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R. K. HATCH
POWER SWING CRANE

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2 Sheets-Sheet 1

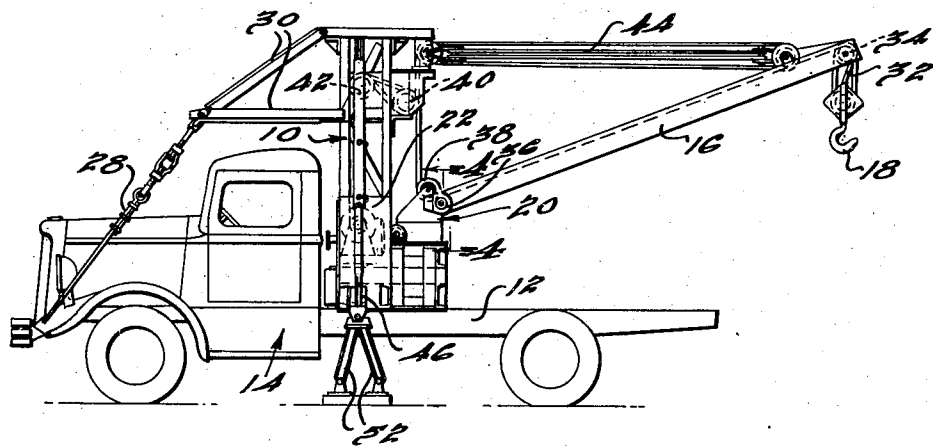


FIG. 1.

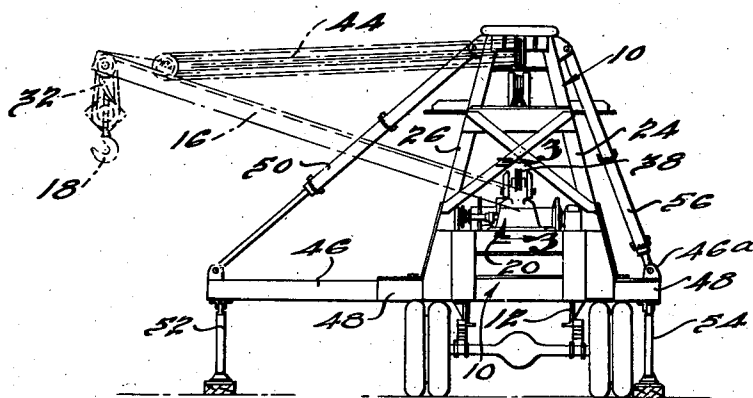


FIG. 2.

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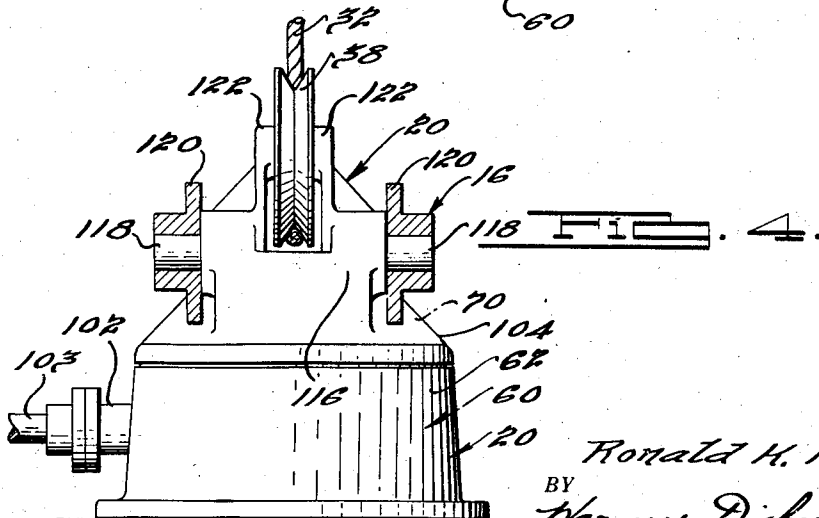
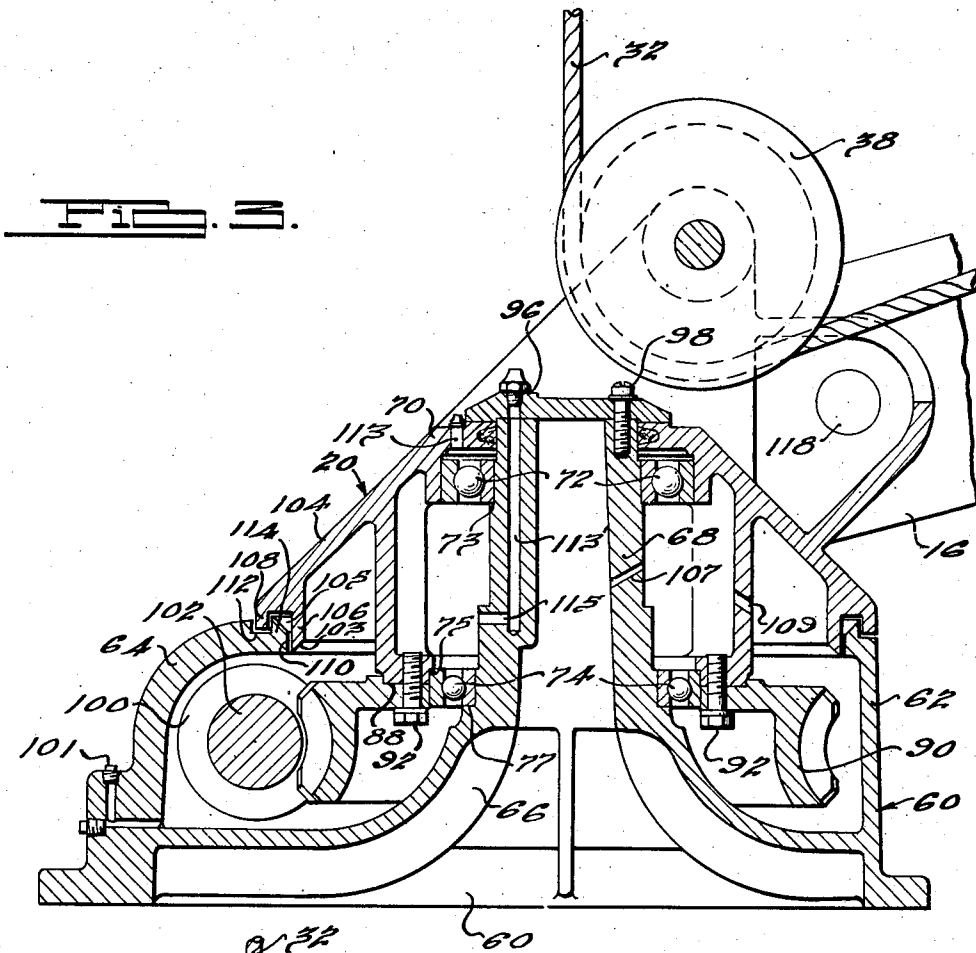
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POWER SWING CRANE

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4 Claims. (Cl. 212—68)

The present invention relates to cranes, and in particular provides a crane of the vehicle carried type, embodying improved power actuated means for effecting a swinging movement of the boom of the crane.

Principal objects of the present invention are to provide a crane of the above generally indicated type, characterized as including improved means for supporting the inner end of the boom and for effecting swinging movements thereof; to provide such a structure in which the swinging mechanism for the boom is arranged for power actuation; to provide such an arrangement characterized as including an improved bearing relationship, the bearings being interposed between the connection to the end of the boom and the connection to the power element; to provide such a construction wherein the inner end of the boom is provided with a head, rotatably supported upon a cooperating structure, and arranged for connection to a source of power; to provide such a construction in which the head forms a closure for a housing adapted to be substantially filled with lubricant so as to continuously lubricate the power actuating element associated with the head; and in which adequate means are provided to vent the housing; and to provide such a construction wherein the head associated with the boom is fitted over a stationarily supported column, having a housing formed at its base, the head acting to enclose the upper portion of the housing.

With the above, as well as other and more detailed objects in view, which appear in the description and in the appended claims, a preferred but illustrative embodiment of the invention is shown in the accompanying drawings, throughout the several views of which corresponding reference characters are used to designate corresponding parts, and in which:

Figure 1 is a view in side elevation of a vehicle-carried crane embodying the invention;

Fig. 2 is a rear view corresponding to Fig. 1, but showing, in dotted lines, the boom swung to one side;

Fig. 3 is a detail view, taken along the line 3—3 of Fig. 2; and

Fig. 4 is an enlarged view, taken along the line 4—4 of Fig. 1.

In a general sense, the invention is directed to the combination in a crane, having means for controlling the hoisting movements thereof, of a power actuated unit for the inner end of the boom, whereby the latter is supported and whereby it may be swung through a desired angle.

As will appear from a complete understanding of the invention, the unit itself may be constructed in a variety of different ways within the spirit and scope of the invention and may be embodied in cranes intended for widely differing applications. The improvements have particular utility in connection with cranes of the so-called vehicle-carried type, and, in an illustrative but not in a limiting sense, are so disclosed herein.

Referring first to Figs. 1 and 2, the crane construction selected to exemplify the invention comprises an A-frame 10 which is supported upon and rises substantially vertically from the frame 12 of a supporting vehicle 14; a boom 16 which carries a hook 18 at its outer end and is connected at its inner end to the hereinafter described improved unit 20; and suitable mechanism, including the winch 22, for effecting the hoisting and lowering movements of the hook 18 and the raising and lowering movements of the outer end of the boom 16.

It will be understood that the A-frame 10 may be of usual construction, and comprises, in the illustrated arrangement, the pair of legs 24 and 26, which are suitably braced together and are supported at their lower ends upon cross-members 48 which form the crane base and which are in turn supported directly upon the vehicle frame. The frame 10 is braced over the cab to the front of the supporting vehicle 14 by means of the lines 28 which are connected to the front end of the vehicle frame and which are also connected to the A-frame 10 through the forwardly extending frame members 30. The just described construction of the supporting structure for the crane is extremely advantageous, in that it occupies only a relatively small percentage of the space behind the cab, leaving a relatively large portion thereof available for load carrying purposes.

It will be understood that the winch 22 is connected to the hook 18 through one or more cables 32, which are trained over a pulley or pulleys 34 at the outer end of the crane, a pulley 36 at the inner end, a pulley 38 carried by the hereinafter described unit 20, and one or more pulleys, such as 40 and 42, which are mounted in the A-frame. In addition, the winch is connected to raise and lower the boom through services of cables including the cables 44. It will further be understood that the winch is selectively controllable, so as to independently raise and lower the hook and raise and lower the boom.

In addition to the foregoing features, it is preferred to provide the crane with slidable outriggers 46 and 46a, which may be slid trans-

versely through the crane base 48, between the extended and the retracted positions. The outrigger 46 is shown in its extended position, in which it is braced by the tubular telescopic brace 50. The companion outrigger 46a is shown in its retracted position, in which its associated tubular telescopic brace 56 is in its retracted or shortened condition. The telescopic braces 50 and 56 may be made of two or more tubes, as will be understood.

It is also preferred to provide the outriggers with jacks 52 and 54, which give vertical support to the outer ends thereof. The jacks 52 and 54 are illustrated as being swingably connected to the outer ends of the associated outriggers 46 and 46a, respectively, so that they may be swung upwardly to retracted position, or, alternatively, may be disconnected therefrom and carried upon the vehicle. It will further be understood that during travel of the vehicle, the outriggers normally occupy the retracted position shown in connection with the outrigger 46a, so that they do not add materially to the overall width of the vehicle.

It will be understood that in operation, the above generally described crane may be utilized for widely varying purposes. Typical duties include the removing of a load from the vehicle 14 to one side of the rear thereof or vice versa, and the transferring of a load from a position at one side of the vehicle 14 to a position at the other side. During the course of such operations, the supporting mechanism for the inner end of the boom is subjected to extremely severe operating loads, since the load reactions thereon have substantial vertical components and also have substantial radial components, which latter components continuously vary in direction as the boom is swung. In addition, both the vertical and the radial components of the load are subject to abrupt changes, caused for example when the load is either engaged or disengaged by the hook 18. Such extreme service conditions have given rise to considerable difficulty in the design of a swinging and supporting mechanism for the inner end of the boom, which is reliable and durable in use and which may at the same time be readily and economically manufactured, installed, and serviced when necessary. The present improved unit 20 has been found in practice to solve the above as well as other difficulties in an extremely effective and simple manner.

Referring now particularly to Figs. 3 and 4, the unit 20 for supporting the inner end of the boom 16 and for swinging the boom comprises generally a base structure 60, adapted to be bolted or otherwise directly secured to the frame of the vehicle 14 or to the crane structure or to other suitable supporting structure. The frame 60 is of generally circular form, and is provided with an upwardly extending annular wall 62, which, with the lower side or bottom 66 of the base, defines an upwardly presenting cup-like housing. A portion of the wall, indicated at 64, is extended radially outwardly to accommodate a driving worm. The bottom 66 of the base 60 is upwardly extended adjacent the center of the base and constitutes a substantially vertical tubular bearing column 68.

The base 60 is surmounted by a head 70, which is rotatably mounted thereon by ball bearing units 72 and 74. The inner race of the ball bearing unit 72, which is adapted to sustain radial loads, is fitted upon the upper portion of the column 68 and the lower face thereof rests upon a shoulder 73 formed on the column 68. The

outer race of the unit 72 is received in a cylindrical portion 75 of the head 70. The outer race of the lower bearing unit 74 is received in a cylindrical portion formed partly within the head 70 and partly within the worm wheel 90. A shoulder 75 formed in the head 70 overlies the upper surface of the just mentioned race. The inner race of the unit 74 is fitted over the standard 68 and rests upon a shoulder 77 thereon. It will be seen, accordingly, that the ball bearing unit 74 sustains both thrust and radial loads.

Head 70 is provided with a flat under surface 88, to which the driving worm wheel 90 is secured by a plurality of circumferentially arranged cap screws 92. The worm wheel 90 is of generally inverted cup-like form. The unit comprising the head 70 and the worm wheel 90 are maintained in fixed axial position relative to the bearing column 68 by means of the lower ball bearing unit 74 and the imposed thrust loads. A cap plate 94, which is fitted to the end of the bearing column 68 and is secured in place thereon by one or more cap screws 96 closes the end of the column 68 and restrains vertical upward movement of the head 70. It will be understood that the flange of the cap plate 96 overlies the upper end of the head 70.

As is described in more detail hereinafter, the inner end of the boom is connected to the head 70, so that rotative movements of the head 70 are correspondingly imparted to the boom and cause a swinging movement thereof. The head 70 is in itself entirely freely continuously rotatable relative to the base 60, so that the only limitations which are imposed on the angle of swing of the boom are those which are imposed by the supporting framework of the crane. In practice, the present disclosed arrangement has been found to freely accommodate an angle of substantially 180°.

The worm wheel 90 is in constant meshing relation with a worm 100, the shaft 102 for which is suitably supported in bearings (not shown) formed in the wall of the base 60. It will be understood that the shaft 102 is preferably connected, through a shaft 103, to a suitable power take-off mechanism (not shown) associated with the main vehicle drive shaft gearing, so that the worm 100 and the worm wheel 90 may be rotated by power derived from the vehicle engine. It will further be understood that the previously described winch 22 may be similarly driven through a conventional power take-off. It will be noticed that in the above described structure the supporting bearings for the rotatable head 70 are interposed between the point at which the load on the boom 16 is applied and the point at which the driving power is applied and that the dead sheave 38 is so mounted that the vertical rope lead from the sheave is co-axial with the pivot center, assuring an unchanged rope lead when the boom is swung from side to side. This arrangement has been found to be particularly advantageous in practice, since the reactions of the load and of the applied driving power, together with the sheave reactions, tend to counterbalance each other, reducing bearing loads.

It is preferred to maintain a lubricant in the reservoir constituted by the base 60 to a level adjacent that represented by the plug 101, so that the worm elements 90 and 100 run more or less completely submerged in a bath of lubricant. In order to seal off the upper and otherwise open surface of the housing constituted by the base 60, so as to prevent the escape of such lubricant as well as to prevent the entrance of dirt or

other foreign matter, it is preferred to so form the head 70 that it acts as a closure for such surface. With this consideration in view, the head 70 is provided with a radially flaring skirt 104, which terminates in spaced flanges 106 and 108. The flange 106 lies closely adjacent the radially inner face of the wall of the reservoir, and the flange 108 is received in a channel shaped recess 112 formed in the outer surface of the wall of the housing. The flanges 108 and 106 define between them a channel which is occupied by an upwardly extending flange 114 formed on the housing wall.

The depending flange 106 is provided with a beveled under-surface 103 and the upstanding flange 114 is provided with a similar but oppositely beveled upper surface 105. The bevel 103 tends to prevent the lubricant in the chamber occupied by the worm and the worm wheel from creeping up into the joint represented by the adjacent surfaces of the flanges 106 and 114, while the second bevel 105 forms an enlarged space or chamber between such flanged surfaces, which tends to break the adhesion of the lubricant, and to allow the latter to gravitate back into the chamber. With this relation, it will be appreciated that an effective closure for the reservoir is provided, which serves to prevent the entrance thereto of dirt or other foreign material, and at the same time permits a spaced relation to be maintained between the skirt of the head and the wall of the housing, so that the only bearing connection between the head and the base is provided by the previously described bearing units 72 and 74.

The above described sealing relation between the skirt 104 of the head 70 and the annular ring of the oil reservoir is found in practice to constitute an effective seal which prevents the escape of any such lubricant. In view, however, of the fact that considerable heat may be developed within the reservoir during operation of the unit, which heat may tend to develop an appreciable oil expansion and air pressure therein, which, if not vented, would tend to force lubricant past the seal, it is preferred to vent the reservoir. In the illustrated arrangement, this is accomplished by providing vent openings 107 and 109 in the wall of the bearing column 68 and in the annular wall of the head 70.

As will be evident from the drawings, lubrication of the bearings 72 and 74 is provided through lubricant passages 113, 113', and 115.

As most clearly appears in Figure 4, the upper portion of the head 70 is provided with a boss-like formation 116, the laterally opposite sides whereof are provided with axially projecting trunnions or hinge pins 118. The trunnions 118 rotatably support the spaced legs 120 which are formed at the inner end of the boom 16. With this relation, a freely pivotal connection is provided between the boom 16 and the head 70. In addition, the head 70 is provided with an upwardly projecting boss formation constituting the spaced legs 122, which form bearing supports for the previously described pulley 38 associated with the cable 32. As pointed out above, the bearings for the sheave 38 are so located that the rope 32 led therefrom is so-axial with the head 70.

Although only one specific embodiment of the invention has been described in detail, it will be appreciated that various modifications in the form, number, and arrangement of the parts may be made within the spirit and scope of the invention.

What is claimed is:

1. In a crane having a boom, the combination of a unit for supporting the inner end of the boom and for swinging the boom comprising a supporting base structure, a member rotatably supported on said base, means on said member adapting it to be driven in rotation, means on said member axially spaced from said first mentioned means adapting said member for connection to the boom, and bearing connections between said base and said member positioned between said first and second means, said bearing connections comprising a pair of axially spaced anti-friction bearings, one located adjacent the boom connection and the other located adjacent the rotational drive.

2. In a crane having a boom, the combination of a unit for supporting the inner end of the boom and for swinging the boom, comprising a supporting base structure and a head rotatably mounted therein, said head having a skirt and said base having an annular wall, said wall and skirt cooperating to define a substantially enclosed housing, means mounted on one end of said head within said housing for adapting said head to be driven in rotation, additional means on the other end of said head external to said housing for adapting it for connection to the boom, bearing connections between said head and base interposed between said first and second mentioned means, said bearing connections comprising a bearing column projecting axially from said base, and bearing openings formed in said head receiving said column.

3. In a crane having a boom, the combination of a unit for supporting the inner end of the boom and for swinging the boom, comprising a base of generally cup-like form having an annular wall and having a bearing column projecting axially from the base at the center thereof, a head rotatably supported on said base, said head having a radially flaring skirt adapted to cooperate with said wall to define a substantially enclosed housing, means including a worm wheel mounted on said head within said housing for adapting said head to be driven in rotation, additional means mounted on the other end of said head external to said housing for adapting the head to be connected to the boom, and bearing elements positioned in said head between said first and second means for rotative connection to said bearing column.

4. In a crane having a boom, a horizontal base having an integrally formed upstanding column, an annular wall on said base surrounding said column in spaced relation, a head surrounding said column and journaled thereon, a worm wheel on the lower end of said head and located in the space between said column and said wall, a skirt on the upper end of said head covering the space between said column and said wall, and means on said head above said skirt for attaching said head to a boom.

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