M. PAUL.

DITCHING MACHINE.

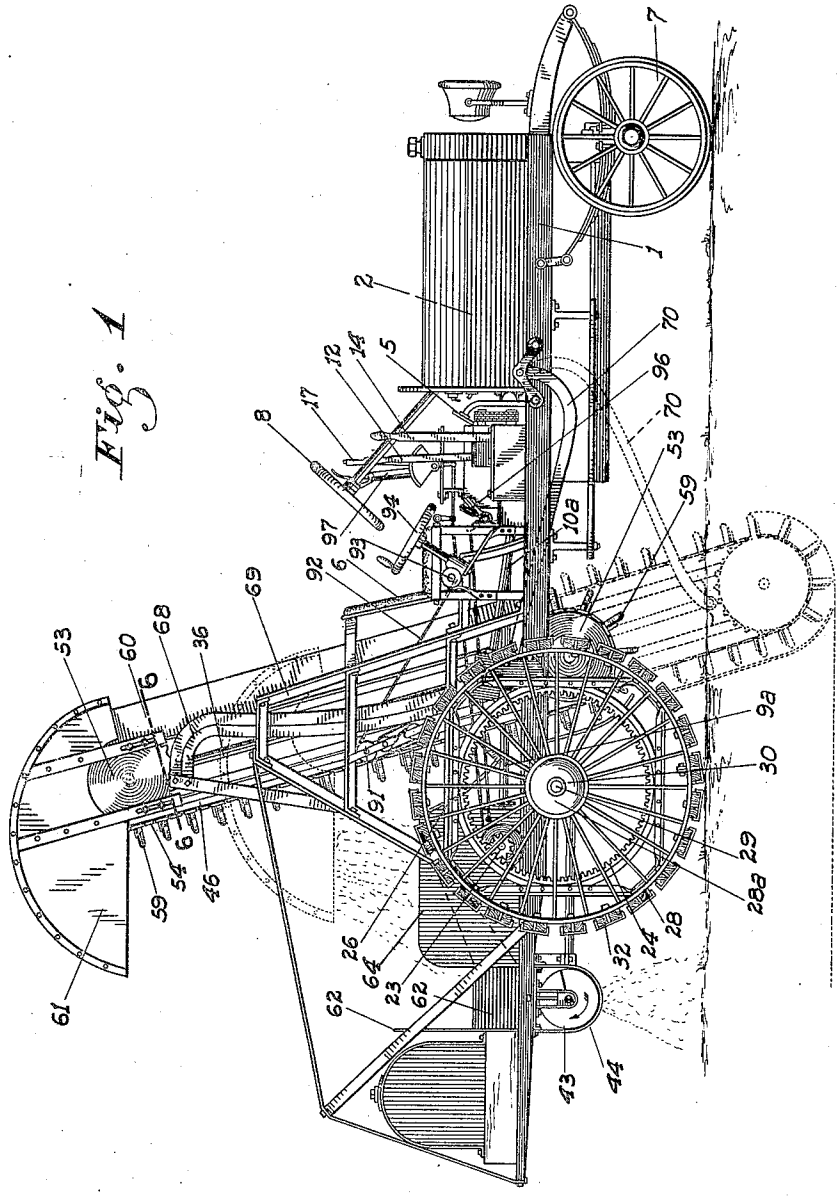
APPLICATION FILED APR. 26, 1920.

1,428,055.

Patented Sept. 5, 1922.

5 SHEETS—SHEET 1.

Fig. 1



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5 SHEETS—SHEET 2.

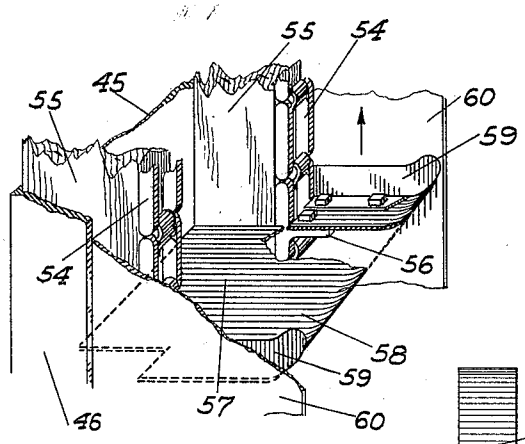


Fig. 9

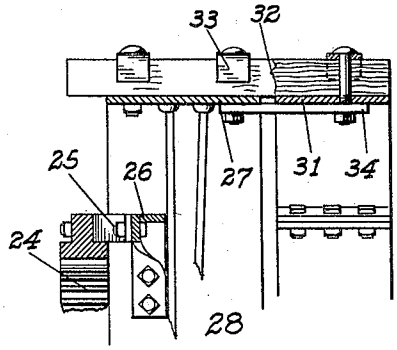


Fig. 10

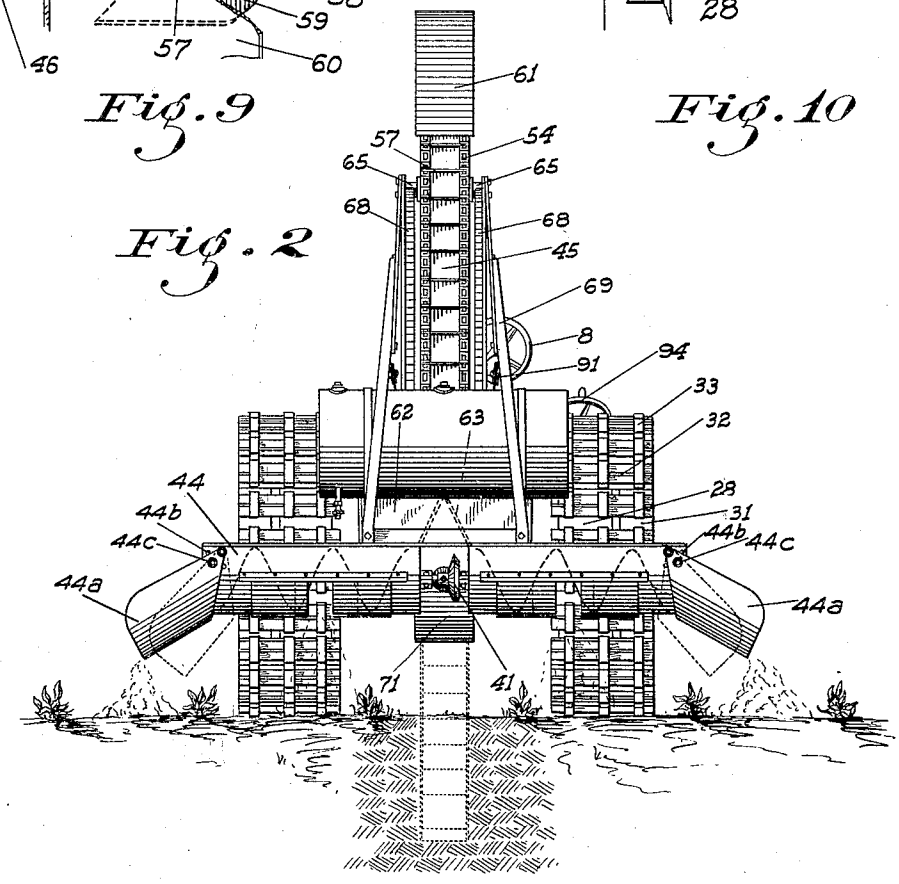


Fig. 2

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5 SHEETS—SHEET 3.

Fig. 3

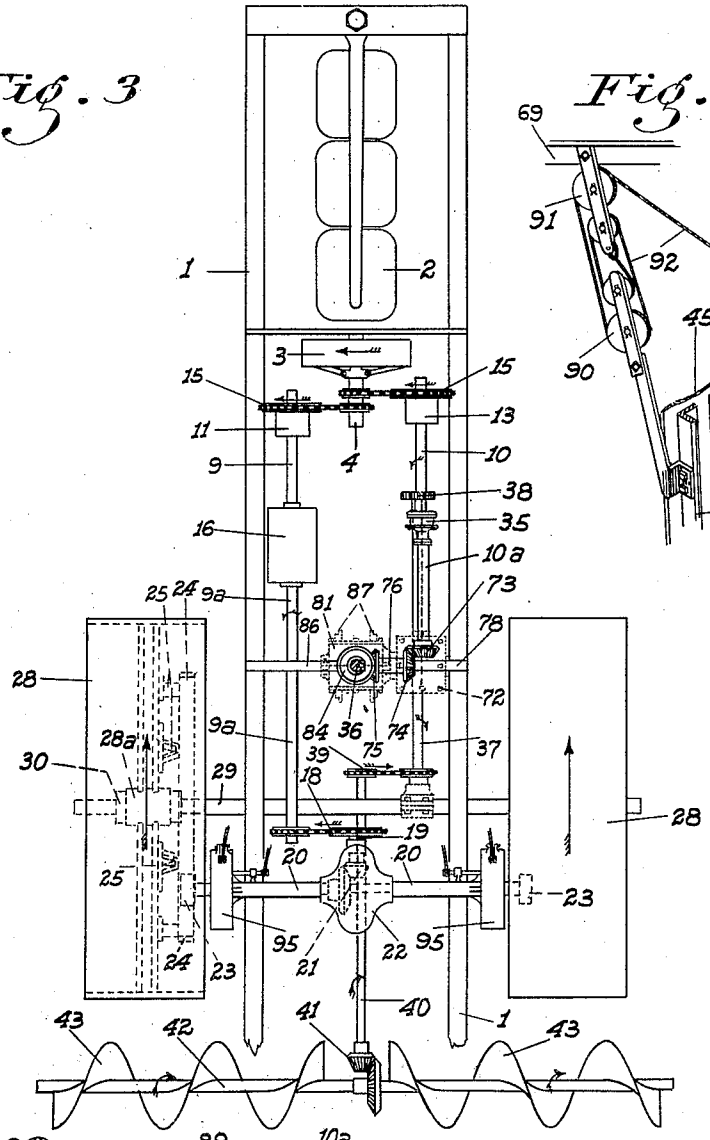
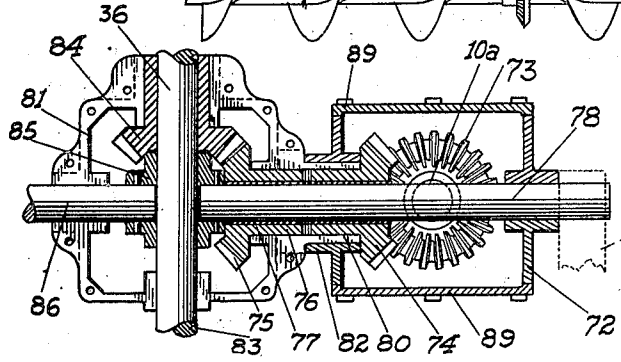


Fig. 11

Fig. 12



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5 SHEETS—SHEET 4.

Fig. 4

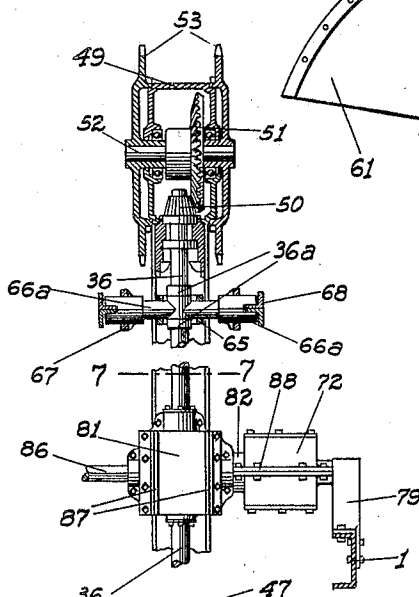


Fig. 5

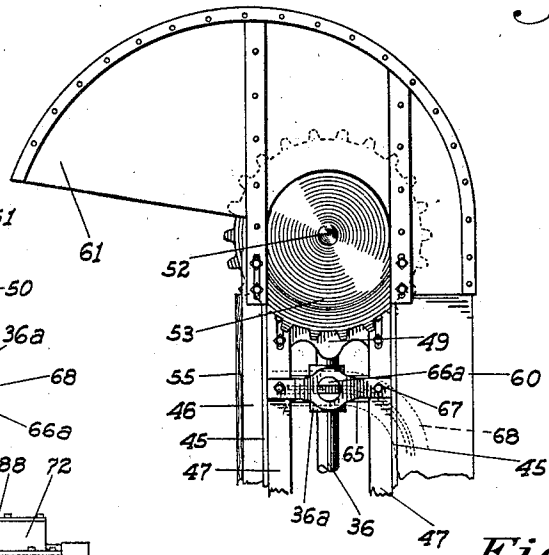


Fig. 6

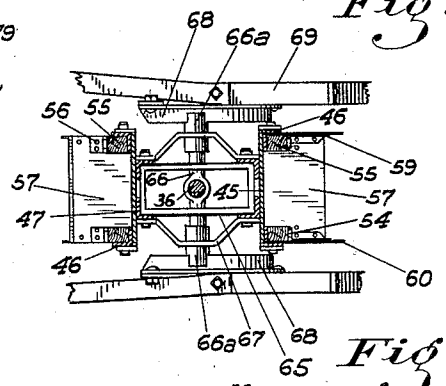


Fig. 7

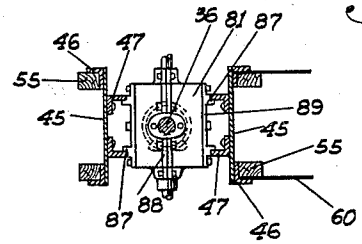
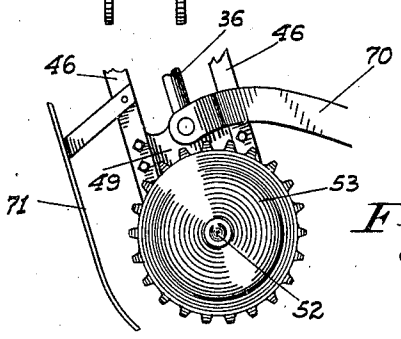


Fig. 8



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APPLICATION FILED APR. 26, 1920.

1,428,055.

Patented Sept. 5, 1922.

5 SHEETS—SHEET 5.

Fig. 14

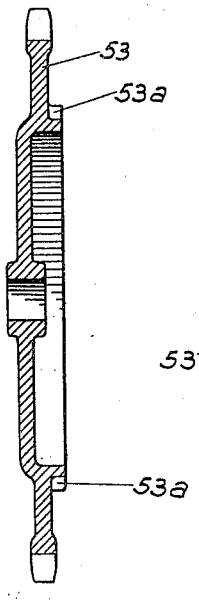


Fig. 13

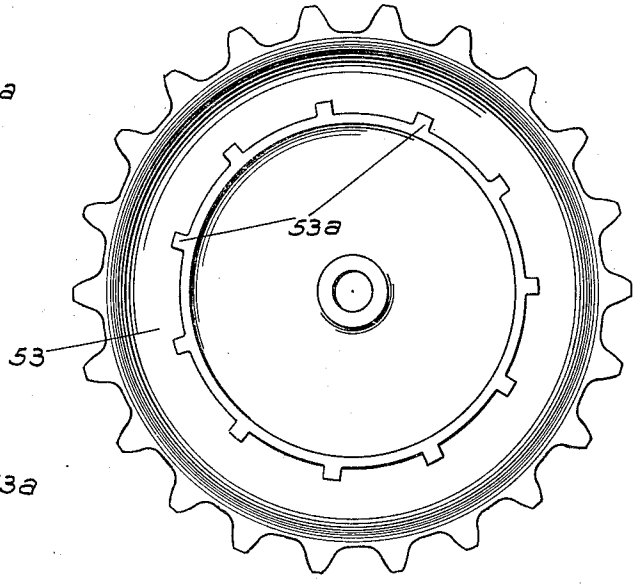
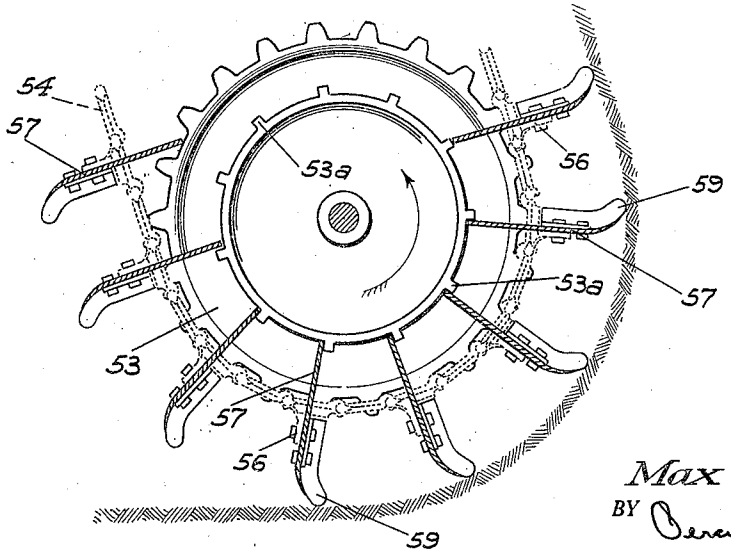


Fig. 15



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ATTORNEY

Patented Sept. 5, 1922. 1,428,055

UNITED STATES PATENT OFFICE.

MAX PAUL, OF STOCKTON, CALIFORNIA.

DITCHING MACHINE.

Application filed April 26, 1920. Serial No. 376,465.

To all whom it may concern:

Be it known that I, MAX PAUL, a citizen of the United States, residing at Stockton, in the county of San Joaquin and State of California, 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 same, reference being had to the accompanying drawings and to the characters of reference marked thereon, which form a part of this application.

This invention relates to improvements in ditching machines of the type constructed on the endless digger-chain principle, and which may also be used for sub-soiling and other purposes.

The principal object of my invention is to provide a digger boom structure carrying one or more endless chains having digging blades thereon, which chains will be driven at both ends of the boom, while at the same time permitting the boom to be raised and lowered to dig at different depths, or to clear the ground entirely.

I have also positioned the digger structure so that the same slants ahead, thus permitting the digging to take place in that direction also, so that the digger blades will be forced into the ground and will act in a manner similar to that of a hand-shovel. A larger quantity of dirt will therefore be raised than with the present type in which the diggers are dragged through the dirt, and the latter is scraped rather than being actually dug. I also provide an arrangement for throwing the load and strain of each digger blade onto the sprocket wheels on which the digger-chains turn, rather than on the chains themselves, so that the latter are relieved of practically all strain.

This enables me to either utilize a lighter structure than is now employed for the same work, or if the same sized chain is used, it will stand up under the hard service to which the same is naturally subjected, for a much longer period of time.

A further object is to arrange the driving mechanism of the ditching machine so that all the operating parts will be driven from a single main shaft, the drives being so arranged that the drive shaft itself may be cut off from the engine, or each different driven unit independently cut out from operation with the remainder.

The arrangement and positioning of my digging structure relative to the machine as a whole, permits the dirt dug and raised to be deposited to the rear of the machine, either to one or both sides thereof, or into the ditch excavated, in the event that the machine is being used as a sub-soiler to renew the soil or to alter the relative position of the strata thereof, rather than to actually dig ditches as such.

I have also provided a means for allowing the driven wheels of the machine to be positioned in different transverse alinement, without interrupting the driving thereof, so that said wheels may be positioned to traverse fields having rows of crops sown at varying distances apart.

These objects I accomplish by means of such structure and relative arrangement of parts as will fully appear by a perusal of the following specification and claims.

In the drawings similar characters of reference indicate corresponding parts in the several views.

Fig. 1 is a side elevation of the complete ditching machine, showing the digging member raised from the ground, the lowered position being indicated in dotted lines.

Fig. 2 is a rear end view of the same.

Fig. 3 is a diagrammatic plan view of the chassis, showing the various drives from the main shaft and the power plant.

Fig. 4 is an enlarged detached rear end view, partly broken to shorten the same and partly in section of the digger structure with the chain removed.

Fig. 5 is a fragmentary side elevation of the upper end of the digging structure, the chain being removed.

Fig. 6 is a cross section taken on a line 6—6 of Fig. 1, showing the guides for the digger chains on the frame thereof, and the guides for said frame on the chassis of the machine.

Fig. 7 is a cross section taken on a line 7—7 of Fig. 4 showing the center-drive gear box.

Fig. 8 is a detached fragmentary side elevation of the lower end of the digger frame, with the chain removed.

Fig. 9 is an enlarged fragmentary perspective view of the chain and digger blade structure, partly broken out.

Fig. 10 is a fragmentary cross section of a driving wheel of the machine, showing the

method of attaching an auxiliary tread portion, and the adjustable driving ring-gear.

Fig. 11 is a fragmentary view showing the multiple pulley arrangement for raising the digger structure.

Fig. 12 is an enlarged sectional view of the drive gearing from the countershaft to the vertical driven digger shaft.

Fig. 13 is a side elevation of a digger-chain sprocket wheel.

Fig. 14 is a sectional view of the same.

Fig. 15 is a view of the sprocket wheel with the chain passing therearound, showing the engagement of the chain digger-blades with the lugs on the sprocket wheel.

Referring now more particularly to the numerals of reference on the drawings, the numeral 1 denotes the main frame of the machine, of any suitable construction. Mounted on the forward end of the frame is a power plant 2, preferably a gas engine, having a master clutch 3 interposed in the drive or engine shaft 4, actuated by a pedal 5 positioned within working reach of the driver from his seat 6.

Front wheels 7 support the forward end of the frame 1, being connected in any desired fashion to be steered from a wheel 8.

Turnably mounted to the frame on each side of the shaft 4 and parallel thereto are shafts 9 and 10. The shaft 9 has an individual friction clutch 11 interposed therein, actuated by a lever 12, while the shaft 10 has a similar clutch 13 actuated by a lever 14. The purpose of these clutches is to allow the same to slip, should either driven member encounter some obstruction which would otherwise tend to break such member. Forward of these clutches, these shafts are operatively connected with the shaft 4 to turn at any desired ratios of speed, by gearing or chain drives, such as is indicated at 15. If desired, I may employ a number of such drives from the engine shaft to the counter shafts, especially the shaft 9, using different ratios of turning, each one being controlled by individual clutches.

The shaft 9 extends into a transmission box 16, having the usual shift-gears therein, which are actuated by a hand-lever 17.

A shaft 9^a, capable of course of different speeds, projects rearwardly from the box 16 and is connected in driving relation as by a chain 18 to a stub shaft 19 positioned centrally of the frame 1.

This shaft drives transverse shafts 20 by means of bevel gears 21, the driven gear of which is formed with a differential enclosed in a housing 22, as is common automobile practice, and for the same purpose.

On the outer ends of the shafts 20 are pinions 23 meshing with internal ring-gears 24 secured by removable lugs or arches 25 to truss-bars 26 secured to the rims 27 of drive wheels 28 turnable and slidably mounted on a fixed shaft 29, the latter being relatively long.

The hubs 28^a of these wheels are held in transverse alinement on the shaft 29 by means of collars 30 thereon. When it is desired to alter the transverse position of the drive wheels, the collars 30 are loosened and shifted, the lugs 25 removed and replaced by longer or shorter ones to maintain the ring gears 24 in meshing alinement with the pinions 23, without disturbing the latter.

By this means, the distance between the wheels may be altered to accommodate the machine to different width rows.

When it is desirable to increase the width of the ground-bearing surface of the wheels, I employ auxiliary tread-members 31, held in place relative to the wheels 28 by means of common grouser-bars 32, which are fixed to the rims of both tread portions by means of clamps 33.

Lateral and twisting movement of the auxiliary members relative to the main wheels may be prevented by means of connecting straps 34 positioned at various points on the interior of the rims, and by suitably positioned cross brace rods or spokes removably mounted to the main wheels and auxiliary tread members.

These auxiliary members may be mounted to the permanent wheels either adjacent the inner or outer edges thereof, as may be desired.

Beyond the clutch 13, the shaft 10 has a universal joint 35 interposed therein, from which point a shaft 10^a extends to drive a vertical digger-shaft 36 a suitable distance forward of the wheel shaft 29, the exact construction of which drive will be described hereafter.

Another shaft 37, below the shaft 10, is driven therefrom forward of the joint 25 by gears 38. This shaft extends rearwardly a certain distance and is then connected as by a chain drive 39 to a parallel shaft 40 extending rearwardly under the differential housing 22, and is then drivingly connected by bevel gears 41 to a transverse shaft 42 positioned behind the wheels 28, on which shaft on both sides of said gearing are fixed oppositely disposed auger conveyors 43, turnable in an open ended chute 44.

Both ends of the chute are provided with extensions 44^a, pivoted to the upper ends of the chute, the latter being provided with a plurality of holes 44^b radial from the pivotal connection, and the extensions being each provided with a single hole adapted to register with any one of the others, so that a bolt 44^c may be passed therethrough to hold the main chute and the extensions in any desired relative angular positions. By this means, the dirt may be dumped between rows of growing crops and not cover the same. It may also be dumped

between two rows on each side, from the ends of the extensions and through lower and adjustable openings in the chute 44 on each side of the gear drive thereof, as shown in Fig. 2.

My improved digger structure comprises a vertical framework preferably consisting of parallel and transversely disposed plates 45, strengthened by outwardly disposed vertical angle irons 46 extending lengthwise thereof, the sides of such angles facing outwardly. Similarly positioned angle irons 47 are fixed to the inner and adjacent faces of the plates 45, and are closer together transversely than the members 46.

This frame structure is of such a width as to permit it to be positioned between the longitudinal members of the frame 1.

Fixed to the digger frame members at the upper and lower ends thereof are centrally positioned boxes 49 into which the digger shaft 36 projects, the lower one being fixed against relative vertical movement, but the upper one being slidable vertically in the members 46, to permit of the chain being tightened.

On the ends of the shaft 36 are bevel pinions 50 meshing with bevel gears 51 on shafts 52 turnably mounted in the boxes and projecting therethrough transversely of the frame 1. These boxes are entirely enclosed, so that they may be packed with grease to ensure quiet and non-wearing operation, and to keep dirt from getting at the gears and bearings.

On the outer ends of the shafts 52 are fixed sprocket wheels 53, over which extend endless chains 54, which slide on wooden bars 55 fixed to and in the angle irons 46. Alternate links of the chains are provided with right-angle brackets 56 on which are fixed transverse digging-plates 57 extending between the chains, both outwardly and inwardly therefrom, so that the inner edges just clear the back plate 45. The outer ends of these plates or blades are curved upwardly as at 58 relative to their direction of movement.

To prevent the strain of digging of the blades from throwing an undue load on the chains and brackets 56, the sprocket wheels 53, and especially the lower ones, are provided with radial and outwardly projecting lugs 53^a suitably positioned and adapted to permit the inner edges of the blades to bear up thereagainst when digging around the wheels (see Fig. 15). By this means, the strain on the outer edges of the blades when digging is taken by the sprocket wheels, while at the same time the corresponding teeth of the sprockets are carrying the strain of the individual chain links to which the blades are connected. Thus the chains themselves as a whole serve merely as connecting members for the blades instead of taking the whole strain of digging. This is also on account of the fact that the lower sprockets being also driven, instead of merely idlers, each tooth becomes a power member, forcing the chain links ahead and the blades thereon into the ground.

To the outer edges of the blades, and projecting upwardly therefrom, are fixed knives 59, extending somewhat beyond the cutting edges of the blades 57.

To the forward angles 46 of the digger frame, which is on the side that the dirt is raised, are fixed side plates 60 extending lengthwise of said frame and above the outer edges of the knives 59. By this means, a trough is formed with the transverse back plate 45 for the retaining of the dirt dug by the blades.

Extending over the top of the digger frame from the upper ends of the plates 60 is a hood 61, projecting a suitable distance to the rear, and having its lower end open to discharge the dirt raised in the trough 60 into the conveyor 44, there being a back-stop plate 62 for said conveyor to catch any dirt tending to fall to the rear thereof, and an upwardly pointing V-shaped diversion member 63 central of said conveyor over the driving gears thereof. A longitudinal trough 64 sloping down to the conveyor is also mounted on the frame 1 ahead of the conveyor, to divert dirt thereinto which falls ahead of the same.

Fixed to the frames 46 just under the upper box 49 is a rigid frame 65 having a cross member 66 fixed therein and extending therethrough, and through which the shaft 36 passes, said shaft having adjustable collars 36^a above and below the cross member, so that when the upper box 49 is adjusted, the shaft may be adjusted to suit.

The upper end of the digger structure is held from longitudinal swaying movement by means of slotted and outwardly projecting guide pins 66^a turnably mounted on the bearing member 66, said pins being held against side strains by means of arches 67 fixed to the digger frame angles 47. These pins engage guides or tracks 68 fixed to an auxiliary frame structure 69 extending upwardly from the main frame 1 on each side of the digger structure, said guides being suitably shaped and curved in a vertical plane to allow vertical movement of the digger structure without binding.

The lower end of the digger structure is held from longitudinal movement by means of radius rods 70 pivotally mounted to the frame 1 forward of said structure, and to the lower gear-box 49 of the latter just above the sprocket wheels 53 thereof.

By reason of the guide structure 66^a—68, and the radius rods 70, the strain incident to digging is taken off the driving mechanism connected to the shaft 36, described here-

after. Also by reason of the radius rods the lower digging end of the digger structure is rigidly held in position without the necessity of permanently mounted guides positioned relatively low on the frame and which interfere with ground clearance when the digger structure is raised.

A shoe 71 is fixed to the rear angles 46 a sufficient distance therefrom to clear the chain blades, and extends from the lower sprocket wheel 53 to a suitable point thereabove, to clean the ditch as the machine advances.

The drive from the shaft 10^a to the digger shaft 36 is arranged as follows:—

The rear end of said shaft is journaled in a box 72, and has on such end inside the box a bevel gear 73.

This gear meshes with a gear 74 formed integral with a similar and spaced gear 75, the two having a common hub 76. This hub is mounted on a bushing 77 which in turn is on a shaft 78 turnably mounted therein, in the box 72, and in a bearing 79 mounted to the frame.

The hub 76 turns in a bearing boss 80 formed integral with a box 81, similar to the box 72 and positioned between the digger frame plates 45. The boss 80 is itself turnable in a sleeve 82 formed integral with the box 72, so that these two boxes and the gear hub and shaft are firmly yet swivelly held together.

The digger shaft 36 projects through the box 81 and is slidable therein, and is provided with a longitudinal keyway 83. A bevel gear 84 is slidably mounted on this shaft, having a key which engages the said keyway, which gear constantly meshes with the gear 75, both said gears being of course enclosed in the box 81.

The shaft 36 is also slidable through a cross member 85, in the box 81, the shaft 78 being fixed in said cross and terminating adjacent the shaft 36. Another shaft 86 is similarly fixed in the cross beyond the shaft 36 and in a projected line with the shaft 78. This shaft projects through the box 81, being turnably mounted therein, and extends to a bearing on the chassis frame the same as the shaft 78. Thus the two boxes are held in positive and inflexible alinement on the frame 1, while permitting swivelling movement thereof.

In order to positively aline the box 81 with the digger frame and yet allow relative vertical movement thereof, the transverse sides of said box are provided with vertical guide lugs 87 (see Fig. 7) adapted to slidably engage the edges of the inner frame-channels 47 of the digger frame.

The boxes 72 and 81 are formed in two halves, bolted together as shown at 88, the box 81 being split vertically and the box 72 horizontally. They also have removable covers 89, so that the gears may be inspected and packed with grease without dismantling the machine.

The digging structure is held by the members 70 in a position so that it has a slight forward slope from its upper to its lower end at all times. Thus a good portion of the digging strain is taken by the digger structure instead of only by the chain and digger blades.

In order to raise and lower the digger structure, I provide on each side thereof multiple pulley units 90 and 91, the former being attached to the digger frame and the latter to the chassis frame.

A rope or cable 92 is operatively passed about each set of pulleys, which is wound on a common drum-shaft 93, which is turned by a hand wheel 94 within reach of the operator.

To brake the progress of the machine, and to aid in steering the same, I employ independent brakes 95 on the shafts 20, operatively connected to foot pedals 96, while an emergency brake mechanism is also included, actuated by a hand lever 97.

From the foregoing description it will be readily seen that I have produced such a device as substantially fulfills the object of the invention as set forth herein.

While this specification sets forth in detail the present and preferred construction of the device still in practice such deviations from such detail may be resorted to as do not form a departure from the spirit of the invention, as defined by the appended claims.

Having thus described my invention what I claim as new and useful and desire to secure by Letters Patent is:—

1. A ditching machine comprising a frame, a power plant thereon, a vertical digger frame suspended in the main frame and adapted for vertical movement, rotatable members on each end of the digger frame, such members carrying an endless digging structure, and positively engaging the same and means for driving both said members from the power plant irrespective of the vertical positioning of the digger frame.

2. A ditching machine comprising a frame, a power plant thereon, a vertical digger frame suspended in the frame and adapted for vertical movement, sprocket wheels on each end of the digger frame, such wheels carrying an endless digging structure, and being both driven from the power plant, and means for altering the vertical position of said digger frame the vertical alinement of the same being maintained substantially constant.

3. A ditching machine comprising a frame, a power plant thereon, a vertical digger frame suspended in the frame and adapted for vertical movement, sprocket wheels on each end of the digger frame, such wheels

carrying an endless digging structure, means for altering the vertical position of said digger structure, and means for driving both sprocket wheels from the power plant irrespective of such vertical positioning.

4. A ditching machine comprising a frame, a power plant thereon, a vertical digger frame suspended in the frame and adapted for vertical movement, sprocket wheels on each end of the digger frame, such wheels carrying an endless digging structure, a vertical shaft turnably mounted in the vertical frame operatively connected with both sprocket wheels to drive the same, and means for turning said shaft from the power plant irrespective of the vertical positioning of the digger frame.

5. A ditching machine comprising a wheel-mounted frame, a digger frame suspended in the frame and adapted for vertical movement, sprocket wheels on each end of the latter frame, such wheels carrying an endless digging structure, a vertical shaft in the digger frame operatively connected to the sprocket wheels to turn the same, a transverse shaft on each side of the vertical shaft in the plane thereof and mounted to the main frame and to the vertical shaft, the latter being arranged for vertical sliding movement relative to the transverse shaft, means for driving the vertical shaft from the plane of the transverse shaft, guide members on the main frame with which said members engage, and radius rods pivoted to the lower end of the digger frame and extending forwardly to the main frame and pivoted to the latter.

6. A ditching machine comprising a wheel-mounted frame, a digger frame suspended in the frame and adapted for vertical movement, sprocket wheels on each end of the latter frame, such wheels carrying an endless digging structure, a vertical shaft in the digger frame operatively connected to the sprocket wheels to turn the same, a box surrounding the vertical shaft slidably mounted to the digger frame and swivelly connected to the main frame and through which the vertical shaft is slidable, a fixed box to one side of the digger frame and in alinement with and adjacent the first named box, a gear slidable on the shaft and fixed in the first named box, another gear in said box meshing with said first named gear, and a driven gear in the fixed box formed integral with the second named gear, both said last named gears being transversely alined and turnably mounted in both of the boxes.

7. A ditching machine comprising a wheel-mounted frame, a digger-frame suspended in the frame and adapted for vertical movement, sprocket wheels on each end of the latter frame. such wheels carrying an endless digging structure, a vertical shaft in the digger frame operatively connected to the sprocket wheels to turn the same, a box surrounding the vertical shaft slidably mounted to the digger frame and swivelly connected to the main frame and through which the vertical shaft is slidable a fixed box to one side of the digger frame and in alinement with and adjacent the first named box, a gear slidable on the shaft and fixed in the first named box, another gear in said box meshing with said first named gear, and a driven gear in the fixed box formed integral with the second named gear, both said last named gear being transversely alined and turnably mounted in both of the boxes, and guide means at the top and bottom of the digger frame connected with the main frame to carry the strain of digging and take the thrust off the swivel point of the vertical shaft with the boxes.

8. In a digging machine, endless chains, digging blades fixed to the chains, and upper and lower sprocket wheels about which the chains pass, both the upper and lower sproket wheels being driven.

9. A ditching machine including a main frame, a rigid digger frame mounted therein and arranged for vertical movement, sprocket wheels at both ends of the digger frame and carrying an endless digger structure, a shaft extending between the sprockets and operatively connected therewith to drive the same, a power driven shaft operatively connected with the first named shaft, the axial lines of said shafts intersecting each other, and means whereby the digger frame and vertical shaft may be moved vertically without distrubing the driving relation between the shafts.

10. A ditching machine including a main frame, a rigid digger frame mounted therein and arranged for vertical movement, sprocket wheels at both ends of the digger frame and carrying an endless digger structure, a shaft extending between the sprocket and operatively connected therewith to drive the same, a power driven shaft operatively connected with the first named shaft, the axial lines of said shafts intersecting each other, radius rods mounted on the main frame and connected to the lower ends of the digger frame, whereby such end would normally describe an arc when moved downwardly, and means between the main frame and the upper end of the digger frame for causing said digger frame to move in a substantially straight vertical path and without throwing any strain on the shafts.

11. A ditching machine including a main frame, a rigid digger frame mounted therein and arranged for vertical movement, sprocket wheels at both ends of the digger frame and carrying an endles digger structure, a shaft extending between the sprockets and operatively connected therewith to drive the same, a power driven shaft operatively

connected with the first named shaft, the axial lines of said shafts intersecting each other, radius rods mounted on the main frame and connected to the lower ends of the digger frame, whereby such end would normally describe an arc when moved downwardly, grooved guides facing each other on opposite sides of the digger frame and projecting upwardly from the main frame, and rollers carried by the digger frame and riding in the grooves, the latter being shaped to allow movement of the digger frame in a substantially straight vertical path without throwing strain on the shafts at their point of intersection.

In testimony whereof I affix my signature.

MAX PAUL.