

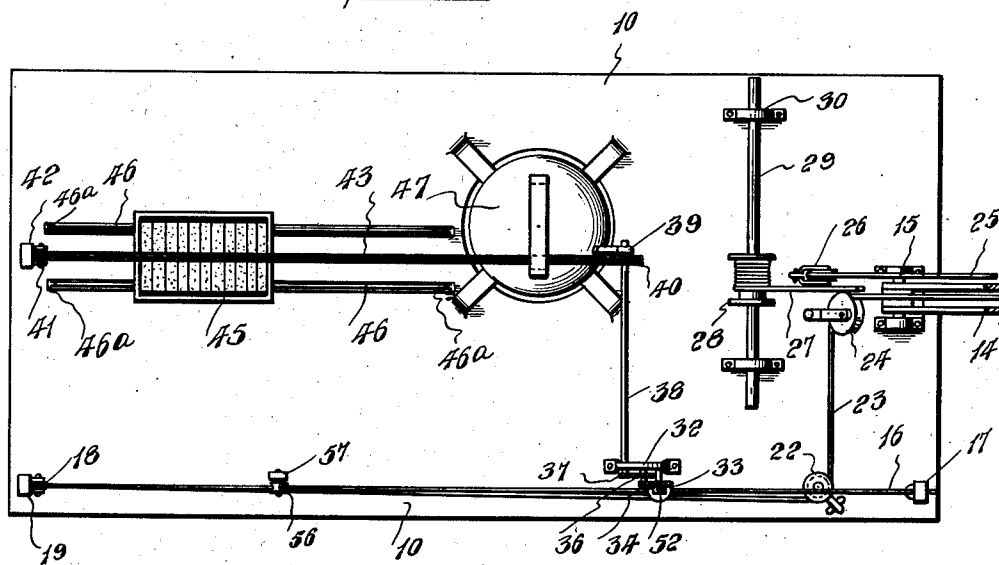
E. T. HIGHT

COUNTERBALANCING MEANS FOR HOISTING APPARATUS

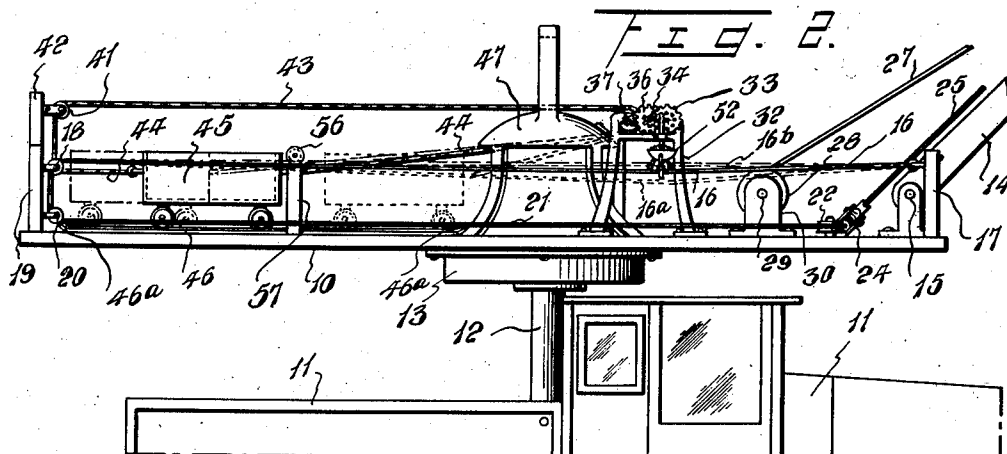
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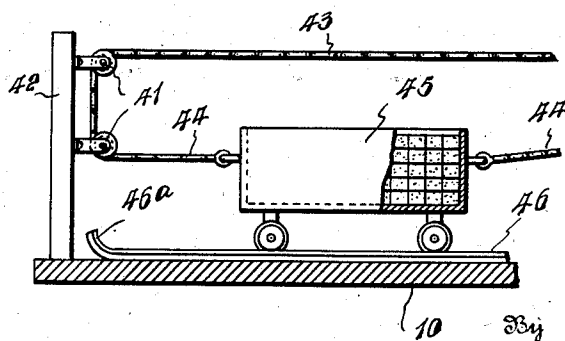
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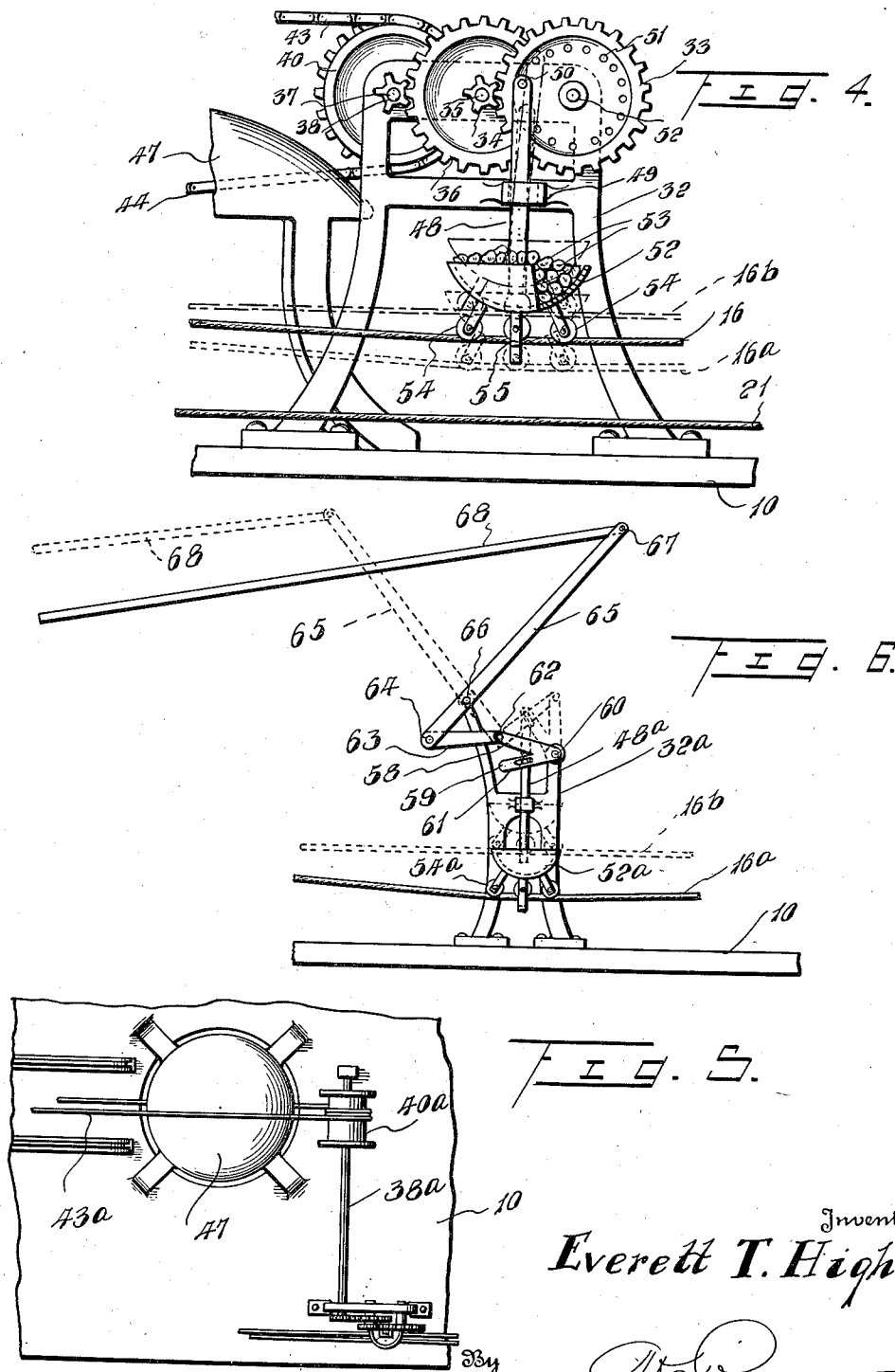
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COUNTERBALANCING MEANS FOR HOISTING APPARATUS

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3 Sheets-Sheet 2



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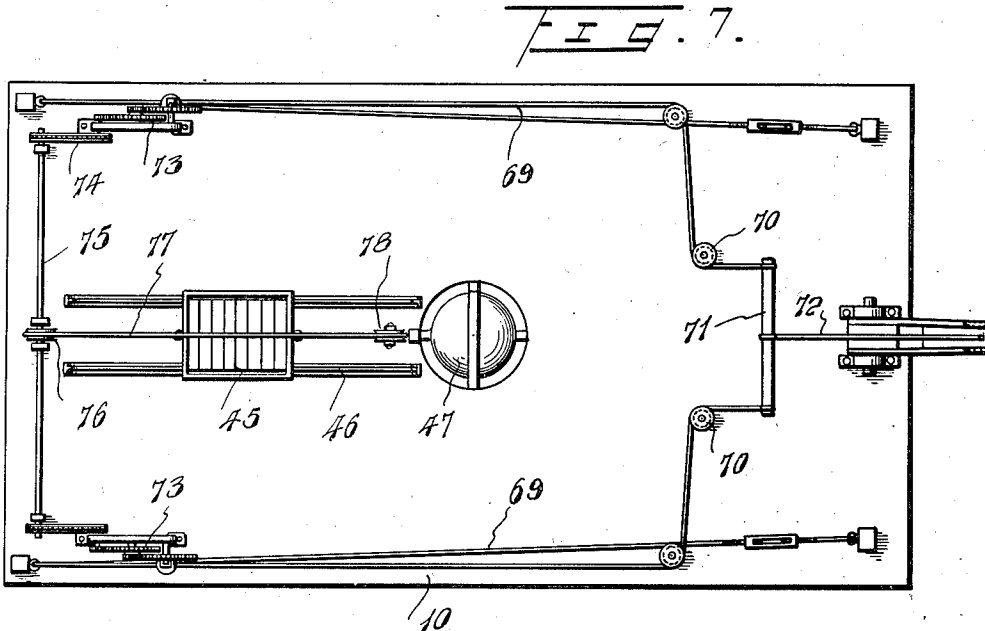
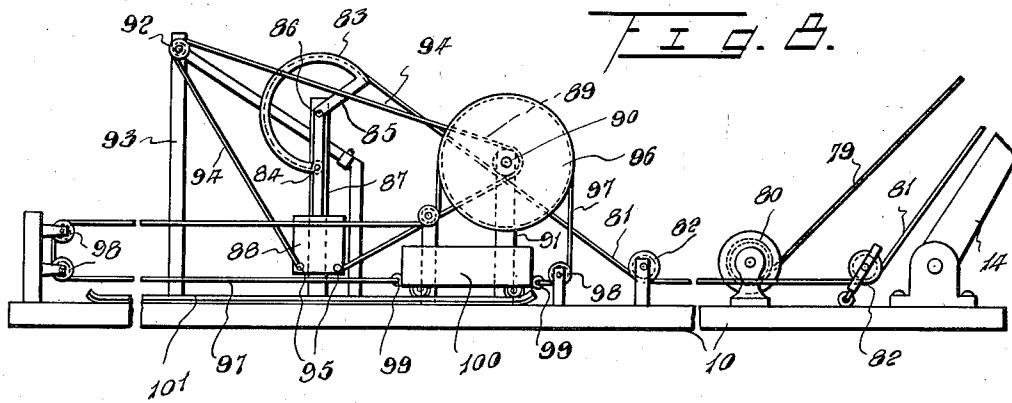
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COUNTERBALANCING MEANS FOR HOISTING APPARATUS

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3 Sheets-Sheet 3



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COUNTERBALANCING MEANS FOR
HOISTING APPARATUS

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8 Claims. (Cl. 212-49)

This invention relates to certain new and useful improvements in counter-balancing means for hoisting apparatus.

The primary object of the invention is to provide counter-balancing means for hoisting apparatus, power shovels and like equipment wherein a swinging arm or boom is employed for lifting weight or weighted materials, the counter-balancing means compensating for weight added to the free swinging end of the boom for maintaining the equilibrium of the frame structure of the hoisting apparatus or the like.

A further object of the invention is to provide counter-balancing means of the foregoing character wherein a weighted element is shifted automatically toward and away from the pivoted end of a swinging boom for counter-balancing the frame structure of the apparatus when weight is added to the boom.

With the above and other objects in view that will become apparent as the nature of the invention is better understood, the same consists in the novel form, combination and arrangement of parts hereinafter more fully described, shown in the accompanying drawings and claimed.

In the drawings:—

Figure 1 is a top plan view of the platform section of a hoisting machine showing the counter-balance in the form of a weighted car operatively engaged with the hoisting cable of a swinging boom;

Figure 2 is a side elevational view showing the platform structure supported on a motor vehicle truck for rotatable adjustment;

Figure 3 is a fragmentary elevational view, partly in section showing the weighted car constituting the counter-balance mounted on tracks carried by a platform;

Figure 4 is a fragmentary side elevational view showing the gear train associated with one of the runs of the hoisting cable for the operation of the counter-balance;

Figure 5 is a fragmentary top plan view showing a cable drive for the weighted car to be substituted for the chain drive shown in Figure 1;

Figure 6 is a fragmentary side elevational view showing the substitution of a series of links and levers for the gear train shown in Figure 4;

Figure 7 is a top plan view similar to Figure 1 of another form of operating means for the weighted car counter-balance; and

Figure 8 is a side elevational view, partly broken away, showing another form of operating means for the weighted car counter-balance.

The hoisting apparatus comprises a rectangular

platform 10 illustrated in Figure 2 as being superposed upon a motor vehicle truck 11 for rotatable movement by means of the vertical shaft 12 carrying a casing 13 at its upper end and beneath the platform 10 that houses mechanism to effect rotatable adjustment, but which does not form the basis of the present invention. One end of the platform 10 has a boom 14 pivotally supported thereon as at 15 for vertically swinging movement and the cable effecting the swinging movement of the boom 14 has one cable section 16 thereof anchored to a standard 17 rising from the end of the platform carrying the boom and at one side thereof as shown in Figure 1. The cable section 16 will hereinafter be referred to as the upper run and extends rearwardly for passage over a pulley 18 at the upper end of a standard 19 carried by the opposite or rear end of the rear platform 10 and at the side thereof in line with the forward standard 17. The upper run 16 of the cable is then directed downwardly for passage over the pulley 20 at the lower end of the standard 19 and is then directed forwardly to form the lower run 21 which passes over a pulley 22 adjacent the forward end of the platform and then angularly directed as at 23 for passage over a pulley 24 adjacent the pivoted end 15 of the boom 14 to be extended to the free swinging end of the boom and doubled several times upon itself as at 25 for passage over a pulley block 26 anchored to the forward end of the platform with the end 27 of the cable wound upon the drum 28 fixed to the shaft 29 journaled transversely of the platform 10 in bearings 30. The shaft 29 constitutes the drive shaft of the apparatus and may be driven in any suitable manner, such as by operative connections (not shown) with the mechanism in the casing 13.

The counter-balance is shiftably mounted upon the platform 10 to compensate for weight added to the swinging end of the boom 14 and is controlled in its operation by tension placed on the boom cable and particularly the upper cable run 16, the counter-balance and the operating means therefor being shown in Figures 1 to 4. A frame structure 32 rises from the platform 10 adjacent the cable runs 16 and 21 and rearwardly of the drive shaft 29 for the support of the gear train and means operated by the upper run 16 of the cable for the operation of the gear train. As shown in Figure 4, the gear wheel 33 rotatably mounted on the upper end of the frame structure 32 meshes with a pinion 34 carried by a shaft 35 that has the gear wheel 36 fixed thereto and said gear wheel 36 meshes with a pinion 37 fixed to

the shaft 38. One end of the shaft 38 is journaled in the frame structure 32 and the other end of the shaft 38 is journaled in a standard 39 rising from the platform 10 adjacent the center line thereof and said shaft 38 adjacent the standard 39 has a sprocket wheel 40 fixed thereto. An endless sprocket chain passes over the sprocket wheel 40 and also passes over the smaller vertically spaced sprocket wheels 41 carried by the standards 42 rising from the rear end of the platform 10 in a manner to provide upper and lower sprocket chain runs 43 and 44, the lower run 44 being split as shown in Figure 3 for attachment to a weighted wheeled car 45 running on tracks 46 mounted on the platform 10. The upper run 43 of the chain connected to the weighted car extends over the housing 46 that rises above the platform 10 to cover a part of the mechanism in the casing 13, not shown, and one lower run section 44 travels through the housing 46 as illustrated in the several figures.

The operating means for the gear train as shown in Figure 4, is interposed between the gear train and upper run 16 of the boom cable and includes a vertically shiftable arm 48 guided in its movement to a guide bracket 49 carried by the frame structure 32, the upper end of the arm 48 being pivotally attached as at 50 eccentrically to the gear wheel 33, the latter being provided with a circular series of pivot openings 51 to vary the position of the arm pivot 50 relative to the gear wheel 33 for purposes presently to appear. A basket or receptacle 52 is carried by the lower end of the arm 48 for the reception of weight elements 53 and guide rollers 54 depend from the receptacle 52 for rolling contact with the upper run 16 of the cable and retained in tracking engagement therewith by the guide strap 55. The gear ratio may be five to one, one fifth turn of the gear wheel 33 causing one complete revolution of the pinion 34 and gear wheel 36 of the shaft 35 and a complete revolution of the gear wheel 36 effects five complete revolutions of the pinion 37 and sprocket wheel 40 keyed to the shaft 38 so that the weighted car 45 will travel a distance over the tracks 46 equal to five revolutions of the sprocket wheel 40. The apparatus is initially set to accomplish proper counter-balancing of the boom 14 when unloaded and such setting is accomplished by adding proper weights to the car 45 and receptacle 52 at the lower end of the arm 48 as shown in Figure 4 as well as determining the proper point of pivotal connection between the upper end of the arm 48 and the gear wheel 33.

The upper run 16 of the boom cable is shown at 16a in Figure 1 in its lowest untensioned position with the boom unloaded and also illustrated at 16b in its uppermost position and tensioned by weight on the boom with the weighted receptacle 52 on the arm 48 at its limit of upward movement as shown by dotted lines. When weight is added to the boom 14 during use of the hoisting apparatus, tension is placed on the upper run 16 of the boom cable with the tendency for the upper run 16 to straighten and be elevated a distance proportional to the weight added to the boom and during such movement of the upper run 16 of the boom cable, the weighted receptacle 52 is elevated as illustrated by dotted lines in Figure 4 to effect rotation of the gear train and operation of the sprocket chain runs 43 and 44 for movement of the weighted car 45 over the track 46 in a direction toward the rear end of the platform 10 and away from the pivot-

ally mounted end of the boom 14 to effect counter-balancing of the apparatus and weight added onto the boom. The upper run 16 of the boom cable is further guided in its movement by the pulley 56 at the upper end of the standard 57 as shown in Figure 2, while movements of the weighted car 45 in opposite directions is limited by the upturned ends 46a of the tracks 46 as shown in Figures 1 to 3. When tension on the upper run 16 of the boom cable is relieved upon removal of work or weight, from the boom 14, the run 16 slackens with a corresponding lowering movement of the weighted receptacle 52 and reversed operation of the gear train to cause the weighted car 45 to move toward the forward end of the platform 10 and still maintain counter-balancing of the apparatus and boom 14.

It is also intended to operate or shift the weighted car 45 by means of a cable as shown in Figure 5 in lieu of the sprocket chain 43, the cable 43a that is connected to a weighted car is wound upon a drum 40a that is substituted for the sprocket wheel 40 of Figure 4, the drum 40a being fixed to the shaft 38a which in turn is operated by the remainder of the gear train mechanism of Figure 4.

It is further intended to employ a system of links and levers in lieu of the complete gear train illustrated in Figure 4, and as shown in Figure 6, the frame structure 32a has an arm 48a mounted thereon for vertical movement with a weighted basket or receptacle 52a at the lower end of the arm. A bell crank lever comprising legs 58 and 59 is pivotally mounted at 60 on the frame structure 32a and the vertically moving arm 48a has a pin and slot connection 61 with the bell crank leg 59. The free end of the bell crank leg 58 is pivotally connected at its free end as at 62 with a link 63, the other end of which is pivoted as at 64 to a lever 65 pivotally mounted on the frame structure 32a as at 66. The other end of the lever 65 is pivotally attached as at 67 to one end of a push rod 68 that is attached at its other end to a weighted counter-balancing car, such as shown at 45 in Figure 3. The weighted receptacle 52a carries rollers 54a cooperating with the upper end 16 of the boom cable. The upper run of the boom cable is illustrated at 16a in its lowered position in full lines and is further illustrated by dotted lines at 16b in its uppermost position for the operation of the links and levers together with the push rod 68 for shifting the weight of the car for counter-balancing weight added onto the boom 14.

In the forms of invention illustrated in Figures 1 to 6, the boom cable 16 that effects operation of the weighted counter-balancing car 45 is located adjacent one side edge of the platform 10, while in Figure 7, the boom cables are duplicated for further counter-balancing of the platform with a boom cable section located adjacent each side edge of the platform and being operatively engaged with the weighted car from the rear end of the platform. As shown in Figure 7, a boom cable arrangement 69 similar to the boom cable shown in Figures 1 and 2 is arranged at each side of the platform 10, the forward ends of the cables 69 passing over guide pulleys 70 and attached at their forward ends to a cross bar 71 adjacent the forward end of the platform 10 and to which bar 71 a boom cable 72 is attached. The boom cable arrangements 69 are illustrated as associated with a gear train mechanism 73 at each side of the platform adjacent the rear end thereof and similar to the gear train shown in

Figure 4 and said gear train has sprocket chain connections 74 with a cross shaft 75 journaled at the rear end of the platform. A pulley 76 is fixed to the shaft 75 intermediate its ends and over which the cable 77 passes, the cable 77 also enclosing a guide pulley 78 adjacent the mechanism housing 47 and said cable 77 is operatively engaged with the weighted counter-balancing car 45 rolling on the tracks 46. With an arrangement of this character, the platform 10 is balanced in all directions.

In Figure 8 of the drawings, another form of operating means for a counter-balancing weighted car is illustrated, the platform 10 carrying a swinging boom 14 while the cable 79 extending from the drum 80 extends to the outer end of the boom 14 with the return run 81 thereof passing over guide pulleys 82 carried by the platform and being engaged with a segment 83 with the terminal end of the cable run 81 anchored to the segment 83 as at 84. The segment is carried by an arm 85 that is pivotally mounted as at 86 upon a standard 87 and the lower end of the arm 85 carries a counter-balancing weight 88. A pulley 89 is mounted on a shaft 90 at the upper end of a standard 91 rising from the platform 10 and a pulley 92 is journaled on the upper end of a standard 93 rising from the platform. A cable 94 passes over the pulleys 89 and 92 and the opposite ends thereof are attached at 95 to opposite sides of the counter-balancing weight 88 on the lower end of the arm 85. A relatively large pulley 96 is fixed to the shaft 90 carrying the pulley 89 and a cable 97 passing over the pulley 96 is guided in its movement by pulleys 98 carried by the platform with opposite ends of the cable 97 attached as at 99 to a weighted counter-balancing car 100 mounted on the tracks 101 carried by the platform 10. When the boom cable 81 is placed under tension by the presence of weight added to the boom 14, the segment 83 is rotated on its pivotal mounting 86 against the tension of the weight 88, movement of the weight 88 operating the cable 94 for rotating the relatively large pulley 96 for the operation of the counter-balancing weighted car 100.

From the above detailed description of the invention, it is believed that the construction and operation thereof will at once be apparent and while there are herein shown and described the preferred embodiments of the invention, it is nevertheless to be understood that minor changes may be made therein without departing from the spirit and scope of the invention as claimed.

I claim:—

1. In a hoisting machine, a swinging boom and cable associated therewith, and means operated by the cable when the boom is loaded for counterbalancing the weighted boom, said means including a weighted element movable in a horizontal path towards and away from the boom, a gear train, a drive connection between the gear train and weighted element and a rod connected to the gear train and depending therefrom and operated by the cable when the latter is placed under tension by a load on the boom for operating the gear train to effect movement of the counterbalancing weighted element.

2. In a hoisting machine, a swinging boom and cable associated therewith, and means operated by the cable when the boom is loaded for counterbalancing the weighted boom, said means including a weighted element movable in a horizontal path towards and away from the boom, a gear train carrying a depending variably weighted arm

resting on a run of the cable and adapted to be raised by the run of the cable when the boom is loaded for operating the gear train, and a chain and sprocket connection between the gear train and weighted element.

3. In a hoisting machine, a swinging boom and cable associated therewith, and means operated by the cable when the boom is loaded for counterbalancing the weighted boom, said means including a weighted element movable in a horizontal path towards and away from the boom, a gear train carrying a depending variably weighted arm resting on a run of the cable and adapted to be raised by the run of the cable when the boom is loaded for operating the gear train, a drum rotatable by the gear train and a cable connection between the drum and weighted element.

4. In a hoisting machine, a swinging boom and cable associated therewith, and means operated by the cable when the boom is loaded for counterbalancing the weighted boom, said means including a weighted element movable in a horizontal path towards and away from the boom, a gear train, an operating arm for the gear train having one end attached to a gear and depending therefrom, a weighted receptacle on the lower end of the arm carrying guide rollers resting on an adjacent run of the boom cable and adapted to be raised by the cable when tension is placed on the cable by loading the boom for the operation of the gear train and operative connections between the gear train and weighted element.

5. In a hoisting machine, a swinging boom and cable associated therewith, and means operated by the cable when the boom is loaded for counterbalancing the weighted boom, said means including a weighted element movable in a horizontal path towards and away from the boom, a gear train, an operating arm for the gear train having one end attached to a gear and depending therefrom, a weighted receptacle on the lower end of the arm carrying guide rollers resting on an adjacent run of the boom cable and adapted to be raised by the cable when tension is placed on the cable by loading the boom for the operation of the gear train and operative connections between the gear train and weighted element, including chain and sprocket mechanism.

6. In a hoisting machine, a swinging boom and cable associated therewith, and means operated by the cable when the boom is loaded for counterbalancing the weighted boom, said means including a weighted element movable in a horizontal path towards and away from the boom, a gear train, an operating arm for the gear train having one end attached to a gear and depending therefrom, a weighted receptacle on the lower end of the arm carrying guide rollers resting on an adjacent run of the boom cable and adapted to be raised by the cable when tension is placed on the cable by loading the boom for the operation of the gear train and operative connections between the gear train and weighted element including a drum operated by the gear train and a cable connection between the drum and weighted element.

7. In a hoisting machine, a swinging boom and cable associated therewith, and means operated by the cable when the boom is loaded for counterbalancing the weighted boom, said means including a weighted element movable in a horizontal path towards and away from the boom, a gear train carrying a depending variably weighted arm resting on a run of the cable and adapted to be raised by the run of the cable when the

boom is loaded for operating the gear train, and a chain and sprocket connection between the gear train and weighted element, the weighted element comprising a wheeled car, a guide track for the car and car stops at the ends of the tracks.

- 5 8. In a hoisting machine, a swinging boom and cable associated therewith, and means operated by the cable when the boom is loaded for counterbalancing the weighted boom, said means including a weighted element movable in a horizontal path towards and away from the boom, a gear train, an operating arm for the gear train

having one end attached to a gear and depending therefrom, a weighted receptacle on the lower end of the arm carrying guide rollers resting on an adjacent run of the boom cable and adapted to be raised by the cable when tension is placed on the cable by loading the boom for the operation of the gear train and operative connections between the gear train and weighted element, the weighted element comprising a wheeled car, a guide track for the car and car stops at the ends of the tracks.

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