No. 844,959. PATENTED FEB. 19, 1907.

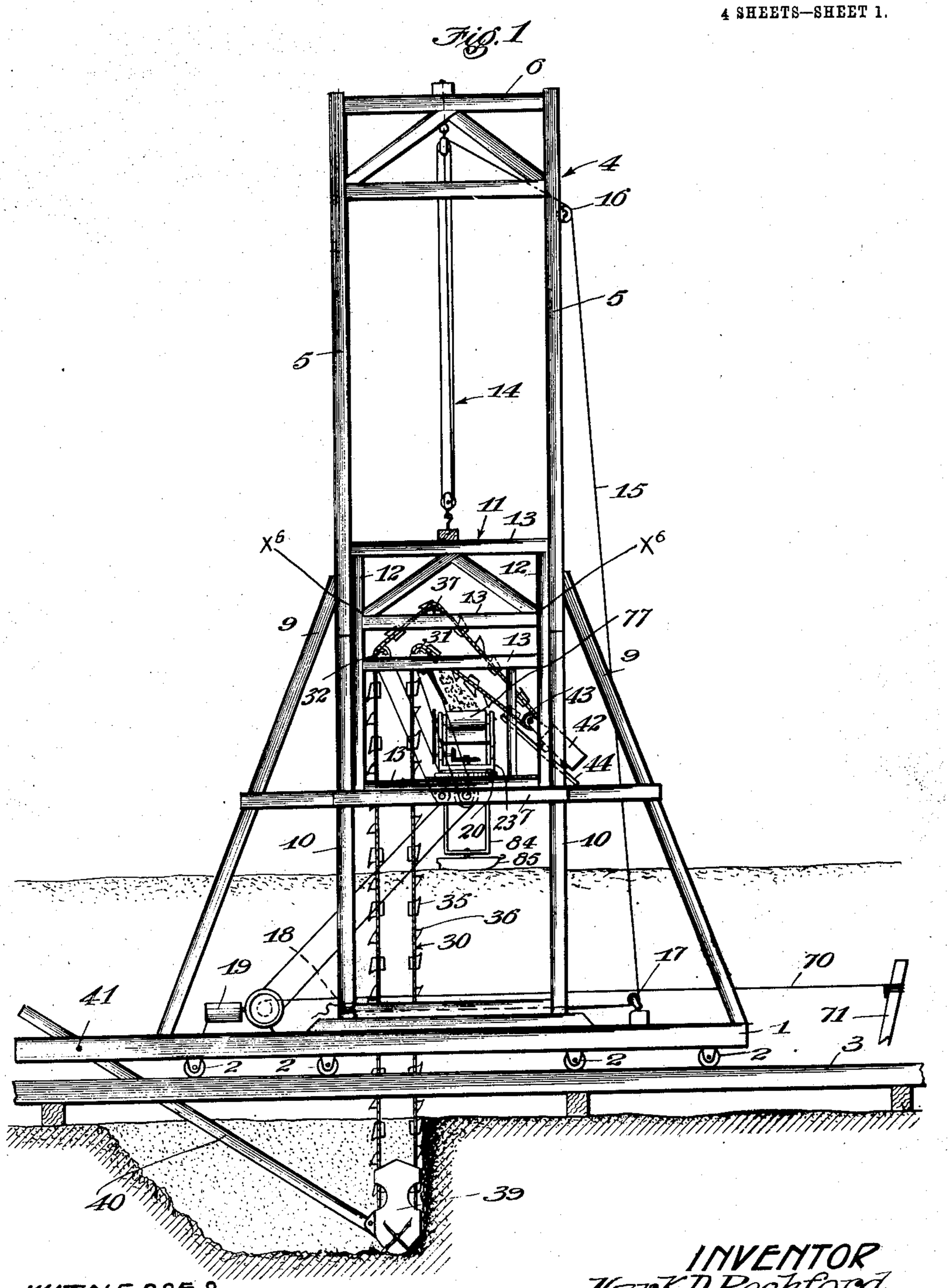
M. D. ROCHFORD.

EXCAVATOR.

APPLICATION FILED FEB. 8, 1904.

4 SHEETS—SHEET 1.

Fig. 1



WITNESSES

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No. 844,959.

PATENTED FEB. 19, 1907.

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APPLICATION FILED FEB. 8, 1904.

4 SHEETS—SHEET 2.

Fig. 5

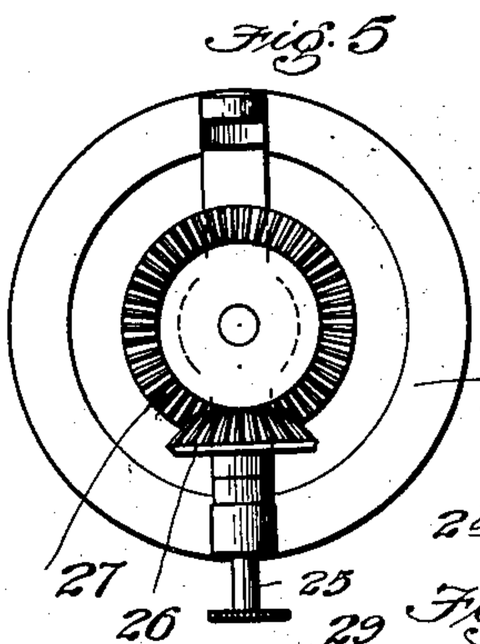

Fig. 4

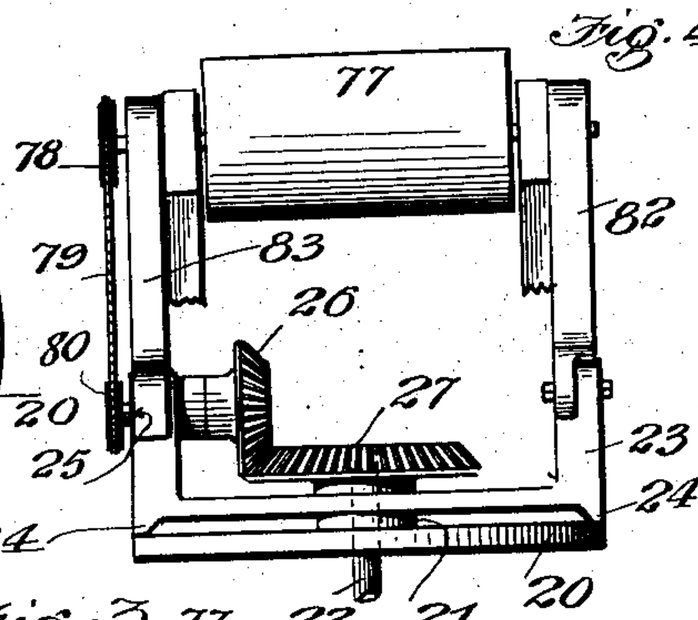

Fig. 2

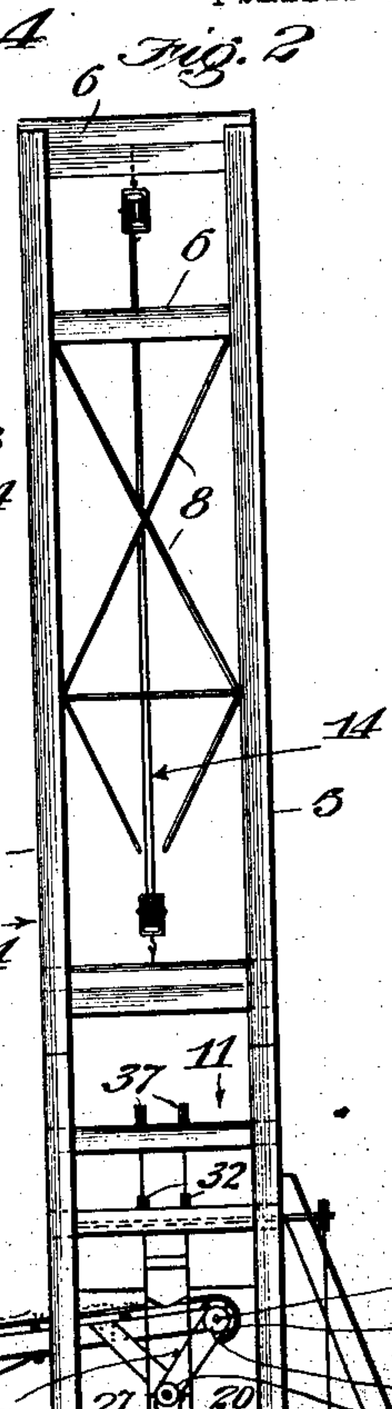

Fig. 3

WITNESSES

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No. 844,959. PATENTED FEB. 19, 1907.

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4 SHEETS—SHEET 3.

Fig. 6

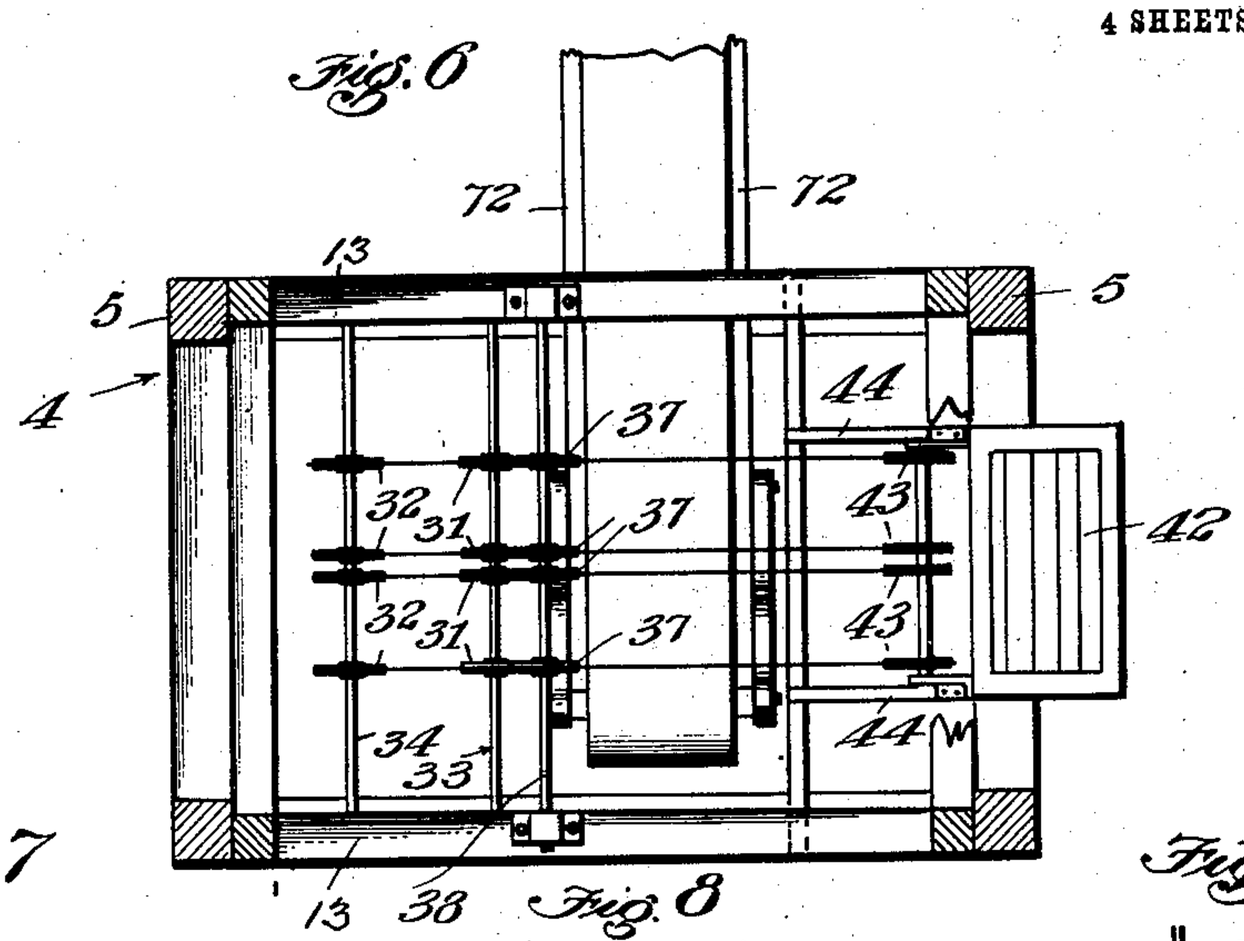
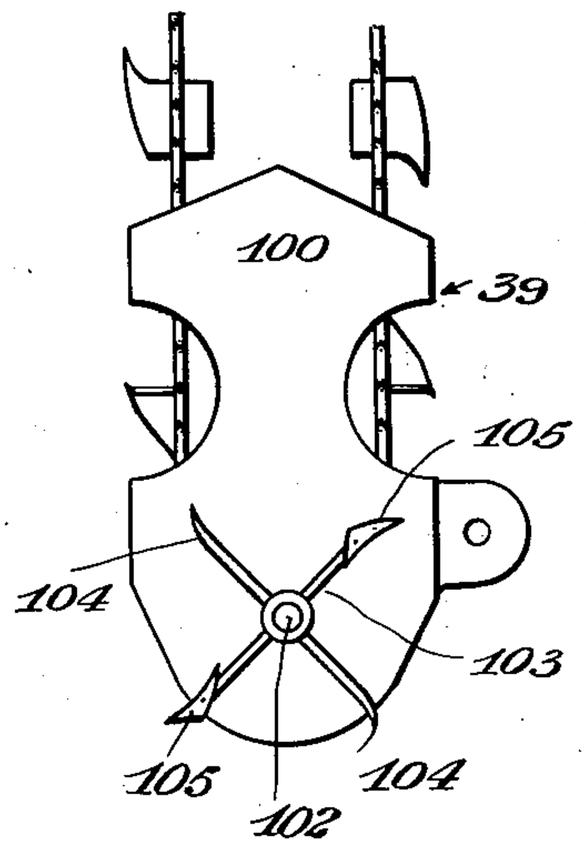


Fig. 8

Fig. 7



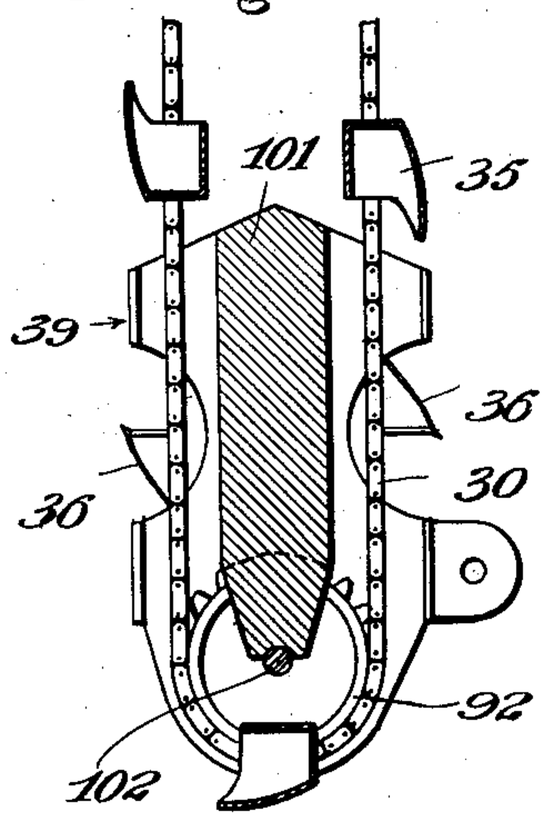


Fig. 9

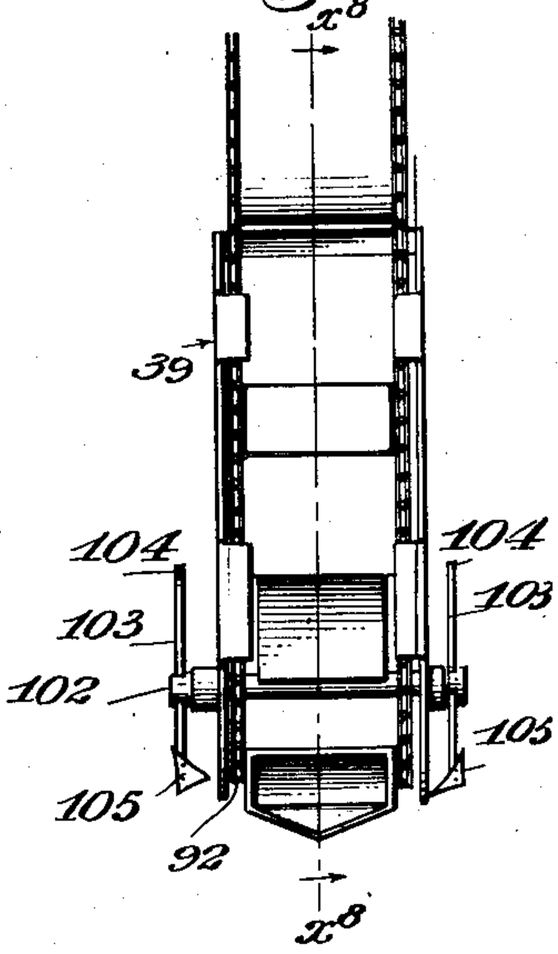
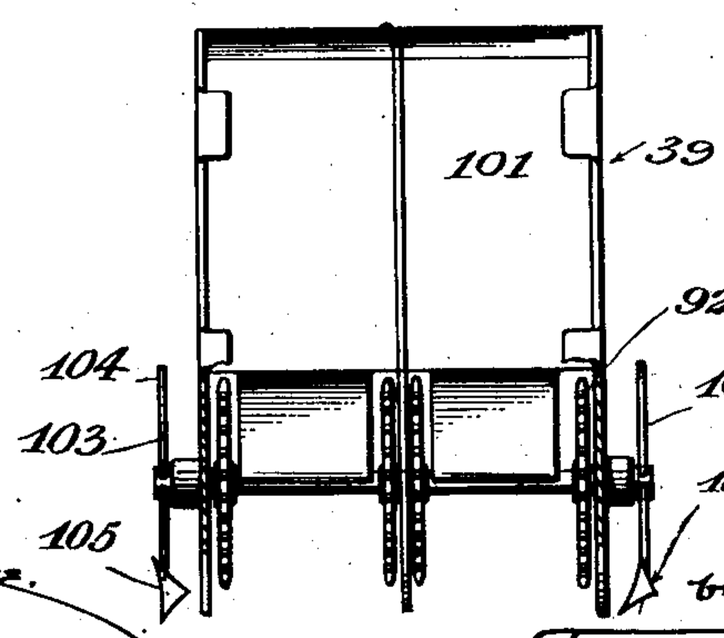


Fig. 10



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APPLICATION FILED FEB. 8, 1904.

4 SHEETS—SHEET 4.

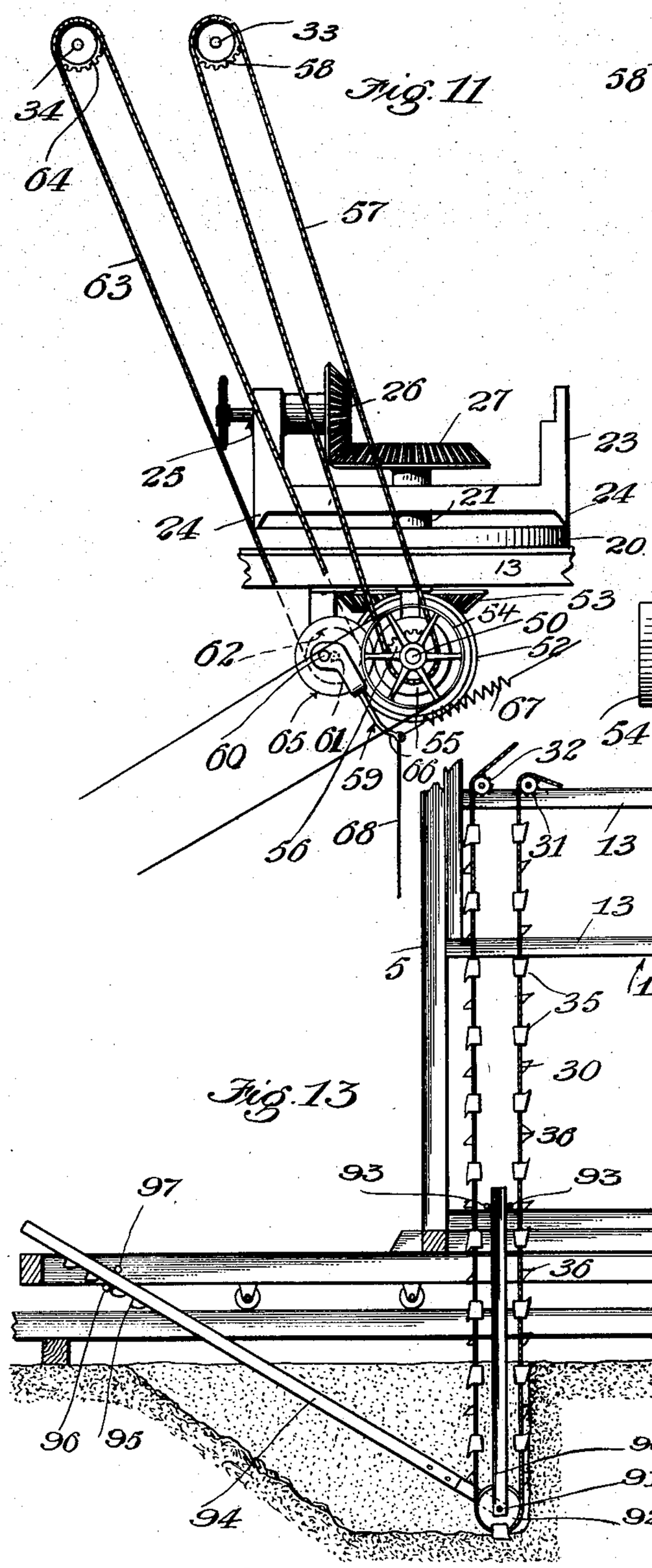

Fig. 11

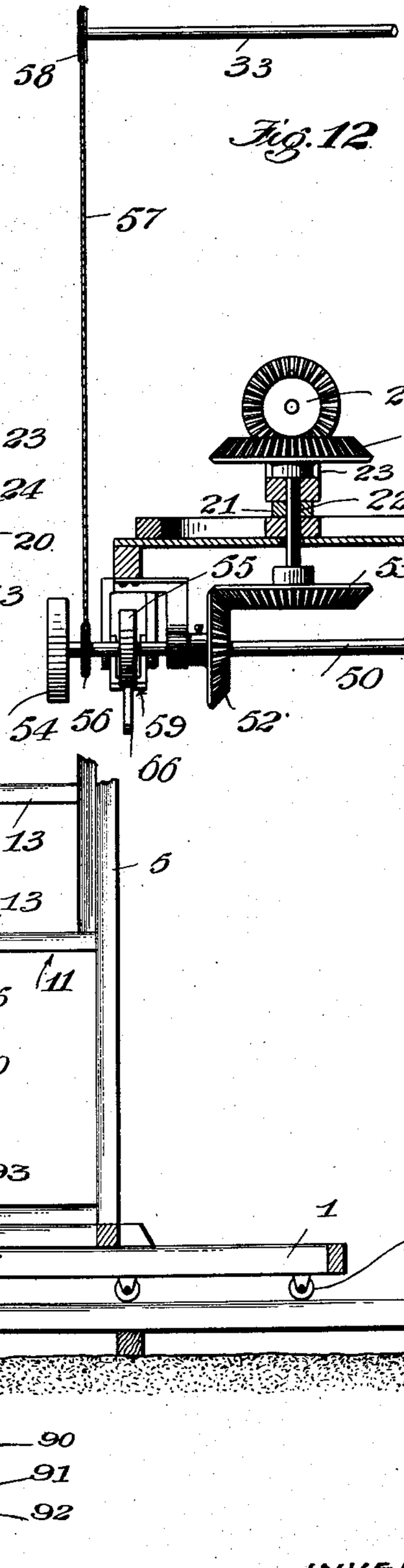

Fig. 12

Fig. 13

WITNESSES

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UNITED STATES PATENT OFFICE.

MARK D. ROCHFORD, OF LOS ANGELES, CALIFORNIA.

EXCAVATOR.

No. 844,959. Specification of Letters Patent. Patented Feb. 19, 1907.

Application filed February 8, 1904. Serial No. 192,534.

To all whom it may concern:

Be it known that I, MARK D. ROCHFORD, a citizen of the United States, residing at Los Angeles, in the county of Los Angeles and State of California, have invented a new and useful Excavator, of which the following is a specification.

This invention relates to an excavator which employs buckets, scoops, or the like carried by an endless chain to perform the excavating-work and which is adapted to make any excavation which extends down from the surface of the ground, and the machine is capable of extracting earth from one point and depositing the earth at another point and has a considerable range of latitude in the depth of digging and a considerable range of movement, while depositing earth at substantially one point.

The application of the excavator is of general utility, it being adapted for forming wells, canals, trenches for receiving conduits, galleries, making railroad cuts and fills, levees of all descriptions, cellars, cleaning out silt or other deposit from irrigating-ditches, and, in fact, in all cases where the excavation extends through to the surface of the ground and earth is to be extracted from one point and deposited at another point.

The main distinguishing feature of the present invention is that an endless chain is provided which carries the buckets or digging devices, and the chain is held in place by means of weights applied at opposite loops of the chain. The chain is thus "balanced," so to speak, and means are provided for controlling the balancing of the chain in such a way that the loop of the chain which is adjacent the digging may be caused to descend or ascend.

Another object of the invention is to provide a novel and efficient conveyer for carrying the earth removed by the digging-chain from the machine and delivering it at a point removed from the machine and to so construct the conveyer that it will deposit earth at any point desired within a considerable latitude and which, while depositing earth at practically one point, will permit the machine to move bodily.

Another important and distinguishing feature is the provision of means whereby the effective range or projection of the digging-loop of the chain into the earth may be altered without the necessity of changing the length of the chain.

Another distinguishing feature of the invention is that when in operation the digging is performed continuously, and the digging, removal, conveyance, and discharge of dirt is carried on also continuously simultaneously therewith. The digging-chain has a continuous movement through a definite orbit, during which the machine is advanced bodily, so that the digging-chain is always held to the work to be performed.

The action of the excavator may be likened, in a way, to that of a band-saw, the endless digging-chain having numerous scoops or buckets and being driven comparatively rapidly, each bucket or scoop removing but a comparatively slight amount of earth, but the numerous buckets on the chain, combined with the rapid movement of the chain, resulting in rapidly cutting through the earth as the machine is advanced.

The accompanying drawings illustrate the invention, and, referring to the same, Figure 1 is a side elevation of the excavator, showing it as set below the banks of a canal and digging out the bottom of the canal, the bottom of the canal being shown in section. Fig. 2 is a front elevation of the machine arranged as in Fig. 1, the earth adjacent the machine being shown in section transversely of the canal. Fig. 3 is a side elevation of the head portion of the conveyer. Fig. 4 is an end view of what is shown in Fig. 3. Fig. 5 is a plan view of the revoluble head which supports the head end of the conveyer. Fig. 6 is a transverse sectional view taken on line X^6 X^6, Fig. 1, somewhat enlarged. Fig. 7 is a side elevation of the follower-weight. Fig. 8 is a longitudinal section on line X^8 X^8, Fig. 9. Fig. 9 is a front elevation of the follower-weight and adjacent portion of the digger-chains. Fig. 10 is a view similar to Fig. 9, showing the follower-weight as constructed for double digging-chains. Fig. 11 is an end elevation of the gearing and adjacent mechanism at the head end of the conveyer, the conveyer being removed. In this view the lower part of the chain 63 is removed, together with its sprocket 62, the position which these parts have in the foreground being indicated by dotted lines. Fig. 12 is a side elevation of what is shown in Fig. 11, part of the framework being sectioned. Fig. 13 is a side elevation showing only the lower portion of the machine and illustrating a different form of follower-weight.

The frame of the machine may comprise a

horizontally-arranged base-frame 1, which may have suitable wheels 2, so that it may be readily moved along, suitable planks 3 being laid down, so that the wheels will have a smooth way over which to travel. The base-framework 1 supports a superstructure which comprises a vertical standard 4, composed of timbers 5, which are tied together at the top by cross-bars 6 and at an intermediate point by other cross-bars 7. The upright bars 5 are further secured in position and braced by truss-rods 8. Stability is given to the superstructure 4 by means of braces 9 and 10, the lower ends of which braces are secured to the base-frame 1.

A cage or gear-carrier 11 is mounted upon the superstructure 4 for vertical adjustment up or down and comprises uprights 12, of which four may be provided, which are tied together by cross-bars 13. The cage 11 is suspended in position by a block-and-tackle arrangement 14, the rope 15 of which is carried down from the upper block of the tackle over rollers 16 and 17, and its end is fastened to a cleat 18.

A hoisting-engine 19 is mounted on the base-frame 1, and when it is desired to raise or lower the cage 11 the rope 15 is attached to the hoist and the cage is thus raised or lowered to the desired point, after which the rope 15 may be given a few turns on the cleat 18 to hold the cage 11 in position, and this permits the operation of the engine 19 without disturbing the position of the cage 11.

Supported upon the lower cross-bars 13 of the cage 11 is a circular track 20, which has a diametrical web 21, forming a journal for a shaft 22.

23 is a revoluble yoke mounted above the track 20 and adapted to be turned around concentric with the shaft 22, having shoes 24, which rest upon the upper face of the track 20 and support the yoke 23 in such a manner that undue friction between the yoke and track is avoided when the yoke it turned. A shaft 25 is mounted in one arm of the yoke 23 and carries a bevel-pinion 26, which meshes with a bevel-gear 27, which latter it mounted on the shaft 22. Thus the yoke 23 may turn to any angle desired in a plane parallel with the face of the track 20 without disturbing the meshing of the two gears 26 and 27. A boom 28 is connected with the yoke 23 and carries a conveyer 29 for receiving and disposing of the earth elevated by the digging apparatus about to be described.

30 designates the endless digging-chain, which is supported at points intermediate its two loops by double sprockets 31 and 32. The sprockets 31 are carried on a shaft 33, which is mounted on cross-bars 13, while the sprockets 32 are carried on a shaft 34, which is also mounted on the cross-bars 13.

In the preferred construction I employ two chains arranged side by side, between which are arranged digging devices comprising buckets or scoops 35, spaced at suitable intervals apart. It is obvious that the digging chain *per se* may consist of but a single chain, the side links of which are spaced apart sufficiently to embrace the buckets 35, and in referring to the "digging-chain" I mean a flexible connection carrying digging devices, whether the flexible connection consists of a single chain to which the buckets are attached or a double chain or a triple chain or any other form of flexible connection.

Between the scoops 35 I prefer to provide digging devices 36, which serve to break up the earth, so that the scoops 35 may the more easily scoop up the earth. The digging-chain is balanced by weights hung from both loops of the chain, and one reach of the chain is supported by sprockets 37, mounted on the shaft 38, journaled in the cross-bars 13. The chain is hung in such a way that a certain portion of its length is sustained in a vertical position, the loop of which is inserted in the ground at the point of excavation, and suspended by the loop is a follower-weight 39, which serves to hold the vertical reaches of the chain taut and also produces a stable mounting for the devices which guide the chain around the loop.

Primarily the machine is designed for the cutting or excavating to be performed by the ascending vertical reach of the digging-chain; but in some cases the digging will be performed by the scoops in their passage around the loop of the chain at the bottom. In order to render the follower-weight 39 more staple and hold the digging-chain more firmly against the work and to prevent the follower-weight from shifting from side to side, I provide a brace 40, which is pivotally attached to the follower-weight 39 and also flexibly attached to the base-frame 1 by a bolt 41.

In cases where the earth is very soft or friable and the cutting resistance comparatively little the brace 40 may be dispensed with; but its employment is advantageous where the machine is put to severe use in cutting hard earth.

In order to maintain the digging-chain under sufficient tension, and especially to keep the ascending reach of the digging-chain firmly and unyieldingly against the work, I provide a balancing or tension weight which is suspended to the upper loop of the digging-chain. The tension-weight may comprise a car 42, as shown, which may be filled with sand or other material and which is fitted with idler-sprockets 43, over which the digging-chain passes. The car 42 may ride upon an inclined track or way 44, and the length of the way 44 is sufficient to permit of a certain amount of raising or lowering of the follower-weight. Its function is not primarily

for securing the different depths of excavation, but for giving the necessary movement of the car so that the chain may be always held taut. The depth of excavation is determined by shifting the cage 11 up or down. In operation the car 42 has a certain amount of play, caused by the automatic raising of the follower-weight when certain controlling devices, hereinafter to be described, have been actuated.

50 is a shaft mounted in brackets 51, which are suspended from lower cross-beams 13 of the cage 11, and the shaft 50 carries a bevel-gear 52, which meshes with a bevel-gear 53 on the lower end of the shaft 22. The shatf 50 also carries a pulley 54, which is belted to the engine 19. The shaft 50 also carries a friction-pulley 55. It also carries a sprocket 56, which is connected by a chain 57 with a sprocket 58, mounted on the shaft 33.

59 is a yoke pivoted by means of trunnions 60 to the framework of the cage. The yoke 59 supports a shaft 61, which is out of center with the trunnions of the yoke, and mounted on the shaft 61 is a sprocket 62, which is connected by a chain 63 with a sprocket 64 on the shaft 34. Also mounted on the shaft 61 is a friction-wheel 65, which is adapted to bear against the friction-wheel 55 and which may be swung into or out of engagement therewith by slightly tilting the yoke 59. The shaft 61 is arranged with respect to the trunnions of the yoke so that when the friction-wheel 65 bears against the friction-wheel 55 the shaft 61 will lie substantially in line with and between the trunnions of the yoke 59 and the shaft 50. The yoke 59 is provided with a handle or lever 66, and a strong pressure between the friction-wheels may be secured by only a slight pull on the lever 66, owing to the arrangement just described. I prefer to normally hold the two friction-wheels in contact, and for this purpose employ a coil-spring 67, which pulls upon the lever 66. A rope 68 is attached to the end of the lever 66 and hangs down so as to be within convenient reach of the operator.

In operation the shaft 50 is driven from the engine 19 and through the medium of gears 52 and 53 drives the shaft 22. The shaft 33 is driven through the medium of sprocket 56, chain 57, and sprocket 58, while the shaft 34 is driven through the medium of the two friction-wheels, sprocket 62, chain 63, and sprocket 64. Thus the shaft 34 is driven in a direction opposite that of the shaft 33. As the shafts 33 and 34 are driven in opposite directions, the digging-chain 30 is continuously driven in the direction of the arrow. By pulling the rope 68 and throwing the friction-wheel 65 out of engagement with the friction-wheel 55 it is obvious that the chain 63 will cease driving the shaft 34 and that the chain 30 will only be driven by the sprockets which are mounted on the shaft 33. Under such circumstances the loop at the bottom of the digging-chain 30 will be gradually raised and the follower-weight 39 will be brought up as the shaft 34 remains stationary, and the tension-weight 42 by its pull on the upper loop of the chain, together with the friction and inertia of the shaft 34, its sprockets, and chain 63, and the sprocket 62, and shaft 61, is, combined, sufficient to prevent the turning of the shaft 34, which causes the follower-weight 39 to be drawn up. If the shaft 34 turns at a speed a trifle less than the shaft 33, the same result will be secured—*i. e.*, the lifting of the follower-weight 39; but the speed at which the follower-weight lifted would be less than when the shaft 34 was stationary. It is obvious that the speed at which the follower-weight rises will depend entirely on the difference between the speeds existing between shafts 33 and 34, the greatest lifting speed of the follower-weight being when the shaft 34 is stationary and the shaft 33 revolves at its highest speed, and said latter movement is that for which the machine is designed. When the follower-weight 39 is being lifted in the manner just described, the end of the brace 40 swings in a circular path, which forces forward the follower-weight 39 as the latter ascends, and the follower-weight is drawn out in a curved path, which causes the ascending reach of the digging chain to be jammed against the earth. This action of the follower-weight may be taken advantage of and utilized when for any reason the digging-chain seems to yield from the earth or does not work to its fullest capacity. When this occurs, by pulling on the rope 68 the follower-weight is jammed forward, as described, and the digging-chain is also forced forward, so that the ascending scoops take stronger bites than before. If it is desired to raise the follower-weight straight up from the excavation, the bolt 41 may be withdrawn, which will allow the brace 40 to recede slightly as the follower-weight is drawn up.

The machine is drawn forward by means of a cable 70, which may be attached to some stationary object in the vicinity, as a stake 71, the other end of the rope 70 being wound up by the engine 19.

The cross-conveyer 29 comprises side beams 72, which may have removable intermediate sections 73, whereby it may be shortened. Beams 72 at one end carry a shaft 74 and at the other end carry a shaft 75. Pulleys 76 are mounted on both shafts 74 and 75, over which runs a conveyer-belt 77. A sprocket 78 is mounted on the shaft 74 and is connected by a chain 79 with a smaller sprocket 80, mounted on the shaft 25, before described. The conveyer-belt 77 may be supported intermediate the pulleys 76 by rollers 81. The beams 72 are supported at

the machine end by brackets 82 and 83. (See Figs. 3 and 4.) The bracket 82 is hinged to one arm of the yoke 23, as shown in Fig. 4, while the bracket 83 has a concave notch, which rests upon the rounded upper end of the other arm of the yoke 23. By this means the conveyer is held from slipping off from the yoke 23 and its weight is borne by the yoke 23 directly.

The outer end of the conveyer may be supported by a bracket 84, which may be mounted on a sled 85 with a swivel 86. Thus the free end of the conveyer may be shifted by drawing along the sled 85, the swivel 86 permitting the necessary movement between the bracket 84 and sled 85, and the fixed end of the conveyer readily swivels on the disk 20, as before described.

It is contemplated in actual work that the earth may be delivered from the conveyer in one pile as the machine moves along. Of course as the machine advances the conveyer will be swung relatively to the machine, and its free end will gradually recede from its original position; but at the same time the earth as deposited will be confined to substantially the same heap for a definite amount of forward movement of the machine.

A truss-rod 87 may be employed to strengthen the side beams 72.

The follower-weight may be constructed in a variety of ways. In Fig. 13 of the drawings I have shown it as comprising a pendulous beam 90, at the lower end of which is carried a shaft 91, upon which is mounted sprockets 92, over which the digging-chain runs. The weight is held in substantially a vertical position by means of two cross-bars 93, between which the beam loosely passes, so that it may have considerable swing without binding between the cross-bars 93. The lower end of the beam 90 may be attached to a brace 94 similar to the brace 40 previously described, and a convenient way of adjusting the swinging radius of the brace 94 is to provide the brace with notches 95, which may engage a cross-bar 96, while a slip-bolt 97 may be placed across the top of the beam to prevent it from jumping up and clearing the cross-bar 96. By withdrawing the slip-bolt 97 the beam 94 may readily be raised and shifted so that one or the other of its notches will engage the cross-bar 96. The follower-weight in another form (shown in Figs. 7 to 9) comprises side plates 100, which are united by a thick web 101, and in the side plates at the lower end of the web is mounted a shaft 102, upon which are mounted the sprockets 92, over which the digging-chain 30 rides. The shaft 102 may project a trifle beyond each face of the side plates 100, and rotating spider-diggers 103 may be employed. A digger 103 may have two of its arms equipped with plain points 104, while two other of its arms may be equipped with blades 105. The digging-chain may carry a double row of buckets, as shown, the follower-weight being slightly modified in construction.

The function of the machine does not wholly reside in making excavations to the exclusion of other important uses to which it may be put, and, while the machine has been termed an "excavator" on account of its predominating adaptability as such, such special adaptability in no wise negatives its efficiency for performing work other than pure excavating. For instance, in cleaning canals having a high bank on the other side of which earth from the bed is to be deposited the machine may remain stationary, with its conveyer extending over the high bank, and the earth from the bed may be transported to the digging-chain by wagons or scrapers and elevated by the buckets on the digging-chain to the conveyer and thence carried over the bank, obviating the heavy duty required to carry the earth up over a high bank by teams. In such cases the digging-chain acts purely as an elevator:

What I claim is—

1. An endless chain, digging devices on the chain, means for driving the chain, and a weight for holding the chain in digging position.

2. An endless chain, digging devices on the chain, and means for suspending the chain at a point intermediate its loops.

3. An endless chain, digging devices on the chain, means for suspending the chain at a point intermediate its loops, and means for balancing the chain.

4. An endless chain, digging devices on the chain, means for suspending the chain at a point intermediate its loops, and a follower-weight hung in one loop.

5. An endless chain, digging devices on the chain, means for suspending the chain at a point intermediate its loops, a follower-weight hung in one loop, and a tension-weight hung in the other loop.

6. An endless chain, digging devices on the chain, and means engaging both reaches of the chain intermediate its loops for driving the same.

7. An endless chain, digging devices on the chain, and means for driving one reach faster than the other to change the position of the loop of the chain.

8. An endless chain, digging devices on the chain, and means engaging both reaches of the chain intermediate its loops for supporting the chain and driving the chain.

9. An endless chain, scoops on the chain, means engaging both reaches of the chain intermediate its loops for supporting the chain and driving the chain, and means for vertically adjusting the last-named means.

10. An endless chain, scoops on the chain, means for supporting and driving the chain, a weight for holding the chain stiff-looped,

and means for moving the chain bodily vertically.

11. An endless chain, scoops on the chain, means for supporting and driving the chain, a weight for holding the chain stiff-looped, and means for moving the chain bodily horizontally.

12. An endless chain, scoops on the chain, means for supporting and driving the chain, a weight for holding the chain stiff-looped, means for moving the chain bodily horizontally, and means for moving the chain bodily vertically.

13. An endless chain, digging devices on the chain, means for driving the chain, and yielding means for holding the chain in digging position.

14. An endless chain, digging devices on the chain, means for suspending the chain at a point intermediate its loops, and means for yieldingly holding both loops taut.

15. An endless chain, digging devices on the chain, means for suspending the chain at a point intermediate its loops, and yielding means engaging the upper loop of the chain for balancing the chain.

16. An endless chain, digging devices on the chain, means for suspending the chain at a point intermediate its loops, yielding means for balancing the chain, and means for varying said balance to rotate said loop without disturbing the other loop.

17. An endless chain, digging devices on the chain, means for suspending the chain at a point intermediate its loops, means for yieldingly holding both loops taut, and means for shortening one loop and simultaneously lengthening the other loop.

18. A loop, sprockets supporting said loop, means for vertically moving said sprockets, and means for driving the chain.

19. An endless chain, means for supporting said chain in two loops one of which is vertical and the other is inclined, and digging devices on the chain.

20. A pair of loops, buckets carried thereby, means for driving said chain, and means at the end of each of said loops for holding both of said loops taut.

In testimony whereof I have hereunto signed my name, in the presence of two subscribing witnesses, at Los Angeles, in the county of Los Angeles and State of California, this 29th day of January, 1904.

MARK D. ROCHFORD

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JULIA TOWNSEND.