

Oct. 19, 1965

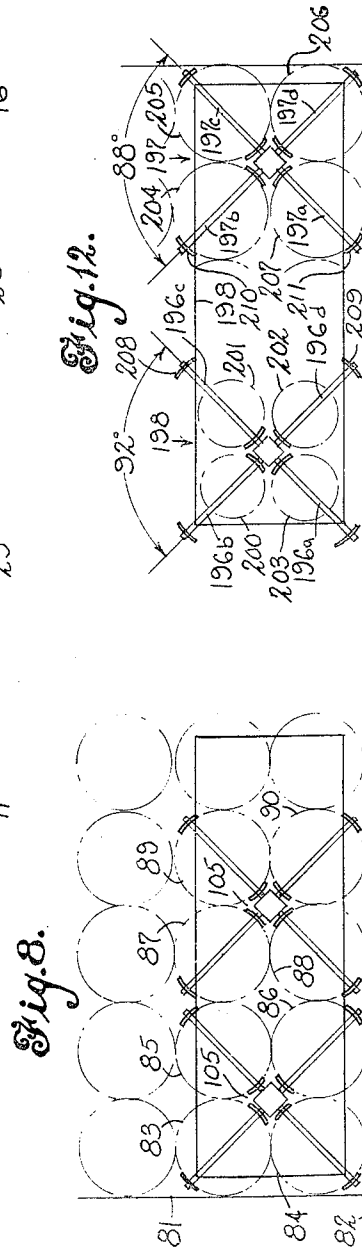
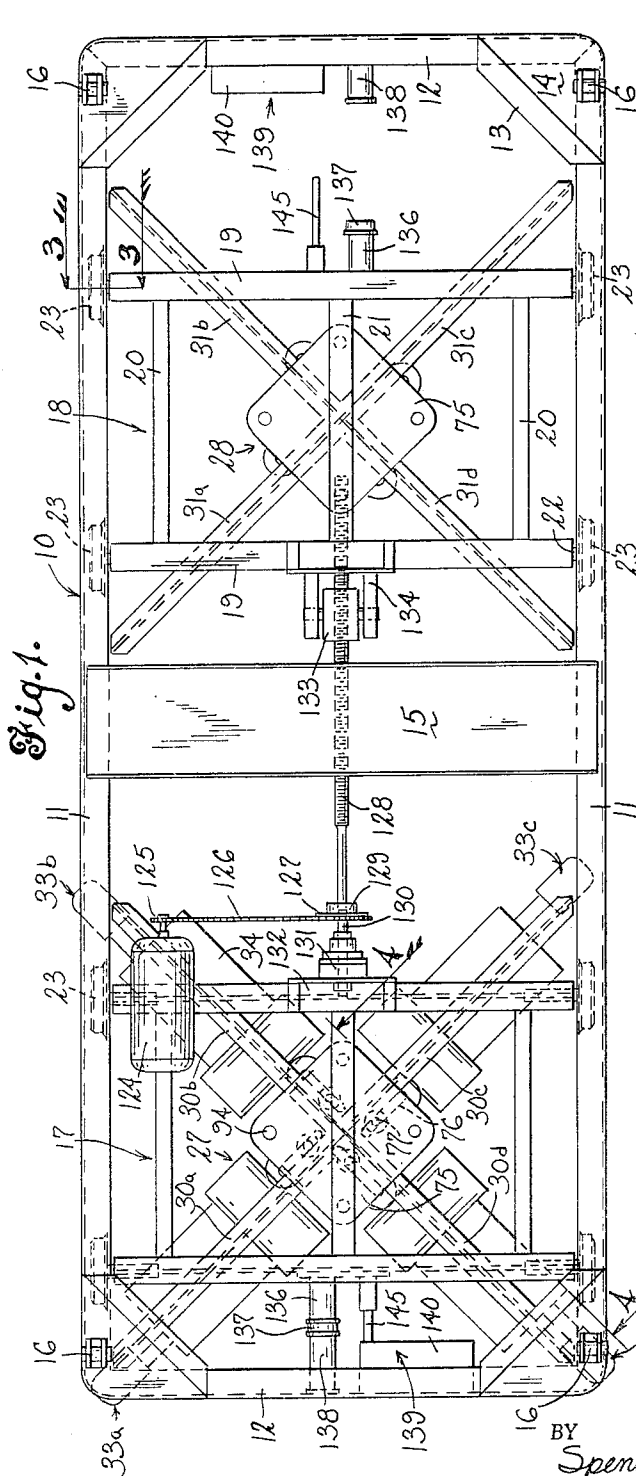
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3,212,808

MULTIPLE ROLL GRAB

Filed March 26, 1963

5 Sheets-Sheet 1



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Fig. 5.

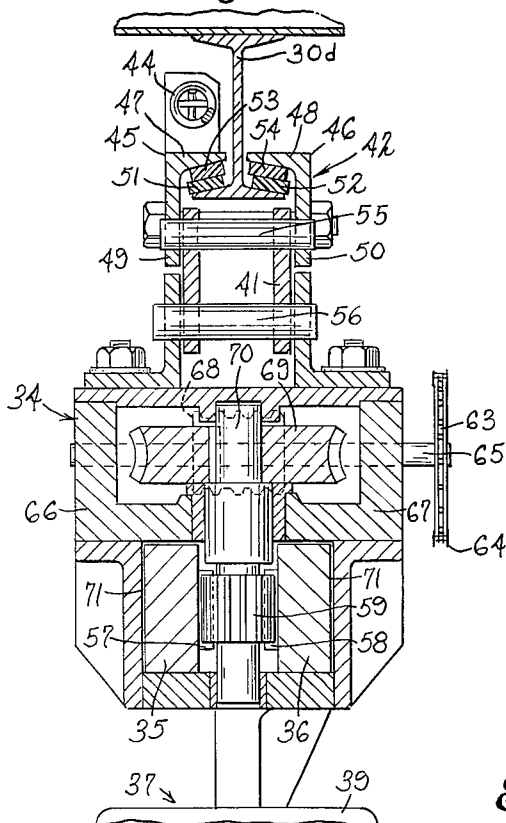


Fig. 3.

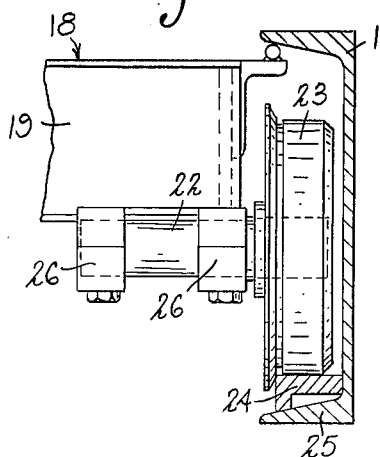


Fig. 6.

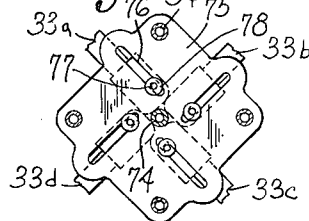
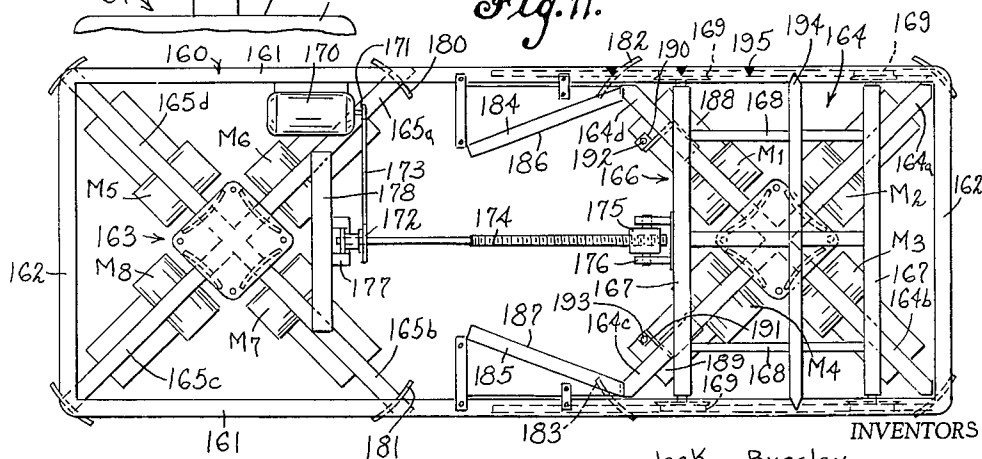


Fig. 11.



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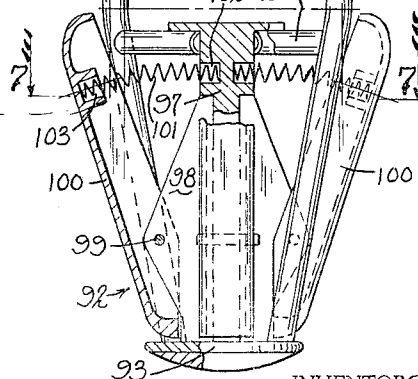
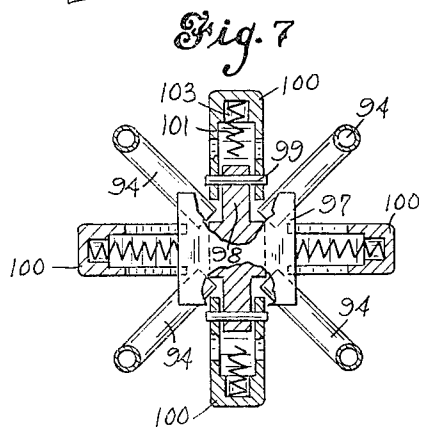
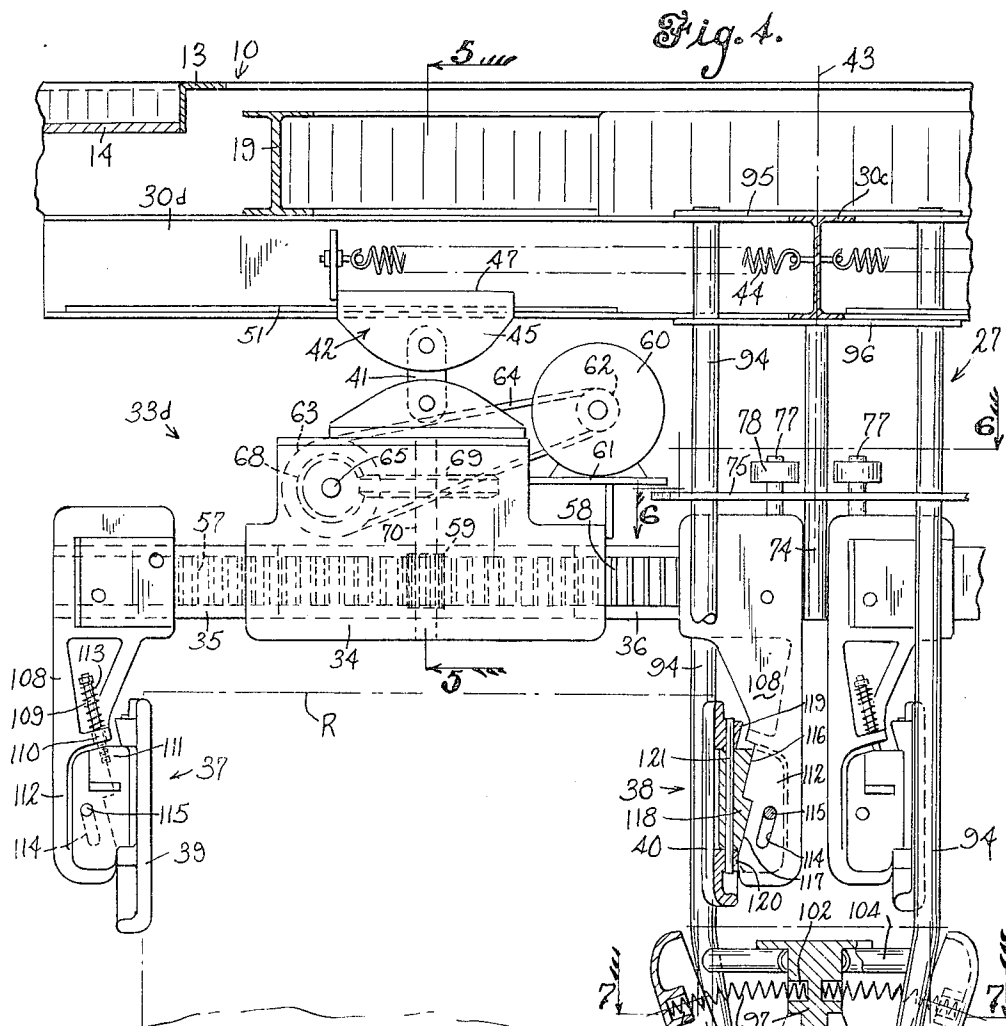
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5 Sheets-Sheet 5

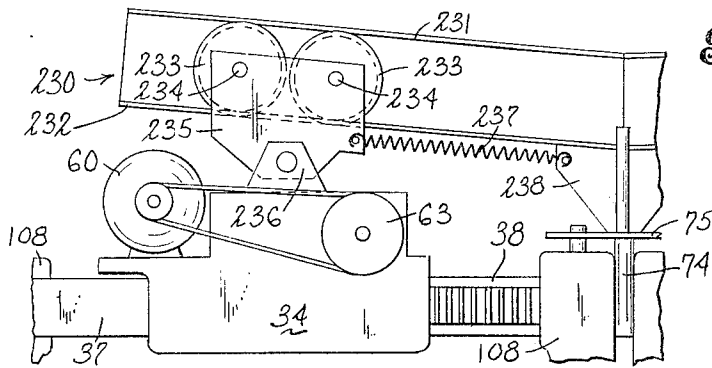
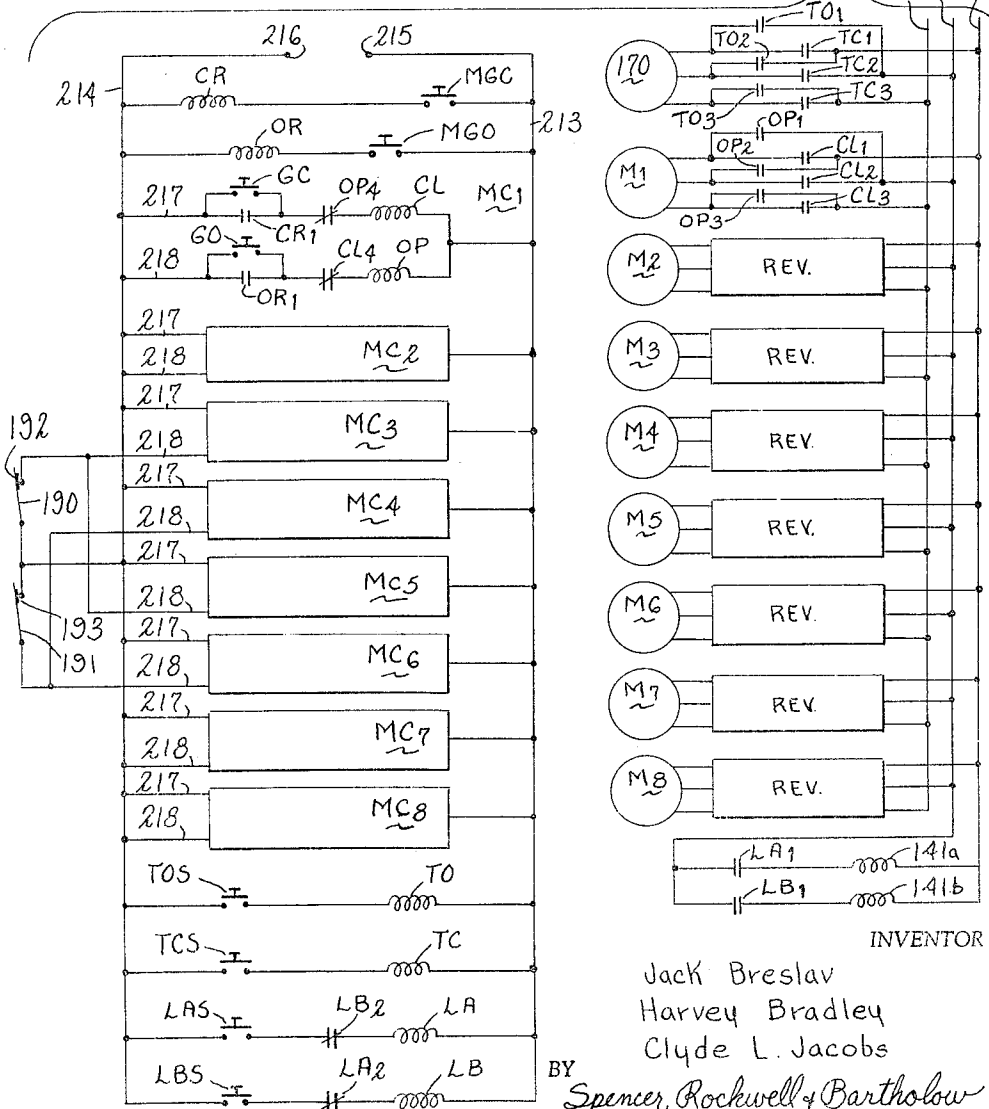


Fig. 13.



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MULTIPLE ROLL GRAB

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19 Claims. (Cl. 294—81)

This invention relates to material handling devices and more particularly to material engaging and lifting apparatus adapted to simultaneously engage and lift a multiplicity of paper rolls, or the like.

In handling material to be loaded for transportation, unloaded for utilization, or transfer to another mode of transportation, the time required to handle the material is quite important, inasmuch as the transportation equipment is tied up and can do no useful work until the materials to be transferred are loaded or unloaded. Another important consideration in the design and use of material handling equipment is the safety afforded working personnel. It is desirable that personnel who position overhead material handling devices to engage and lift material do not remain beneath the material as it is being raised. In order to accomplish the latter objective, the material handling device should be self-positioning, or positionable, with respect to the material to be engaged and lifted, so that no personnel need be in proximity to the material or beneath the material handling apparatus.

The present invention contemplates material handling apparatus arranged to engage and lift a multiplicity of rolls; such as rolls of paper or newsprint stacked with the roll axis vertical, transport such rolls to a new location and deposit such rolls in a uniform arrangement at the new location. This invention provides a compact multiple-roll grab assembly arranged to be self-positioning with respect to a multiplicity of aligned rolls that are arranged to be engaged and lifted by the grab assembly. As used herein, the term "grab" refers to apparatus adapted to engage an object on opposite sides thereof and hold the object when the apparatus is lifted. The term "grab assembly" refers to an arrangement of one or more such grabs.

The invention further provides a grab assembly which is self-positioning with respect to a plurality of rolls to be engaged and each individual grab of the grab assembly is self-positioning with respect to the roll upon which it will operate. The invention further provides a multiple-grab apparatus comprising plural grab assemblies wherein the grab assemblies are movable relative to one another to compensate for rolls of varying diameter and nests of rolls of varied position.

Accordingly, an object of this invention is to provide a new and improved grab assembly for simultaneously handling a multiplicity of rolls of material.

Another object of this invention is to provide a new and improved grab assembly in which the assembly is self-positioning with respect to the materials to be handled and, in addition, the individual grabs of the assembly are self-centering with respect to the material each will handle.

A further object of this invention is to provide a multiple-grab assembly having new and improved mechanisms for operatively positioning grab assemblies and individual grabs thereof with respect to material to be handled.

A further object of this invention is to provide a multiple-grab assembly arranged to pick up a multiplicity of nested rolls wherein the rolls, when picked up, nest together in a manner which facilitates uniform arrange-

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ment of rolls transferred by the grab assembly and also tends to lock the jaws of each grab against the engaged rolls.

A still further object of this invention is to provide a new and improved material-handling apparatus arranged to rapidly transfer a multiplicity of rolls of paper or like material.

Other objects of the invention will in part be obvious and will, in part, appear hereinafter.

The invention, accordingly, comprises the features of construction, combinations of elements, and arrangement of parts which will be exemplified in the constructions hereinafter set forth, and the scope of the invention will be indicated in the claims.

For a fuller understanding of the nature and objects of the invention, reference should be had to the following detailed description taken in connection with the accompanying drawings, in which:

FIG. 1 is a plan view of a multiple-roll grab apparatus according to the invention;

FIG. 2 is a front elevation of the multiple-roll grab apparatus of FIG. 1;

FIG. 3 is a sectional view taken along line 3—3 of FIG. 1;

FIG. 4 is a view taken along line 4—4 of FIG. 1, partly in section;

FIG. 5 is a sectional view taken along line 5—5 of FIG. 4;

FIG. 6 is a view taken along line 6—6 of FIG. 4;

FIG. 7 is a view taken along line 7—7 of FIG. 4 with certain parts omitted and cut away to facilitate understanding of the illustrated device;

FIG. 8 illustrates a manner in which the apparatus of FIGS. 1 to 7 operates to engage a multiplicity of rolls;

FIG. 9 is a plan view of the latching mechanism of FIG. 1, with portions thereof cut away;

FIG. 10 is a sectional view taken along line 10—10 of FIG. 9;

FIG. 11 is a plan view of another multiple roll grab apparatus embodying the invention;

FIG. 12 illustrates a manner in which the apparatus embodying the invention operates to engage rolls stacked in spaced nests;

FIG. 13 is a view, similar to FIG. 4, of another embodiment of a grab suspension according to the invention; and

FIG. 14 is a schematic diagram of a preferred electrical network for controlling the operation of the multiple roll grab apparatus of FIG. 11.

Referring now to FIGS. 1 and 2 which illustrate one preferred embodiment of the invention, the apparatus shown comprises a frame member 10 having side sills 11 connected by end sills 12. Each adjoining side and end sill is further connected by diagonal braces 13 and gusset plates 14 at the corners of the frame 10. A center brace 15, which acts as a stiffening element, may also be provided at the center of the frame 10 between side sills 11. As more clearly shown in FIG. 2, end sills 12 and side sills 11 are preferably formed as channel members, as hereinafter described. Lifting lugs 16 are provided adjacent the corners of frame member 10 for supporting or suspending the frame and grab assemblies. Frame member 10 is preferably supported from the four lugs by wire cables or the like carried from an overhead crane, not shown.

Controllably movable on frame member 10, as hereinafter more fully described, are trolleys 17 and 18, each of which comprises spaced-apart end frame members 19, connecting side frame members 20 and a center frame member 21. As more clearly shown in FIG. 3, secured at each end of the end frame members 19, are axles 22

each having a flanged wheel 23 rotatably mounted thereon. The flanged wheels 23 are movable on a track comprising an angle member 24 which is mounted on the bottom flange 25 of side sills 11. Axles 22 are secured to end frames 19 by means such as clamping collars 26.

Supported from each of the trolleys 17 and 18 are grab assemblies generally indicated at 27 and 28, respectively. In the illustrated embodiment of the invention, each of the grab assemblies 27 and 28 comprises four grabs. As shown in FIG. 4, each of the grabs of a grab assembly is suspended from a grab support arm, 30a, 30b, 30c, 30d and 31a, 31b, 31c and 31d, respectively, the support arms of each grab assembly being substantially 90° apart.

The grab-support arms 30a-30d and 31a-31d are carried by their associated trolleys 17 and 18 and each support a grab 33a, 33b, 33c and 33d therefrom. Each grab is substantially identical to the others and all may be exemplified by the grab 33d suspended from grab-support arm 30d, as illustrated in FIG. 4. Grab 33d comprises a grab housing 34 having outboard and inboard grab arms 35 and 36, respectively, movable therein in opposite directions as hereinafter explained. An outboard jaw assembly 37 is secured to one end of outboard grab arm 35 and an inboard jaw assembly 38 is secured to one end of inboard grab arm 36. Jaw assemblies 37 and 38 provide spaced-apart work engaging jaws 39 and 40, respectively, arranged to engage vertically disposed rolls or similar material positioned therebetween.

Each grab is supported from its associated grab support arm and is movable thereon. Grab housing 34 is supported from support arm 30d by means of a hanger 41 depending from a grab carrier 42, which, in accordance with one aspect of the invention, is movable on grab support arm 30d and is biased toward the vertical center line 43 of grab assembly 27. Such biasing is accomplished by resilient biasing means such as a helical spring 44 connected between grab carrier 42 and a point near the center of the grab assembly. Grab carrier member 42 is arranged to be freely slidable on its grab-support arm 30d and, in a preferred form, comprises spaced-apart angle members 45 and 46 having generally horizontal legs 47 and 48, respectively, which overlie bottom flanges 49 and 50 of grab support arm 30d.

To make grab-carrier member 42 freely slidable on grab-support arm 33d, suitable means are provided to minimize the friction therebetween. In the illustrated structure, the upper surfaces of flanges 49 and 50 are preferably provided with steel tracks or rails 51 and 52 which mate with polytetrafluoroethylene ("Teflon") tracks or rails 53 and 54, which are provided on the under surfaces of overlying legs 47 and 48, respectively. The rails 53 and 54 may be of bronze, nylon or other suitable material having a low coefficient of friction. Rails 51-54 may be secured to their respective surfaces by any suitable means, for example, by being secured thereto with bolts having their heads recessed below the sliding surfaces of the rails or steel rails 51 and 52 may be welded to their respective flanges 49 and 50. Grab carrier member 42 carries a hanger pin 55 supporting hanger 41, and hanger 41 in turn supports grab housing 34 by means of hanger pin 56 mounted thereon.

Each grab includes means (FIGS. 4 and 5) for actuating the arms thereof to move the jaws thereof toward and away from each other to engage or release a roll or other object positioned therebetween. Each of grab arms 35 and 36 have racks 57 and 58, respectively, defined thereon which are drivingly engaged by a pinion 59 on opposite sides thereof. The grab actuating means comprises a motor 60 mounted on a platform 61 provided therefor on grab housing 34. Motor 60 drives rack-engaging pinion 59 by means of a sprocket pinion 62 mounted on the shaft thereof and drivably connected to sprocket gear 63 by a sprocket chain 64. Sprocket gear 63 is mounted on a shaft 65 rotatably mounted on side walls 66 and 67 of grab housing 34. A pinion 68 mounted on shaft 65 drives a gear 69 on a shaft 70 verti-

cally disposed in and rotatably carried in grab housing 34. Rack-engaging pinion 59 is mounted on shaft 70 and arranged to drive racks 57 and 58 and therefore grab arms 35 and 36, respectively, in passage 71 defined in grab housing 34.

When motor 60 is energized, it drives sprocket gear 63 and pinion 68 through sprocket chain 64. Pinion 68 drives gear 69 which produces rotation of shaft 70 and pinion 59 thereon. Rotation of pinion 59, which drivingly engages racks 57 and 58 on grab arms 35 and 36, respectively, produces movement of the grab arms 37 and 38 in opposite directions to either move the work-engaging jaws 39 and 40 toward each other or away from each other depending upon the direction of rotation of motor 60. In this manner work-engaging jaws 39 and 40 may be moved toward each other to engage a roll on opposite sides thereof prior to lifting of the roll. To facilitate engagement of the rolls, the engaging surfaces of jaws 39 and 40 are made concave to substantially match the contour of a roll to be lifted. Also rubber pads, not shown, may be bonded or otherwise secured to the work-engaging surfaces of the jaws to protect a load engaged thereby.

In accordance with the invention, each grab 33a-33d is movable on its associated grab support arm, to facilitate positioning of the grab with respect to a roll to be engaged. Further in accordance with the invention, each grab supported from each grab support arm is biased toward the center of a grab assembly by a biasing means, as previously disclosed. Means are provided centrally of each grab assembly to limit movement of each of inboard jaw assemblies 38. As illustrated, such movement limiting means may comprise a vertically disposed back-up rod depending centrally of grab assembly along center line 43.

With this arrangement, the inboard jaw assembly 38 of each grab of a grab assembly does not normally move from the position shown in FIG. 4. If pinion 70 is rotated to drive racks 57 and 58 outwardly of grab housing 34, inboard jaw assembly 38 will abut back-up rod 74. Since jaw assembly 38 cannot then move, grab housing 34 moves outwardly with respect to grab support arm 30d against the restraining force of spring 44. Since inboard jaw assembly 38 does not move, grab arm 36 does not move and pinion 59 travels on rack 58 moving grab housing 34 outwardly. At the same time pinion 59, engaging rack 57 on grab arm 35, drives grab arm 35 outwardly to increase the span between the work-engaging jaws 39 and 40 and centrally position grab housing between jaws 39 and 40.

As previously stated, the inboard jaw assemblies 38 of each grab are normally in contact with back-up rod 74. However, when the inboard and outboard jaws of a grab are closing on a roll and the outboard jaw member first engages the roll, rack 57 will act as a fulcrum for pinion 59, and rack 58 on grab arm 36 will be moved outwardly by pinion 59, causing inboard jaw assembly 38 to move outwardly until jaw 40 contacts a roll positioned between jaws 39 and 40. However, after a roll is engaged and as frame 10 is hoisted, causing the grab to lift the engaged roll R, indicated in broken line in FIG. 4, biasing spring 44 will pull grab carrier member 42 and grab housing 34 toward center line 43 until the inboard jaw assembly 38 contacts back-up rod 74 or the engaged rolls contact each other if there is initial contact between the rolls. In this manner the actuating motor of each grab not only open and closes the jaws of the grab, but also operatively and centrally positions the grab to engage a roll or like object.

With this arrangement, when a group or nest of four rolls are engaged and lifted by a grab assembly, they will inherently be bunched in a compact arrangement and will be stacked uniformly in a predetermined, spaced relationship upon set-down and release from the grab assembly. This provides more uniform stacking of rolls as they may be loaded into a confined space, such as a

hold of a vessel, and facilitates subsequent unloading or handling of the rolls. Additionally, the arrangement of the inboard jaw assembly movement limiting means, back-up rod 74, with the inboard jaw assembly biased there against, prevents relative movement of racks 57 and 58 and pinion 59, thereby tending to produce a locking action on the grab arms of each grab when a roll is engaged.

Means are provided for limiting outward movement of inboard jaw assemblies 38 and avoid over extension of springs 44 and possible over extension of the grabs on their grab support arms.

Secured to back-up rod 74 is a guide plate 75 (FIG. 6) having longitudinal slots 76 of predetermined length defined therein, which receive limit pins 77 extending from the inboard jaw assembly 38 of each grab of a grab assembly. The limit pins are provided with stops 78, as shown. The length of slots 76 limit the outward travel of limit pins 77 and therefore the travel of inboard jaw assemblies 38. Stops 78, which are of larger diameter than the width of slots 76, limit the degree the grab housings may tilt on their associated hangers 41.

This organization and operation of the grabs of a grab assembly allows the four inboard jaw assemblies thereof to be positively inserted centrally of a nest of four rolls. Reference is made to FIG. 8 which illustrates the manner in which a multiple roll grab apparatus embodying the invention may be utilized to engage and pick up nested rolls, such as rolls of paper. The rolls of FIG. 8 are arranged in square patterns of four rolls and are aligned in rows and columns in a container which may be the hold of a ship defined by walls or bulkheads 81 and 82. Inasmuch as FIG. 8 is only diagrammatically illustrative of an operation of a multiple roll grab apparatus embodying the invention, the frame 10 is shown only in outline form. To pick up the rolls 83-90, the frame 10 is positioned thereabove and the trolleys 17 and 18, not shown in FIG. 8, are moved on the frame to position grab assembly 27 centrally over rolls 83-86 and grab assembly 28 centrally over rolls 87-90.

In accordance with the invention, each of grab assemblies 27 and 28 is provided with a centering device or probe to guide a grab assembly centrally of a nest or group of rolls having their roll axes defining a rectangular pattern, as exemplified by rolls 83-86 and 87-90.

In the illustrated embodiment of the invention, each of the grab assemblies 27 and 28 includes a centering device or probe 92 (FIGS. 4 and 7), which is arranged to be inserted centrally of a nest of four rolls in the recess defined therebetween, to guide the inboard jaw assembly of each grab of the grab assembly into proper position to engage the rolls to be lifted. Each centering device 92 comprises a nose-probe member 93 suspended on a plurality of support rods 94 depending centrally of grab support arms 30a-30d. Rods 94 are secured in support plates 95 and 96 which are disposed above and below support arms 30a-30d, respectively, and secured thereto, preferably by welding. A member 97, having a plurality of pivot-providing ears 98 extending therefrom at substantially right angles to each other, is carried on probe 93 centrally thereof. Ears 98 each carry a pivot pin 99. Pivoted to each of ears 98 by means of the associated pivot pin 99 are guide shoes 100. Each guide shoe 100 is biased outwardly adjacent the upper end thereof by means of a spring 101. Each spring 101 is received at one end thereof in a spring pocket 102 provided therefor on each of shoes 100 and received at the other end thereof in a pocket 103 provided therefor by member 97. Member 97 is held at the upper end thereof by rod members 104 joining member 97 and each of support rods 94 and rigidly spacing support rods 94 therefrom.

Centering device 92 provides a grab assembly which is self-positioning with respect to a nest of rolls. When the centering device 92 is lowered toward a recess 105

defined by a nest of four rolls (FIG. 8), and if the centering device 92 is off center with respect to recess 105, one or more of shoes 100 will engage a roll and be pivoted about its pivot pin and compress the associated spring 101 between the shoe and member 97 of the centering device. The compressed spring tends to bias the centering device 92 away from the contacted roll and move it centrally of the recess. In a like manner, the other guide shoes may contact other rolls defining recess 105 until the centering device is in a position to move vertically into recess 105 and position the jaw assemblies of individual grabs of the grab assembly on opposite sides of each of the nested rolls.

The organization and arrangement of the grab assembly centering device with the individual grabs being movable on its own support arm provide several advantageous features. It allows a multiplicity of grab units to be assembled in a relatively small package. It also provides a positive centering means for a grab assembly and insures that the inboard jaw of each grab will always reside within an area of predetermined dimension. In this respect, it may be noted, from FIG. 4, that the inboard jaw of each grab in its normal position is within the outline of centering device 92, and held in this position by spring 44. This arrangement allows the centering device to be inserted into a recess defined between a nest of rolls without danger of the inboard jaw assemblies striking a roll as the centering device is lowered into the recess and ensures that the inboard jaw assemblies will be positioned within the recess to engage the surfaces of rolls, without damage to a roll or any protective wrapping thereon.

Each of the jaw assemblies 39 and 40 (FIG. 4) is arranged to tightly engage a roll as it is lifted by a grab. Any tendency by a roll to slip between the jaws engaging the roll, acts to tighten the jaws of the jaw assemblies on the slipping roll.

Each of jaw assemblies 37 and 38 comprises a jaw support member 108 secured to each of grab arms 35 and 36 and a work-engaging jaw 39 and 40, respectively. A portion of jaw 40 of jaw assembly 38 is cut away to more clearly illustrate the structure of the jaw assemblies 37 and 38. The work-engaging jaws are supported from jaw-support members 108 by means of bolts 109 which extend through ledge 110 of jaw support members 108 into spaced-apart portions 111 of each of jaws 39 and 40, which extend rearwardly thereof on either side of portion 112 of jaw support members 108. Springs 113 are disposed between the heads of bolts 109 and ledge 110 to resiliently support the jaws therefrom.

A slot 114 is provided in portion 112 of jaw support members 108 and a pin 115 movable in slot 114 is carried between spaced-apart portion 111 of jaws 39 and 40. Jaw support member portion 112 has parallel inclined surfaces 116 and 117 which mate with parallel inclined surfaces of jaw member 118. A jaw member 118 is pivotally connected between ears 119 and 120 of each of jaws 39 and 40 by means of pin 121 extending therethrough into ears 119 and 120.

This structure of the jaw assemblies 37 and 38 allows the jaws 39 and 40 to move with respect to their associated jaw support members 108 on the mating inclined surfaces therebetween. When such movement occurs, pin 115 moves in slot 114 parallel to inclined surfaces 116 and 117, acts as a guide and as a limit on downward movement of jaws 39 and 40. Jaws 39 and 40 are allowed to pivot slightly about vertical pin 121 to enable the work-engaging surfaces of jaws 39 and 40 to adjust to the surfaces of a roll engaged between jaws 39 and 40.

If a roll R, as exemplified in broken line is tightly engaged between jaws 39 and 40 of a grab and frame member 10 is raised to lift roll R, roll R, due to friction between the roll and the work-engaging surfaces of jaws 39 and 40 will exert a downward force on jaws 39

and 40. Jaws 39 and 40 will then move downwardly with respect to inclined surfaces 116 and 117 of jaw-support members 108. Such downward motion of jaws 39 and 40 on inclined surfaces 116 and 117 produces inward movement thereof causing the work-engaging surfaces to more tightly engage or grasp roll R on opposite sides thereof.

In accordance with the invention, the grab assemblies 27 and 28 are arranged for movement relative to each other on their supporting frame 10, to provide positioning of the grab assemblies in accordance with the diameter of rolls to be engaged and lifted, and also to facilitate positioning of the grab assemblies to engage and lift spaced-apart nest or groups of rolls. As illustrated in FIGS. 1 and 2, a motor 124 is mounted on trolley 17. The shaft of motor 124 has a sprocket pinion 125 mounted thereon which is connected by a sprocket chain 126 to a sprocket gear 127 arranged to drive a screw shaft 128. Screw shaft 128 is mounted at one end thereof in a slip clutch 129 which connects screw shaft 128 to a shaft 130 rotatably mounted in a bracket 131, carried by frame 132 on trolley 17. The other end of screw shaft 128 is threadably received in a non-rotatable nut 133 carried by a bracket 134 on the adjacent end frame 19 of trolley 18.

When trolley 17 is held stationary and the motor 124 is energized to drive screw shaft 128, trolley 18 carrying nut 133 will either advance upon or away from trolley 17 depending upon the direction of rotation of screw shaft 128. However, if trolley 18 is fixed in position and motor 124 is energized, trolley 17 would advance towards or away from trolley 18 depending upon the direction of rotation of screw shaft 128. Therefore, when trolley 17 is stationary, the nut 133 moves on the threads of screw shaft 128 and when trolley 18 is stationary, the screw shaft 128 moves with respect to nut 133. The slip clutch, indicated generally at 129, may be provided to prevent stalling of motor 124 if one of the trolleys is driven against the end sills 12. In this manner, the position of each of the trolleys 17 and 18 relative to the other may be varied. To place a predetermined limit on outward movement of each of the trolleys 17 and 18, the outboard end frames thereof each carry a bumper 136 having a resilient pad 137 thereon adapted to coast with a bumper 138 on each of the end sills 12.

Locking means generally indicated by the reference numeral 139 and more clearly shown in FIGS. 9 and 10 are provided to lock each of the trolleys 17 and 18 to an adjacent end sill 12. Each locking means 139 comprises a housing member 140 mounted on an end sill 12 and carrying therein a latching means comprising a coil 141 and a plunger 142 having a pin 143 extending therefrom. As shown in FIG. 9, when coil 141 is not energized, the plunger 142 and the pin 143 extend into a slot 144 in housing 139. Mounted on each of the outside end frames 19 of trolleys 17 and 18 is a latching member 145 pivotally mounted at one end thereof by means of a pin 146 on a bracket 147 carried on the outer frame 19 of each of the trolleys. The latching member 145 extends into slot 144 and has a notch 148 therein arranged to engage pin 143 extending into slot 144. As more clearly shown in FIG. 10, guide members 149 are provided to retain pin 143 in position against any force that the latching member may exert thereon in the direction of travel of the trolleys. In FIG. 9, plunger 142 is shown in the position normally occupied when coil 141 is not energized. In this position, pin 143 is biased toward slot 144 by springs 150. If either of the trolleys 17 or 18 is latched in position at the end of the frame 10 and it is desired to move the latched trolley, it will be necessary to energize coil 141 to retract plunger 142 therein and move pin 143 out of engagement with notch 148 in latching member 145. After the trolley is unlatched and moved, coil 141 may be de-energized to allow pin 143 to return to its normal

position. Thereafter, if a trolley should be moved to a latched position, the latching member 145, by virtue of its inclined leading edge 151, upon approaching a latched position will strike pin 143 and pivot about pin 146 a distance sufficient to allow latching member 145 to pass beyond pin 143 and receive pin 143 in notch 148. Latching member 145 is resiliently supported intermediate its ends by a spring 152.

With this arrangement, each of the trolleys 17 and 18 and the grab assemblies carried thereby may be varied in position on the frame member 10, and also the position of the trolleys relative to each other may be predetermined.

FIG. 11 illustrates another preferred embodiment of the invention in which multiple grab assemblies are arranged for relative movement on a frame member. This multiple-roll grab apparatus comprises a frame 160 having side sills 161 and end sills 162. Carried by frame 160 is a stationary grab assembly 163 and a grab assembly 164 movable thereon. Grab assemblies 163 and 164 may be constructed in the same manner as grab assembly 27, previously described. However, in FIG. 11 the grab support arms 165a, 165b, 165c and 165d of grab assembly 163 are supported directly from the frame 160. Movable grab assembly 164 is carried by a trolley 166 which comprises end frames 167 and side frames 168. Trolley 166 is further constructed in the same manner as trolleys 17 and 18 of FIG. 1 and has flanged wheels 169 rotatably mounted on the end frames 167 thereof which are movable on said sills 161, as illustrated in FIG. 3. A trolley-drive motor 170 is mounted adjacent grab assembly 163 on a side sill 161 and through a sprocket pinion 171 on the shaft thereof drives a sprocket gear 172 by means of a sprocket chain 173. Sprocket gear 172 is mounted on a screw shaft 174 for rotation therewith. Screw shaft 174 is threadably received by a non-rotatable nut 175 carried by a bracket 176 on the inboard end frame 167 of trolley 166. The other end of screw shaft 174 is rotatably journaled in a bracket 177 carried on a cross member 178 by grab support arms 165a and 165b.

To prevent the outboard jaws 180 and 181 of the grabs supported from grab arms 165a and 165b from possibly interfering with the outboard jaws 182 and 183, respectively, of the grabs supported from grab support arms 164c and 164d of movable grab assembly 164 as trolley 166 is moved toward grab assembly 163, means are provided for limiting outward movement of jaws 180 and 181, also jaws 182 and 183, which include the provision of members 184 and 185 on side sills 161, which provide inclined surfaces 186 and 187, respectively.

The grab assembly 164 comprises grab support arms 164a, 164b, 164c and 164d, each supporting therefrom a grab, as illustrated in FIG. 4. Mounted on grab housing 188 and 189, supported from grab support arms 164c and 164d, are limit switches 190 and 191, having actuating arms 192 and 193, respectively. Actuating arms 192 and 193 are adapted to contact inclined surfaces 186 and 187 and thereby actuate limit switches 190 and 191, respectively, when the grab arms are extended a predetermined distance along the length of the grab support arm. This distance varies with the distance between grab assemblies 163 and 164. As hereinafter explained, actuation of limit switches 190 or 191 causes interruption of power to the motors driving the grabs including jaws 180, 181, 182 and 183, to prevent further outward movement of jaws 180 and 182, and 181 and 183 and possible interference therebetween.

The apparatus of FIG. 11 also may include an indicator 194 carried by trolley 166, arranged to be aligned with marks 195 on one of side sills 161. The marks 195 aid an operator in properly positioning trolley 166 with respect to grab assembly 163 in accordance with the diameter of rolls to be engaged and lifted.

FIG. 12 illustrates, in outline form, how a multiple-

grab apparatus embodying the invention may be utilized to handle nests of rolls of different diameter, and of spaced-apart position. As shown, grab assemblies 196 and 197 are relatively movable on frame 198 in accordance with either of the structures previously described. With an arrangement of this type, grab assembly 196 may handle rolls 200, 201, 202 and 203 which are of a different diameter than rolls 204, 205, 206 and 207, handled by grab assembly 197, and which are spaced therefrom. Moreover, each grab assembly can handle rolls of variable diameters and of different heights dependent on the distance the jaws of the grabs depend from their grab arms. Thus, a multiple-roll grab apparatus, in accordance with the invention, wherein plural grab assemblies are relatively movable on a supporting frame member, provides a great deal of flexibility in handling rolls of varying diameter and nests of spaced-apart rolls. The grab support arms 196a-196d of grab assembly 196 are arranged with the longitudinal axis of grab support arms 196b and 196d aligned, and the longitudinal axes of grab support arms 196a and 196c aligned. Also, the longitudinal axes of grab support arms 197b and 197d, and grab-support arms 197a and 197c of grab assembly 197 are aligned. To minimize the possibility of the outboard grab jaws 208 and 209 interfering with the outboard grab jaws 210 and 211, respectively, the angles included between corresponding adjacent support arms of each grab assemblies 196 and 197 may be varied slightly in opposite directions. For example, the angle defined between support arms 196c and 196b is illustrated as 92°, while the angle defined between support arms 197c and 197b is illustrated as 88°. The angle is selected in accordance with the span of the grabs when in full open position and the expected size of a recess defined between rolls to be engaged. It will be understood that the grab support arms of grab assemblies 163 and 164 may be arranged in this manner. With this arrangement, the adjacent grabs of the grab assemblies may be opened to a greater extent before the outer jaw assemblies of adjacent grabs, interfere.

The multiple-grab apparatus, grab assemblies and individual grabs thereof disclosed, are electrically operated as hereinafter described.

Movable grab assembly 164 (FIG. 11) includes grabs, as illustrated, supported from grab-support arms 164a-164d, each grab including grab actuating motors M1, M2, M3 and M4, arranged in the same manner as grab actuating motor 60 of FIG. 4. In addition, stationary grab assembly 163 includes a grab, supported from grab-supported arms 165a-165d, each grab including a grab actuating motor M5, M6, M7 and M8, arranged in the same manner as grab actuating motor 60.

Referring now to FIG. 14, which schematically illustrates the electric control network of the multiple-roll grab of FIG. 11, the grab adjusting motors of each grab assembly M1-M4 and M5-M8 are illustrated as three-phase induction-type motors which receive electrical energy from bus lines L1, L2 and L3, connectable to a source of three-phase electric power, not shown. The phases of each of the motors M1-M8 are connected to one of the bus lines L1, L2 and L3 through reversing contacts, as hereinafter described, while the trolley drive motor 170 is likewise connected to bus lines L1, L2 and L3 through reversing contactors.

The controls for each of the grab adjusting motors M1-M8 are connected between lines 213 and 214, which are connected at terminals 215 and 216, respectively, to a suitable source of electric power, not shown. In accordance with an aspect of the invention, the grab motors M1-M8 may be individually, reversible operated to open or close an individual grab or they may all be operated simultaneously. The motor control network may be so arranged that the grab adjusting motors of one grab assembly or the other grab assemblies may be operated independently from a master control. How-

ever, for simplicity of illustration, means are disclosed for operating each of the grab actuating motors individually, or all eight grab motors simultaneously. Motor control circuits MC1-MC8 each control operation of one of motors M1-M8, respectively. Inasmuch as each of the circuits MC1-MC8 are identical, only circuit MC1 is represented schematically and circuits MC2-MC8 are represented in block form. Likewise, the reversible connections of motors M1-M8 to a source of power illustrated as bus lines L1, L2 and L3 are identical and only the reversing connections for motor M1 are shown in detail, the reversing connections for motors M2-M8 being represented by blocks REV. Circuit MC1 which controls the operation of motor M1, comprises a grab close relay CL connected in series with a normally closed contact OP4 and normally open contact CR1 in line 217 connected between lines 213 and 214. A grab-open relay OP is connected in series with a normally open contact OR1 and normally closed contact CL4 in a line 218, connected between lines 213 and 214.

Contact coil CL, when energized, closes contacts CL1, CL2 and CL3 in the lines connecting motor M1 to lines L1, L2 and L3 to energize motor M1 for rotation in a direction to close the grab actuated thereby. Contactor coil CL when energized, also opens normally closed contact CL4 in line 218 to prevent energization of relay OP. Contactor coil OP when energized, closes contacts OP1, OP2 and OP3 in the lines connecting motor M1 to bus lines L1, L2 and L3 to energize motor M1 for rotation in a direction to open the grab actuated thereby. Contactor coil OP, when energized, also opens normally closed contact OP4 to prevent energization of contactor coil CL.

Contact coil CL may be energized individually either by closing grab close switch GC across contact CR1 or by closing master grab switch MGC to energize master grab close relay CR which closes contact CR1 and similar contacts in lines 217 of circuits MC2-MC8. When contactor coil CL is energized, contacts CL1, CL2 and CL3 close connecting motor M1 to bus lines L1, L2 and L3 and contact CL4 is opened to prevent energization of grab open relay OP. Relay OP may be individually energized by closing grab open switch GO across contact OR1 or by closing master grab open switch MGO which allows master grab open relay OR to be energized. Relay OR, when energized, closes contacts OR1 and similar contacts in lines 218 of circuits MC2-MC8.

It will be apparent that the grab open and grab close contactor coils OP and CL, respectively, are electrically inter-locked and one must be de-energized before the other can be energized. Assume now, that contactor coil CL is energized and contacts CL1, CL2 and CL3 are closed. Motor M1 is energized and drives the jaws of the grab actuated thereby toward engagement with an object. When the object is engaged, the jaws are prevented from further movement and motor M1 is cut off the line.

When the load has been transported and set down at its next location, the jaws of the grab controlled by motor M1 may then be opened by closing switch GO of circuit MC1 or master-grab open switch MGO which energizes relay OR to pick up contact OR1 and connect relay OP across lines 213 and 214. When relay OP is energized, contacts OP1, OP2 and OP3 are closed to connect motor M1 to bus lines L1, L2 and L3, and normally closed contact OP4 is opened to disable relay CL and thus prevent inadvertent closing of contacts CL1, CL2 and CL3.

The grab actuating motors may thus be operated individually, in selected groups, or all simultaneously, dependent on the number and position of rolls or other objects to be handled. While the apparatus embodying the invention has been illustrated and described as being electrically actuated through specific circuitry, it is to be understood that hydraulic or other suitable actuating

means including other electrical control circuits may be utilized in practice of the invention.

The drive motor 170 for trolley 166 is controlled by relays TC and TO and switches TCS and TOS in series therewith, respectively, across lines 213 and 214. When switch TCS is closed, relay TC is connected across lines 301 and is energized and closes contacts TC1, TC2 and TC3, connecting trolley drive motor 170 to bus lines L1, L2 and L3, for one direction of rotation to move trolley 166 toward grab assembly 163. When switch TOS is closed, relay TO is energized to close contacts TO1, TO2 and TO3, connecting motor 170 to bus lines L1, L2 and L3, and thereby drive trolley 166 away from grab assembly 163. As illustrated, the trolley-line motor controls are not inter-locked, however, if such interlocking is deemed necessary it may be easily provided.

It will be noted that lines 218 containing relays OP in the control circuits MC3 and MC5 of motors M3 and M5, respectively, are connected to line 214 through normally closed switch 190, and lines 218 containing contactor coils OP of circuits MC4 and MC6 are connected to line 214 through normally closed switch 191. Switches 190 and 191 are mounted on grab housings 188 and 189 (FIG. 11) supported from grab-support arms 164c and 164d of grab assembly 164 and have actuating arms 192 and 193, respectively, arranged to open these switches if the actuating arms 192 or 193 contact inclined surfaces 186 or 187, respectively, to limit further outward movement of the outboard jaws 183 and 182 of the grabs supported from the grab-support arms 164c and 164d, and also the outboard jaws 180 and 181 of the grab supported from grab support arms 165a and 165b. Let it be assumed that the motors M3 and M4 of grab assembly 164 are being driven in such a direction as to open the jaws of their respective grabs. As previously described, when the grab jaws are opened the grab housings thereof will move outwardly on the support arms. However, if the grab housings 188 and 189 move outwardly a sufficient distance such that the switch actuating arms 192 or 193 engage inclined surfaces 186 or 187, respectively, or if trolley 166 is moved a sufficient distance toward grab assembly 163 such that the switch actuating arms 192 or 193 engage inclined surface 186 or 187, switches 190 and 191, all respectively, will be opened. Opening of switch 190 will open the circuit through relays OP of circuits MC3 and MC5 which will cause the contacts controlled thereby in the circuit of motors M3 and M5 to open and disconnect motors M3 and M5 from bus lines L1, L2 and L3. When motors M3 and M5 are disconnected from the source of power, they are disabled from adjusting the jaws of their respective grabs and jaws 183 and 181 can be extended no further.

In a similar manner, if the switch 191 is open due to actuating arm 193 thereof contacting inclined surface 187, relays OP of circuits MC4 and MC6 will be disconnected from line 214 and de-energized. De-energization of relays OP of circuits MC4 and MC6 disconnects motors M4 and M6 from bus lines L1, L2 and L3, by opening the contacts controlled thereby in the circuit of each of motors M4 and M6, and motors M4 and M6 will be disabled and inoperative to adjust the jaws of the grabs associated therewith. This arrangement prevents jaw 183 from interfering with or fouling jaw 181 and jaw 182 from interfering or fouling with jaw 180.

The electric control network has been described as applicable to the apparatus of FIG. 11, however, it is apparent that the same controls may be utilized for the apparatus of FIG. 1. Where the apparatus of FIG. 1 is utilized, means are provided for controlling the latching relays 141 (FIG. 9) which latch trolleys 17 and 18 (FIG. 1) to adjacent end frames. In FIG. 14 relays 141a and 141b are each connected in series with a normally open contact LA1 and LB1, respectively across lines L2 and L3. Contacts LA1 and LB1 are controlled by relays LA

and LB which also control normally closed contacts LA2 and LB2, respectively.

Consider that relay coil 141a controls the latching mechanism 139 (FIG. 1) associated with trolley 17 and relay 141b controls the latching mechanism 139 associated with trolley 18. If latch switch LAS is closed, relay LA becomes energized and closes contact LA1 which energizes relay 141a and unlatches trolley 17 from the end sill 12, adjacent. Relay LA also opens contact LA2 in series with relay LB to prevent relay LB from becoming inadvertently energized by closing of switch LBS which would allow relay 141b to become energized and unlatch trolley 18 from its adjacent end sill 12. The latching mechanisms are interlocked, as indicated, to ensure that both trolleys are not unlatched at the same time.

In FIG. 13 another grab suspension and grab positioning arrangement 230 embodying the invention is illustrated. In this grab arrangement, elements equivalent to the grab arrangement of FIG. 4 are identified by the same reference numerals. A grab housing 34 is suspended from a grab-support arm 231, comprising a beam having a lower flange 232 on which wheels 233 are movable. Supported from the axles 234 of wheels 233 is a support member 235 which pivotally carries grab housing 34 by means of bracket 236 secured thereto.

The grab housing 34 is biased inwardly toward the center of the grab assembly by resilient means comprising spring 237 connected between support member 236 and a gusset plate 238. Grab-support arm 231 may be inclined, as illustrated, to decrease the size of the spring 237 required to bias grab housing 34 and inboard jaw assembly 38 toward the back-up rod 74 and also to compensate for friction between flange 232 and wheels 233. Otherwise the operation of this apparatus is the same as that described in conjunction with FIG. 4.

A multiple grab embodying the invention has primarily been disclosed as comprising four grabs on grab-support arms extending essentially equiangularly from a central axis. However, it is to be understood that a multiple-grab assembly embodying the invention may comprise only two grabs movably supported on grab-support arms spaced 180°, and suitably biased centrally thereof. Moreover, grab assemblies comprising any practical plurality of grabs supported on angularly spaced grab-support arms may be constructed for general or particular purposes without departing from the scope of the invention.

Preferred embodiments of the invention, which efficiently achieve the objects of the invention set forth as well as those made apparent from the foregoing description, have been illustrated and described for purposes of disclosure. However, other embodiments of the invention as well as modifications to the disclosed embodiments thereof may occur to those skilled in the art which do not depart from the spirit and scope of the invention. Accordingly, it is intended to cover in the appended claims all embodiments and modifications of the invention which fall within the spirit and scope of the invention.

What is claimed is:

1. A multiple-roll grab assembly for engaging and lifting a plurality of vertically positioned rolls defining a recess therebetween, said grab assembly comprising a plurality of angularly spaced grab support arms extending from the center of said grab assembly, each of said support arms supporting a grab movable thereon, each of said grabs comprising a pair of spaced apart jaws movable toward and away from each other to engage and release a roll disposed therebetween, and means biasing each of said grabs toward the center of said grab assembly, means disposed centrally of said grab assembly for stopping movement of the inboard jaw of each of said grabs whereby movement of said jaws away from each other produces outward movement of the associated grab housing on its supporting arm, and means depending centrally of said grab assembly for entrance into the recess and centering

of said grab assembly with respect to said plurality of rolls.

2. The grab assembly of claim 1 further comprising means for operating said grabs selectively or simultaneously.

3. The grab assembly of claim 1 wherein said guiding means comprises a probe having a plurality of shoes pivotally mounted thereon about associated horizontal axes, said shoes having their upper portions biased outwardly by resilient biasing means whereby when said centering device is inserted into a recess defined by a nest of rolls to be engaged, said shoes will engage said rolls and compress the associated biasing means thereby producing a force on said shoes tending to move said centering device away from the rolls engaged by said shoes.

4. The grab assembly of claim 3 wherein the jaws of each grab are pivotal about a vertical axis.

5. The grab assembly of claim 1 wherein said grabs each further comprises a grab housing having grab arms extending therefrom each grab arm supporting one of said jaws on its outer end and being movable towards and away from each other to cause said jaws to engage or release a roll disposed between said jaws, and a grab-housing carrier member slidable on an associated grab-support arm and supporting said grab housing therefrom.

6. A multiple-roll grab assembly comprising four grab-support arms extending substantially horizontally from a vertical center line at essentially right angles to each other, each of said support arms having a grab supported therefrom and longitudinally movable thereon, each of said grabs comprising a pair of work-engaging jaws movable towards and away from each other and adapted to engage or release an object positioned therebetween, means positioned centrally of said grab assembly for preventing movement of the inboard jaw of each grab therebeyond, means biasing each of said grabs toward the center of said grab assembly whereby the inner jaw of each grab is biased towards said movement preventing means, means for producing relative movement of the jaws of each grab, and a centering device depending centrally of said grab assembly and arranged to be inserted into a recess defined by a nest of four rolls, said centering device including resilient means adapted to engage said rolls and guide said centering device centrally of said defined recess.

7. The grab assembly of claim 6 wherein each of said grabs further comprises a grab housing, grab arms therein movable in opposite directions, a pinion mounted in said grab housing and drivingly engaging on opposite sides thereof racks defined on said arms, one of said jaws supported from and depending from the end of each of said arms and means for driving said pinion to move said jaws toward or away from each other, said grab housing being supported from said support arm by a grab carrier movable thereon, said means biasing said grabs comprising resilient means connecting said grab carrier and a central portion of said grab assembly to bias said grab housing centrally of said grab assembly.

8. A multiple-grab apparatus for engaging and lifting a plurality of vertically positioned rolls comprising a frame member having longitudinal side members, a pair of multiple-grab assemblies supported on said frame member, said grab assemblies being relatively movable on said side members, each of said grab assemblies comprising a plurality of angularly spaced grab-support arms extending from the center of said grab assemblies, each of said support arms supporting a grab comprising a pair of spaced-apart jaws movable toward and away from each other to grab or release an object therebetween, and a centering device depending centrally of each grab assembly adapted to fit intermediate a plurality of rolls to be engaged and center said grab assembly with respect to the rolls.

9. The apparatus of claim 8 wherein both of said grab assemblies are movable on said frame.

10. The apparatus of claim 8 wherein one of said grab assemblies is fixed in position on said frame and the other of said grab assemblies is movable on said frame.

11. The grab apparatus of claim 8 wherein said frame member comprises parallel side sills and end sills, one of said multiple-grab assemblies is supported on said frame member on one end thereof and the other of said multiple-grab assemblies is movable on said side sills with respect to the first of said grab assemblies.

12. The multiple-grab apparatus of claim 8 further comprising means for moving one of grab assemblies with respect to the other of said one grab assembly, comprising a screw shaft supported at one end thereof on one of said grab assemblies and threadably received at the other end thereof in a non-rotatable nut carried by the other of said grab assemblies whereby the other of said grab assemblies is movable relative to said one grab assembly dependent upon the direction of rotation of said screw shaft.

13. The multiple-grab apparatus of claim 8 further including means for sensing when said grab assemblies are moved within a predetermined distance of each other and means responsive to said sensing means for limiting the span of jaws of adjacent grabs of said assemblies.

14. A multiple-grab apparatus for engaging and lifting a plurality of vertically positioned rolls comprising, a frame member having longitudinal side sills, a pair of multiple-grab assemblies supported on said frame member and movable on said side sills, each of said grab assemblies comprising a plurality of angularly spaced grab-support arms extending from a vertical center line of said grab assembly, each of said grab-support arms supporting a grab therefrom comprising a pair of spaced apart jaws movable toward and away from each other to engage or release an object positioned therebetween, and means for moving said grab assemblies on said side sills.

15. The multiple-grab apparatus of claim 14 including means for selectively latching each of said grab assemblies at a respective end of said frame.

16. The multiple-grab apparatus of claim 14 wherein said means for moving comprises a screw shaft supported at one end on one of said grab assemblies and threadably received in a non-rotatable nut carried by the other of said grab assemblies whereby rotation of said screw shaft produces movement of one of said grab assemblies.

17. The apparatus of claim 14 wherein said grab assemblies are mounted on trolleys movable on said side sills.

18. A multiple grab assembly comprising a plurality of angularly spaced grab support arms extending from the center of the grab assembly, each of said support arms supporting a grab comprising a housing member, a pair of arms movable in said housing member in opposite directions, work engaging jaws depending from the end of each of said arms, means for moving said arms towards and away from each other to engage or release an object disposed between said jaws, means biasing each of said grabs toward the center of said grab assembly, each of said housing members being supported from a carrier member movable on an associated supporting arm, and means for limiting movement of the inboard jaw of each grab whereby when said arms of each grab are moved to open said jaws, said inboard jaw engages said limiting means and thereby causes the housing member to move outwardly on its support arm.

19. Apparatus for engaging and lifting a plurality of vertically positioned rolls, comprising, a frame member, a pair of roll lifting assemblies supported on said frame, at least one of said assemblies being movable on said frame, each of said assemblies comprising a plurality of angularly spaced support arms extending from the center of the assembly, each of said support arms carrying a roll engaging and lifting means thereon, each of said roll en-

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gaging and lifting means being movable along its support arm, biasing means interconnecting each of said roll engaging and lifting means with the center of its assembly and continuously urging each of said roll engaging and lifting means toward the center of said assembly along its support arm, means depending centrally of each assembly for centering the assembly with respect to a plurality of rolls, and means for moving said at least one of said assemblies on said frame.

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