(No Model.) 3 Sheets—Sheet 1.

# H. HENDERSON.

## DITCHING AND GRADING MACHINE.

No. 354,136. Patented Dec. 14, 1886.

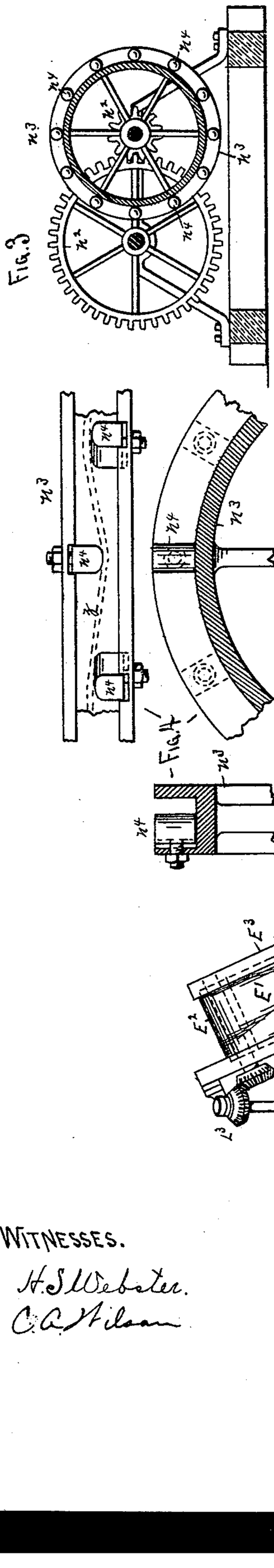

FIG. 3

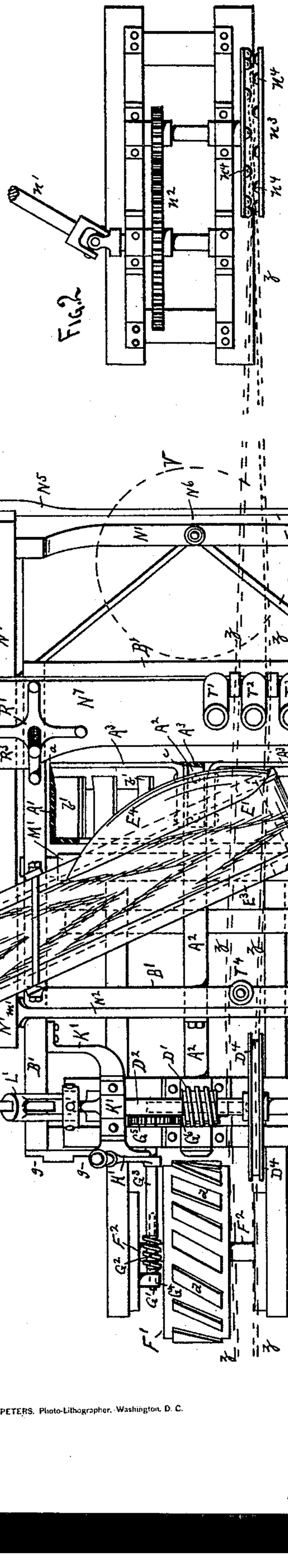

FIG. 2



FIG. 4



FIG. 1

WITNESSES.

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(No Model.) 3 Sheets—Sheet 2.

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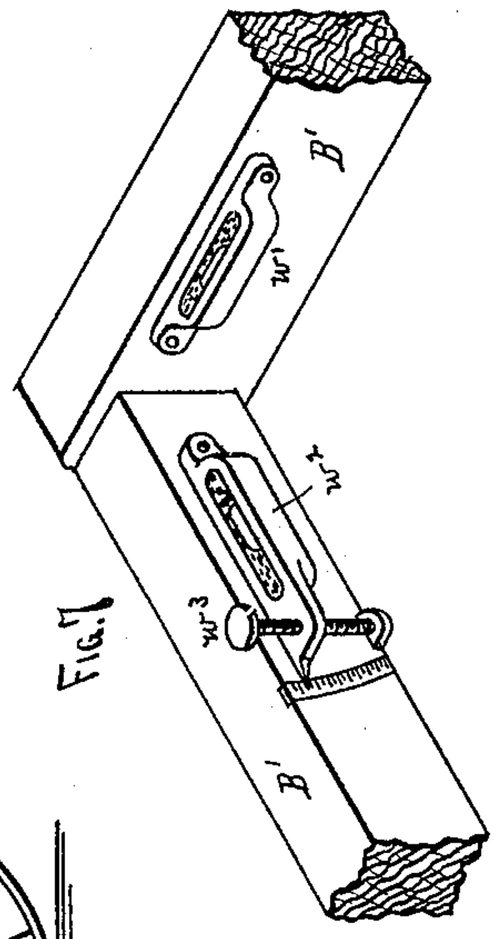

FIG. 7

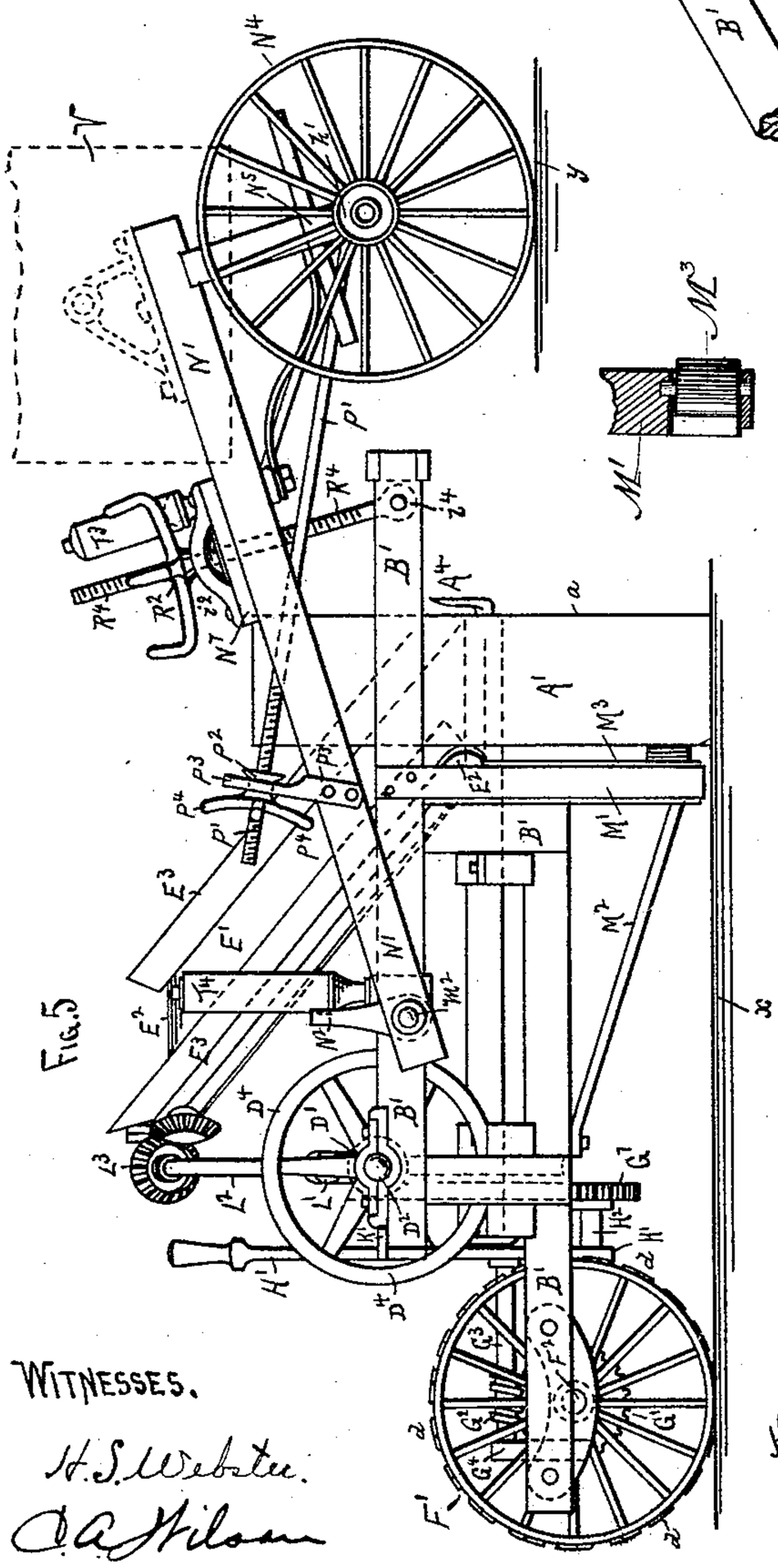

FIG. 5

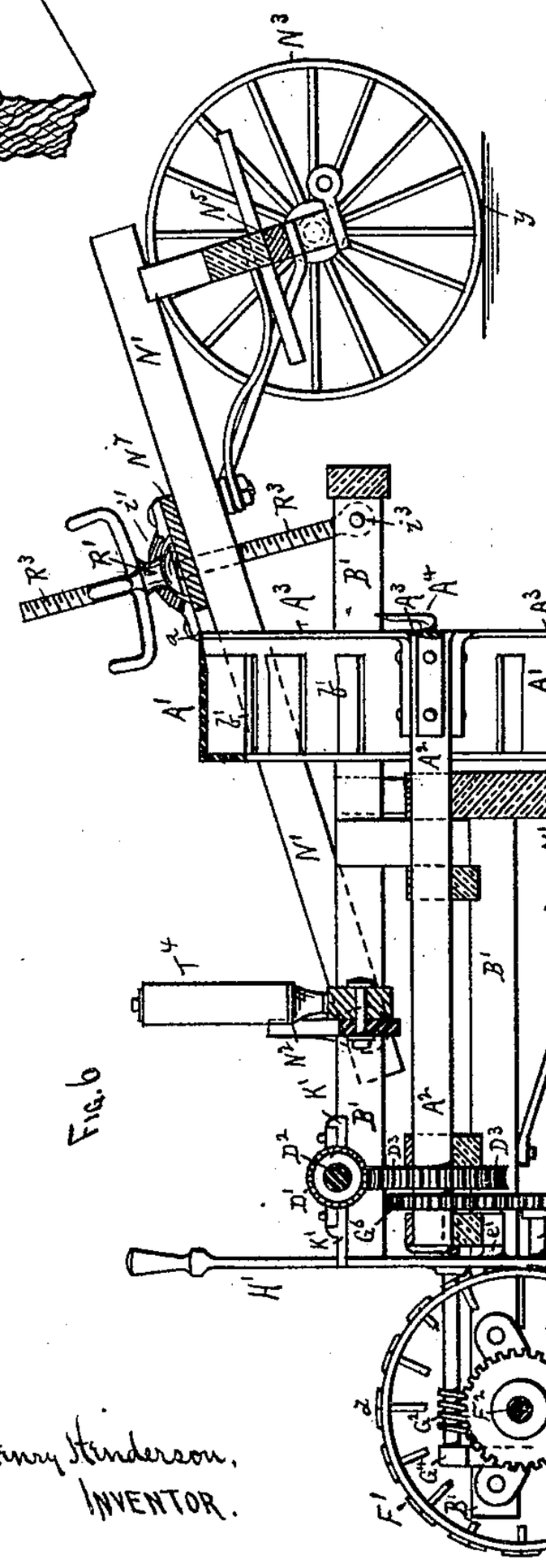

FIG. 6

WITNESSES.

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(No Model.) 3 Sheets—Sheet 3.

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## DITCHING AND GRADING MACHINE.

No. 354,136. Patented Dec. 14, 1886.

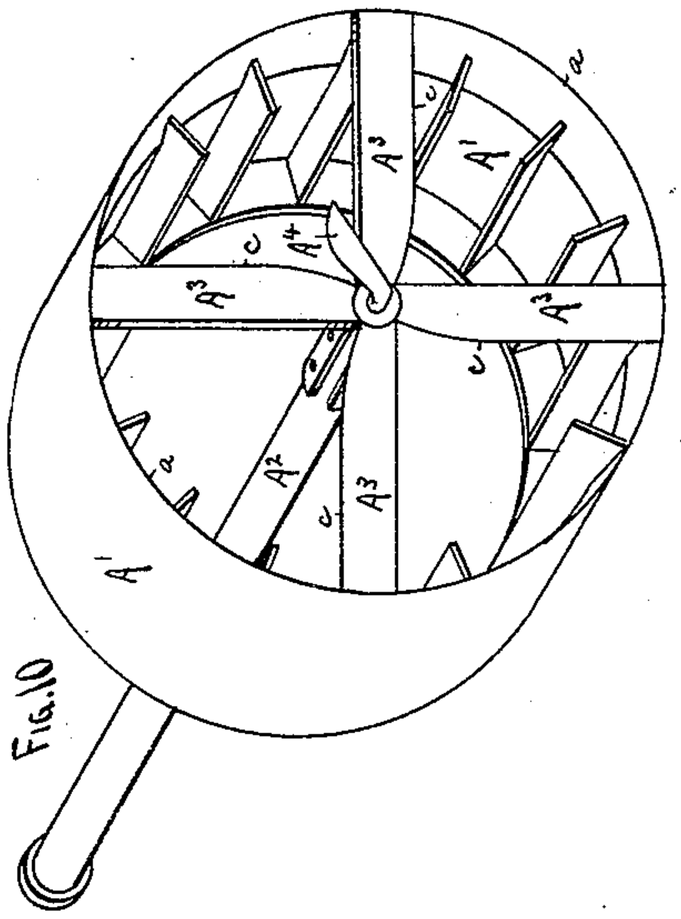


FIG. 10

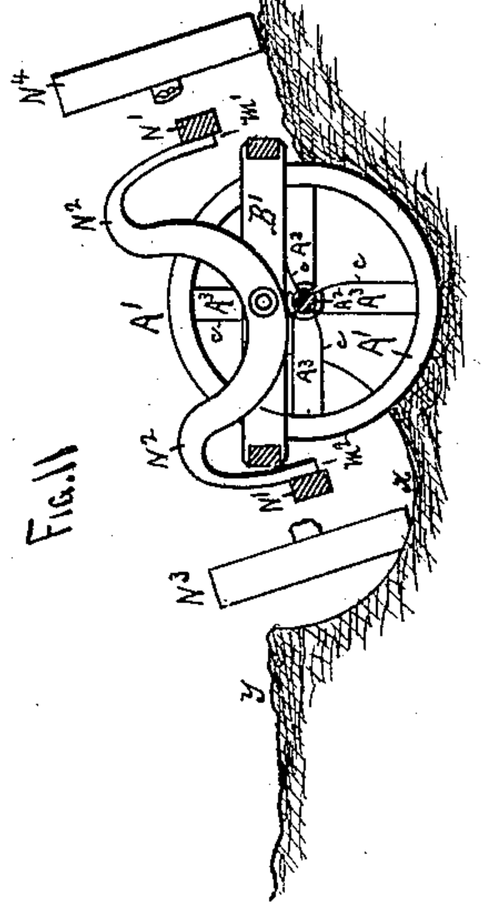


FIG. 11

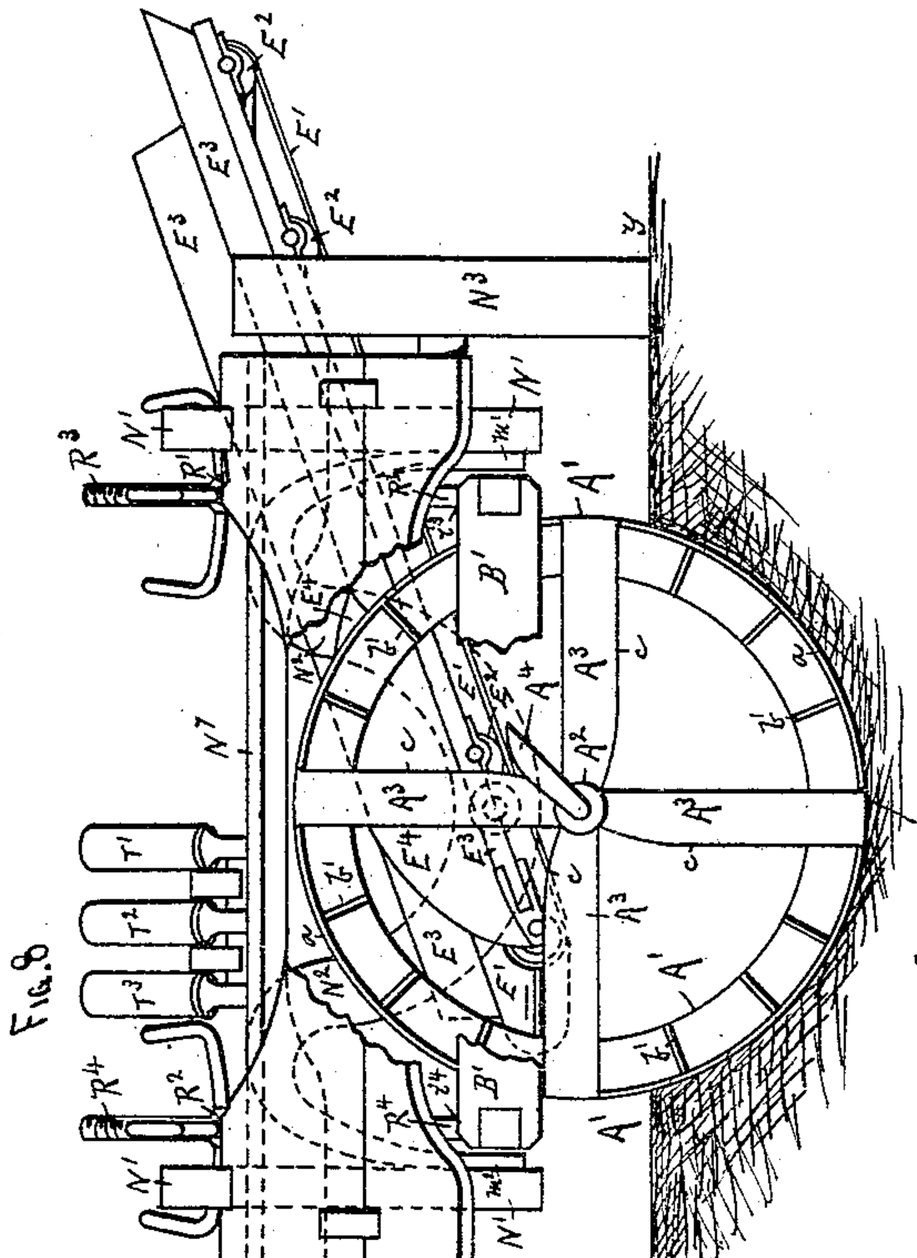


FIG. 8

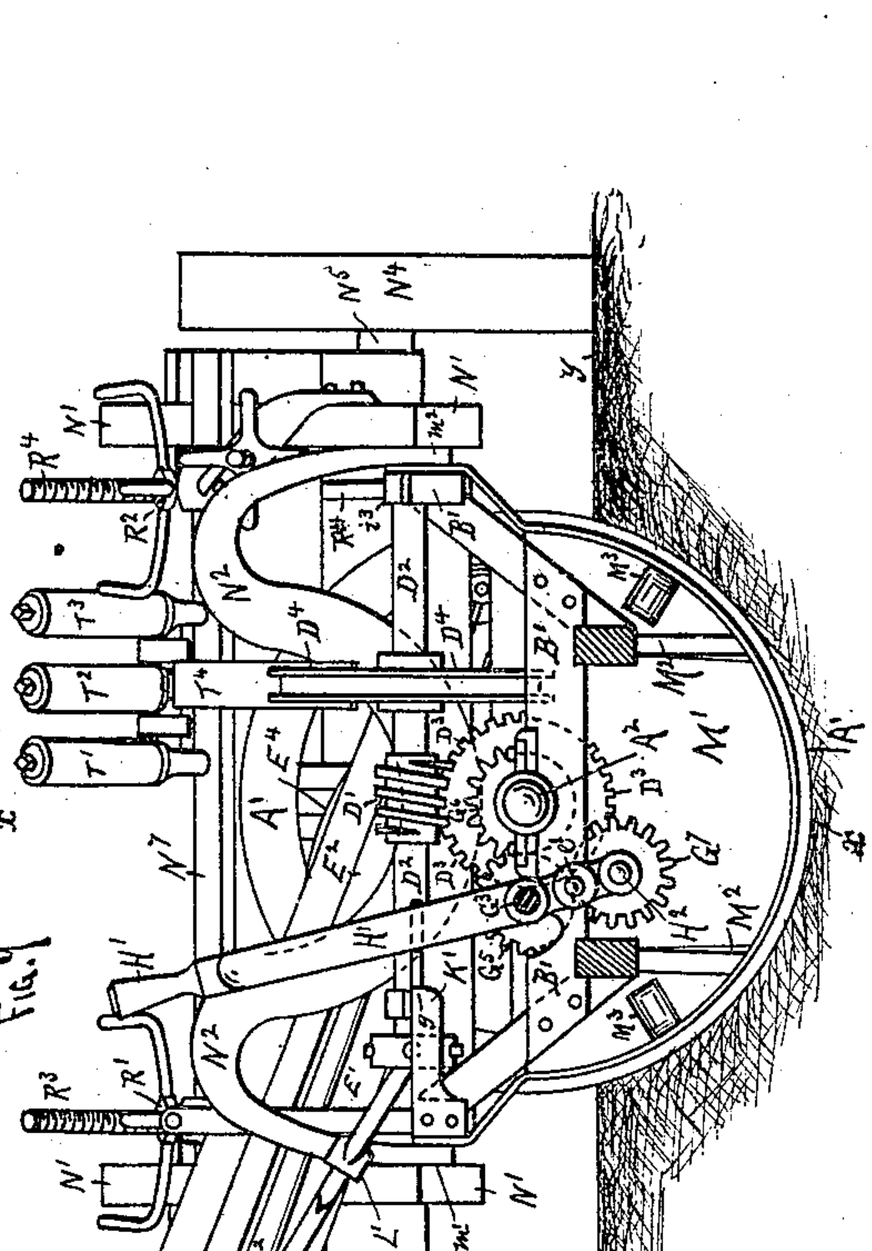


FIG. 9

WITNESSES.
H. S. Webster.
C. A. Wilson.

Henry Henderson.
INVENTOR.

# UNITED STATES PATENT OFFICE.

HENRY HENDERSON, OF HALSTAD, MINNESOTA.

## DITCHING AND GRADING MACHINE.

SPECIFICATION forming part of Letters Patent No. 354,136, dated December 14, 1886.

Application filed April 22, 1886. Serial No. 199,731. (No model.)

*To all whom it may concern:*

Be it known that I, HENRY HENDERSON, a citizen of the United States, residing at Halstad, in the county of Norman and State of Minnesota, have invented certain new and useful Improvements in Ditching and Grading Machines, of which the following is a specification.

In the drawings, Figure 1 is a plan view of the machine complete. Fig. 2 is a plan view, and Fig. 3 is a sectional side elevation, of the mechanism for operating the endless cable whereby the machine is drawn through or over the ground. Fig. 4 shows enlarged details of a portion of the rim of the main driving-wheel in the cable-operating mechanism shown in Figs. 2 and 3, illustrating the manner of constructing the "tension." Fig. 5 is a side elevation of the machine complete. Fig. 6 is a sectional side elevation. Fig. 7 is an enlarged perspective view of a portion of the frame-work, illustrating the manner of arranging the leveling and grade-indicating apparatus. Fig. 8 is a front elevation, and Fig. 9 is a rear elevation, of the machine, the latter view being partially in section. Fig. 10 is a perspective view of the main excavating drum detached. Fig. 11 is an outline view, reduced, of the main parts of the machine, illustrating the manner in which the machine is used in "grading" or forming enlarged ditches.

A′ is a circular drum or wheel of steel, having a cutting-edge, *a*, and provided on its interior with a series of carriers, *b*′, converging toward the center. The rim of the drum is connected at its edge *a* to a shaft, $A^2$, by blades $A^3$, as shown, one edge, *c*, of each blade being sharp and curved slightly. Projecting from the end of this central shaft, $A^2$, is a small knife, $A^4$, which is turned off at right angles to the shaft, as shown.

The shaft $A^2$ projects backward through the drum A′, and is suitably mounted in an oblong frame, B′, and adapted to be revolved by a worm, D′, on a cross-shaft, $D^2$, engaging with a worm-wheel, $D^3$, on the shaft $A^2$. The shaft $D^2$ is adapted to be revolved by an endless cable leading from the mechanism shown in Figs. 2 and 3 around a cable-pulley, $D^4$, on the shaft $D^2$, as hereinafter described, the whole causing the drum A′ to be revolved as it is drawn through the ground, so that its blades $A^3$ will cut the soil off from in front of the drum, and which then falls from the carriers *b*′, by which it is delivered upon an endless apron or belt, E′, and conveyed off to one side and delivered upon one bank of the ditch.

Near the center of the drum A′ the motion of the knives $A^3$ is very slow, and they do not cut as rapidly as they do near the rim, and to overcome this objection the small knife $A^4$ is arranged to cut the soil at the center and in advance of the knives $A^3$, to counteract the slow action of the main knives near the center.

F′ is a trailing wheel fast to an axle or shaft, $F^2$, journaled across the rear of the frame B′, and provided on its rim with spurs *d*, to prevent its slipping. This wheel F′ is intended to travel in the bottom of the ditch in the rear of the cutting-drum, and is adapted to be revolved positively to force the machine through the soil.

On the axle $F^2$ of the wheel F′ is a worm-wheel, G′, adapted to be engaged by a worm-wheel, $G^2$, on a small horizontal shaft, $G^3$, the latter secured at one end in a suitable bearing, $G^4$, and provided on the other end with a pinion, $G^5$, adapted to engage with a gear, $G^6$, on the shaft $A^2$, alongside the worm-gear $D^3$. By this means the revolving motion of the shaft $A^2$ is communicated to wheel F′ to cause it to force the machine through the ground. The shaft $G^3$ is journaled near the pinion $G^5$ through a lever, H′, the latter pivoted near its lower end at *e*′ to the frame B′, as shown in Fig. 9.

In the extreme lower end of the lever H′ is a stud, $H^2$, on which an idler-pinion, $G^7$, is journaled, this pinion engaging with the pinion $G^5$ on the shaft $G^3$.

The position of the pivot *e*′ is such that when the lever H′ is thrown over toward the center of the machine the pinion $G^5$ will engage with the gear $G^6$, and then when the lever is moved outward away from the center the gear $G^5$ will be disconnected from the gear $G^6$, and then when the lever H′ is thrown outward still farther the gear $G^7$ will engage with the gear $G^6$ and reverse the motion. Thus by throwing the lever H′ over to its extreme position to the right, as in Fig. 9, the gear $G^6$ will connect the wheel F′ with the running-

gear, and cause the wheel F′ to be revolved forward to force the machine forward. Then if the lever H′ be moved over to the left one-half its stroke both of the gears $G^5$ $G^7$ will be disconnected from the gear $G^6$ and the wheel F′ rendered inoperative, and then when the lever H′ is thrown over to the extreme left the gear $G^7$ will be connected to the gears $G^6$ and the motion of the wheel F′ reversed to run the machine backward. Thus by the use of one lever, H′, the mechanism may be set in operation to move the machine forward or backward, or thrown out of gear, so that it will remain stationary.

The shaft $D^2$ is journaled at one end in a frame or hanger, K′, one side of this hanger also being provided with notches *g*, into which a rib on the lever H′ fits to support the latter in any one of its three positions.

The shaft $D^2$ is connected, through a universal coupling, L′, shaft $L^2$, and gears $L^3$, with the apron-belt E′ of the elevator, which conveys away the earth cut loose by the drum A′, by which means the apron-belt is operated. This apron-belt is suitably mounted on rollers $E^2$ in a frame, $E^3$, and supported in any suitable manner upon the frame B′. The lower end of the frame $E^3$ is supported inside the drum A′, close to the rear sides of the cutters $A^3$, and is provided with a curved gathering blade or shield, $E^4$, on which the earth is thrown by the carriers *b*′, and from which it runs upon the upwardly and outwardly running apron E′. By this means all the earth that is cut loose by the knives $A^3$ is thrown upon the apron E′ and carried away.

In the rear of the lower part of the drum A′ a semicircular plate, M′, is suspended beneath the frame B′, and supported by braces $M^2$, to form a stop to prevent the earth being thrown out through the rear of the drum. This stop-plate is provided with a series of rollers, $M^3$, to support the drum A′ in event of any extra pressure being brought to bear against it.

N′ is a frame embracing the frame B′, and connected to it at the rear by a pivoted cross-beam, $N^2$, and carrying on its forward end the usual bearing-wheels, $N^3$ $N^4$, the latter being journaled on an axle, $N^5$, which is pivoted centrally at $N^6$ to the forward cross end of the frame N′, as shown.

P′ is a rod, pivoted by one end at *h*′ to the axle $N^5$, near the wheel $N^4$, and running backward and upward and provided with a screw-thread, and fitting through a nut, $P^2$, in a yoke, $P^3$, attached to the frame N′, as shown.

The nut $P^2$ is provided with arms $P^4$ for turning it, and is formed convex, so that it will "roll" between the sides of the yoke $P^3$ when the position of the axle is changed to prevent cramping. By this simple device it will be readily seen the axle $N^5$ may be turned upon its pivot $N^6$ to cause the wheels $N^3$ $N^4$ to be "cramped," and thus change the course of machine in forming curves in the ditches, and also when transporting the machine from place to place.

Secured across the top of the frame N′ is a plank, $N^7$, on top of which are two small metal holders, *i*′ $i^2$, adapted to each support a nut, R′ $R^2$, through which screws $R^3$ $R^4$ pass, the lower ends of these screws being pivoted at $i^3$ $i^4$ in the side of the frame B′. By revolving the nuts R′ $R^2$ the relative distance between the frame B′ and N′ may be changed to regulate the depth of the cut of the ditch. The distance between the wheels $N^3$ $N^4$ is considerably greater than the width of the drum A′, or the ditch which it will form, the wheels $N^3$ $N^4$ being intended to run upon the ground upon each side of and ahead of the ditch.

In Figs. 5 and 6 the lower lines of the wheels $N^3$ $N^4$ are shown somewhat higher than the drum A′ and wheel F, the line *x* representing the bottom of the ditch, and the line *y* representing the level of the surrounding soil.

The frame N′, as before stated, is pivotally connected to the frame B′ by the cross beam $N^2$, the ends of the latter being also pivoted, as shown at *m*′ $m^2$, to the rear ends of the sides of the frame N′. By this means the frame N′ is adjustable by the screws $R^4$ $R^3$, to enable the frame N′ to be set at an angle to the frame B′ and its attachments, so that no matter how uneven the ground may be the frame B′ and the ditch-forming mechanism can be kept in a level position.

A spirit-level bulb, *w*′, is attached to one of the cross-bars of the frame B′, as shown in Figs. 1 and 7, so that the frame B′ and its attachments may be kept in a level position crosswise, and a similar spirit-bulb, $w^2$, is shown adjustably attached to one of the horizontal sides of the frame B′, so that the frame may be kept in a level position, or any required inclination given to it in forming ditches with grades.

If the ditch is to be formed level, then the bulbs $w^2$ will be set parallel with the horizontal center line of the frame B′; but if the ditch is to be formed with a grade, then the bulb $w^2$ will be adjusted by the set-screw $w^3$ until it is at an angle to the frame B′ and corresponding to the grade to be formed. Then if the frame B′ be adjusted by the screws $R^3$ $R^4$ until the spirit-bubble in the bulb $w^2$ indicates a level position of the bulb the bottom line of the ditch will of course be cut at the grade to which the "level" is set.

This machine will also be found very useful in grading roads, and also in railroad work.

A ditch greater in diameter than the drum A′ can readily be formed by first cutting a ditch, as before described, and then adjusting the frame N′ to an angle to the frame B′, and allowing one of the wheels $N^3$ or $N^4$ to travel in the ditch thus formed, while the other wheel $N^3$ or $N^4$ travels upon the top of the soil, as indicated in Fig. 11, the drum A′ then being in a position to cut another ditch alongside the first one, and so on to any required extent. This illustrates one of the important advantages of the adjustable connection between the frame B′ and N′.

T' T² T³ T⁴ represent guide-rollers, between which the endless cable runs from the wheel $n^3$ to the pulley D⁴, to prevent it from swaying sidewise, or from being affected by changes in position of the machine.

The cable-operating mechanism illustrated in Figs. 2, 3, and 4 is shown adapted to be run by either steam or horse power applied to a tumbling-rod, $n'$, which, through a train of gears, $n^2$, communicates motion to a main driving-wheel, $n^3$, over which the cable (shown only by dotted lines $z$ in Figs. 1, 2, and 4) is placed. The rim of this wheel $n^3$ is hollow, and is provided at intervals with wooden blocks $n^4$, which project inward toward the center of the rim, and between which blocks the cable runs in a zigzag course, thus greatly increasing the friction and preventing the cable from slipping, while at the same time not increasing the strain or wear on the cable. The blocks $n^4$ will be adjustable, as shown in Fig. 4, so that the tension can be increased or decreased, as required. If the blocks $n^4$ be adjusted farther inward toward the opposite rim, the angles of the zigzag course of the cable around the wheel will be increased, and thus increase the friction, and if the blocks be set farther outward, then the friction will be decreased, as circumstances may require.

The cable-operating mechanism shown in Figs. 2 and 3 is set and secured by suitable anchors, about three hundred feet. (more or less, as the case may be,) ahead of the machine on the line of the ditch to be formed. The cable $z$ is then run from the wheel $n^3$ to and once around the wheel D⁴, and thence passed around or through a snatch-block or pulley in the rear of the machine, and thence back to the wheel $n^3$. (The snatch-block is not shown in the drawings, as its use is so common and well known.)

The cable $z$, in its passage from the wheel $n^3$ to the wheel D⁴, passes between the rollers T³ T² and on one side of the roller T⁴, and in its passage from the snatch-block to the wheel $n^3$ it passes between the rollers T' T², and the rollers thus serve to guide the cable and keep it in its proper position. When the wheel $n^3$ is rapidly revolved, it will cause the cable to revolve the wheel D⁴, and thus communicate motion to the shaft A² and wheel F', and cause the machine to be moved slowly forward at the same time that the cutting-drum A' forms the ditch through the soil. The cable $z$ being wound entirely around the wheel D⁴ causes the latter to move along in the "bight" of the cable without shortening or lengthening it. Generally, when steam is used to operate the drive-wheel $n^3$, the latter will be placed directly upon the main shaft of the engine, the intervening gears $n^2$ dispensed with.

If preferred, a boiler and engine may be set upon the frame N' and the wheel D⁴ driven by a chain or cable directly therefrom, the position of the boiler and engine being indicated by dotted lines $v$ in Figs. 1 and 5.

I do not wish to be limited to any particular power or means for operating the machine, as I am aware that many different devices may be employed.

This machine will be found very useful in all kinds of grading and excavating. The elevated end of the belt E' may be arranged high enough so that it will deliver the earth excavated by the drum A' into wagons or upon cars.

Having thus described my invention, what I claim as new is—

1. In a ditching-machine, a revolving cutting-drum formed of a rim having a cutting forward edge and provided with radiating blades and internal carriers, substantially as and for the purpose set forth.

2. A frame, B', supporting a revolving cutting-drum, A', endless conveyer-belt E', and means, substantially as described, for moving said frame and cutting-drum forward or backward by the same mechanism that revolves said cutting-drum.

3. In a ditching or excavating machine, a cutting-drum, A', mounted on a frame, B', and adapted to be revolved, frame N', adjustably connected to frame B' by swivel-bar N², and having axle N⁵ and bearing-wheels N³ N⁴, adjusting-screws R³ R⁴, whereby the relative positions of the frames N' and B' may be changed, and spirit leveling-bulbs, substantially as and for the purpose described.

4. In a ditching or excavating machine, the cutting-wheel consisting of the drum A', having carriers $b'$, and connected to central shaft, A², by radiating cutting-blades A³, and having central forwardly-projecting knife, A⁴, frame B', supporting said shaft and drum, and means for revolving said shaft and drum and forcing said frame forward at the same time, substantially as set forth.

5. In a ditching or excavating machine, the combination of a cutting-wheel consisting of drum A', having carriers $b'$, and connected to central shaft, A², by radiating cutters A³, frame B', carrying said shaft and drum and provided with shield E⁴, elevator E', constantly revolving shaft D² upon said frame, and connected to and adapted to operate said elevator E' and shaft A², wheel F' on shaft F², supporting the rear of said frame B', gears G' G² G⁶ G⁷ G⁵, and shaft G³, connecting said shafts F² and G³, and lever H', whereby the motion of said wheel F' may be reversed, substantially as and for the purpose set forth.

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

HENRY HENDERSON.

Witnesses:
C. N. WOODWARD,
JOHN B. SANBORN.