J. S. HENDERSON.

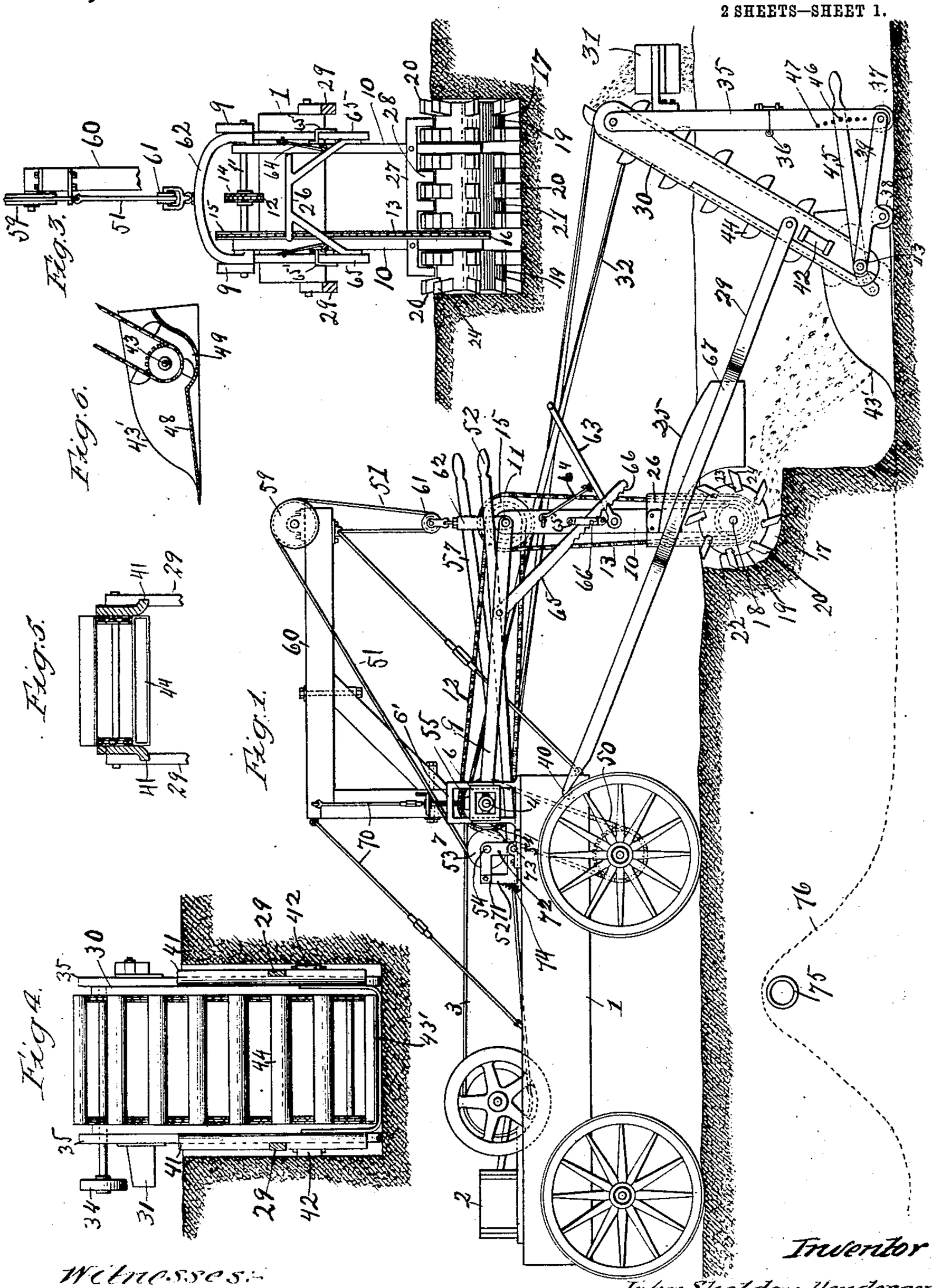
EXCAVATOR.

APPLICATION FILED SEPT. 23, 1908.

954,863.

Patented Apr. 12, 1910.

2 SHEETS—SHEET 1.



Witnesses:-

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Inventor

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J. S. HENDERSON.

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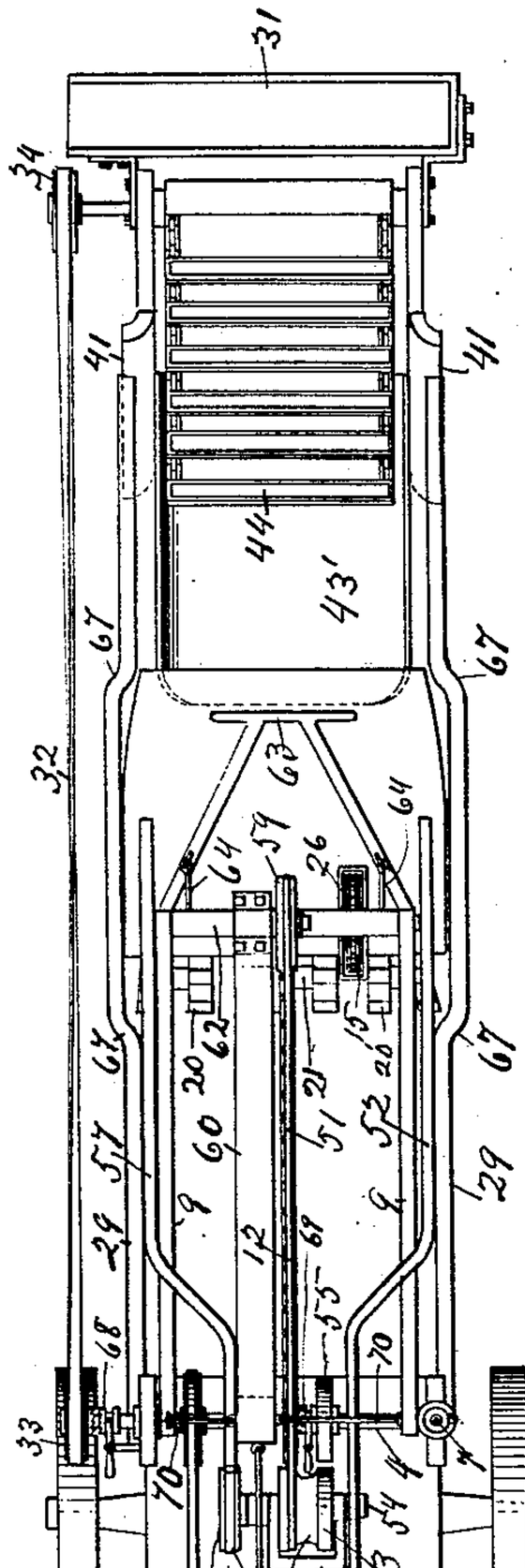

Fig. 2.

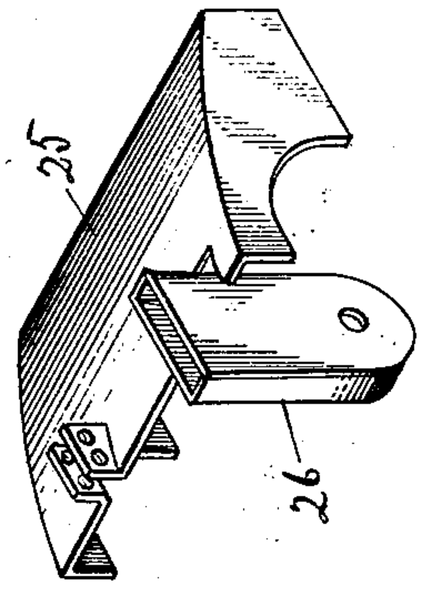

Fig. 10.

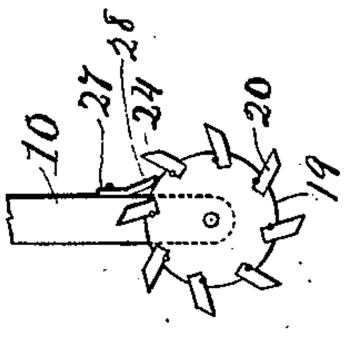

Fig. 7.

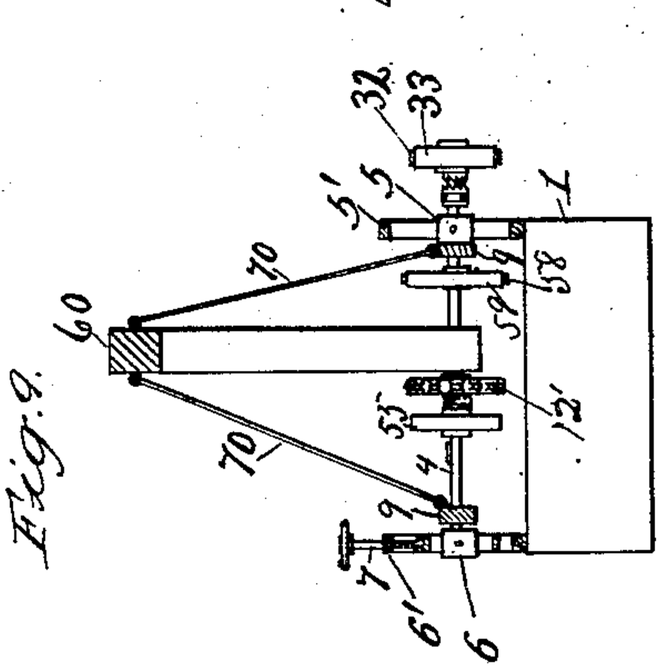

Fig. 9.

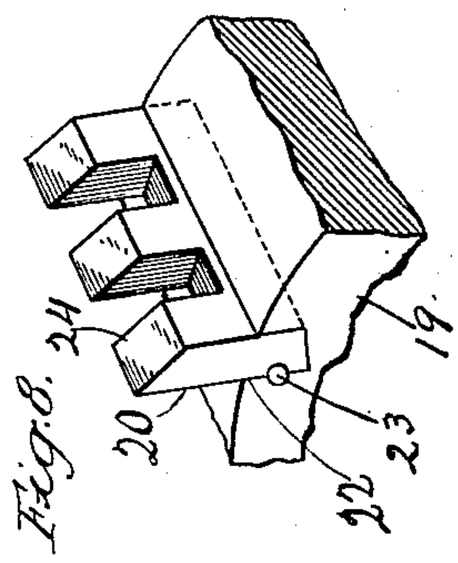

Fig. 8.

Witnesses:-

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UNITED STATES PATENT OFFICE.

JOHN SHELDON HENDERSON, OF LOS ANGELES, CALIFORNIA.

EXCAVATOR.

954,863. Specification of Letters Patent. Patented Apr. 12, 1910.

Application filed September 23, 1908. Serial No. 454,456.

To all whom it may concern:

Be it known that I, JOHN SHELDON HENDERSON, 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 Improvement in Excavators, of which the following is a specification.

This invention relates to excavators and more particularly to devices for digging trenches for conduits, as gas and water pipes, electric and other conduits, &c., and also for making open drains or ditches.

In cities there is an almost constant demand for new trenches in which to extend the conduit systems of the various kinds, and these trenches are generally about twenty inches wide by four feet, more or less, in depth, from which the earth is first thrown and is then replaced after the desired pipes or conduits have been placed in position. These trenches are generally dug by hand or manual labor, which is slow and costly and in the more densely populated portions of the city the earth must be removed as fast as dug out to prevent too great an obstruction to travel between the time the work begins until it is completed, owing to the length of time required for doing the work.

The principal object of my invention is to avoid this long delay and additional expense by providing a machine which can utilize power from any suitable source and will quickly excavate the earth to any desired depth and deposit it along side of the trench ready to be thrown back after the conduit has been laid.

Another object is to provide means by which the machine can be quickly and accurately adjusted to cause it to form the walls of the trench vertically irrespective of the lay or inclination of the surface of the ground over which the machine may be passing.

Another object is to make the machine self propelling so that it can be quickly and easily moved from place to place, and especially be moved forward along the course of the trench, by the same source of power by which the earth is excavated after the machine has been brought to rest, or while it is moving.

Another object is to provide means by which one person can easily and quickly control the digging mechanism and another can control the power, thereby reducing the cost of labor to a minimum.

Another object is to provide means by which the height of the discharge end of the elevator can be varied, as by lowering it to pass under obstructions, &c.

Another object is to provide means for varying or changing the angle or inclination of the lower end of the elevator to cause it to bear against the bottom of the trench at all times, and especially when moving up or down to pass over an obstruction, as a pipe or conduit lying at an angle to the course of the trench being dug.

Other objects will appear as the nature and operation of the machine is further disclosed in the description and from an inspection of the accompanying drawings which form a part of the specification, and in which—

Figure 1 is a side elevation of one form of mechanism embodying the invention, showing the same as at work. Fig. 2 is a top plan view of the machine. Fig. 3 is a transverse sectional view looking forward from a point to the rear of the excavating cylinder, with the hood over said cylinder omitted. Fig. 4 is a similar view looking toward the elevator. Fig. 5 is a transverse sectional view through the elevator looking down. Fig. 6 is a vertical longitudinal sectional view through the lower end of the elevator. Fig. 7 is an end view of the excavating cylinder. Fig. 8 is a broken perspective view of the same. Fig. 9 is a rear plan view of the main driving shaft looking forward. Fig. 10 is a perspective view of the hood.

Referring more particularly to the drawings which are for illustrative purposes only and, therefore, are not drawn to any particular scale, 1 indicates a truck or vehicle of any suitable kind, preferably in the form of a traction engine with the usual piston and cylinder 2 for transmitting power to the operating mechanism through a belt 3. In the construction shown in the drawings belt 3 actuates a main shaft 4, which is journaled transversely at the rear of the vehicle frame in bearings 5 and 6. The bearing 5 is preferably pivotally supported so that the opposite end of the shaft can be moved up and down by means of the screw 7 which engages at its lower end with the bearing

6 so as to permit of the shaft being held in a horizontal position irrespective of the contour of the ground over which the vehicle is moving.

Pivotally connected with the rear end of the vehicle frame, as by means of the shaft 4, are two arms 9, which are pivotally connected at their rear ends with a pair of depending arms 10 by means of a shaft or cross piece 11. An excavator of any suitable construction is mounted in the lower ends of the arms 10 and adapted to be driven from the shaft 4, as by means of the sprocket chains 12 and 13 from a sprocket wheel 12′ on the shaft, the chain 12 from the shaft 4 passing over a smaller sprocket wheel 14 on the shaft 11, which in turn transmits power to a larger wheel 15 and thence through the chain 13 to another smaller wheel 16 connected with the excavating tool, thereby giving the excavator the necessary speed to cause it to rapidly break down the earth as at 17 and discharge it from the cut.

In the form of excavator shown in the drawings a shaft 18 is journaled in the lower ends of the arms 10 upon which the wheel 16 is mounted and which shaft has each end projecting beyond the arms far enough to receive short cylinders 19. Mounted upon the shaft between the arms 10 at the side of the wheel 16 is a cylinder 21, preferably somewhat longer than either of the cylinders 19, and all of said cylinders are provided with teeth 20. The outer teeth of the cylinders 19 are preferably set outward at a slight angle to cause them to make a trench a trifle wider than the length of the shaft 18, as shown more particularly in Fig. 3. The teeth are preferably set into the surface of the cylinders by means of suitable sockets, as channels 22 extending longitudinally thereof and are held against removal by keys or locks 23 that enter recesses formed therein and in the walls of the channels. Where the teeth are formed from a solid bar, as shown in the drawings, a portion of one edge of the bar is milled or cut away at suitable distances apart to form the teeth 20 and the other edge is set in the channel, although it is evident that they could be formed and secured in the cylinders in any other manner, the only requirement being that they be strong enough to stand the strain to which they will be subjected. They are preferably set at a pitch or angle to permit of their free ends, which are sharpened by beveling off their rear sides as shown at 24, readily entering the earth and breaking it to pieces.

Owing to the high speed at which the cylinders are driven a hood or shield 25 is preferably placed over them to prevent the earth from being scattered too badly or thrown into the rest of the machinery. A flat tube like guard 26 is preferably placed over the sprocket wheel 16 and the lower portion of the chain 13 to prevent the earth getting into them and preventing their free operation. A cleaner 27 is also preferably located above the cylinders, as by being secured to the arms 10, with its teeth 28 projecting down between the teeth 20 of the cylinders so as to prevent roots, &c. from being wrapped around the cylinders.

Arranged to be drawn to the rear of the excavator, as by bars 29, is an elevator 30, which discharges into a trough 31 leading to one side of the trench. The elevator is driven from the main shaft 4 by means of a belt 32, which passes over pulleys 33 and 34. The elevator frame is supported by legs 35 which are preferably pivoted or hinged as at 36 to permit of the upper end of the elevator being lowered to pass under an obstruction, as under a street car track. A wheel 37 is mounted at the lower end of each leg and another one 38 is journaled in each of the base pieces 39, which connect the legs with the lower end of the elevator frame. The forward end of each of the bars 29 is preferably formed as a hook 40 which will permit of the lower end of the elevating mechanism being pushed forward, if necessary, when the upper end is lowered by bending the legs 35. The forward edges of the sides of the elevator frame are also flared outwardly as shown at 41 to engage with the sides of the trench and prevent the earth being thrown backward past the elevator, and a roller 42 is preferably mounted upon each side of the elevator frame to engage with the sides of the trench and prevent the frame from catching on slight projections.

Pivotally mounted at the lower end of the elevator, as upon the shaft 43, is a scoop 43′ which is adapted to receive the earth from the excavator and hold it in position for being engaged by the elevator buckets 44 and carried up out of the trench. The forward edge of the scoop is in the form of a blade that is adapted to be held in engagement with the bottom of the trench by means of a handle 45 that extends to the rear and is adjustably connected with the leg 35 by means of a pin 46 and the perforations 47. The bottom of the scoop upon the inside is preferably inclined from the front nearly to the rear as shown at 48, and is then depressed to form sort of a trough 49, into which the earth is thrown by the excavator or forced by the forward movement of the scoop, and from whence it is removed by the buckets 44.

By constructing a machine as above described it is evident that a trench of the required width and of any desired depth can be quickly dug through the ordinary earth formation by successively moving the truck or vehicle 1 forward the distance of one cut of the excavator, through the belt 50 from

the shaft 4 to one of the vehicle wheels, while the excavator is held suspended above the ground by the rope or cable 51. The cable is then loosened and the excavator permitted to descend by gravity while it is being rapidly rotated, which will loosen the earth and throw it into the elevator by means of which it will be carried to the top and deposited at one side of the trench. After the excavator has reached the bottom of the trench the operator who stands directly to the rear of it upon one side of the trench operates a lever 52 that projects to the rear from the vehicle and throws a friction wheel 53 at one end of a shaft 54 into engagement with another wheel 55 upon the shaft 4 and thereby causes a drum 56 upon the shaft 54 to be rotated and the cable 51 to be wound thereon. As soon as the excavator has been raised to the desired height the operator releases his hold upon the lever 52 and operates another lever 57, which also projects to the rear from the vehicle, and thereby applies an ordinary brake 58 to a wheel 59 on the shaft 54 and holds the excavator at that point until he is ready to again let it descend as, after the vehicle has been again moved forward the desired distance.

The cable is passed over a pulley 59 upon a crane 60 that is mounted on the vehicle and down under another pulley 61 that is suitably connected with a bail 62 that is connected with the shaft or cross piece 11. A handle 63 is secured to the depending legs 10 so as to project to the rear in position for being grasped by the operator when it is desired to move the excavator to the front or rear of a vertical position to adjust it for another cut. The handle may be held in its inclined position by means of rods or hooks 64 to prevent it from falling when the operator is manipulating the levers 52 and 57. As the excavator will frequently meet with considerable opposition in being driven into hard ground, or against a temporary obstruction, a lock is preferably used to hold the two sets of arms, 9 and 11, in any adjusted position into which they may be placed. In the drawings this lock is shown as a bar 65, which is pivotally connected with one of the arms 9 and has its rear end provided with teeth 66 that are adapted to engage with a pin 66′ in one of the arms 10, and thereby hold them in said fixed or adjusted position relatively to each other. The rear end of the bar is passed under a strap or guard 65′, and the forward edges of the teeth are preferably inclined which will permit of their sliding over the pin when the lower ends of the arms 10 are moved forward. The bars 29 are bent or sprung outward for a suitable distance of their lengths as shown at 67 to prevent their engaging with the excavator frame as it is being raised and lowered or otherwise manipulated as above described.

Clutches 68 and 69 are provided for throwing the excavator and elevator mechanisms into or out of operative engagement with the shaft 4, and braces or guy rods 70 are provided for rigidly holding the crane 60 in position. Although the friction mechanism for raising and lowering the excavator may be of any desired character I have shown the shaft 54 mounted in a frame 71 having posts 72, that are pivotally mounted upon the vehicle frame so as to permit of their upper ends being moved toward and from the shaft 4. The rear end of the lever 52 is connected with this frame so as to move it forward and back whenever the lever is rocked upon its fulcrum or pivot point 73. A spring 74 normally holds the frame 71 to the rear to prevent the friction wheels engaging with each other except when the lever 52 is operated.

In addition to permitting the excavator being swung to the front or rear of a vertical line and thereby giving it very great amplitude or scope of movement in moving it vertically to form the trench its vertical movement can be changed or varied as desired independently of its forward and rearward movement to permit of its passing over another pipe 75, as shown by the dotted lines 76 in Fig. 1. In passing over an obstruction in this manner the scoop 43′ is given the proper inclination or angle by the handle 45 to cause its forward edge or blade to remain in substantial contact with the bottom of the trench and thereby gather up the loose dirt and deliver it to the elevator. This ability to vary the pitch or angle of the scoop will also permit of the elevator being gradually started down into the trench when the trench is being first opened up, or a short length of the trench can be dug in the usual manner into which the elevator can be lowered and the machine then operated the same as though the elevator had been lowered gradually.

By constructing the different parts of the machine strong enough to withstand any strain that may be ordinarily placed upon them and providing a motor or engine with sufficient power to drive the excavator and the elevator, a trench can be formed very rapidly in ordinary ground, and in case of obstructions of any kind being encountered the machine can be moved over them as above described and the trench at that point can be completed by hand. In this manner a trench can be formed so quickly that the conduit can be placed therein and the earth thrown back upon it without the necessity of removing the dirt to prevent congestion of travel or the inconvenience that frequently arises from hand digging. Ordinarily a trench of four feet in depth is suffi-

cient, but by jointing the excavator crane or supporting arms 9 and 11, a much deeper trench can be formed without any inconvenience. For instance, with arms of only three feet in length a trench nearly six feet deep can be dug by simply straightening the joint between the arms so as to stand substantially vertically and in alinement.

In passing over uneven ground the engineer or operator of the motor or vehicle has only to look at the level 8 and then by turning the screw 7 in the proper direction he can cause the shaft 4 to stand horizontally, which will hold the other parts in position for making vertical walls or sides for the trench, the crane 60 being preferably mounted upon the shaft 4, and the lateral guy rods being connected therewith or with the bearings therefor. In this manner two men can dig a trench much faster and with as much accuracy as several men could do the work in the ordinary hand method.

If desired, the vehicle can be given a slow, substantially constant, forward movement instead of an intermittent movement, and the excavator or cylinder can be made to engage with the earth at the proper point by swinging it to the front or rear as the case may be.

Having described my invention, I claim:

1. A vehicle, an arm pivotally supported thereon and extending rearwardly therefrom, a second arm pivoted to and depending from the first named arm, means for adjustably supporting the first named arm, means for adjusting the angular position of the second arm on the first arm, a rotary excavator supported at the lower end of the second arm, and means for rotating said excavator.

2. A vehicle, a shaft extending transversely of the vehicle, a motor connected to said shaft, an arm pivotally supported on said shaft and extending rearwardly from the vehicle, a second shaft journaled in said arm, a second arm pivotally mounted in said second shaft and depending therefrom, a rotary excavator journaled at the lower end of the second arm, and power transmitting connections between said first and second shafts and between the second shaft and the excavator.

3. In an excavator, a vehicle, a shaft arranged transversely at the rear end thereof, bearings for said shaft, one of which is pivotally mounted and the other is vertically movable, power transmitting means on said shaft, a flexible support connected with the shaft at one end, a rotary cylinder journaled in the free end of the support, power transmitting means from said means on the vehicle to the cylinder and carried by said support, and means for moving said end of the shaft and its bearing vertically.

4. In an excavator, a vehicle, a shaft journaled transversely at the rear end thereof, flexible arms pivotally connected with said shaft, a rotary excavator at the free ends of said arms, power transmitting mechanism from said shaft to said excavator and supported by said arms, and a toothed latch for temporarily holding said arms against flexion.

5. In an excavator, a vehicle, a shaft journaled transversely at the rear end thereof, two pairs of arms pivotally secured together at one end, one end of each pair of said arms being mounted upon said shaft, a rotary excavator mounted in the free ends of the other pair of arms, power transmitting mechanism from said shaft to said excavator, and hoisting mechanism connected with said arms at their pivoted ends.

6. In an excavator, a vehicle, a shaft journaled transversely at the rear end thereof, a friction wheel on said shaft, a winding mechanism adapted to be moved into and out of engagement therewith, pivoted arms connected with said shaft at one end, a rotary excavator journaled in the free ends of said arms, and a cable connected with said arms at their pivots and adapted to be wound upon said winding mechanism when the same is moved into engagement with the friction wheel on said shaft.

7. In an excavator, a vehicle, a shaft journaled transversely at the rear end thereof, a friction wheel on said shaft, friction winding mechanism, a rearwardly extending lever for moving said mechanism into and out of engagement with said wheel, a vertically movable excavator, a support therefor, means from said shaft to the excavator for actuating the excavator, a yoke connected with said support, and a cable from said support to said winding mechanism.

8. In a excavator, a vehicle, a shaft journaled transversely at the rear end thereof, a friction wheel on said shaft, winding mechanism adapted to be moved into and out of engagement with said wheel, a brake for said mechanism, two rearwardly extending levers, one of which is adapted to control movement of said friction mechanism and the other one to control the operation of said brake, a vertically movable excavator, a support therefor, a yoke connected with said support, and a cable from said support yoke to said winding mechanism.

9. In an excavator, a vehicle, a shaft journaled transversely at the rear end thereof, and provided with driving mechanism, a crane mounted on said shaft and extending to the rear of said vehicle means for moving the ends of said shaft vertically to hold the shaft in a horizontal position, a pulley on the rear end of said crane, winding mechanism on the vehicle adapted to be actuated by part of the driving mechanism on said shaft, a cable from said mechanism to

and over said pulley, an excavator suspended from said cable, and means for actuating said excavator from a part of the driving mechanism on said shaft.

10. In an excavator, a vehicle, a shaft journaled transversely at the rear end thereof, jointed arms pivotally secured on said shaft at one end, a shaft journaled in the free ends of a portion of said arms, the ends of which project beyond said arms, toothed cylinders secured upon said shaft, one of said cylinders being between said arms and the other two upon the outsides thereof, and driving mechanism from the shaft on the vehicle to the shaft at the ends of the arms for rotating the cylinders, and having its intermediate portion supported by said arms.

11. In an excavator, a vehicle, a shaft journaled transversely at the rear end thereof, jointed arms pivotally secured at one end to said shaft, a shaft journaled at the free ends of a part of said arms, the ends of which extend beyond said arms, sprocket wheels on said shafts and at said joint respectively, sprocket chains over said sprocket wheels arranged to rotate the shaft at the free ends of said arms at a greater speed than the shaft on the vehicle, and toothed cylinders mounted on the shaft at the free ends of said arms, one of said cylinders being between said arms and the other two being on the projecting ends of the shaft.

12. A vehicle, an arm pivotally supported thereon and extending rearwardly therefrom, a second arm pivoted to and depending from the first named arm, means for adjustably supporting the first named arm, means for adjusting the angular position of the second arm on the first arm, a rotary excavator supported at the lower end of the second arm, and means for rotating said excavator, said excavator carrying a rotary member having teeth projecting radially therefrom, the teeth at the ends of said member extending laterally beyond the rotary member.

13. In an excavator, a vehicle, a shaft journaled transversely at the rear end thereof, jointed arms pivotally secured at one end on said shaft, a rotary member at the free ends of a portion of said arms, sprocket chains for rotating said cylinder from the shaft on the vehicle, a hood over said cylinder, and a guard around the lower portion of said sprocket chain.

14. A vehicle, a shaft extending transversely of the vehicle, a motor connected to said shaft, an arm pivotally supported on said shaft and extending rearwardly from the vehicle, a second shaft journaled in said arm, a second arm pivotally mounted in said second shaft and depending therefrom, a rotary excavator journaled at the lower end of the second arm, power transmitting connections between said first and second named shafts and between the second shaft and the excavator, and means for holding the first named arm in different angular positions for vertical adjustment of the excavator.

15. In an excavator, a vehicle, a shaft journaled transversely at the rear end thereof, a pair of arms pivotally secured at one end to said shaft, a pair of arms pivotally secured to the free ends of said first mentioned arms, an excavator rotatably mounted at the free ends of said second pair of arms, means for actuating said excavator from said shaft, a keeper and a pin upon one of said last mentioned arms, and a bar pivotally secured at one end to one of the first mentioned arms and having its free ends notched and passed through said keeper in position for adjustably engaging with said pin.

16. In an excavator, a vehicle, a shaft journaled transversely at the rear end thereof, a pair of arms pivotally secured to said shaft at one end, a second pair of arms pivotally secured to the free ends of the first pair of arms, an excavator mounted at the free ends of the second pair of arms, means for actuating said excavator from said shaft, a rearwardly extending handle secured to said second pair of arms for moving the free ends thereof to adjust the same, and means for holding said second pair of arms in their adjusted position.

17. In an excavator, a vehicle, a shaft journaled transversely at the rear end thereof, jointed arms pivotally connected with said shaft, a rotary toothed excavator mounted at the free ends of said arms, a toothed cleaner secured to said arms in position for projecting between the teeth of the excavator, and means for rotating said excavator from said shaft.

18. A vehicle, a shaft extending transversely of the vehicle, a motor connected to said shaft, an arm pivotally supported on said shaft and extending rearwardly from the vehicle, a second shaft journaled in said arm, a second arm pivotally mounted in said second shaft and depending therefrom, a rotary excavator journaled at the lower end of the second arm, power transmitting connections between said first and second named shafts and between the second shaft and the excavator, and means for holding the depending arm in different angular positions for horizontal adjustment of the excavator.

19. A vehicle, a shaft extending transversely of the vehicle, a motor connected to said shaft, an arm pivotally supported on said shaft and extending rearwardly from the vehicle, a second shaft journaled in said arm, a second arm pivotally mounted in said second shaft and depending therefrom, a rotary excavator journaled at the lower end of the second arm, power transmitting connections between said first and second named shafts

and between the second shaft and the excavator, and means for holding the rearwardly extending arms and the depending arms in different angular positions for vertical and horizontal adjustment of the excavator.

20. In an excavator, a vehicle, a vertically movable excavator carried thereby, an elevator to the rear of the excavator and connected with said vehicle, a scoop pivotally secured at the lower end of said excavator, a handle secured to the scoop and projecting to the rear thereof, and means for adjustably securing said handle in a vertical position.

21. In an excavator, a vehicle, a vertically movable excavator carried thereby, an elevator to the rear of the excavator and connected with the vehicle, said elevator being provided with a jointed support, and the connection between the elevator and the vehicle being adjustable longitudinally.

22. In an excavator, a vehicle, a rotary excavator carried thereby, an elevator to the rear of the excavator, the sides of which are provided with rollers and bars extending from the elevator to the vehicle, and being loosely connected at the forward end to said vehicle, and means for varying the height of the upper end of said elevator.

In testimony whereof, I have hereunto set my hand at Los Angeles, California, this 14th day of September 1908.

JOHN SHELDON HENDERSON.

In presence of—
W. S. Boyd,
Frank L. A. Graham.