PORTABLE CRANE
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9 Claims. (Cl. 212—59)

This invention relates to a crane, and particularly pertains to a portable crane of the type shown in my issued U. S. Patents Numbered 2,143,111 and 2,200,274.

In various types of construction work, and particularly in connection with the erection of building structures made of sections of pre-formed concrete and the like, it is desirable to provide a portable crane which has a wide span from the end of the crane to the support, and which at the same time does not require the use of a boom of excessive length. It is also desirable to provide a crane which may be loaded compactly upon a vehicle, such as a truck, and moved from place to place and thereafter set up for operation without difficulty. It is the principal object of the present invention to provide a portable crane of the horizontal boom type, which may be easily mounted upon a truck and manipulated to operate in swinging a boom in a horizontal plane or a vertical plane, the said structure being compact in its design, exceedingly strong so that it may carry a heavy weight, and may be easily and flexibly manipulated by control means.

It is another object of the present invention to provide a crane structure of the type here disclosed which utilizes various driving elements salvaged from discarded trucks and automobiles, whereby the crane structure may be built inexpensively and rapidly while conserving metals now required for armament purposes.

The present invention contemplates the provision of a portable crane structure including a vehicle for transporting the crane and providing a base, a tower carried upon the vehicle, and a boom, the boom being collapsible with relation to the tower when not in use and provided with various control elements, whereby all of the parts may be easily moved to and from their operative positions as well as caused to be driven through various operations when the structure is erected for action.

The invention is illustrated by way of example in the accompanying drawings, in which:

Figure 1 is a view in side elevation showing the crane mounted on a truck and disposed in its folded position preparatory to transportation.

Figure 2 is a view in plan showing the truck frame, the stabilizing means therefor, and the base unit as seen on the line 2—2 of Fig. 1.

Figure 3 is a view similar to Fig. 1 showing the truck and crane in position for operation.

Figure 4 is an enlarged fragmentary view in side elevation showing the skip structure carried by the boom.

Figure 5 is a schematic view in perspective showing the cable system of the crane.

Figure 6 is an enlarged view in transverse section through the boom and the skip structure as seen on the line 6—6 of Fig. 4.

Figure 7 is an enlarged view in elevation showing the rear end of the truck and the crane structure thereupon.

Figure 8 is an enlarged view in plan showing the power and transmission unit of the crane as seen on the line 8—8 of Fig. 3.

Figure 9 is a view in longitudinal section through one of the drum units as seen on the line 9—9 of Fig. 6.

Figure 10 is a view in plan showing the base of the crane and the turntable as seen on the line 10—10 of Fig. 3.

Figure 11 is an enlarged fragmentary view showing the base of the crane and the power unit as seen in elevation and with parts broken away to disclose its details.

Figure 12 is a view in side elevation showing one of the clutch and driving units.

Figure 13 is a view in horizontal section through the driving units as seen on the line 13—13 of Fig. 12.

Figure 14 is a fragmentary view in longitudinal section showing the details of a driving unit and the manner in which the shaft and gears are connected.

Figure 15 is a view in side elevation illustrating a modified form of crane and showing in dotted lines the crane as collapsed.

Figure 16 is a diagrammatical view showing the cable arrangement of the form of the invention shown in Fig. 15.

Referring more particularly to the drawings,

Figure 10 indicates a chassis of a truck mounted on a running gear including a front axle unit 11 and a rear axle unit 12. Mounted upon the truck is a crane base 13. The crane base, as particularly shown in Figs. 10 and 11, is in the form of a cylindrical concrete block having a cavity 14 in its central portion and carrying a spider 15 near the mouth of this cavity to support and center a turntable pin 16. The outer edge of the spider is formed with down-turned flanges 17 which are imbedded within the base structure. Inclined braces 18 extend upwardly and inwardly to the turntable pin 16 to brace the same. Disposed around the upper marginal edge of the base 13 is a channel band 19 which carries a chain 20. The channel band is rolled to circular
form, and when the concrete block is cast the space between the legs of the channel are filled with concrete so that the band will be anchored in position. The band and its chain are provided as a substitute for the usual spur gear formed as a part of a crane turntable structure. Spur gears of large diameter are expensive but, it has been found that drive chains from automotive trucks may be salvaged and welded around the band 19 to serve the same purpose as gearing. This chain is engaged by a plurality of roller chain sprockets 31, the mounting for which will be hereinafter disclosed. It will be noted that since the diameter of the band 19 is greater than the diameter of the base 13 an upper trackway 22 and a lower trackway 23 will be provided in spaced horizontal planes. The upper trackways form a circular path for turntable rollers 24 which are carried by the floor frame 25 of a turntable tower. The lower trackways 23 receive balancing rollers 26 which are secured to the frame 25 by standards 27. These rollers are mounted upon trunnions 28 and roll along the trackway 23 acting to stabilize the platform 25 when an overhanging weight is imposed upon the crane. The frame 25 carries a spider 29 having a central bearing 30. Mounted within the bearing 30 is a ball-bearing structure 31 which receives the upper end of the turntable pin 16, thus the pin 16 centerizes the spider 29 and maintains the rollers 24 and 26 in their circular paths of travel.

The turntable frame, as shown in Fig. 8 of the drawings, comprises opposite side rails 22 and 23, an end rail 34, and a bolting plate 35 at the opposite sides. Intermediate cross braces 28, 37 and 38 are also provided. The length of the side rails is such as to provide an overhanging platform at one end of the frame structure. Secured upon the portion of the frame which is centered over the base 13 is a tower structure comprising vertical posts 39 and horizontal braces 40. At the juncture of the posts and braces horizontal boom pins 41 are journaled. The boom pins 41 extend through suitable bearings 42 in a truss 43. This truss comprises a main beam 44, diagonal struts 45, and a king post 46. The bearings 42 are formed at one end of the main truss beam 44, the opposite end of the beam 44 is a shaft 47 upon which a plurality of sheaves are journaled, as will be hereinafter described. Intermediate the length of the beam 44 and adjacent to the king post 46 is a pivot shaft 48 which receives the end of the boom 49. The boom 49 is of the box girder type, and as shown in Fig. 6 of the drawings comprises upper longitudinal angle bars 50 and lower angle bars 51. The upper angle bars are disposed with their legs inwardly to form the corners of the beam, while the lower angle bars are disposed with one leg extending outwardly and horizontally to form a trackway at opposite sides of the beam as well as to add strength to the beam. Reinforcing tie bars 52 connect the members 50 and 51 together vertically, while cross tie bars 53 connect the members horizontally. The angle bars 51 are straight, and thus provide a straight trackway for a truss structure 54. The upper angle bars 50 are inclined downwardly at their opposite ends to brace the ends of the boom structure.

By reference to Figs. 1 and 3 of the drawings, it will be seen that the truss 43 and the boom 49 are articulately connected to each other, and that the truss 43 is pivotally mounted upon the tower structure in a manner to permit the truss and boom to fold to a collapsed and substantially horizontally aligned position, as shown in Fig. 1, and to swing upwardly and rearwardly to the erected position shown in Fig. 3.

When the boom is in its operative position, as shown in Fig. 1, the trolley structure 64 may move horizontally along the boom. This trolley structure comprises side rails 55 and 56. These are parallel to each other and disposed at opposite sides of the boom. Mounted upon these rails are rollers 57 which are carried upon trunnions 58. The rollers rest upon the outwardly projecting horizontal flanges of the angle bars 51. Suspended from the members 55 and 56 are shackles 59 carried upon pins 60. Two of the boom shackles are suspended from each of the members 55 and 56, respectively, and are cross-connected by tie bars 61. These shackles hang downwardly and are free to swing in vertical planes parallel to the boom. The lower ends of the shackles are provided with pivot pins 62 which carry pivotted tie bars 63 to insure that the free ends of the shackles swing in unison. Extending between these tie bars is a cross-bar 64 from which a center shackle 65 is supported. This shackle carries a sheave 66 to receive a hoisting weight 67. The weight is led around sheaves 68 of a hoisting hook 69 or other suitable device, such as a skip. The pivot pin 62 carried by the pair of shackles 59 nearest to the crane tower is provided with a pulley 70 over which the cable 71 is led. The cable 71 is led over a sheave 72 carried upon the pivot shaft 48 of the boom and is then secured to a skip drum 72. The trolley is moved back and forth by a cable 73 which is attached to the forward end of the trolley at 74 and is led around a sheave 75 carried upon a shaft 47 at the free end of the boom 49. This cable passes around a sheave 76 and is led down to one side of a trolley drum 78. The opposite side of the trolley drum, indicated at 79, has a cooperating trolley cable 80 attached to it and winding in the opposite direction from the cable 74. The cable 80 is led over a sheave 81 and is attached to the frame of the trolley 54 at 82. Attention is directed to Fig. 4 of the drawings, where it will be seen that a loop 84 of the cable 80 is normally made by a spring 83. This spring is secured to the cable 80 at 84 and tends to bow the main length of the cable taut from the drum 79 to the connection 84, and compensates for differences in diameter of the wound cable on the drum sections 78 and 79 of the trolley drum. This drum is generally indicated by the numeral 85.

The truss and boom are moved from their collapsed position, as shown in Fig. 1 of the drawings, to their erected position, as shown in Fig. 3 of the drawings, by the action of a cable 86. This cable is wound around a boom drum 87 and is reeved over a series of sheaves 88 upon the pivot shaft 47 and sheaves 89 of a sheave block 90. The shaft 47 is at the free end of the truss 43. The sheave block is connected by shackle bars 91 to the boom 49 at a point midway the ends thereof, as indicated at 92. Attached to the apex of the sheave block 90 is a cable 86 which is connected to the turntable main frame and limit the upward swing of the truss 43. When the truss and boom are in their collapsed position, as shown in Fig. 1, it is desirable to mount a post 94 upon the upper face of the truss 43. This post is provided with shafts 95 over which the cable 86 is led so that a pull of the cable 86 between the sheaves 88 and 89 will tend to swing the truss 43 upwardly and shift the boom 49 rearwardly to the position shown in Fig. 3. When the boom and truss are
in their collapsed position, as shown in Fig. 1, the overhanging portion of the boom 49 is supported by an inclined brace 86 which is mounted detachably in a socket 97 carried on the chassis 10 of the truck.

The foregoing description was concerned with the boom construction and the trolley and skip arrangement. One of the great values of this invention from a commercial and economical standpoint has been the design of the power plant and hoisting mechanism, and the manner in which used automobile axles, transmissions and clutches have been utilized in this construction, with the result that a highly efficient and flexible driving control has been provided from relatively inexpensive materials.

Referring particularly to Figs. 8, 9, and 11-14, inc. the details of the power unit and the driving mechanism will be seen.

Mounted upon the side of the turntable frame is a power plant 98. This is preferably an internal combustion engine provided with the usual clutch and transmission 99 for driving a propeller shaft 100. The propeller shaft 100 connects to the usual drive shaft 101 of a gear unit 102. This gear unit has been reconfigured from an automobile rear axle differential, and as shown in Fig. 14 of the drawings includes a driving pinion 103 carried by the shaft 101 and in mesh with a bevel gear 104 mounted upon a spider 105. The spider structure 105 is formed with reduced tubular ends 106 which carry antifriction bearings 107. These bearings are mounted in bearing brackets 108 formed as a part of the gear housing element 109. The gears 104 are suitably secured to the spider 105 so that the spider will be driven thereby. Extending through the center of the spider 105 is a splined shaft 110 which is engaged by keys welded in position in the spider so that the shaft 110 may be withdrawn if desired. Mounted upon the propeller shaft 100 is a brake drum 111 carrying a brake shoe 112. A suitable operating connection 113 moves the brake. It is in turn connected to a lever carried upon a shaft 114. This shaft also carries a lever connected to a clutch rod 115, the opposite end of which is connected to a clutch lever 116. The shaft 114 is suitably journaled in the power unit and may be fitted at its opposite end with a foot pedal 117, so that when the foot pedal is depressed the clutch will be disengaged, while simultaneously setting the brake.

The splined shaft 110 extends through gear units 102a, 102b and 102c. These units are all constructed as shown in Fig. 14 of the drawings and as described in connection with the unit 102. Each one of them has been made from a central portion of an automobile rear axle, and after the axle housing has been cut off to suitable lengths the abutting ends of axle housings are welded together, as indicated at 118. This construction is shown in detail in Fig. 13 of the drawings. The shaft 110 thus simultaneously drives parallel drive shafts 119, 120 and 121. The drive shaft 119 leads to a clutch and transmission structure 122a, and the shaft 120 leads to a clutch and transmission structure 122b, and the shaft 121 leads to a clutch and transmission structure 122c. These units are in duplicate, as indicated in Fig. 8 of the drawings, and their details of construction are shown particularly in Fig. 9. Here it is to be seen that the clutch and fly-wheel housing is secured through the plate 35 of the turntable frame 25. A clutch 123 is operated by a clutch pedal 124. The usual speed changing gear set is operated by a gear shifting lever 125, and a brake 126 is operated by a lever 127.

The transmission unit 122a is provided with a propeller shaft 128, which, as particularly shown in Fig. 11 of the drawings, leads to a speed changing gear unit 129. A shaft 130 is driven through the unit 129 and drives a gear unit 130a by which the drum 85 is driven, as will be hereinafter explained. The gear unit 130a includes a bevel pinion 131 on the shaft 128 and a gear 132 mounted upon a spider 133 which drives hoisting drum 134 upon which the boom 85 is keyed. The structure is supported upon channel section frame uprights 135 and 136 which are carried upon the overhanging end of the turntable frame 25 and are supported by braces 137.

Mounted upon the driving side of the gear changing unit 125 is a sprocket 138. A sprocket chain 139 passes around this sprocket and a sprocket 140 carried upon the shaft 141 of a speed changing gear set 142. The gear set 142 drives a shaft 143. This shaft is connected to a gear unit 135b identical with the unit 135a shown in Fig. 9 of the drawings, and which unit drives the boom drum 87. It will be seen by this arrangement the boom can be hoisted and the skip operated simultaneously, or the boom hoisting operation may be discontinued, after which the skip may be driven independently.

The transmission unit 122b drives a propeller shaft 144. This leads to a gear unit 140c by which the drum 72 is driven.

The transmission unit 122c drives a propeller shaft 145 connected to a gear unit 146. This unit is secured to the turntable frame and has a downwardly extending shaft 147 upon which the sprocket 21 is mounted. This sprocket is in mesh with the sprocket chain 20, which is secured around the member 19 of the crane base 13.

Since the crane here disclosed is mounted upon the usual motor truck, it is obvious that the frame of the truck must be held rigidly during operation of the crane, and that the load shall not be imposed upon the spring suspension of the truck. In order to accomplish this, Jacobs 150 and 151 are mounted under the front and rear cross members of the frame 14 and are carried by relatively large base members 152 which rest upon the ground. Similar Jacobs 153 and 154 are disposed at opposite sides of the main frame, as shown in Figs. 1 and 2. These Jacobs are mounted upon horizontally swinging brace elements 155 and 156, respectively. The brace elements are pivoted to brackets 157 and 158 secured to the sides of the main frame 10. Adjustable swinging braces 159 and 160 are provided and are mounted upon brackets 161 and 162, respectively, which permit the braces 159 and 160 to swing outwardly and to be locked in a desired adjusted position by pins 163.

Referring to Figs. 15 and 16 a modified form of the invention is disclosed, which provides a fixed pivot for the boom 48, as indicated at 164. This pivot takes the place of the pivot shaft 41 employed in the previously described form of the invention, and thus makes it unnecessary to lift the entire weight of the boom when moving it from its collapsed to erected position. In this form of the invention the truss 43 is employed and swings from the dotted line position shown in Fig. 5 to the solid line position shown in that figure. In this form of the invention the
cable winding drum 87 for the boom is fitted with a cable 165 which leads upwardly over a sheave 166. The cable 165 leads over the sheave 166 and around sheaves 167 disposed on the top of the boom and near the free end thereof. The cable is then led around sheaves 168 at the end of the main beam 44 of the truss 43. Thus, as the drum 87 winds the cable 165 it will act to shorten the distance from the sheaves 167 and 168 and draw the truss 43 upwardly until it pulls the guy wires 93 taut. The operation and control will of course be the same as previously described.

In operation of the form of the invention shown in Figs. 1–14, inc. the crane is assembled as shown in Fig. 1 and disposed upon the truck in its collapsed condition. The truck is then driven to the site of operations, after which the jacks 150 and 151 are set to lift the truck frame 10 and take the weight off of the spring suspension. The members 155 and 156 are then swung outwardly at the opposite sides of the truck and in the direction of the arrows a. The braces 158 and 160 are then swung out in the direction of the arrows b and set by the lock pins 163. The engine 98 is then started and the transmission 99 operated to establish a driving connection from the engine through the clutch 116 and to the shaft 118. The various gear units 162a, 162b and 162c are then driven simultaneously. The operator thereafter places the transmission unit 122a in driving engagement with the shaft 118, and then operates the transmission unit 142 to drive the boom drum 87. This places tension upon the boom cable 56 and draws the truss 43 and the boom from the position shown in Fig. 1 of the drawings to the position shown in Fig. 3. When the guy wires 93 are taut the transmission unit 142 is thrown into neutral and a brake 134 is set to hold the drum against rotation. It is understood that each of the drums 72, 85 and 87 are equipped with such a brake. The transmission unit 125 may then be moved from a neutral position to drive the shaft 128 and the trolley drum 88. It will be recognized that since each of the transmission units is fitted with reverse gears that a positive winding or unwinding movement of the drums may be accomplished. When the trolley has been properly positioned with relation to the load, the load drum 72 may be raised and lowered to manipulate the hook structure 65 or a skip bucket used as a substitute therefor. It will also be understood that the transmission 122c may be operated as desired to drive the gear set 146 and cause the shaft 147 to rotate the sprocket 21 in engagement with the sprocket chain 20 securing around the base of the crane. It will be seen that when an overhanging load is imposed upon the crane 43, the load on the turntable structure from the 89a to stabilize the load.

It will thus be seen that the invention here disclosed provides a compact and strong crane capable of handling large loads over a long range, and that the same is stabilized by means of the turntable structure from the 89a to stabilize the load.

The transmission parts are improvised from old automobile driving gears, that the structure is decidedly durable and may be cheaply manufactured.

While I have shown the preferred form of my invention as now known to me, it will be understood that various changes may be made in combination, construction and arrangement of parts by those skilled in the art, without departing from the spirit of my invention as claimed.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:

1. A crane, comprising a relatively fixed base formed with an annular turntable trackway thereon, a turntable platform mounted to rotate upon said base and with relation to the trackway, a fixed tower carried by the platform and carrying a horizontally disposed pivot pin at its upper end, a truss mast pivoted to said pin and adapted to swing in a vertical plane, a boom pivotally mounted to the mast at a point intermediate the ends of the mast to swing in a vertical plane, a prime mover carried by the turntable platform, a winding drum mounted upon the prime mover, means interposed between the prime mover and the winding drum for driving the same, a cable connected with the winding drum and rove over the free end of the mast and operatively connected to the boom, whereby said cable when wound will simultaneously swing the free end of the mast upwardly on its pivot and move the boom upwardly and outwardly to an operative position, guy wires connecting the mast to the turntable platform for limiting the upwardly swinging movement of the mast and supporting the weight of the boom and its load, and means connected with said prime mover for rotating the turntable frame upon the base.

2. In a crane structure, a tower, a substantially horizontal boom supported therefrom, a longitudinal trackway on the boom, a trolley structure adapted to move along said trackway, a cable fixed to the trolley at a point intermediate its ends, a drum to which one end of the cable is secured and upon which the cable may be wound when the drum is rotated in one direction, the opposite end of the cable being led around the free end of the boom and being secured to said drum to unwind when the drum is winding the first named cable length, means compensating for variation in the effective lengths of said cable ends instant to the winding and unwinding thereof, whereby the trolley will be moved along the trackway without strain on the cable, and a spring element attached to one side of the trolley structure and to the cable in a manner to form a loop in the cable, whereby variation in the effective cable length is provided.

3. In a portable crane structure, a vehicle upon which said structure is mounted, a base for the crane mounted upon the vehicle formed by a monolithic concrete block having an enlarged annular flange around the upper end thereof, and an annular member of channel shape circumferentially grooved on a side thereof, a channel overhanging opposite horizontal faces of the flange, whereby parallel annular trackways will be formed.

4. The structure of claim 3 including a turntable post rigidly secured centrally of said base, a power driven mechanism for raising and lowering the turntable structure and moving along the trackways of the annular flange on the base.
5. The structure of claim 3 including a turntable post rigidly secured centrally of said base, a turntable structure mounted upon said post, rollers carried by the turntable structure and moving along the trackways of the annular flange on the base, a gear circumscribing the annular base flange, a sprocket engaging the same mounted on a shaft on the turntable structure, and means mounted on the turntable structure for driving said shaft.

6. In a crane structure, a frame, an engine mounted thereon, a transmission unit including a clutch and a set of speed changing gears driven by the engine, a distributing shaft driven by the transmission unit, a cable drum for raising and lowering a boom, a cable drum for moving a trolley in opposite directions along a boom, a drive shaft establishing a driving connection between the distributing shaft and the trolley cable drum, and a drive shaft for the boom cable drum driven from the trolley cable shaft.

7. The structure of claim 6 including a power transmission unit interposed in the length of the trolley shaft, and a power transmission unit interposed in the length of the boom shaft and driven from the trolley drum shaft in advance of its transmission unit, whereby said drums may be simultaneously driven at the same or different speeds and may be separately rendered inoperative.

8. The structure of claim 6 including a power transmission unit interposed in the length of the trolley shaft, a power transmission unit interposed in the length of the boom shaft and driven from the trolley drum shaft in advance of its transmission unit, whereby said drums may be simultaneously driven at the same or different speeds and may be separately rendered inoperative, and a power transmission unit interposed between the trolley shaft and the distributing shaft, said unit including a clutch, speed changing gears and a brake.

9. A crane, comprising a fixed base, a turntable thereon, a turntable frame mounted to rotate around the vertical axis of the turntable, a tower fixed to said frame, a boom pivot mounted at the upper end of said tower, a boom pivotally supported on the boom pivot for vertical swinging movement, a mast pivoted upon the boom pivot and adapted to swing upwardly, a power unit carried on the turntable frame, a boom cable drum driven from said power unit and a cable connected therewith for simultaneously swinging the mast to an erected position and the boom to an operative position, and restraining means for limiting the upward swinging movement of the mast and supporting the weight of the boom and a load carried thereon.

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