Sept. 7, 1965 R. W. LARSON 3,204,795

LOG LOADING APPARATUS

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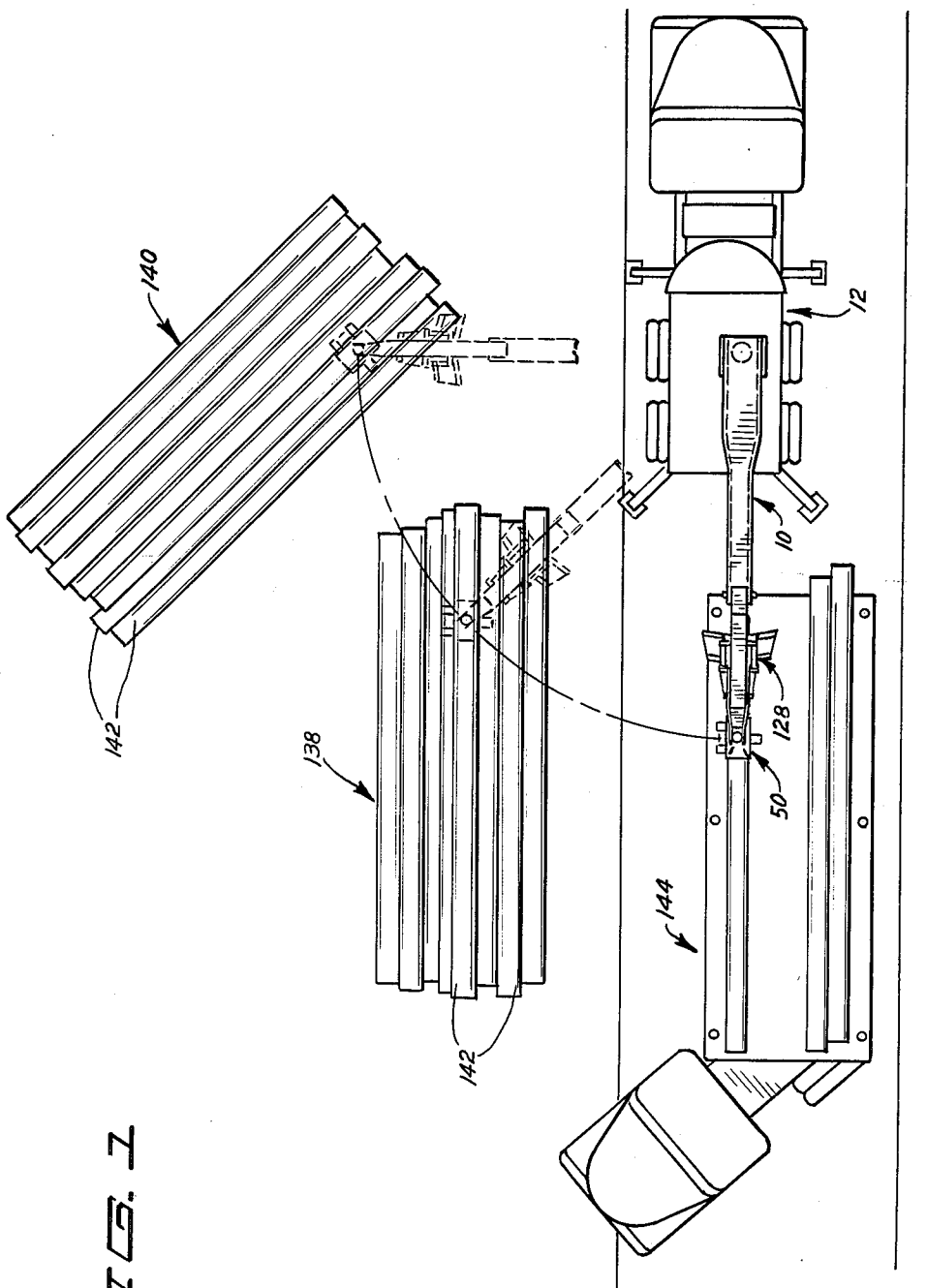

FIG. 7

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LOG LOADING APPARATUS

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FIG. 2

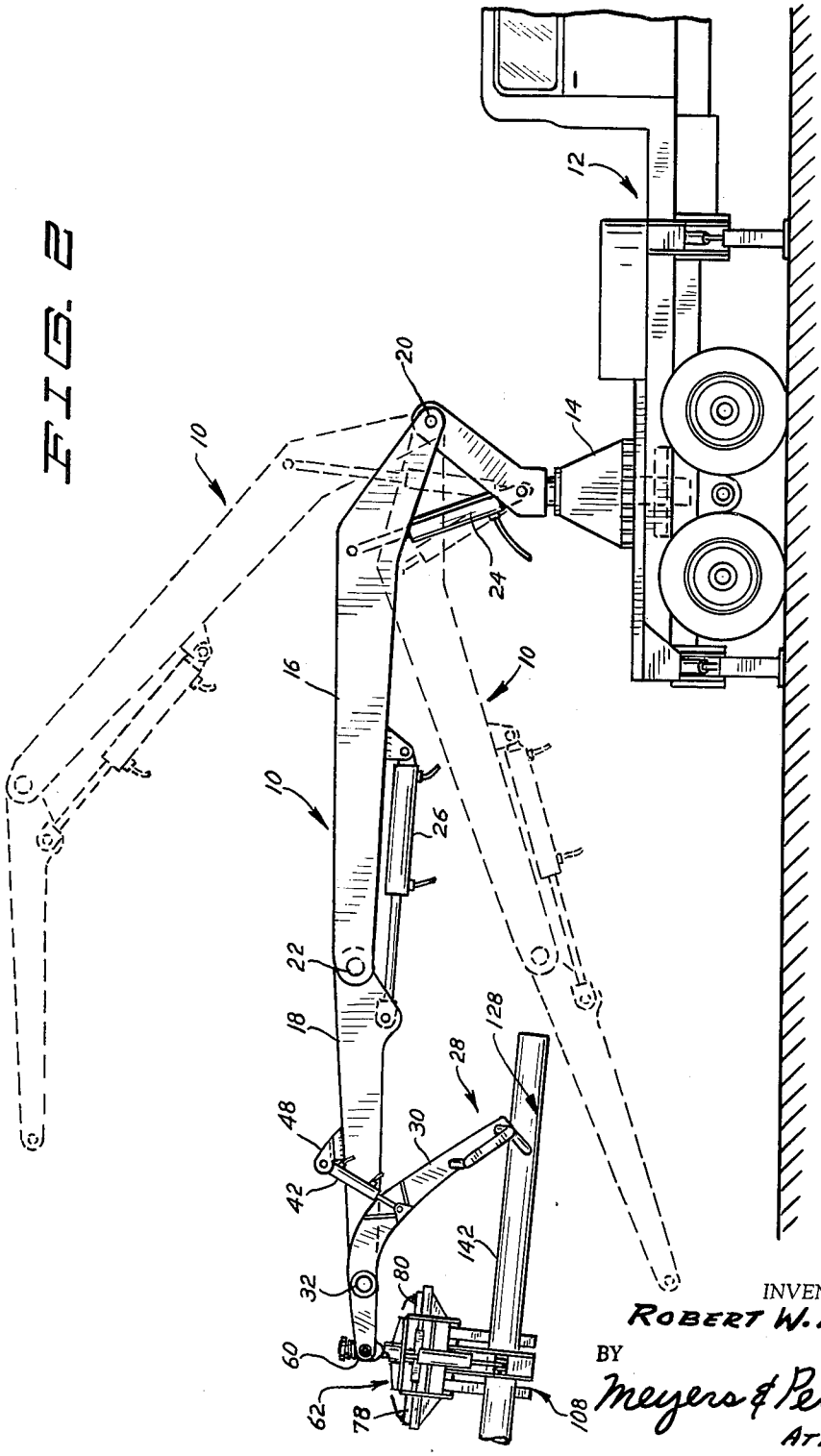

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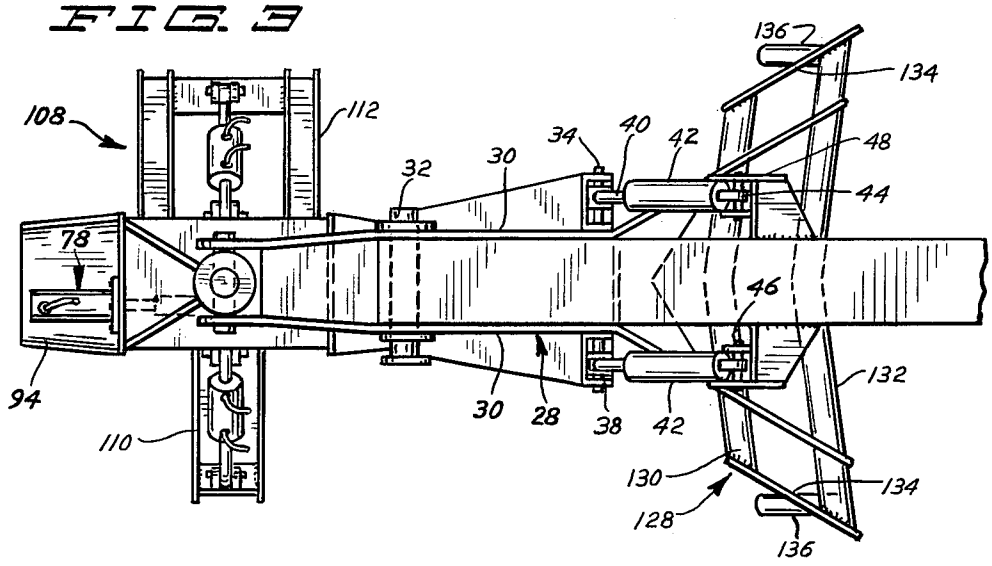
FIG. 3



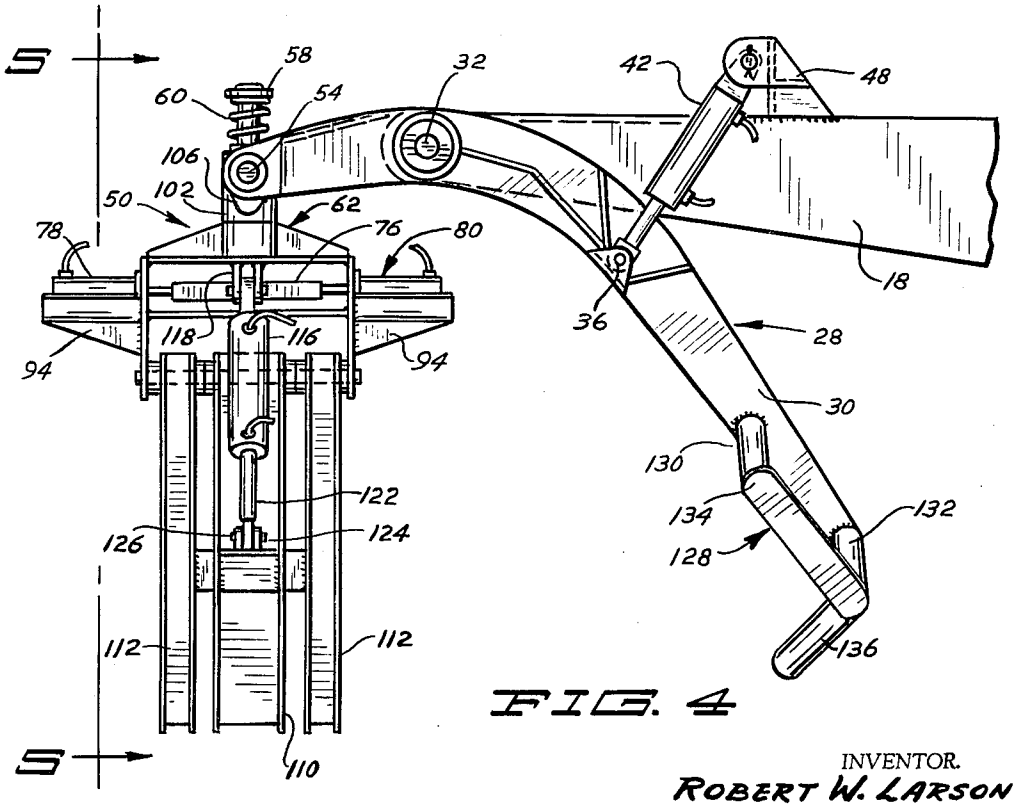


FIG. 4

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LOG LOADING APPARATUS

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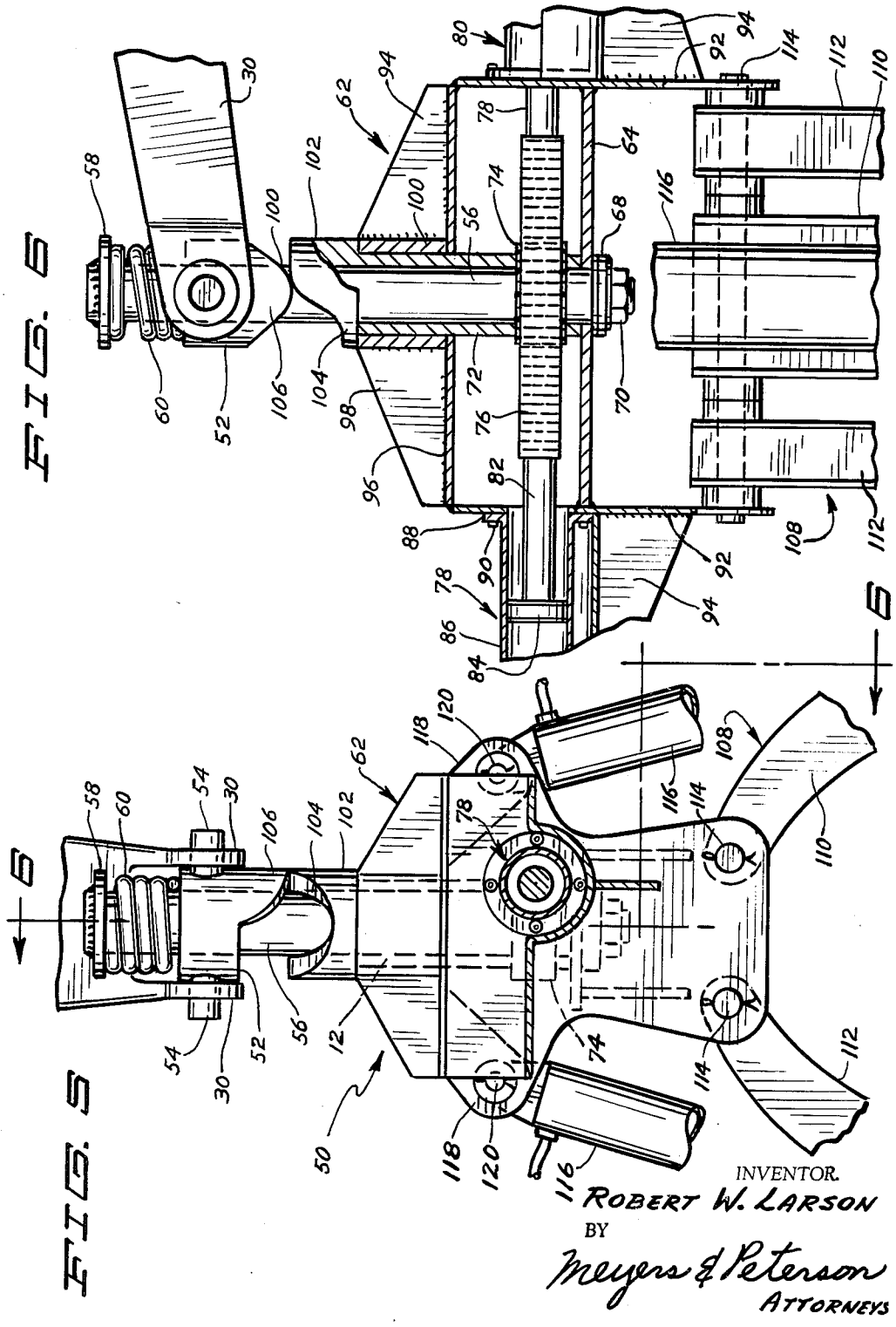

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3,204,795

LOG LOADING APPARATUS

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13 Claims. (Cl. 214—147)

This invention relates generally to loading or handling apparatus, and pertains more particularly to apparatus of this character in which a boom assembly is rotatable about a generally vertical axis and has a grapple suspended from the free end thereof.

A general object of the invention is to decrease substantially the time required to transfer articles requiring orientation, such as tree length logs, from one place to another. By way of example, the invention envisages the lifting of logs from a pile of such logs on the ground, even though the pile is at any arbitrary angle, and loading the logs onto a nearby truck, or presenting such logs in a properly oriented manner to a slasher which is customarily employed in the logging art for cutting the tree length logs into shorter lengths called sticks. For convenience, the transferring of a load comprising an individual article is considered herein, though it is understood that a plurality of logs or other articles such as pipes may also be handled.

More specifically, the invention has for an object the indexing of the grapple into a preferred angular position with respect to the boom assembly, which preferred angular position results in the grapple being properly aligned with the logs to be picked up. It is within the contemplation of the invention to preset the grapple into this predetermined angular position and have the grapple automatically returned or indexed back to such position each time a log is to be picked up from a given pile.

Another object of the invention is to provide for the automatic freeing or disengagement of the indexing means by the weight of the log, such freeing action permitting the grapple to be moved into a different angular position with respect to the boom assembly that is more suitable for loading purposes, such as being in direct alignment with the longitudinal axis of the boom assembly.

Yet another object of the invention is to provide for the leveling of the log once it has been picked up or lifted from the pile, the indexing means in no way interfering with the means for leveling the log.

Quite briefly, the invention includes an articulated boom assembly swingable about a generally vertical axis and which boom assembly can be also swung upwardly and downwardly. At the free end of the boom assembly is suspended a grapple which is capable of being swiveled about a transverse axis and about an axis perpendicular to said transverse axis. An adjustable cam arrangement is utilized for indexing purposes, which after being once set, always assures that the grapple will be properly oriented for picking up successive loads of logs or groups of logs from a given pile. The cam arrangement becomes automatically disengaged once a load has been picked up due to the weight of such load. However, when the load that has been picked up has been transferred and released, then the grapple automatically returns by spring action to the preset position in preparation for picking up the next load.

These and other objects and advantages of my invention will more fully appear from the following description, made in connection with the accompanying drawings, wherein like reference characters refer to the

same or similar parts throughout the several views and in which:

FIGURE 1 is a top plan view of my loading apparatus shown in the immediate vicinity of two piles of logs that are to be loaded onto a nearby truck;

FIGURE 2 is a side elevational view corresponding to FIGURE 1, the view being on a somewhat larger scale and also showing the loading apparatus in two phantom outline positions;

FIGURE 3 is a top plan view illustrating the free end of the boom assembly and the parts carried thereby;

FIGURE 4 is a side elevational view corresponding to FIGURE 3;

FIGURE 5 is a view, partly in section, taken generally from the left in FIGURE 4 along the line 5—5, and

FIGURE 6 is a sectional view taken generally in the direction of line 6—6 of FIGURE 5.

Referring now in detail to the drawings, a rotary main boom assembly designated in its entirety by the reference numeral **10** has been pictured, this boom assembly being mounted on a truck **12** through the agency of a capstan **14**. In the illustrated instance, the boom assembly **10** includes articulative boom members labeled **16** and **18**. Boom member **16** is pivotally connected to the capstan **14** by a transverse pivot pin **20**, whereas the end boom member **18** is pivotally connected to the boom member **16** by means of a second transverse pivot pin **22**. Thus, the boom assembly **10** is designed to be swung or rotated about a vertical axis, and the boom member **16** is adapted to be raised and lowered by a hydraulic ram **24**, whereas the end boom member **18** is pivotally movable with respect to the boom member **16** by reason of a second hydraulic ram **26**. These hydraulic rams, as others to be referred to hereinafter, are of conventional construction, each including a cylinder and piston. Solely for the sake of simplifying the drawing as much as possible, the hydraulic lines for supplying fluid under pressure to the various hydraulic rams, both those that have been mentioned and those that will soon be referred to, have been omitted. Likewise, the lines used for effecting rotation of the capstan **14** have been omitted.

At this time, attention is directed to the employment of a heel boom structure **28** comprised of a pair of generally parallel side members or strips **30**. The heel boom structure **28** is supported at the free end of the boom assembly **10** through the agency of a transverse pivot pin **32** extending through the heel boom structure **28** and the end boom member **18**. The pivot pin **32**, it will be noted, is located intermediate the ends of the heel boom structure **28**. Aft of the pivot pin **32** are laterally spaced clevises **34**, these clevises **34** being located on the heel boom structure **28** at either side thereof. Each clevis **34** has a pin **36** extending therethrough and also through a cylindrical member **38** fixedly carried at the projecting end of a piston rod **40**. Consequently, there are two piston rods **40** that are associated with the two hydraulic rams **42** that have been depicted and which are best seen in FIGURE 3. The closed end of each hydraulic ram **42** is equipped with an ear **44** through which a transverse pin **46** extends. In this way, the hydraulic rams **42** are responsible for urging the heel boom structure **28** arcuately about pivot pin **32** as viewed in FIGURES 2 and 4 in order to achieve a leveling action hereinafter described.

A swivel mechanism has been denoted generally by the reference numeral **50**. Included in the over-all construction of the swivel mechanism **50** is a sleeve bearing **52** having oppositely projecting pins **54** fixedly disposed thereon, the pins **54** being received in apertures at the left ends of the strips **30** comprising the heel boom structure **28**.

In this way, the swivel mechanism **50** is pivotal about a transverse axis provided by the oppositely directed pins **54**.

As can best be understood from FIGURES 5 and 6, a vertical cylindrical column or shaft **56** is reciprocally mounted in the sleeve bearing **52**. The column or shaft **56** has at its upper end a head plate or flange **58** that provides an enlargement which bears against the upper end of a coil spring **60**. Hence, the coil spring **60** reacts against the sleeve bearing **52** to normally urge the column or shaft **56** upwardly. However, the biasing action of the spring **60** is overcome in a manner that will become more apparent as the description progresses.

The swivel mechanism **50** also includes in the illustrated situation a frame that has been generally designated by the reference numeral **62**. It will be observed from FIGURE 6 that the frame has as a part thereof a base plate or bottom platform labeled **64** provided with an aperture **66** therein. The lower end of the column or shaft **56** extends through the aperture **66** and the shaft has a thrust bearing **68** held in place by a retaining nut **70**. By reason of this mode of attachment, the frame **62** can be rotated about the longitudinal axis of the shaft **56**, the thrust bearing **68** permitting this.

Loosely encircling the shaft **56** is a sleeve **72** having a pinion **74** integral therewith near its lower end. In mesh with the pinion **74** is a gear rack **76**. The gear rack **76** is disposed for reciprocable movement and is actuated by a pair of rams **78, 80**. Each ram **78, 80** includes a piston rod **82** directly connected to the ends of the gear rack **76**, a piston **84** and a cylinder **86**. The cylinders **86** are formed with flanges at **88** and bolts **90** permit the cylinders **86** to be secured to vertical plates **92** constituting a portion of the frame **62**. Also contributing to the support of the cylinders **86** belonging to the rams **78, 80** are underlying brackets **94** which can be attached to the vertical plates **92**, as by welding.

It will be further noted that the frame **62** includes an upper plate or platform **96** and that there are angularly directed gussets **98** that maintain a sleeve bearing **100** in an encircling relationship with the previously-mentioned sleeve **72**. It will be recalled that it was stated that the frame **62** can be rotated about the column or shaft **56** and the sleeve bearing **100** functions as a guide in permitting this, doing so in combination with the thrust bearing **68** that has previously been alluded to. Stated somewhat differently, the sleeve bearing **100** is made integral with the frame **62** by virtue of the angularly directed gussets **98** which have their vertical edges welded to the sleeve bearing **100** and their lower edges to the upper plate or platform **96**.

The sleeve bearing **100** is formed with a collar **102** at its upper end, the collar functioning as one part of a two-part drum cam and having therein a cam notch **104** for an indexing purpose presently to be made manifest. Engageable in the cam notch **104** is a cam lobe **106** integral with the previously-mentioned sleeve bearing and constituting the second part of the two-part cam.

The swivel mechanism **50** supports a grapple unit **108** comprising cooperable sets of jaws **110** and **112** which are pivoted at their upper ends by pins **114** between the vertical plates **92** on the frame **62**. For the purpose of actuating the jaws **110, 112** into open and closed positions with respect to each other are rams **116** having their closed ends pivotally connected to clevises **118** through the agency of pins **120**. The rams **116** have projecting piston rods **122** which by means of clevises **124** on the jaws **110, 112** are pivotally connected to the jaws by pins **126**.

Whereas the swivel mechanism **50** and the grapple unit **108** are suspended from one end of the heel boom structure **28**, the heel boom structure **28** carries at its other end a downwardly facing cradle unit **128** composed of rods or tubes **130, 132** which are bowed upwardly between their ends and welded to the strips **30** comprising the structure **28**. The ends of the rods or tubes **130, 132** are joined by connecting struts **134** and downwardly directed side strips **136** complete the construction of the cradle unit **128**.

Having presented the foregoing description, the manner in which my invention operates will now be presented. To assist in the operational presentation, it will be helpful to refer to two piles of logs **138, 140** each composed of a plurality of individual logs **142**. As can be discerned from FIGURE 1, the pile **138** is generally parallel to the truck **12** carrying the boom assembly **10** and the pile **140** is at approximately a 45 degree angle with respect to the truck. It will be further assumed that the logs **142** contained in the piles **134, 140** are to be transferred from their ground location to a trailer truck **144** that is to haul the logs away.

In order to effect the loading of the logs **142** onto the truck **144**, and assuming that the logs **142** in the pile **138** are to be lifted first, the operator of the truck mounted boom assembly **10** will cause the boom assembly **10** to be swung about the vertical axis provided by the capstan **14** to the first phantom outline position shown in FIGURE 1.

The grapple unit **108** may be in any angular position with respect to the general axis of the boom assembly **10** when the boom assembly reaches the first phantom outline position of FIGURE 1. However, with the grapple unit **108** above the pile **138**, the operator utilizes the rams **78, 80** to reciprocate the gear rack **76** by admitting fluid under pressure to the appropriate ram. Because the coil spring **60** has biased the column or shaft **56** upwardly, there will have been effected an automatic engagement of the cam notch **104** with the cam lobe **106**. Hence, when the gear rack **76** is reciprocated, the presence of the cam lobe **106** in the notch **104** will resist any turning or rotation of the sleeve bearing **100** relative to the sleeve bearing **52**. Consequently, the frame **62** is rotated relative to the sleeve bearing **100** when the gear rack **76** is reciprocated, since the pinion **74** is retrained from rotation under these assumed conditions. Of course, rotation of the frame **62** results in the grapple unit **108** being turned therewith. Thus, it is an easy task to align and thereby preset the grapple unit **108** so that its jaws **110, 112** are in a position to pick up the first log **142** from the pile **138**.

To pick up the first log **142** from the pile **138**, the operator will normally utilize the ram **24** to lower the boom assembly **10** to the lower phantom outline position illustrated in FIGURE 2, although the ram **26** can assist in this particular accomplishment if need be. When the boom assembly **10** has been lowered so that the open jaws **110, 112** of the grapple unit **108** embrace the first log **142**, the operator then activates the hydraulic rams **116** so as to close the jaws **110, 112** about the log **142**.

As the boom assembly **10** is raised, the weight of the log will immediately cause the grapple unit **108** and the frame **62** to be moved downwardly with respect to the column or shaft **56**. In other words, the coil spring **60** which normally biases the column or shaft **56** upwardly is compressed by the weight of the log **142**. Compression of the spring **60** and the concomitant relative downward movement of the frame **62** automatically results in a disengagement of the notch **104** from the lobe **106**. This condition is clearly shown in FIGURES 5 and 6. With the notch **104** lowered so that the lobe **106** is no longer received therein, it will be appreciated that the entire frame **62** is free to be rotated about the column or shaft **56**. In this regard, the gear rack **76** has already been indexed so as to rotate the frame **62** into a particular angular position with respect to the pinion **74**. Thus, when the entire frame **62** is lowered on the column or shaft **56**, the sleeve bearing **72**, which loosely encircles the column or shaft **56**, will be permitted to rotate freely relative to said column or shaft **56**.

The manner in which the rotation relative to the column or shaft **56** is achieved is by swinging the boom

assembly 10 about the vertical axis proivded by the capstan 14 so that the boom assembly is in substantial alignment with the longitudinal axis of the particular log 142 that has been picked up by the grapple unit 108. Owing to the fact that the log 142 will be initially picked up or raised nearer one end than the other, it follows that the far end remains on the pile 138 and the swinging of the boom assembly 10 before raising the entire log causes the end that is still resting on the pile 138 to serve as a pivot point for achieving a general alignment of the log with respect to the boom assembly.

Even though the alignment between the log 142 and boom assembly 10 mentioned immediately above has been obtained, the heavier end of the log, that is, the end thereof more remote from the grapple 108 will still be resting on the pile 138 or on the ground, as the case may be. This gives the operator two choices. First, he can immediately bring the rams 42 for the heel boom structure 28 into action which force the cradle 128 downwardly against the elevated end portion of the log 142, thereby raising the heavier end of the log 142 to clear the pile 138 sufficiently to permit the boom assembly 10 to be swung about the vertical axis provided by the capstan 14. Usually, though, the boom assembly 10 will be raised through the operation of the ram 24 so that no part of the grappled log 142 will be touching the pile 138. Then the rams 42 will be activated or operated to cause the cradle 128 to be forced downwardly to level the log as shown in FIGURE 2. In both instances, the heel boom structure 28 is caused to pivot in a clockwise direction as viewed in FIGURE 4 about the pivot pin 32. The pins 54, of course, permit the swivel unit 50 to pivot into or assume whatever angular relationship is necessary to effect the leveling of the log 104.

With the log 142 both level and in alignment with the longitudinal axis of the boom assembly 10, the boom assembly 10 can be swung about its vertical axis until the log 142 is over the trailer truck 144. When this angular relationship has been realized, then the boom assembly 10 can be lowered through the agency of the ram 24 and also the ram 26. When the log 142 has been placed or deposited on the trailer truck 144 then rams 116 of the grapple unit 108 are actuated so as to open the jaws 110, 112 and thereby release the log 142.

The release of the log 142 permits the spring 60 to again raise the column or shaft 56 and such action will move the frame 62 upwardly with the consequence that the lobe 106 is brought into re-engagement with the notch 104. Due to the sloping edges of the notch 104 and the lobe 106, there is a camming of the collar 102 in a direction so as to cause the swivel mechanism and the suspended grapple unit 108 to assume the same angular positions they assumed when they were first brought over the pile 138. It will be appreciated that the grapple unit 108 is relatively light in weight and the desired rotative alignment is easily re-established.

It is important to recognize that the re-orienting of the grapple unit 108, as above outlined, is accomplished without causing the gear rack 76 to reciprocate and act against the pinion 74. Thus, the initial reciprocation of the gear rack 76 causes a presetting of the grapple unit 108 in a desired rotative position that is suitable for picking up the logs 142 from the pile 138 and the grapple will always be automatically returned or indexed back to this rotative position. Thus, when the boom assembly has been swung back to the same angular position over the pile 138 in which the presetting was done, the grapple unit 108 will be properly oriented for the next log to be picked up from this particular pile.

When the logs 142 from the pile 140 are to be loaded, then naturally a re-adjustment is needed since a presetting of the grapple unit 108 for the pile 138 will no longer be suitable. This is easily done, however, by merely reciprocating the gear rack 76 so that it turns the grapple unit 108 into a more pronounced angular position, such position resulting in the proper alignment of the jaws 110, 112 for the axial direction in which the logs 142 of the pile 140 extend.

After resetting the grapple unit 108 so that it is suitable for the pile 140, the same steps are repeated. Namely, the operator lowers the boom assembly 10 so that the log 142 from the pile 140 can be picked up. With one end still resting on the pile 140, the boom assembly 10 can be swung so as to effect a general axial alignment of the log 142 with the longitudinal axis of the boom assembly 10. Then, the boom assembly 10 can be raised sufficiently so as to completely elevate the log and then deposit it on the trailer truck 144 by swinging the boom assembly about its vertical axis provided by the capstan 14.

While the foregoing operational description is believed to be clearly understandable and straightforward, a special explanation should be given with respect to the relative positions of the indexing means depicted in the various views. The indexing means includes the collar 102 with its notch 104 and the lobe 106 on the sleeve 52, as well as the pinion 74 and rack 76. Because of the various angles through which these parts are moved, it would not be logical to show them in any other angular positions than those pictured in FIGURES 4–6. FIGURE 4 is representative of the swivel mechanism 50 with no log being picked up by the grapple unit 108.

Assuming that logs 142 from the pile 138 are to be picked up, the grapple unit 108 would in practice have been indexed into an angular position, but this would have resulted in a twisted view of the unit 108 in FIGURE 4 (and also FIGURE 3), a view indeed difficult to present. As far as the indexing action is concerned, though, the lobe 106 merely prevents the collar 102 from rotating because in this situation the lobe 106 is engaged in the notch 104, thereby resulting in only the rotation of the grapple unit 108 when the rack 76 is reciprocated because the pinion 74 is under these circumstances held fast by the lobe 106 and notch 104.

As for FIGURES 5 and 6, it will be perceived that in this situation the weight of a log 142 has caused the collar 102 to be moved downwardly so that the lobe 106 is no longer engaged in the notch 102, thereby permitting the swivel mechanism 50 and the grapple unit 108 to assume any desired angular position, including that shown. The illustrated position shown in FIGURES 5 and 6, quite obviously, corresponds to the solid line position of the boom assembly 10 presented in FIGURE 1, that is, just before the log 142 is released for deposit onto the truck 144.

When the log 142 is released, then the coil spring 60, which has been compressed by the weight of the log, expands, and in doing so causes the sloping edge of the notch 104 profiled in FIGURE 6 to ride upwardly against the right edge of the lobe 106 with the consequence that the collar 102 is rotated relative to the column or shaft 56. The pinion 74 fixedly carried at the lower end of the sleeve 72, which is integral with the collar 102, reacts with the rack 76 to rotate the frame 62 and the grapple unit 108. When the lobe 106 has become fully seated in the notch 106, the grapple unit 108 will have been automatically indexed back to its preset position. This is the position illustrated in FIGURE 4 but with the grapple unit 108 actually swiveled or twisted into an angular position corresponding to that shown in the first phantom outline position of FIGURE 1, this being the preset position for the pile 138.

It will, of course, be understood that various changes may be made in the form, details, arrangements and proportions of the parts without departing from the scope of my invention as set forth in the appended claims.

What is claimed is:

1. Loading apparatus for articles requiring orientation which comprises:

(a) a boom assembly swingable about a generally vertical axis;

(b) load engaging means;

(c) means suspending said load engaging means from the free end of said boom assembly for rotation relative thereto;

(d) means urging said load engaging means into one angular position with respect to the longitudinal axis of said boom assembly when uninfluenced by the weight of a load, and

(e) means for rendering said urging means ineffectual when said load engaging means is influenced by the weight of a load so that said engaging means can be rotated to a different angular position.

2. Loading apparatus in accordance with claim **1** in which:

(a) said one angular position is out of alignment with said boom assembly and said different angular position is in substantial alignment with said boom assembly.

3. Loading apparatus in accordance with claim **2** including:

(a) means for leveling said load when said engaging means is in said different angular position.

4. Loading apparatus in accordance with claim **3** in which said leveling means includes;

(a) a heel boom structure pivotally connected intermediate its ends to said free end of said boom assembly, and

(b) a cradle attached to the end of said heel boom structure nearer said vertical axis engageable with a laterally extending end portion of the load held by said engaging means,

(c) said engaging means being suspended for swivel movement from the other end of said heel boom structure.

5. Loading apparatus for articles requiring orientation which comprises:

(a) a boom;

(b) means mounting one end of said boom for rotation about a generally vertical axis;

(c) means suspended adjacent the other end of said boom providing a bearing structure;

(d) a shaft member extending downwardly thrrough said bearing structure;

(e) grapple means carried by said shaft at the lower end thereof for engaging a load to be picked up;

(f) spring means normally urging said shaft member upwardly in said bearing structure, and

(g) means including a first cam element fixedly associated with said bearing structure and a second cam element fixedly associated with said grapple means,

(h) said cam elements having a profile such as to cause said grapple means to automatically assume a desired angular relationship with said boom when said shaft is urged upwardly by said spring means to cause pressural engagement of said cam elements;

(i) whereby the action of said spring means will be overcome when said grapple means is lifting a load and the weight of such load causing separation of said cam elements to permit rotation of said grapple means.

6. Loading apparatus for articles requiring orientation which comprises:

(a) a boom assembly swingable about a generally vertical axis;

(b) a first sleeve member carried at the free end of said boom assembly with its longitudinal axis generally vertical;

(c) a shaft reciprocably disposed in said first sleeve member;

(d) a second sleeve member encircling said shaft;

(e) grapple means rotatably supported at the lower end of said shaft;

(f) spring means normally biasing said shaft and second sleeve member upwardly, and

(g) interengaging cam means on said two sleeve members for urging said second sleeve member into a particular angular relation with said first sleeve member when said second sleeve member is biased upwardly.

7. Loading apparatus for articles requiring orientation which comprises:

(a) a boom assembly swingable about a generally vertical axis;

(b) a first sleeve member carried at the free end of said boom assembly with its longitudinal axis generally vertical;

(c) a shaft reciprocably disposed in said first sleeve member;

(d) a second sleeve member encircling said shaft;

(e) grapple means rotatably supported at the lower end of said shaft;

(f) spring means normally biasing said shaft and second sleeve member upwardly;

(g) interengaging cam means on said two sleeve members for urging said second sleeve member into a particular angular relation with said first sleeve member when said second sleeve member is biased upwardly;

(h) a third sleeve member encircling said shaft,

(i) said grapple means being rotatable with said third sleeve member, and

(j) means for rotatably positioning said third sleeve member relative to said second sleeve member.

8. Loading apparatus in accordance with claim **7** in which said last-mentioned means includes:

(a) a pinion gear on said second sleeve member, and

(b) a gear rack in mesh with said pinion gear,

(c) said gear rack being disposed for reciprocable movement relative said grapple means.

9. Loading apparatus in accordance with claim **8** including:

(a) a heel boom structure for leveling a load held by said grapple means,

(b) said heel boom structure being pivotally supported between its ends to the free end of said boom assembly, and

(c) said first sleeve member being mounted on the end of said heel boom structure farther from said vertical axis for pivotal movement about a transverse axis, whereby the other end of said heel boom structure can be forced downwardly to level a load held by said grapple means when said grapple means is in a rotative position aligned with said boom assembly.

10. Loading apparatus in accordance with claim **6** in which:

(a) said cam means includes a lobe on said first sleeve member and a cooperable notch in said second sleeve member.

11. Loading apparatus for articles requiring orientation which comprises:

(a) support means adapted to be moved into various spatial positions;

(b) first cam means mounted on said support means;

(c) load engaging means;

(d) means suspending said load engaging means from said support means for rotation about a generally vertical axis and for limited longitudinal movement along said axis;

(e) second cam means mounted for movement with said load engaging means and engageable with said first cam means to cause said load engaging means to assume a preferred rotative position with respect to said support means, and

(f) means biasing said load engaging means upwardly to cause engagement of said respective cam means and hence to effect said preferred rotative position,

(g) whereby when said load engaging means engages a load of sufficient weight to overcome the action of said biasing means said second cam means will be pulled downwardly to effect disengagement of said second cam means from said first cam means.

12. Loading apparatus in accordance with claim 11 in which:

(a) said second cam means is rotatively adjustable relative to said load engaging means, and

(b) power means for actuating said second cam means into a selected rotative position to determine said preferred rotative position of said load engaging means with respect to said support means.

13. Loading apparatus in accordance with claim 12 in which:

(a) said load engaging means includes a grapple, and

(b) a heel boom pivotally carried by said support

means for loading elongated objects when held by said grapple.

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HUGO O. SCHULZ, *Primary Examiner.*