loss from such piles, less risk of mixture with foreign matter and the building up of the piles is considerably slower. Also, the average distance of drop from the conveyor to the pile will, in ordinary practice, be reduced with a consequently reduced degradation through breakage of sized material.

Aside from these advantages the useful scope of the unloader boom principle is made possible to many vessels on which it would otherwise have little or no economic value. A vessel having clear deck space too limited, either because of its size or the presence of deck structures, cannot profitably use the fixed length conveyor boom which its clearances permit. It can, however, in many instances so use an extensible boom. Where limitations are less sharp the device still offers great advantages. For any available deck space a relative enhancement of value over that of a fixed length boom can be provided, the only final limitation being the stability of the boat. In the

instances where deck clearance permits the installation of a boom of fixed length equal to the maximum length of my device, the latter still adds the advantages of the variable radius of discharge to equal maximum range. Also the economy of stowed length with my improved construction affords wide latitude in locating the in-board support at such a point as will give the most desirable arcs of horizontal swing together with the most convenient working of the vessel.

When loading the vessel it is necessary to extend the boom outboard at approximately right angles, and always on the off-shore side, to gain access to hatchways. The compactness of my invention as compared with a boom of fixed equal operating length minimizes the list of the vessel so induced and the difficulties and hazards incidental to obstruction of passing traffic.

Furthermore when it becomes necessary to shift cargo from one portion of the vessel to another with the fixed length boom conveyor the material must first be unloaded to the shore and then reshipped by means of shore equipment. Whereas with my improved device the cargo may be shifted without taking it off the vessel and without any equipment other than that used in the ordinary discharge of cargo.

Although but one specific embodiment of this invention is herein shown and described, it will be understood that details of the construction shown may be altered or omitted without departing from the spirit of this invention as defined by the following claims.

I claim:

1. A cargo unloading device comprising a main boom, a shuttle boom movable along said main boom for variable longitudinal extension thereof, means adjacent the outward end of said main boom arranged to support said shuttle boom independently in all positions of movement of the same, a tail guide on the inward end of said shuttle boom, and tail guide receiving means in appropriate position on said main boom to engagingly receive said tail guide automatically and secure the inward end of said shuttle boom against displacement when the same is in retracted position.

2. In a cargo unloader comprising a hollow main boom having a longitudinally-disposed shuttle boom therein arranged to be telescopingly extended therefrom and retracted thereinto, said shuttle boom being movably carried by and mainly supported between spaced upper and lower pairs of guide means disposed adjacent the outward end of said main boom, a tail guide on the inner end of said shuttle boom, and for-

wardly-flared longitudinally-extending means on said main boom arranged to receive said tail guide when said shuttle boom is retracted and secure the inward end of said shuttle boom against displacement when the same is in stowed position.

3. In a ship-board cargo unloading device comprising an extensible boom pivotally supported on a boat from a fixed point at one end for both vertical and horizontal angular movement and having side frames each of which is a vertically-disposed truss extending the length of the boom, the said pivot connection attaching to the lower chords of said trusses, elevating tackle extending from a point adjacent the pivotally-supported end of the boom and above the point of boom support and attached to the lower chord of each of said side frame trusses adjacent the middle of the maximum operating length of said boom.

4. In a boat unloader comprising a boom and cargo conveyor of specific length, said boom having one end pivotally connected to the boat structure, means including a second conveyor operable independently of the first conveyor and adjustable longitudinally thereof to vary the point of ultimate cargo discharge axially of said boom in either axial direction with respect to the outward end thereof, said boom being arranged for both vertical and horizontal pivotal movement relative to the boat, and said means and second conveyor being mounted and arranged for operation irrespective of the attitude of said boom relative to said boat and the pivot connection thereon.

5. The combination with a boat of an unloading boom of fixed length having one end pivotally secured to the boat and having a longitudinally extending conveyor discharging adjacent its outward end, a shuttle boom carried parallelly by and wholly supported by the first boom and arranged to be adjustably extended beyond the outward end thereof, a reversible longitudinally extending conveyor on said shuttle boom arranged to receive material discharged from the first conveyor and to deliver said material from either end irrespective of the position of said shuttle boom with respect to the outward end of the first boom, and means to swing said first boom horizontally on its pivot and project the same outwardly beyond either side of said boat, all arranged whereby material may be discharged from said shuttle to any point between the side of the said boat and the farthest extended reach of said shuttle.

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