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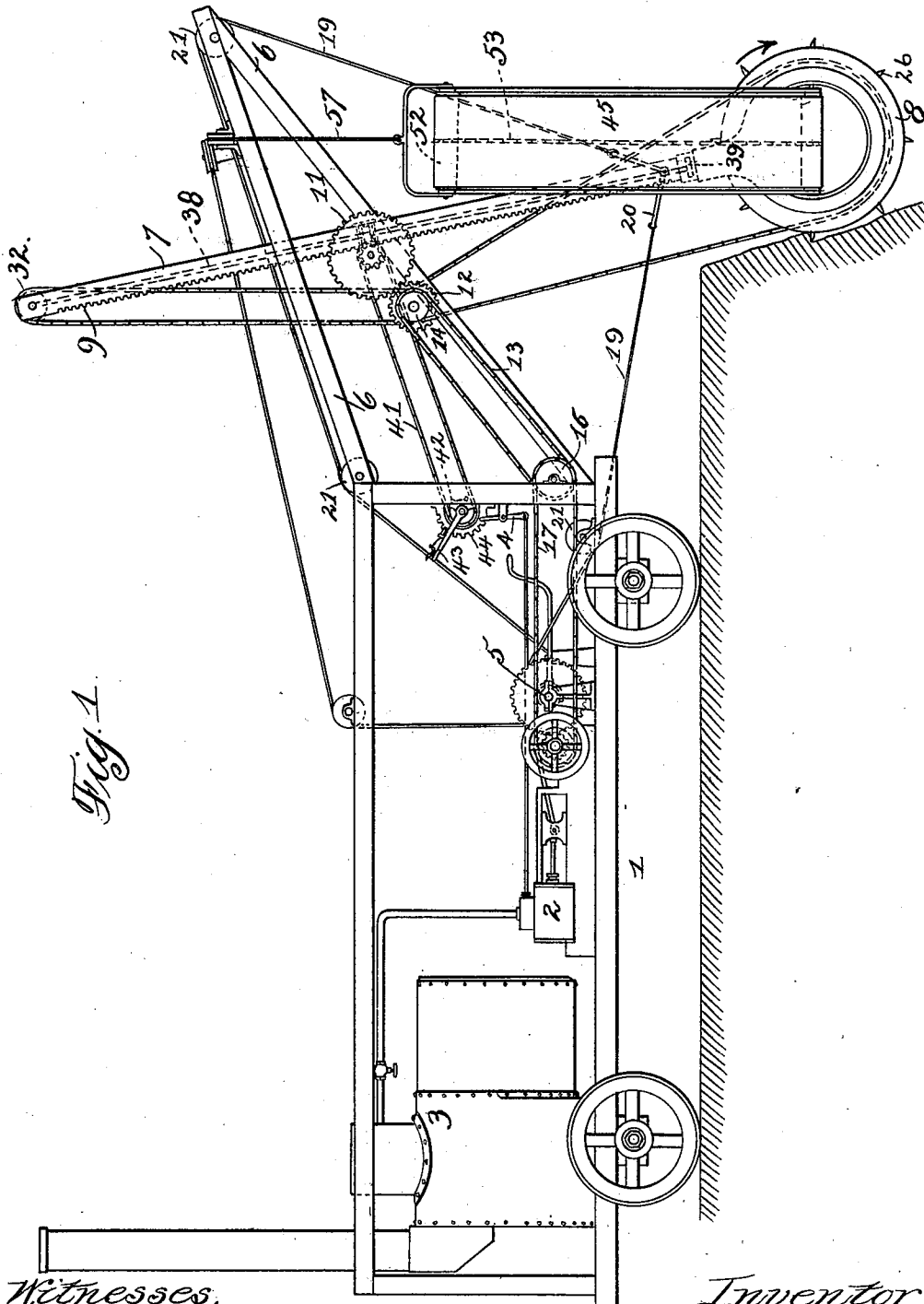
Patented Aug. 14, 1900.

L. V. BROPHY.
EXCAVATING MACHINE.

(Application filed May 25, 1899.)

(No Model.)

3 Sheets—Sheet 1.



Witnesses.
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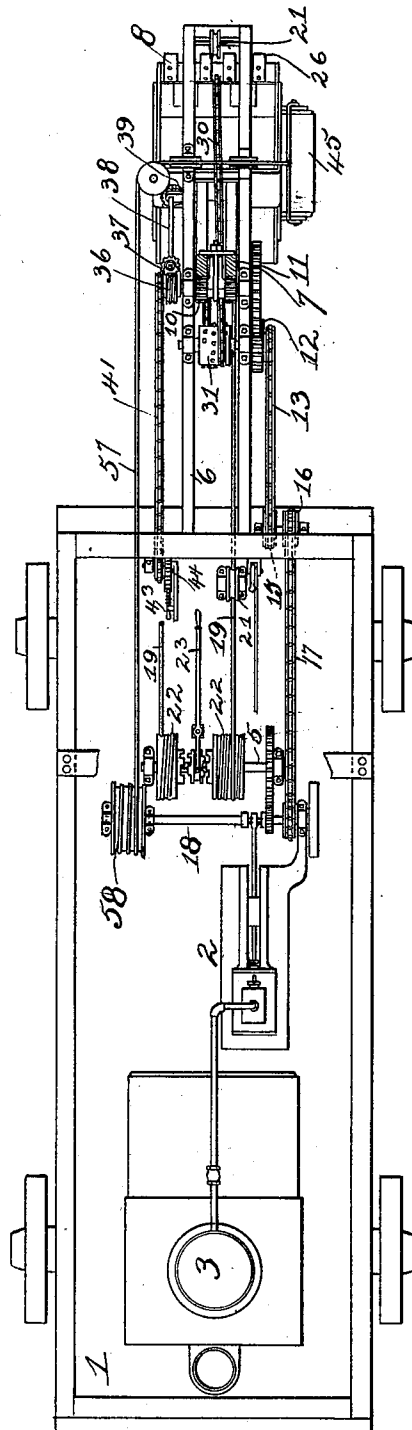
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3 Sheets—Sheet 2.

Fig. 2.



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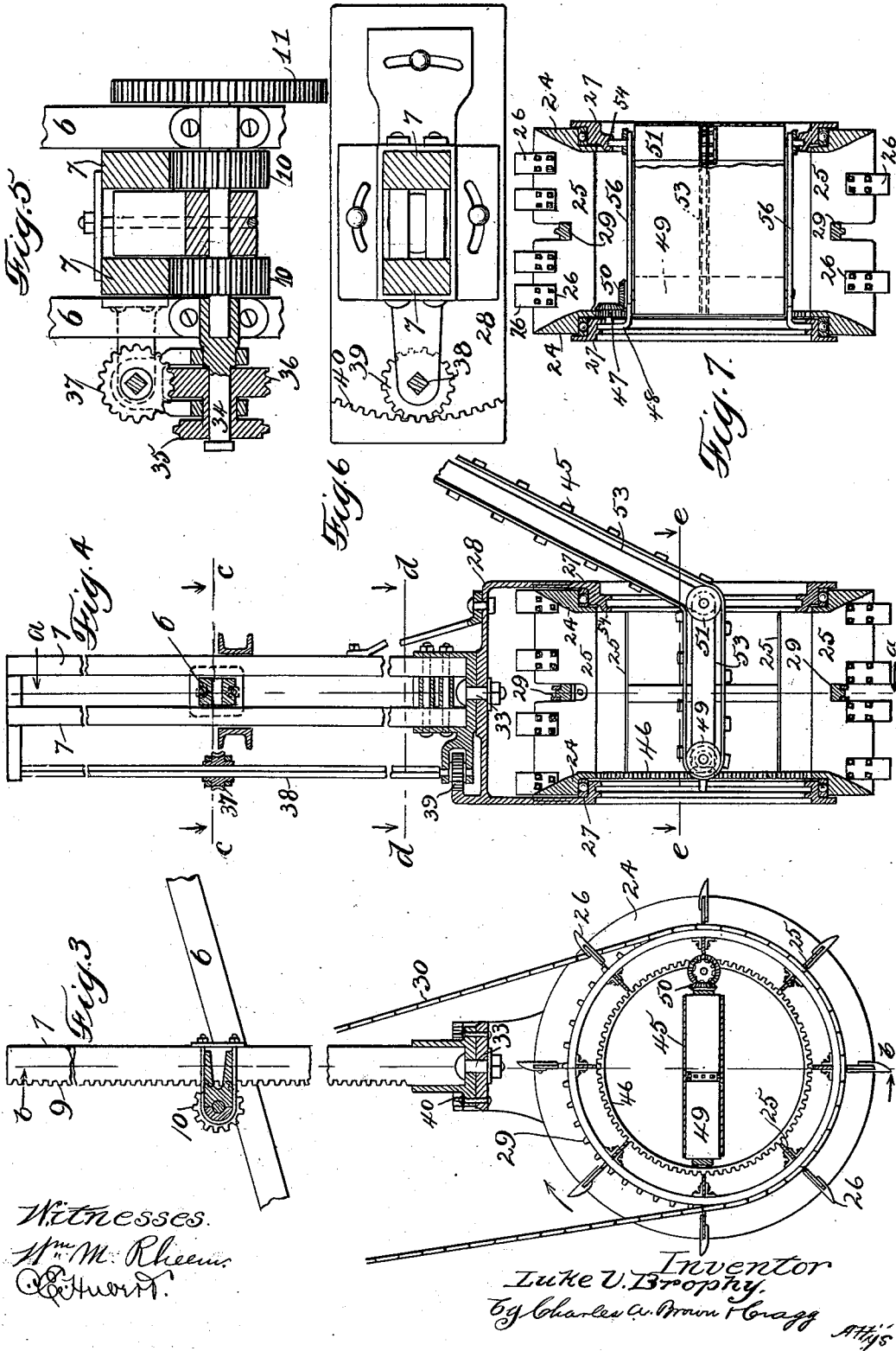
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3 Sheets—Sheet 3.



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UNITED STATES PATENT OFFICE.

LUKE V. BROPHY, OF CHICAGO, ILLINOIS, ASSIGNOR, BY MESNE ASSIGNMENTS, TO FREDERICK C. AUSTIN, OF SAME PLACE.

EXCAVATING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 655,955, dated August 14, 1900.

Application filed May 25, 1899. Serial No. 718,289. (No model.)

To all whom it may concern:

Be it known that I, LUKE V. BROPHY, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Excavating-Machines, (Case No. 3,) of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates to dredging-machines, and has for its object the improvement in the construction of apparatus of this class and the provision of improved means whereby the operation of the dredging-machines is rendered more effective.

More particularly my invention relates to that class of dredging apparatus in which rotating dippers are employed, the dippers being mounted to rotate upon dipper-arms capable of being placed at different angles to the ground and also capable of longitudinal travel. Machines of this class possess an advantage in that they are capable of digging ditches toward the machines, so that the machines in their travel may be supported upon solid ground without the necessity of employing staging or pilework; which would be required to sustain the banks of the ditches if the machines followed the shovels operated thereby instead of preceding the same. A great defect exists, however, in machines employing rotary dippers as heretofore constructed, which is due to the fact that as the machine progresses over the ground the dipper is enabled to cut a ditch equal in depth approximately only to the radius thereof, the hub or shaft portions where the dipper is rotatably mounted by coming in contact with the uncut earth preventing the dipper from digging deeper. Thus, for example, if it is desired to dig a ditch five feet in depth it is necessary to employ a rotating dipper or cutting-wheel having a cutting diameter approximately of ten feet, and if a six-foot ditch is required it would be necessary to have a wheel employing a cutting diameter approximately of twelve feet, so that the size of the dipper to be employed depends upon the depth of the ditch or excavation that is to be made. In practice rotating dippers twenty feet in di-

ameter have been employed to cut ditches ten feet deep. It is advantageous, especially where tile-ditches are being dug, to have the work proceed rapidly, so that the drain-tiles may be laid as fast as the ditch is dug and so that it will not be necessary to travel over the same ground two or more times to widen the ditch in order to enable the rotary dippers to dig deeper, since by this latter method expensive piling or staging would have to be provided to prevent the machine in its second or third course from caving in the banks by its weight.

My invention has for its object the provision of improved mechanism whereby rotary dippers may be made of any suitable cutting diameter properly to excavate the dirt, which diameter need not be dependent upon the depth of the excavation that is to be made and by means of which mechanism rotary dippers may be employed not only for the purpose of digging tile-ditches, but may also be employed in making excavations of other character.

In practicing my invention I prefer to employ a rotary dipper having a diameter of, for example, five feet, and I employ in connection with this rotary dipper means whereby the dipper may be made to cut wide enough so that the dipper, with its mountings and immediate appurtenances, may be received as deeply as may be desired into the ditch that is dug. I prefer to rotate the dipper in a direction to cause the ditch or excavation to be dug toward the machine, so that the machine may have solid ground upon which it may rest and over which it may move as the excavation is proceeded with.

The invention may have several embodiments, according to the nature of the work that is to be performed. In one embodiment as preferably constructed for tile-ditching machines I mount the rotary dipper upon a dipper-arm which is capable of longitudinal travel upon a fixed boom, and which also may be made, by means of suitable mechanism, to assume any desired angle to the ground. The dipper is supported by means of journal-bearings upon one end of the dipper-arm, suitable adjusting mechanism being employed for enabling the dipper to cut the ditch or channel

of a width sufficient to permit the dipper-arm and other parts that may be associated with the dipper to descend within the ditch if it should be desired to have the ditch deeper than the radius of the dipper or to dig a ditch wider than the dipper.

My invention may satisfactorily be practiced also by mounting the rotatable dipper upon a dipper-arm traveling upon a swinging boom supported from a rotating mast.

I do not wish to be limited to the precise nature of the machine employed in practicing my invention, nor to the direction with reference to the machine in which the excavations are to be made.

I will explain my invention more particularly in one of its embodiments by reference to the accompanying drawings, which illustrate the application thereof to tile-ditching machines.

In the drawings, Figure 1 is a side elevation of a tile-ditching machine constructed in accordance with the invention. Fig. 2 is a plan view of the apparatus shown in Fig. 1, parts being removed more clearly to show certain details of construction. Fig. 3 is an elevation of the dipper and parts immediately associated therewith on line *a a* of Fig. 4. Fig. 4 is a sectional elevation on line *b b* of Fig. 3. Fig. 5 is a plan view on line *c c* of Fig. 4. Fig. 6 is a plan view on line *d d* of Fig. 4. Fig. 7 is a plan view on line *e e* of Fig. 4.

Like characters of reference indicate like parts throughout the different figures.

A wheeled vehicle 1 is preferably employed which carries a prime mover or motor 2, preferably a steam-engine, supplied with steam from a boiler 3, an operator's valve-lever 4 being provided for starting, stopping, controlling the speed of, and reversing the engine. A jack-shaft 5 is provided which receives rotary motion from the engine through intermediate gearing, clutch mechanism, herein-after more fully to be described, being employed for reversing the direction of travel of certain parts driven by the engine as required. Where narrow excavations are to be made, I preferably employ a stationary boom 6, carried by the vehicle, and support the dipper-arm 7, carrying the rotary dipper 8, at its lower end upon the said boom. The dipper-arm may be moved longitudinally and may have its angular position with relation to the ground governed by well-known mechanism, such as that illustrated.

The dipper-arm is composed of two parallel members faced with racks 9, engaging pinions 10, mounted upon a shipper-shaft carried by the boom, these pinions being rotated by power-transmission mechanism interposed between the same and the prime mover. I preferably employ a gear-wheel 11 upon the shipper-shaft and a gear-wheel 12, meshing with the gear-wheel 11, a sprocket-chain 13, engaging the sprocket-wheel 14, keyed upon the same shaft with the gear-wheel 12, and a second sprocket-wheel 15, mounted upon the

same shaft with a sprocket-wheel 16, a sprocket-chain 17, engaging the sprocket-wheel 16, and a driving sprocket-wheel upon the main engine-shaft 18. The operator by the manipulation of the lever 4 may effect the longitudinal travel of the dipper-arm in either direction through the agency of the pinions 10 and the said power-transmission mechanism intervening between the same and the prime mover. The angular position of the dipper-arm 7 may be controlled by the well-known means illustrated, comprising cables 19, attached to an angular arm 20, whose elbow is pivoted to the dipper-arm. The cables 19 pass over sheaves or guiding-pulleys 21 and winding-drums 22, whose operative engagement with the prime mover is controlled by the clutch 23. The rotary dipper 8 may be of any suitable form conforming to the character of the work that is to be done. I preferably construct the dipper of two annular end plates 24, united by a series of transverse ribs 25, upon each of which a plurality of separated cutting-blades 26 are mounted, these cutting-blades being preferably removably secured to the said transverse ribs, so that they may be readily replaced when broken. Each set of blades constitutes a cutting-lip. In order to make a clean cut, the blades upon adjacent transverse ribs are relatively displaced.

I preferably mount the dipper upon journals 27 27, preferably interposing ball-bearings between the said journals and the end plates or portions 24. The journals 27 are united by a yoke 28, mounted upon the lower end of the dipper-arm. I preferably apply power to the central peripheral portion of the dipper, for which purpose I preferably place a sprocket-wheel 29 in the central peripheral portion of the dipper, this wheel preferably being of considerably smaller diameter than the cutting diameter of the dipper. A sprocket-chain 30 engages the wheel 29 and is passed around a helical sprocket-wheel 31, mounted upon the same shaft with the sprocket-wheel 14, the sprocket-chain also preferably passing over an idler 32, Fig. 1, carried upon the upper end of the dipper-arm, so that slack in the chain may be properly provided for.

The dipper when employed in a machine traveling ahead of the ditch as it is being completed is rotated in the direction indicated by the arrows, the rotation being preferably at a more rapid rate of speed than that heretofore employed, the amount of soil taken out by each scraper or cutter or each set of cutters being preferably comparatively light, so that the parts to which the dipper is directly secured need not be massive. In the machine shown the dipper is brought into service as the dipper-arm is being raised, which operations, by means of my invention, I am enabled to effect by a single operating means comprising in this instance, as has been said, the sprocket-wheel 14, driven by suitable means and serving through suitable means to rotate

the pinions 10 and the helical sprocket-wheel 31.

While I prefer only to excavate soil as the dipper-arm is being elevated, it is obvious to those skilled in the art that the dipper may be operated at other times.

In order to enable the rotary dipper to descend into the ditch beyond its journal-supports, I provide means whereby the dipper may in its operation cut the ditch as wide or wider than the space between the dipper supports or journals and the immediate appertaining parts to provide sufficient clearance between the same and the sides of the ditch. This I preferably accomplish by providing mechanism for shifting the dipper transversely of the line of travel to change its plane of rotation. In practice I preferably change the angular position of the axis of rotation of the dipper with relation to the line of travel of the machine or the line of the ditch to enable the dipper to cut a wider space than the actual cutting width of the lips upon the dipper. This transverse adjustment of the dipper may be effected in several ways. In the present instance I prefer pivotally to support the yoke 28 upon the lower end of the dipper-arm 7 by a pivot-bolt 33, located, preferably, centrally between the parallel members of the dipper-arm, suitable bracing mechanism being employed to reinforce the bolt 33 in supporting the dipper and provide mechanism for swinging the dipper and other parts carried by the yoke 28. This means preferably consists of the mechanism shown most clearly in Figs. 1, 3, 4, 5, and 6. Referring to these figures, I provide a journal 34, coaxial with the pinion 10, mounted upon the boom. Upon this journal or shaft is provided a sprocket-wheel 35, to which sprocket-wheel a worm-wheel 36 is rigidly secured, the said sprocket-wheel and worm-wheel being adapted freely to rotate upon the journal 34. The worm-wheel 36 engages a second worm-wheel 37, rotatable with but longitudinally movable upon a shaft 38, to which it is adapted to impart rotary motion. The shaft 38 is journaled at its ends in suitable bearings carried by the dipper-arm. As the dipper-arm is moved longitudinally with reference to the pinions 10 the shaft 38 moves longitudinally with reference to the wheel 37. As the dipper-arm is rotated upon the pinions 10 the wheel 37 rotates bodily therewith. Upon the lower end of the shaft 38 is provided a pinion 39, engaging an internal segmental rack 40, provided upon the yoke 28. By turning the wheels 35 and 36 the shaft 38, with the pinion 39, will also be turned to swing the yoke and the dipper. I preferably place all the operating mechanism within the reach of one man, and therefore provide a sprocket-chain 41 between the wheel 35 and a sprocket-wheel 42 upon the vehicle. A hand-lever 43, cooperating with a segmental set-rack 44, is provided for rotating the wheel 42 through a limited range, and thereby effecting a corre-

sponding swinging motion of the yoke 28 through a limited range, the desired adjustment of the dipper that has been effected being maintained by the locking device upon the hand-lever 43.

While I have shown one way of effecting the transverse adjustment of the dipper and the angular position of its axis with relation to the line of the ditch or excavation, it is apparent to those skilled in the art that other mechanism may also be employed for effecting this adjustment, and I do not therefore wish to be limited to the precise means I have herein shown and particularly described for enabling the dipper to cut a ditch of greater width than that of any of its cutting-lips. The particular style of blades or knives for excavating the soil may be varied to suit different conditions. In the particular type of machine shown I prefer to employ the construction illustrated, buckets not performing the best service in this particular connection. I prefer to leave the central portion of the dipper hollow, this central space having direct communication with the segmental spaces between the transverse ribs 25, whereby the excavated material is thrown into the hollow space merely by the force of gravity as these ribs successively approach an upper vertical position.

It is desirable to convey the excavated material to one side of the ditch, for which purpose I employ a conveyer 45 of suitable construction, preferably made of rubber, and provided with rubber cleats placed transversely thereof. Referring more particularly to Figs. 3, 4, and 7, this conveyer is preferably operated by an internal gear 46, engaging a pinion 47, journaled upon a support 48, and serving to rotate a roller 49 through the agency of miter-gears 50. This roller engages the belt conveyer and serves in part to effect its travel. I also preferably employ additional rollers 51 52, operated by sprocket-chains 53, receiving their motion from the roller 49. In order that the cleats or ribs upon the belt conveyer may occupy approximately horizontal positions, I provide supports for the shafts of the rollers 49 and 51, which may vary with relation to the journals 27, as the angular position of the dipper-arm with relation to the ground varies. For this purpose the shaft or journal of the roller 51 is elongated and engages a peripheral groove 54 in one of the annular journals 27, the support 48 for the journals of the roller 49 engaging also a peripheral groove 55 in the remaining journal 27. Cross-pieces 56 are provided, through which the journals of the rollers 49 and 51 pass.

In order to maintain approximately a given angle between the conveyer and the dipper-arm, I provide means for elevating and lowering the upper end of the conveyer as the dipper is elevated and lowered. For this purpose, I preferably, provide a cable 57, passing over suitable guiding-sheaves and at-

tached to a drum 58, which is rotatable in reverse directions by the shaft 18, so that the upper end of the conveyer is elevated and lowered with the dipper-arm, as well as the lower end.

While I have herein shown and particularly described one embodiment of my invention, it is obvious that its application may be made to widely-differing structures and that modifications may readily be made without departing from the spirit of the invention, and I do not therefore wish to be limited to the precise construction shown; but,

Having thus described my invention, I claim as new and desire to secure by Letters Patent—

1. In an excavating-machine, the combination with a rotary dipper constructed to excavate toward the machine, of a pivotal mounting for said dipper permitting the movement of the dipper substantially in the horizontal plane of its axis, and means for actuating said dipper and for controlling its pivotal movement, substantially as described.

2. In an excavating-machine, the combination with a supporting-arm of the rotary dipper mounted thereon, a pivotal connection provided between the supporting-arm and the dipper whereby the plane of rotation of said dipper may be adjusted, and means for actuating said dipper and for controlling its pivotal movement, substantially as described.

3. In an excavating-machine the combination with a dipper-arm, a mounting therefor permitting its longitudinal movement and angular adjustment, a rotary dipper disposed upon said arm, a mounting therefor permitting the movement of said dipper substantially in the horizontal plane of its axis, and means for actuating said dipper and for controlling its movement in the horizontal plane of its axis, substantially as described.

4. In a machine of the class described the combination with a dipper-arm having mountings permitting its longitudinal movement and angular adjustment, of a rotary dipper mounted thereon to rotate substantially in the plane of the direction of the movement of the machine, a mounting for the dipper permitting the control of the plane of rotation of said dipper, and means for actuating the dipper and for controlling its plane of rotation, substantially as described.

5. In a machine of the class described the combination with a dipper-arm, means for securing its longitudinal movement and for adjusting its angular position with respect to the ground, of a rotary dipper mounted at the end of said dipper-arm, a pivotal mounting for said rotary dipper permitting the adjustment of the dipper's rotation substantially in a horizontal plane through its axis, means for securing rotation of the dipper and for adjusting its plane of rotation, substantially as described.

6. In a rotary dipper for excavating-machines, the combination with annular end

plates 24, of a plurality of transverse ribs 25 connected with said end plates, the said ribs being disposed to provide a central open portion within the dipper, journal-bearings exterior to said central open portion, and within the plane of rotation of the cutting-blades, and cutting-blades provided upon the said ribs, substantially as described.

7. In a rotary dipper for excavating-machines, the combination with annular end plates 24, of a plurality of transverse ribs 25 connected with said end plates, the said ribs being disposed to provide a central open portion within the dipper, journal-bearings exterior to said central open portion, and a plurality of relatively-displaced cutting-blades 26 provided upon the several ribs, substantially as described.

8. In an excavating-machine, the combination with a movable dipper-arm, of a rotary dipper having a journal-mounting for supporting the same upon the dipper-arm, the said journal-mounting having a swinging or rotary connection with the dipper-arm, whereby the dipper may be moved transversely, substantially as described.

9. In an excavating-machine, the combination with a dipper-arm mounted to move longitudinally and have its angular position with relation to the ground varied, of a rotary dipper having a journal-mounting for supporting the same upon the dipper-arm, the said journal-mounting having a swinging or rotary connection with the dipper-arm, whereby the dipper may be moved transversely, substantially as described.

10. In an excavating-machine, the combination with a dipper-arm mounted to move longitudinally and have its angular position with relation to the ground varied, of a rotary dipper having a journal-mounting for supporting the same upon the dipper-arm, the said journal-mounting having a swinging or rotary connection with the dipper-arm, whereby the dipper may be moved transversely, a shaft 38 mounted to rotate in bearings carried by the dipper-arm, a pinion 39 upon the said shaft, a gear 40 carried by the journal-mounting, and means for effecting the rotation of the said shaft to move the journal-mounting with the dipper transversely, substantially as described.

11. In an excavating-machine, the combination with a dipper-arm, of a boom, a rack provided upon the dipper-arm, a pinion mounted upon the boom, means for effecting the longitudinal travel of the dipper-arm through the agency of said pinion and rack, the dipper-arm being adapted to rotate about the axis of the pinion, a rotary dipper, means for rotating the same, a journal-mounting for the dipper having pivotal or swinging connection with the dipper-arm, a shaft 38 mounted in bearings carried by the dipper-arm and carrying a pinion 39, a rack 40 carried by the journal-mounting and engaging the latter pinion, a worm-wheel 37 rotatable

with and longitudinally movable with respect to the shaft, a second worm-wheel 36 coaxial with the first aforesaid pinion, and means for rotating the latter worm-wheel to effect the transverse movement of the dipper, substantially as described.

12. In a rotary dipper for excavating-machines, the combination with end plates 24 24, of a series of transverse ribs 25, and a plurality of relatively-displaced blades 26 upon each of said ribs, substantially as described.

13. In a rotary dipper for excavating-machines, the combination with end plates 24 24, of a series of transverse ribs 25, a plurality of cutting-blades 26 upon each of said ribs, and a journal 27 for each of said end plates, substantially as described.

14. In a rotary dipper for excavating-machines, the combination with end plates 24 24, of a series of transverse ribs 25, a plurality of cutting-blades 26 upon each of said ribs, a journal 27 for each of said end plates, and ball or roller bearings interposed between the end plates and the journals, substantially as described.

15. In an excavating-machine, the combination with a rotary dipper having a hollow interior and provided with a series of transverse relatively-displaced cutting-lips, the spaces between which have direct communication with the said hollow interior, of a conveying device extending within the said interior longitudinally of the axis of rotation of the dipper to receive the material removed by the dipper as it falls from the said lips, and means for effecting the travel of the conveying device, substantially as described.

16. In an excavating-machine, the combination with a rotary dipper, of journals 27

therefor, the said dipper being provided with a hollow interior and having transverse cutting-lips, the spaces between which have communication with the said hollow interior, a conveyer extending within the dipper longitudinally of its axis of rotation, and interior gearing within the hollow dipper for effecting the travel of the conveyer operated by the dipper in its rotation, substantially as described.

17. In an excavating-machine, the combination with a dipper-arm, of a rotary dipper mounted thereon, and unitary means adapted simultaneously to effect the longitudinal travel of the dipper-arm and the rotation of the dipper, substantially as described.

18. In an excavating-machine, the combination with a longitudinally-movable dipper-arm, of a rotary dipper mounted thereon, a conveyer for removing the excavated material, and means for moving the said conveyer with the dipper-arm as the latter is moved longitudinally, substantially as described.

19. In an excavating-machine, the combination with a longitudinally-movable dipper-arm, of a rotary dipper mounted thereon, a conveyer having its lower end movable with the dipper, and means for effecting the movement of the upper end of the conveyer as the dipper-arm is moved longitudinally to maintain the desired angular position of the conveyer with relation to the dipper-arm, substantially as described.

In witness whereof I hereunto subscribe my name this 12th day of May, A. D. 1899.

LUKE V. BROPHY.

Witnesses:

GEORGE L. CRAGG,
CHARLES E. HUBERT.