(No Model.) 6 Sheets—Sheet 1.

H. G. LANE.

DITCHING MACHINE.

No. 381,704. Patented Apr. 24, 1888.

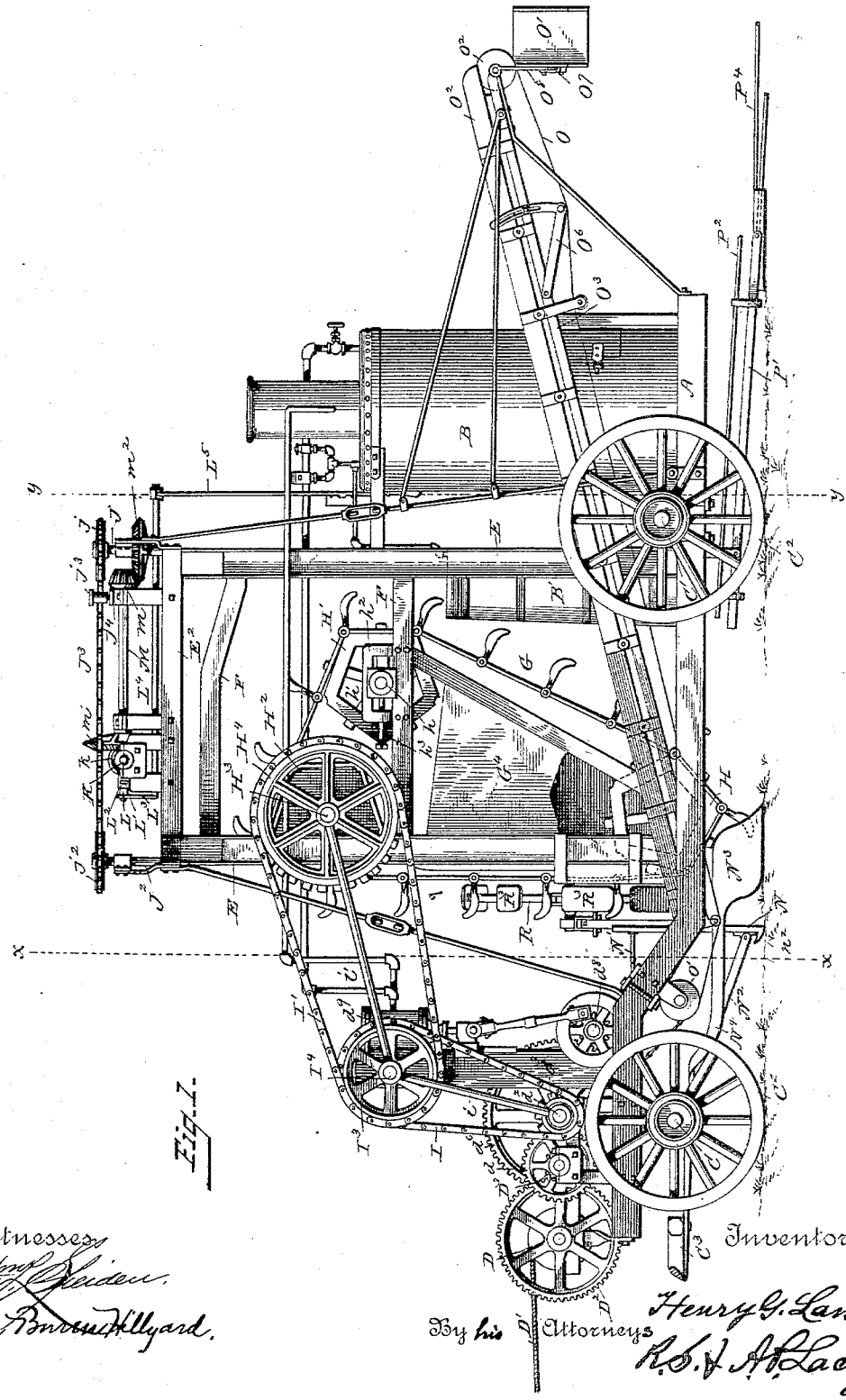


Fig. 1.

Witnesses,
Wm. F. Linden.
Van Buren Kellyard.

Inventor.
Henry G. Lane.
By his Attorneys
R. S. & A. Lacey

N. PETERS, Photo-Lithographer, Washington, D. C.

(No Model.) 6 Sheets—Sheet 2.

H. G. LANE.

DITCHING MACHINE.

No. 381,704. Patented Apr. 24, 1888.

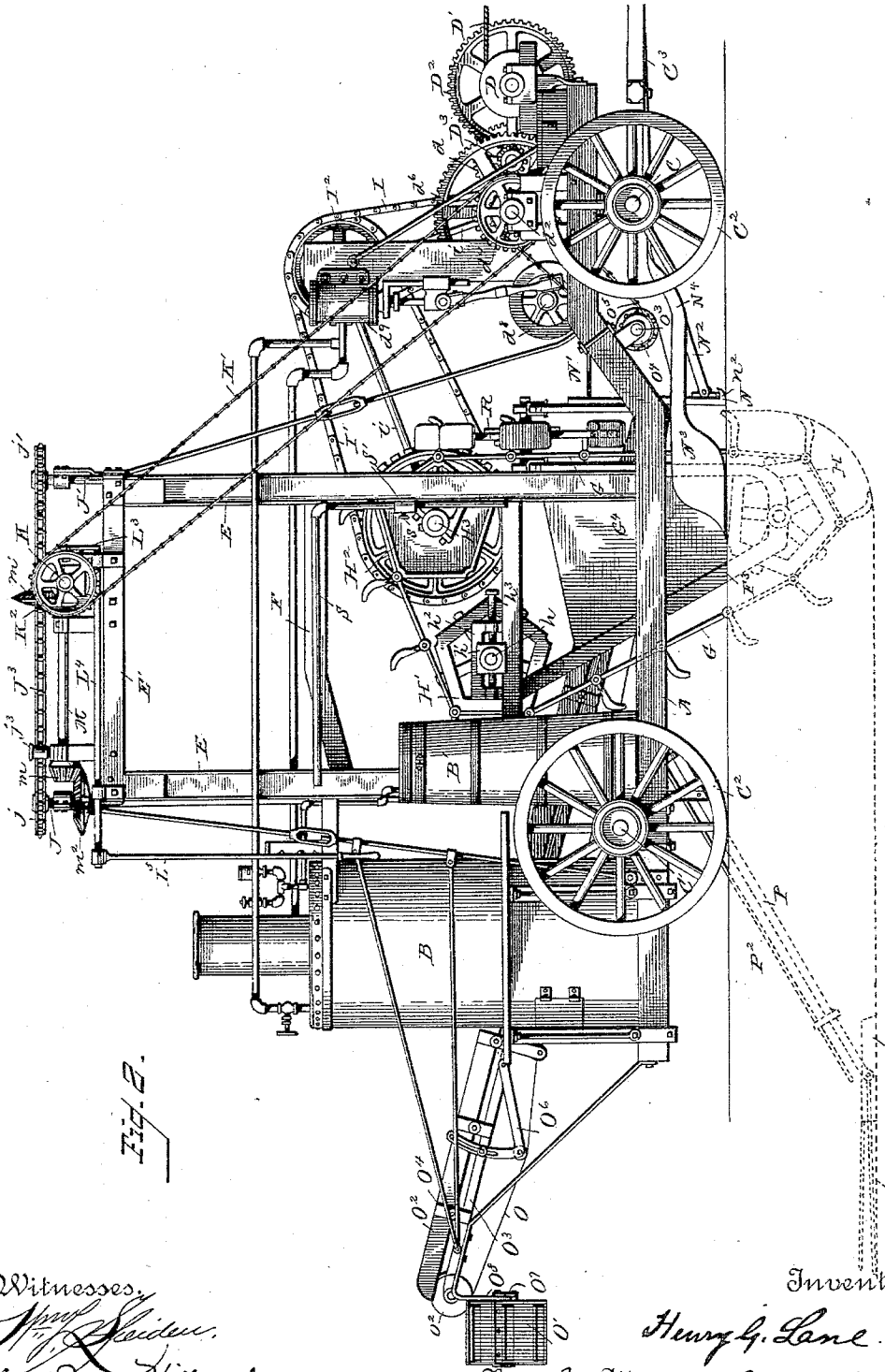


Fig. 2.

Witnesses.
Wm. F. Geiden.
Van Buren Hillyard.

Inventor.
Henry G. Lane.
By his Attorneys
R. S. & A. Lacey.

N. PETERS, Photo-Lithographer, Washington, D. C.

(No Model.) 6 Sheets—Sheet 3.

H. G. LANE.

DITCHING MACHINE.

No. 381,704. Patented Apr. 24, 1888.

Fig. 3.

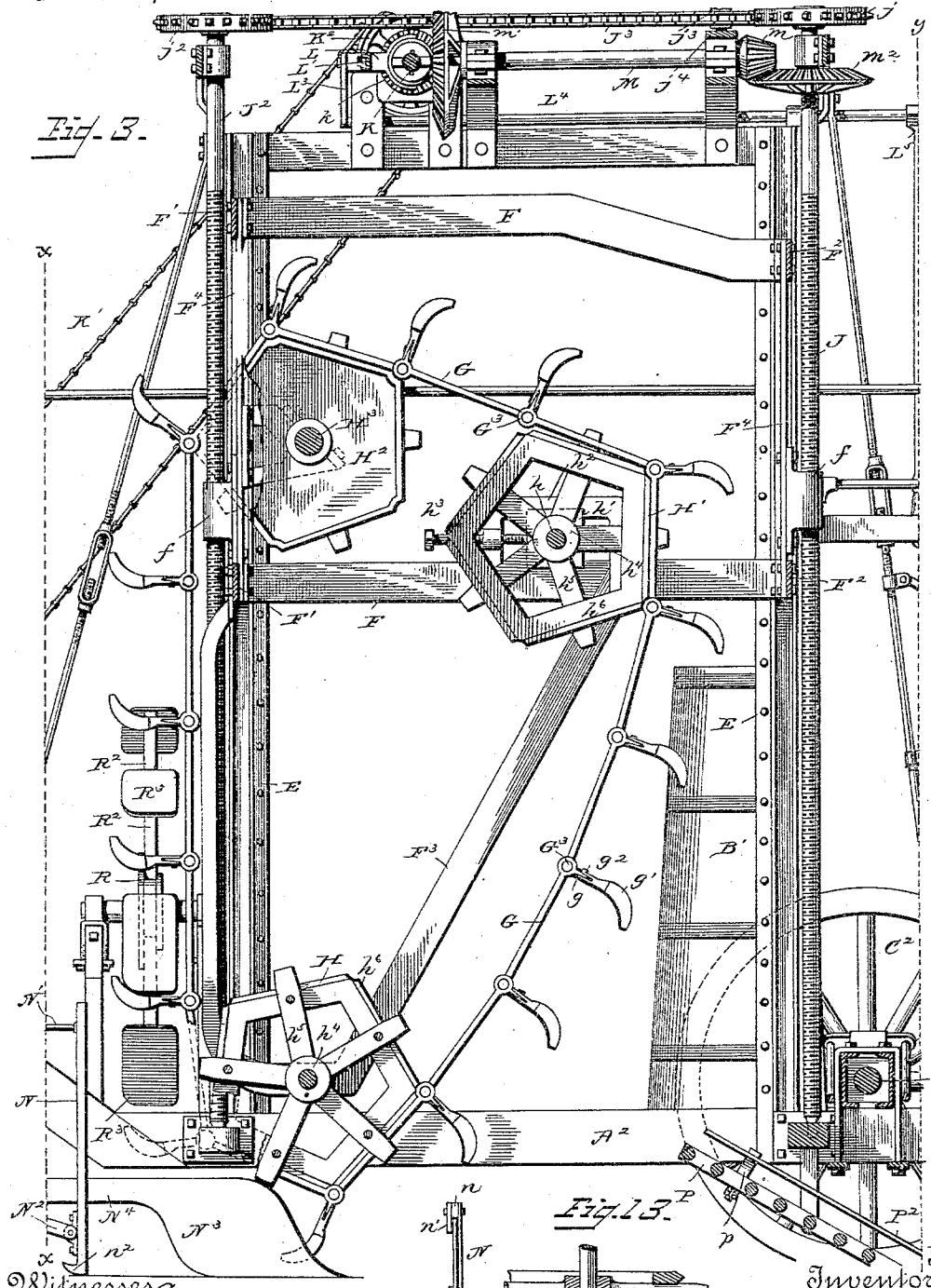


Fig. 13.

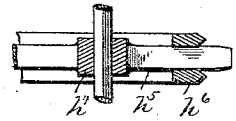
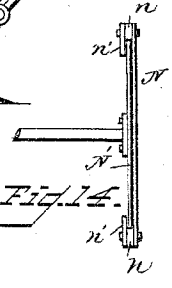


Fig. 14.



Witnesses
Wm. F. Sheden.
Van Buren Willyard.

Inventor.
Henry G. Lane.
By his Attorneys
R. S. & A. P. Lacey.

N. PETERS, Photo-Lithographer, Washington, D. C.

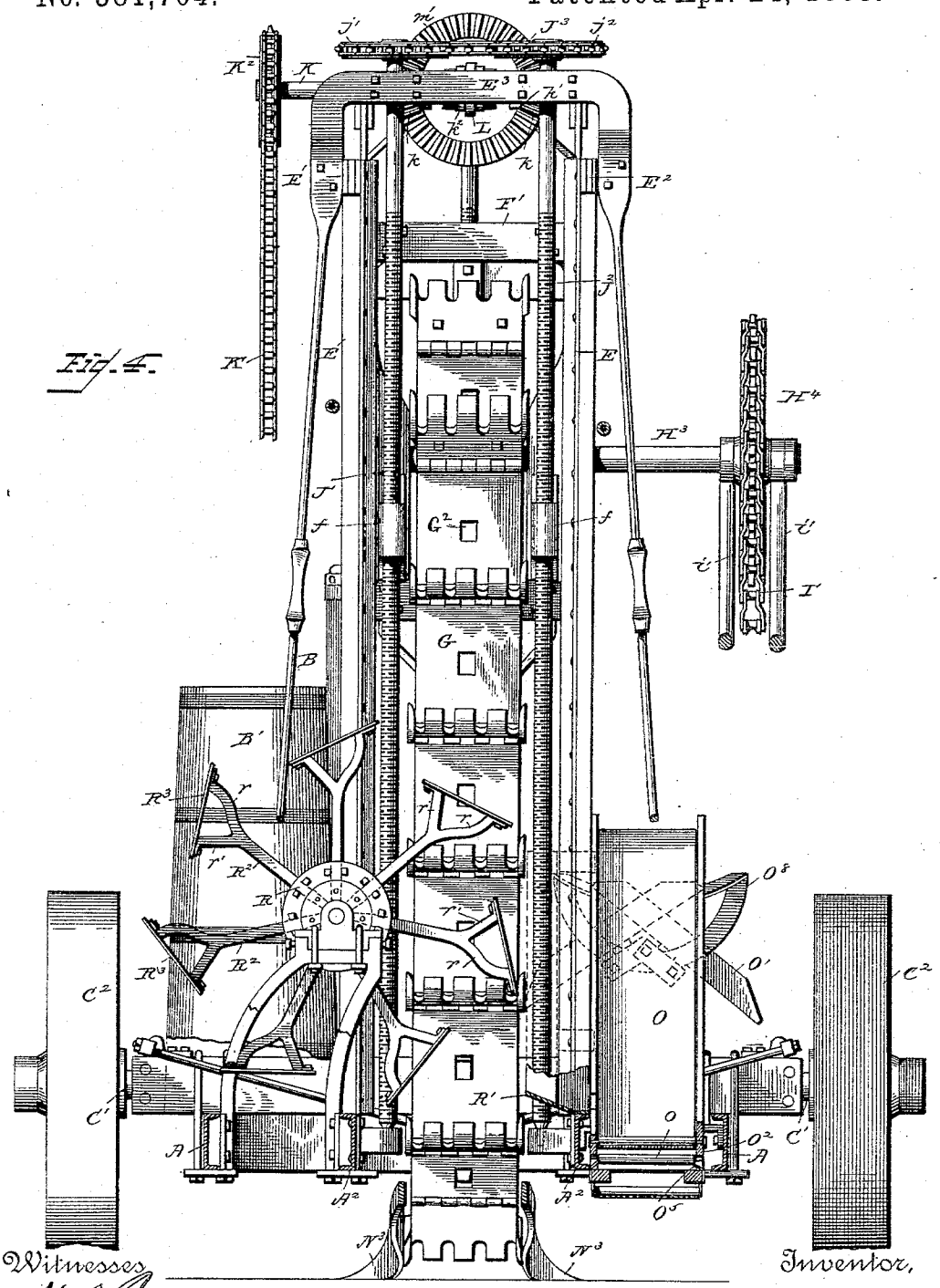
(No Model.) 6 Sheets—Sheet 4.

H. G. LANE.

DITCHING MACHINE.

No. 381,704. Patented Apr. 24, 1888.

Fig. 4.



Witnesses,
Henry Kleiser.
Van Buren Hillyard.

Inventor,
Henry G. Lane.
By his Attorneys
R. S. & A. P. Lacey

N. PETERS, Photo-Lithographer, Washington, D. C.

(No Model.) 6 Sheets—Sheet 5.

H. G. LANE.

DITCHING MACHINE.

No. 381,704. Patented Apr. 24, 1888.

Fig. 5.

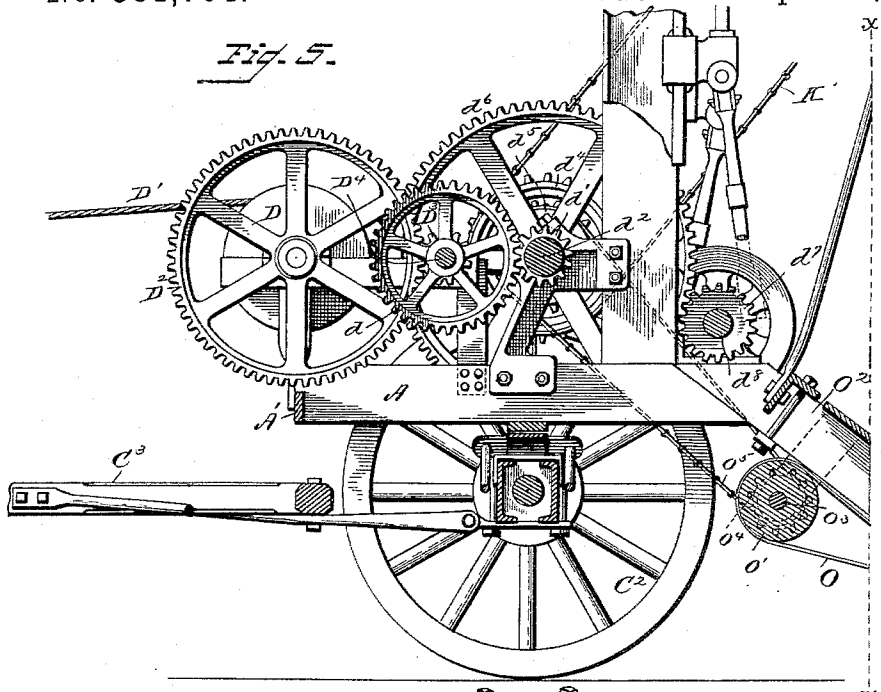
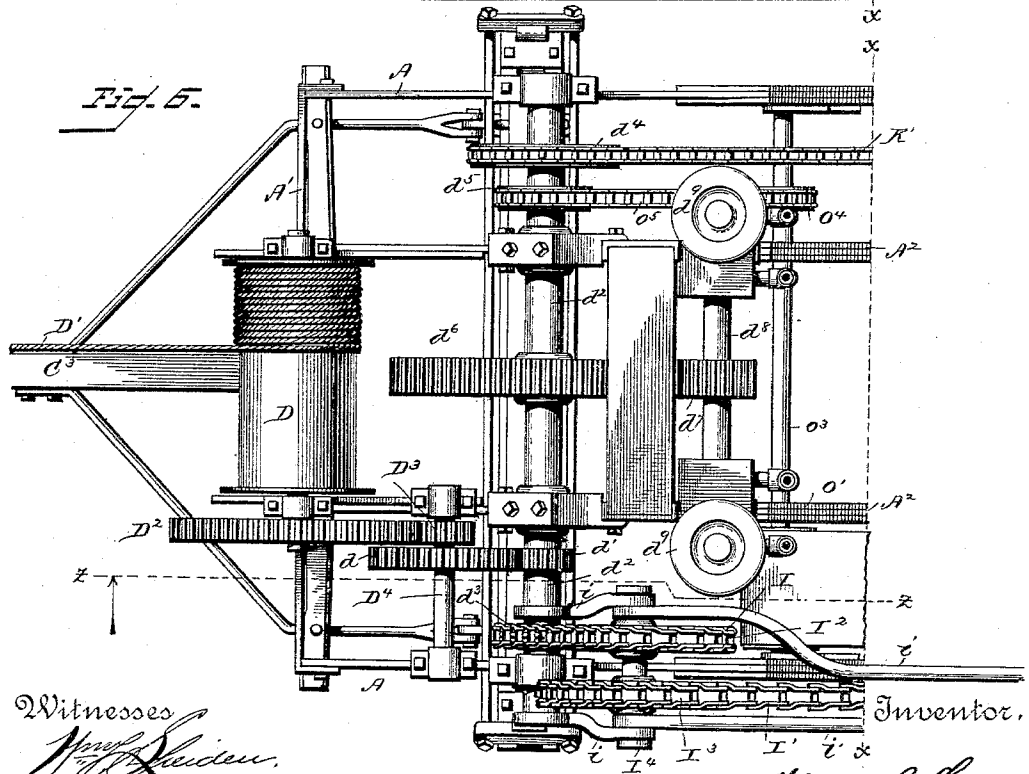


Fig. 6.



Witnesses
Henry Sheiden.
Van Buren Hillyard.

Inventor.
Henry G. Lane.
By his Attorneys
R. S. & A. Lacey.

N. PETERS, Photo-Lithographer, Washington, D. C.

(No Model.) 6 Sheets—Sheet 6.

H. G. LANE.

DITCHING MACHINE.

No. 381,704. Patented Apr. 24, 1888.

Fig. 7.

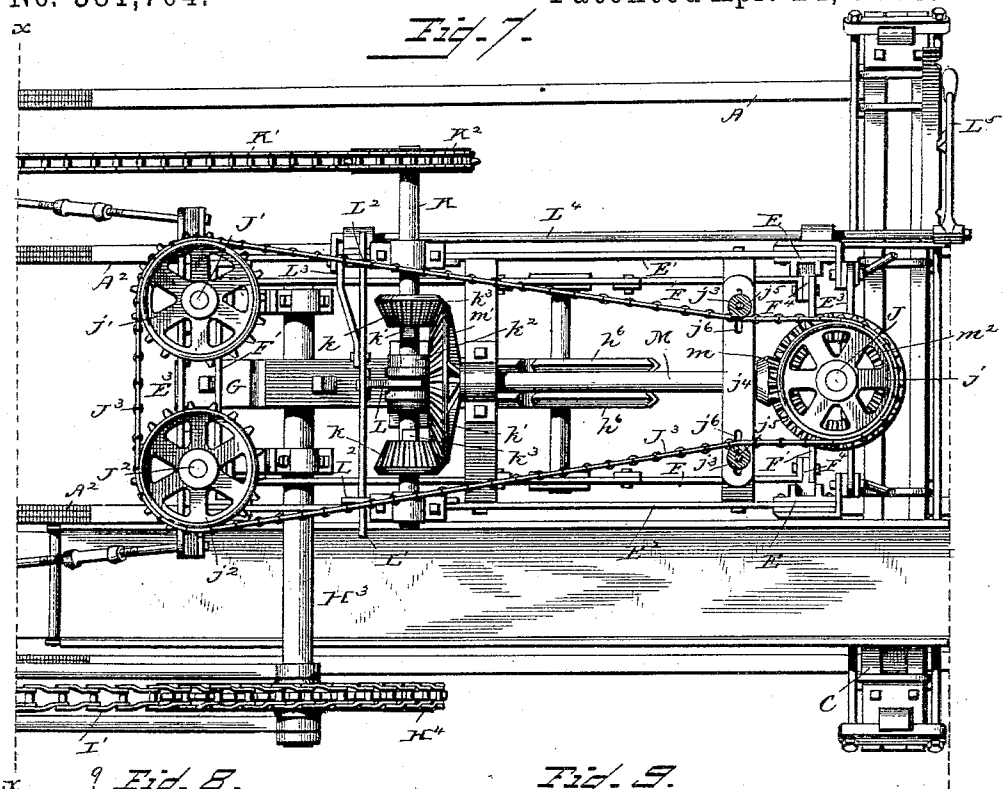


Fig. 8.

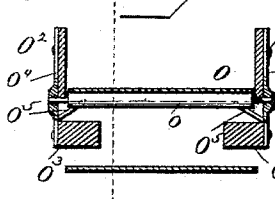


Fig. 9.

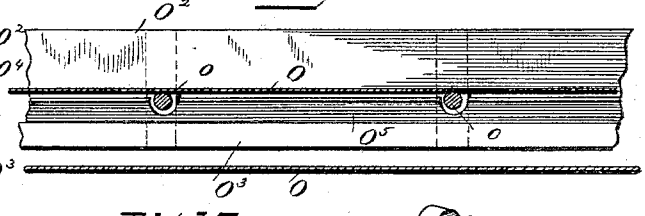


Fig. 12.

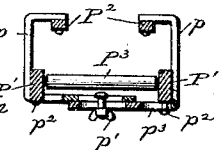


Fig. 10.

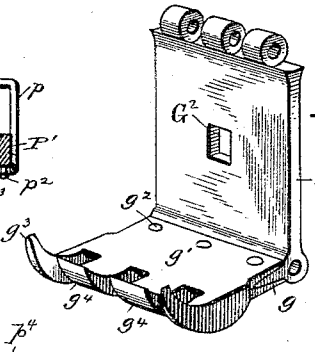


Fig. 11.

Witnesses.

Wm. F. Gaidew.

Van Buren Hillyard.

Inventor.

Henry G. Lane.

By his Attorneys

R. S. & A. P. Lacey.

N. PETERS. Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

HENRY G. LANE, OF BUCYRUS, OHIO.

DITCHING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 381,704, dated April 24, 1888.

Application filed January 6, 1888. Serial No. 259,977. (No model.)

To all whom it may concern:

Be it known that I, HENRY G. LANE, a citizen of the United States, residing at Bucyrus, in the county of Crawford and State of Ohio, have invented certain new and useful Improvements in Ditching-Machines; and I do 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 the letters and figures of reference marked thereon, which form a part of this specification.

This invention relates to a tile-ditching machine which excavates the trench, deposits the tile in the trench, and covers the tile with the earth excavated in the formation of the trench.

The object of the invention is, first, to provide simple, convenient, and efficient means for regulating the depth of the ditch; second, to devise a construction whereby the ditch can be graded in a convenient manner; third, to contrive devices for depositing the tile in the ditch and covering them in an economical and expeditious way; fourth, to construct an excavator which will be simple and compact in arrangement and perform its work in a rapid and efficient manner; fifth, to provide a means for positively relieving the excavating device of the earth removed from the trench without impeding its progressive movement; sixth, to provide devices for preventing the earth removed from the trench from falling in the path of the excavating device; seventh, to devise a mechanism for preventing loose earth from falling on the bottom of the trench; eighth, to construct a tile layer or guide which is adjustable to different-sized tiles, and will hold the tile in position until partially covered, thereby insuring its being laid in a straight course; ninth, to provide a means for the excavator-chain which will not become readily clogged up; tenth, to construct a mud-belt support or trough which will be self-clearing from detached earth, and, lastly, to produce a machine for the purposes hereinbefore mentioned which will be readily accessible to all its parts, self-propelling, easily adjusted to a given grade, and equipped so that the grade of the trench may be had irrespective of the roll and swell of the ground, and which will be compact, efficient, durable, and convenient of operation.

The improvement consists of the novel construction of the frame and the combination therewith of a vertically-movable sash or gate carrying the excavating device, of the mechanism for transmitting motion to the said excavating device and allowing of a vertical adjustment of the said sash, of provisions for mechanically adjusting the said sash, of an ejector to forcibly push the earth from the earth-removing devices, and which will be automatic in its operation, gradually engaging with the said earth-removing devices, and progressively advancing to its work in a positive manner, and gradually disengaging itself from the said earth-removing devices after it has performed its work, and of the novel features and peculiar construction and combination of parts, which will hereinafter be more fully described and claimed, and shown in the accompanying drawings, in which—

Figure 1 is a side view, parts being broken away, of a tile ditching and laying machine of my invention, showing the relative position of the parts prior to reducing the machine to practice; Fig. 2, a side view of the machine, looking at the side hidden from view in Fig. 1, showing the same reduced to practice; Fig. 3, a detail side view of that portion of the machine comprised between the lines X X and Y Y of Fig. 1, on an enlarged scale; Fig. 4, a front view of Fig. 3, or a section on the line X X of Fig. 1, on an enlarged scale; Fig. 5, a side view, parts being broken away and partly in section on the line Z Z of Fig. 4, of that portion of the machine in front of the line X X of Fig. 1 on an enlarged scale; Fig. 6, a top plan view, parts being broken away, of that part of the machine forward of the line X X of Fig. 1 on an enlarged scale; Fig. 7, a top plan view of that part of the machine embraced between the lines X X and Y Y of Fig. 1 on an enlarged scale; Fig. 8, an enlarged view of the mud-belt and mud-belt support or trough as seen in cross section in Fig. 4; Fig. 9, a longitudinal section of a portion of the mud-belt and its support or trough on the line 9 9 of Fig. 8; Fig. 10, a perspective view of the earth-removing device or link of the excavator-chain on an enlarged scale; Fig. 11, a perspective view

of the lower portion of the tile-layer on an enlarged scale; Fig. 12, a cross-section on the line 12 12 of Fig. 11; Fig. 13, a detail cross-section, parts being broken away, of the improved sprocket-wheel for supporting the excavator-chain; and Fig. 14, a top plan view of the shield, showing the front end of the T-bar in engagement therewith.

The truck-frame of the machine comprises side sills, A, and front and rear sills A′. The propelling and actuating mechanism is supported at the front end of the frame. The boiler B, for generating the steam, is located at the rear end of the frame, and the excavating devices are located intermediate these points. Thus it will be seen that the excavating devices are held down by a weight in front and a weight in the rear thereof, and these weights are disposed directly above the front and rear axles, C and C′, respectively, thereby relieving the middle portion of the truck-frame of excessive weight and rendering it susceptible of better abnormal strain without rupture. By having the mechanism disposed as just described the weight is more evenly distributed on the truck-frame, and the supporting-wheels C^2 carry about equal amount of load.

The machine can be drawn forward by any well-known means or power, which may be applied to the tongue C^3, but preferably by the rope or cable D′, which is wound around the drum or windlass D. One end of the rope or cable is fastened to a stump of a tree or stake (not shown) driven into the ground some distance in advance of the machine. The other end of the rope or cable is secured to the drum, and is wound thereon by the multiple-power gearing, presently to be more fully described, to propel the machine forward. The trunnion or journal of the drum has the gear-wheel D^2 keyed thereto, which meshes with the pinion D^3 on the shaft D^4, having the gear-wheel d mounted thereon and meshing with the pinion d' on the shaft d^2, extending the width of the truck-frame, and having a sprocket-wheel, d^3, at one end and sprocket-wheels d^4 and d^5 at its opposite end, and midway between its ends the gear-wheel d^6, which meshes with the pinion d^7 on the power-driven shaft d^8. This shaft d^8 is driven by any suitable motive power attached to and carried by the machine. The most economical form of power for this class of machinery is steam, and two single-acting steam engines, d^9, are employed for driving the shaft d^8—one engine being applied to one end of the shaft and the other engine to the other, and both being so disposed that they will not stop on a dead-center. Motion is not only imparted to the propelling mechanism from shaft d^2, but likewise the excavating devices, the mud-carrier, and the mechanism for adjusting the excavating devices.

The boiler B is supplied with water from the tank B′, which is located close thereto, the two being about equally balanced on the rear axle. The tank B′ is set to one side of the longitudinal center of the machine, as most clearly shown in Fig. 4, to about balance the mud-belt and mud-belt support located to the other side of the longitudinal center, which, as shown, is the left-hand side of the machine. The four uprights or standards E, secured at their lower ends to the intermediate sills, A^2, parallel with the side sills, A, and connected at their upper ends by the side bars, E′ E^2, and the end bars, E^3, and braced by suitable stay-bars, support and guide the excavator-carrying frame in its vertical movements. The excavator-carrying frame comprises an upper and lower rectangular frame composed of side bars, F, and end bars, F′ and F^2. The frames are suitably connected by the vertical bars F^4 and support the bracket F^5, the lower end of which bracket is adapted to enter the ditch and support the lower bight of the excavator-chain G. The bracket F^5 is made up of two corresponding parts, which are located at a distance apart and have the sprocket-wheel H mounted between their lower ends. A second sprocket-wheel, H′, is mounted upon the shaft *h*, journaled near the rear end of the lower frame of the excavator-carrying frame in adjustable bearings *h*′, held in the ways h^2, through a side of which the set-screw h^3 passes for adjusting the bearing to make up any slack in the excavator-chain. A third sprocket-wheel, H^2, located near the upper forward corner of the excavator-carrying frame, is mounted upon the shaft H^3, upon which is supported the gear-wheel H^4, which is in gear with the sprocket-pinions d^3 by suitable mechanism which will permit the free vertical movements of the excavator-frame. The same, as shown, consists of the sprocket-chains I and I′, the sprocket-wheels I^2 and I^3, and the equalizing-shaft I^4, on which is fixedly mounted the sprocket-wheels I^2 and I^3. The shaft I^4 is called "equalizing-shaft," because it is always equidistant from the shafts d^2 and H^3 whatever its relative position, thereby maintaining an even tension on the sprocket-chains I and I′ during the various adjustments of the excavator. This shaft I^4 is journaled between two pairs of rods at their points of intersection. The rods *i* and *i*′ of each pair of the said rods have their inner or overlapping ends held together by the equalizing shaft I^4 and their outer ends mounted on the shafts d^3 and H^3, respectively. When the excavator-frame rises and falls, the ends of the rods *i*′ receive a corresponding movement and the rods *i* vibrate about shaft d^2 to hold shaft I^4 equidistant from d^2 and H^3, so that there will be no lost motion between the sprocket-chains I and I′ and their supporting sprocket-wheels.

The lower sprocket-wheel, H, is protected by a housing, G^4, which is bolted to the lower portion of the bracket F^5. This housing prevents loose earth from falling back into the ditch and onto the wheel H, and is preferably made of sheet metal, which extends from one side bar of the bracket F^5 to the other side bar.

The sprocket-wheels H and H′, which in

practice receive a great amount of loose earth, are constructed with a view to prevent them from packing and becoming clogged up with earth, and to this end they are composed of a hub, h^4, radial arms h^5, and side rims, h^6, bolted to the sides of the arms h^5 at a short distance from their ends. The ends of the arms projecting beyond the rims h^6 form the sprockets or teeth which engage with and fit in the openings G^2 in the links G′ of the excavator-chain G. The rims h^6 are spaced apart to permit the escape of loose earth, and their outer edges are beveled to a chisel-edge to prevent the lodgment and packing of earth on them.

The excavator-carrying frame can be adjusted vertically to any desired point by any well-known means for regulating the depth of the ditch to be excavated, either by hand or by mechanical contrivances. The latter are preferred, and three screws, J J′ J^2, extending parallel with the uprights E, are provided for the purpose. These screws have sprocket-wheels j j' j^2 secured to their upper ends, respectively, and pass through suitably-threaded projections f, extending from the bars F^4 of the excavator-carrying frame. The screws J′ and J^2 are arranged near each of the forward uprights or standards E and pass through corresponding threaded projections, f, near each lower corner of the front end of the excavator-carrying frame. The shaft K, mounted parallel with the shaft d^2, receives its motion therefrom by the sprocket-chain K′, which passes around the sprocket-wheel d^4 on the said shaft d^2 and the sprocket-wheel K^2 on the shaft K. The three feed-screws J, J′, and J^2 are geared together to revolve synchronously by suitable devices, as the sprocket-chain J^3, which passes around the sprocket-wheels j, j' and j^2. One of the feed-screws, J, is provided with a crown gear-wheel, m^2, which meshes with a pinion, m, on the shaft M, journaled longitudinally of the machine and at right angles to the shaft K. The pinion m is on one end of the shaft M, and the opposite end of the said shaft is provided with a bevel gear-wheel, m', which is constantly in mesh with two idle-pinions, k, on the shaft K. These idle-pinions k are disposed so as to come on diametrically opposite sides of the gear-wheel m', so as to revolve the shaft M in one or the other direction, according to whichsoever idle-pinion k is keyed to the shaft K. Either pinion k is keyed to shaft K by the clutch-sleeve k^2, mounted upon the shaft K in the space between the idle-pinions k. This clutch-sleeve k^2 is constructed and arranged to turn with said shaft K and have a longitudinal adjustment, so that when shifted to the right it will engage with the right-hand pinion and effect a movement of the shaft M in one direction and simultaneously impart a motion to the feed screws in a corresponding direction, and when shifted to the left the reverse of the operation just described will be effected and the feed-screws will be rotated in an opposite direction. The pitch of the thread on the several feed-screws is the same, the sprocket-wheels j, &c., are in equal size, and the pinions k are alike. Consequently the excavator-carrying frame in its several adjustments will be moved so as to always remain parallel to its normal position or a given horizontal plane.

The clutch-sleeves k^2 can be shifted to the right or left in any approved manner; but to facilitate the operation I have provided the yoke L, having its ends fitting in an annular groove in the clutch-sleeve, the bar supporting the yoke and having its ends fitting loosely in brackets L^2, the arm L^3, connecting with the bar L′, the rock-shaft L^4, and the hand-lever L^5, secured to the rock-shaft and extending within convenient reach of the operator or engineer. The pinions k have half-clutches k' on their opposing sides, which are adapted to engage with corresponding half clutches, k^3, on the end of the clutch-sleeve k^2. When the clutch-sleeve is adjusted midway between the idle-pinions k k, the shaft K imparts no motion to the shaft M or the feed-screws, but when shifted to the right or left it engages with one or the other pinion and locks it to the shaft K and effects a movement of shaft M and the feed-screws.

The slack of the sprocket-chain J^3 is taken up by two pulleys, j^3, mounted on the ends of the cross-bar j^4 and held adjustably thereon by having its supports j^5 fitting in the slots j^6. The two sides of the chain J^3 are embraced by the pulleys j^3, which can be brought closer together or separated, as required, to obtain the proper degree of tension on the said belt J^3.

The carrier belt G is composed of a series of links, G′, secured together by bolts G^3. The opposite ends of the links have corresponding rounded projections spaced at intervals apart and transversely apertured to permit the passage of the bolt when corresponding ends are fitted together. A rib, g, projects laterally from each link and forms an integral part thereof. It may be located at any point intermediate the ends; but for durability and strength it projects from one end—preferably the rear end—in line with the pivotal connection between two adjacent links. It is designed to receive the excavator-blade g', which is secured thereto by bolts g^2. The excavator-blade is recessed to fit over the rib, which may be of any desired shape in cross section, wedge shape being preferred, with the wider end adjacent the links to better withstand the strain. The front edge of the excavator-blade has a series of fingers chisel-edged for better removing the earth in the process of excavating. The extreme or outer fingers, g^3, are somewhat longer than the intermediate fingers, g^4, and are beveled on their inner sides from front to rear, forming knife-edge points, which cut the sides of the ditch by a smooth clean cut, so that portions will not fall into the trench. The links are generally made of cast metal, and the excavator-blades are made of a comparatively harder substance—such as steel or chilled iron—so as to perform the work in an efficient

and rapid manner. The openings G^2 through the links are adapted to receive the spurs of the sprocket-wheels H, H′, and H^2. The sprocket-wheels are of the same size and are many sided, the sides being equal and of a length corresponding with the length of the links of the excavator-chain. The corners are cut away to receive the hinge-joints of the links.

The shield N is adapted to travel upon the ground just in front of the excavator-chain, and consists of a broad plate of sheet material—such as metal—fifteen inches wide, more or less, and three feet long, more or less. It sets upright, and in practice is dragged over the ground just in front of the said excavator-chain to prevent the excavated earth from falling down in front of the excavator-chain after the teeth of the said excavator-chain leave the trench and before they reach the ejector.

A vertical groove is formed near each edge of the shield on its front or working side to receive the ends of the T-bar N′, which is bolted at its front end to the truck-frame. The T-bar is held rigid and the shield N is adapted to rise and fall to accommodate itself to uneven ground, and yet be firmly braced by the T-rod N′. These vertical grooves are formed by securing a bar, *n*, to each edge of the shield and placing on these bars a second bar, *n*′, wider than bar *n*, so as to overlap the edges of *n*, as shown most clearly in Fig. 14. The bars N^2 connect the lower end of the shield N with the front axle in such a manner that the shield N is free to have a vertical movement. The lower end of the shield is turned up to form a nose-bar, n^2, which facilitates its riding over the ground, or the nose-bar may be a separate piece bolted to the lower edge of the shield. This nose-piece takes the wear and permits the shield to ride easily over small obstructions.

The cleaners N^3, two in number—one arranged on one side of the excavator-chain and the other on the other side—are adapted to travel on the surface of the ground close to the edges of the ditch to push aside all loose earth that may fall from the excavating-teeth before they reach the ejector, thereby preventing it falling back into the trench, and they are formed of sheet metal and have their front and rear edges gradually sloped from front to rear, and at the same time curved outwardly after the fashion of a mold-board of a plow, so as to throw the loose earth away from the edges of the trench. The cleaners are firmly secured to the front axle by the beam-extension N^4.

The carrier-apron or mud-belt O, located on one side of the machine, is supported on suitable rollers, *o*, and is driven so that the upper portion travels from front to rear and carries the earth to the rear of the machine and deposits it in the chute O′, which can be adjusted to deliver the earth into or to one side of the ditch. The carrier-apron or mud-belt is located between the sides O^2 and forms with them the mud-trough, and is supported at its ends on suitable rollers, *o*′ o^2. The roller *o*′ is mounted on a shaft, o^3, parallel with the shaft d^2, having a sprocket-wheel, o^4, on the end opposite roller *o*′, and geared with the said shaft d^2 by the sprocket-chain o^5, which passes around the sprocket-wheels o^4 and d^5. The sides O^2 of the mud-trough are supported on the beams or scantlings O^3, which are held steadfast by suitable braces and stay-bars, and are connected with said beams O^3 by the stakes or bars O^4, which form bearings for the rollers *o*. A space is left between the lower edges of the sides O^2 and the tops of the beams O^3 for the escape of any earth that may fall from the mud-belt. The deflectors O^5, two in number—one for each side of the mud-trough—are arranged in the said space between O^2 and O^3 and are inclined upwardly, the lower edges resting on O^3 and the upper edges extending within the edges of O and close to its under side, as shown most clearly in Fig. 8. The deflectors turn the earth outward and prevent it dropping on the lower side of the belt and being carried forward. The mud-belt passes over a roller journaled at its ends in the elbow-brackets O^6, located near the rear end of the mud-trough, and having their horizontal branches pivoted to the beams O^3, and their vertical branches, which are slotted and formed on the arc of a circle, adjustably secured to the said beams O^3, so as to carry the said roller to and from the mud-trough to increase or diminish the tension on the mud-belt, as may be required.

The chute O is provided at its inner side with a clip, O^7, which braces the segment O^8, depending from the end of the mud-trough. The clip is adapted to be loosened and tightened and is adjustable on the segment O^8 to regulate the pitch of the chute and its position to deliver the earth in the ditch or to one side thereof.

The tile-chute comprises the ways P and P′, the guide-bars P^2, the shoe Q, and the bottom Q′. The ways P and P′ are pivotally connected at their upper ends with the truck-frame just in front of the rear axle and have their lower ends pivotally connected with the shoe Q. Thus the chute can adapt itself to any depth of ditch, and the shoe can accommodate itself to run flat on the bottom of the trench. The ways P and P′, which are timbers or bars, have rollers P^3 journaled between them to support the tiles and form the bottom of the chute. The guide-bars P^2 are supported on the upper ends of the brackets or clips *p*. The lower ends of these brackets are slotted and overlapped and adjustably secured together by the set-screw *p*′, which extends through the said slots therein. These brackets *p* are secured to the ways P and P′ by the set-screws p^2, which pass through slots p^3 therein. The tiles in their passage from the machine to the trench are guided by the bars P^2, which keep them in alignment. These bars P^2 are adjustable to and from each other to adapt them for receiving different-sized tiles. When adjusting the

bars P^2, it is necessary that the screws p' and p^2 be loosened. The set-screw p' fixes the position of the bars P^2 when adjusted, and the screws p^2 fix the position of the bars P^2 relative to the chute.

The shoe Q is a triangular piece and is adapted to travel on the bottom of the trench to smooth it and push away any loose dirt to the sides thereof, so that the tiles may be deposited on a perfectly-smooth bed. The bottom Q′ rests on the bottom of the trench and supports the tile until it is deposited in the trench, and it is provided with side guide-bars, P^4, corresponding with the guide-bars P^2, to prevent the lateral displacement of the tile, and which are adjustable to accommodate different sized tiles. This bottom Q′ is adapted to drag some distance in the rear of the machine and supports the tile until it is partly covered, thereby insuring the tiles being laid end to end in perfect alignment, which is of vital importance, as no projections are left at the joints to catch foreign matter, which too frequently is the source of drains becoming choked up.

The front portion of the excavator-chain travels in a vertical line, and the earth carried up by the excavator-blades is pushed laterally therefrom by the ejector R and falls onto a chute, R′, from which it is delivered to the carrier-apron O. The ejector, formed after the fashion of a wheel, is composed of a hub, radial arms or spokes R^2, and cross-heads R^3, which correspond in size to the size of the excavator-blades and have their lower edges conformed to the contour of the upper surface of the excavator-blades in side elevation, so as to remove all the earth from the said blades. The outer ends of the spokes are bifurcated or separated to form the two branches or arms r and r', which have the cross-heads R^3 fastened thereto. The outer edges of the branches or arms r are formed on an ogee curve, as shown most clearly in Fig. 4, to facilitate the disengagement of the cross-heads from the excavator-blades. The ejector is journaled in suitable bearings to one side of the excavator-chain, and the spokes are sufficiently long to extend across the excavator-blades to permit the cross-heads to travel from right to left across the said excavator-blades, and are in sufficient number so that one will engage with each blade of the excavator-chain. The ejector is rotated by having its spokes engaging with the excavator-blades, and the cross-head of the spoke in engagement with the excavator-blade is lifted up with the progressive movement of the excavator-chain, and is at the same time forced across the said excavator-blade, pushing the earth therefrom. This operation takes place when the spoke is traveling from a nearly vertical position to about a horizontal plane during a quarter of a revolution of the ejector. Now, when the spoke is traveling from the said horizontal position to a nearly vertical position diametrically opposite its first position, the cross-head is lifted and carried back over the excavator-blade to again take its turn and operate in the manner just described. The ogee-curved edge of the arm r, coming in contact with the nearer edge of the excavator-blade, rides smoothly over the same and prevents the lower edge of the cross-head from catching or hanging on the excavator-blade. The cross-heads incline outwardly from top to bottom relative to the spokes, and when coming in contact with the excavator-blade form an acute angle therewith, which is the position best adapted for effectively removing all the earth from the said excavator-blade in a satisfactory manner. The ejector is wholly automatic in its operation, engaging with the excavator-chain, performing its work, and disengaging itself after the fashion of the teeth of two meshing gear-wheels.

The grader, an angle-bar, S, (seen only in Fig. 2) is fastened to the excavator-frame so that its horizontal branch can be adjusted to any level by having its vertical branch passing through the sleeve S′, fastened to one of the vertical bars of the said excavator-carrier frame and held adjustably therein by the set-screw s, which passes through a side of the said sleeve S′. This angle-bar can be swung around to bring its horizontal branch at right angles to the line of draft of the machine, or to fold it close to the said excavator-carrying frame, which latter position it is shown as occupying in Fig. 2. In operation stakes (not shown) are set along the line of the proposed drain and provided with cross-pieces indicating the drain. When starting, the excavator-carrying frame is lowered the proper distance corresponding to the depth of the ditch, care being taken to allow for low lands, and the grader is adjusted to align with the cross-pieces on the said stakes.

As the machine advances and the grader rises or falls below the grade indicated by the stakes, the attendant operates lever L^5 to shift the clutch-sleeve k^2 and throw the feed-screws in gear to elevate or lower the excavator-carrying frame whichever may be desired to bring the grader to the grade, so that the ditch may be excavated to the required grade. The tile is placed by the attendant on the tile-chute and gravitates to the bottom of the ditch, being pushed off the bottom Q′ by the weight of the tile on the chute. The rollers P^3 diminish the friction, so that the tiles glide readily down the chute. The excavated earth is deposited on the carrier-apron o and conveyed by it to the rear of the machine, and may be deposited on the tile in the ditch or to one side of the ditch, as desired, by properly adjusting the chute O′.

The machine can be used for trenching only, in which event the tile-chute may be dispensed with, and the chute O′ will be adjusted to deliver the earth to one side of the trench.

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

1. In a ditching-machine, the combination of the truck-frame having front and rear supporting-wheels, the propelling mechanism and the engine at one end of the frame nearly above the axle of the supporting-wheels, the boiler and the water-tank at the other end of the frame, the boiler being in the rear of and the water-tank in the front of the axle of the supporting-wheels, and the elevator located wholly between the ends of the frame and held down to its work by the weight of the devices at each end of the frame, substantially as set forth.

2. In a ditching-machine, the combination of the truck-frame, the engine and propelling mechanism located at the front end of the frame, the boiler and water-tank at the rear end of the frame, the excavating devices between the two ends of the frame, and the mud-belt or carrier-apron, said mud-belt being located on one side of the frame and the water-tank on the opposite side to evenly distribute the weight over the truck-frame, substantially as described.

3. In a ditching machine, the combination of the shaft d^8, the engines applied to each end of the shaft d^8, the shaft d^2, having the sprocket-wheel d^5 on its outer end, the gearing d^6 d^7, connecting the shafts d^2 and d^8, the shaft o^3, extending from one side to the other side of the machine and having the sprocket-wheel o^4 on one end and the roller o' on the other end thereof, the sprocket-chain o^5, connecting the sprocket-wheels d^5 and o^4, and the mud-belt supported at one end on the roller o' and driven thereby, substantially as specified.

4. The combination, with the truck-frame, the uprights, and the excavator-carrying frame composed of an upper and lower rectangular frame united by vertical bars and a bracket depending from the lower frame, of three sprocket-wheels, two of the wheels being placed at about the same level, the one in advance of the other, the rear one being journaled in adjustable bearings, and the third wheel being journaled in the lower ends of the bracket, and the elevator-chain supported by and passing around the said sprocket-wheels, substantially as and for the purpose described.

5. The combination, with the vertically-adjustable excavator-carrying frame, the shaft H^5, having the sprocket-wheel H^4, and the shaft d^2, having the sprocket-wheel d^3, of the shaft I^4, having the sprocket-wheels I^2 and I^3, the rods i and i', and the sprocket-chains I and I', substantially as and for the purpose described.

6. In a ditching-machine, the combination, with a vertically-adjustable excavator and a power-driven shaft, of an equalizing-shaft placed intermediate of the power-shaft and the excavator, and gearing connecting the equalizing-shaft with the excavator and with the power-driven shaft, substantially as and for the purpose described.

7. The combination, in a ditching-machine, of the vertically-adjustable excavator having an extended shaft, H^3, and the sprocket-wheel H^4 thereon, the shaft d^2, having the sprocket-wheel d^3, the equalizing-shaft I^4, having two sprocket-wheels, the sprocket-chains I and I', and the two pairs of rods i and i', embracing the aforesaid wheels and having their adjacent ends united by the said equalizing-bar, which is journaled therein, and their outer ends journaled on the shafts H^3 and d^2, respectively, substantially as and for the purpose described.

8. The combination, with the excavator-carrying frame and the excavator-chain, of the sprocket-wheel for supporting said chain, consisting of a hub, radial spokes, and side rims, substantially as set forth.

9. The combination, with the excavator-chain, of a sprocket-wheel support consisting of a hub, radial spokes, and rims fastened to the sides of the spokes at a short distance from their outer ends, the outer edges of the rims being beveled to a chisel-edge, substantially as and for the purpose described.

10. The combination, with the truck-frame, the uprights, the excavator-carrying frame, the feed-screws connected to revolve together, the power-driven shaft K, the shaft M, geared at one end with a feed screw and having a gear-wheel, m', at the other end, the pair of idle-pinions k and k', mounted on shaft K and meshing with the gear-wheel m' on diametrically-opposite sides thereof, each pinion having a half-clutch, the double clutch k^2, mounted on shaft K and adapted to move thereon between the pinions k and k', and means for moving the said clutch k^2, substantially as and for the purpose described.

11. The combination of the uprights, the excavator-carrying frame, the feed-screws, the sprocket-wheels, the sprocket-chain, the power-shaft K, the pair of idle-pinions, gearing connecting the idle-pinions with one of the feed-screws, the clutch-sleeve, and hand-lever suitably connected with the clutch sleeve, as and for the purpose described.

12. The combination of the truck-frame, the uprights, the vertically-adjustable excavator-carrying frame, the feed-screws, the sprocket-wheels, the sprocket-chain, the shaft M, geared at one end with one of the feed-screws and having a gear-wheel, m', on its opposite end, the power-driven shaft K, the idle pair of pinions k, meshing with the gear-wheel m', the clutch-sleeve working between the pinions, the yoke, the hand-lever, and the intermediate devices connecting the hand-lever and yoke, as and for the purpose described.

13. The combination, with the excavator-carrying frame, the feed-screws geared to revolve together, the power-driven shaft K, the idle-pinions geared with one of the said feed-screws, and the clutch-sleeve, of the yoke L, the bar L', the rock-shaft L^4, the arm L^3, connecting one end of the rock-shaft with bar L', and the hand-lever L^5, fastened to the other

end of the rock-shaft and extending within convenient reach of the operator, substantially as and for the purpose described.

14. In a ditching-machine, the combination of the vertically-adjustable excavator-carrying frame, the feed-screws, the sprocket-wheels, the sprocket-chain, the cross bar j^3 and the rollers j^5, embracing the sprocket-chain and adjustable on the bar j^4, substantially as and for the purpose described.

15. In a ditching-machine, the combination, with the adjustable excavator carrying frame, the sleeve S′, and set-screw *s*, of the grader composed of a right-angled bar having its vertical branch inserted in said sleeve and adjustable vertically and horizontally therein, as and for the purpose described.

16. The combination, with the ditching machine, of the tile-chute composed of ways and adjustable side guide-bars, substantially as described, to accommodate different-sized tiles.

17. The combination, with the ditching-machine, of the tile-chute composed of ways and rollers journaled between the ways and forming a support for the tile, substantially as set forth.

18. The combination, with the ditching machine, of the tile-chute, the adjustable brackets *p*, and the guide-bars carried by the brackets, substantially as and for the purpose described.

19. The combination, with the ditching-machine, of the tile-chute, the brackets *p*, having their lower ends slotted, the set-screw p', and the guide-bars secured to the upper ends of the brackets, substantially as set forth.

20. The combination, with the ditching-machine, of the tile chute, the guide-bars, the adjustable brackets having slots p^3, and the set-screws p^2, for securing the brackets to the tile-chute in any relative position, substantially as and for the purpose described.

21. The combination, with the tile-chute, of the shoe located beneath and extending forward of the said tile-chute and pivotally connected therewith, substantially as and for the purpose described.

22. The combination, with the tile-chute and the shoe located beneath and extending forward of the said tile-chute, of the bottom Q′, connected with the said shoe and extending rearwardly therefrom, substantially as and for the purpose described.

23. The combination, with the tile-chute having side guide-bars, of the shoe pivotally connected with the tile-chute and extending forward thereof, the bottom Q′, and the horizontal guide-bars p^4, pivotally connected with the side guide-bars of the tile-chute and independent of the bottom Q′, and the shoe Q, substantially as and for the purpose specified.

24. The combination, with the tile-chute having side bars laterally adjustable, of the shoe and the bottom Q′, provided with side guide-bars adjustable laterally, substantially as and for the purpose specified.

25. The combination, in a ditching-machine, of the excavator and two clearers embracing the sides of the excavator and having sloping front and rear edges and curved outwardly like mold-boards of plows, and having beam-extensions which are connected with the axle of the machine, substantially as and for the purpose described.

26. The combination, with the excavator, of the shield N, substantially as and for the purpose described.

27. The combination, with the excavator, of the shield N, adapted to travel on the ground in advance of the excavator and provided with a curved nose, n^2, at its lower end, substantially as and for the purpose described.

28. In a ditching-machine, the combination, with the excavator, of the shield N, the brace-bar N′, having a positive connection with the shield and permitting it to rise and fall, and the bar N^2, substantially as described.

29. The combination, in a ditching-machine, of the shield having vertical grooves near each edge, the T-bar N′, having its ends fitting in the grooves, and the bars N^2, substantially as described.

30. In a ditching-machine, the combination, with the excavator-carrying frame, hereinbefore specified, and the bracket F^3, supporting the lower sprocket-wheel, of the housing G^4, closing in the lower portion of the bracket and forming a shield for the said sprocket-wheel, and the excavator-chain embracing the housing, substantially as set forth.

31. The combination, with the scantlings O^3, the sides O^2, supported at a distance above the scantlings, and the mud-belt supported between the sides, of the deflectors O^5, substantially as and for the purpose described.

32. The combination, with the sides and scantlings and the mud-belt, of the elbow-bracket O^6, pivoted at one end to the scantling and vertically adjustable at the other end, and the roller journaled between the brackets and adapted to bear on the mud-belt, substantially as and for the purpose described.

33. The combination, with the mud-trough and the chute O′, of the segment O^8 and the clamp O^7, for regulating the pitch of the chute and its direction of inclination, substantially as and for the purpose described.

34. A link for an excavator-chain, having a rib projecting laterally therefrom and an excavator-blade secured to said rib, substantially as and for the purpose described.

35. A link for an excavator-chain, having a rib projecting therefrom and the excavator-blade provided with a recess for receiving said rib and secured thereto, substantially as and for the purpose specified.

36. A link for an excavator-chain, having an excavator-blade projecting laterally therefrom, forming excavator-fingers at its forward edge, the extreme fingers of which are longer than the intermediate fingers and are sharpened to a knife-edge, substantially as and for the purpose set forth.

37. The combination, with the excavator,

the lifting side thereof moving in a straight line, of an ejector having a pivotal support and adapted to travel in a vertical plane and be projected across the path of the excavator-blades, substantially as set forth, for the purpose described.

38. The combination, with the excavator, of the ejector composed of radial arms or spokes, and blades set crosswise of the spokes and secured to their ends to form cross-heads, substantially as described.

39. The combination, with the excavator, of a spoke and the blades set at an incline to the spoke and secured to the end thereof to form a cross-head that is set obliquely or at an incline to the spoke, substantially as described, for the purpose specified.

40. The combination, with the excavator, of a spoke having the lower side of its outer end forming an ogee curve, substantially as and for the purpose described.

41. The combination, with the excavator, of a spoke having its outer end bifurcated to form two arms, the lower arm forming an ogee curve, and the cross-head secured to the arms, substantially as set forth.

42. The herein-described ejector, for the purpose described, composed of a hub, spokes having bifurcated ends, and the cross-heads set at an incline to radial lines, substantially as described, for the purpose specified.

In testimony whereof I affix my signature in presence of two witnesses.

HENRY G. LANE.

Witnesses:
ISAAC CAHILL,
A. WICKHAM.