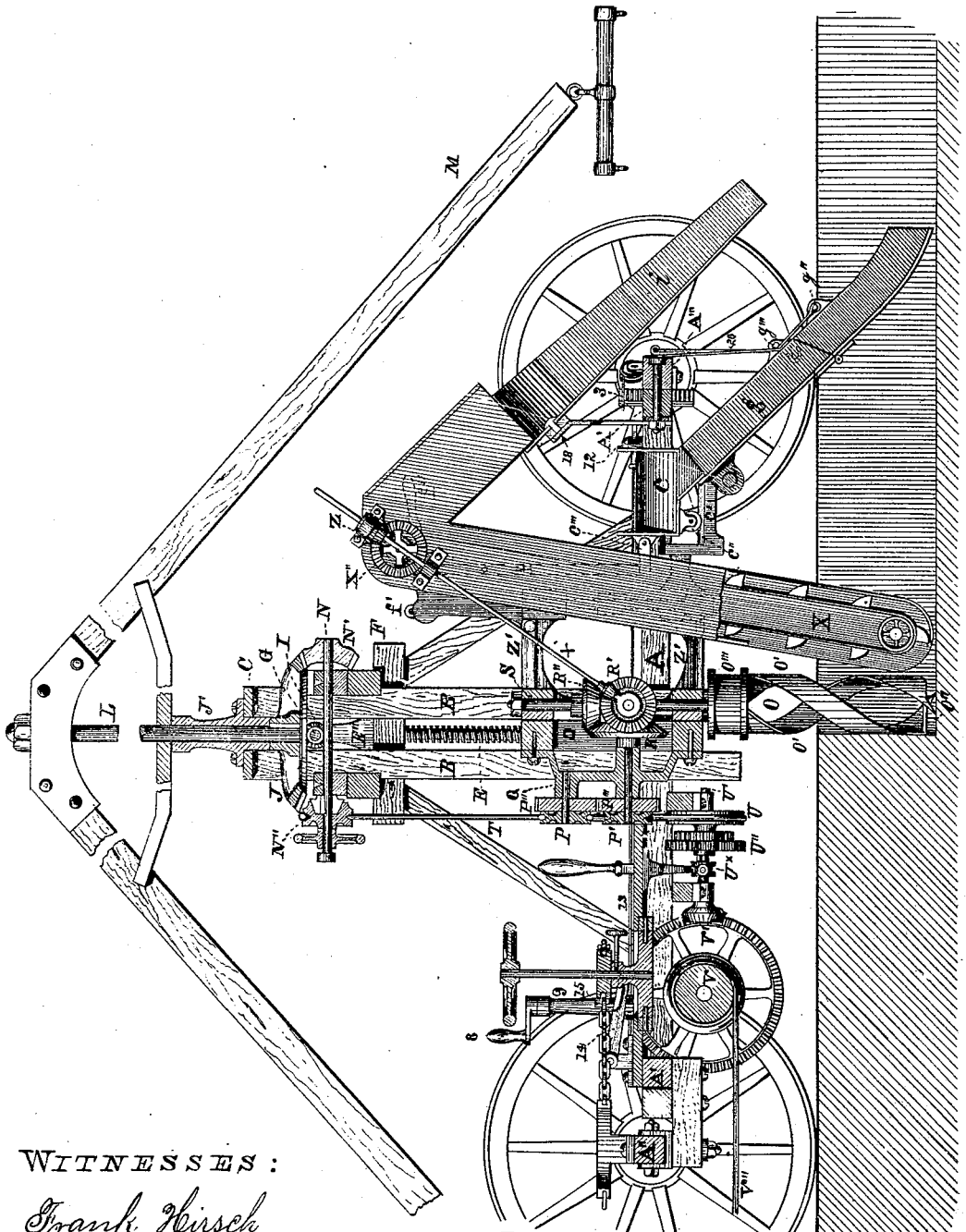
4 Sheets—Sheet 1.

J. F. YOUNG.

DITCHING AND TILE LAYING MACHINE.

No. 181,887. Patented Sept. 5, 1876.



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Jno. P. Stark.

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Jonas F. Young.

by Michael P. Stark

his Attorney

4 Sheets—Sheet 2.

J. F. YOUNG.

DITCHING AND TILE LAYING MACHINE.

No. 181,887. Patented Sept. 5, 1876.

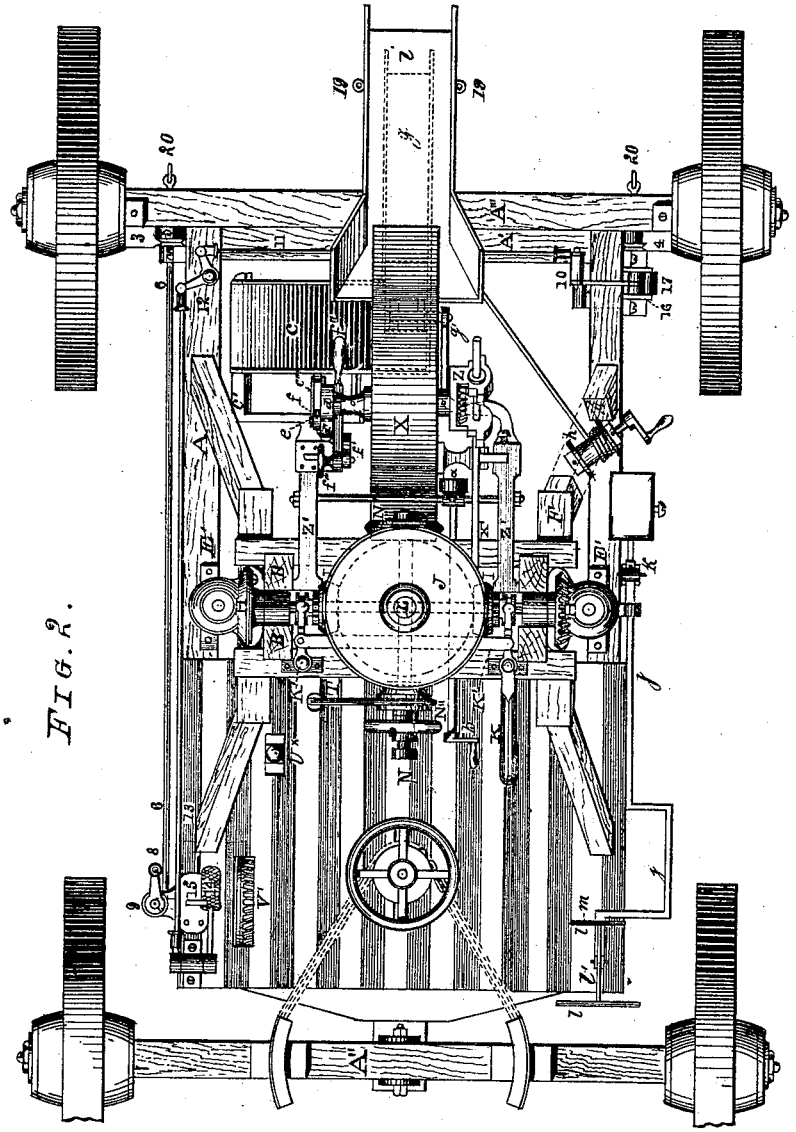

FIG. 2.

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4 Sheets—Sheet 3.

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DITCHING AND TILE LAYING MACHINE.

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FIG. 3.

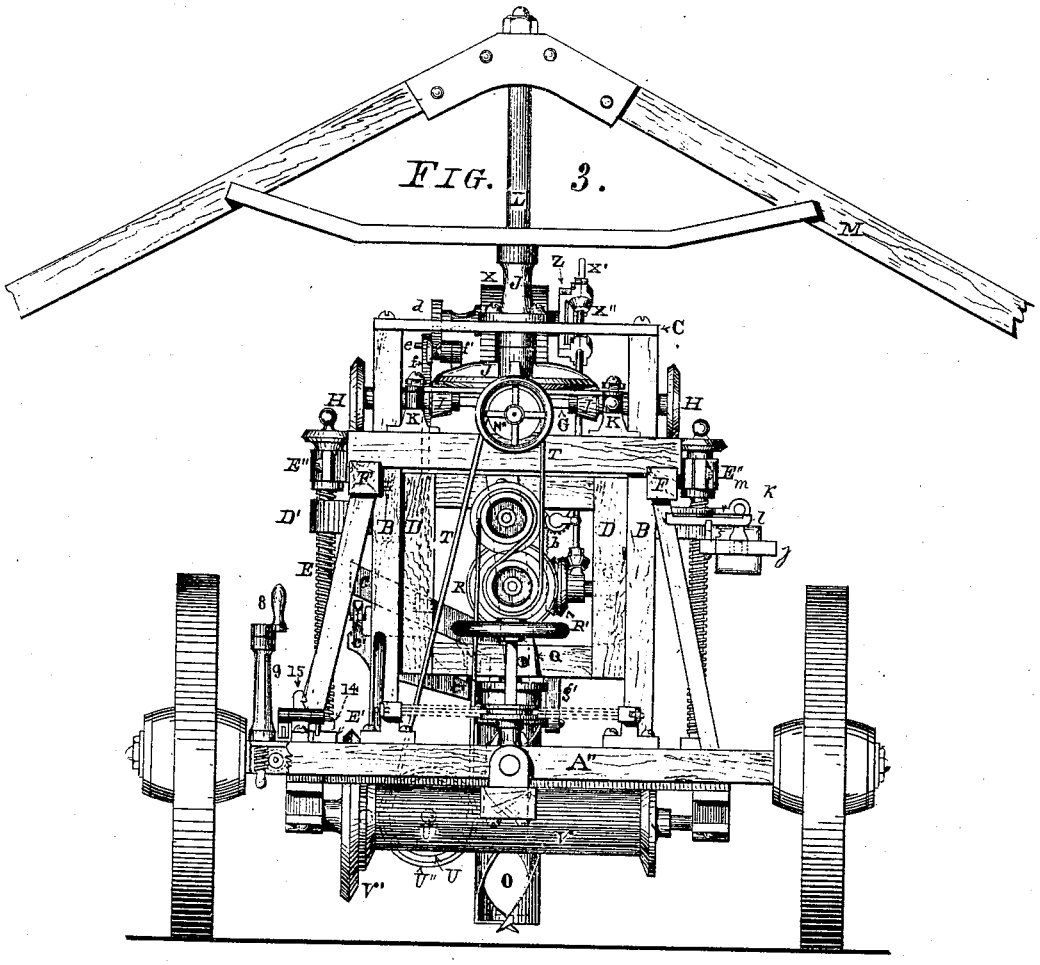


FIG. 5.

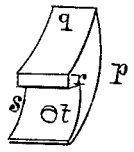
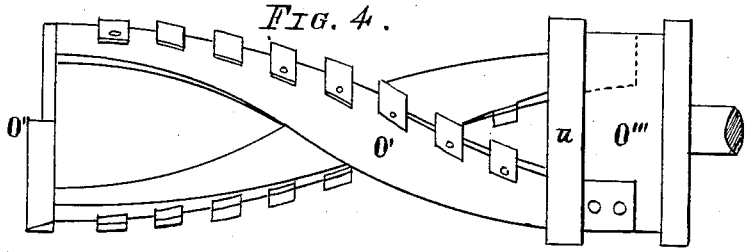


FIG. 4.



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4 Sheets—Sheet 4.

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DITCHING AND TILE LAYING MACHINE.

No. 181,887. Patented Sept. 5, 1876.

FIG. 6.

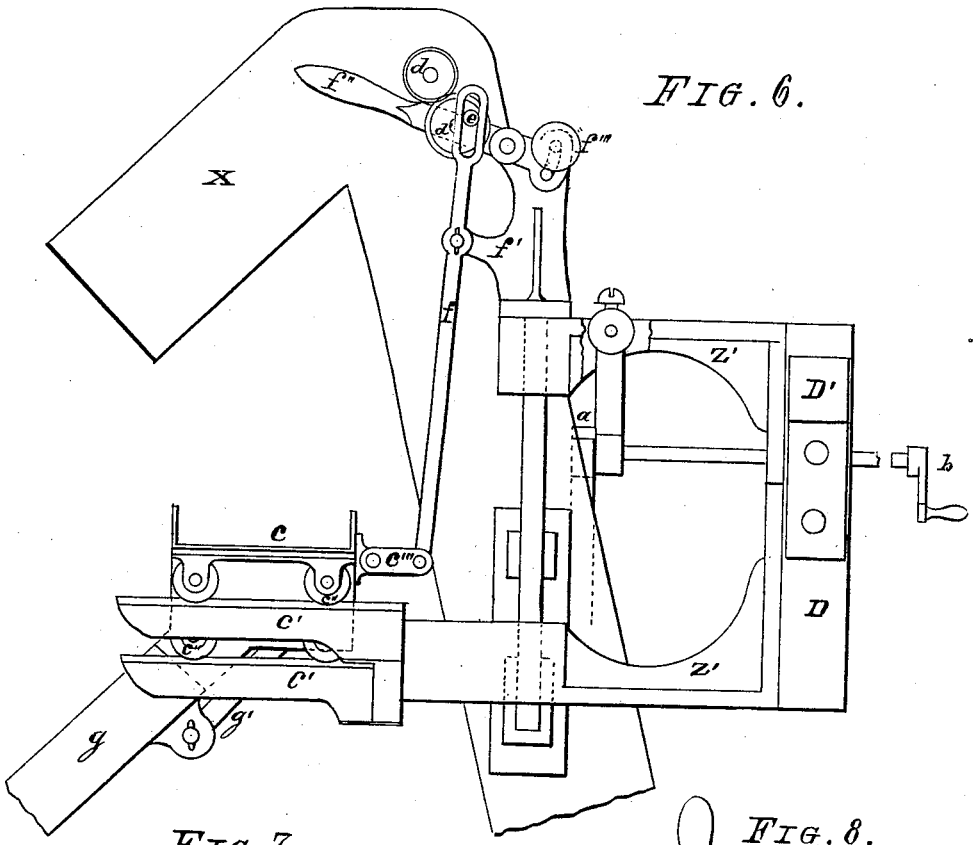


FIG. 7.

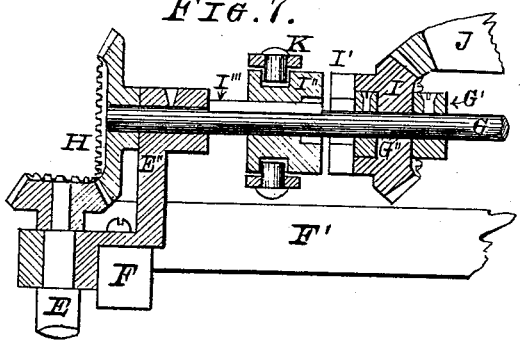
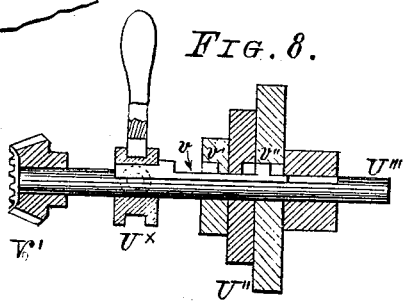


FIG. 8.



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INVENTOR:

Jonas F. Young,

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UNITED STATES PATENT OFFICE.

JONAS F. YOUNG, OF NIAGARA FALLS, NEW YORK.

IMPROVEMENT IN DITCHING AND TILE-LAYING MACHINES.

Specification forming part of Letters Patent No. **181,887**, dated September 5, 1876; application filed May 11, 1876.

To all whom it may concern:

Be it known that I, JONAS F. YOUNG, of Niagara Falls, in the county of Niagara and State of New York, have invented a Compound Ditching and Tile-Laying Machine; and I do hereby declare that the following description, taken in connection with the accompanying sheets of drawings, forms a full, clear, and exact specification, wherein are set forth the nature and object of my invention, and the best mode by which it is carried into effect.

The object of my present invention is the production of a machine that shall cut a ditch, deposit the necessary tiles, and cover the excavation in one operation. To this end I construct a portable frame of suitable material and dimensions, having a sliding frame operating in uprights, to which sliding frame I attach an auger revolved by suitable machinery, and also an elevator receiving its motion through properly-arranged gearing and connections, in such manner that the earth or soil cut by the revolving auger shall be raised out of the excavation by said elevator, and deposited either on the sides of or directly into the same again, at some distance from the auger, as the case may be. Directly in the rear of the elevator, I locate a vibrating inclined chute, upon which I deposit the tiles to be laid into the excavation, said vibrating chute being in communication with a fixed spout or tube passing to the bottom of the ditch, through which said tiles pass in their way to the said ditch, the vibrating of the inclined chute causing the tiles thereon to move toward and into the fixed spout, down which they will slide by their own gravitation, and arrange themselves successively in a continuous line, as the machine moves forward, which is accomplished by a drum upon which a rope is wound by the action of the machinery.

In order to elevate and lower the auger, as necessity requires, I suspend the sliding frame carrying the bearings for the auger by means of nuts engaging with properly-arranged screws operated by a bevel-gearing. All the operating parts of my machine are set in motion by animal or other power.

The drum by means of which my machine is propelled is provided with means for instantly varying or arresting the speed or forward movement of the machine, as circumstances may demand.

To enable others skilled in the art to which my invention appertains to make and use the same, I shall proceed to describe its particulars of construction, and thereby refer to the hereinbefore-mentioned drawings, which form a part of this specification, and illustrate my invention more fully.

In these drawings, Figure 1 is a longitudinal sectional elevation. Fig. 2 is a plan. Fig. 3 is a front elevation. Fig. 4 is an elevation of the auger detached. Fig. 5 is a perspective view of a detached cutter. Figs. 6, 7, and 8 are detached views of various operating parts.

Like letters of reference indicate corresponding parts in all the figures.

A are two longitudinal beams of wood, of proper dimensions to sustain the superstructure. They are placed parallel a suitable distance apart, and connected on their extremities by the transverse beams A′. Centrally attached to each of the longitudinal beams, by suitable connecting-timbers, are two uprights, B, connected with each other on their upper end by the plate C, or other suitable means. These uprights are placed a sufficient distance apart to allow the introduction of a rectangular frame, D, sliding in the space between the uprights, said frame D being suspended by means of nuts D′ engaging with two vertical screws, E, extending from near the upper end of the uprights B down to the longitudinal beams, and revolving thereupon within the step-bearings E′, and on their upper end in bearings E″ secured to the connecting-timbers F. The screws E receive motion from the transverse shaft G through the bevel-gearings H, the shaft itself being rotated by the bevel-wheels I connecting with the main driving-wheel J. In order to elevate or lower the frame D, it is necessary to revolve the screws E in the proper direction, and to accomplish this object I arrange the bevel-wheels I loosely upon the shaft G, and provide each with a friction or other clutch, I′, operated simultaneously by the levers K

and connecting-bar K′ in such manner that when one of the clutches I′ is thrown into gear the other will be disengaged.

The wheels I revolve in opposite directions, so that the proper clutch, engaging with the corresponding wheel, causes the shaft G to revolve in one direction, while the opposite clutch, when engaged, causes a reverse motion, while, if both clutches are disengaged, the said shaft G will remain motionless. J is the main driving-wheel attached to the shaft L, and revolved by a number of horses hitched to the sweeps M. The main shaft L has suitably-arranged bearings above the uprights B, such as illustrated at J′, or similar contrivances. N is an auxiliary driving-shaft, arranged longitudinally and at right angles to the shaft G, to communicate motion to the auger O by means of the bevel-wheel N′ keyed to one end of said shaft N, and engaging with the main driving-wheel J and a belt-pulley, N″, on the opposite and forward end of said shaft. This belt-pulley N″ is provided with a friction-clutch, as clearly shown in Fig. 1, for engagement and disengagement, and it connects, by means of a chain or other endless belt, T, with the pulleys P P′, revolving with their shafts within bearings in the bracket Q attached to the frame D.

To the rear end of the shaft carrying the pulley P′ is fastened a bevel-wheel, R, engaging with the double-faced bevel-wheel R′, arranged to revolve horizontally, and with the bevel-wheel R″, constructed to turn in a horizontal plane, the latter one being attached to the auger-shaft S, and the former to a suitably-arranged shaft, S′, having its bearing on the side of the sliding frame D to communicate motion to the elevator X, as hereinafter to be described.

The auger-shaft S has two bearings attached to the frame D, within which it revolves, and it is provided on its lower extremity with the auger O. The endless belt T passes from the pulley N″ to the pulley P′, thence upwardly over the pulley P, and then downwardly over the pulley U secured to the shaft U′. This pulley serves to rotate a differential gearing, consisting of a series of gear-wheels of different diameters attached to said shaft U′, and engaging with a corresponding series of similar gear-wheels, U″, revolving loosely upon the shaft U‴. Either one of the latter series of gear-wheels, when engaged with the shaft U‴ by means of the clutch U×, will cause this shaft to partake of its motion, and thereby to revolve the drum V by means of the bevel-gearing V′. This drum serves to propel the machine by the rope V″, fastened with one end to a fixed point in advance of the machine, and winding upon said drum as it revolves. The speed or forward movement of the machine is controlled by the differential gearing heretofore mentioned, and it may be arrested by throwing the clutch U× out of gear.

So far as the different elements hereinbefore described are concerned, they relate to the production of the excavation for the deposition of tiles, which is accomplished by the vertically-revolving auger O, which will cut the soil longitudinally as the machine advances. The loose earth is removed by means of the elevator X, which is driven by the shaft X′, having on its lower extremity a bevel-pinion engaging with the double-faced bevel-wheel R′, and near its upper end a corresponding bevel-pinion engaging the bevel-wheel X″ attached to the elevator-bucket driving-shaft. The upper bevel-pinion slides upon the shaft X′ by a feather and groove, and it revolves within the movable bearing Z.

The elevator X is suspended between four brackets, Z′, secured to the rear side of the sliding frame D, and is raised or lowered by a rack and pinion, *a*, and a shaft and handle, *b*, from the forward end of the machine. The brackets Z′, as well as the shaft and handle *b*, are secured to the sliding frame D. By this arrangement the elevator X may be raised or lowered simultaneously with the auger O, or independently of the same by the rack and pinion *a*.

c is an inclined chute, moving horizontally by means of grooved wheels *c*″, or similar contrivance, upon the rails *c*′, attached to one of the lower brackets Z′. This chute is vibrated from the elevator-bucket shaft by means of the cog-wheel *d* engaging a similar wheel, *d*′, provided with a crank-pin, *e*, operating in a slot-hole of the lever *f*, said lever being pivoted to the support *f*′ attached to one of the upper brackets, Z′, and connected with the chute *c* by the links *c*‴.

The crank-wheel *d*′ has its bearing in a hand-lever, *f*″, pivoted to the support *f*′, and provided with means for adjustment, such as a set-screw, *f*‴, passing through a slot-hole in the hand-lever *f*″ into the support *f*′. Other devices, however, may be resorted to to accomplish the object of vibrating the inclined chute *c*, if desired. This chute *c* inclines toward the center of the machine, and has connection on its lower end with a fixed spout, *g*, pivoted to a support, *g*′, fastened to one of the lower brackets Z′, opposite the rails *c*′. This spout *g* is constructed of two pieces hinged centrally, and it is manipulated by a winch, *h*, and a chain or rope attached with its end to the cross-bar *g*″ of the lower piece of the spout *g*, and passing over a similar bar, *g*‴, on the lower extremity of the upper piece of said spout. The spout *g*, on account of its being attached to the sliding frame D, through the intervention of the brackets *g*′ and Z′, partakes of the motion of said sliding frame; but to adjust it in the ditch, and to raise it entirely above the ground for portability, I have resorted to the hereinbefore-mentioned winch *d*.

The whole machine is rendered portable by means of wheels placed on the front and rear

axles A'' A''', respectively. This forward axle is supported centrally in a universal joint, and it is governed by means of the hand-wheel operating a chain passing over a chain-pulley, and attached with its both ends to segments secured to said axle. The rear axle is pivoted centrally to the rear tranverse beam A''', and is adjustably retained in position by means of the toothed segments 3 and 4 attached near the outer ends of said axle. One of these segments, 3, is operated by the pinion 5, attached to the shaft 6, which extends longitudinally to the platform, and is actuated by a worm and worm-wheel, 7, operated by the handle 8, fastened to an upright shaft passing through the standard 9. The other segment, 4, communicates motion to a brake, consisting of a drum, 16, and a brake-shoe, 17, operated by the lever 10, rod 11, bell-crank 12, rod 13, and the foot-lever 14, which latter is provided with a tooth or serrated stop-bar, 15, to retain said treadle 14 in any desired position.

The segments 3 and 4 are provided with curved plates on their faces, engaging with grooved wheels placed behind the pinions engaging with said segments.

When the machine is moving forward its tendency is to cause bending of the rear axle, and to remedy this I have resorted to said curved plates and grooved pulleys or wheels to keep the rear axle in close contact with the rear transverse beam A', and thereby the segments and pinions 3 and 4 in gear.

In order to cut a ditch, the machine, being brought upon its field of action, is started by hitching the requisite number of animals to the sweeps, and the gear that operates the screws E engaged by the lever K. This will cause the auger O to descend, and to cut a cylindrical hole of the proper depth. During the cutting of this hole the elevator X is kept suspended above the ground by the rack and pinion *a*.

If desired, the drum V may be caused to revolve with the auger, the rope V'' having been previously fastened to a stake in advance of the machine. By this mode I start the ditch with a slope, and continue until the desired depth of the excavation is attained. In this case the elevator X needs to be kept suspended only for a short distance above the lower extremity of the auger, and it can be caused to descend as the machine advances. As soon as the proper depth is reached the movement of the frame D is arrested, when the machine will proceed to cut longitudinally an excavation, whose bottom is parallel with the surface of the ground over which it has traveled. The soil detached by the auger is raised by the elevator X, and deposited either on one or the other side of the excavation, or back into the same, by means of the pivoted spout *i*, which may be swung in any direction.

After the machine has commenced to cut to the proper depth I deposit the tiles to be laid into the excavation upon the vibrating chute *c*, side by side, which chute, being arranged on an incline, will cause these tiles to move toward the lower end thereof. This lower end is inclined toward the rear of the machine or at an angle to the base of the vibrating chute, said inclination beginning about midway, so that when the tiles reach this end they will incline toward the rear end and drop into the pivoted spout *g*. This spout contains a sufficient number of tiles, which, resting one upon the other, exert sufficient pressure upon the lowest one to cause it to leave the spout as the machine advances. In this way the tiles arrange themselves in a continuous line in the ditch, which is at once covered up with the dirt removed by the auger in front, and the ground restored to its original condition. If tiles of a smaller size or of varying sizes must be laid I arrange the sides of the depositing-spout *g* in such manner as to be adjustable to the size of the tiles. It is necessary that this spout should correspond to the tiles to be deposited, in order to form a straight line when laid into the ditch. In order to cut the bottom of the ditch in a straight line without regard to the undulations of the ground over which the machine passes, and, also, to cut a ditch with a perfectly uniform slope, I provide the sliding frame with a leveling device, consisting of the horizontally-suspended bar *f*, pivoted in a universal joint, K, from the sliding frame D (with the center of motion in line with the center of the auger-shaft,) and provided on its forward extremity with the sighting device, composed of two horizontal bars, *l*, pivoted to a connecting-bar, *l'*, and provided with hair-lines *m*. This sighting device has a universal movement, and it operates in conjunction with a stake placed at the extreme point of the ditch to be excavated in the following manner: Supposing the ditch to be cut with a uniformly-sloping base. The stake, placed at the extreme end, is marked conspicuously at a point corresponding to the distance from the lowest point of the auger in the ditch to the hair-lines on the sighting device when in a horizontal position, minus the difference of the initial and terminating depth of the ditch. Now, the hair-lines are adjusted to cut the marked point on the advance stake, and the machine set in motion. From time to time, as the machine advances, the attendant examines the position of the machine in regard to the fixed point of the stake, and if he finds that the hair-lines point to a position above the mark, it indicates that the sliding frame D should be lowered, or vice versa. If this adjustment is frequently made the cut will be of a nearly perfect slope, no matter how irregular the surface of the operating field may be. To cut a ditch with a straight bottom of an average depth, the operation is precisely the same as that described, except that the mark on the advance stake is made accordingly. To cut a ditch along a

side-hill, and make its walls perpendicular, the machine must be tilted accordingly. This I accomplish by the adjusting device on the rear axle, consisting of the toothed segment 3, operated by the pinion 5 on the shaft 6, and the worm-wheel and worm 7 actuated by the handle 8 in such manner that turning said handle in the proper direction causes the machine to tilt, the center of motion being in the king-bolt connecting the rear axle with the machine. By this arrangement I can keep the auger O perfectly vertical within the limits of adjustment of the segment.

To prevent the machine from shaking on account of the backlash in the teeth of the adjusting segment and pinion, I provide the opposite end of the rear axle with the segment 4, which actuates the brake-drum 16 in such manner that, when the brake 17 is applied by means of the treadle 14 being depressed, it will securely hold the pinion applied to the brake-shaft. If, now, a slight turn will be given to the handle 8, the play in the teeth will be taken up, and the machine thereby securely held in position. I have only applied this adjusting arrangement to the rear axle, and pivoted the front axle in a universal joint, which will allow said front axle to adjust itself to the various positions of the machine.

To avoid stumps, or other surface obstacles in the field, and also to cut curved ditches, and, furthermore, for portability of the machine, the front axle is pivoted in such manner that the machine can turn a curve, and thus avoid any obstruction that may be in its path. If the machine should strike a large stone, or other obstructions buried in the ground, the operation of the auger and winding-drum is arrested by disengaging the friction-clutch N″ and the auger elevated by the elevating-gear. The obstruction can then be removed by suitable hand-tools, and the position of the auger restored. Should these obstructions be of such a nature as to be insurmountable by the machine, it will be necessary to advance the same and to begin a new ditch at a place past such obstructions, the unfinished space between having to be excavated by manual labor.

As heretofore stated, the friction-clutch on the pulley N″ is operated by means of a hand wheel and screw in such manner that any amount of friction can be caused to exist between the pulley and the clutch. By this arrangement I am enabled to adjust the friction so as to cause the pulley to slide on the clutch, should the auger strike an obstruction, which would cause increased friction, or arrest its motion entirely, thereby also decreasing or entirely arresting the forward movement of the machine, and avoiding undue strain on or breakage of the moving parts.

It will be observed that the cutter O is constructed of the two helical plates O′, jointed on their lower extremity by the double-lipped plate O″, and attached with their upper end to the head O‴, said bands being set into recesses in said head and held in position by the band *u* shrunk thereon. In this manner the advance edges of the plates O′ form the cutting-edges and the interior of the said auger a passage for the soil toward the elevator. If desired, the bands may be provided with connecting-pieces for stability. The leg of the elevator, which may be covered or open, and the buckets therein, are of a width slightly less than the diameter of the auger, so that the dirt is all removed from the ditch, the speed of the buckets being such that the capacity of the elevator is considerably in excess of the work to be performed.

In order to cut ditches of different width, I change either the auger and elevator or the auger alone. In this case I construct the elevator of a width corresponding to the narrowest excavation, and provide its leg with scrapers or other suitable means, to collect and convey the dirt to the elevator-buckets.

As hereinbefore mentioned, the advancing edges of the auger-plates O′ form the cutting-edges, and these are beveled and quite sharp. This construction will answer in most all cases in ordinary soil; but if a very loamy or gravely soil must be excavated, I may provide the bands with detachable cutters *p*, as illustrated in Figs. 4 and 5, consisting of narrow curved pieces, *q* being the cutting-edge, *r* a shoulder resting against the cutting-edge of the plates O′, *t* an aperture in the cutters for attachment to said sides by means of said bolts, and *s* the shank, by means of which the cutters are applied. These cutters are made of cast-steel, properly tempered, and may be removed from the auger when dull, or for renewal when broken.

If it is simply desired to cut ditches without depositing tiles, I disconnect the vibrating chute *c* by lowering the lever *f‴*, which will throw the gear-wheel *d′* out of contact with the driving-wheel *d*. In this case the elevator-chute will be swung over to deposit the removed dirt on either side of the excavation, said spout being pivoted to the support 18, attached to the transverse beam A′, and held in position by the staples 19, engaging with the hooks 20; but to enable the animals traveling in a circuit around the machine, when operating the same, to mount the piled-up dirt and to cross the ditch, I attach a separate portable bridge to the rear end of the machine.

My machine will cut excavations of any practicable depth, and deposit the tiles therein automatically, on account of the introduction of the sliding frame D, to which all the operative parts except those causing the forward movement of the machine are fastened. It will also cut ditches for sewer, gas, or water pipes; or, if kept stationary, and provided with a suitable earth-auger, for digging post-holes, and for many other purposes.

I will here call attention to the arrangement,

with the pulleys P P′, of the gear-wheels P″ P‴, attached to said pulleys. This I have designed to add the tractive force of the belt passing over the upper idle-pulley P to that of the driven pulley P′, which thereby increases the capacity of said pulley. The idle-pulley P is rendered necessary, to allow the operation of the machine in all the various positions of the sliding frame without slacking of the belt. This belt may be either of flexible material, as leather, rubber, &c., or it may be a properly-constructed chain, the latter being preferable on account of its greater strength, and the comparatively slow speed of said belt, which is, perhaps, less than the proper working speed of a leather or other flexible belting. If a chain is employed, the grooves in the pulleys are properly recessed to correspond with the chain.

I will here further call attention to the differential gearing for the rope-drum, which embodies several novel features, the principal one being that of instantly varying or arresting the speed of said drum. This is accomplished by means of a sliding key, *v*, attached to the clutch U×, and operating in a keyway in the shaft U‴. This key has projections *v′*, which alternately engage slots *v″* in the gear-wheels U″, so that sliding the key in one direction or the other will engage one of the series of said gear-wheels. The particulars of this arrangement will easily be understood by reference to Fig. 8 of the drawings.

Instead of moving the vibrating chute *c* upon rails, in conjunction with the anti-friction rollers *c′*, I may suspend said chute by suspension-rods from above, or support the same by pivoted braces from below, which means I consider mechanical equivalents for the rollers as described.

Having thus fully described my invention, I desire to secure to me by Letters Patent of the United States—

1. The combination, with the uprights B, of the sliding frame D, operated by the screws E, and a reversing-gearing arranged to receive its motion from the main driving-wheel J, substantially as described, for the purpose stated.

2. The combination, with the uprights B, of the sliding frame D, operated by the screws E, a reversing-gearing, and a driving-gearing for the auger, both sets of gearings being constructed to receive their motion from the main driving-wheel T, substantially as described, for the use and purpose set forth.

3. The combination, with the uprights B, of the sliding frame D, screws E, nuts D′, bevel-wheels H, and the reversing-gearing, consisting of the bevel-wheels I engaging the main bevel-wheel J, and provided with suitable clutches for engagement and disengagement of the wheels I, as described.

4. The combination, with the frame D, of the bracket Q, pulley P′, bevel-wheel R, and the bevel-wheel R″, attached to the auger-shaft S, said frame being adjustable vertically, substantially as described, for the purpose stated.

5. The combination, with the sliding frame D, of the bracket Q, pulley P′, bevel-wheel R, bevel-wheel R′, and the shaft X′, whereby the elevator is operated substantially in the manner, and for the use and purpose described.

6. The combination, in a ditching-machine with a movable support, of the elevator X, constructed and arranged to be elevated with said movable support and independently of the same, substantially as described.

7. The combination, with the vertically-sliding frame D, having the brackets Z′, of the elevator X, said elevator being suspended between said brackets, substantially as described.

8. The combination, with a ditching-machine, of a device for laying tiles, said device being located in the rear of the auger cutting the ditch, and operated by suitable connecting-gearing from the main gearing, the whole being arranged to operate substantially in the manner described, for the purpose stated.

9. In a ditching and tile-depositing machine, a vibrating chute, arranged to receive the tiles to be deposited, and to convey them into the ditch by means of a properly-arranged spout, substantially as described.

10. The combination, with the sliding frame D, of the vibrating chute *c*, as described.

11. The combination, with the sliding frame D, of the vibrating chute *c*, and the pivoted spout *g*, as described.

12. In a ditching or tile-laying machine, the depositing-spout *g*, said spout being provided with means for adjustment to the depth of the excavation, as described.

13. The combination, with the vibrating chute *c*, of the pivoted spout *g*, both being arranged to operate upon, and connected to, an adjustable support, substantially as described.

14. The combination, with the vibrating chute *c*, of the lever *f*, connected with said chute by the links *c‴*, and operated by the crank-wheel *d′* engaging, with its crank-pin *e*, a slot-hole on the upper extremity of said lever, substantially as described.

15. The disengaging device for the vibrating chute *c*, consisting of the hand-lever *f*, pivoted to the support *f′*, and carrying the crank-wheel *d′*, and provided with means for adjustment, substantially as described.

16. In a ditching-machine, and in combination therewith, a propelling device constructed and provided with a differential gearing, substantially as described, for instantaneously varying the forward movement of said machine, substantially as described.

17. The combination, with a differential gearing, of the drum V, arranged to be operated by said differential gearing for the purpose of propelling the machine, substantially in the manner and for the purpose described.

18. In a ditching-machine, and in combination therewith, the shaft U′, provided with a

suitably-arranged pulley for giving motion to said shaft, and with a series of gear-wheels of different diameters permanently attached, and a series of corresponding gear-wheels, U″, revolving upon the shaft U‴, and provided with a clutch, $U^{\times}$, constructed and arranged substantially as described, for instantaneously varying the forward movement of the machine, or arresting the same, as stated.

19. The combination, with the rear axle A″, of the segment 3 engaging the pinion 5 operated by the shaft 6, and a suitable device for giving motion to said shaft 6, substantially as described, for the use and purpose stated.

20. The combination, with the rear axle A″, of the segments 3 and 4, and the curved inwardly-projecting plates attached to said segments, and engaging with grooved wheels placed behind the pinions engaging with said segments, substantially as described, for the use and purpose stated.

21. The combination, with the adjusting device for the rear axle, of a suitably-arranged brake, whereby said axle is locked in position, substantially as described.

22. The combination, with the segment 3 and its operating device, of the segment 4, brake 16 and 17, and an operating device for said brake, consisting, essentially, of the foot-lever 15, connected with said brake by means substantially as described.

23. The combination, with the sliding frame D, capable of a vertical adjustment, of the pulleys N″, P, P′, and U, belt or chain T, and the auger O, substantially as described, for the use and purpose stated.

24. In a ditching-machine, an adjustable sliding frame carrying the auger or cutter, a device, substantially as described, for giving motion to said auger in its various positions from the main driving-pulley, by means of a chain or belt, substantially as described.

25. In a ditching-machine, the combination, with a vertically-adjustable auger, of the suspended sighting device consisting of the horizontal longitudinal bar *j*, pivoted by means of the universal joint *k*, and provided on its forward extremity with the pivoted bar *l′*, provided with the horizontal transverse bars *l* having the hair-lines *m*, substantially as described.

26. In a ditching-machine, a vertically or obliquely revolving auger, composed of the shaft S, head O‴, helical bands O′, and the lipped plate O″, said bands being arranged to form sections of a cylinder whose interior has a free and unobstructed passage for the dirt, substantially as described.

27. The combination, with the helical plates O′, of the detachable cutters *p*, for the purpose stated.

28. The cutters *p*, constructed with the shoulder *r*, and provided with means for attachment, substantially as described.

29. The combination, with the pulleys P P′, of the gear-wheels P″ P‴, and the pulley N″, as described.

30. In a ditching-machine, the combination, with the main driving-gear, and the driven gearing, of a friction-pulley, arranged either on the driving or driven gearing, with capability of automatically retarding or arresting the movements of the auger and elevator, and the forward movement of the machine, substantially in the manner as, and for the use and purpose, described.

In testimony whereof I have hereto set my hand in the presence of two subscribing witnesses.

J. F. YOUNG.

Attest:

MICHAEL J. STARK,
JNO. P. STARK.