No. 796,257. PATENTED AUG. 1, 1905.

H. W. SARGENT.

DITCHING MACHINE.

APPLICATION FILED JULY 16, 1904.

5 SHEETS—SHEET 1.

FIG. 1

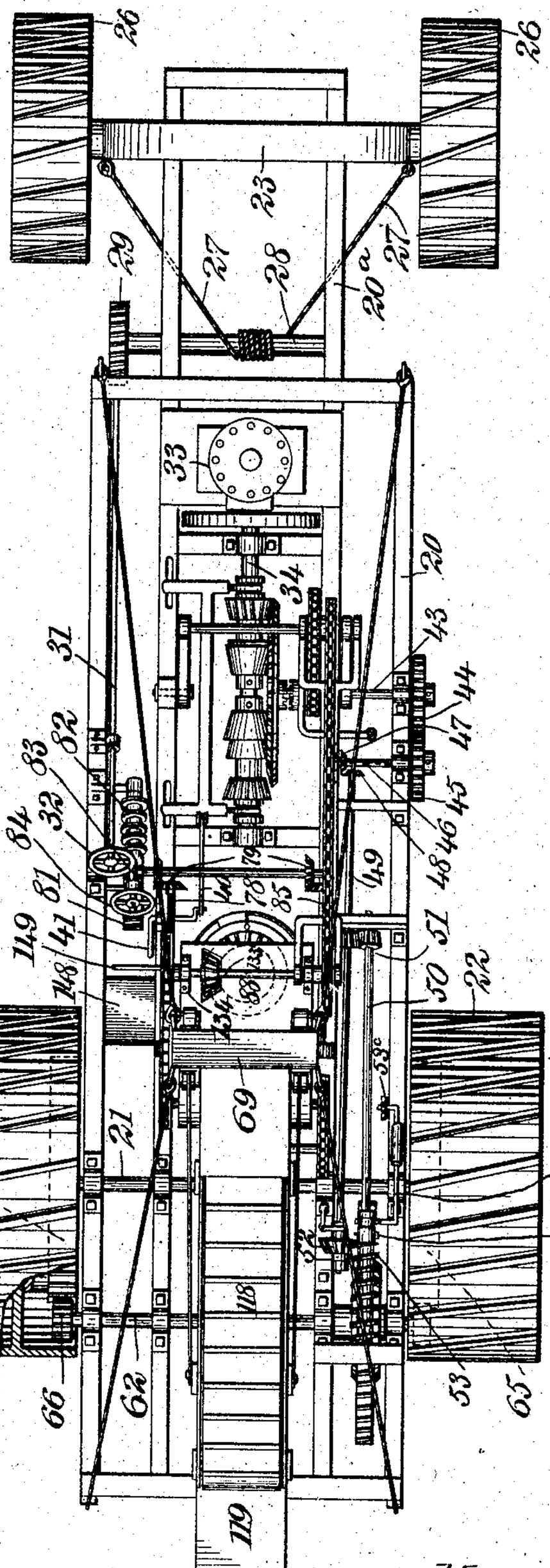


FIG. 16

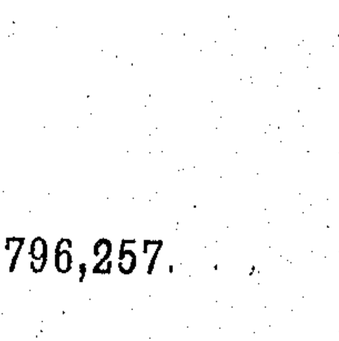


FIG. 14

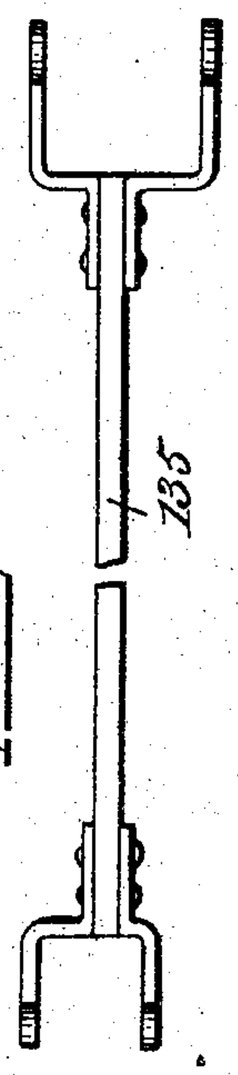


FIG. 13

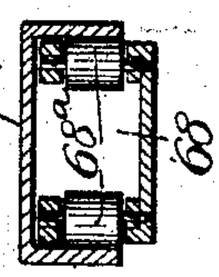
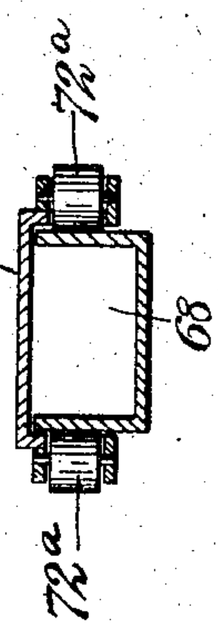


FIG. 12



WITNESSES:

J. A. Brophy

Isaac B. Owens.

INVENTOR

Herbert W. Sargent

BY Munn & Co.

ATTORNEYS

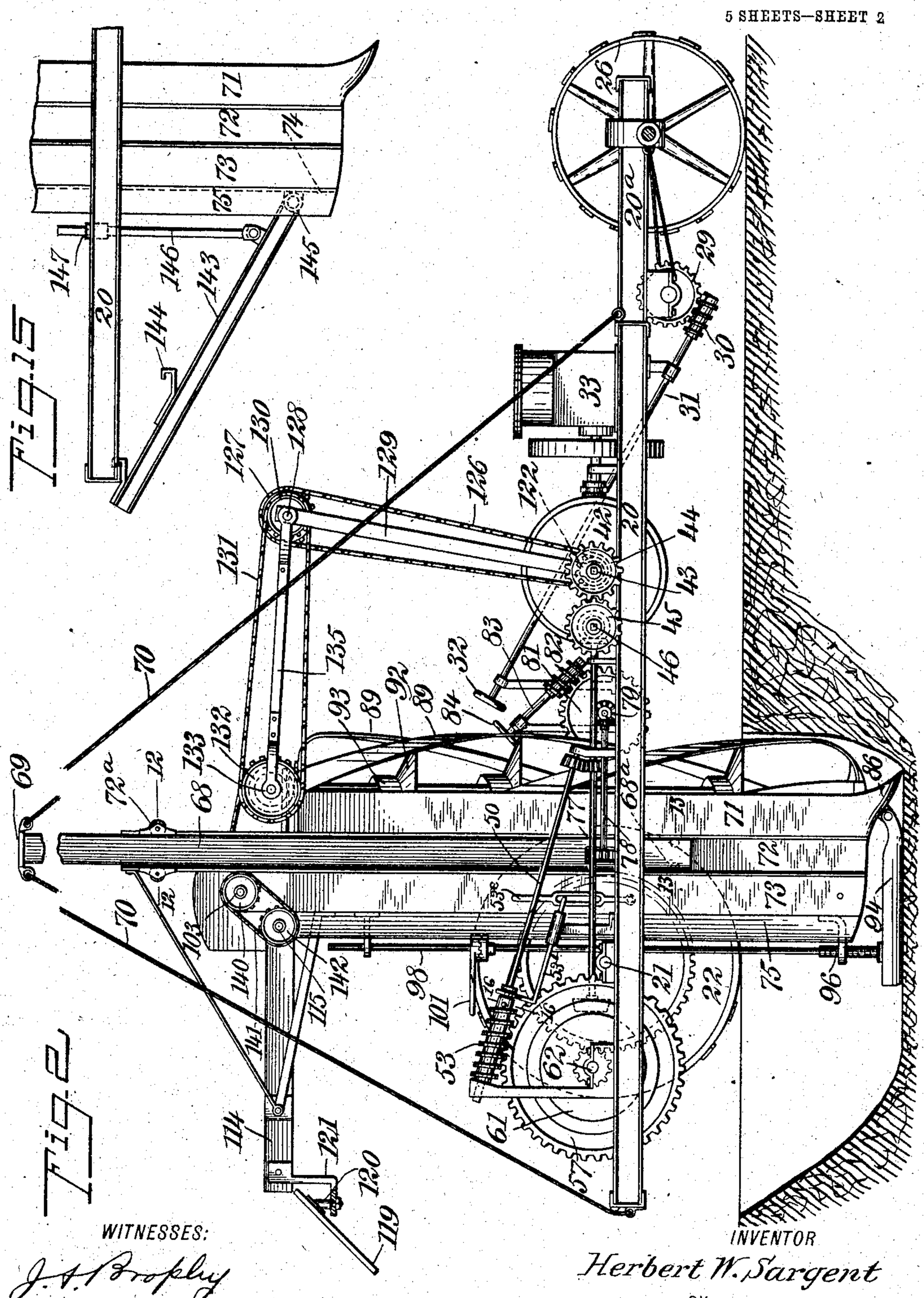
No. 796,257. PATENTED AUG. 1, 1905.

H. W. SARGENT.

DITCHING MACHINE.

APPLICATION FILED JULY 16, 1904.

5 SHEETS—SHEET 2



No. 796,257. PATENTED AUG. 1, 1905.

H. W. SARGENT.

DITCHING MACHINE.

APPLICATION FILED JULY 16, 1904.

5 SHEETS—SHEET 3.

Fig. 3

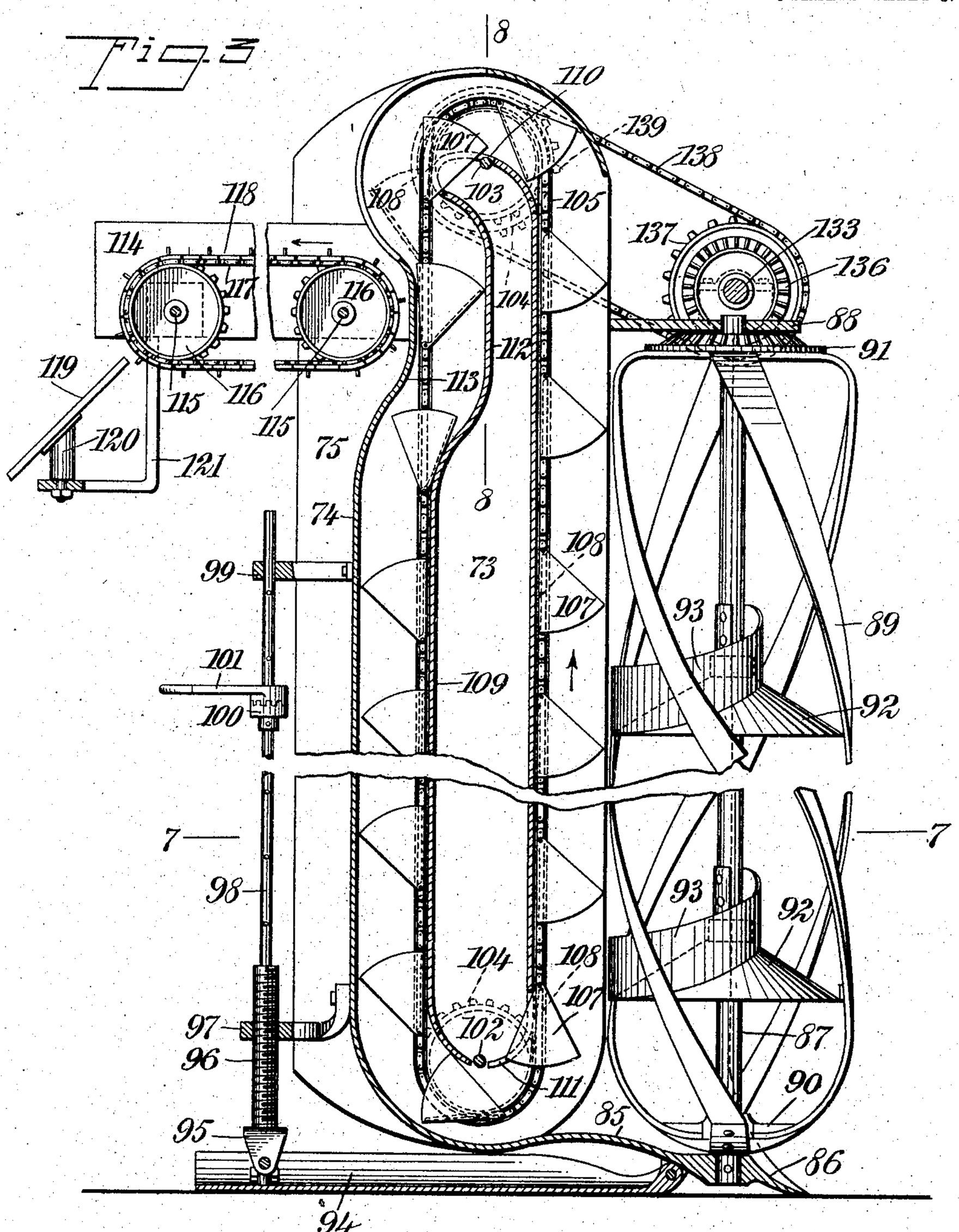
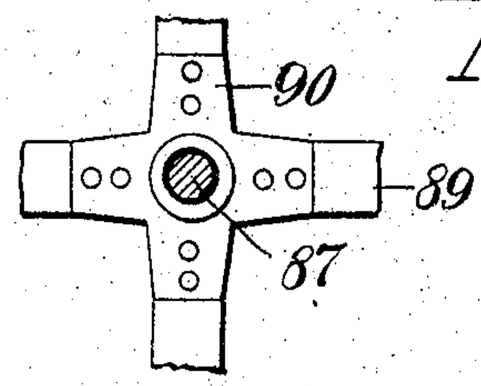


Fig. 11



WITNESSES:

J. A. Brophy

Isaac B. Owens.

INVENTOR

Herbert W. Sargent

BY Munn & Co

ATTORNEYS

No. 796,257. PATENTED AUG. 1, 1905.

H. W. SARGENT.

DITCHING MACHINE.

APPLICATION FILED JULY 16, 1904.

5 SHEETS—SHEET 4.

Fig. 4

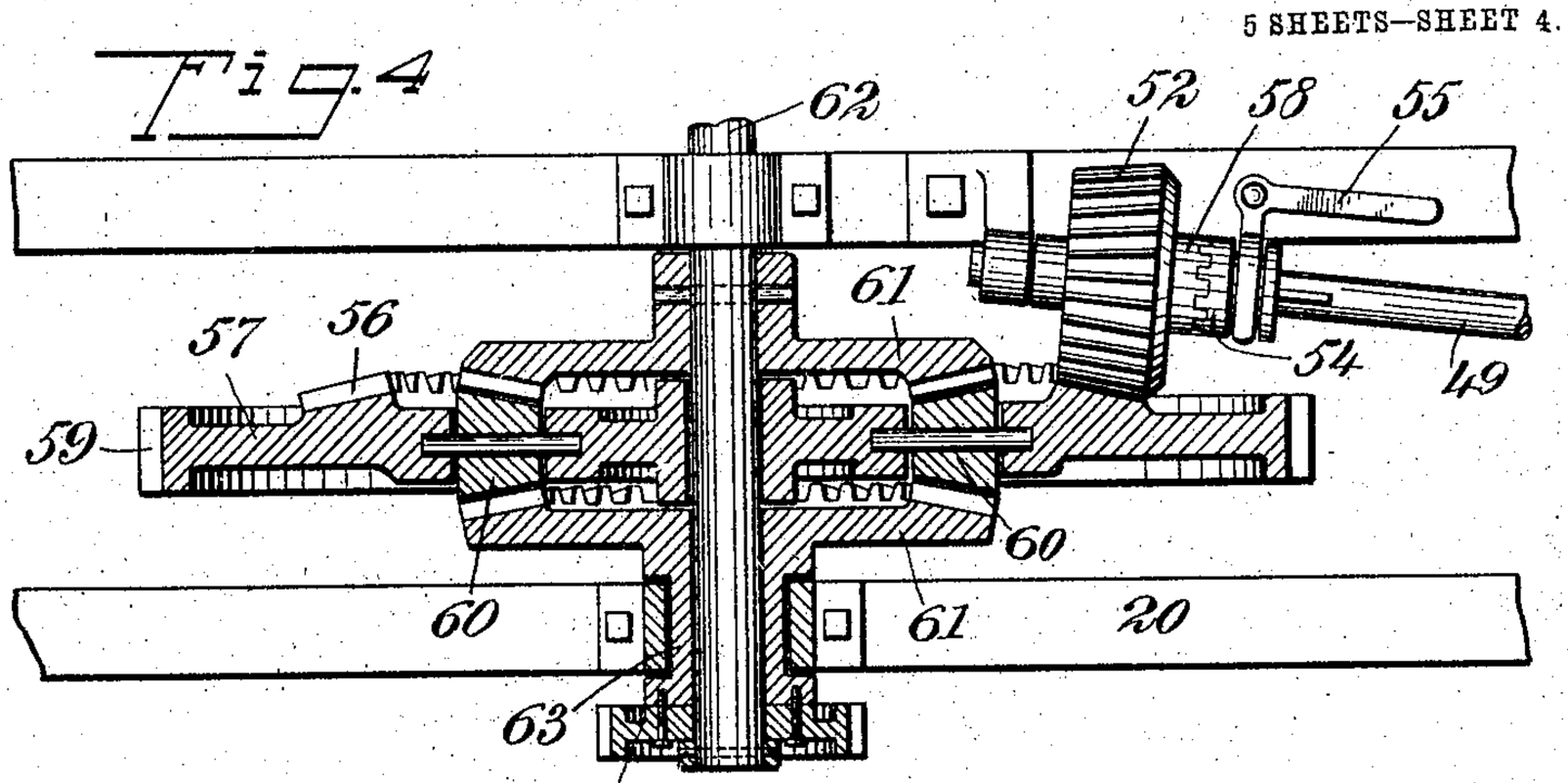


Fig. 5

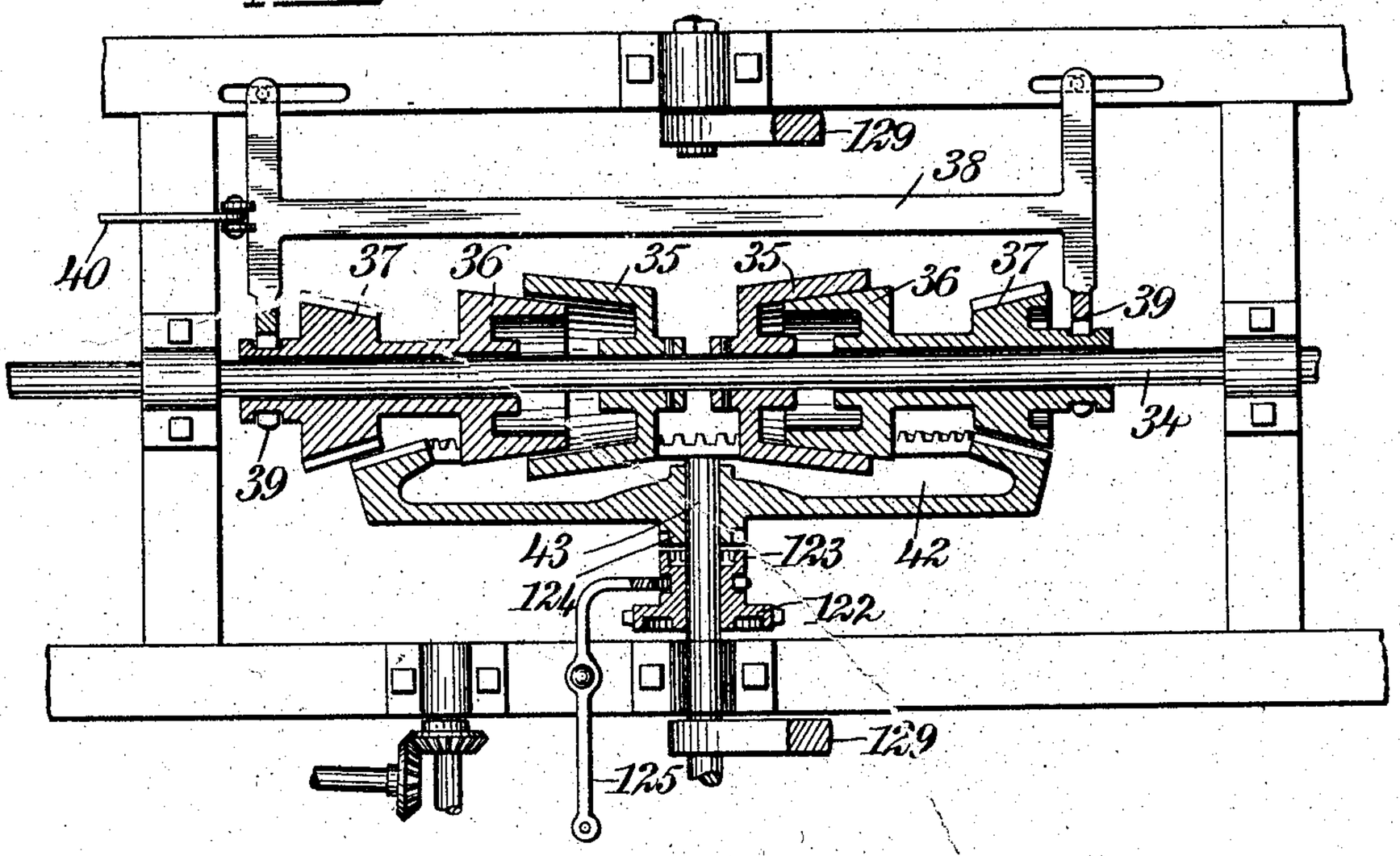
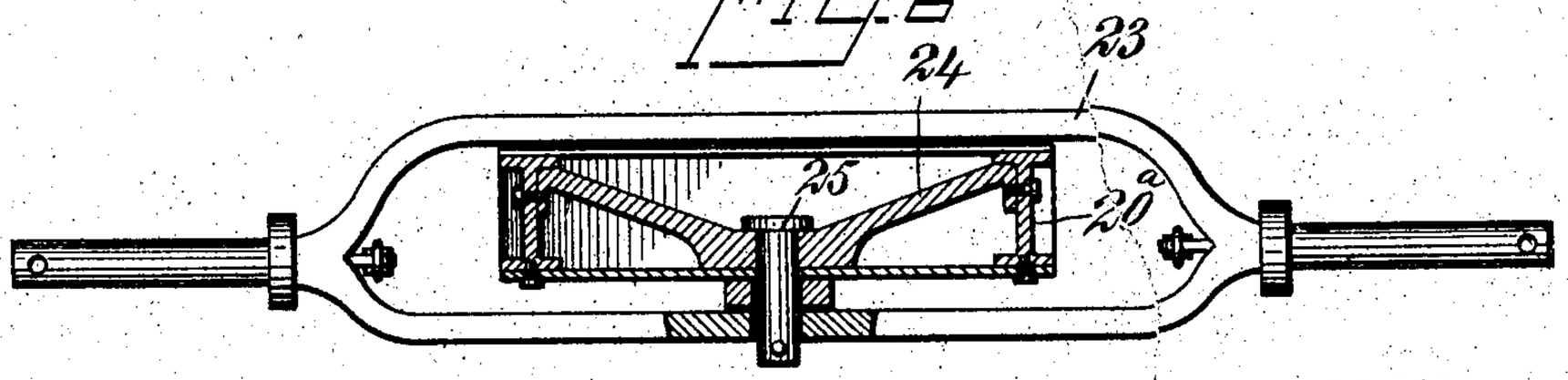


Fig. 6



WITNESSES:

J. A. Brophy

Isaac B. Owens.

INVENTOR

Herbert W. Sargent

BY Munn & Co

ATTORNEYS

ANDREW. B. GRAHAM CO., PHOTO-LITHOGRAPHERS, WASHINGTON, D. C.

No. 796,257. PATENTED AUG. 1, 1905.

H. W. SARGENT.

DITCHING MACHINE.

APPLICATION FILED JULY 16, 1904.

5 SHEETS—SHEET 5.

Fig. 7

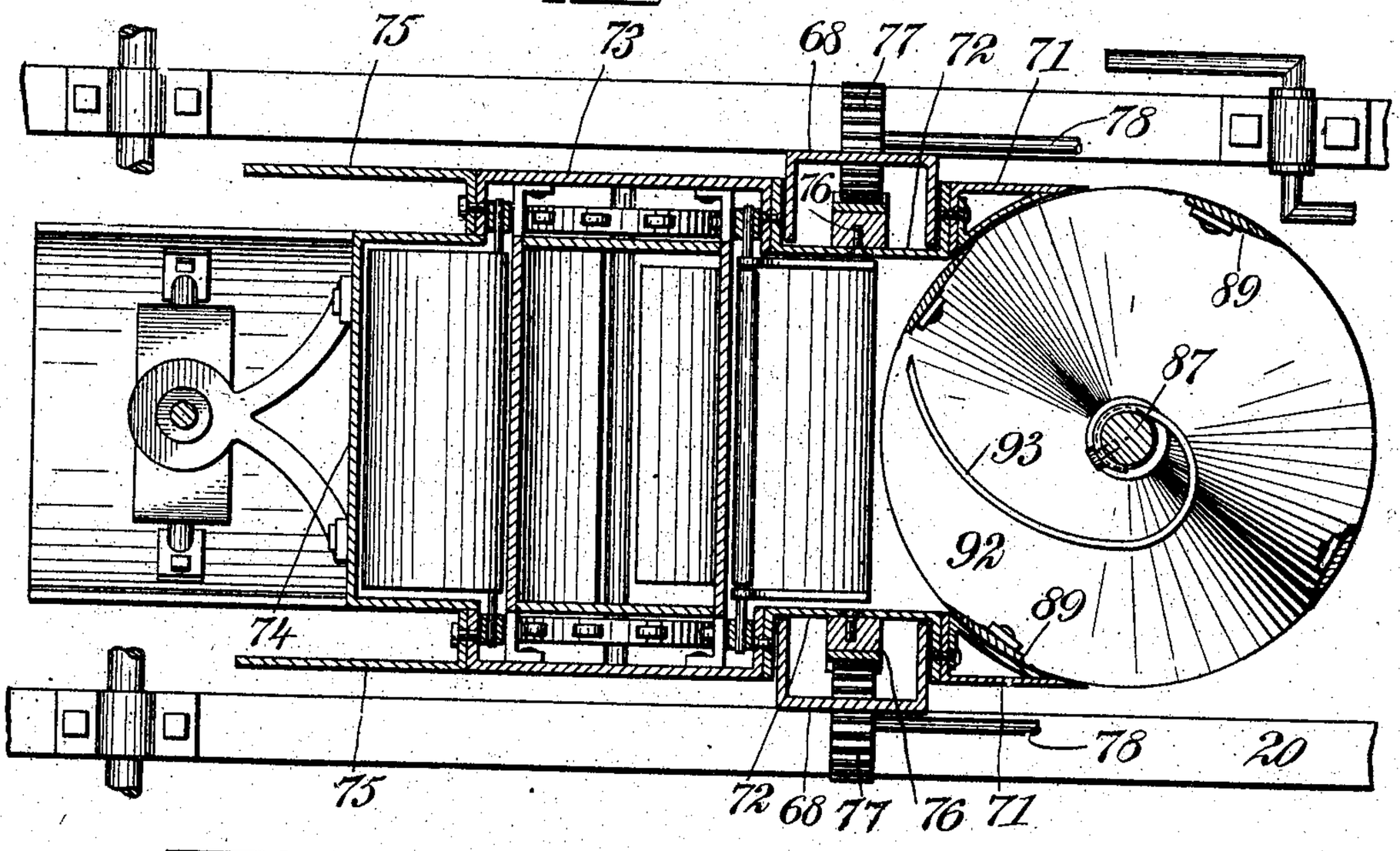


Fig. 8

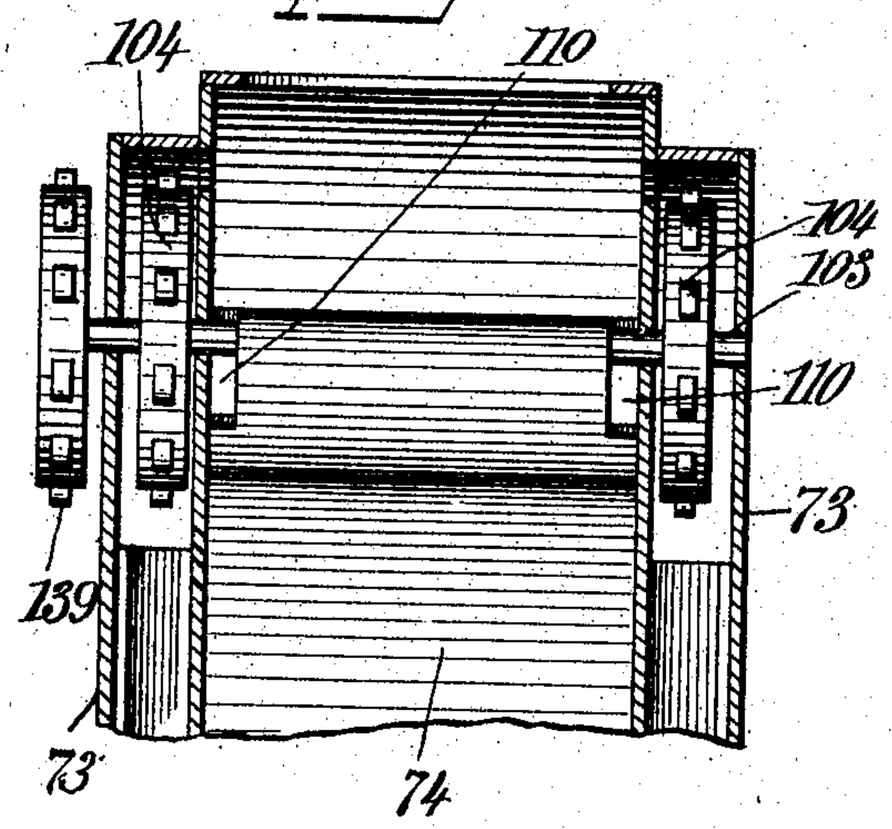


Fig. 9

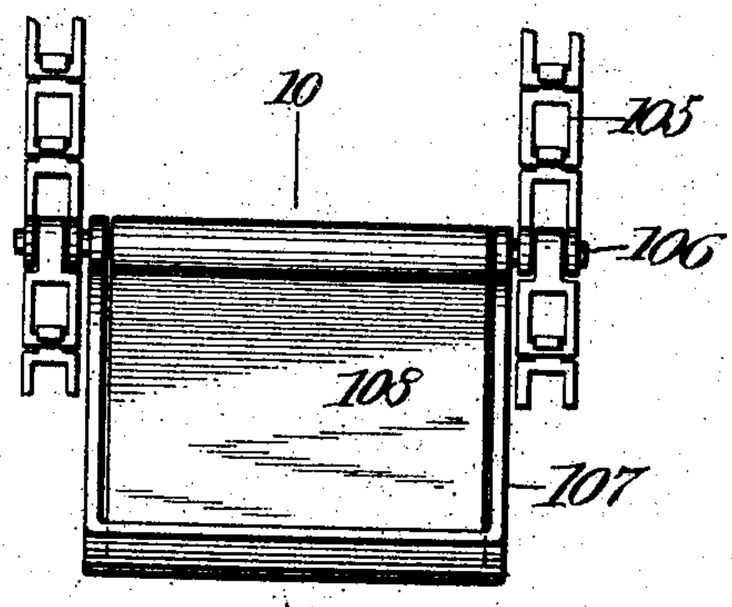
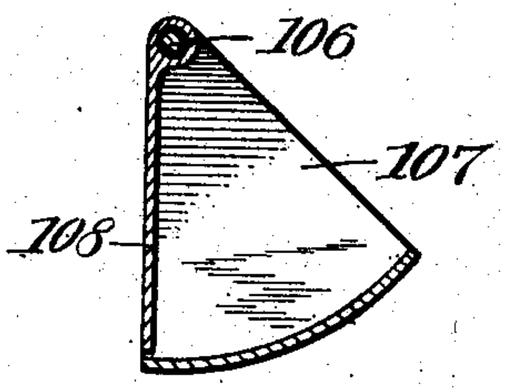


Fig. 10



WITNESSES:

J. A. Brophy

Isaac B. Owens.

INVENTOR

Herbert W. Sargent

BY

Munn & Co.

ATTORNEYS

UNITED STATES PATENT OFFICE.

HERBERT WELLINGTON SARGENT, OF NEAR FONDA, IOWA.

DITCHING-MACHINE.

No. 796,257. Specification of Letters Patent. Patented Aug. 1, 1905.

Application filed July 16, 1904. Serial No. 216,880.

To all whom it may concern:

Be it known that I, HERBERT WELLINGTON SARGENT, a citizen of the United States, residing near Fonda, in the county of Pocahontas and State of Iowa, have invented a new and Improved Ditching-Machine, of which the following is a full, clear, and exact description.

The invention relates particularly to a self-propelled ditching-machine, although various of its features are applicable to ditching-machines of other types, as will be apparent.

In its preferred embodiment the invention comprises a wheeled frame mounting a cutting and elevating mechanism, so that these parts may be vertically adjusted, the cutter turning on a vertical axis and being adapted to extend into the ditch and cut away the earth, while the elevator, acting behind the cutter, takes up the earth thus dislodged and disposes of the same, discharging it either at one side of the ditch or back into the ditch in the rear of the machine, the latter adjustment being employed in case that drain or sewer pipes are being laid directly behind the apparatus. The depth at which the ditch is dug may be regulated both by the vertical adjustment of the cutter and by the adjustment of a shoe which follows the plow at the base of the cutter and may be operated effectually to control the position of the cutting apparatus.

The apparatus is driven when at work by a peculiar low-speed gear, and when the apparatus is not at work, but is being propelled from one point to another, a high-speed gear may be thrown in, so as to increase the speed of the apparatus.

Reference is had to the accompanying drawings, which illustrate as an example the preferred embodiment of my inventive idea, in which drawings like figures of reference indicate like parts in the several views, and in which—

Figure 1 is a plan view of the complete machine. Fig. 2 is a side elevation thereof, showing the machine at work in a ditch. Fig. 3 is an enlarged vertical section showing the cutter with its plow and shoe and the elevating devices in operative adjustment. Fig. 4 is an enlarged sectional view of the differential drive. Fig. 5 is an enlarged sectional view of the reversing-gear. Fig. 6 is an enlarged sectional view of the front portion of the frame of the apparatus, showing the front or steering axle in section. Fig. 7 is an enlarged sectional view essentially on the line 7 7 of Fig. 3. Fig. 8 is an enlarged sectional view essentially on the line 8 8 of Fig. 3. Fig. 9 is an enlarged front elevation of one of the buckets of the elevator. Fig. 10 is a section on the line 10 10 of Fig. 9. Fig. 11 is a fragmentary plan view of the bottom part of the cutter, showing the axial shaft in section. Fig. 12 is a detail section on the line 12 12 of Fig. 2. Fig. 13 is a detail section on the line 13 13 of Fig. 2. Fig. 14 is a detail plan view of the link for mounting certain of the shafts employed in driving the cutting and elevating apparatus. Fig. 15 is a reduced fragmentary view showing an adjustable brace for the cutting and elevating apparatus to hold the same rigid, particularly when the apparatus is employed in digging ditches of comparatively great depth; and Fig. 16 is a detail section on the line 16 16 of Fig. 2.

The frame 20 of the apparatus may be of any desired design. As here shown, it is rectangular in general form, having a front extension 20^a, and said frame is adapted to carry water and oil tanks for furnishing the fuel and cooling-water to an internal-combustion engine, which is the means preferably employed for driving the apparatus. A rear axle 21 is suitably secured to the frame and carries the broad-faced traction-wheels 22. The front axle 23 (see Fig. 6) is spliced to inclose the front section 20^a of the frame, and said frame is at this point braced by a bolster 24, carrying a king-bolt 25, whereby the front axle is mounted to swing on the frame, turning the front or pilot wheels 26, and thereby steering the vehicle. Connected with the end portion of the axle 23 are cables 27, which pass over a drum 28. Said drum has a worm-gear 29 attached, and meshed therewith is a worm 30, carried on a shaft 31, suitably journaled in the frame and extending rearward. The rear end of said shaft carries a hand-wheel 32, facilitating the manual rotation of the shaft, and in this way the ditching-machine may be steered as it is being propelled over the ground. The engine 33 may be of any type desired and, as here shown, is mounted on the front part of the frame. The engine-shaft 34 extends longitudinally of the machine rearward from the engine and (see Fig. 5) has fixed thereto two internal clutch-cones 35, coacting with which are corresponding clutch-cones 36, loose on the engine-shaft and suitably connected with miter-pinions 37. The pinions 37 and cones 36 are adapted to be slid on the engine-shaft 34, so as to alternately

engage the cones 36 with the corresponding cones 35 and in this manner to impart rotary movement to the pinions in opposite directions, one pinion being active, while the other is inactive. This shifting of the cones and gears is effected by a sliding frame 38, having forks 39 engaged with the gears and connected to a link 40 and hand-crank 41, facilitating the manual adjustment of said parts. The gears 37 are adapted alternately to mesh with a miter crown-gear 42, carried fast on a transverse shaft 43, which is revolubly mounted in the frame. This shaft 43 may therefore be driven in either direction by a proper adjustment of the transmission-gear above described, and from said shaft 43 is taken the power for driving the machine and also for driving the ditching devices.

The shaft 43 has a gear 44 meshing with corresponding gear 45 on a shaft 46, revolubly mounted in the frame just rearward of and parallel with the shaft 43. A miter-gear 47 on the shaft 46 meshes with a corresponding gear 48 on a revoluble shaft 49, which extends longitudinally of the machine. A shaft 50 is mounted longitudinally in the machine and is driven from the shaft 49 through the medium of gears 51 of any suitable type. Both the shafts 49 and 50 are employed for transmitting the driving movement to the rear axle, the shaft 49 transmitting at a high speed and the shaft 50 at a low speed. This is effected by a beveled gear 52 on the shaft 49 and a worm 53 on the shaft 50. The beveled gear 52 (see Fig. 4) is loose on the shaft 49 and is formed with a clutch-face 58, coacting with a clutch-collar 54, splined on the shaft. Said collar is actuated by a suitable hand-lever 55 and may be moved in and out of engagement with the clutch-face 58, so as to render the gear 52 fast or loose on its shaft, as desired. The said gear meshes with a circular series of miter-gear teeth 56, formed on a wheel 57. The worm-wheel 53 meshes with worm-teeth 59, formed on the periphery of said wheel 57. The worm 53 may be provided with any suitable device for rendering it active or inactive, as desired. As here shown, (see Figs. 1, 2, 4, and 16,) this purpose is effected by fitting the worm 53 to slide on a feather 50^a on the shaft 50 and providing the worm with a forked rod 53^b, operative by a lever 53^c. The worm is held from sliding on the shaft by a removable pin 53^a. (Best shown in Fig. 16.) When it is desired to render the worm inactive, the pin 53^a is withdrawn, and by pressure on the lever 53^c, aided by revolution of the shaft 50 in the correct direction, the worm will be caused to screw out of engagement with the worm-wheel, and when it is desired to render the worm active the pressure on the lever 53^c and the direction of revolution of the shaft 50 should be reversed and the worm allowed to screw itself into mesh with the worm-wheel, after which the worm may be locked by the pin 53^a. Now it is clear that by throwing out the gear 52 and turning the worm 53 a slow movement will be imparted to the wheel 57, and upon reversing the action of these gears a relatively high speed will be imparted to said wheel 57. The wheel 57 forms part of a differential drive, said wheel being centrally recessed to carry pinions 60 of said gear. These pinions mesh with the side gears 61, one of which gears is keyed to a drive-shaft 62, revolubly mounted in the frame, and the other of which gears has an extended hub 63 fastened to a pinion 64, loose on the shaft 62. The shaft 62 also mounts loosely the wheel 57, and said shaft extends transversely in the frame from one side to the other thereof, the pinion 64 meshing with a spur-gear 65, fastened to the rim of one of the driving-wheels, and the other end of the shaft 62 carrying a pinion 66, in mesh with a corresponding spur 67, fastened to the rim of the other driving-wheel.

Mounted on each side of the frame 20 is a vertically-extending guide-beam 68. Preferably these beams (see Figs. 12 and 13) are formed of channel-iron and carry at their top a cross-beam 69, to which guys 70 are suitably connected, these guys being four in number, extending two forward and two rearward and being fastened at their lower ends to the respective corners of the main part 20 of the frame. Said guide-beams 68 serve to guide the framing of the cutting and elevating apparatus, and this framing comprises (see Figs. 2 and 7) vertically-extending side shields 71, suitable walls 72 forming vertical guideways respectively receiving the beams 68, side and rear walls 73 and 74 forming the elevating-housing, and shields 75 projecting rearward from the elevator-housing and adapted to enter the trench to support the side walls thereof. In working with soft soil extension-plates may be attached to the side shields 75 to extend the same any desired length rearward, and these may be braced against each other to prevent their collapse, as will be fully understood. The whole of the said frame for mounting the cutting and elevating appararatus is secured rigidly together, and the guide-beams 68 and guideways 72 are mounted to slide freely up and down, so as to project the cutting apparatus any distance into the earth or to raise the same clear of the earth, so as to permit the movement of the machine from one point to another. To relieve friction between the parts 68 and 72, contact-rollers 68^a and 72^a may be provided. (See Figs. 2, 12, and 13.) When the ditching devices are not at work, this raising and lowering movement is effected by means of racks 76, attached to the ditching-frame at openings within the guideways 72, the channel-iron beams 68 receiving the racks. Meshed with said racks are gears 77, which extend through openings in the guide-beams 68 and are car-

ried, respectively, on revoluble shafts 78, mounted at each side of the frame 20 and extending forward. (See Fig. 1.) The shafts 78 are connected by miter-gearing 79 with a transverse shaft 80. This shaft is revolubly mounted in the frame and has fastened to one end a worm-wheel 81, wherewith is meshed a worm 82, carried on an inclined shaft 83, suitably mounted on the frame and having at its rear end a hand-wheel 84, facilitating its manual rotation. By this device rotary movement may be imparted to the gears 77 and said gears caused to raise or lower the cutting and elevating mechanism, as may be desired.

As best shown in Fig. 3, the rear wall 74 of the elevator-housing is extended forward to form a boot 85, the front end of which carries a downwardly-inclined plow 86. Fastened in said plow and partly sustained thereby is a vertical shaft 87, the upper end of which is sustained in a frame-plate 88, projecting forward from the elevator-housing. The cutter comprises spiroform blades 89, which give the cutter as a whole a cylindric form and which are turned in at their lower ends to fasten to the spider 90 loosely on the shaft 87 and at their upper ends to a gear-plate 91, also loosely mounted on the shaft 87. Fastened to the blades 89 and turning therewith are conical tables 92, which loosely encircle the shaft 87 and serve the double function of bracing the cutting-blades 89 and of forming supports for the earth dislodged by the blades. Coacting with the tables 92 are scrapers 93, which are sustained immovably by a shaft 87 and which lie over the respective tables, so as to cause the dirt collected on the tables to be dislodged therefrom at the rear side of the cutter in position to be engaged by the elevator-bucket, to be hereinafter fully set forth. Pivoted to the under side of the boot 85 and rearward of the plow 86 is a shoe 94, which is preferably convex form on its bottom and which is adapted to run along the bottom of the ditch or trench. Said shoe has joined thereto a fork 95, loosely connected with a screw 96, working in a stationary nut 97, attached to the rear wall 74 of the elevator-housing. The screw 97 is adapted to be revolubly operated through a shaft 98, attached to the screw and mounted on its upper end 99, projecting rearward from the elevator-housing. Any desired device may be provided for turning the shaft 98—for example, a clutch-collar 100 may be provided with devices for adjustably fixing it to the shaft 98 at various points along the length of the shaft and a coacting clutch-arm 101 employed, so that a turning movement in either direction may be imparted to the screw 96, and thereby the rear portion of the shoe may be raised or lowered. By raising the shoe the plow 86 is permitted to go deeper into the earth, and thus the depth of the ditch is increased, and by lowering the rear end of the shoe a reverse action is obtained. It is in this manner that the depth at which the cutting apparatus works may be regulated during the ditching operation.

Mounted in the upper and lower ends of the elevator frame or housing are revoluble shafts 102 and 103, carrying the sprocket-wheels 104 of the elevator, which comprises in addition chains 105, cross-rods 106, (see Figs. 9 and 10,) bucket sides 107, and bucket-bottoms 108. The bucket sides are essentially U-shaped in form and are pivotally mounted on the cross-rods, the outer walls of the buckets being arc-shaped, and the bottoms 108 are separate from the buckets and are loosely mounted on the rod 106 between the side walls of the buckets. Within the elevator-housing is a guide 109, suitably sustained and having a vertical front wall, as shown. Against this wall the buckets lie when moving upward, as indicated by the arrow in Fig. 3, and said wall causes the bottoms 108 to lie in their proper or active position, holding the earth in the elevator-buckets. At its upper part, however, the guide 109 is formed with a slot 110, allowing the bodies 107 of the buckets to fall forward while holding in rearward position the bottoms 108. After passing the slot 110 the bodies and bottoms of the buckets fall rearward, as indicated by the broken lines in Fig. 3. This relative movement between the bucket bodies and bottoms causes the earth to be ejected from the buckets. At its lower end the guide 109 is formed with slots 111, which allow the bucket-bodies 107 to swing slightly rearward preparatory to beginning their upward and earth-receiving movement. The guide 109 and the rear wall 74 of the elevator-housing have forwardly-curved portions 112 and 113 at the upper part of the elevator, forming thereby a space receiving the front end of a conveyer, which is sustained in frame-pieces 114, projecting rearward from the elevator-housing, and which comprises shafts 115, sprocket-wheels 116, chains 117, and lags 118, which may be of any desired form. The earth as it is discharged from the buckets falls on this conveyer and is moved rearward thereby, the conveyer in turn discharging upon a chute 119, which is adjustably mounted by a leg 120, carried on a hanger 121, sustained from the frame-pieces 114. This chute 119 may be adjustable to discharge rearward into the trench, covering the pipes which have been laid therein, or it may be turned sidewise to deliver the earth at one side of the trench. As the machine advances through the earth, therefore, a rotary cutter discharges the soil and forms the trench, the plow 86 cutting the earth at the bottom of the trench and the depth being regulated by the shoe 94, as explained. The earth dislodged from the cutter is thrown rearward into the elevator, which raises the same and discharges it upon the conveyer, which disposes of the earth, as will be understood from the foregoing description.

The gearing for driving the cutting, elevating, and conveying devices has for its prime mover a sprocket 122, loose on the shaft 43 and formed with a clutch-face 123, coacting with a corresponding face 124 on the gear 42.

125 indicates any desired device for manually shifting parts 122 and 123 to connect or disconnect the sprocket with or from the gear 42. Said sprocket 122 has a chain 126 running over it and over a sprocket 127, mounted on a shaft 128. The shaft 128 is journaled at the upper ends of arms 129, which extend vertically and are mounted at their lower ends to swing around a transverse axis coincident to that of the gear 122. (See Figs. 2 and 5.) Mounted to turn around the axis of the shaft 128 and connected with the sprocket 127 is a sprocket 130, over which runs a chain 131, extending rearward to and around a sprocket 132, fastened on a transverse shaft 133, revolubly mounted in boxes 134, fastened to the frame-plate 88, before described. Connected loosely with the shaft 133 is a link 135, (see Figs. 2 and 14,) the forked ends of which respectively embrace sprocket 132 and sprockets 127 and 130, and the forward end of which link is loosely connected with the shaft 128. In this manner the shaft 133 is revolubly driven irrespective of the vertical adjustment of the cutter and elevator framing, the arms 129 swinging forward or backward through the action of the link 135, according to the vertical adjustment of the said framing. The said shaft 133 carries a miter-gear 136 in mesh with the gear-plate 91, whereby the gear-plate 91 (see Fig. 3) operates to impart to the cutter its characteristic rotary movement. The shaft 133 also carries a sprocket 137, (see Fig. 3,) over which runs a chain 138, extending rearward to and around a sprocket 139, mounted on the shaft 103, whereby to drive the elevator. Said shaft 103 carries at its right-hand end, opposite the sprocket 139, a sprocket 140. Over this sprocket a chain 141 extends, this chain driving a sprocket 142, fast to the inner shaft 115 of the conveyer, thus driving the conveyer.

Fig. 15 shows the manner of bracing the lower end of the cutter and elevator frame to prevent undue strain on the parts during the ditching operation. This bracing device is particularly useful when ditches of relatively great depths are being dug, since at this time the strain on the parts is greatest. Brace-beams 143 have at their rear ends one or more hooks 144, adapted to effect an adjustable engagement between the brace-beams and the rear end of the frame 20. The brace-beams extend downward and forward into the ditch and have rollers 145 at their front ends engaged with the rear walls 74 of the elevator framing or housing. The front ends of the beams 144 are held in position by supporting-rods 146, pivotally joined to the beams and extending upward to the frame 20, said rods being provided with hooks 147, enabling them to be adjustably engaged with the said beams of the frame 20.

The organized operation of the apparatus may be traced as follows: When the machine is to be transported from place to place, the cutting and elevating devices are raised so that the plow and shoe will clear the earth, the clutch-faces 123 and 124 are disconnected, and the gear 52 is thrown into action. The engine may then be started, and by the transmission mechanism illustrated in Fig. 5 the machine may be propelled forward or backward and through the proper operation of the hand-wheel 32 effectively steered. To employ the machine for ditching, the gear 52 should be rendered inactive and the worm 53 thrown into action, thus imparting a relatively slow speed to the machine. The cutting and elevating devices should then be lowered into engagement with the earth through the operation of the hand-wheel 84, and upon the inactivity of the plow the cutter will gradually descend into the earth, the machine advancing meanwhile under the action of the worm 53. When the desired depth has been reached, operation of the hand-wheel 84 should be arrested and the further vertical movement of the cutting devices controlled entirely by the shoe 94 in the manner above set forth. A single operator may conveniently stand on a platform 148, arranged at the left-hand side of the machine with the various controlling parts adjacent thereto, as illustrated in Fig. 1. One or more sights 149 (see Fig. 1) may be connected with the cutting and elevating devices and these sights employed in connection with marks placed along the range in which the ditch is to be formed, so that in this manner not only may the apparatus be propelled over its true course, but also the ditch may be dug with its bottom on a true level irrespective of unevenness in the surface of the earth, this being effected by raising or lowering the cutting apparatus following the decline or rise in the surface of the earth. In cases where the ditch or trench is to be employed for the reception of a pipe-line the pipe may be laid directly behind the machine and the chute 119 arranged to deliver the earth back into the trench, thus completing the pipe-line as the trench is formed. In other cases where an open trench is desired the earth may be thrown sidewise by the proper adjustment of the chute.

Various changes in the form, proportions, and minor details of my invention may be resorted to at will without departing from the spirit and scope thereof. Hence I consider myself entitled to all such variations as may lie within the terms of my claims.

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

1. In a ditching-machine, the combination with a framing adapted to be moved over the

ground, of a cutter, means for adjustably mounting the same on the frame, a plow at the lower end of the cutter and an adjustable shoe following the plow.

2. In a ditching-machine, the combination with a frame adapted to be moved over the ground, of a cutter, an elevator adapted to receive the earth from the cutter, means for adjustably mounting the elevator and cutter on the framing, a plow at the lower end of the cutter, and an adjustable shoe following the plow.

3. In a ditching-machine, the combination with a framing adapted to be moved over the ground, of a cutter adjustably mounted on the framing, a shoe adjustably mounted at the lower end of the cutter, and means for adjusting the shoe and operating the cutter.

4. In a ditching-machine, the combination with a framing adapted to be moved over the ground, of a housing vertically adjusted on the framing, a cutter and elevator mounted in the housing, and means for operating the cutter and elevator.

5. In a ditching-machine, the combination with a framing adapted to be moved over the ground, of a housing vertically adjusted on the framing, a cutter and elevator mounted in the housing, means for operating the cutter and elevator, and a plow mounted at the lower end of the cutter.

6. In a ditching-machine, the combination with a framing adapted to be moved over the ground, of a housing vertically adjusted on the framing, a cutter and elevator mounted in the housing, means for operating the cutter and elevator, a plow mounted at the lower end of the cutter, a shoe adjustably mounted at the lower end of the cutter behind the plow, and means for adjusting the shoe.

7. In a ditching-machine, the combination with a framing adapted to be moved over the ground, of a cutter, means for mounting the same vertically adjustable on the frame, a downwardly-inclined plow at the lower end of the cutter, and an adjustable shoe following the plow.

8. In a ditching-machine, the combination with a framing adapted to be moved over the ground, of a cutter, means for mounting the same vertically adjustable on the frame, a downwardly-inclined plow at the lower end of the cutter, a shoe having its front end pivoted rearward of the plow whereby to permit vertical adjustment of the rear end of the shoe, and means for effecting said vertical adjustment of the shoe.

9. In a ditching-machine, the combination with a framing adapted to be moved over the ground, of a cutter, means for adjustably mounting the cutter on the frame, and devices for operatively driving the cutter irrespective of its adjusting movement, said devices comprising a rotary prime mover on the frame, an arm swinging on the frame around an axis coincident to that of the rotation of the prime mover, a link pivotally connecting the free end of the arm with the means for mounting the cutter, and gear elements extending from the prime mover to the cutter, said gear elements including parts turning around the centers of the pivots between the arm and link, and the link and cutter mounting means.

10. In a ditching-machine, the combination with a framing adapted to be moved over the ground, of a cutter, means for adjustably mounting the cutter on the frame, devices for operatively driving the cutter irrespective of its adjusting movement, said devices comprising a rotary prime mover on the frame, an arm swinging on the frame around an axis coincident to that of the rotation of the prime mover, a link pivotally connecting the free end of the arm with the means for mounting the cutter, and gear elements extending from the prime mover to the cutter, said gear elements including parts turning around the centers of the pivots between the arm and link, and the link and cutter mounting means, an elevator mounted to be adjusted with the cutter, and means for driving the elevator from a driving element of the cutter.

11. In a ditching-machine, the combination with a framing, of a cutter supported thereon and comprising a group of spiroform blades in cylindric relation to each other to form a cylindric cutter, and means for revolubly driving said blades.

12. In a ditching-machine, the combination with a framing, of a cutter supported thereon and comprising a group of spiroform blades in cylindric relation to each other to form a cylindric cutter, and means for revolubly driving said blades, the blades being mounted to turn around a vertical axis.

13. A cutter for ditching-machines, comprising a group of spiroform blades in cylindric relation to each other to form a cylindric cutter.

14. A cutter for ditching-machines, comprising a group of blades forming an open cylinder, and a table lying within said cylinder and connected to said blades.

15. A cutter for ditching-machines, comprising a group of blades forming an open cylinder, a table lying within said cylinder and fastened to said blades, means for revolubly mounting the blades and table, and a stationary scraper coacting with the table.

16. In a ditching-machine, the combination with a framing adapted to be moved over the ground, of a shaft supported on the frame, a group of cutter-blades mounted to turn around the shaft, means for driving said blades, a table located within the group of blades and attached thereto and turning around the shaft, and a scraper attached to the shaft and bearing on the table.

17. In a ditching-machine, the combination

with a framing adapted to be moved over the ground, of a rotary cutter mounted on the frame and comprising a group of blades in essentially cylindric relation, a table lying within the group of blades and fastened thereto, a stationary scraper coacting with the table to throw the earth off the same, an elevator located rearward of the cutter and receiving the earth therefrom, and means for driving the cutter and elevator.

18. In a ditching-machine, the combination with a framing, of a cutter, an elevator adapted to receive the earth from the cutter, a conveyer adapted to receive the earth from the elevator, and means for mounting and driving the cutter, elevator and conveyer, all of said parts being mounted on the frame to be vertically adjustable thereon.

19. An elevator comprising an endless belt, bucket-bodies pivotally mounted thereon, bucket-bottoms pivotally mounted thereon, and means for causing a relative movement between the bucket bodies and bottoms, said means comprising a guide having slots therein adapted to receive parts of the bucket-bodies.

20. In a ditching-machine, the combination of an adjustable cutter, a plow in connection with the lower part thereof and adapted to run in the bottom of the ditch, and an adjustable shoe rearward of the plow and having connection with the plow and cutter, and also adapted to run in the bottom of the ditch for the purpose specified.

21. In a ditching-machine, the combination of an adjustable cutter, a plow at the lower portion thereof and adapted to run in the bottom of the ditch, a shoe rearward of and pivotally connected with the plow, and means for adjusting the shoe around the pivot, the shoe being also adapted to run in the bottom of the ditch.

22. In a ditching-machine, the combination of an adjustable cutter, and an adjustable shoe in connection with the lower part of the cutter and adapted to run in the bottom of the ditch for the purpose specified.

23. In a ditching-machine, the combination of an adjustable cutter, a shoe located rearward of the cutter and having a pivotal connection therewith, the shoe being adapted to run in the bottom of the ditch, and means for adjusting the shoe around the pivot.

24. A cutter for ditching-machines comprising a group of spirally-disposed blades in essentially cylindric relation, means connecting the ends of the blades together, and means for revolubly mounting the blades and said connecting means.

25. A cutter for ditching-machines comprising a group of spirally-disposed blades, means connecting the ends of said blades together, and means for revolubly mounting the blades and said connecting means.

26. A cutter for ditching-machines comprising a group of spiroform blades, means connecting the ends of said blades together to form a rigid structure, a central shaft on which said means are revolubly mounted, and mechanism for revolubly driving said blades and said connecting means.

27. A cutter for ditching-machines in the form of an open or skeleton cylinder, and comprising a plurality of spiroform blades extending along the sides of the cylinder across the axis thereof, and means for connecting the blades together.

28. A rotary cutter for ditching-machines comprising cutting parts forming an open cylinder, and a table lying within and turning with said cutter.

29. A rotary cutter for ditching-machines comprising parts forming an open cylinder, a table lying within and turning with said cylinder, means for revolubly mounting the cylinder and table, and a stationary scraper coacting with the table.

30. A rotary cutter for ditching-machines comprising cutting parts forming an open cylinder, a table lying within and turning with the cylinder, a shaft on which the cylinder and table are mounted, means for rotating the cylinder and table, and a scraper attached to the shaft and coacting with the table.

31. A cutter for ditching-machines comprising a group of spiroform blades in cylindric relation, means for joining said blades together, means for mounting the blades to turn, and a table located within said open cylinder and attached to the blades.

32. A cutter for ditching-machines comprising a group of spiroform blades in cylindric relation, means for joining said blades together, means for mounting the blades to turn, a table located within said open cylinder and attached to the blades, and a stationary scraper coacting with the table.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

HERBERT WELLINGTON SARGENT.

Witnesses:

V. E. HARDY,

A. E. SARGENT.