Dec. 8, 1942. H. E. SWANSON 2,304,486

CROWD FOR BOOM STRUCTURES

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Fig. 1

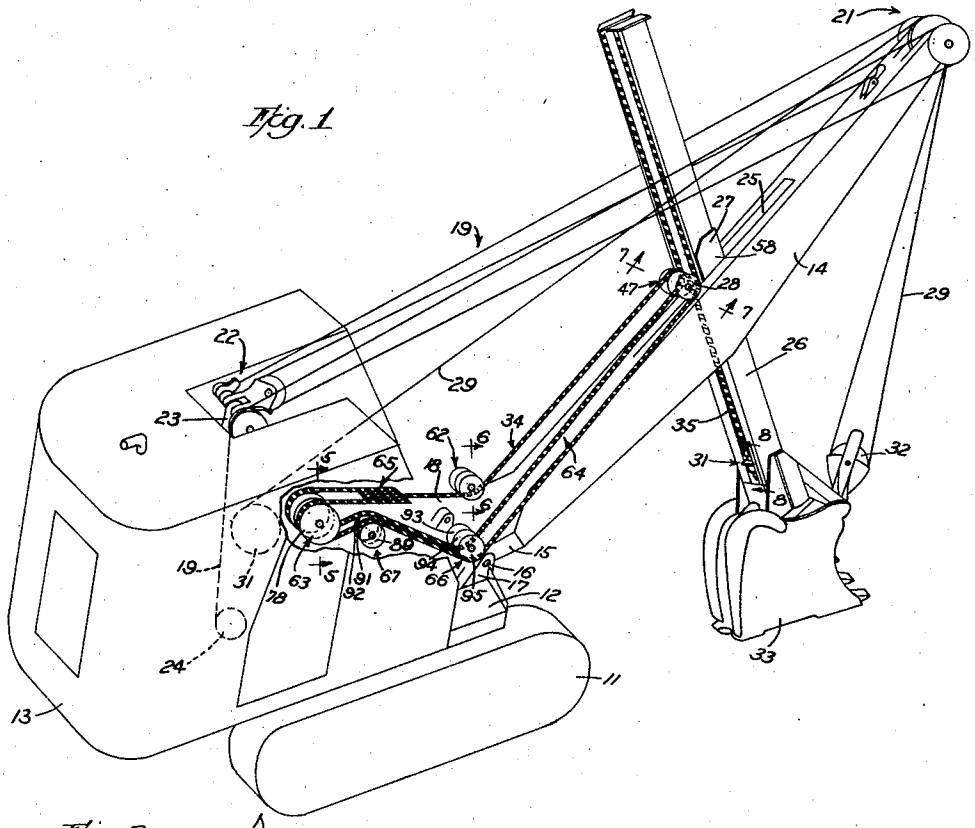


Fig. 2

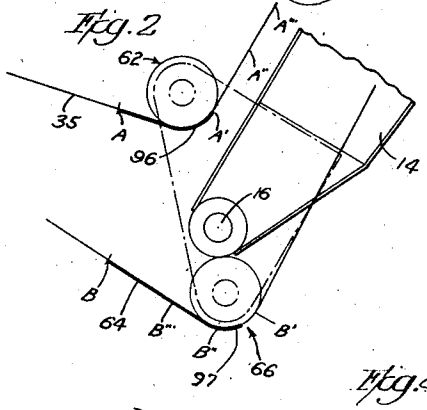


Fig. 3

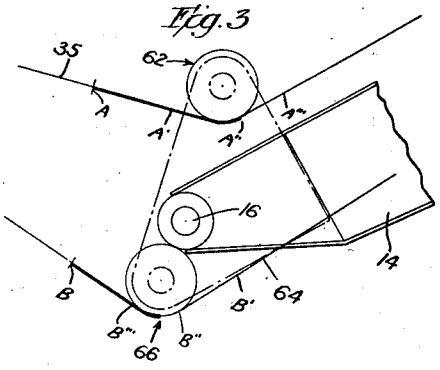
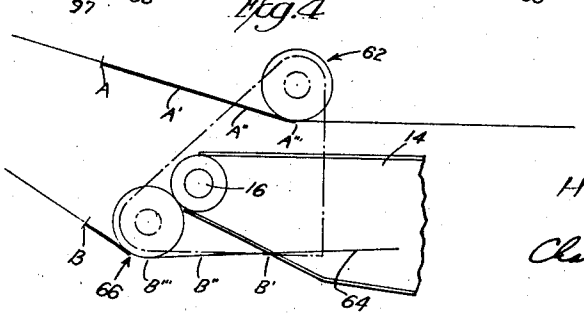


Fig. 4



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Fig. 5

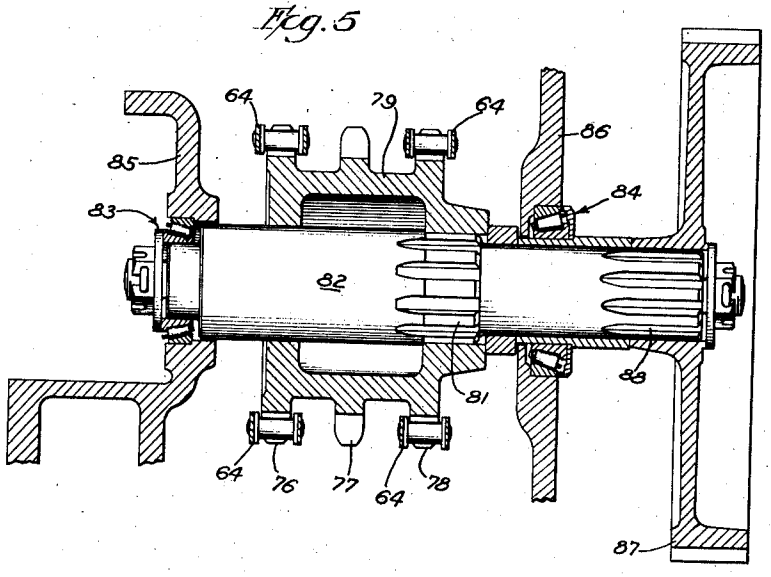


Fig. 6

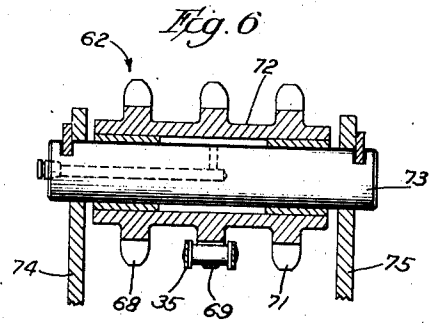


Fig. 7

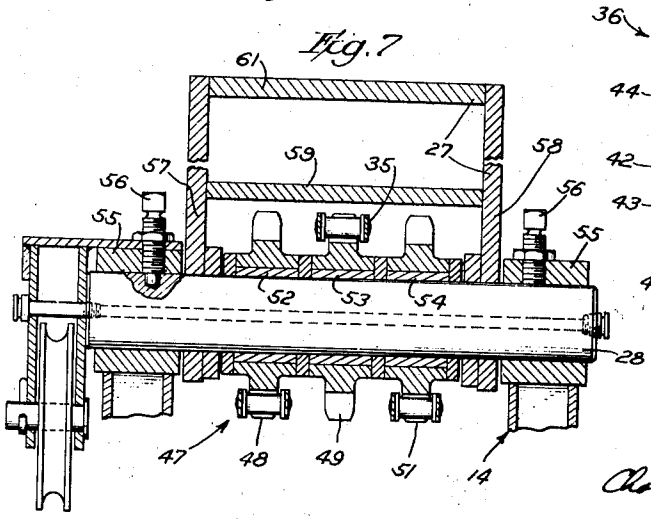
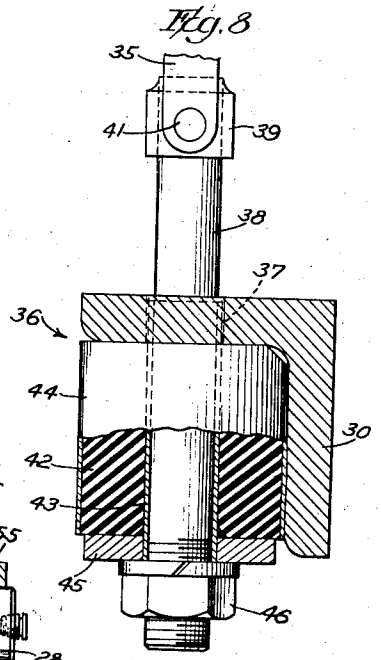


Fig. 8



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CROWD FOR BOOM STRUCTURES

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5 Claims. (Cl. 214—135)

This invention relates in general to boom structures and has more particular reference to a crowding belt assembly therefor that is self-adjusting to expedite adjustment of a live boom about its pivotal footing.

The invention is especially useful in power shovel installations of the character employing a live boom with a dipper stick having a scoop or dipper upon one end. In these installations the dipper stick is conventionally longitudinally adjustable in a mount therefor pivotally secured to an intermediate section of the boom. Boom hoisting cables normally support the boom in a selectively inclined position, and other cables passing over pulleys at the free end of the boom are connected with the dipper for drawing it outwardly from the boom footing with a scooping action while pivoting the dipper stick about the axis in its pivotal mounting. During such scooping action the dipper is crowded downwardly so it will penetrate or slide under material being loaded thereinto. This crowding of the dipper is effected by a crowding belt or chain portion connected with an upper part of the dipper stick and extending downwardly along such stick to and about a belt guide means in the form of a sprocket idler journalled coaxially with the dipper stick mounting, the stick and hence the dipper being urged downwardly when a tensile force is exerted upon a part of the belt extending beyond said belt guide means. A retrieving belt portion, which is connected with the dipper stick at a point below the belt guide means, extends upwardly and about said guide means wherefore exertion of sufficient tensile force upon the part of this second belt portion beyond the belt guide means will retract the dipper stick endwise upwardly in its mounting and thus lift the dipper. Usually these two belt portions are end portions of a single belt of which an intermediate portion is wrapped about a reversing rotor constituting a driver therefor, so that when this rotor is rotated in one direction the aforesaid crowding belt portion will be wound toward and upon the rotor for crowding the dipper while the retrieving portion is payed out to prevent its trammeling of the crowding action, and so that when the rotor is rotated in the opposite direction the retrieving portion will be wound toward and upon the rotor for raising the dipper while the crowding portion is payed out to avoid trammeling the dipper raising action. It follows that when the reversing drum is held fast the crowding and retrieving belt portions necessarily secure the dipper stick against endwise movement in either direction.

In these prior structures the crowding and retrieving belt portions have extended as free flights directly from the guide means on the boom to the reversing rotor and both above the pivotal boom footing. Consequently if the boom should be lowered said flights would first have to be lengthened to permit this adjustment, and, on the other hand, if the boom should be raised said flights would have to be shortened to preserve this proper tautness. Changes in the length of the belt flights has involved the inconvenient step of loosening one of the belt portions at its anchorage on the dipper stick to readjust the overall belt length, wherefore changes in boom elevation have been annoying time-consuming tasks.

A principal object of the invention is the provision of an improved boom structure employing a crowd belt operable to adjust a work member such as a dipper stick in opposite directions, but requiring no auxiliary adjustment pursuant to pivotal movement of the boom upon its footing.

Another important object of the invention is the provision of a live boom structure including crowd and retrieving belt portions having respective flights leading from belt guide means at an intermediate part of the boom to a reversing means for pulling in either of said flights while paying out the other, and also including additional belt guide means adjacently to the boom at its footing and over which said flights respectively pass before reaching said reversing means.

A further important object of the invention is the provision of a live boom structure having additional belt guide means which are spaced transversely of the boom and are upon substantially opposite sides of the pivotal axis for the boom at its footing.

A still further object of this invention is the provision of a live boom structure wherein the belt guide means are mounted upon opposite sides of the boom and upon substantially opposite sides of the axis in its pivotal footing.

Numerous other objects and advantages of the invention will be apparent as it is better understood from the following description, which, when taken in connection with the accompanying drawings, discloses a preferred embodiment thereof.

In the drawings,

Figure 1 is a perspective side view of a power shovel machine embodying a preferred form of the invention;

Fig. 2 is a fragmentary diagrammatic side view

of the footing end of the boom shown in Fig. 1, together with belts and belt guide means in the form of sprocket wheels arranged in accordance with the present invention;

Fig. 3 is a view like Fig. 2 illustrating the relative position of the parts when the boom occupies a different angle of inclination;

Fig. 4 is also a view like Fig 2 but illustrating the parts when the boom is in the horizontal;

Fig. 5 is a sectional view taken through the reversing drive shaft assembly as indicated on the line 5—5 in Fig. 1;

Fig. 6 is a sectional view taken on the line 6—6 of Fig. 1 and showing an idler assembly for the rack-in or retrieving portion of the crowding belt;

Fig. 7 is a sectional view illustrating a shipper shaft assembly, the view being taken on the line 7—7 of Fig. 1; and

Fig. 8 is an enlarged view partly in section of a yieldable anchorage for the rack-in end of the crowding belt, this view being taken as generally as indicated by the line 8—8 in Fig. 1.

Referring to the drawings, the invention is shown in association with a mobile power shovel machine mounted upon crawlers 11, one of which is shown in Fig. 1, at opposite sides of a frame (not shown) on which there is mounted a turntable 12 provided with the usual cab 13 which encloses a power plant, various parts driven thereby and controls therefor which manipulatable by an operator. A live boom 14 has a footing portion 15 pivotally mounted upon a footing pin 16 carried in a pair of spaced-apart upright standards 17 and 18 upon the turntable 12 adjacently to its front edge. The boom 14 is of the beam type and hollow for minimizing its weight. The outer end of the boom is supported by several flights of a hoist cable 19 extending between a pulley assembly generally designated 21 upon the outer end of said boom and a second pulley assembly 22 fastened upon a mount 23 carried by the turntable 12. A drum 24 is adapted to be driven in one direction for winding in the cable 19 for hoisting the boom and for rotation in the opposite direction for paying out the cable and permitting the boom to lower.

A socket 25 at an intermediate section of the boom receives a work member in the form of a dipper stick 26 and also a pivotal mounting member 27 in which the dipper stick is axially movable. Said mounting member 27 is pivotally connected with the boom 14 by means of a shaft 28; see Figs. 1 and 7. Pivotal movement of the dipper stick 26 and of its pivotally supported mounting member 27 is accomplished by a dipper cable 29 of which a section passes over one of the pulleys in the pulley assembly 21 and extends backwardly to a drum 31 in the cab 13. It will be seen that when the drum 31 is driven counter-clockwise, as viewed in Fig. 1, the cable 29 in acting upon a pulley 32 connected with a dipper 33 upon the lower end of the dipper stick will cause the latter to pivot counter-clockwise while the dipper 33 is advanced outwardly and upwardly with a scooping action.

Axial movement of the dipper stick 26 is accomplished by means of a crowd belt 34 which in the present instance is a chain, although it may be a smooth belt or cable if desired. Upward or retrieving movement of the dipper stick is effected by a rack-in or retrieving belt portion 35 of which the free end is connected with a lower portion of the dipper stick by a yieldable anchorage device 36 shown in detail in Fig. 8. Said anchorage device includes a flanged stud 30 secured to the dipper stick in a suitable manner and provided with an aperture 37 in which a bolt 38 is reciprocally mounted. The upper end of the bolt 38 is provided with a transversely apertured head 39 facilitating attachment therewith of the lower link of the belt portion 35 by means of a pin 41. An annular yieldable cushion member 42 which may be of rubber surrounds a shank portion of the bolt 38 immediately below the flanged portion of the stud 30. A metal sleeve 43 is disposed between the cushion member 42 and the bolt 38 while a cylindrical confining sleeve 44 is disposed about the outer periphery of said member 42. The lower end of the sleeve 43 projects endwise below the member 42 where it receives a washer 45 which is held in place by a nut 46 turned upon the lower threaded end of said bolt 38. It will be seen that force applied upwardly to the bolt 38 will cause the washer 45 to press endwise against the cushion member 42 which will yield slightly under the force and thereby provide a yieldable anchorage for the lower end of the belt portion 35.

Said belt portion 35 extends upwardly from its lower end to and about a belt guide means 47 which in the present instance consists of a plurality of idler sprockets 48, 49 and 51 in the shipper shaft assembly shown in detail in Fig. 7. These idler sprockets are carried rotatively upon the shipper shaft 28 where they ride upon bushings 52, 53 and 54. It will also be seen in Fig. 7 that the shipper shaft is held non-rotatively in bushings 55 therefor in the boom 14 by means of set screws 56, and that side plates 57 and 58 of the mounting member 27 for the dipper stick are journalled upon said shipper shaft. The space between transverse plates 59 and 61 is that in which the dipper stick is reciprocally disposed.

From the belt guide means 47 the retrieving belt portion 35 extends backwardly as a flight beneath an additional belt guide means 62 and to and about a reversing drive means 63. The single belt portion 35 is joined to and between the components of a double belt portion 64 as indicated at 65. When the belt portions consist of chains the overlapping sections at 65 are connected by using long pins common to each of the chain portions and for connecting their links together.

The double belt portion 64, for the main part, constitutes the crowd portion of the belt for forcing the dipper stick downwardly. It is connected with the dipper stick near its upper end and from this point extends downwardly to and about the belt guide means 47 in the opposite direction to which the belt portion 35 extends about such belt guide means, the components of this belt portion passing upon either side of the belt portion 35 and about the sprockets 48 and 51 as shown in Figs. 1 and 7. From the belt guide means 47 the crowd belt portion 64 extends downwardly and forwardly as a flight about a second additional belt guide means 66 and over an idler belt guide means 67 to and about the reversing drive means 63.

Referring now to Fig. 6 the belt guide means 62 will be seen to include a plurality of sprocket idlers 68, 69 and 71 integral with a sleeve 72 journalled upon a shaft 73 of which the ends are secured in standards 74 and 75 projecting upwardly from the footing end of the boom 14. The belt portion 35 is shown meshed with the idler sprocket 69 although the sprockets 68 and 71 are adapted to mesh with the components of the double belt portion 64 incident to rotation of the reversing drive means 63 sufficiently

clockwise as viewed in Fig. 1 to displace the double belt portion into registry with the guide means 62.

In Fig. 5 the reversing drive means will be seen to include three driver sprockets 76, 77 and 78, integral with a hub member 79 which is splined at 81 to a countershaft 82. Said countershaft is journalled upon roller-bearing units 83 and 84 in respective walls 85 and 86 of a gearbox. Driving force for rotating the countershaft 82 and hence the sprockets 76, 77 and 78 is received through a gear 87 splined to the counter-shaft at 88. Means (not shown) is provided for selectively driving the gear 87 in either direction. The axial spacing of the sprockets 76 and 78 corresponds to the lateral spacing of the belt components in the crowder belt portion 64 wherefore these sprockets are meshed with the belt portion 64, and the center sprocket 77 is adapted to mesh with the retrieving belt portion 35 when the sprockets 76 and 78 are rotated sufficiently counter-clockwise as viewed in Fig. 1 for advancing the belt portion 35 into registry with said sprocket 77.

The idler guide means 67 also comprises three axially spaced sprockets of which the outermost mesh with the components of the double belt portion 64 and of which the intermediate sprocket is adapted to mesh with the retrieving belt portion 35. These sprockets of the idler belt guide means 67 are designated 89, 91 and 92.

The second of the additional guide means, 66, at the foot of the boom 14 is constructed similarly to the belt guide means 62 shown in detail in Fig. 6, but the sprockets 93, 94 and 95 thereof, corresponding to the sprockets 68, 69 and 67 of the belt guide means 62, are supported upon the boom beneath the pivotal axis in the footing pin 16 instead of above this axis. Such relative position of the additional belt guide means 62 and 66 with respect to the footing pin 16 is illustrated in Figs. 2, 3 and 4.

Manually controlled clutch means (not shown) is provided in the cab 13 for enabling an operator to selectively connect the reversing drive means 63 with the power plant (not shown) for rotation in either direction. When the drive means is thus connected for rotating counter-clockwise the retrieving belt portion 35 will be drawn inwardly for raising the dipper stick while the crowder portion 64 of the belt will be payed out to permit such upward movement of the dipper stick. Clockwise rotation of the reversing means 63 will obviously cause the dipper stick to be moved downwardly for crowding the dipper 33 beneath material to be loaded therein while the dipper stick is pivoted counter-clockwise for advancing the dipper outwardly with a scooping action. Such pivotal movement of the dipper stick is accomplished by winding the cable 29 upon the drum 31 as explained hereinabove.

In Fig. 2 the boom 14 is illustrated at a 60 degree angle of inclination with respect to the horizontal while in Fig. 3 it is shown at a 30 degree angle and in Fig. 4 it is shown in the horizontal position. As explained hereinabove the inclination angle of the boom is controlled by a hoist cable 19, and it is the function of the additional belt guide means 62 and 66 to so control the relative lengths of the belt spans respectively between the guide means 62—66 and said guide means 47 that during pivotal movement of the boom 14 about the axis in the footing pin 16 the ends of these spans at the guide means 47 will co-describe substantially an arc having its point of generation coincident with the axis in said shaft 16. Such regulation of the belt spans respectively between the guide means 62—66 and the guide means 47 will enable the boom 14 to be raised and lowered freely without any trammeling effect of the belt 34 and without any strain upon the latter.

As previously pointed out the additional belt guide means 62 is above the boom pivot pin 16 and the additional guide means 66 is below the pin 16 and the distances between these guide means and the pin 16 is such that the belt portions 96 and 97 contiguous with said belt guide means 62 and 66 will be spaced substantially equal radial distances from said pin. The guide means 62 and 66 are also arranged upon substantially diametrically opposite sides of the pin 16 and in close proximity therewith. With this arrangement of the belt guide means 62 and 66 the sprockets therein will roll along their respective belt portions in opposite directions when the boom is pivoted and the effective rolling distances of said sprockets will be substantially equal. For example, if two points A and B are arbitrarily chosen upon the belt portions 35 and 64 as shown in Figs. 2, 3 and 4 and the points A′ and B′ are determined upon these belt portions at the points of tangency of the aforesaid belt spans (disposed between the belt guide means 62—66 and the belt guide means 47) when the boom is in the 60 degree position shown in Fig. 2, and if tangential points A″ and B″ are determined upon these belt portions like the determination of the points A′ and B′ but when the boom is in the 30 degree position and if tangential points A‴ and B‴ are similarly determined when the beam is in the horizontal, the following table will express the functional relation of distances traversed by the sprockets in the belt guide means 62 and 66 along their respective belt portions:

AA′ plus BB′ equals C
AA″ plus BB″ equals C
AA‴ plus BB‴ equals C

where C is a constant.

It will be seen therefore when the boom 14 is pivoted that the belt guide means 62 and 66 simply roll along their respective belt flights without exerting positive driving force upon the spans extending respectively therefrom backwardly to the reversing drive means 63. When, for instance, the boom 14 is moved clockwise from the 60 degree position in Fig. 2 toward the horizontal position in Fig. 4 the guide means 62 in rolling along the retrieving belt portion 35 will tend to shorten the span between this belt guide means and the belt guide means 47, but, concurrently, the belt guide means 66 will be rolling backwardly upon the crowd belt portion 64 and thereby tend to lengthen the span extending along the beam from this guide means to the guide means 47. Meanwhile as the beam 14 lowers, the guide means 47 will be rotated by the belt portions 35 and 64, counter-clockwise as viewed in Fig. 1, while taking up the increment of belt span payed out by the belt guide means 66 and while paying out into the span of the belt portion 35 enough of such belt portion to compensate for the shortening effect of this span by the forwardly advanced guide means 62. Because of this rotation of the guide means 47 the dipper stick 26 will be elevated relatively to the boom. This however is of no substantial consequence since the operator can

readily adjust the dipper stick to the desired height by manipulating the controls for causing rotation of the reversing means 63 in the proper direction. When the hoisting cable 19 is taken in upon the drum 24 for raising the boom 14 from the horizontal toward the position shown in Fig. 2 the belt guide means 62 and 66 will be moved in the opposite direction along their respective belt portions, thereby causing the guide means 47 to rotate slightly clockwise whereby the dipper stick will be moved endwise downwardly, but again the operator can readily adjust the dipper stick to the desired axial position by manipulation of said controls for causing the reversing drive means 63 to rotate in the desired direction.

It will be seen therefore that I have provided a boom structure in which the crowd belt is expediently operable in either direction for reversing endwise movement of a dipper stick and that the arrangement of the crowd belt is such that it interferes in no way with the raising and lowering of the boom. In this way the machine is made so readily manipulatable that frequent readjustment of the boom to the most advantageous elevation is practicable.

It is thought that the invention and many of its attendant advantages will be understood from the foregoing description, and it will be apparent that various changes may be made in the form, construction and arrangement of the parts without departing from the spirit and scope of the invention or sacrificing all of its material advantages, the form hereinbefore described being merely a preferred embodiment thereof.

I claim:

1. In a boom structure having a boom pivotal about a transverse axis intersecting its footing, and a work member movable in opposite directions on said boom; means for effecting such movement of the work member, comprising belt guide means on tne boom at a position spaced axially thereof from said footing and for rotation about a single axis, second belt guide means disposed adjacent the part of said footing intersected by said footing axis, belt portions connected with said work member at respective positions removed oppositely from said first belt guide means and extending to and circumferentially about such guide means in opposite directions and thence lengthwise of the boom to and about respective of said second belt guide means, and means connected with sections of the belt portions reaching beyond said second belt guide means and operable to pull in either of said belt portions while paying out the other.

2. In a boom structure having a boom pivotal about a transverse axis intersecting its footing, and a work member movable in opposite directions on said boom; means for effecting such movement of the work member, comprising belt guide means on the boom at a position spaced axially thereof from said footing and rotatable about a single axis substantially parallel with the footing axis, second belt guide means disposed adjacent the footing at respective positions spaced transversely of the boom and upon opposite sides of said footing axis, belt portions connected with said work member at respective positions removed oppositely from said first belt guide means and extending to and circumferentially about such guide means in opposite directions and thence lengthwise of the boom to and about respective of said second belt guide means, and means connected with sections of the belt portions reaching beyond said second belt guide means and operable to pull in either of said belt portions while paying out the other.

3. In a boom structure having a boom pivotal about a transverse axis intersecting its footing, and a work member movable in opposite directions on said boom; means for effecting such movement of the work member, comprising belt guide means on the boom at a position spaced axially thereof from said footing and rotatable about a single axis substantially parallel with the footing axis, second belt guide means disposed upon said boom adjacent the part of the footing intersected by said footing axis, said second belt guide means being at respective positions spaced transversely of the boom and upon opposite sides of said footing axis, belt portions connected with the work member at respective positions removed oppositely from said first belt guide means and extending to and circumferentially about such guide means in opposite directions and thence lengthwise of the boom to and about respective of said second belt guide means, and means connected with sections of the belt portions reaching beyond said second belt guide means and operable to pull in either of said belt portions while paying out the other.

4. In a boom structure having a boom pivotal about a transverse axis intersecting its footing, and a work member movable in opposite directions on said boom; means for effecting such movement of the work member, comprising belt guide means upon an intermediate portion of the boom and rotatable about a single axis, belt drive means disposed in a position removed from alignment with said belt guide means and the part of the footing intersected by said footing axis, belt portions connected with said work member at respective positions removed oppositely from said belt guide means and extending to and circumferentially about said guide means in opposite directions, one of said belt portions including components spaced axially of said rotatable guide means on the boom and between which the other belt portion is disposed upon said guide means, said belt portions extending in flights from said guide means to said belt drive means, and second guide means for said flights and disposed adjacently to and respectively above and below the part of the boom footing intersected by said footing axis, said flights being displaced laterally respectively about said second guide means to provide, in each of said flights, a span running generally axially of the boom between its associated second guide means and said first named guide means, and said second guide means being so spaced radially of the footing axis that the parts of the belt flights contiguous therewith are spaced substantially equally from the footing axis and the relative positions of said second guide means circumferentially of said axis being such that the ends of said spans, when moved with said first named guide means about said footing axis, will describe substantially an arc generated about such footing axis.

5. In a boom structure having a boom pivotal about a transverse axis intersecting the footing and projecting generally forwardly from said footing, a dipper stick having upper and lower ends and movable endwise in said boom, and a dipper upon the lower end of said dipper stick; means for effecting such endwise movement of the dipper stick, comprising belt guide means upon an intermediate portion of the boom ad-

jacently to said stick and rotatable about a single axis substantially parallel with the footing axis, reversible belt drive means disposed rearwardly of said footing and out of alignment with said belt guide means and the axis-intersected part of said footing, a crowding belt portion comprising laterally spaced components connected with an upper end section of the dipper stick and extending downwardly thereof to and circumferentially about said guide means in one direction and thence as a flight to said belt drive means, a retrieving belt portion connected with a lower end section of said stick and extending upwardly to and about said guide means in the opposite direction at a section between said belt components and thence as a flight to said drive means, and second belt guide means respectively for said flights and disposed adjacently to and respectively above and below said footing axis, said retrieving belt flight being displaced downwardly about the upper second guide means and said crowding belt flight being displaced downwardly about the lower second guide means whereby said second guide means effect spans in said flights running generally axially of the boom to said first named guide means, and said second guide means being so spaced radially of the footing axis that the parts of the belt flights contiguous therewith are spaced substantially equally from such axis and the relative positions of said second guide means circumferentially of said footing axis being such that the ends of said spans, when moved with said first named guide means about said footing axis, will describe substantially an arc generated about such axis.

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