

May 6, 1930.

G. M. HARRY

1,757,572

HOE

Filed Oct. 1, 1928

3 Sheets-Sheet 1

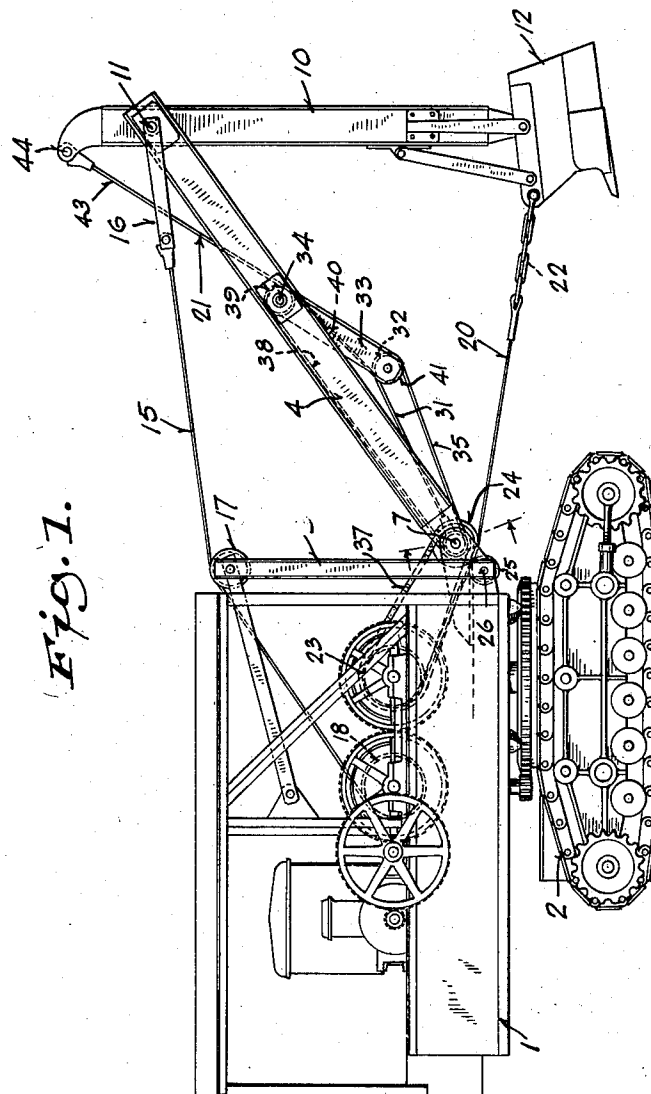


Fig. 1.

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3 Sheets-Sheet 2

Fig. 2.

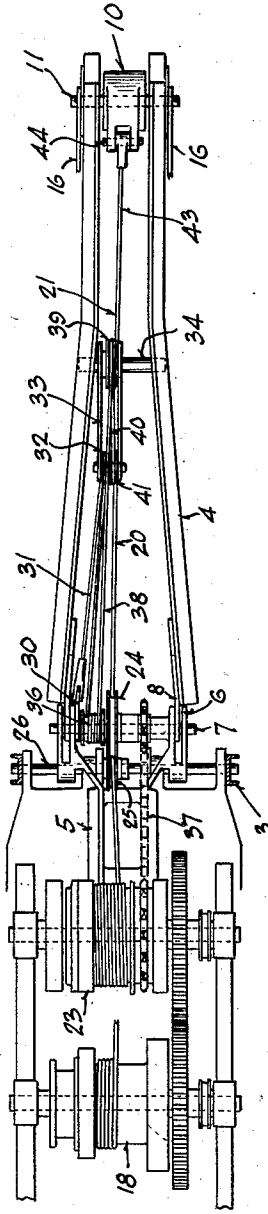
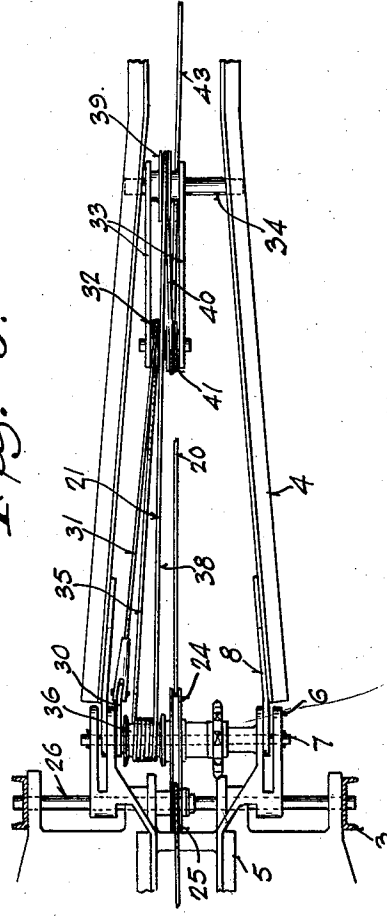


Fig. 3.



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3 Sheets-Sheet 3

Fig. 4.

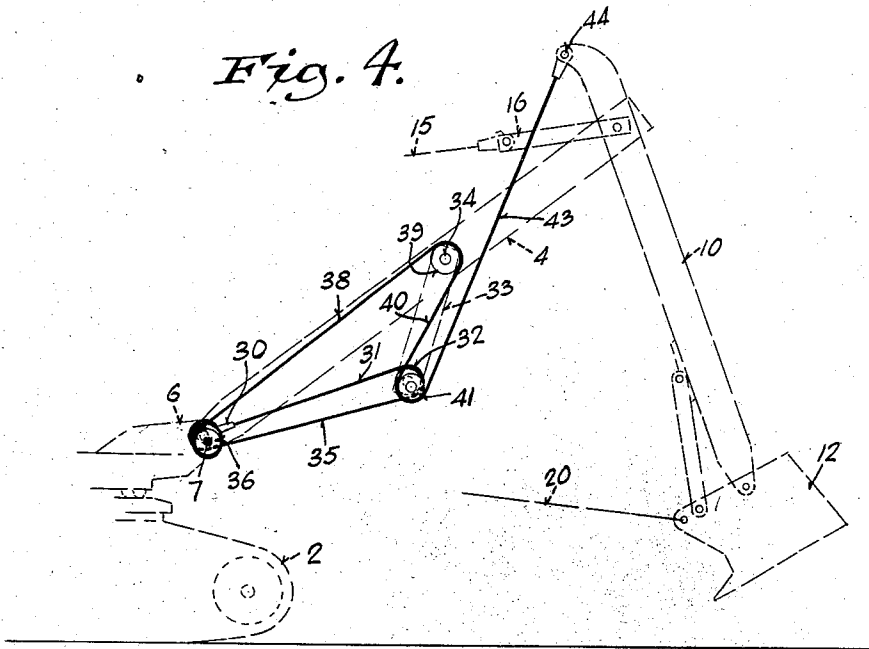
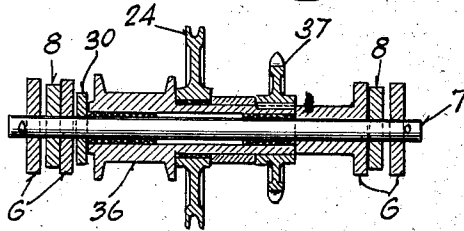


Fig. 5.



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HOE

Application filed October 1, 1928. Serial No. 309,514.

This invention relates in general to excavating machines and more particularly to a power shovel of the back-acting or hoe type, also frequently referred to as instroke ditchers or power hoes.

Such excavating machines are widely used and although a number of different types are employed they all embody practically the same essential features and differ only in details of construction. In general such power shovels comprise a revolvable platform mounted on a tractor or suitable running gear; a swingable boom mounted on the platform for up and down movement; a dipper stick pivoted to the boom and extending above and below the boom; an excavating bucket or dipper carried by the lower end of the stick; a hoisting drum mounted on the platform and controlling a hoisting line connected to the upper end of the dipper stick; and a digging drum mounted on the platform and controlling a digging line or hauling line connected to the bucket and consequently to the lower end of the dipper stick. The hoisting line and the digging line constitute the sole means provided for controlling the raising and lowering of the boom and the angular position of the dipper stick relative to the boom. It is essential with all these constructions to oppose the forces exerted through the hoisting line and the digging line in order to control the position of the boom and swing the dipper stick for digging. Thus, when hoisting the boom it is necessary to maintain a tension on the digging line while the hoisting line is being pulled in by the hoisting drum and if any slack occurs in the digging line (and this not infrequently occurs due to the slipping on the brake controlling the operation of the digging drum), the dipper stick and its bucket swing outwardly with a jerk and the boom drops until the slack in the digging line is taken up. Moreover, with these old types of construction, when the digging line is pulled in to swing the excavating bucket and dipper stick for digging, the boom is necessarily lifted up somewhat. This is unavoidable but it is undesirable to have the angular position of the boom always disturbed during a digging operation. Then again, in dumping the excavating buckets of these prior constructions, it is necessary to relieve the tension on the digging line. This results in the bucket and the dipper stick being forcibly jerked outwardly and upwardly, the boom dropping. To check this, the digging line must be put under tension again. This operation subjects all of the parts to severe and sudden shocks and strains and it is dangerous as it is liable to snap the controlling cables or to cause a collapse or failing in the hoisting tackle in which event the boom and dipper drop to the ground with destructive force. Moreover, because of the necessity of opposing the force of the hoisting line to that of the digging line, it is necessary to use a booster drum to increase the digging force and the digging line speed is practically cut in half.

One of the principal objects of the present invention is to provide an excavating machine of the back-acting shovel or power hoe type which avoids these difficulties and disadvantages and which provides for the independent control and actuation of the boom and dipper stick while permitting of a smooth and easy raising or lowering of the boom and a smooth and speedy though forcible actuation of the dipper stick. The raising and lowering of the boom and the swinging of the dipper stick are entirely independent each of the other. In this way the dipper stick may be accurately located or spotted in any position throughout its entire range of movements without any movement of the boom and with a smooth or easy motion on the part of the dipper stick. Further, the dipper stick may be positioned to dump the excavating bucket without any jerking and

without the imposition of sudden shocks or strains on any elements of the machine, and the boom may be raised and lowered without disturbing the angular relation of the dipper stick thereto. The full force applied to the digging line is effective to impart digging movement to the excavating bucket without opposition by the force utilized to maintain the boom in proper position and as a consequence the digging line speed is doubled over the speed now available and no booster drums or similar mechanism are required to augment the drive imparted through the digging line. Finally all of the operating lines employed are maintained uniformly taut and tensioned throughout all phases of the operation.

In accordance with the present invention the excavating machine proposes the usual revolvable platform mounted on a tractor or suitable running gear. A swingable boom is mounted on the platform in the usual manner for up and down movement. To the outer end of the boom a dipper stick is pivoted and extends above and below the same, the lower end of the dipper stick carrying an excavating bucket or dipper facing downwardly toward the ground in the extended position of the dipper stick and toward the machine when the lower end of the dipper stick is swung toward the machine. So far, the construction of the standard machine is not varied in any essential manner. However, in lieu of supporting and controlling both the boom and the dipper stick by two lines, the present invention proposes the provision of three lines or cables. More particularly, the present invention proposes a boom hoisting line extending from the boom hoisting drum on the platform over a pulley on the usual A-frame to the outer end of the boom, the boom hoisting line being directly connected to the boom and not intermediately connected therewith through the dipper stick. The dipper stick is controlled by means of a digging line connected to the excavating bucket in the usual manner and controlled from the digging drum. For swinging the dipper stick outwardly and upwardly a dipper hoisting line is provided and is controlled by a dipper stick hoist drum which may be driven by suitable gearing from the digging drum. The dipper hoisting line has associated therewith means for maintaining a constant and uniform tension thereon in any position of the dipper stick and boom.

Other objects and advantages reside in certain novel features of the construction, arrangement and combination of parts which will be hereinafter more fully described and particularly pointed out in the appended claims, reference being had to the accompanying drawings forming a part of this specification, and in which:

Figure 1 is a view in side elevation showing an excavating machine embodying the present invention;

Figure 2 is a fragmentary plan view illustrating the digging and hoisting drums and their association with the boom and dipper stick;

Figure 3 is an enlarged fragmentary plan view showing the reeving of the dipper hoisting line;

Figure 4 is a diagrammatic view in side elevation further illustrating the reeving of the dipper hoisting line; and

Figure 5 is a detail view showing the assembly at the axis of swing of the boom in transverse vertical central section.

Referring to the drawings, and more particularly to Figure 1, the numeral 1 designates generally a revolving platform of an excavating machine embodying the present invention, this revolving platform being mounted on the usual tractor or running gear such as indicated at 2. As is conventional in the art and industry, mechanism for driving the machine and for swinging the platform are mounted on the platform 1. All of this is well known and needs no detailed description here. The various mechanism provided on the revolving platform of a machine of this character is well exemplified in the patent to Arthur G. Henricks No. 1,570,061, granted January 19, 1926, for hoisting mechanism for excavating cranes, and also in the patent to Louis Wehner, No. 1,570,108, granted January 19, 1926, for excavator crane.

At the forward end of the platform 1, the so-called A-frame 3 is mounted and is suitably supported and held in position on the revolving platform. A boom 4 has its lower end pivotally mounted on the revolvable platform so as to be capable of swinging up and down in a vertical plane. As illustrated in Figures 2 and 3, this pivotal mounting may be effected by utilizing a heavy casting or bracket 5 suitably secured to the revolvable platform and having bifurcated arms 6 supporting a fixed pivot shaft 7. Pivot plates 8 are riveted to the elements of the boom 4 and have pivot openings which receive the shaft 7. Any suitable pivotal mounting may be provided in lieu of the one shown for the sake of illustration. To the other end of the boom 4, a dipper stick 10 is pivotally connected as at 11, so that the dipper stick extends above and below the boom. An excavating bucket or dipper 12 is carried by the lower end of the dipper stick in the usual manner.

The boom 4 is raised and lowered and is held in adjusted position by means of a boom hoist line 15 having direct connection with the boom 4, that is, a connection that is independent of the dipper stick 10. In the present embodiment of the invention this

connection between the boom hoist line 15 and the boom 4 is shown as consisting of a bail 16 fastened to the line 15 and pivotally connected to the boom by means of the projecting portions of the pivot 11, these projecting portions of pivot 11 being fitted in bearing openings provided in the bail. Intermediate its ends the boom hoisting line 15 is trained over a guide sheave 17 mounted on the A-frame 3 and rearwardly of this guide sheave the boom hoist line 15 extends downwardly to a boom hoisting drum 18 around which it is wound. The boom hoisting drum 18 is driven and controlled in the usual manner.

The dipper stick is actuated and controlled by means of a digging line 20 and a dipper hoisting line designated generally at 21. The digging line 20 is connected by bail or chains 22 with the excavating bucket 12 and consequently is connected with the lower end of the dipper stick 10 to which this bucket 12 is fastened. This digging line 20 extends rearwardly and upwardly to the usual digging drum 23 mounted on the platform and controlled and driven in the usual manner. Intermediate its ends the digging line 20 passes between and partially around guide sheaves designated at 24 and 25, the guide sheave 24 being mounted on the shaft 7 and the guide sheave 25 being mounted on a shaft 26 also utilized to support the A-frame. The dipper stick hoist line 21 has one end dead-ended as at 30 on the shaft 7 and from the anchored end 30 a run 31 extends forwardly to a pulley 32 rotatably mounted at the lower end of a tensioning or equalizing frame 33 made up of a pair of arms or plates pivotally supported at their upper ends on the boom as indicated at 34. After passing around the pulley 32 the dipper hoisting line 21 is formed with a run 35 which extends back to a dipper hoisting drum 36 rotatably mounted on the shaft 7 and driven by chain and sprocket gearing 37 from the digging drum 23. A few turns of the dipper hoist line 21 are wrapped around the drum 36 and beyond those turns the line 21 is formed with a run 38 extending up along the boom and over a pulley 39 rotatably mounted on the shaft 34 or axis of swing of the tensioning or equalizing arms 33. After passing over the pulley 39 the line 21 is formed with a run 40 which extends down around and over a pulley 41 also mounted at the lower end of the equalizing arm 40 and beyond the pulley 41 the dipper hoist line is formed with a run 43 extending and pivotally connected to the upper end of the dipper stick 10 as indicated at 44.

With this construction when the digging line 20 is hauled in by appropriate rotation of the digging drum 23 the drum 36 is driven by the chain and sprocket gear 37 from the digging drum so that this dipper hoist drum is rotated in a clockwise direction as viewed

in Figure 4 and the turns of the dipper hoist line on this drum 36 are so driven as to pull in on the run 35 and pay out on the run 38. This swings the tensioning or equalizing arm in a clockwise direction as viewed in Figure 4 and draws it up toward the boom 4 and eventually into substantial alinement with the boom. As a result of this action the runs 31 and 35 are shortened considerably and the cable thus made available permits the run 43 to lengthen to the extent necessary to accommodate the outward throw of the upper end of the dipper stick 10. When the digging line 20 is paid out, the drum 36 is driven in a counter-clockwise direction, as viewed in Figure 4, and this permits the run 35 of the dipper hoist line to pay out and consequently lengthens both the runs 35 and 31 but the run 38 is pulled in to shorten the run 43 and consequently the upper end of the dipper stick is pulled inwardly and the lower end of the dipper stick of the excavating bucket 12 swings outwardly. During this action the equalizing or tensioning arm is swung in a counter-clockwise direction and maintains the runs 31 and 35 taut as they are lengthened. In other words, a uniform and even tension is maintained on the entire dipper stick hoist line in all phases of the operation.

In Figure 4, the axes of pulleys 32 and 41 and adjacent sections of the drum 36 are diagrammatically shown as offset but it is to be understood that this is done merely to simplify and clarify illustrations and that in the actual construction as shown in other figures of the drawing the pulleys 32 and 41 are on the same axis and the drum 36 is of uniform diameter.

With this construction the boom 4 may be raised and lowered without disturbing the angular relation of the dipper stick 10 and in fact raising and lowering of the boom is entirely independent of the dipper stick or of the control arms for the dipper stick. Similarly, the dipper stick 10 may be swung relative to the boom without disturbing the support of the boom as the means for swinging the dipper stick is entirely independent of the means for supporting the boom. The raising and lowering of the boom and the control of the dipper stick is so positive and certain that all of the motions essential to the operation of the machine and of which these parts are capable are effected smoothly and easily and with maximum speed and power. When the digging drum is driven to haul the excavating bucket inwardly for digging, the full force applied to the digging line 20 is effectively transmitted to the bucket 12 as there is no force opposing the swing of the bucket except the weight of the parts, the ordinary frictional resistance, and the resistance which the material presents to the digging action of the bucket. The dipper hoist line at this time is automatically paid

out to the proper extent as its drum 36 is driven from the digging drum at the proper speed, the chain and sprocket gearing 37 being constructed and proportioned to synchronize properly the drive of the drum 36 with the drive of the digging drum 23. Similarly, on the return movement of the excavating bucket or when it is being swung up for dumping, the dipper stick may be freely and speedily swung and accurately spotted or stopped in the proper location as the boom is independently supported and as the digging line is paid out to a degree proportional to the hauling in of the dipper hoist line.

From the foregoing it will be understood that the digging drum and the dipper hoist drum, being positively geared to each other and being connected with the digging line and dipper hoist line for reeling and unreeling the same, provide means for moving the lines in opposite directions at a constant linear velocity ratio whereby to impart appropriate motion to the dipper stick. The tensioning device, associated with the dipper hoist line, operates automatically to so vary the path of travel of the dipper hoist line as to feed the dipper hoist line at a slow instantaneous speed at one end of the path of travel of the upper end of the dipper stick and at increasing instantaneous speeds throughout the remainder of the path of travel of the upper end of the dipper stick in one direction. This action is reversed when the dipper stick is swung in the opposite direction and as a result the lines are maintained uniformly taut in all phases of the operation.

The invention claimed is:—

1. A power hoe including a platform, a boom mounted on the platform for up and down movement, a dipper stick pivotally mounted on the boom for swinging movement and projecting above and below the same, an excavating bucket carried by the lower end of the dipper stick and facing downwardly toward the ground when the dipper stick is extended and facing toward the machine when the dipper stick is swung toward the machine, a boom hoisting drum mounted on the platform, a boom hoist line wound on the drum and directly connected with the boom for raising and lowering the boom and holding the same in position, a digging drum mounted on the platform, a digging line wound on the digging drum and connected to the excavating bucket, a dipper hoist drum driven from the digging drum, and a dipper hoist line actuated from the dipper hoist drum and connected to the upper end of the dipper stick.

2. A power hoe including a platform, a boom mounted on the platform for up and down movement, a dipper stick pivotally mounted on the boom for swinging movement and projecting above and below the same,

an excavating bucket carried by the dipper stick and facing downwardly toward the ground when the dipper stick is extended and facing toward the machine when the dipper stick is extended and facing toward the machine when the dipper stick is swung toward the machine, a boom hoisting drum mounted on the platform, a boom hoist line wound on the drum and directly connected with the boom for raising and lowering the boom and holding the same in position, a digging drum mounted on the platform, a digging line wound on the digging drum and connected to the excavating bucket, a dipper hoist drum driven from the digging drum, a dipper hoist line having one end anchored to the platform and having its other end connected to the upper end of the dipper stick, an intermediate portion of the dipper stick hoist line being wrapped around said dipper hoist drum and driven thereby, and means co-acting with the dipper hoist line for maintaining a uniform and even tension on the same in all positions of the boom and dipper stick.

3. A power hoe including a platform, a boom mounted on the platform for up and down movement, a dipper stick pivotally mounted on the boom for swinging movement and projecting above and below the same, an excavating bucket carried by the dipper stick and facing downwardly toward the ground when the dipper stick is extended and facing toward the machine when the dipper stick is swung toward the machine, a boom hoisting drum mounted on the platform, a boom hoist line wound on the drum and directly connected with the boom for raising and lowering the boom and holding the same in position, a digging drum mounted on the platform, a digging line wound on the digging drum and connected to the excavating bucket, a dipper hoist drum driven from the digging drum, a dipper hoist line having one end anchored to the platform and having its other end connected to the upper end of the dipper stick, an intermediate portion of the dipper hoist line being wrapped around said dipper hoist drum and driven thereby, means co-acting with the dipper hoist line for maintaining a uniform and even tension on the same in all positions of the boom and dipper stick, and comprising a tensioning arm having one end pivoted to the boom and provided with guide pulleys at its pivoted end and at its free end, the dipper hoist line having a run extending from its anchored end to a pulley located at the free end of the tensioning arm, a run extending from said last mentioned pulley to the dipper stick hoist drum, a run extending from the dipper hoist drum to a pulley located at the axis of swing of the tensioning arm, a run extending from said last mentioned pulley to a pulley located at the free end of said tensioning arm and a

run extending from said last mentioned pulley to the upper end of the dipper stick.

4. A power hoe including a boom mounted for up and down movement, hoisting mechanism for raising and lowering the boom and holding it in adjusted position, a dipper stick pivotally supported on the outer end of the boom and extending above and below the same, an excavating bucket carried by the lower end of the dipper stick and facing downwardly toward the ground in the extended position of the dipper stick and toward the machine when the dipper stick is swung inwardly, a digging line connected to the excavating bucket, a dipper hoisting line connected to the upper end of the dipper stick, and means carried by the boom and co-operable with the dipper hoist line for maintaining a uniform tension thereon in all positions of the dipper stick.

5. A power hoe including a boom mounted for up and down movement, a dipper stick mounted on the boom for swinging movement, an excavating bucket carried by the dipper stick, hoisting means for raising and lowering the boom and supporting it in adjusted position, means independent of said hoisting means for swinging the dipper stick and including a digging line connected to the excavating bucket, a dipper hoist line connected to the upper end of the dipper stick, a drum for driving the dipper hoist line, and an equalizing device swingably mounted on the boom and having pulleys at its pivoted and at its free ends around which the dipper hoist line is reeved.

6. A power hoe including a platform, a boom mounted on the platform for up and down movement, hoisting mechanism for the boom, a dipper stick swingably supported by the boom, an excavating bucket carried by the dipper stick, a digging drum mounted on the platform, a digging line actuated from the digging drum and connected to the excavating bucket, a dipper hoist line connected to the upper end of the dipper stick, a dipper hoist drum mounted at the axis of the boom foot and from which the dipper hoist line is driven, gearing for driving the dipper hoist drum from the digging drum, and means carried by the boom and co-operable with the dipper hoist line for automatically maintaining the same uniformly taut in all phases of the operation.

7. A power hoe including a platform, a boom mounted on the platform for up and down movement, hoisting means for the boom, a dipper stick swingably supported by the boom, an excavating bucket carried by the dipper stick, a digging drum mounted on the platform, a digging line actuated from the digging drum and connected to the excavating bucket, a dipper hoist line connected to the upper end of the dipper stick, a dipper hoist drum mounted at the axis of the boom

foot and from which the dipper hoist line is driven, gearing for driving the dipper hoist drum from the digging drum, an equalizing device pivotally supported on the boom and having pulleys at its pivoted and free ends, said dipper hoist line being reeved around said pulleys.

8. A power hoe including a boom mounted for up and down movement, a dipper stick mounted on the boom for swinging movement, an excavating bucket of the hoe type carried by the dipper stick, separate hoisting tackle for the boom, a digging line and a dipper hoist line connected with the dipper stick for swinging the same independently of the hoisting tackle for the boom, synchronized drives for the dipper hoist line and the digging line and a tensioning device co-operable with the dipper hoist line for maintaining the same uniformly taut in all phases of the operation.

9. An excavating machine of the character described including a boom mounted for up and down movement, a dipper stick mounted on the boom for swinging movement, an excavating bucket carried by the dipper stick, separate hoisting tackle for the boom, a digging line and a dipper hoist line connected with the dipper stick for swinging the same independently of the hoisting tackle for the boom, means for appropriately driving the digging line and the dipper hoist line, and a tensioning device supported for movement in a predetermined path and having guiding means coacting with the dipper hoist line for maintaining the same uniformly taut in all phases of the operation.

10. An excavating machine of the character described including a boom mounted for up and down movement, a dipper stick mounted on the boom for swinging movement, an excavating bucket carried by the dipper stick, separate hoisting tackle for the boom, a digging line and a dipper hoist line connected with the dipper stick for swinging the same independently of the hoisting tackle for the boom, drums positively geared to each other for reeling and unreeling said lines, and means associated with the dipper hoist line for feeding the same to and pulling the same from the dipper stick at a slow instantaneous speed at one end of its path of travel and at varying instantaneous speed through the remainder of the path of travel of the dipper stick.

11. An excavating machine of the character described including a boom mounted for up and down movement, a dipper stick mounted on the boom for swinging movement, an excavating bucket carried by the dipper stick, separate hoisting tackle for the boom, a digging line and a dipper hoist line connected with the dipper stick for swinging the same independently of the hoisting tackle for the boom, drums positively geared to each other

for reeling and unreeling said lines, and positively actuated means associated with one of said lines for varying its path so as to supply said line to the dipper stick only in accordance with its motion as caused or permitted by the other line.

12. An excavating machine of the character described including a boom mounted for up and down movement, a dipper stick mounted on the boom for swinging movement, an excavating bucket carried by the dipper stick, separate hoisting tackle for the boom, a digging line and a dipper hoist line connected with the dipper stick for swinging the same independently of the hoisting tackle for the boom, driving means for moving said lines in opposite directions at a constant linear velocity ratio to impart motion to the dipper stick, and tensioning means associated with and actuated by the dipper hoist line for maintaining both lines uniformly taut throughout the motion of the dipper stick.

13. An excavating machine of the character described including a boom mounted for up and down movement, a dipper stick mounted on the boom for swinging movement, an excavating bucket carried by the dipper stick, separate hoisting tackle for the boom, a digging line and a dipper hoist line connected with the dipper stick for swinging the same independently of the hoisting tackle for the boom, driving means for moving said lines in opposite directions at a constant linear velocity ratio to impart motion to the dipper stick, and positively actuated means associated with one of the lines for varying the amount of the line fed to the dipper stick in such a manner as to maintain both lines taut throughout the movement of the dipper stick.

14. An excavating machine of the character described including a boom mounted for up and down movement, a dipper stick mounted on the boom for swinging movement, an excavating bucket carried by the dipper stick, separate hoisting tackle for the boom, a digging line and a dipper hoist line connected with the dipper stick for swinging the same independently of the hoisting tackle for the boom, a power drive for said lines, and means responsive in its action to the angularity of the boom and dipper stick and associated with one of the lines for varying the amount of the line fed to the dipper stick in such manner as to maintain both lines taut throughout the movement of the dipper stick.

15. An excavating machine of the character described including a boom mounted for up and down movement, a dipper stick mounted on the boom for swinging movement, an excavating bucket carried by the dipper stick, separate hoisting tackle for the boom, a digging line and a dipper hoist line connected with the dipper stick for swinging the

same independently of the hoisting tackle for the boom, means for appropriately driving the digging line and the dipper hoist line, and a shiftable tensioning device supported for movement in a predetermined path and shiftable in response to variations in the angularity of the boom and dipper stick and co-operable with one of said lines to maintain the same uniformly taut in all phases of the operation.

In witness whereof, I hereto affix my signature.

GEOFFREY M. HARRY.