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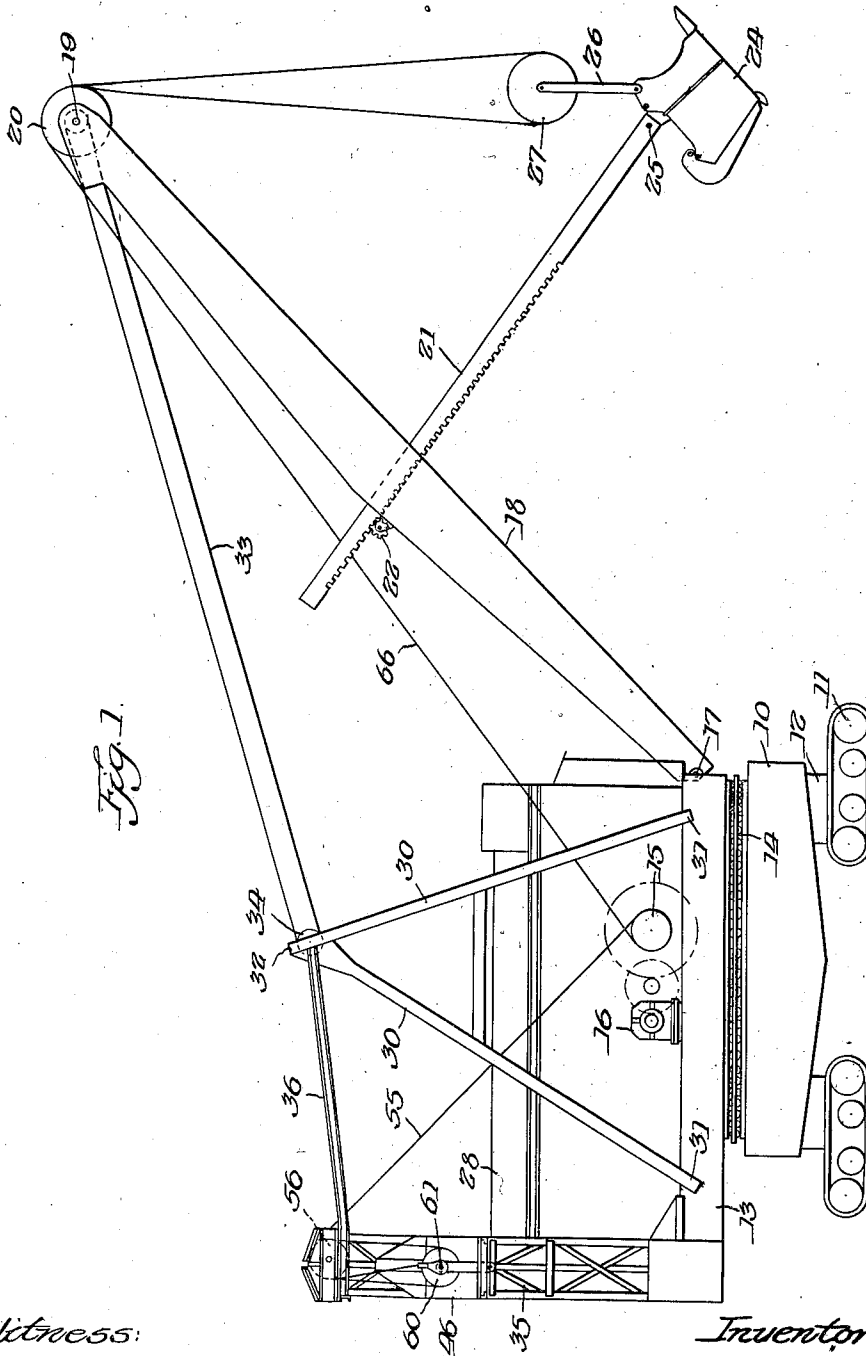
J. PENGLASE

2,173,341

POWER EXCAVATOR

Original Filed Oct. 20, 1930

3 Sheets-Sheet 1



Witness:

R.B. Dawson:

Inventor:

Joseph Penglase:

By: Vrsina and Raulo
Attys

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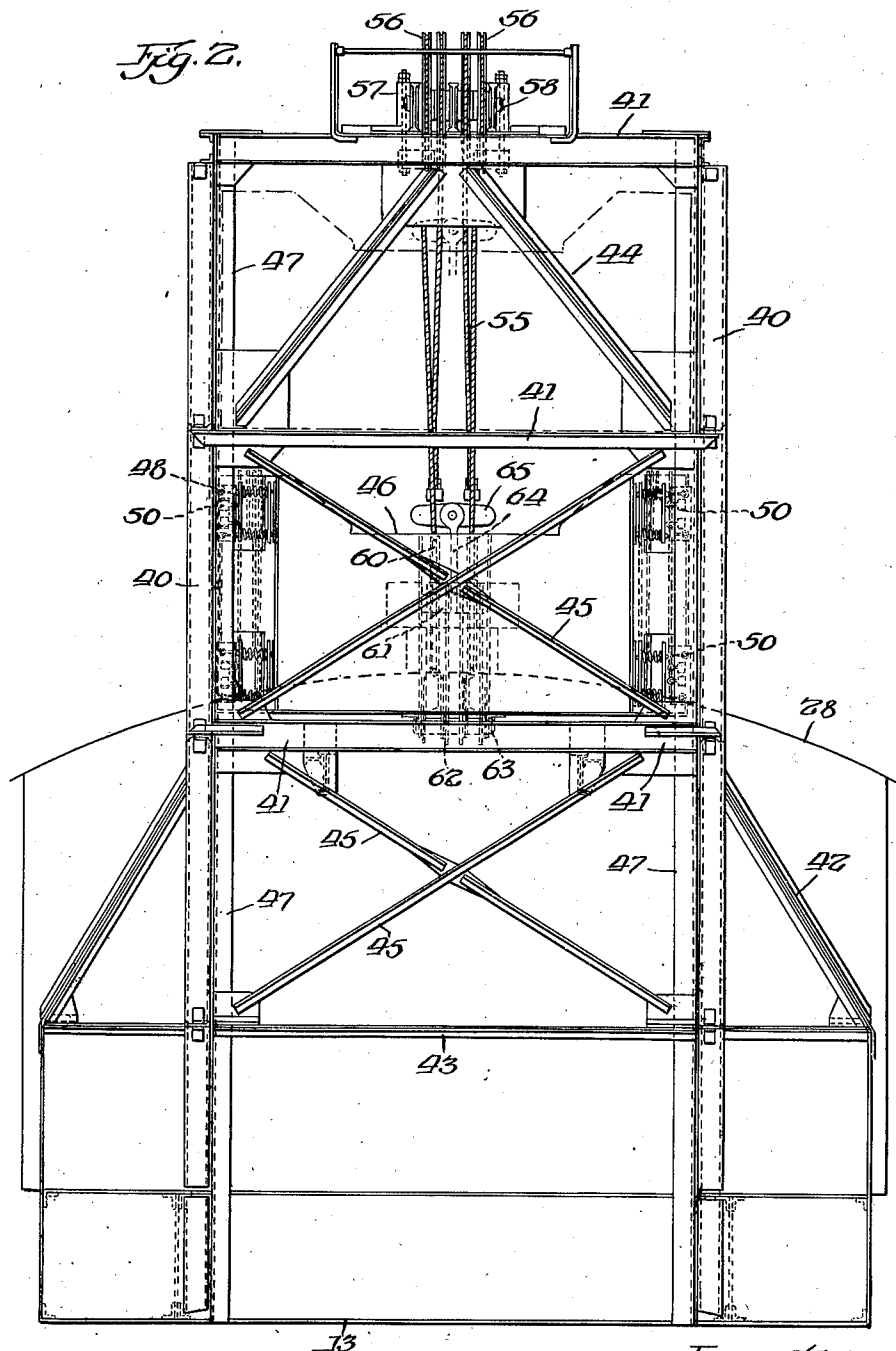
J. PENGLASE

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POWER EXCAVATOR

Original Filed Oct. 20, 1930

3 Sheets-Sheet 2



Witness:
R. B. Davison.

Inventor:
Joseph Penglase:
By: *Wain and Rumber*
Attys.

Sept. 19, 1939.

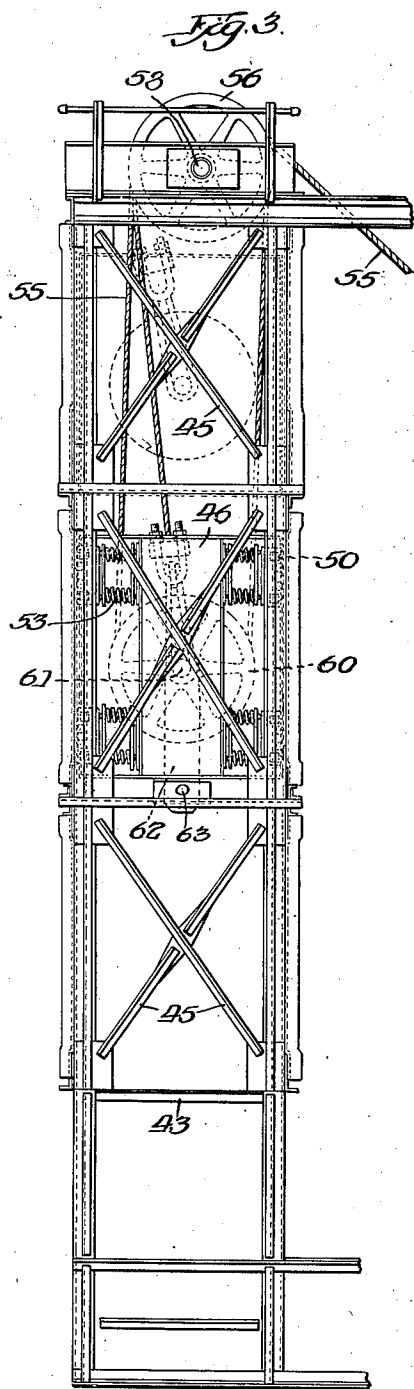
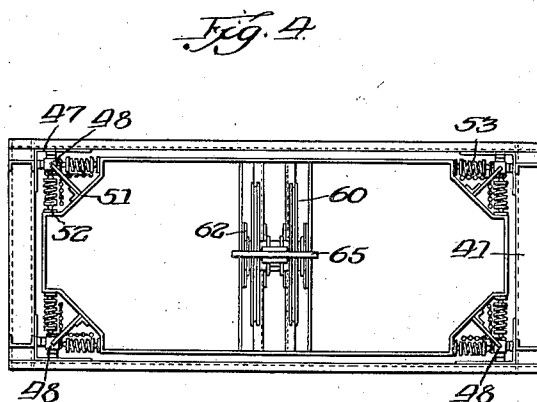
J. PENGLASE

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POWER EXCAVATOR

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3 Sheets-Sheet 3



Witness:
R. Davidson

Inventor
Joseph Penglase
By Usina and Rauh
Attys.

UNITED STATES PATENT OFFICE

2,173,341

POWER EXCAVATOR

Joseph Penglase, Rogers City, Mich.

Continuation of application Serial No. 490,022,
October 20, 1930. This application February
24, 1934, Serial No. 712,827

6 Claims. (Cl. 214—135)

The invention relates to excavating machines of the shovel type and has reference more particularly to means for counter-balancing the weight of the movable dipper during the raising and lowering operations. The present application is a continuation of my earlier filed case Serial No. 490,022 filed October 20, 1930.

Excavating shovels with which the present invention is concerned have heretofore been provided with ballast or dead weight built into the revolving frame at a point substantially opposite the support for the boom and associated dipper mechanism. This weight was necessary to balance the overhanging weight of the boom and functioned to absorb the vibrations due to the digging operations. The invention contemplates the use of such ballast not only for performing its usual functions but also for acting as active ballast by counter-balancing the movements of the dipper mechanism.

An object of the invention is to provide novel counter-balancing mechanism which will function to materially increase the operating efficiency of the shovel with which it is associated.

Another object of the invention is to provide excavating machinery with a movable counter-weight for connection with the dipper mechanism to appreciably reduce the maximum power demand required for operation of said excavating machinery and which will also make for uniformity in said power demand.

Yet another object is to provide a movable counter-weight for steam or electric shovels which will reduce the power demand required for the digging operations and also for raising of the load by substantially balancing the weight of the dipper, therefore leaving only the material handled to be raised by the power means. Also the invention proposes to make the power demand more uniform by using the power means to raise the counter-weight, permitting a free descent of the dipper, or, in other words, driving the dipper down. It is desired that the dipper have a free descent so that the same will pass beyond the vertical position for location back toward the frame where the length of the digging stroke is a maximum. Also control of the counter-weight by the power means as described provides an automatic brake for gradually bringing the dipper to rest at the end of its descent without shock or strain on the operating mechanism.

Another object is to provide mechanism for counter-balancing the digging operations of excavating shovels which will be simple but sturdy in construction, efficient in operation, and which will fulfill all requirements of service.

With these and various other objects in view, the invention may consist of certain novel features of construction and operation, as will be more

fully described and particularly pointed out in the specification, drawings and claims appended hereto.

In the drawings, which illustrate an embodiment of the invention and wherein like reference characters are used to designate like parts—

Figure 1 is an elevational view of an excavating shovel showing the structure of the present invention applied thereto;

Figure 2 is a detail view showing the construction of the counter-weight gantry

Figure 3 is a fragmentary side elevational view of the counter-weight gantry and

Figure 4 is a plan view of the same.

The device of the present invention is shown as applied to the commercial type of excavating shovel which comprises a lower truck frame 10 having caterpillar traction elements 11 secured thereto through means of bolsters 12. A frame 13 is mounted upon the lower truck frame 10 in a manner to have rotating movement thereon, by means of the rollers 14 located intermediate the revolving frame and truck frame. Located upon the revolving frame 13 is the hoisting winch and operating mechanism for the shovel including the hoisting drum 15 operatively connected to any source of power which may comprise either a reversible power means 16 or a reciprocating steam engine, not shown. Pivotaly mounted at 17 to the forward end of the revolving frame is a boom 18, preferably of truss formation and provided at its extreme outer end with a shaft 19 for rotatably mounting a plurality of sheaves 20. Located intermediate the boom 18 is a dipper arm 21, whose under-surface is provided with a rack for engaging with the pinion 22 rotatably mounted on the boom 18. By operation of the pinion 22 the dipper arm 21 is reciprocated to effect the desired movements of the dipper 24 secured at 25 to the outer end of the arm. Fastened to the dipper 24 is a yoke 26 which in turn is secured to a sheave 27.

Shovel mechanism of the type as described provides for suitable enclosures for the operating machinery and operator which in the present instance comprises the housing designated in its entirety by 28, the housing being suitably mounted upon the revolving frame 13. Also mounted upon the revolving frame is an overhead truss and gantry formed by the beams which are riveted to the revolving frame as at 31 and joined at their upper end as at 32. The structure provides longitudinal strength and rigidity for the rotating frame and also forms a support for the boom 18. The boom is suspended in a manner such that it can be raised or lowered through actuation of the operating machinery and for this purpose boom hoisting cables 33 are provided having connection to the boom at 19 and to the gantry through means of the pulley 34.

The above structure, it is to be understood, comprises the preferred embodiment of excavating machinery with which the device of the present invention is adapted to be associated, but the present invention is not limited in its commercial application to the type shown and may be applied with equal efficiency to other types of out-digging excavators.

The present invention provides a counter-weight frame or gantry designated in its entirety 35, Figure 1, which is located upon the revolving frame 13 at the rear thereof, and includes an upright box-like frame preferably rectangular in cross-section, extending a distance above the housing 28 and secured at its upper end to the overhead truss and gantry by means of a tie beam 36. Referring particularly to Figure 2, the counter-weight gantry 35 is shown as comprising a plurality of upright beams 40 riveted at their lower end to the revolving frame 13 and connected intermediate their length by transversely extending beams 41 and braced by diagonal braces 42. The diagonal braces 42 and lower transverse braces 43 serve to rigidly fasten the counter-weight gantry to the housing 28. Upper diagonal braces 44 and cross braces 45 serve to unite the gantry into a rigid and sturdy structure.

For providing the slideway for accommodating the counter-weight 46, Figure 2, right-angle beams 47 are employed, which are secured in any suitable manner to the beams 40 and extend the entire length thereof. The counter-weight 46 is constructed of a cross section to substantially fit within the slideway provided by the beams 47 and is provided at its four corners with bearing blocks 48 in which are mounted a plurality of rollers 50. The rollers 50 are mounted so as to have bearing engagement against both inner surfaces of the right-angle beams 47. The cut-out portions 51 of the counter-weight 46 provide seats 52 for accommodating resilient springs 53 which have engagement against the bearing blocks 48 to resiliently urge the same and the rollers 50 toward the beams 47. This construction provides rotating members for engaging the angle beams forming the slideway in the counter-weight gantry, the members being resiliently urged into engagement, thus providing for substantially frictionless movement of the counter-weight in the gantry.

The counter-weight 46 is preferably constructed of a box filled with scrap iron or concrete to provide the necessary ballast. The counter-weight is suspended from the gantry 35 through means of a plurality of hoisting cables 55, which cables pass from the hoisting drum 15 over a plurality of sheaves 56 rotatably mounted upon the counter-weight gantry. Any suitable supporting mechanism 57 is provided bolted to the upper transverse beam 41 to form supporting means for the gantry sheave pin 58, the pin forming the trunnion upon which the sheaves 56 are rotatably mounted. Similar sheaves 60 are also provided journaled upon the counter-weight sheave pin 61 located centrally of the counter-weight 46. The pin 61 is fastened to hangers 62 which extend downwardly to slightly beyond the bottom of the counter-weight so that by means of a hanger pin 63 passing through openings in the hangers, the same are in turn fastened to the counter-weight. Also connected to the pin 61 but extending in the opposite direction from the hanger 62, is an equalizing bar 64 which, through means of the equalizer 65 secured there-

to, functions to provide a support to which the hoisting cables 55 are secured.

The cables 55 are connected at one end to the counter-weight as described and pass around the sheaves 56 mounted on the top of the counter-weight gantry and then around the sheaves 60 journaled centrally of the counter-weight. The cables then extend over the second set of sheaves 56 and are connected to the hoisting drum 15, as shown in Figure 1. Also connected to the hoisting drum are similar cables 66 which pass over the sheaves 20 located on the extremity of the boom 18 and around the sheave 27, carried by the yoke 26 forming part of the dipper mechanism. It is thus seen that by actuation of the hoisting drum 15 through the source of power employed, for example, the reversible electric motor 16, the dipper 24 is raised and lowered as desired to accomplish the digging operations. This actuation of the hoisting drum 15, however, also causes vertical reciprocation of the counter-weight 46 and the same therefore exerts a counterbalancing effect on the dipper 24 in its travel in both directions.

However, in the actual digging operations performed by excavating machinery of the type described it is desired that the dipper have a free descent so that its momentum will carry the dipper past the vertical position where it can be positioned immediately adjacent the base of the shovel ready for another digging operation. To permit this free descent of the dipper the motor 16 is employed to raise the counter-weight, it being only necessary to rotate the drum 15 to wind up the cable 55 and play out cables 66, 35 therefore in effect driving the dipper down. Power is therefore required in the lowering of the dipper as the counter-weight is raised by the motors and in the digging and raising operations of the dipper in lifting the weight of the material handled.

Two cables 55 are preferably employed, secured as nearly as possible to the center of the counter-weight 46 so that each cable acts as a safety for the other. Also the arrangement of sheaves and cables described is employed in order to materially reduce the necessary height required for the counter-weight gantry while at the same time providing for the maximum travel of the counter-weight 46. It is noted that the gantry 35 is securely braced and anchored to the revolving frame 13, this being necessary since the hardest digging with the consequent heavy fore and aft vibrations and the hardest plugging of the swing both occur with a dipper nearest its lowest position when the counter-weight is practically in its highest position.

The counter-weight 46 is preferably of a weight slightly less than that of the empty dipper 24 and handle 21 so that the combined weight of the dipper and handle is available to accelerate the dipper in its downward movement.

As the weight of the empty dipper and arm is only slightly greater than the weight of the counter-balance, it will be seen that this leaves substantially only the material handled to be elevated by the motor or other source of power as may be employed. Therefore an advantage arising by reason of the device described is a material reduction in the maximum power load required during digging operations and raising of the loaded dipper. In other words the hoisting load becomes uniformly smaller, whereas, on the other hand the power demand during lowering of the dipper is increased in that the engine

is utilized to raise the counter-weight with the result that there is a fairly uniform power demand. The counter-weight can be utilized to exert a counter-balancing effect on the lowering operations of the dipper as well as the raising operation whereby the descent of the dipper may be controlled without the elaborate braking mechanism heretofore necessary. Also the reversibility of the electric motors or reciprocating steam engine or other source of power that may be employed is utilized as the dipper reaches its lower-most position to brake further movement of the dipper, which is gradually brought to a stop in desired position without intensive application of the brakes and therefore a substantial reduction in brake maintenance results.

The present invention necessitates the construction of a gantry for accommodating the movable counter-weight, the gantry and counter-weight providing the ballast heretofore employed as dead or inactive weight so that the same performs a double function. The location of the counter-weight on the revolving frame opposite the pivotal support for the boom serves to counter-balance the overhanging of the boom and also functions to absorb the vibrations due to the digging operations.

It is to be understood that I do not wish to be limited by the exact embodiment of the device shown, which is merely by way of illustration and not limitation, as various and other forms of the device will of course be apparent to those skilled in the art without departing from the spirit of the invention or the scope of the claims.

The term "reversible power means" as used in the appended claims is intended to cover any suitable power means, such as an electric motor, together with necessary drive connections associated therewith whereby the winch or hoisting drum is capable of being driven in reverse directions. The claims are intended to include means, such as motors, which are constructed to actually operate in reverse and also means, such as motors, which constantly rotate in one direction but which ultimately drive in reverse directions through the instrumentality of gears or other suitable reversing connections. The essential feature is merely that the winch is capable of being power driven in opposite directions irrespective of the particular means by which this is accomplished.

I claim:

1. In a power shovel, the combination of a power base, an inclined boom, a dipper handle mounted thereon for swinging in a vertical plane about a point, an excavating dipper carried by said handle, a sheave on the outer end of said boom, a winch on said base, a hoisting rope leading from said winch over said sheave to said dipper to cause said handle to swing in a vertical plane, a reversible power means for selectively driving said winch to wind or unwind said rope, a weight on said base mounted for raising and lowering movements, and means connecting said weight to said winch whereby the descent of said weight aids said winch in the winding of the rope to raise the dipper.

2. In a power shovel, the combination of a power base, an inclined boom, a dipper handle mounted thereon for swinging in a vertical plane about a point, an excavating dipper carried by said handle, a sheave on the outer end of said boom, a winch on said base, a hoisting rope leading from said winch over said sheave to said dip-

per to cause said handle to swing in a vertical plane, a reversible power means for selectively driving said winch to wind or unwind said rope, a weight on said base mounted for raising and lowering movements, and means connecting said weight to said winch whereby the descent of said weight aids said winch in the winding of the rope to raise the dipper, said weight being sufficient to substantially counter-balance the unloaded dipper and handle.

3. In a power shovel, the combination of a power base, an inclined boom, a dipper handle mounted thereon for swinging in a vertical plane about a point and for reciprocation with respect to said point, an excavating dipper carried by said handle, a sheave on the outer end of said boom, a winch on said base, a hoisting rope leading from said winch over said sheave to said dipper to cause said handle to swing in a vertical plane, a reversible power means for selectively driving said winch to wind or unwind said rope, power means to reciprocate said handle, a weight on said base mounted for raising and lowering movements, and means connecting said weight to said winch whereby the descent of said weight aids said winch in the winding of the rope to raise the dipper, said weight being sufficient to substantially counter-balance the unloaded dipper and handle.

4. In a power shovel, the combination of: the conventional elements of an ordinary out-digging reciprocating power shovel and a weight mounted for raising and lowering movements, and means connecting said weight with the hoist winch element of said shovel, said connection being constructed and arranged whereby the lowering of the counter-weight aids the hoist winch in raising the dipper element of said shovel, the power means for operating said hoist winch being capable of driving said winch in reverse directions.

5. In a power shovel, the combination of: the conventional elements of an ordinary out-digging reciprocating power shovel and a weight mounted for raising and lowering movements, and means connecting said weight with the hoist winch element of said shovel, said connection being constructed and arranged whereby the lowering of the unloaded dipper is accompanied by the raising of the counter-weight, the power means for said winch being capable of driving said winch in reverse directions whereby said counter-weight can be positively raised by said power means to permit free and unrestricted descent of said dipper.

6. In a power shovel, the combination of a supporting base, an inclined boom pivotally supported by said base, a dipper handle mounted on said boom for swinging in a vertical plane about a point, an excavating dipper carried by said handle, a hoisting drum on said base, a counter-weight on said base mounted for raising and lowering movements, hoisting ropes connecting said counter-weight with the hoisting drum and also said dipper with the hoisting drum, and a reversible power means for selectively driving said hoisting drum, whereby the driving of said drum to raise the dipper is aided by the fall of the counter-weight, and whereby said hoisting drum may be driven to raise the counter-weight in order to permit free and unrestricted descent of said dipper.

JOSEPH PENGLASE.