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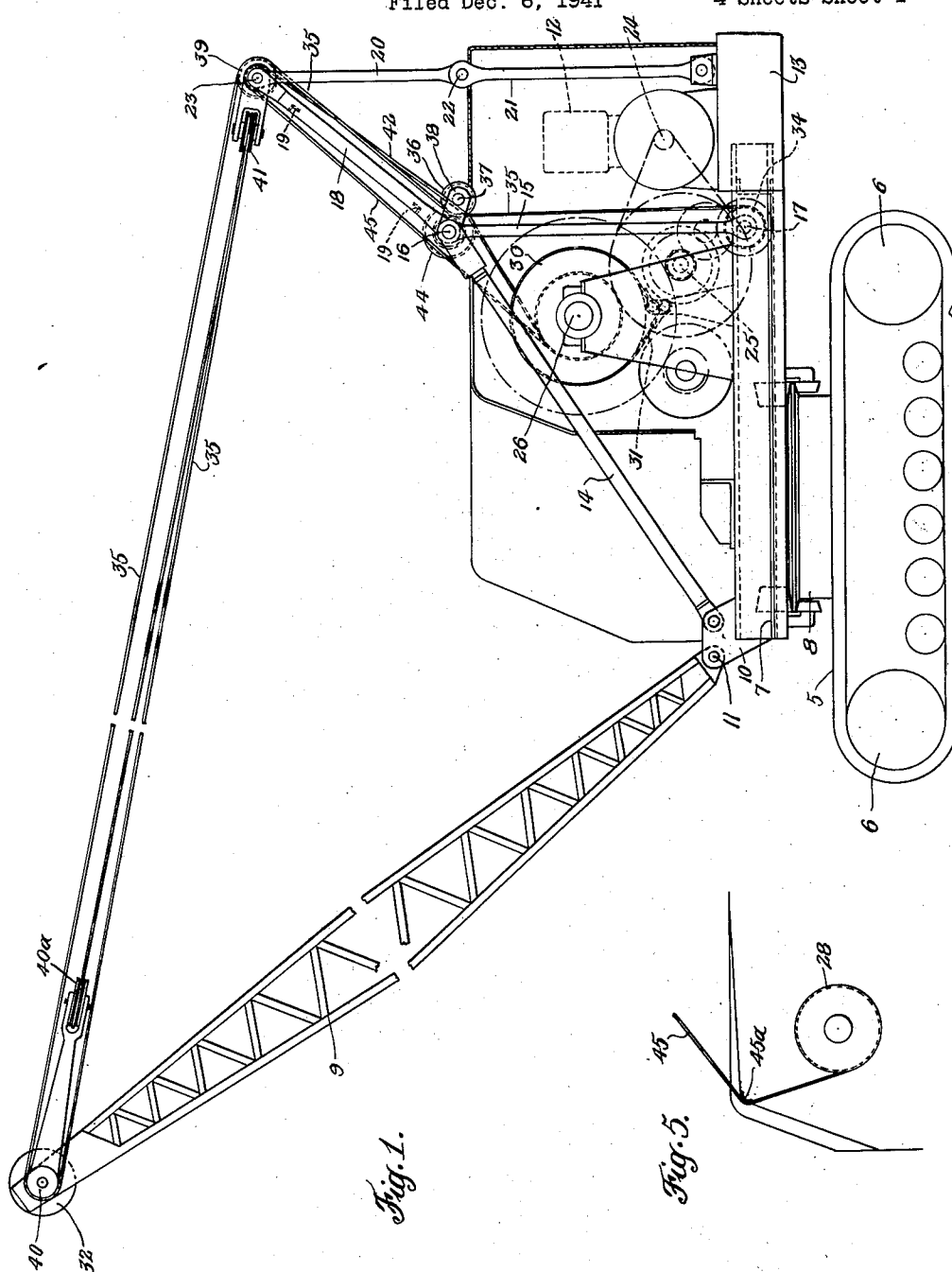
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HIGH GANTRY FOR LOAD-HANDLING MACHINES

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4 Sheets-Sheet 1



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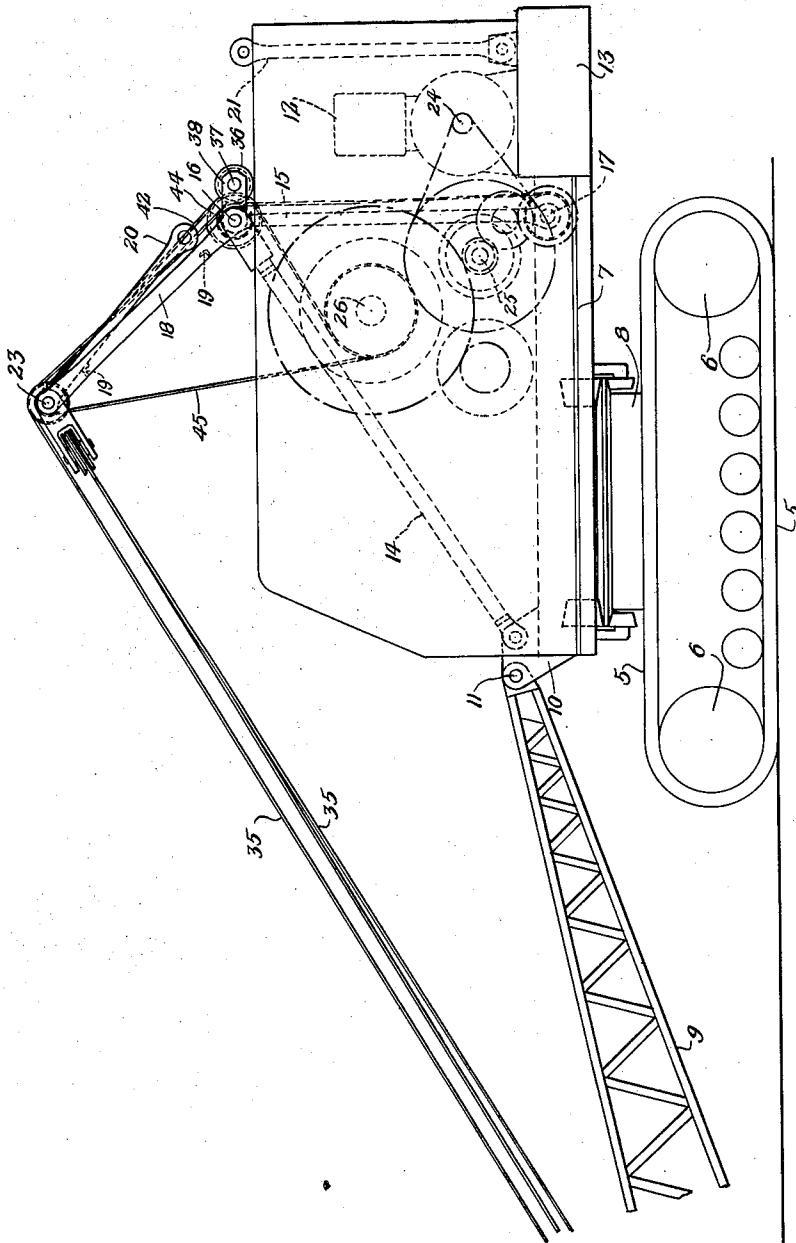
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Fig. 2.



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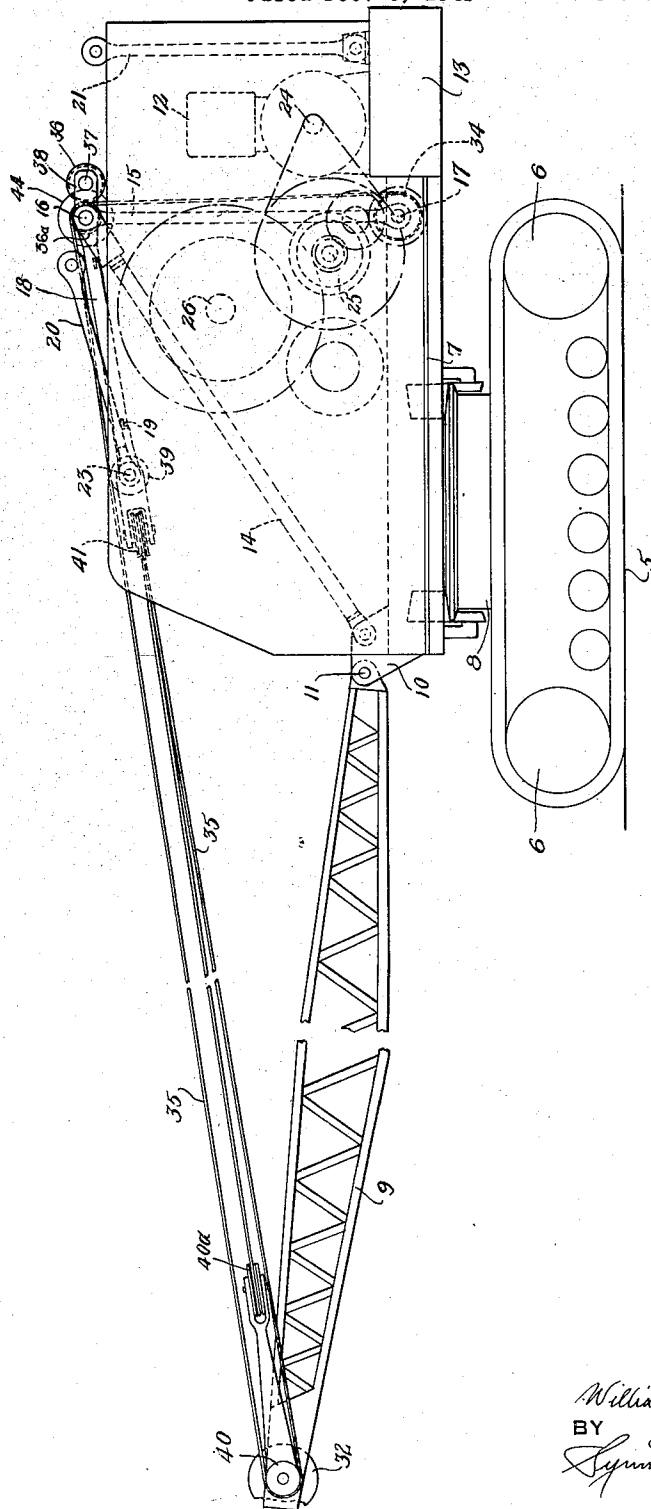
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Fig. 3.



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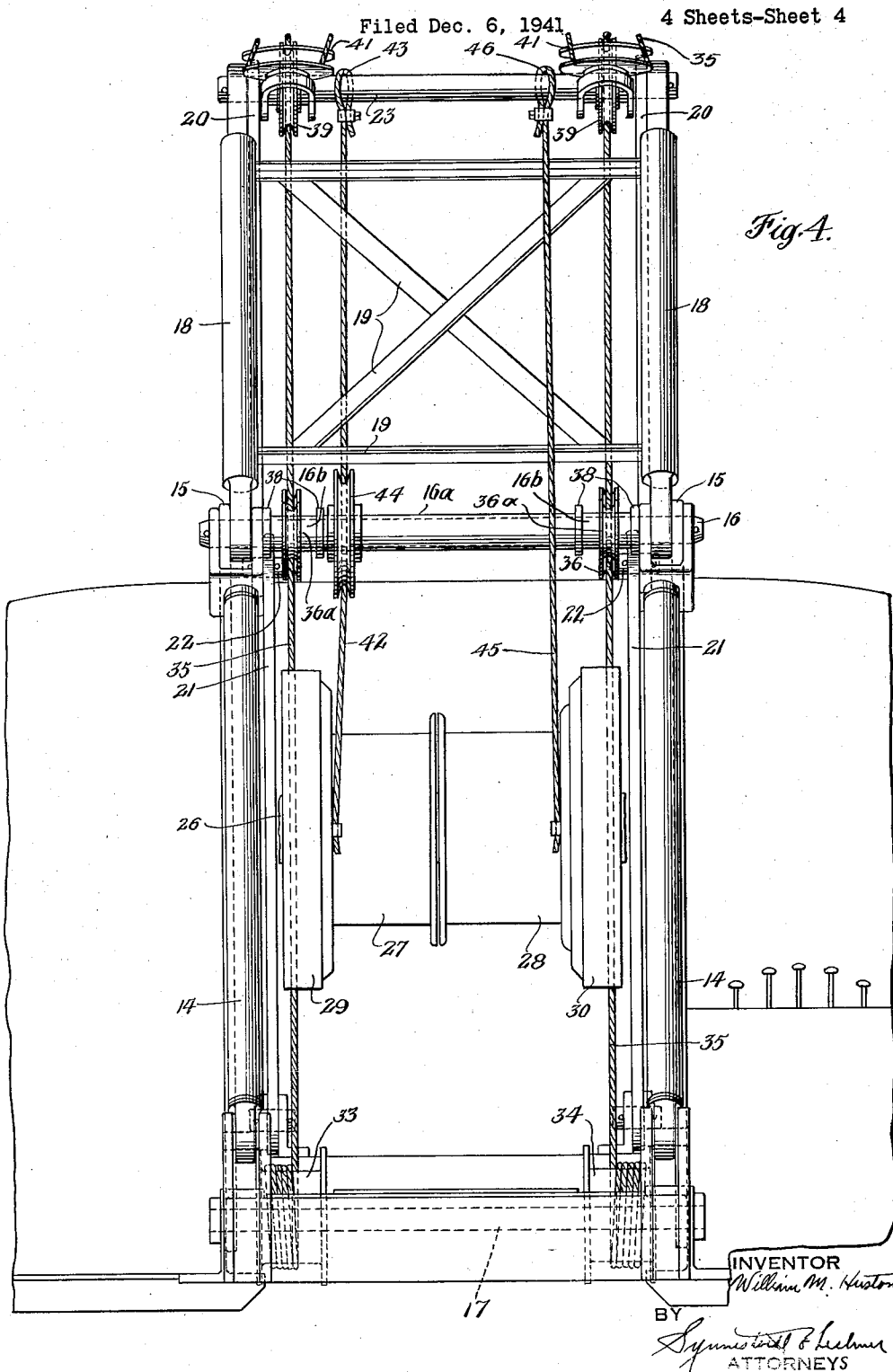
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UNITED STATES PATENT OFFICE

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HIGH GANTRY FOR LOAD-HANDLING MACHINES

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23 Claims. (Cl. 212—59)

This invention relates to load-handling machines, such as cranes, clamshells, draglines and other similar equipment.

Many machines of this type require a relatively long boom, and in order to reduce compression loads in the boom it is desirable to employ a relatively high gantry. For this purpose, a gantry extension is commonly used, such extension comprising a gantry framing surmounting the normal or standard low gantry of the machine.

Because of the weight of the parts, erection and dismantling of the gantry extension involves considerable work, even where these operations are carried on in a shop. Moreover, it is frequently found, especially in city operations, that the gantry extension exceeds the usual clearance provided under bridges, etc., and must therefore be lowered when moving the machine.

In view of the foregoing, in some prior machines, provision has been made for detaching or collapsing the gantry extension, as by separating certain fastenings and manually lowering the framing. Similar manual handling of the parts was also required for erection. In addition to the work involved, the prior manual type of erection and dismantling is slow and troublesome.

With the foregoing in mind, the present invention provides improved structure for gantry extensions, and also novel means for raising and lowering the gantry.

Thus, the invention contemplates an improved arrangement of compression and tension elements in a high gantry, the arrangement being considerably simplified as compared with prior practice.

The gantry extension of the present invention is further arranged so that it may be associated with a machine having the more or less standard low gantry, provision being made so that the machine is readily convertible for use either with the standard gantry or with the gantry extension.

In addition to the foregoing, the gantry extension provided by this invention may readily be adjusted between the normal operating position and a collapsed position, power means being employed for this purpose. Since the framing and associated parts of the gantry extension are relatively heavy, the provision of power means is of considerable advantage for collapsing and extending the gantry, not only when the machine is moved from place to place, but also in initial assembly.

In accordance with another aspect of the in-

vention, the power means for effecting raising and lowering of the gantry extension utilizes certain power mechanisms with which a machine of this type is normally equipped. Thus, in the preferred arrangement, provision is made for utilizing a cable drum, such as a hoist drum, in which event, an auxiliary cable is temporarily reeved to the drum and connected with the gantry extension so that the clutch and brake for the drum may serve in raising and lowering the gantry extension.

Still further, the invention contemplates arrangement of a boom hoist line in such manner that actuation of a boom hoist drum may be employed to effect at least a portion of the adjustment movement of the gantry extension between its normal operating position and its collapsed position.

The invention further contemplates the arrangement of the main forward compression member, which mounts the gantry head shaft, for bodily pivoting as a unit, about a pivot axis at its lower end, in such manner that said member swings toward the boom, when collapsing, and lies adjacent the top of the cab; the use of power-actuated means on the machine for so swinging said member and for returning it to its normal rearwardly-inclined position; the effecting of such operation by normal control means on the machine; the employment in this operation of a portion of the cabling normally running from sheave means at the base of said member, upwardly adjacent thereto, over the top thereof and thence to the boom; and the securing of the compression structure of the gantry in its normal position by means of releasable elements normally working only in tension, such as paired disconnectible tension bars extending from the head of said structure to the base of the machine, at least one such bar moving into folded parallelism with the compression means, upon collapsing of the gantry.

How the foregoing objects and advantages are attained, together with others which will occur to those skilled in the art, will be apparent from a consideration of the following description, referring to the accompanying drawings, in which—

Figure 1 is a side view of a crane equipped with a gantry extension in accordance with this invention, certain parts being shown in vertical section, others in elevation, and still others diagrammatically. In this figure the gantry extension is shown in its normal operating position.

Figure 2 is a view similar to Figure 1 but

illustrating the boom lowered to the ground, and with the gantry extension partially collapsed.

Figure 3 is a view similar to Figures 1 and 2 but illustrating the gantry extension in fully collapsed position, with the boom raised somewhat from the ground, to a position suitable for moving the machine.

Figure 4 is a front elevational view of the gantry structure and of certain operating parts described hereinafter, this view being on an enlarged scale as compared with the others.

Figure 5 is a fragmentary view illustrating a modification.

The machine shown is of the crane type, which would normally have a boom of considerable length but, in order to permit illustration of the machine as a whole on a reasonably large scale, the boom has been broken out in several of the figures.

The machine illustrated has the usual crawler mechanism, indicated diagrammatically at 5 and 6. The base structure 7 of the machine is rotatively mounted on the tractor truck 8. The boom 9 is pivotally connected with brackets 10, as indicated at 11, to provide for raising and lowering of the boom; and the base structure further carries the power plant 12 and the counterweight 13, as well as the operating machinery, some of which is described hereinafter.

The standard low gantry comprises a pair of front legs 14 and a pair of back legs 15, these pairs of legs being joined at their upper ends by gantry shaft 16. The forward ends of the front legs 14 are pinned to the brackets 10 and the lower ends of the back legs 15 are mounted on stationary boom hoist shaft 17.

The gantry extension also incorporates a pair of front compression legs 18 having interbracing indicated at 19, the lower ends of legs 18 being connected with shaft 16 with freedom for pivotal movement about the axis of shaft 16, so that the gantry extension may be swung from the normal operating position of Figure 1 to the collapsed position of Figure 3. Normally, the upper ends of extension legs 18 are fixed in position by pairs of tension links or back legs 20 and 21, each pair 20—21 being detachably connected by a removable pin 22, so that the front legs may be released for forward collapsing movement. The lower ends of legs 21 may be fastened to any suitable part of the rotating base assembly, or to the counterweight 13 (as herein illustrated) which, of course, is rigid with the base.

Gantry head shaft 23 serves to interconnect the upper ends of legs 18 and 20 so that the gantry extension, as well as the standard low gantry, constitutes a rigid triangulated structure capable of carrying the heavy loads encountered in operation.

In connection with the foregoing, it should be noted that the tension links 20—21 are longitudinally aligned and constitute a straight-line connection between the top of the gantry extension and the base structure of the machine. In view of this, generally horizontal compression bracing intermediate the upper and lower ends of links 20—21 is unnecessary. This arrangement is still further of advantage since the links 20—21 need only carry tension loads and may, therefore, be of relatively light construction.

In accordance with customary practice, the engine or power plant 12 is used for a number

of purposes, including the functions discussed below.

Power is transmitted from the engine crankshaft 24 to the jack shaft 25 and from there through appropriate gearing to the hoist drum shaft 26, which customarily mounts at least two drums 27 and 28 (see Figure 4). Drum 27 is provided with a clutch and brake unit 29, the clutch serving to couple drum 27 with the shaft 26 and the brake serving to control free rotation of the drum with respect to the shaft. The details of the clutch and brake of unit 29 need not be considered as they may be of well known construction, such as the common internal expanding clutch and external contracting brake, respectively cooperating with the inside and outside of a drum structure.

A similar control unit 30 is associated with drum 28, the brake band of this unit being indicated at 31 in Figure 1.

Ordinarily, at least one of the drums on the hoist drum shaft 26 cooperates with a hoist line extending over the boom point sheave 32, this hoist line being omitted from the drawings to simplify the disclosure.

Raising and lowering of the boom 9 is effected by means of a pair of boom hoist drums 33 and 34 rotatively mounted on boom hoist shaft 17, these drums being adapted to be driven from the jack shaft 25 through appropriate power transmission mechanism which need not be considered herein, since the same forms no part of the invention per se. The two ends of the boom hoist cable 35 are reeved respectively on said drums 33 and 34, the circuit of this cable to the boom point being as follows:

From each drum the cable runs upwardly and over a sheave 36, the sheave at each side being carried by a pin 37 which is mounted by pairs of hangers 38 supported by and projecting rearwardly from the gantry shaft 16 (see Figures 1 and 4). From sheaves 36 cable 35 extends upwardly and rearwardly and thence over sheaves 39 mounted on gantry head shaft 23, and between the gantry head and the boom point the cable is arranged to provide a multi-part line, six parts being herein illustrated, for which purpose a pair of head sheaves 40 is provided at the boom point, a center sheave 40a at the boom, and two sheaves 41 at the gantry head.

Appropriate power clutch and brake devices are associated with boom hoist drums 33 and 34 in order to provide for controllably raising and lowering the boom 9.

With the foregoing structural features in mind, attention is now called to the provisions which are made for collapsing and raising the gantry extension. First assume that the gantry is extended as shown in Figure 1, and that it is desired to collapse the same to the position shown in Figure 3. For this purpose the boom is lowered to the ground as shown in Figure 2 (or optionally to a generally horizontal position, and appropriately blocked up or supported in such position). Removable pins 22 are now withdrawn so as to disconnect back legs 20—21. In order to swing the gantry legs 18 forwardly the boom hoist line 35 is taken in by means of drums 33—34. This may be relied upon for swinging of the gantry legs 18 forwardly to the vertical position, after which the action of gravity will, of course, tend to cause the gantry extension to swing downwardly toward the positions of Figures 2 and 3. Control of this downward movement of the gantry extension is provided for by employ-

ing a temporary detachable cable 42, one end of which is fastened at 43 to the gantry head shaft 23, from which the cable extends downwardly to the rear of the floating sheave 44, to be temporarily reeved on a drum, such as drum 27 on the hoist drum shaft 26 (see Figure 4).

It will be understood, of course, that cable 42 is preferably applied in the manner described prior to commencing the collapsing operation, so that when the gantry extension reaches that position in which gravity will tend to swing the same downwardly, the brake of unit 29 which is associated with drum 27 may be employed to controllably retard the downward movement of the gantry. In this way shocks or damage to the mechanism, and manual handling of the parts, are eliminated.

Upon completion of the collapsing operation, the boom may be raised somewhat from the ground (as shown in Figure 3) in order to permit traveling without dragging of parts, for which purpose the boom hoist line 35 may be taken in, the line at this time cooperating with sheaves 36a mounted on gantry shaft 16 (see Figure 4).

In projecting the gantry again to its normal operating position, the clutch of unit 29 associated with drum 27 may be actuated to take in cable 42 until the compression legs 18 again reach the vertical position. Continued movement may be controlled by the boom hoist line 35. Since, at this time, the weight of the parts would tend to cause the gantry to drop rearwardly, the boom hoist brake is employed so as to retard paying-out of the boom hoist line. When the gantry head shaft 23 has reached the normal operating position, pins 22 may again be inserted to interconnect the pairs of back legs 20—21.

During these downward and upward swinging movements of the gantry extension, sheave 44 maintains cable 42 spaced from shaft center 16, so that an appropriate angle of pull is provided. This sheave 44 may be split for convenience in removal and replacement thereof, and when mounted, the sheave is free to move axially of the gantry shaft 16. Preferably, the sheave rides on the spacer sleeve 16a which sleeve, in cooperation with additional sleeves 16b, serves to properly space the various parts which are mounted on the gantry shaft.

As an alternative to employment of the boom hoist line in the manner described above, for both collapsing and projecting the gantry, the invention contemplates employment of a second temporary and detachable cable 45, one end of which is reeved on drum 28 and the other end of which is secured to the gantry head shaft 23, as indicated at 46 in Figure 4. With the temporary cable 45 applied, the clutch of unit 30 associated with drum 28 may serve to apply the required gantry raising force, so as to move the gantry from the normal operating position up to the vertical, after which continued collapsing movement may be controlled by employing the brake of unit 29 for drum 27 (on which cable 42 is reeved).

With the second temporary cable attached, when the gantry extension is being raised and has reached the vertical position, its further movement (clockwise when viewed as in Figures 1 to 3) may be controlled by the brake of unit 30 which is associated with the drum 28. Thus the gantry legs 18 may be brought accurately to the desired position and then retained in that position while the pins 22 are replaced, so as to again interconnect the pairs of rear legs 20—21.

As clearly appears in Figure 1, because of the relative disposition of the drum 28 and gantry shafts 16 and 23, the temporary cable 45 (when reeved as above described onto drum 28) lies sufficiently to the front of shaft center 16 that the required lifting angle or leverage is secured. It will be understood that if various of the gantry parts and the drum to be used for this purpose are differently located, an appropriate floating sheave for cable 45 may be mounted on gantry shaft 16 or at some other suitable point, giving cable 45 the required angle to effect raising of the gantry from the position shown in Figure 1 to the vertical.

In connection with the reeving of cables 42 and 45 on drum 27 and 28, it may be mentioned that this may be accomplished either by temporarily removing the cables normally reeved on said drums or, if desired, temporary cables 42 and 45 may be reeved on top of the cables normally carried by drums 27 and 28, in which latter event additional cable and sockets or fasteners would be employed on drums 27 and 28. Since the required extent of reeving of the temporary cables is very small, the application of the temporary cables on top of those normally carried by the drums would not result in undesirably extensive "taking-in" or "paying-out" of the normal cables.

Since cable 45 moves forwardly and rearwardly during the collapsing and projection of the gantry (as will be seen from comparison of Figures 1, 2 and 3), the cab roof of this embodiment of the invention is provided with an appropriate longitudinal slot accommodating said cable 45. As an alternative (see Figure 5) a rubbing plate 45a may be arranged at the forward edge of the cab roof, and temporary cable 45 merely permitted to ride across this plate during the collapsing and projecting operations.

In either arrangement, the cab structure is provided with appropriate cut-outs or wells so as to accommodate the gantry extension when in collapsed position (see Figure 3). Such a center cut-out or well may also serve to accommodate the cross-over sheaves 41 when these are applied to the gantry head shaft 16, as when the extension or high gantry is not being employed.

When the machine is converted for operation with the standard low gantry, only relatively minor changes in structure are required as, for instance, mounting the cross-over sheaves 41 on the gantry shaft 16, instead of on the head shaft 23.

In accordance with the foregoing, provision is made for raising and lowering a gantry extension by power means, the raising and lowering movements being effectively controllable, in view of which these operations are greatly simplified. Raising and lowering of the gantry extension may also be accomplished much more quickly than has been possible heretofore, and with a considerable saving in man power.

Moreover, the foregoing is accomplished with simple means, the only auxiliary parts required being one or two temporary cables (such as 42 and 45), and floating sheave 44, which sheave, as already noted, is preferably of split construction so as to be readily removable from gantry shaft 16. In connection with the simplicity of the arrangement and operation, it is especially to be noted that provision is made for utilizing power mechanism (drums, clutches and brakes) of the machine provided for some normal function, such as hoisting.

Structurally, the gantry extension of this in-

vention is very simple, the simplicity flowing, in large part, from the employment of substantially straight-line tension links interconnecting the head of the gantry extension and the base structure of the machine. Because of this arrangement, the use of horizontal compression members as a part of the gantry extension (for instance, extending rearwardly from gantry shaft 16 adjacent the roof of the cab) becomes unnecessary.

I claim:

1. In a load-handling machine having a base, a boom mounted on said base for raising and lowering movement, a gantry, a gantry shaft, and a gantry extension, with which latter a boom hoist line is associated, the gantry extension comprising a compression member extended upwardly and rearwardly from a pivot on the gantry shaft, said boom hoist line being adapted to swing said compression member forwardly on said pivot for collapse to a generally horizontal position, and substantially straight-line tension elements interconnecting the head of the gantry extension and the base of the machine and serving to fixedly position the head of the gantry extension.

2. A construction in accordance with claim 1 in which said tension elements for fixing the position of the head of the gantry extension include at least a pair of substantially aligned elements, with releasable interconnecting means therefor.

3. In a load-handling machine having a base carrying a cab and a boom, a collapsible gantry structure extended appreciably above the top of the cab and incorporating compression means pivotally mounted at the lower end for forward collapsing movement to a generally horizontal position adjacent the top of the cab, cable means adapted by association with the head of said gantry structure to swing said compression member to its collapsed position as aforesaid, and straight-line tension elements interconnecting the head of the gantry structure and said base in such position as to act normally in the tension only.

4. A construction in accordance with claim 3 in which the compression means of the gantry structure and a tension element connected thereto are adapted to move into folded parallelism upon collapsing movement to said generally horizontal position.

5. A construction in accordance with claim 3 in which said tension elements include at least a pair of aligned readily separable elements one of which is adapted to remain connected to the compression means and to move therewith to the collapsed position.

6. In a load-handling machine having a boom, a collapsible gantry structure having a main forward compression member mounting the gantry head shaft, said member being pivoted at its lower end and adapted, for collapsing purposes, to swing as a unit bodily about the axis of said pivot forwardly toward the boom, and cable means adapted for cooperation with the head shaft to effect such collapsing as aforesaid.

7. A construction according to claim 6, together with normal control means for the machine operative to control said cable means in effecting such collapsing.

8. A construction according to claim 6, in conjunction with power means for actuating said cable means.

9. A construction according to claim 6, in conjunction with power means for actuating said ca-

ble means to raise said member upwardly and rearwardly toward its normal position.

10. In a load-handling machine having a boom, a collapsible gantry structure comprising a main forward member having a pivotal mounting adjacent its foot and carrying adjacent its head suitable supporting means for the cabling which passes upwardly and over said supporting means and thence forwardly to the boom so that in normal operation the cabling places said forward member under a compression load acting in a direction which tends to move said member bodily as a unit about the axis of its pivot forwardly toward the boom, releasable means normally holding said member as against such movement, and means for effecting such movement of said member for lowering of the gantry.

11. A construction according to claim 10, wherein the means for effecting movement of said member includes cabling arranged to cooperate with said supporting means.

12. A construction according to claim 10, wherein the means for effecting movement of said member includes a portion of the said cabling which passes to the boom, same being disposed to pass upwardly adjacent to said member and thence over said supporting means.

13. A construction according to claim 10, wherein the means for effecting movement of said member includes cabling arranged to cooperate with said supporting means, and sheave means adjacent said pivotal mounting with which said cabling also cooperates.

14. In a load-handling machine having a base and a boom pivoted thereon, a gantry shaft, a gantry extension member pivoted on said shaft with its free end projecting upwardly and somewhat rearwardly of the shaft, a boom hoist line and operating means therefor, a boom hoist line sheave mounted adjacent to and rearwardly of said shaft, an operating drum for effecting a normal operating function of the machine, and a supplemental line adapted to be connected to the upper end of said extension member and reeved on said drum, the extension member being collapsible to an inoperative position by first taking up on the boom hoist line to raise it upwardly to a vertical position from which it will fall forwardly and downwardly to a substantially horizontal position under the control of said supplemental line and the drum on which it is reeved.

15. The structure of claim 14 in which a releasable tension means is provided between the upper end of the extension member and the base.

16. The structure of claim 14 wherein the extension member is raised and returned to its operative position by first taking up on said supplemental line until the gantry reaches its vertical position from which it will fall rearwardly under the control of said boom hoist line.

17. In a load-handling machine having a base and a pivoted boom, a gantry structure pivoted at its lower end and adapted to swing to either side of a vertical position, a boom hoist line passing over an upper portion of said structure, an operating drum for the hoist line, a supplementary line adapted to be connected to an upper portion of said structure, and an operating drum for said supplementary line, said lines and drums being arranged to cooperate in swinging said gantry structure on its pivot to raise and lower the same, one line serving to raise said structure in one direction and the other to retard its fall on the opposite side of its vertical position and vice versa.

18. The arrangement of claim 17 in which a

releasable tension means is provided between the upper end of the specified structure and the base, which tension means holds the said structure in a fixed upright position during raising and lowering of the boom.

19. In a load-handling machine having a base and a pivoted boom, a gantry normally serving to support the boom and comprising a heavy gantry member pivoted at its lower end and adapted to swing to either side of a vertical position, a pair of drums for effecting normal operating functions of the machine, a line reeved on each drum with its free end associated with the upper end of said gantry member, said lines and drums being arranged to cooperate in swinging said member on its pivot to raise and lower the same, one line serving to raise the member in one direction and the other to retard its fall on the opposite side of the vertical position and vice versa.

20. The structure of claim 19 in which said member is a compression member, and a releasable tension means is provided between the upper end of it and the base, which tension means holds said gantry member in a fixed upright position during raising and lowering of the boom.

21. In a load-handling machine having a base and a boom pivoted thereon, a gantry compression member pivoted at its lower end and, when in use, normally inclining to the rear of its vertical position, a boom hoist line passing over said compression member, and gantry collapsing mechanism, said mechanism including means for raising said gantry member to vertical position and means for retarding its fall to a substantially

horizontal position on the opposite side of said vertical position.

22. In a load-handling machine having a base and a boom pivoted thereon, a low gantry having a gantry shaft, a gantry extension pivoted on said shaft and itself having a gantry head shaft, said gantry extension, when in use, normally inclining to the rear of a vertical position, a boom hoist line sheave on each shaft, a supplemental boom hoist line sheave mounted on the low gantry shaft slightly to the rear of said first sheave, a boom hoist line passing over said supplemental sheave and over said head shaft sheave when the gantry extension is in its normal operating position, a releasable tension element between the gantry head shaft and said base, a drum for effecting a normal function of the machine, and a supplemental line reeved on said drum and connected to said head shaft, said boom hoist line and said supplemental line being arranged to cooperate in swinging the extension on its pivot to raise and lower the same, said extension being collapsed by first taking up on the boom hoist line until the extension assumes a vertical position from which it will fall forwardly and downwardly to a substantially horizontal collapsed position under the retarding control of said supplemental line, said boom hoist line passing over said first sheave on the low gantry shaft when the gantry extension is thus collapsed.

23. The structure of claim 22 wherein raising of the extension and returning it to its normal operating position is accomplished by reversing the action of said lines.

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