

[54] **COMPOSITE STRUCTURAL MEMBER**  
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**254/124**

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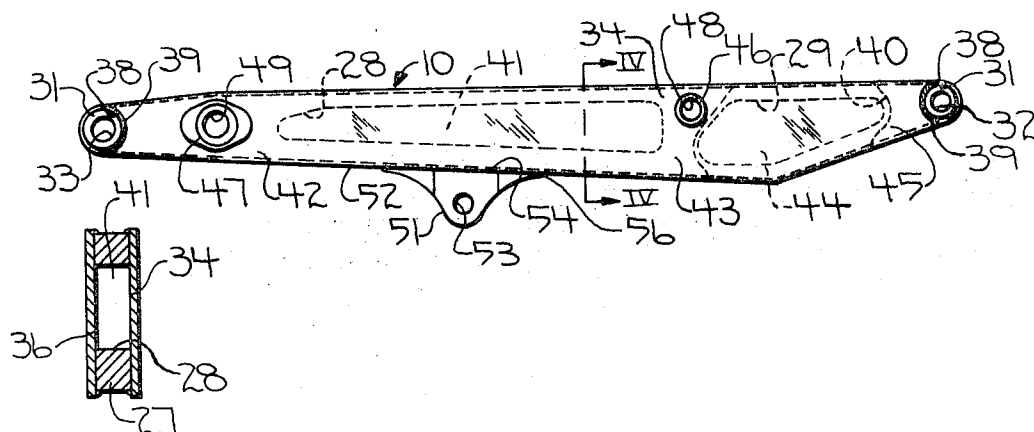
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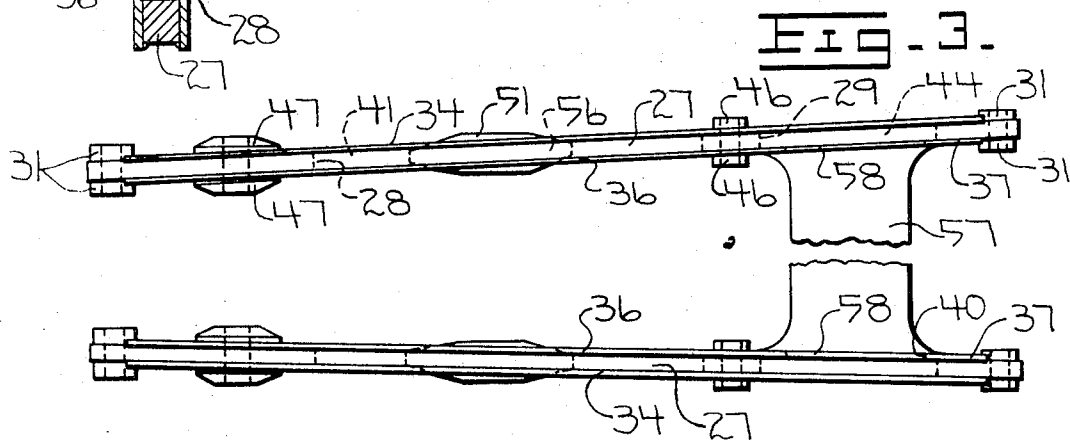
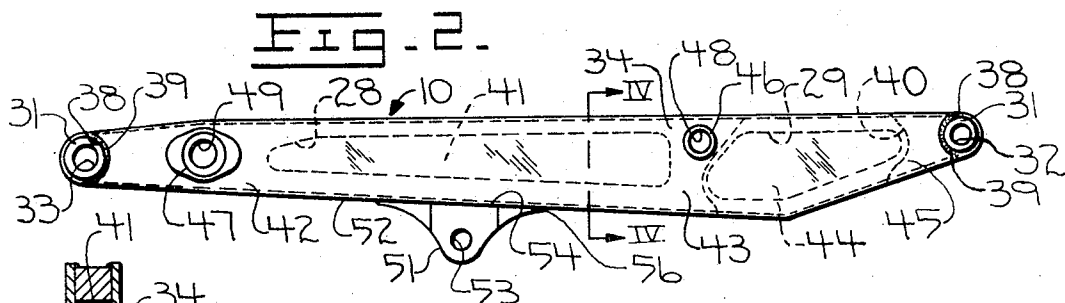
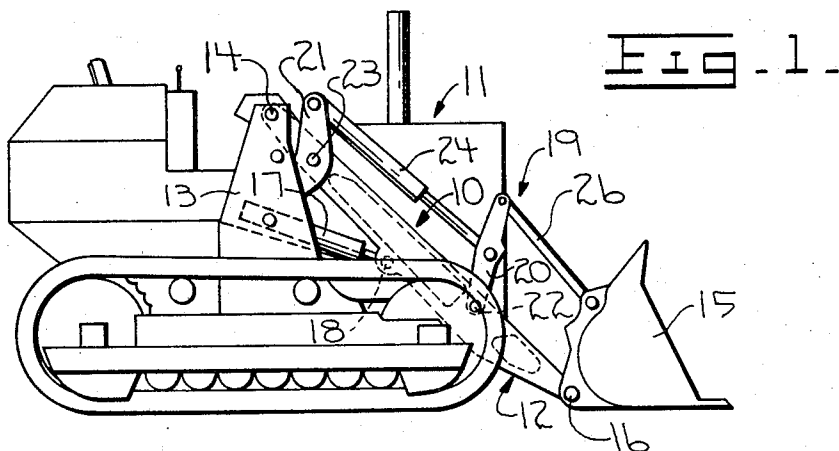
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[57] **ABSTRACT**

An elongated structural member with a central plate having apertures therein intermediate the ends thereof and having side plates secured thereto forming a laminated construction whereby the side plates and apertures form cavities within the structural member to provide a hollow, box-beam cross section for a portion of the length thereof in the areas of minimum stress and to provide solid sections in areas of maximum stress.

**11 Claims, 4 Drawing Figures**





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## COMPOSITE STRUCTURAL MEMBER BACKGROUND OF THE INVENTION

Bucket loaders usually have a pair of lift arms pivotally mounted upon a vehicle frame, which lift arms support a bucket on forward ends thereof. Typical lift arms, such as those shown in U.S. Pat. No. 3,254,780 to Midtbo, are fabricated to form a hollow beam section having tubular bosses integrated therein to provide bearing surfaces for pivot pins or other connections. Although such hollow beam construction utilizes material to advantage by providing a lightweight lift arm, the arrangement is deficient because the weakest points in the construction are generally at the weld joints where the tubular bosses are welded on.

It is also possible to fabricate box-beam structures by constructing a central member having several individual elements. However, such an assemblage requires complicated fixturing for welding and also many joints which create high stress areas which are subject to premature failure on loading.

In other instances, lift arms are composed of a single solid piece of material cut from a plate. Although such constructions are generally stronger than fabricated lift arms, the extra weight of such solid members substantially reduces the pay load that the loader can safely handle.

## OBJECTS OF THE INVENTION

It is an object of this invention to provide an improved structural member, such as a loader lift arm, for supporting an implement mounted thereupon.

Another object of this invention is to provide an improved lift arm structure having cavities therein to reduce the weight thereof.

A further object of this invention is to provide a lift arm structure having a laminated construction comprising a central member sandwiched between a pair of side plates wherein the central member has longitudinally extended apertures therein which provide, in conjunction with the side plates, a hollow box-beam construction for portions of the lift arm, which portions correspond to areas of minimum stress and which provide solid sections in areas of maximum stress.

Other objects and advantages of the present invention will become readily apparent upon reference to the accompanying drawing and following description.

## BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a side elevational view of a lift arm structure embodying the principles of the present invention utilized within a bucket support assembly for a loader-type vehicle.

FIG. 2 is an enlarged side elevational view of the lift arm structure of FIG. 1 removed from the bucket support assembly on the vehicle.

FIG. 3 is a plan view of the lift arm structure of FIG. 2.

FIG. 4 is an enlarged transverse vertical section through the lift arm structure taken on the line IV—IV of FIG. 2.

## DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring more particularly to the drawing, a lift arm structure embodying the principles of the present invention is generally indicated by the reference numeral 10 in association with a loader-type vehicle 11. The vehicle mounts a bucket support assembly, generally designated by the reference numeral 12, which utilizes a pair of lift arm structures fabricated in accordance with the present invention. The lift arm structures pivotally mount the bucket support assembly on a loader frame 13 of the vehicle by means of a pivot pin 14 disposed on each side of the vehicle. It should be noted that the lift arm structure and the associated components of the bucket support assembly are precisely duplicated on the opposite side of the vehicle from that shown in FIG. 1. Accordingly, in FIG. 3, identical reference numbers are applied to corresponding elements of the lift arm structure on either side of the vehicle. Only one set of the components of the bucket support assembly appearing in FIG. 1 will be hereinafter described for convenience and clarity.

A bucket 15 is pivotally mounted upon the distal end of the lift arm structure 10 by means of a pivot pin 16. The lift arm structure and the bucket are raised and lowered by means of a hydraulic jack 17, the rod end of which is pivotally connected by a pin 18 to the lift arm structure at a location intermediate pivot pins 14 and 16.

The bucket support assembly further includes a tilt linkage system 19 which is employed to control and vary the bucket angle in a plurality of load, carry and dump positions. The tilt linkage system includes a lever 20 which is mounted upon the lift arm structure near the distal end thereof and a bell crank lever 21 which is pivotally attached to the proximal end of the lift arm structure by means of pivot pins 22 and 23, respectively. A hydraulic jack 24 extends between the levers 20 and 21 and a link 26 extends between the lever 20 and the bucket to position it angularly with respect to the lift arm structure.

Referring more particularly to FIGS. 2 and 3, each of the lift arm structures 10 includes a one-piece, elongated center member 27. This member is solid except for the presence of elongated apertures 28 and 29 cut therein intermediate the ends thereof to reduce weight in the composite structure and, except for holes provided for receiving pivot pins or the like, the apertures 28 and 29 define solid sections in the center member at each of its ends and centrally thereof between the apertures. Aperture 28 is located between the pins 22 and 23 while aperture 29 is located at the distal end of the lift arm structure approximately between the pins 16 and 22. A plurality of solid forged bosses 31 are welded to the ends of the center member 27 on both sides thereof. Bores 32 and 33 extend through the bosses 31 and the center member adjacent to the opposite ends of the lift arm structure.

A side plate 34, having a profile substantially matching that of the center member, is disposed between the end bosses 31 and is secured to the outer side surface of the center member by means of welding along the corresponding edges of the side plate and center member. A pair of longitudinally-spaced side plates 36 and 37 are individually secured by welding to

the inner side surface of the center member between the end bosses 31 so as to form a laminated-type construction. The bosses 31 extend laterally outwardly beyond the inner and outer side plates. The opposite ends of the side plates 36 and 37 which are adjacent to the bosses 31 and both ends of the side plate 34 have curved portions 38 which correspond to the curvature of the bosses 31. Spaces 39 are provided between the portions 38 and the bosses, which spaces are filled as by welding. The portions of the side plates 36 and 37 which are adjacent to the aperture 29 provide an elongated opening 40 in the inner side of the lift arm structure for receipt of a tubular member 57, described more fully hereinafter.

A cavity 41 is formed in the lift arm structure 10 by the side plates 34 and 36 and the aperture 28 between the solid sections 42 and 43. Another cavity 44 is formed in the lift arm structure by the side plate 34 and the aperture 29 between a solid section 45 and solid section 43.

A pair of sets of bosses 46 and 47 are welded to the side plates 34 and 36 in longitudinally-spaced relation. A bore 48 extends through the bosses 46, center member 27 and side plates 34 and 36. A bore 49 is similarly disposed through the bosses 47, center member 27, and side plates 34 and 36.

A bracket element 51 is welded to a bottom edge portion of the center member 27 and to the side plates 34 and 36 intermediate the proximal and distal ends of the lift arm structure. The bracket element 51 is provided with a bore 53 and has an elongated base portion 54 which provides edges 56 contoured to afford a substantial weld joint for distribution of stress loading to the lift arm structure.

The pair of lift arm structures 10 utilized in the bucket support assembly 12 are rigidly interconnected by a hollow tubular spacer member 57. The tubular spacer member 57 has a flared flange portion 58 at each of its ends. Each such flange portion is disposed in an opening 40 between inner side plates 36 and 37, which opening is contoured to the shape of the tubular spacer member. The spacer member is welded to both the center member 27 and to the side plates 36 and 37 of each lift arm structure to form the integral bucket support assembly.

In view of the foregoing, it is apparent that the structure of the present invention provides an improved lift arm structure having a laminated, box-like construction in which the center member and side plates provide elongated cavities within the lift arm structure to reduce its weight without appreciable sacrifice in strength. Such a construction provides a box-beam cross section for a substantial length of the structure, and also provides solid sections at high stress areas such as pivot pin bores.

The lift arm structure utilizes strength characteristics of a box-beam construction for areas of minimum stress while providing solid sections in the areas of maximum stress. It is also apparent that the one-piece center member provides greatly simplified fabrication and produces a stronger beam than would a conventional multi-piece center member integrated by weld joints in highly stressed areas.

While the invention has been described and shown with particular reference to the preferred embodiment,

it will be apparent that variations and modifications are possible and that such variations and modifications would fall within the spirit of the present invention and the scope of the appended claims.

We claim:

1. A composite structural element for use in mounting a movable implement upon a vehicle comprising; elongated integral center means having opposite end portions and opposite sides surfaces, said elongated integral center means having a plurality of apertures between said opposite end portions which apertures pass completely through said opposite side surfaces of said center means, plate means secured to said opposite side surfaces, said plate means forming a box-like cavity in said composite structural element, load-carrying boss means secured to said structural elements and extending laterally outwardly beyond the confines of said plate means on opposite sides of said structural element, said boss means being disposed on said structural element longitudinally spaced away from said box-like cavity.

2. The invention of claim 1 wherein a plurality of cavities are provided longitudinally between said boss means.

3. The invention of claim 2 wherein said plate means include one plate member extending longitudinally between said opposite end portions of one of said side surfaces and a plurality of plate members extending longitudinally between said opposite end portions on the other of said side surfaces of said elongated integral center means.

4. An elongated structural member adapted to be pivotally mounted on a vehicle for pivotally supporting an implement in outwardly extending relation to said vehicle comprising; a one-piece center member having opposite side surfaces and opposite ends and including an aperture therethrough which forms solid sections at each of said opposite ends, and outer plates having profiles which substantially match that of said center member and which are secured to said opposite side surfaces to form a laminated construction, said outer plates cooperating with said aperture to form a cavity within said structural member which provides a hollow, box beam cross section for a portion of the length of said structural member which portion corresponds to an area of minimum stress and which forms solid sections in areas of said structural member of maximum stress.

5. The structural member of claim 4 including bores extending through said outer plates and said solid sections of said center member individually adjacent to said opposite ends of said structural member.

6. The structural member of claim 4 wherein said center member has a pair of apertures therethrough forming a solid section therebetween and wherein a bore extends through said outer plates and said solid section.

7. The structural member of claim 6 including attachment means for pivotally connecting one end of a hydraulic jack thereto for pivoting said structural member relative to said vehicle.

8. The structural member of claim 7 wherein said attachment means is a bracket element having a bore therein and being secured in depending relation to said center member and said side plates.

9. The invention of claim 4 wherein a rigid, transverse tubular member is disposed in interconnecting relation between said structural member and an identical structural member to form an integral rigid lift arm assembly.

10. An elongated lift arm structure pivotally mountable on a vehicle for pivotally supporting an implement in outwardly extending relation therefrom comprising; a one-piece center member having opposite side surfaces and opposite ends, and having a plurality of apertures therein which define solid sections at each of the ends of said center member and between said apertures; outer plates having a profile substantially matching that of said center member, said outer plates being secured to said opposite side surfaces of said center member and between its opposite ends to form a laminated construction, said side plates and said apertures defining cavities within said structural member to provide a hollow box-beam cross section for a portion

of the length thereof which corresponds to areas of minimum stress and to provide solid sections in portions which correspond to areas of maximum stress; a plurality of bosses individually secured to said side surfaces of said center member adjacent to the ends thereof and extending laterally outwardly beyond said outer plates, and bores extending through said bosses and said solid sections for mounting said implement on said vehicle.

11. The lift arm structure of claim 10 wherein a hydraulic jack is provided for pivoting the lift arm structure relative to said vehicle and wherein an attachment means is included for pivotally connecting one end of said hydraulic jack to said lift arm structure, said attachment means including a bracket element having a bore therein and being secured in depending relation to said center member and said side plates.

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