

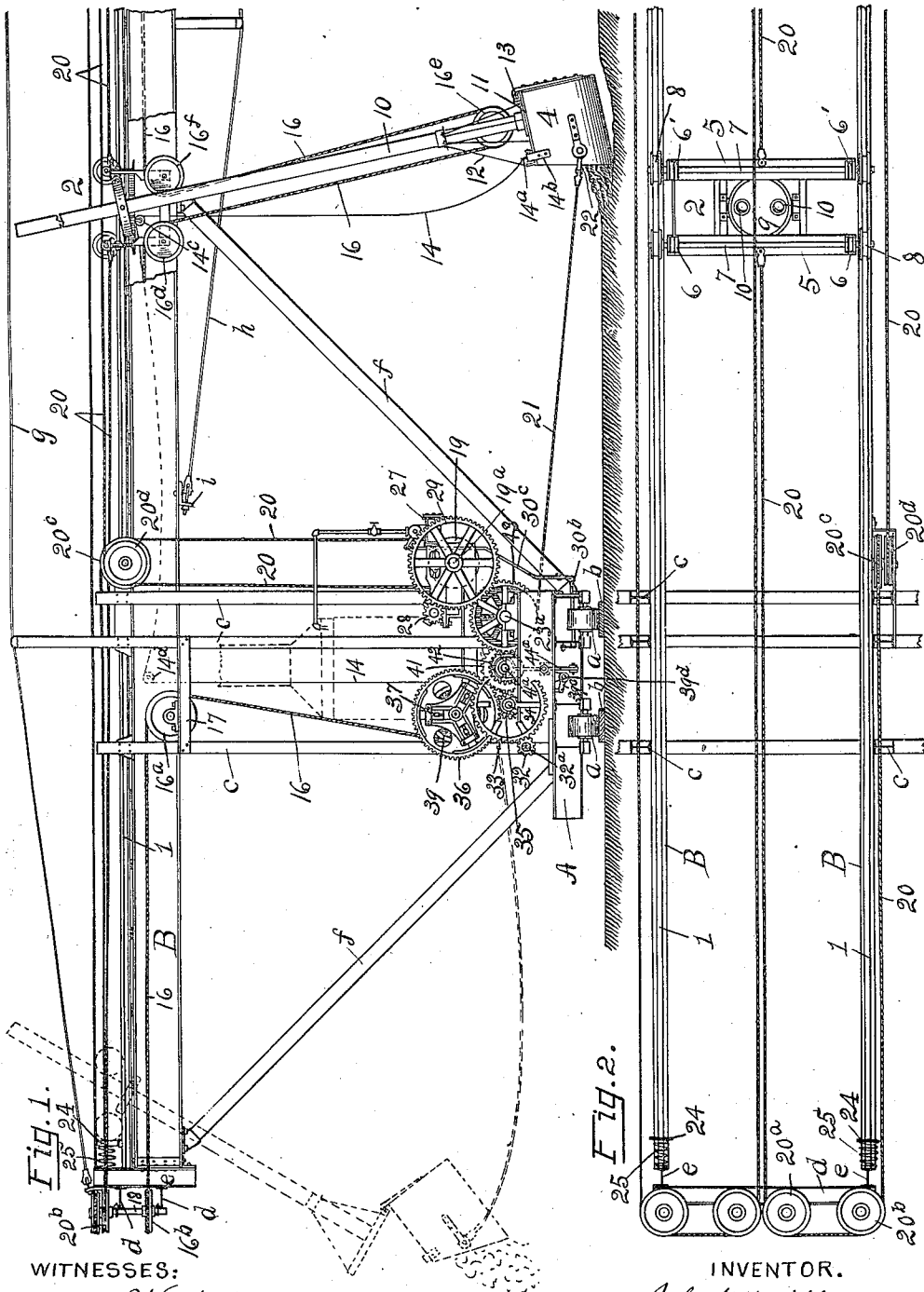
No. 820,055.

PATENTED MAY 8, 1906.

J. H. W. LIBBE.
EXCAVATOR.

APPLICATION FILED DEC. 4, 1905.

3 SHEETS—SHEET 1.



WITNESSES:

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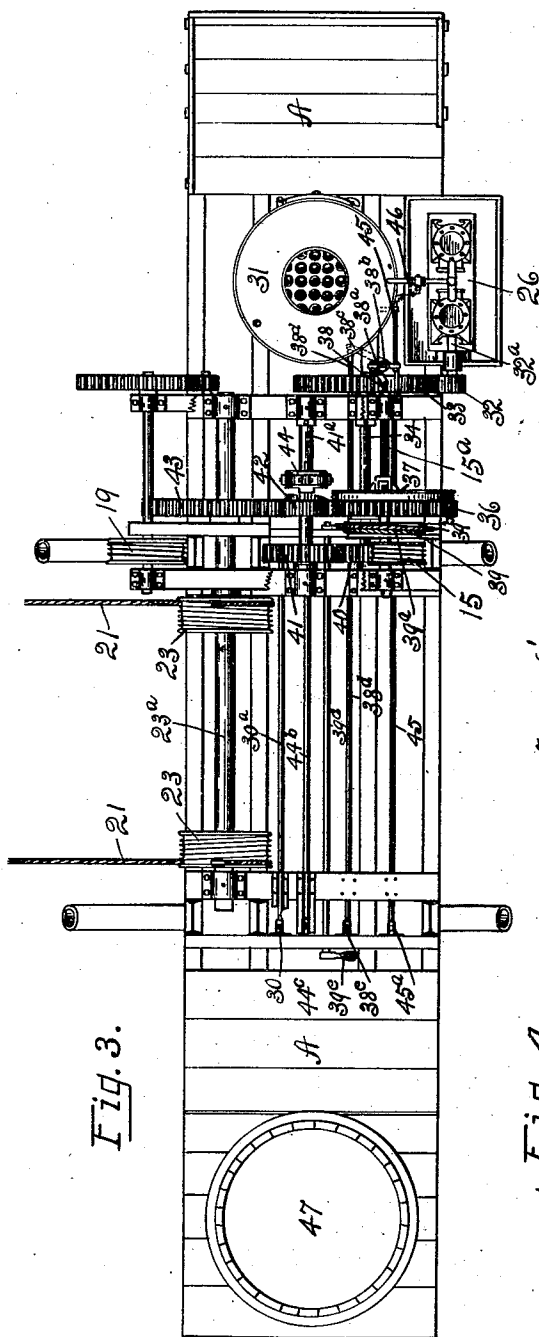


Fig. 3.

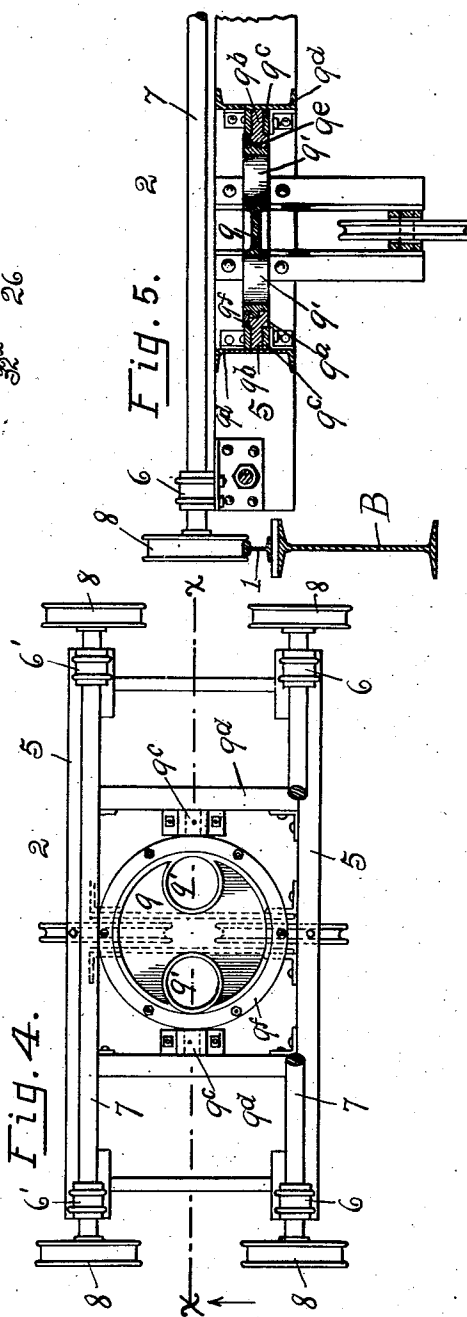


Fig. 4.

Fig. 5.

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UNITED STATES PATENT OFFICE.

JOHN H. W. LIBBE, OF TOLEDO, OHIO.

EXCAVATOR.

No. 820,055.

Specification of Letters Patent.

Patented May 8, 1906.

Application filed December 4, 1905. Serial No. 290,062.

To all whom it may concern:

Be it known that I, JOHN H. W. LIBBE, a citizen of the United States, and a resident of Toledo, in the county of Lucas and State of Ohio, have invented certain new and useful Improvements in Excavators; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to figures and letters of reference marked thereon, which form a part of this specification.

My invention relates to excavating apparatus of the class especially employed for digging, deepening, cleaning, or widening open ditches and ship-canals.

An object of my invention is the provision of a machine of the class described which has its frame so constructed as to enable it to span the ditch or canal to be worked and be mounted for locomotion on the banks thereof, thus enabling the machine to easily pass over bridges and other obstructions disposed over or in the channel of the ditch or canal without necessitating the removal of such obstruction or the carrying of the machine around the same, as is the case with the crane type of excavators, which, due to their construction, travel in the channel of the ditch or canal.

A further object of my invention is the provision in an excavator for open ditches or ship-canals of two independently-operated dippers movable to alternately secure their respective loads from the bed or sides of the ditch or canal and to have their discharge on opposite sides thereof, whereby to double the capacity of machines of the kind employing a single dipper.

Further advantages of my machine will be apparent by reference to the following specification and to the accompanying drawings, forming a part thereof, in which—

Figure 1 is a side elevation of substantially one-half of the apparatus comprising my invention with portions thereof broken away and the dipper operative from such portion in the act of loading. Fig. 2 is a top plan view thereof with the machinery removed and showing the dipper-carriage and the driving or controlling cables therefor. Fig. 3 is a plan of the platform at either end of the apparatus, showing the operating mechanism with portions of the frame broken away and the engine for communicating movement to

the dipper-carriage-controlling cable removed. Fig. 4 is a top plan view of a dipper-carriage. Fig. 5 is a vertical section of a portion of the dipper-carriage, taken on the dotted line *x x* in Fig. 4. Fig. 6 is a side elevation of the apparatus with the operating mechanism removed and showing one dipper in the act of loading and the other returning after having discharged its load. Fig. 7 is a diagrammatic plan view thereof, illustrating the course of each carriage-controlling cable with respect to its carriage; and Fig. 8 is a similar view illustrating the course of the dipper elevating or hoisting cables.

Referring to the drawings, A A represent two platforms or stages, which are suitably spaced apart as the width of the ditch or channel to be dug or worked may require and are equipped on the under sides thereof with suitable rollers or wheels *a* for locomotion, which run on temporary rails or planks *b*, laid on the respective banks or at the sides of the ditch or canal to be worked. These platforms or stages are shown as connected by truss-beams B B, which are supported in spaced parallel relation at the proper height above the platforms by columns or uprights *c*, arising from said platforms, and are of sufficient length to span the ditch or canal and have their ends extending a distance beyond the outer sides of the platforms, as the point of discharge of the dippers may require. Cross-beams or end pieces *d d* rigidly connect the beams B B at their ends and are shown as being spaced therefrom by the vertical members *e e*, which project a short distance above the surface plane of the spanning-beams. The beams B B are longitudinally braced with respect to the platforms A A by the bracing members *f*. Bracing-cables *g* and *h* are also positioned longitudinally of each spanning-beam, the former being disposed above the beams and having their ends fixed adjacent the ends of said beams and their intervening portions elevated by a prolongation of one of the columns *c* of each platform, and the latter being disposed below the beams and having their ends fixed thereto, as at *i*.

A rail 1 is laid or formed upon the surface of each beam B B to provide a track on which the cars or carriages 2 and 2' for carrying the dippers 4 and 4', respectively, are adapted to travel longitudinally of said beams. These cars or carriages, which are best shown in Figs. 4 and 5, are the same in construction and comprise a rectangular frame portion 5

of suitable length to pass freely between the beams A A and provided with two sets of bearing blocks or hangers 6 6', in which the shafts 7 7, carrying at their ends the periph-
 5 erally-flanged wheels or rollers 8 for riding on the rails 1, are mounted. In the center of the frame 5 is pivotally mounted a disk-like head 9, which has its pivotal axis disposed at right angles to the line of movement of the car-
 10 riage and is provided with two vertical openings 9', through which the two sticks 10 of the associated dipper loosely pass. The manner of mounting this head, as shown in the drawings, consists in the provision of a
 15 ring 9^a, having trunnions 9^b formed on opposite sides thereof and mounted within bearings 9^c, secured to transverse frame-pieces 9^d of the carriage, said ring being also formed on its upper inner edge with an annular groove
 20 9^e on the head 9, as shown in Fig. 5. The head 9 is retained to its seat in the ring 9^a by the ring 9^f, which is bolted or otherwise suitably secured to the ring 9^a and adapted to
 25 permit a free turning of the head in the ring 9^a. It is thus apparent that the head 9 may have both a pivotal movement with the trunnions 9^b as its axis and an independent rotary movement with respect to the ring 9^a.
 30 The dipper-sticks 10, which pass through the opening 9' in the head 9, are parallel throughout their lengths and have their lower or inner ends rigidly and firmly secured in any suitable manner to approximately the center
 35 of the top 11 of the dipper with which they are associated and are laterally braced adjacent such ends by rods, cables, or the like 12, which rigidly connect the dipper-top 11 at its sides with collars 12^a on said sticks. The
 40 top 11 of each dipper is hinged to the back thereof, as at 13, so as to permit the open end of the dipper to swing downwardly from the top when being dumped, as shown by dotted lines in Fig. 1. The tripping of a dipper is
 45 effected by the pulling of a cord 14, which has one end secured to a latch member 14^a on the top 11 of the dipper, which latch member is operated by a pulling of the cord to move a bolt (not shown) from engagement with a
 50 catch 14^b on either side of the dipper-body. The other end of this cord extends up to the carriage of the dipper over a sheave 14^c, thence over a sheave 14^d, and down to adjacent the position of the operator.
 55 The two dippers 4 and 4', which have their discharge on opposite sides of the ditch or canal and have the direction of their corresponding movements reversed, are each controlled by a separate operating mechanism
 60 which is mounted on the platform over which the associated dipper has its discharging movement. As the operation of and means for controlling each carriage and its dipper are the same, except that their relative posi-
 65 tions and directions of travel are reversed,

the operation and controlling mechanism of only one dipper will be described.

During the filling and dumping operation of a dipper three distinct movements are im-
 70 parted thereto—namely, the hoisting and lowering of the dipper relative to its carriage, the digging movement of the dipper relative to its carriage, and the movement of the dip-
 75 per with its carriage longitudinally of the spanning-beams for the purpose of discharging its load at the side of the ditch or canal and returning to reload.

The hoisting and lowering or vertical move-
 80 ment of a dipper is effected by the proper direction of rotation of the channeled drum 15, which is mounted on the shaft 15^a and connected with the dipper through the medium of a cable 16. This cable has one end se-
 85 cured to said drum in position to be wound thereon, thence passes upward over the sheave 16^a, carried by a cross-beam 17 of the frame, thence horizontally around the con-
 90 tiguous end of the beam B in engagement with the sheaves 16^b and 16^c, carried by the vertical shafts 18 at such end, thence be-
 95 tween and in parallelism with the two spanning-beams to the carriage carrying said dipper, passing over the sheave 16^d, carried thereby, and down under the sheave 16^e, which is mounted between the dipper-sticks
 100 10, adjacent their point of connection with the dipper, thence upward over the sheave 16^f, which is mounted on the opposite side of the carriage to the sheave 16^d, thence contin-
 105 uing its course between the beams B B, passing through an open portion of the carriage carrying the other dipper, and finally having its end fixed at 16^g to the cross-piece connecting the proper ends of the spanning-
 110 beams, as shown in Fig. 8.

The movement of a carriage longitudinally of the beams B B for the purpose of disch-
 115 arging its load at the side of the canal or ditch is effected by a proper direction of rotation of the drum 19, which is mounted on a shaft 19^a at the same end of the platform of the frame as the drum 15 and connects with the asso-
 120 ciated carriage through the cable 20. This cable, which may be termed a "motor-cable," has one end fixed to the front or outer end of the associated carriage, thence passes around the sheaves 20^a and 20^b, which are mounted
 125 above the sheaves 16^b and 16^c on the shafts therewith, thence passes along the outer side of the beam disposed on the side of the frame with the drum 19, over the sheave 20^c, and
 130 down to said drum, around which it is passed a series of times to have a tight frictional engagement therewith, after which it passes upward over the sheaves 20^d, mounted on the spindle with the sheave 20^c, and continues its course along the side of said beam to the opposite end thereof, where it passes around the two horizontally-aligning sheaves 20^e and 20^f, thence passes back between the vertical

planes of the two spanning-beams, either through or over the frame of the other carriage of the apparatus, and finally has its end fixed to the opposite side of the attached carriage to that first engaged, thus forming an
 5 endless cable with the attached carriage forming the connection between its ends.

The digging movement of the dipper is imparted thereto through the two draft-cables 21, which have their dipper ends connected to opposite sides of the dipper through the medium of the pivotal arms 22 and their other ends fixed to drums 23 23 in position to wind thereon when they are turned. These
 15 drums are mounted on a shaft 23^a between the transversely-spaced uprights arising from each platform of the frame and in the line of movement of the dipper and have their peripheries formed with right and left
 20 spiral grooves, so that the cables are each caused to wind thereon toward the center of the shaft. The provision of the two draft-cables 21 and their manner of connection with the dipper forms an important feature
 25 of my invention, as an even and direct pull is thus applied to each side of the dipper and a turning thereof, due to one side of the dipper striking a stone or other hard substance, is prevented. The connection of the cable
 30 ends with the pivotal arms 22 facilitates a free movement of the dipper as it passes up and outward over the drums 23 on its discharging movement, the position of the cables with respect to the dipper when the lat-
 35 ter is at the limit of its outward movement being reversed.

Each dipper-carriage is brought to an abrupt stop at its limit of outward movement on the spanning-beams by contact with
 40 a bumper 24, one of which is positioned adjacent each end of said beams in the path of movement of the contiguous carriage and yieldingly spaced from the vertical members
 45 *d d* at the ends of the beams by compression-springs 25. As a carriage is thus stopped the impetus of its dipper causes it to swing out and throw its contents a distance from the end of the machine, as shown by dotted lines in Fig. 1, the dipper being tripped at the
 50 desired point by a pulling of the trip-cord 14 by the operator.

The drums 15 23 23 are driven by an engine 26 through a series of properly-proportioned gears and pinions and have their move-
 55 ments controlled by suitable clutches, while the drum 19, on which the motor-cable of the associated carriage is wound, is driven by the engine 27 through the medium of the pinion 28 on the engine-shaft and the meshing gear
 60 29 on the shaft 19^a with said drum, and has its rotation controlled by a throttling of the engine. The throttling of the engine 27 is effected by a movement of the lever 30,
 65 which is positioned at the operator's end of the platform on which the mechanism is

mounted and connects with the throttle-valve of the engine through the medium of the push-rod 30^a, cranked shaft 30^b, and link 30^c, as shown in Figs. 1 and 3. The lever 30
 70 may be operated to cause a working of the drum 19 in either direction of rotation, so that opposite directions of movement may be communicated to the associated carriage. These engines preferably receive their steam-
 75 supply from a common boiler 31, which is mounted on the platform therewith. The mechanism shown for communicating motion to the drums 15 and 23 from the engine
 80 26 consists in mounting a pinion 32 on the engine-shaft 32^a for meshing with the spur-gear 33 on the shaft 34, which shaft also carries a pinion 35 for driving the spur-gear 36,
 85 which is loosely mounted on the shaft 15^a with the drum 15. A three-armed friction-clutch 37 is carried by the shaft 15^a in position for its arms to engage an annular flange
 90 on the gear 36. This clutch has its movement controlled by a shipper-rod 38, the outer end of which has toggle connection, as shown at 38^a, with a vertical rock-shaft 38^b,
 95 from the lower end of which shaft extends an arm 38^c, having pivotal connection with one end of a push-rod 38^d, the other end of which rod extends to the operator's side of the plat-
 100 form and has connection with an operating-lever 38^e. 39 represents a brake-drum, which is fixed on the shaft 15^a and is encircled by a brake band or cable 39^a, one end of which is fixed to the frame, as at 39^b, while
 105 the other end thereof connects with an arm 39^c, carried by the rock-shaft 39^d, which rod carries a second arm or treadle 39^e in position to be depressed by the operator's foot. A pinion 40 is also carried by the shaft 34 and
 110 drives a gear 41, fixed to the shaft 41^a, which shaft also carries a loose pinion 42 for meshing with the gear 43, carried by the drum-shaft 23^a. The rotation of the pinion 42 relative to its shaft is controlled by a jaw-clutch, the movable member 44 of which
 115 slides on a feather on the shaft 41^a and is reciprocated by a shipper-lever 44^a, which connects with a push-rod 44^b having an operating-lever 44^c at its other end positioned adjacent the operator's stand. The throttle-
 120 valve of the engine 26 has connection with one end of a rock-shaft 45 through suitable link-and-arm-connection, as shown at 46, and is controlled by a throttle-lever 45^a, which is disposed adjacent the operator's stand and
 125 has connection with said rock-shaft. 47 represents a water-tank, which is shown in Fig. 3 as being positioned on the operator's side of the platform.

The operation of the apparatus comprising
 130 my invention is as follows: The left-hand dipper 4, having been lowered to the position shown by full lines in Fig. 1, is caused to dig its nose into the mud, gravel, dirt, or other material forming the part to be excavated 135

and be filled by the working of the drums 23 23, which are thrown into operation by a proper movement of the lever 44° controlling the clutch member 44, thus effecting a shortening of the two draft-cables 21 and an outward movement of the dipper, which is caused to make a substantially straight cut during such movement by the throwing of the drum 19 into operation to effect an outward movement of the carriage with the dipper in its digging operation, the driving mechanism of the motor and draft-cables being properly geared for that purpose. The line of draft of the cables 21 being direct with respect to the opposite sides of the dipper causes a steady even pull to be applied to each side of the dipper and prevents a turning thereof due to one side of the dipper meeting with greater obstructions than the other. After the dipper has made its apportioned cut the mechanism driving the motor-cable is stopped, the clutch member 44 released to permit a free movement of the drums 23 23, and the friction-clutch 37 thrown into operation by a movement of the lever 38° controlling the same to cause a working of the drum 15 and a consequent shortening of the cable 16 and elevating of the dipper. As the dipper reaches the proper elevation to permit it to freely pass over the portion of the platform in its path of movement the rotation of the drum 15 is preferably stopped by a throttling of the engine 26, but may be stopped, if desired, by a releasing of the clutch 37, in which latter case the operator depresses the brake-treadle 39° with his foot to tighten the band on the brake-drum 39 to prevent an unwinding of the elevating-cable. This being done, the operator opens the throttle-valve 30 of the engine 27 to cause a working of the drum 19 in the proper direction to move the carriage and its dipper toward the end of the beams B B, at which it is dumped through the medium of the communicating cable 20. As the outward movement of the carriage on its track is stopped either by its contact with the bumper 24 or by the stopping or reversing of the engine 27 the impetus of the loaded dipper causes it to swing out and throw its contents a desired distance from the machine or into a car positioned on the bank of the ditch or canal at the end of the machine, the dipper being tripped at the proper moment by a pulling of the trip-cord 14. As the dipper swings back after discharging its load its movement is taken up by the throwing of the drum 19 into operation in the proper direction of rotation to return the carriage to a position over the ditch or canal where it is desired to lower the dipper to secure a fresh load. The lowering of the dipper, which lowering is effected by the operator releasing the pressure of his foot from the brake-treadle 39° to permit the dipper to drop by its own weight, is timed to

take place as it swings to the right after the stopping of the carriage on its return movement, thereby causing the dipper as it drops to dig its nose into the ground at an angle to a horizontal plane. The relative movements of the two dippers is so timed that one is discharging its load as the other is loading, thereby keeping each out of the way of the other and performing double the amount of work that could be performed by one in the same length of time.

It is obvious that the objections incident to the use of excavators which are required to be mounted in the channel of the ditch or canal and ride on the bottom thereof are avoided by my construction, which enables the ditch or canal to be entirely spanned and bridges or other obstructions therein passed without the removal of such obstruction or the dismantling of the excavator and carrying it around the same.

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

1. In an excavator, a stage, a member elevated above and having its ends extended in opposite directions from the stage, a dipper carried by said member and movable over the stage in its discharging movement whereby its load is secured on one side and discharged on the other side of the stage, and mechanism for causing the dipper to dig and discharge its load.

2. In an excavator, a stage, a horizontal member supported over and having its ends extended in opposite directions from the stage, a dipper suspended from said member and movable both at right angles to and in parallelism therewith and operative to secure its load on one side of the stage and to travel over and have its discharge on the other side of the stage, and mechanism for causing the dipper to dig and discharge its load.

3. In an excavator, a frame comprising two spaced stages or trucks, and a spanning member connecting said stages or trucks and having one end extended on the opposite side of one stage or platform to its central portion, a dipper freely suspended from the spanning member and adapted to have swinging, vertical and horizontal movements and operative to secure its load on one side of the stage or truck contiguous to the extended end of the spanning member and have its discharge over on the other side of said stage or truck, and mechanism for communicating the digging and discharging movements to the dipper.

4. In an excavator, a frame comprising spaced stages or platforms, and a spanning member connecting the stages or platforms, a dipper freely suspended from the spanning member and operative to secure its load from between the stages or platforms and to have its discharge over and on the opposite side of

one of the stages or platforms, and mechanism for causing the dipper to dig and discharge its load.

5 5. In an excavator, a frame having spaced trucks, and a spanning member connecting said trucks, two dippers movably carried by the spanning member and having their discharging movements in opposite directions longitudinally of the spanning member, said
10 dippers being also movable vertically of the spanning member, and mechanism mounted on each truck for communicating said movement to the associated dipper.

6. In an excavator, a frame, having spaced
15 stages or platforms, and a spanning member connecting the stages or platforms, two dippers carried by the spanning beams and operative to alternately dig and discharge their loads, the discharge taking place adjacent
20 the ends of the spanning beams, said dippers having swinging and vertical movements relative to said beam and independent mechanism for each dipper for causing it to dig and discharge its load.

25 7. In an excavator, a frame having stages or platforms, and a straight horizontal spanning member connecting the stages or platforms and having its ends extending beyond the same, two dippers freely suspended from
30 the spanning member and operative to alternately secure and discharge their loads, the discharge thereof taking place at the opposite extended ends of the spanning member and beyond the associated stage or platform,
35 and independent mechanism for each dipper for causing it to dig and discharge its load.

8. In an excavator, a channel-spanning frame mounted for locomotion on the banks of the channel and having a horizontal spanning beam extended at its ends, two dippers
40 movably carried by the spanning beam and having their discharging movements in opposite directions relative to the channel, said dippers being also movable vertically and
45 pivotally of the spanning beam, independent mechanism for communicating the discharging movements to each dipper and independent means for elevating each dipper after securing its load.

50 9. In an excavator, the combination with a horizontal beam, of a carriage movable on said beam and having a variously-pivoted head, a dipper carried by and having its dipper-stick in connection with and movable
55 relatively to said head, and mechanism for communicating motion to the carriage and imparting vertical and horizontal movements to the dipper.

10. In an excavator, the combination with
60 the spanning beam, of a dipper carried by said beam and mounted to have vertical longitudinal, vertical swinging and horizontal pivotal movements relative to the beam, mechanism for communicating the swinging
65 and vertical movements to the dipper, and

mechanism for communicating the longitudinal movement thereto.

11. In an excavator, the combination with the spanning beam, of a carriage mounted for longitudinal movement thereon, a dipper carried by and movable both pivotally and radially of the carriage, mechanism for communicating motion to the carriage, and mechanism for communicating both the pivotal and the radial movements to the dipper. 70

12. In an excavator, the combination with the spanning beam, of a carriage mounted for movement longitudinally of the beam and having a horizontally-disposed variously-pivoted part, a dipper carried by and having a
80 movement relative to said pivotal part, means for communicating motion to the carriage, means for communicating a pivotal movement to the dipper, and means for communicating a movement to the dipper relative to
85 the pivotal part.

13. In an excavator, the combination with the spanning beam, of a carriage mounted for movement longitudinally of the beam, a dipper suspended from and having its stick
90 passed loosely through the carriage whereby to permit it to have a vertical and a lateral swinging movement relative to the carriage, draft mechanism for communicating a direct digging pull to the dipper, means for hoisting
95 the dipper, and means for imparting movement to the carriage.

14. In an excavator, the combination with the channel-spanning member, of two dippers carried by the spanning member, each
100 being mounted to have a swinging, a vertical and a horizontal movement relative to the beam, mechanism for imparting horizontal movement to each dipper, mechanism for swinging each dipper to secure its load, and
105 mechanism for elevating each dipper after it has secured its load.

15. In an excavator, a stage or platform, a beam elevated above the stage or platform and having a portion of its length disposed
110 over the channel to be worked and a portion extending over the channel-bank on the opposite side of the contiguous stage to the major portion of the beam, a carriage mounted on and movable lengthwise of the beam, a
115 dipper carried by the carriage and mounted to have both a vertical and a digging movement relative thereto, mechanism for communicating the digging movement to the dipper, mechanism for elevating the dipper, and
120 mechanism for driving the carriage in reverse directions whereby the dipper is caused to have a movement longitudinally of the beam and to swing out to discharge its load from the bank end thereof at the limit of outward
125 movement of the carriage and then return to reload.

16. In an excavator, a stage or platform, a beam supported thereby and disposed transversely of the ditch or canal over the channel
130

and bank thereof, a carriage mounted on and movable longitudinally of the beam, a dipper carried by the carriage and mounted to have both a vertical and swinging movement relative thereto, mechanism for elevating the dipper after it has secured its load, mechanism for driving the carriage longitudinally of the beam, and a bumper with which the carriage has contact on its outward or discharging movement whereby to cause an abrupt stopping of the same and an outward swinging of the dipper to discharge its load from the mouth or open end thereof.

17. In an excavator, the combination of a stage, a horizontal track supported thereover and having its end extending beyond the stage, a carriage movable on the track and over the stage, a dipper pivotally carried by the carriage and movable to secure its load on one side of the stage and discharge it on the other side thereof, a yielding bumper with which the carriage has contact at a predetermined point in its outward or discharging movement whereby to cause an abrupt stopping of the same and a consequent outward swinging movement of the dipper to effect a discharge of its load from the side thereof disposed in the direction of its discharging movement, and mechanism for driving the carriage and imparting digging and vertical movements to the dipper.

18. In an excavator, the combination with the beam and carriage movable thereon, of a dipper movably suspended from the carriage, a winding-drum, mechanism for operating the drum, a cable extending to each side of the dipper from the drum whereby a direct and even pull is communicated from the drum to each side of the dipper, said cables having their dipper ends in pivotal connection with the dipper sides, and means for elevating the dipper relative to its carriage.

19. In an excavator, the combination with a horizontally-disposed member, of a carriage mounted on and movable longitudinally of the member, said carriage having a head turnable on a horizontal axis disposed transversely of the member and also turnable on a vertical axis relative to the carriage, a dipper movably suspended from the carriage and having a plurality of sticks loosely extending through said head, means for imparting a digging movement to the dipper, and means for elevating it relative to the carriage.

20. In an excavator, a stage mounted for locomotion on the bank of the channel to be worked, parallel beams supported by the stage to form a track and having their ends extending in opposite directions from the stage, a carriage mounted for movement longitudinally of the beams, a dipper suspended from the carriage and movable relative thereto, draft mechanism for the dipper in the line of its digging movement, means for elevating the dipper to enable it to pass

over the draft mechanism, and means for imparting movement to the carriage whereby the dipper is caused to travel over the draft mechanism and to have its discharge on the opposite side of the stage to the point of digging.

21. In an excavator, the combination with the beam, of a carriage movable thereon, a dipper movably carried by the carriage, means for imparting the digging movement to the dipper, means for elevating the dipper, and means for moving the carriage to a point where the dipper discharge takes place, the dipper in such movement passing over the means for imparting the digging movement thereto.

22. In an excavator, the combination with the beam, of a carriage movable thereon, a dipper movably carried by the carriage, and means for imparting movement to the dipper relative to its carriage, said means comprising a drum, mechanism for imparting rotation thereto, a cable having one end secured to the drum and thence having its course guided up to and around one end of the beam, thence parallel therewith through the carriage and to the opposite end of the beam where its other end is fixed, the portion passing through the carriage being looped and in engagement with the dipper, whereby a shortening of the cable effects an elevation of the dipper.

23. An excavator, comprising two stages mounted for locomotion on opposite channel-banks, a spanning truss supported by the stages and having its ends projecting beyond the respective stages, two carriages movable on the truss and over their associated stages, a dipper carried by each carriage and having a vertical and swinging movement relative thereto, and each having its discharge away from the associated stage and on the bank side thereof, and mechanism on each stage for driving the associated carriage and imparting vertical and swinging movements to the attached dipper.

24. In an excavator, the combination with a beam, and a carriage movable thereon, of a dipper carried by the carriage and movable therewith and relative thereto, and direct draft means for the dipper over which it is caused to pass in its discharging movement.

25. In an excavator, the combination with a horizontally-movable carriage, of a dipper having its stick in loose pivotal engagement with the carriage, said dipper being movable to discharge its load outwardly and away from itself in the line of its digging movement, and draft means for imparting a direct digging pull to the dipper, said means being disposed intermediate of the digging and discharging positions of the dipper.

26. In an excavator, a pivotally-suspended dipper, a draft mechanism disposed in the line of digging movement of the dipper, and a

draft-cable leading from each side of the dipper to the draft mechanism, whereby a direct pull is communicated to each side of the dipper from such draft mechanism.

5 27. In an excavator, a pivotally-suspended dipper, a draft mechanism disposed in the line of movement of the dipper, and a draft-cable leading from each side of the dipper to the draft mechanism, said cables being
10 spaced throughout their lengths whereby a

substantially direct pull is communicated to each side of the dipper.

In testimony whereof I have hereunto signed my name to this specification in the presence of two subscribing witnesses

JOHN H. W. LIBBE

Witnesses:

CORNELL SCHREIBER,
C. W. OWEN.