

[54] MATERIAL HANDLING APPARATUS

1,229,913 12/1966 Germany 198/36

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[57] **ABSTRACT**

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[58] **Field of Search**214/10, 142; 212/48, 49;

198/36; 37/189, 189 B, 190, 190 B

[56] **References Cited**

UNITED STATES PATENTS

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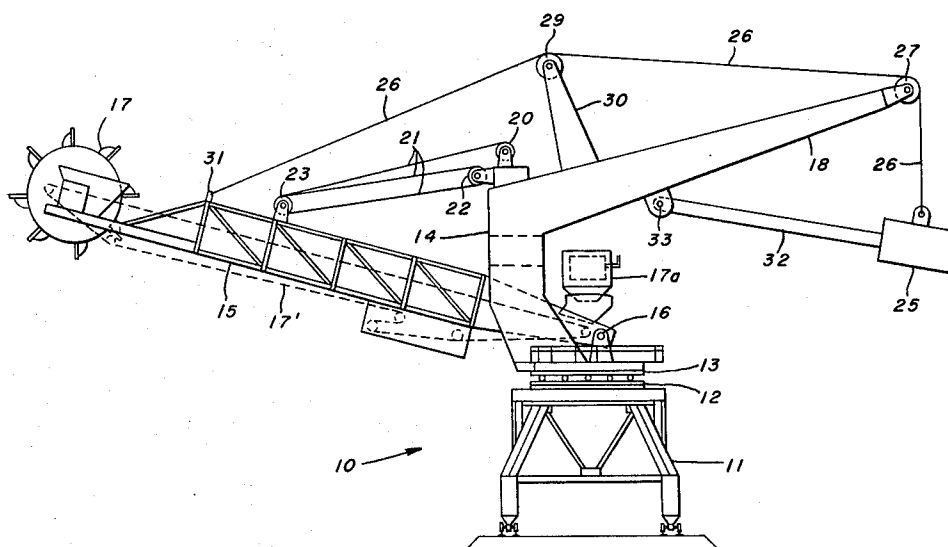
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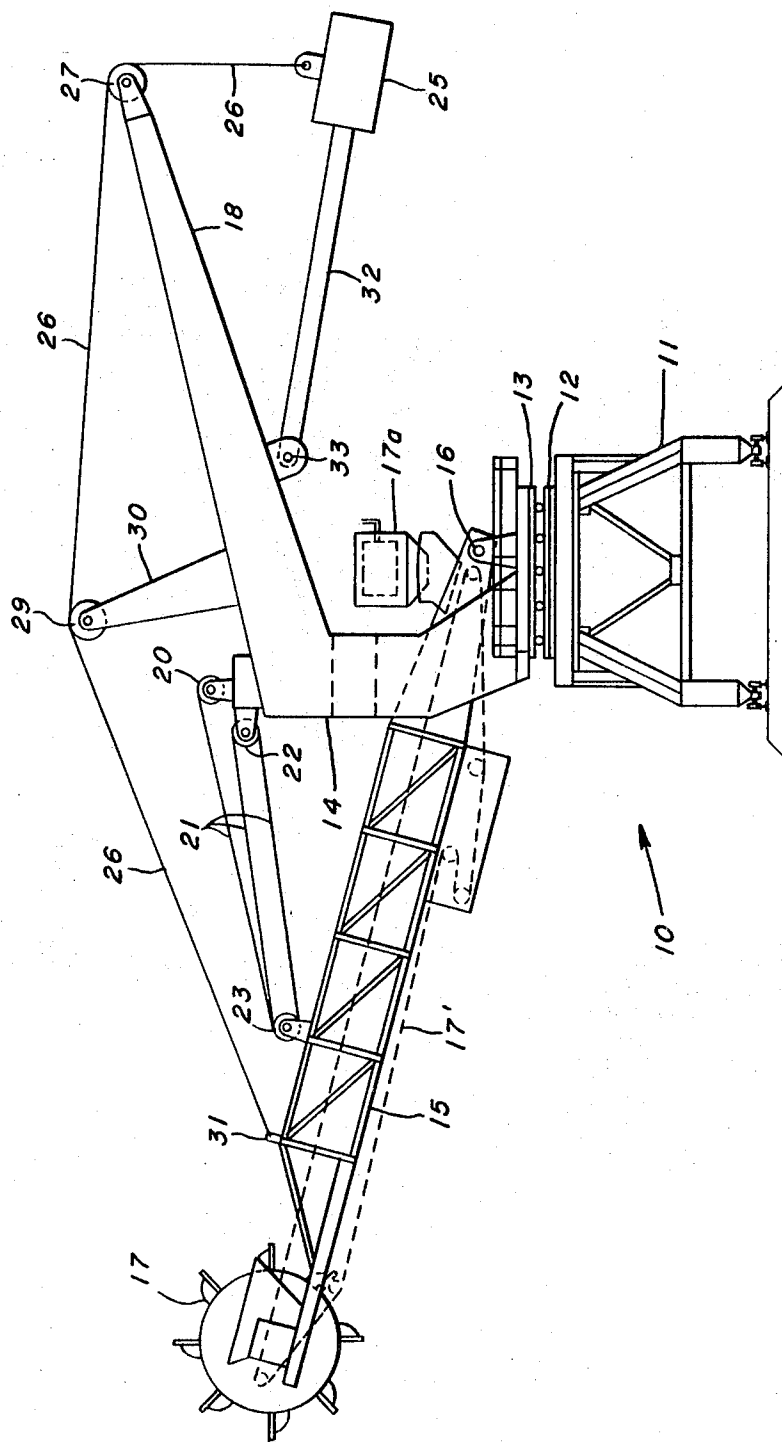
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7 Claims, 1 Drawing Figure

There is shown a mobile material handling structure, such as a bucket wheel stacker and reclaimer having a carriage on which is a turntable structure comprising the turntable itself, with a mast, a load boom pivoted to swing in a vertical arc, and a counterweight at the end of a pivoted strut that extends out beyond the turntable in a direction diametrically opposite the load boom. A cable, connected with the counterweight, passes over the mast and is attached to the boom, so that as the boom swings up or down from a level position, the pivoted strut with its counterweight swings in an opposite direction from a level position. The center of mass of the counterweight is roughly about as far from the center of rotation of the table as the center of mass of the load boom so that the moment arms through which the two masses are effective to counterbalance each other are approximately equal at all times.





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MATERIAL HANDLING APPARATUS

This invention is for material handling equipment, especially traveling material stacking and reclaiming apparatus of the type having a turntable on which is a mast with a boom that is raised and lowered during the operation of the equipment. More specifically the invention is for certain improvements in an apparatus such as shown in allowed application of Laimons Naruns, Ser. No. 687,227, filed Dec. 1, 1967, now U.S. Pat. No. 3,530,999 one of the joint inventors of the invention herein disclosed.

In the said application, it is explained that in equipment of this kind having a wheeled support on which is a turntable structure having a mast and boom thereon, it is common to provide some counterweight arrangement on the mast to counterbalance the boom and thereby prevent the turntable bearings from being unevenly loaded to an excessive degree. It is further explained that if the boom for any reason comes to rest on the ground or on a stack of bulk material, the boom is then ineffective to oppose the weight of the counterbalance, tending to tilt the turntable in a direction toward the counterweighted side. This results in unevenly loading the turntable bearings at the now overweighted side, and even tipping the machine over.

In said copending application, this condition is avoided by providing an outrigger on the mast extending laterally from the mast in a direction diametrically opposite the boom. On this outrigger there is a counterweight, but instead of the counterweight being fixed on the outrigger, it is movable vertically in a cage or guide. A cable attached to the weight is guided over a sheave on the outrigger and over another sheave on the mast with its other end attached to the boom. In this arrangement the weight serves the dual purpose of counterbalancing the weight of the boom in its normal luffing motion, that is, its raising and lowering motion, while also providing the counterweight to equalize the forces on the mast and turntable.

While performing satisfactorily in each of these capacities, the cage or guideway on the outrigger is a cumbersome arrangement, and the guides for the counterweight are exposed to weather and dust and must be kept lubricated. Normally the counterweight may move in a limited distance in the cage, and only at certain times may it travel close to one end or the other of its guides so that these portions of the guides may be neglected or become a possible cause of the counterweight failing to move freely at some critical time.

Also, with the counterweight and outrigger so arranged, the moment arm through which the weight is effective is fixed since the weight moves vertically, whereas the moment arm of the center of mass of the boom constantly changes as the boom moves toward or away from a horizontal position. Expressed differently, the further a weight is moved horizontally away from the center of the turntable, the longer is the lever through which the weight is effective to tilt the table, and the nearer the weight is moved horizontally toward the center of the table, the shorter the leverage and the less the tilting effect. As the boom swings vertically from a horizontal position upward (or downward) the closer in a radial or horizontal direction its weight approaches the center of the table and its tilting effect diminishes, and as the boom moves down toward a horizontal position the tilting effect of the boom on the table increases. As opposed to this, the counterweight on the outrigger as disclosed in said copending application is always the same distance horizontally from the center or center axis of the turntable so that its counterbalancing effect cannot shift as the effective weight of the boom shifts.

The present invention is designed to simplify the construction and reduce maintenance and reduce the likelihood of malfunctioning. Moreover it provides an arrangement to preserve a more nearly uniform balance between the boom and the counterbalance wherein the moment arm through which the counterweight is effective changes generally in proportion to the shifting of the moment arm of the center of weight of the boom. To this end the counterweight is at the outer end of a strut which is pivoted to the mast to move in a

vertical arc, and there is a cable connected with the counterweight, the cable passing over one or more sheaves on the mast structure and its other end is attached to the load boom. The pivoted strut with the counterweight therefore swings down as the load boom is raised, and vice versa. The distance of the counterweight from the center of the table is roughly comparable to the distance from the center of the table to the center of weight of the load boom, so that both are effective through moment arms of comparable lengths. As in the copending application, the counterweight will keep the cable taut if the work boom comes to rest on the ground or heap of material to prevent any substantial uneven distribution of the load to one side of the turntable or mast. It likewise serves a second function of counterbalancing the boom in its luffing motion.

In the accompanying drawing, showing somewhat schematically a preferred embodiment of the invention, the Figure is a side elevation of a bucket wheel bulk material stacker and reclaimers.

Referring to the drawing, there is illustrated the stacker and reclaimers designated generally as 10. It comprises a mobile carriage 11. On the carriage there is a turntable assembly comprising a fixed circular track 12 and a rotatable table 13 with intervening bearings (not shown), this part of the assembly being conventional and well known in the art. Typically a turntable in a machine of this type may be of the order of 18 feet in diameter, a dimension that is mentioned merely as an indication of the massive size and weight of the structure here involved. There is a vertically extending mast 14 mounted on the turntable, the mast as here shown being a so-called C-type of mast, the base of which is eccentrically positioned on the table 13. A load boom 15 extends through the mast and is pivotally supported on the turntable at 16 for movement in a vertical arc. It has a bucket wheel 17 at its outer end, this arrangement also being known in the art, although in many cases an equivalent arrangement is provided where the boom is pivoted to the mast itself, as shown for example in the Naruns application. A usual conveyor belt is indicated in broken lines at 17' for use in the movement of material between the bucket wheel and the carriage. A tripper is indicated at 17a. Such an arrangement is known in the art and the C-type mast is used to clear the tripper as the turntable rotates.

There is a cantilever section 18 on the mast extending in a direction diametrically opposite the direction in which the boom extends. At the top of the mast there is a power-driven winch or luffing drum 20 from which luffing cables 21 are reeved around sheaves 22 on the mast and sheaves 23 on the boom, the end of the cable being dead-ended on either the load boom or the mast. Operation of the luffing drum raises or lowers the load boom in the usual way.

According to the present invention there is a counterweight 25 to which is attached a cable 26 that passes over a sheave 27 on the mast cantilever section and over a sheave 29 on post 30 extending up from the mast with its other end anchored to the boom at 31, preferably at a point beyond the sheaves 23 for the luffing cable.

The counterweight is secured to the outer end of pivoted strut 32 that is carried by some part of the turntable assembly, usually being pivoted to the mast structure where it clears the tripper 17a. It is here shown pivoted on the cantilever portion 18 at pivot 33 which is located on the underside of the cantilever portion 18.

It will be seen that as the load boom lifts or lowers, the cable 26 will cause the counterweight 25 with its pivoted strut 32 to also swing in a vertical arc, but it lowers as the load boom raises, and vice versa. Therefore the long axis of the load boom and the long axis of the strut are at all times at roughly equal but opposite angles to the central axis of the turntable. Thus if the center of mass of the boom is assumed, for purpose of illustration to be about as far from the center axis of the turntable as the sheave 23 in the diagram, and the center of the counterweight 25 is about the same distance from said

axis, the moment arms through which each mass is effective as the load boom swings up or down from horizontal will be about the same. In this way the invention not only eliminates the need for a vertical guide cage for the counterweight, but compensates to a considerable extent for the change in the effect of the increasing or decreasing length of the moment arm of the mass of the boom as it raises and lowers. In addition the counterweight 25 continues to counterbalance the normal luffing action of the boom. At the same time the counterweight 25 along with cantilever section 18 is effective to counterbalance the boom so that the forces on the mast and turntable are for practical purposes counterbalanced. In prior constructions, if the bucket wheel should come to rest on a pile of material or on the ground, the conventional counterweight would then be unbalanced, imposing an excessive unbalanced load on the turntable bearings, and the apparatus might be so unbalanced as to topple toward the counterweighted side. With this invention, if the bucket wheel comes to rest, the counterweighted strut will exert the same pull on line 26, endeavoring to raise the boom and seek to maintain the normal balanced condition that exists when the bucket wheel is in the air and prevent excessive unbalanced loading of the turntable bearings. The apparatus cannot, for this reason, topple toward the counterweighted side.

We claim:

1. In a material handling apparatus of the type having a carriage, a turntable assembly on the carriage comprising a turntable, a mast structure on the turntable, a load boom pivotally connected with the turntable for movement in a vertical arc and a hoisting drum and cable for raising and lowering the load boom, the invention comprising:

- a. a strut extending in a direction diametrically away from the boom pivotally connected at one end with a part of the turntable assembly for movement in a vertical arc,

- b. a counterweight on said strut,
- c. a second cable of fixed length fixedly connected at one end with said counterweight, and
- d. the mast structure having sheaves thereon over which the cable passes, the other end of the second cable being fixed to the load boom between its pivotal connection to the turntable and its working end.

2. The invention defined in claim 1 wherein the radial distance from the center of mass of the load boom to the axis of rotation of the turntable is at least roughly comparable to the distance from the center of mass of said counterweight to said axis.

3. The invention defined in claim 1 wherein the loadboom and the pivoted strut are arranged through said cable to move in substantially equal but opposite vertical arcs with respect to the horizontal when the load boom is being raised or lowered.

4. The invention defined in claim 1 wherein the pivoted strut with its counterweight are arranged to keep said cable taut at all times whether or not the free end of the boom is resting on the ground or on a stack of material.

5. The invention defined in claim 1 wherein the strut is pivotally attached to the mast at a level above the level where the load boom is pivotally attached to the turntable.

6. The invention defined in claim 1 wherein the apparatus is a stacker-reclaimer and the mast is a C-mast with a cantilever portion extending therefrom in a direction diametrically opposite the boom and said strut is pivotally attached to said cantilever portion and extends under said cantilever portion with its free end pointing in the direction of the free end of the cantilever structure.

7. The invention defined in claim 6 wherein the sheave for said cable is at the free end of the cantilever portion of the mast.

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