Nov. 13, 1956 E. O. MARTINSON 2,770,372

BOOM

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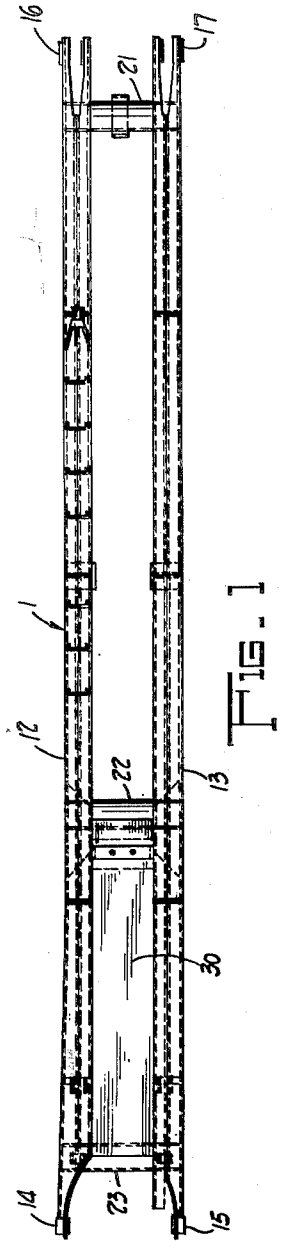


FIG. 1

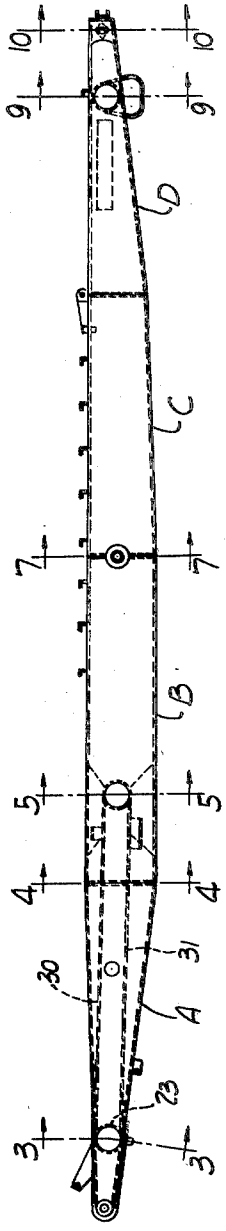


FIG. 2

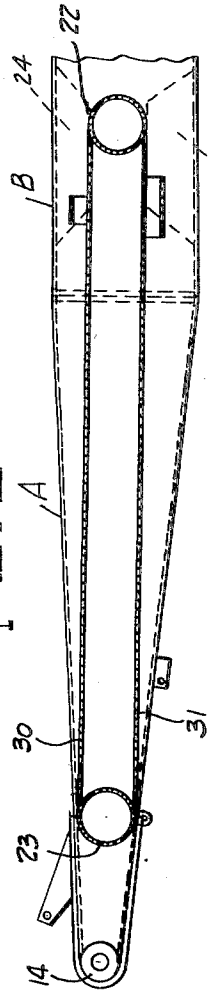


FIG. 12

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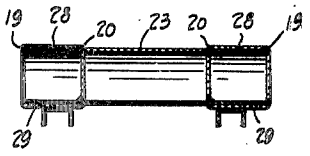


FIG. 3

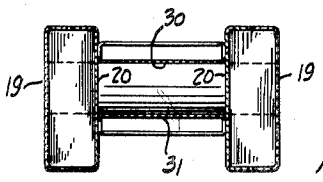


FIG. 4

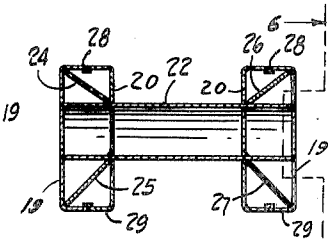


FIG. 5

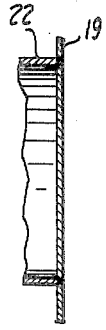


FIG. 6

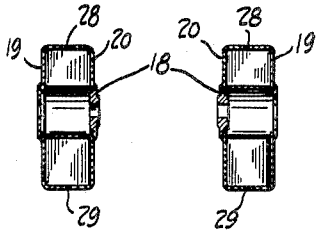


FIG. 7

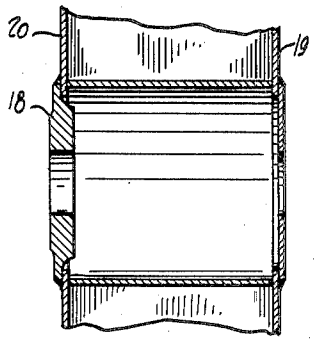


FIG. 8

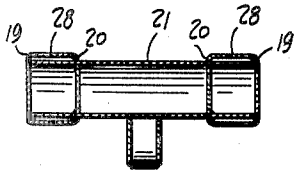


FIG. 9



FIG. 10

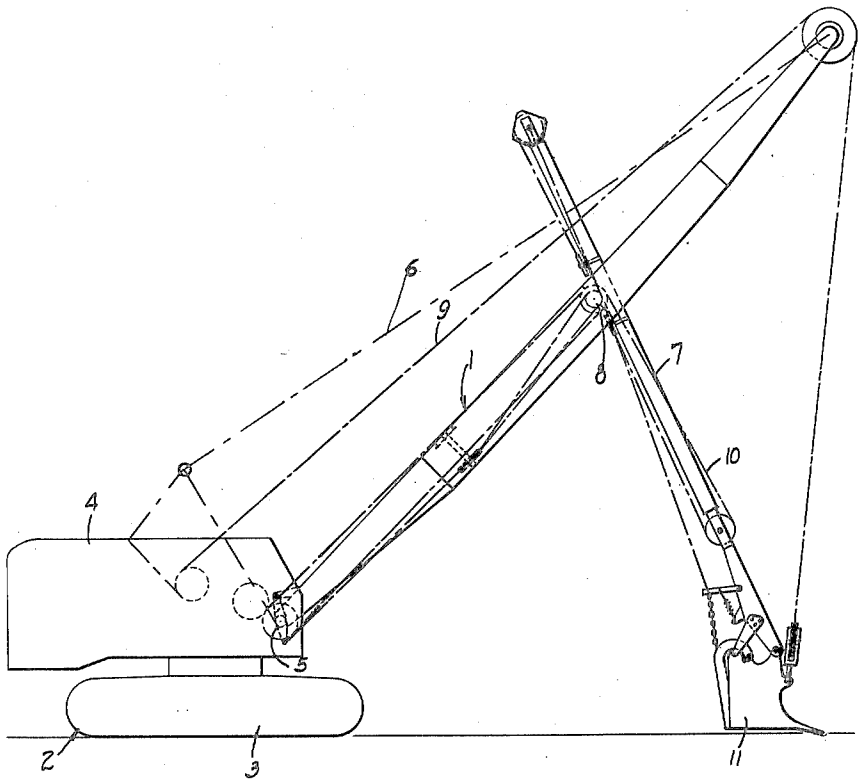
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Fig. 11



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2,770,372

BOOM

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Application April 29, 1952, Serial No. 285,001

3 Claims. (Cl. 212—144)

This invention relates to power shovels or similar construction equipment, which includes a boom having a material handling member carried thereby, which transfers or imparts twisting and side bending forces to the boom.

In such equipment where it is desirable to mount a single dipper stick between boom side members, swinging or sweeping of a bucket usually carried at the end of the stick, imparts a side pressure to the boom and results in severe twisting stresses in the boom.

Since most booms use heavy X-bracing or heavy arched cross plates between side members, the side sweeping effect on the dipper stick causes a high concentration of stresses at corners. The exceeding of allowable values during repeated or fatigue loading, results in creation of cracks at the points of highest stress. Once started, a crack progresses rapidly and must obviously be quickly repaired. However, since the structure itself is not changed by repair alone, the causes and results of the cracks are not eliminated.

It is therefore a principal object of this invention to provide a structure which will effectively resist the twisting stresses in the boom, by distributing the resisting forces as uniformly as possible throughout.

It is a further object of this invention to accomplish such distribution by provision of one or more tubular cross members, connecting the longitudinal side members of the boom. Such tubes, or a single tube as the case may be, are preferably of round configuration and securely welded to the side members whereby the distribution of the resisting forces around the entire circumference of the tubes is effected and uniformity thereof is obtained.

It is a further object of this invention to provide a structure in which three cross tubes are preferably provided, although a lesser number may be provided, and to so locate said tubes as to effectively carry out the distribution of stresses imparted thereto.

It is a further object of this invention to locate the tubes in the most effective relationship in the boom so as to carry out the reduction holding deflection to a minimum and to reduce the length over which the maximum stresses occur in the side members.

It is a still further objective of this invention to locate one of the tubes as near as possible the shipper shaft of the boom to effectively counteract the forces which are imparted to the side members by the dipper stick through the shipper shaft.

It is a still further object of this invention to provide a boom in which the side members are preferably made in the form of box girders, so as to render the structure more effective, and to connect the ends of the respective tubes to both of the side walls of each side member by securely welding the same thereto.

It is a further object of this invention, by so connecting the respective tubes to the side members, to effectively distribute the resisting moment of the cross tubes to all of the walls of each side member.

It is a further object of this invention to provide for the insertion of diaphragms in the tubes in line with the side walls of the girders to provide a substantially continuous wall and increase the effectiveness of each of the said members and the structure as a whole.

It is a further object of this invention to provide structure which will effectively resist the side bending forces on the boom and more particularly to include therein a diaphragm comprised of a continuous substantially flat plate welded to and between the side members, and to certain of the cross tubes.

It is a further object of this invention to provide for an additional diaphragm to be furnished, which may be substantially parallel to and spaced from the first diaphragm, the said diaphragm in turn being similarly fastened to the respective side members and to certain of the tubes.

Other and further objects of this invention will be understood from a consideration of the specification appended hereto, and set forth in the drawings, wherein:

Figure 1 is a top plan view of a boom constructed in accordance with the objects of this invention.

Figure 2 is a side elevational view of the boom shown in Figure 1.

Figure 3 is a sectional view taken about on the line 3—3 of Figure 2, looking in the direction of the arrows.

Figure 4 is a sectional view taken about on the line 4—4 of Figure 2, looking in the direction of the arrows.

Figure 5 is a sectional view taken about on the line 5—5 of Figure 2, looking in the direction of the arrows.

Figure 6 is a fragmentary sectional view, greatly enlarged, of the manner of connection of one of the cross tubes to the side wall of one of the girders, taken on the line 6—6 of Figure 5.

Figure 7 is a sectional view taken about on the line 7—7 of Figure 2, looking in the direction of the arrows.

Figure 8 is an enlarged view taken about in the center of one of the side sections in Figure 7, same being greatly enlarged to show detail.

Figure 9 is a sectional view taken about on the line 9—9 of Figure 2, looking in the direction of the arrows.

Figure 10 is a sectional view taken about on the line 10—10 of Figure 2, looking in the direction of the arrows.

Figure 11 is a somewhat diagrammatic view showing the boom of this invention as being mounted upon a typical machine, and the relationship of the various elements thereof.

Figure 12 is an enlarged vertical cross-sectional view of the left end of the boom shown in Figure 2.

Referring initially to Figures 1, 2 and 11, the boom generally shown and designated as 1, in Figure 1, is shown as being mounted in a machine generally designated 2, which machine comprises a travel supporting structure in the form of a crawler unit designated 3, said unit 3 having mounted thereabove a superstructure 4 in which the various operating machinery is provided, and which is intended to be rotated with respect to the supporting structure 3. The boom 1 is shown as being pivotally supported at 5, upon the superstructure 4, the same being adapted to be raised and lowered by means of a cable 6, in accordance with the conventional operation of the machine.

A dipper stick 7 is shown as being mounted on a shipper shaft 8 supported in the boom intermediate the ends thereof, and adapted to be raised and lowered by the cable 9, connected at the bucket end on the dipper stick 7. The dipper stick is adapted to be reciprocated in the usual saddle block carried on the shipper shaft by cable means 10, so as to extend and retract the same with respect to the boom in accordance with conventional operation. It should be understood that the dipper stick 7 in this particular example, is mounted intermediate or between the respective side members of the boom 1 as will be subsequently explained.

In view of this construction, and in accordance with general known operating characteristics of machines of this type, swinging of the superstructure 4 on the travel supporting means 3, when the dipper stick 7 is extended, will impart to the boom severe twisting stresses and additionally side bending forces are likewise imparted, which are desirably to be reduced to a minimum or at any rate substantially distributed throughout the boom structure as a whole.

With the foregoing in mind, and dealing now with the other figures in the drawings, the boom 1 is shown as being comprised of substantially identical side members 12 and 13, which are provided at their corresponding ends with the foot mounting pivotal members 14 and 15, and at the head thereof with the sheave mounting portions 16 and 17. The side members 12 and 13 are fabricated from channels, and since each side member is substantially the same as the corresponding opposite side member, one will be specifically described at this point. Each of the side members, is comprised of a series of sections, designated A, B, C and D. The section A will be denoted the foot section and is comprised of substantially similar generally triangular shaped opposed sections of channel-like configuration, which are welded at their opposed edges and include a backing strip therein for fastening the respective side members together. The section B is similarly formed, the same being of substantially rectangular outline, the section C being similar to section B, and the section D being very similar to the section A, previously referred to — all of the said sections being formed as generally described.

The sections are thereafter welded at their adjoining ends, so as to comprise the side member as a whole, suitable backing strips being provided at the adjoining ends of each section which are welded in accordance with conventional practice.

As above indicated, there are thus provided two substantially similar box girders, designated 12 and 13, which are provided at substantially their center portions as shown in Figure 7 with a shipper shaft mounting bearing arrangement indicated at 18. Each of the girders 12 and 13 being box-like, includes an outer side wall 19 and an inner side wall 20, as shown in Figures 3 to 10 inclusive, these side walls being the webs of the channels previously referred to. In order to provide for the spacing of the respective girder members 12 and 13, a first cross tube 21 as shown in Figure 1, is mounted at the outer end of the boom structure and extends between and at substantially right angles to the respective girders. This particular cross tube 21, as shown in Figure 9, is fastened to each of the side walls 19 and 20 of the respective girder members 12 and 13, by passing through suitable openings therein, the tube 21 being preferably of round configuration and suitably welded to the respective side walls. After the tube 21 is welded to the respective inner and outer walls 19 and 20, the discs which were previously cut out so as to provide for the insertion of the tube 21 in the respective girder members, are inserted again and placed in line with said inner and outer walls, and securely welded in place so as to provide for substantial continuity of the respective inner and outer walls.

A second tube 22 (see Figures 1 and 5) is similarly fastened to the respective side members 12 and 13, said tube 22 passing through the inner walls 20 and outer walls 19, and being fixed to the respective walls of each of the girder members as was true with the first tube 21, previously mentioned. The discs which were cut out to accommodate the tube, are likewise replaced, and welded in place so as to provide for continuousness of the respective side walls.

A third tube 23 (see Figures 1, 2 and 3) is likewise similarly fastened to the respective inner and outer walls 20 and 19 as was true with the previously mentioned tubes 21 and 22. It will be noted that the tubes 21, 22 and 23 are substantially parallel and extend at right angles between the respective girder members 12 and 13, being fastened firmly thereto preferably by welding, and the said girder members are in effect, continuous members, the tubes 21, 22 and 23 not actually interrupting their continuity but since the discs have been replaced in the ends of the tubes in line with the inner and outer walls, as diaphragms, uniform distribution of the stresses imparted to the tubes is effected.

The tube 22 is preferably fixed to the girder members 12 and 13 as near as possible to the mounting 18 for the shipper shaft, said mounting of the tube 22 being further effected so as to distribute the stresses thereon so as to include the diagonal diaphragms 20, 24, 25, 26 and 27, as shown in Figures 1, 2 and 5, said diaphragms extending from the inner wall adjacent the connection of the tube 22 therewith, to the outer wall at the outer juncture thereof with the upper and lower walls 28 and 29 for each of the respective girder members.

In order to minimize the concentration of side bending forces, and to distribute those forces more uniformly throughout the boom, the tubes 22 and 23 are in effect connected by diaphragms 30 and 31, the diaphragm 30 extending tangentially between the upper portions of the tubes 22 and 23, being connected thereto and likewise welded at the side edges thereof to the inner walls 20 of the girders 12 and 13. The lower diaphragm 31 is similarly connected to the respective tubes 22 and 23 and the inner walls 20 of the girders, said diaphragm being substantially parallel and spaced as will be apparent. It should be understood that either of the above diaphragms may be provided, or both, as the case may be and as the structure of the boom as a whole demands.

While additional tubes may be provided, similar to the tubes 21, 22 and 23, it has been found that the three tubes are sufficient, even in very large booms, so as to adequately distribute the stresses to resist the same by distributing the resisting forces around the complete circumference of the respective tubes wherein the weld connections of the tubes to the side members are uniform.

It should be noted that the use of a large number of cross braces or X-braces has been eliminated, and a very simple and yet effective construction is provided for carrying out the purposes of a boom which is designed to resist twisting stresses and side bending forces during operations thereof, which stresses and forces may be imparted to the boom by reason of a particular type of material handling member carried thereby. It should be understood that the type of machine in which the boom is adapted to be incorporated, is not necessarily limited to that in which a superstructure such as 4 (shown in Figure 11) is adapted to be rotated with respect to a travel supporting structure such as 3. Likewise, the invention is not limited to machines in which the boom 1 is pivoted to the superstructure 4, but is intended to be available for incorporation in machines wherein any twisting stresses or side bending forces are adapted to be imparted thereto by a member such as the bucket 11, or a similar material handling member in operation of the machine.

I claim:

1. A composite boom of the class described, comprising a pair of substantially identical box-like girder members having inner and outer webs, a plurality of tubular cross members spaced along the girder members, the respective ends of the cross members being entered in aligned openings in the inner and outer webs of said girder and being welded thereto around the openings, combined with a pair of diaphragms extending between two of the tubular members and the inner walls of the girder members, said diaphragms being spaced in substantial parallelism about a distance equal to the diameter of the tubular members, and the diaphragms being securely welded to the inner walls aforesaid and tangentially to the tubular members.

2. A composite boom as claimed in claim 1 wherein the boom is provided with shipper shaft bearing means on the inner and outer webs of said girder members at a point intermediate the ends of the boom, and wherein the tubular member to which the outer ends of the spaced diaphragms are attached is re-enforced by diagonal diaphragms extending from the inner web of each girder adjacent the point of connection of the said tube therewith, to the outer web of such girder adjacent the outer juncture thereof with the upper and lower walls of such girder.

3. A composite boom of the class described, comprising a pair of substantially identical girder members having web portions, a pair of tubular cross members spaced along the girder members, the respective ends of the cross members being entered in openings in the web of each girder and being welded thereto around the openings, disc like parts welded within the tubular members in alignment with the webs of the girder members, and a

diaphragm extending between the tubular members and the webs of the girder members, said diaphragm being continuously welded to the said webs and tangentially continuously welded to the said two tubular members.

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