

Dec. 30, 1924.

H. H. FRANKS

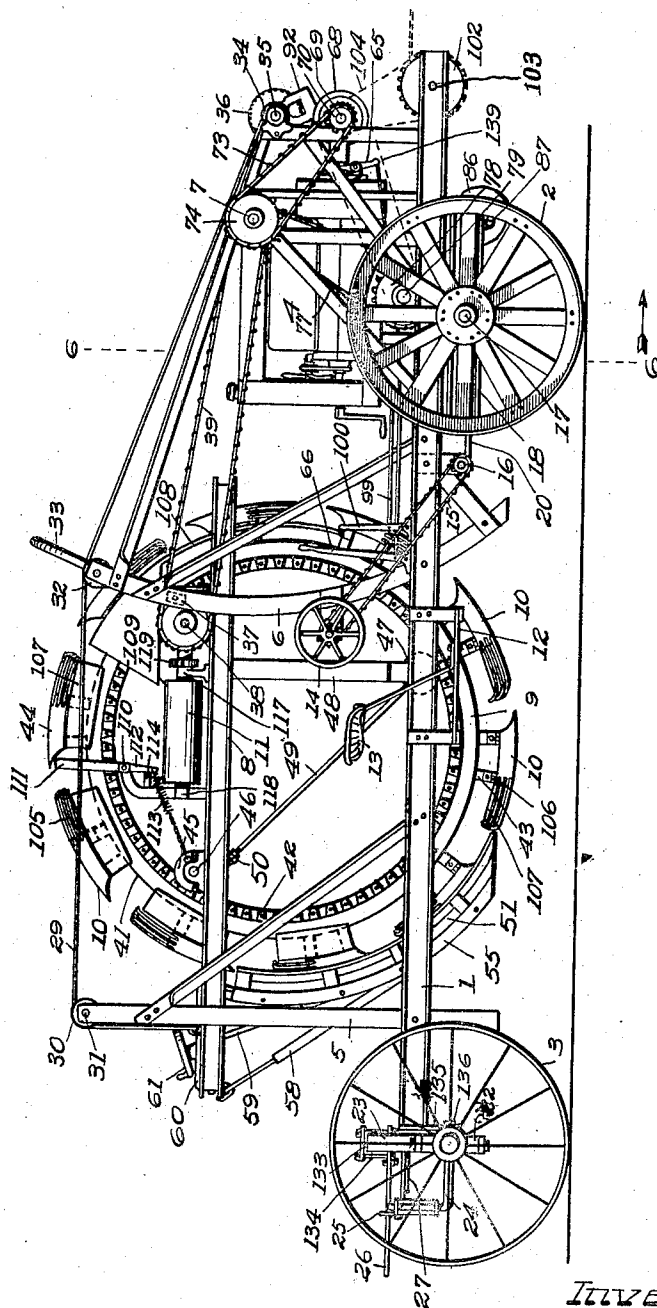
1,521,236

TRENCHING MACHINE

Filed Nov. 23, 1921

4 Sheets-Sheet 1

FIG. 1.



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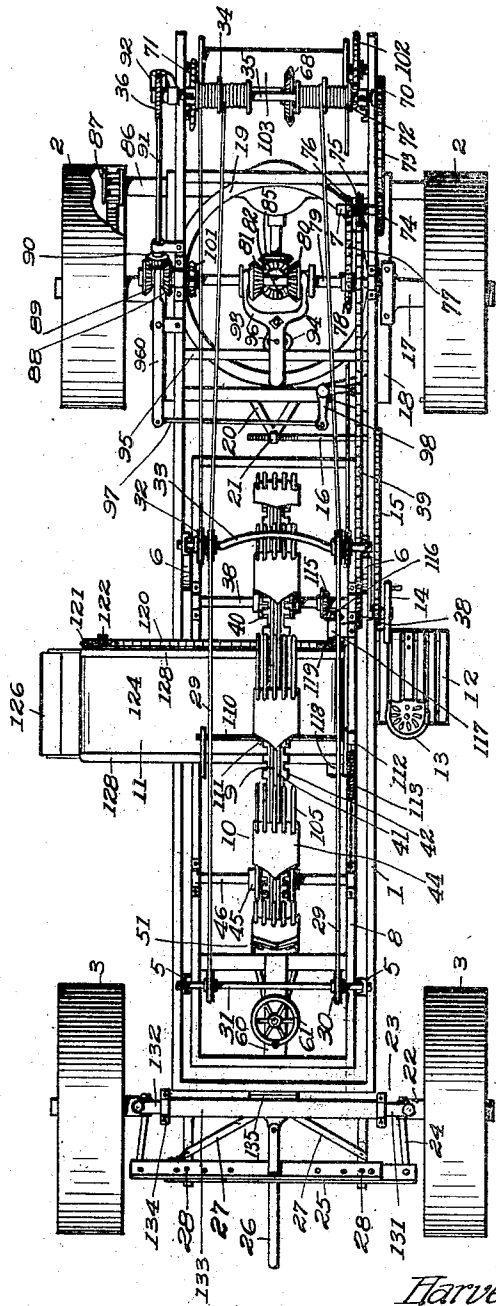
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Fig. 2.



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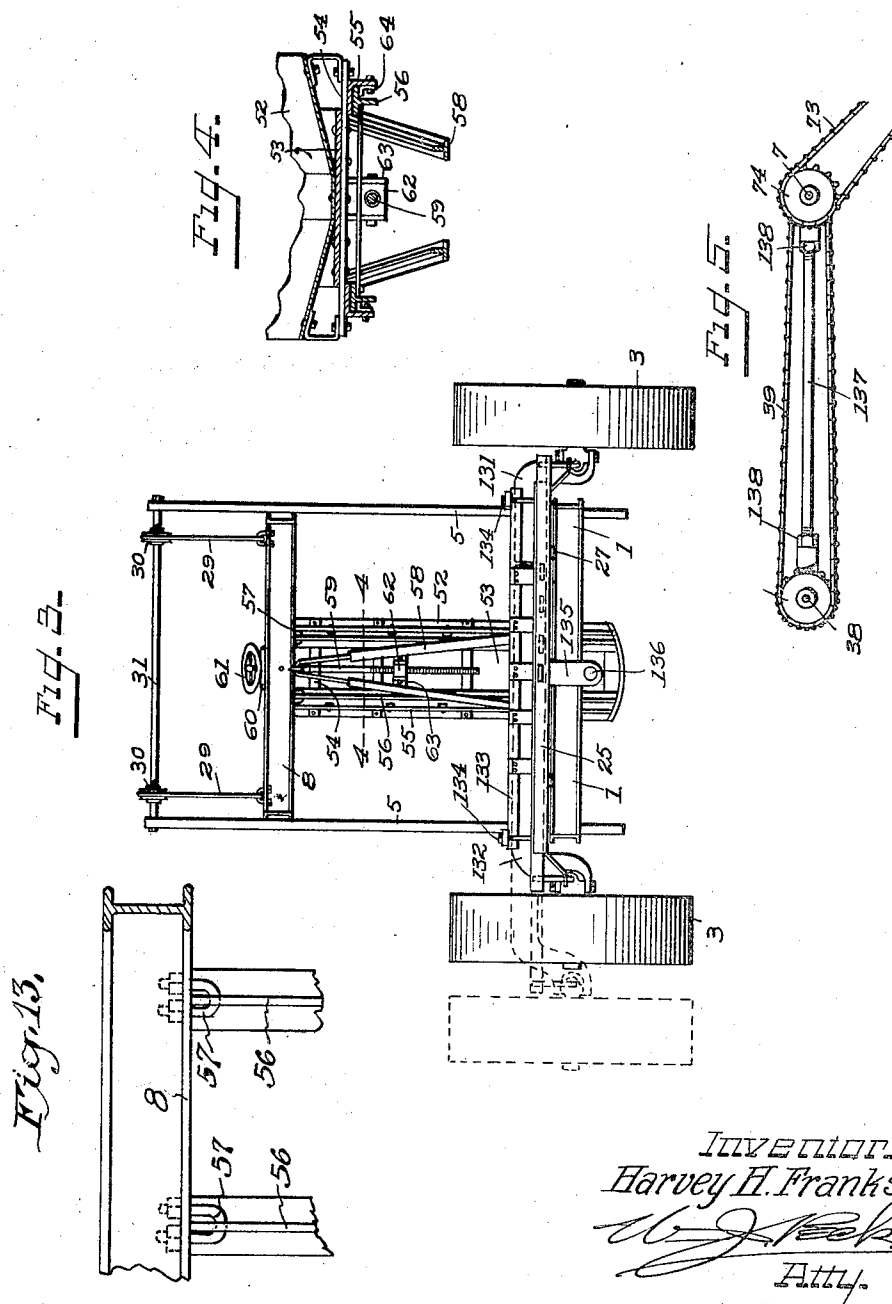
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TRENCHING MACHINE

Filed Nov. 23, 1921

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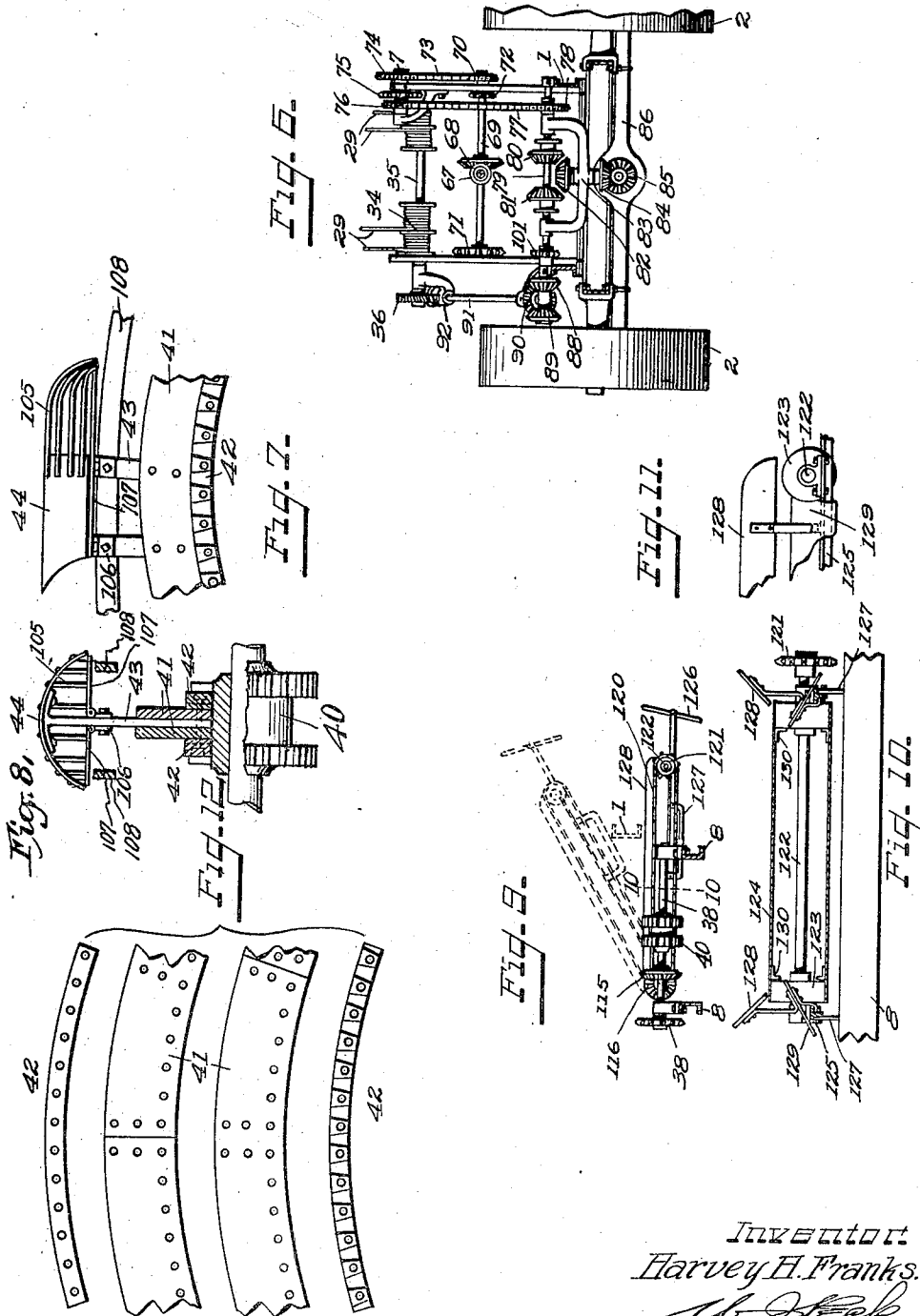
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1,521,236

TRENCHING MACHINE

Filed Nov. 23, 1921

4 Sheets-Sheet 4



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Patented Dec. 30, 1924.

1,521,236

UNITED STATES PATENT OFFICE.

HARVEY H. FRANKS, OF DIXON, ILLINOIS.

TRENCHING MACHINE.

Application filed November 23, 1921. Serial No. 517,160.

To all whom it may concern:

Be it known that I, HARVEY H. FRANKS, a citizen of the United States, and a resident of Dixon, in the county of Lee and State of Illinois, have invented certain new and useful Improvements in Trenching Machines, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming part of this specification.

My invention relates to machines for digging trenches within which drain or other pipes are to be laid, and more particularly to that class of such machines which operate by power and are self propelled.

One object of my invention is to provide a machine which shall be relatively cheap to construct, efficient to operate, of simple and durable construction.

Another object of my invention is the provision of a construction which may be operated to dig curved trenches.

Another object of my invention is the provision of means whereby the machine may be operated in marshy or similar places where traction is difficult.

Other objects of my invention will be described in the specification.

The novelty of my invention will be hereinafter more fully set forth and specifically pointed out in the claims.

In the accompanying drawings,

Fig. 1, Sheet 1, is a side elevation of a machine embodying my invention.

Fig. 2, Sheet 2, is a plan view of Fig. 1.

Fig. 3, Sheet 3 is a rear end view of the rear portion of the machine.

Fig. 4, Sheet 3, is a sectional plan view taken on the dotted line 4—4 of Fig. 3. This view is on an enlarged scale.

Fig. 5, Sheet 3, is a detail of the radius mechanism of the machine in a modified form.

Fig. 6, Sheet 4, is a sectional end view of the forward portion of the machine taken on the dotted line 6—6 of Fig. 1, looking in the direction of the arrow.

Fig. 7, Sheet 4, is an enlarged detail side view of a portion of the bucket carrying ring and one of the buckets.

Fig. 8, Sheet 4, is an end view of Fig. 7.

Fig. 9, Sheet 4, is a side view of the conveyor and its associated parts.

Fig. 10, Sheet 4, is an enlarged sectional end view of Fig. 9 taken on the line 10—10 of Fig. 9, looking to the right.

Fig. 11, Sheet 4, is an enlarged view of the right end of Fig. 9, the sprocket and chain being removed.

Fig. 12, Sheet 4, is a composite view of the construction of the bucket carrying ring.

Fig. 13, Sheet 3, is an enlarged detail view of a portion of Fig. 3.

The same numerals of reference are used to indicate identical parts in all the figures.

As showing one form of construction embodying my invention, I have shown a machine consisting of a main frame 1, which is supported by forward ground wheels 2, and rear ground wheels 3, the main frame carrying, near its forward end, a motor 4, which may be the usual internal combustion engine such as used in trucks, or any other suitable form of motor, the power from which is used to operate the balance of the machine, except as otherwise noted herein.

The main frame 1 carries guiding standards 5 and 6, the standards 5 being at the rear of the main frame while the standards 6 are forward of the center of the main frame and are preferably curved as shown, the radius of the curvature being from the center of the shaft 7 which, together with its connections will be described later herein.

A vertically movable frame 8 is mounted between the standards 5 and 6 and this frame carries the bucket ring 9, the latter carrying a series of buckets 10. An endless belt conveyor 11 is also carried by the frame 8 to discharge the earth, brought up by the buckets, to the side of the machine.

An operator's platform 12 is mounted on the main frame 1 and carries a seat 13 adjacent to which is mounted a steering wheel 14 from which a sprocket chain 15 leads to a shaft 16 which steers the front wheels 2, these wheels being mounted on stub axles 17 (Figs. 2, and 6,) which are carried by a fifth-wheel frame 18 which is connected to the main frame 1 by the fifth-wheel 19, the fifth-wheel frame being operated to accomplish the steering of the forward end of the machine by means of a bracket 20 which carries a nut 21 which engages threads formed on the shaft 16 so that as this shaft is turned in one direction the machine will be steered to the right and vice-versa.

The rear wheels 3 are mounted on steering knuckles 22 carried by the ends of the rear axle 23, each steering knuckle being provided with a steering arm 24, the two

arms being connected together for simultaneous movement by a tie rod 25, the latter being provided with a lever 26 for its operation.

5 As shown more clearly in Fig. 2, a pair of braces are carried by the rear axle, these braces being numbered 27 and extending rearward from the rear axle structure and being positioned so that the tie rod 25 may
10 be locked thereto as by pins 28 so that under normal conditions, the rear wheels are locked against steering.

The movable frame 8 is carried by cables 29, there being four of these cables, two
15 being attached to the frame 8 near its rear end and two near its front end, the rear cables passing up from the frame and over sheaves 30 carried by a shaft 31 mounted at the upper ends of the standards 5, these
20 cables then passing forward and over the double grooved sheaves 32, carried by the arched shaft 33 carried by the upper ends of the standards 6, from which point the cables pass forward and are attached to and
25 adapted to be wound upon, drums 34 carried by a shaft 35, the latter being operated by a worm wheel 36 through connections to be later described. The cables 29 which are attached near the front end of the frame
30 8 pass upward and over the double grooved sheaves 32 and then forward to the drums on the shaft 35, the construction and operation of the parts just described being such that as the shaft 35 is operated in one or
35 the other direction, the frame 8 is raised or lowered.

The frame 8 carries a guide block 37 in engagement with the channel of each of the standards 6 so that as the frame is
40 raised or lowered it is moved forward and back in such manner that the shaft 38 is always maintained a predetermined distance from the shaft 7, each of these shafts carrying sprockets over which the chain
45 39 passes, this chain serving to rotate the shaft 38 in any position of the frame 8.

The shaft 38 carries a double gear 40, shown in Fig. 9, this gear meshing with and driving the bucket ring 9, which is
50 composed of a pair of segmental rings 41, Fig. 12, each of which carries a segmental gear ring 42, the rings 41 being spaced apart and carrying between them the standards 43 which carry the buckets 44, Figs.
55 7 and 8, the double gear 40 by its engagement with the gear segments 42 serving to drive the bucket ring, and also guide the bucket ring and prevent its sidewise displacement, it being noted that the teeth
60 of the segmental gears 42 extend laterally from the body portion and are open at their outer diameter, the body portion of the segmental gears riding in the groove of the double gear 40.

65 A guide roller 45 is carried by a shaft

46 which is suitably journaled on the frame 8, and a second guide roller 47 is carried by a pendant arm 48 from the frame 8, the pendant arm 48 being adjustably braced in position by the braces 49 which are ad-
70 justably connected to the frame 8 as by the lock nuts 50.

An adjustable guide or shoe 51 is carried by the frame 8 at the rear end thereof, this shoe comprising, as better shown in Fig.
75 4, a forward member 52, a plate 53, cross members 54 and a pair of angle irons 55, all suitably riveted or bolted together.

The structure just described is carried by a frame comprising a pair of T irons 56
80 carried by the frame 8 and attached thereto as by U bolts 57 Fig. 13 and braced in position by the braces 58 which are also attached to the frame 8.

A lead screw 59 is mounted on the frame
85 8 as by the bracket 60 and carries on its upper end a hand wheel 61 whereby it may be operated, its lower threaded portion passing through a nut 62 carried by a pair of brackets 63 which are attached to the rear
90 face of the plate 53. A series of clips 64 are carried by the angle irons 55 and engage the edges of the T irons 56 to retain the shoe 51 in proper relation to its frame, the construction and operation of the parts just de-
95 scribed being such that as the hand wheel 61 is operated, the shoe is raised or lowered along its frame, the shoe being curved and being mounted on a curved frame so that it always travels at the same distance from
100 the buckets 44.

I will now describe the power connections from the motor 4, the latter being provided with a suitable clutch which is controlled by the shifter 65, Fig. 1, which in
105 turn is controlled by the lever 66 mounted on the main frame in position to be operated by the driver of the machine. The clutch controls a pinion 67, Fig. 6, which meshes with and drives a gear 68 carried
110 by the shaft 69, the latter carrying sprockets 70, 71, and 72.

A chain 73 passes from the sprocket 70 to the sprocket 74 carried by the shaft 7, the latter carrying sprockets 75 and 76,
115 the chain 39 passing over the sprocket 75 and a chain 77 passing over the sprocket 76 and also over a sprocket 78 carried by shaft 79, the latter also carrying the splined bevel gears 80 and 81, either of which may
120 engage the gear 82 carried on the vertical shaft which passes through the bearing 83 and carries bevel gear 84 on its lower end, which meshes with the bevel gear 85 which in turn drives the differential in the axle
125 housing 86. At the ends of the axle housing 86, pinions 87, Fig. 2, engage gear teeth carried by the wheels 2.

Referring again to Fig. 6, the shaft 79 also carries a pair of splined bevel gears
130

88 and 89 either one of which is adapted to mesh with the bevel gear 90 carried by the angularly arranged shaft 91 which extends forward and upward to the bracket 92 carried by the shaft 35, this bracket affording a bearing for the upper end of the shaft 91 and a housing for a worm which meshes with the worm wheel 36 carried by the shaft, 35.

As shown more clearly in Fig. 2 the bevelled gears 80 and 81 are engaged by a shifter 93 which is carried by a bracket 94 attached to one of the cross members 95 of the main frame 1, the bracket 94 being provided with three holes either of which is adapted to be engaged by a pin 96 which passes thru the shifter 93 and which, when engaged with either of the holes of the bracket 94, locks the shifter 93 so that the gears are in the neutral position or locks the parts so that the gear 80 is engaged with the gear 82, or so that the gear 81 is engaged, the position of the shifter 93, when either of the gears 80 or 81 are engaged, determines whether or not the machine moves forward or backward.

The gears 88 and 89 are controlled by a shifter 960 which is operated by a connecting rod 97 extending from a bell-crank 98 connected as shown in Fig. 1 by the rod 99 with lever 100, so that either of the gears 88 or 89 may be brought into mesh with the gear 90 to rotate the shaft 91 in either direction to raise or lower the frame 8.

Referring again to Fig. 6, the shaft 79 also carries a sprocket 101 which is in line with the sprocket 71 carried by the shaft 69, the latter being the main power shaft of the machine and it is to be noted that the sprocket 71 is considerably larger than the sprocket 101 while the sprocket 70 is considerably smaller than the sprocket 74 of the shaft 7. The sprockets 71 and 101 are provided so that when it is desired to move the machine when the bucket wheel is not to be operated, the chain 77 may be removed from the sprockets 76 and 78 and placed over the sprockets 71 and 101 in which case the shaft 79, when the clutch of the motor is engaged, will rotate at considerably higher speed than when the connections are as shown in Fig. 6, these connections being shown in their proper order when the machine is to be moved ahead at a speed proper for digging.

The sprocket 72 carried by the shaft 69 is in line with a sprocket 102, Figs. 1 and 2, which is carried by a drum shaft 103 mounted at the front of the main frame and upon which any suitable cable may be wound, the end of the cable being attached to any stationary object at a distance ahead of the machine so that under conditions where the traction of the front wheels 2 is not sufficient to move the machine forward, a chain,

shown in dotted lines at 104 Fig. 1, may be passed over the sprocket 72 and 102 thus providing a winch to advance the machine.

Referring more particular to Figs. 7 and 8, each bucket 44 is provided with a plurality of tines 105 and the standards 43 of each bucket carry hinges 106, arranged on each side thereof, each pair of hinges carrying a plate 107 these plates serving, during the upward movement of the buckets, to prevent the contents from falling from the bucket. To hold the plates 107 in the position shown in Figs. 7 and 8 during the upward movement, guides 108 are carried by the frame 8 and project downward a sufficient distance to come in contact with the plates 107, the guides 108 extend upward to and terminate at guide board 109 so that when the buckets have passed beyond the end of the guide 108 the plates 107 drop and permit the contents of the bucket to fall upon the conveyor 11.

A cross shaft 110 is mounted above the conveyor 11 and carries a series of fingers 111 which serve as strippers to remove the contents from the buckets when the condition of the material being operated upon is such that this material adheres to the bucket or to the plates 107, the shaft 110 being provided with an arm 112 to the lower end of which a spring 113 is connected, the arm 112 normally resting against a stop 114, so that the stripping fingers 111 are yieldingly held in operating position.

I will now describe the conveyor 11 and its mounting and driving connections, referring more particularly to Figs. 1, 2, 9, 10, and 11. The shaft 38 carries a bevel gear 115 which meshes with and drives a similar gear 116 carried by a shaft mounted on bearings 117 and 118 carried by the frame 8, this shaft carrying a sprocket 119 from which a chain 120 passes to sprocket 121 carried by shaft 122 at the discharge end of the conveyor, the shaft 122 carrying the drive rollers 123 over which the conveyor apron 124 passes, the similar rollers being loosely mounted on the shaft which carries sprocket 119, the construction being such that the drive for the conveyor is at the discharge end so that the tight side of the apron carries the material being handled.

The frame of the conveyor comprising a pair of side rails 125, shown more clearly in Figs. 10 and 11 which may extend beyond the conveyor and carry a deflector 126. The conveyor is pivoted on the shaft which passes thru the bearings 117 and 118 and the rails 125 each carry a shoe 127 which normally rests upon the frame 8 and which, when the frame 8 is lowered below the main frame 1, comes in contact with the main frame 1 and tilts the conveyor to the

dotted position shown in Fig. 9 so that the material being handled is conveyed over the main frame 1 to the discharge point at all times. Flare-boards 128 are mounted above the conveyor apron to prevent the material from moving side-wise off of the apron and a second set of flare-boards 129 is mounted between the upper and lower portion of the apron, the ends of each of these flare-boards being fitted to the shape of the rollers 122 as shown more clearly in Fig. 11 so that any accumulation of material on the outer surface of these rollers is scraped off, thus maintaining the proper diameter for these rollers and proper operating conditions for the apron. A series of lugs 130 is attached to the apron 124 to maintain the apron in proper side-wise relation with the conveyor structure, these lugs coming against the inner surface of the rollers 122 and acting as guides for the apron.

When the machine is used to approximately its maximum capacity the amount of material discharged forms a considerable ridge and to permit the rear wheel on the discharge side of the machine to travel forward without running upon this ridge, the rear axle is made extensible, one of the rear wheels being carried on a short section 131, Fig. 3, while the other wheel is carried on a long section 132 both of these sections telescoping into the rear axle structure and being held in place therein by the axle cap 133 and the clamp bolts 134 the tie rod 25 being preferably composed of two sections so that it may be extended in length when the rear wheel on the discharge side of the machine is moved from the full line position of Fig. 3 to the dotted line position. The whole rear axle structure is pivotally connected to the main frame 1 as by the link 135 and pin 136 so that the level of the main frame and the balance of the machine is controlled by the front wheels.

While the machine is in operation for digging a trench, should it be necessary to curve any portion of the trench, the front portion of the machine is steered in the direction desired whereupon the operator releases the rear steering tie rod by extracting the pins 28 and by moving the lever 26, steers the rear end of the machine so that the turning radius of the machine is established at a point approximating the extended axis of the bucket ring 9 with the result that the machine may continue its digging operation round the curve, whereupon the parts are reset and the digging continued. Without the ability to steer the rear wheels as just described, it would be either be necessary to stop the forward progress of the machine and raise the bucket ring and buckets, and reset the machine at the new angle, or it would be

necessary to provide a clearance in some other manner, either of which methods of procedure would result in a delay in the progress of the work.

In place of the curved standards 6 previously described for maintaining the proper center distance of the shafts 7 and 38, these standards may be straight and a radius rod 137 may extend from the shaft 7 and a point in axial alignment with it on the opposite side of the machine the radius rod preferably being adjustable as by right and left threads and held in position by lock nuts 138.

The operation of the machine is as follows:—The drive chain 77 is removed from the position shown in Fig. 1 and placed in the dotted position 139 where it is in engagement with the sprocket 71 and 101 whereupon as the motor 4 has been started, the shifter 93 is moved to the forward driving position, and the clutch of the motor is engaged and the machine moved forward to the point of beginning of the trench to be dug.

The drive chain 77 is again replaced in the position shown in Figs. 1, 2 and 6 and the shifter 93 moved to the neutral position and the shoe 51 elevated as high as it can be moved whereupon the clutch is again re-engaged and the lever 100 is operated to engage the gearing to rotate the shaft 91 and with it the shaft 35 in the proper direction to lower the frame 8. As the buckets form the beginning of the trench and when the lowering process has continued until the shoe 51 comes in contact with the ground, the clutch is disengaged and the shifter 93 operated to engage the wheel driving mechanism whereupon, after having re-engaged the clutch, the machine starts forward and the buckets continue to descend until the proper depth has been reached, whereupon the operator moves the lever 100 to shift the raising and lowering mechanism to neutral and the digging operation proceeds.

Should the elevation of the ground change and require a greater or less depth of the ditch, this may be obtained while the machine is advancing by shifting the lever 100 to lower or raise the buckets as required.

During the operation of the buckets in the ground, the shoe 51 is adjusted until its lower end just clears the bottom of the trench being dug, this shoe serving to steady the bucket ring and its buckets and prevent them from cutting down the sides of the trench while the buckets are traveling downward to their work.

Should an obstruction be met which it is impossible to dig thru, the machine may be reversed thru the medium of the shifter 93 and the obstruction removed.

It will be noted from the above that I have produced a machine in which the major portion of the weight is carried on the solid ground ahead of the trench, and one in which the tractive effort is all exerted ahead of the trench, the walls of the trench only having to carry while the machine is in operation, the weight of the rear portion of the machine; a machine in which the rear wheels may be spread apart thereby further reducing the probability of caving in the banks of the trench; a machine which, when the ground conditions are not such as to provide traction, carries means for moving it forward in the form of a power operating winch; a machine which may dig curves as well as straight trenches and which when operated on curves, turns its curve on a radius on the center of the extended axis of the digging element; a machine which is provided with a proper forward speed for digging purposes and greater forward speed for transporting it; and a machine of simple and substantial construction.

Having thus fully described my invention I claim:—

1. In a trenching machine, the combination of a main frame, forward driving and steering wheels therefor, rear supporting and steering wheels for the main frame, a digging element carrying frame vertically movable with relation to the main frame and guided in its movement, a digging element rotatably mounted on the digging element carrying frame, reversible power connections from the motor to the driving and steering wheels, and power connections from the motor to the digging element.

2. In a trenching machine, the combination of a main frame, driving and steering wheels for supporting the forward part of the frame, a motor carried by the machine, a digging element carried by the main frame and vertically moveable with relation thereto, disengageable reversible driving connection between the motor and driving and steering wheels, disengageable connections from the motor to the digging element, and a guide shoe for the digging element and moving with this element when the latter is raised or lowered.

3. In a trenching machine, a combination of a main frame, driving and steering wheels for the forward portion of the frame, supporting and steering wheels for the rear portion of the frame, a vertically moveable digging element carried by the machine, driving connections from the motor to the driving wheels, driving connections from the motor to the digging element, a conveyor extending laterally from the point of discharge from the digging element, and means whereby one of the supporting and steering wheels may be

moved to travel beyond the discharge from the conveyor.

4. In a trenching machine, the combination of a main frame, steering and driving wheels for the forward part of the frame, supporting wheels for the rear part of the frame, a power operated digging element carried by the main frame, a laterally discharging conveyor from the digging element, a motor for the power operated digging element and the driving wheels, and means whereby one of the rear supporting wheels may be moved to a path of travel beyond the discharge from the conveyor.

5. In a trenching machine, the combination of a main frame, steering and driving wheels for the forward portion of the frame, steering and supporting wheels, disengageable reversible connections from the motor to the driving wheels, a digging element carrying frame vertically movable with relation to the main frame, a digging element rotatably carried by the latter frame, driving connections from the motor to the digging element, a guide shoe for the digging element and carried by the digging element frame, a laterally discharging conveyor from the digging element, and means for moving one of the steering and supporting wheels to a path of travel beyond the discharge from the conveyor.

6. In a trenching machine, the combination of a main frame, a digging element carrying frame vertically moveable to positions above and below the main frame, a digging element carried by the digging element carrying frame, a discharge conveyor pivotally mounted on the digging element carrying frame adjacent one side thereof and extending laterally to a point beyond the opposite side of said frame, a shoe or rest carried by the conveyor and normally resting upon the digging element carrying frame and adapted to contact with the main frame when the digging element carrying frame is lowered below the main frame, and power connections for the digging element and conveyor.

7. In a trenching machine, the combination of a main frame, a digging element rotatably and vertically moveably mounted thereon, buckets carried by the digging element and comprising in between tines extending rearwardly of the buckets, a closure plate for each bucket and extending to approximately the rear end of the tines, and a guide for holding the closure plates in closed position until the buckets reach discharging position.

8. In a trenching machine, the combination of a main frame, a digging element carrying frame carried thereby, means for raising and lowering the digging element

carrying frame, a guiding and driving element carried by the digging carrying frame, a guiding element carried by the digging element carrying frame, an adjustable pendant guiding element carried by the digging element carrying frame, a digging element carried and guided by the last three mentioned guiding and driving elements, a motor for the machine, and power connections from the motor to the guiding and driving element.

9. In a trenching machine, the combination of a main frame, guiding standards carried thereby, guiding pulleys carried by the upper ends of the standards, a digging element carrying frame between the guiding standards, raising and lowering cables attached to said frame and base over said pulleys, a common hoisting drum shaft for all the cables and to which the latter are attached, a motor for the machine, a power shaft driven by the motor, a radial movement controlling element limiting the movement of the digging element carrying frame to a radius centering in the power shaft, a digging element carried by the digging element carrying frame, driving connections therefor, and connections between the latter and the power shaft for operating the digging element.

10. In a trenching machine, the combination of a frame vertically moveable to positions above and below the main frame, a digging element and connections carried by the latter frame, a transverse conveyor carried by the latter frame and projecting beyond one side thereof, a pivotal mounting for said conveyor whereby when the digging element carrying frame is lowered below the main frame the conveyor will operate above the main frame, flare-boards carried by said conveyor, and combined flare-boards and scrapers mounted partly between the upper and lower portions of

the apron of the conveyor and co-operating with the apron rollers to maintain said rollers in proper diameter.

11. In a trenching machine, the combination of a main frame, a vertical moveably mounted rotatably digging element carried thereby intermediate the ends thereof, steering and driving wheels for the forward portion of the machine, a motor for operating the machine, and steering and supporting wheels for the rear of the machine whereby the machine may be operated to dig a curved trench, the curvature being established on the extended axis of the digging element.

12. In a trenching machine, the combination of a main frame, a digging element carried intermediate the ends thereof, a laterally extending conveyor, a motor for the machine and mounted ahead of the digging element, driving wheels for the machine and ahead of the digging element, an extensible rear axle provided with steering mechanism and carrying steering and supporting wheels and mounted at the rear end of the machine whereby one of the said wheels may be moved to a path of travel beyond the discharge from the conveyor.

13. In a trenching machine, the combination of a main frame, a digging element operably mounted thereon intermediate the ends thereof, laterally extending discharge conveyor for the digging element, steering and driving wheels for the forward portion of the machine, and an extensible rear axle carrying supporting wheels and provided with a normally inactive steering mechanism whereby a turning radius for the machine may be established on the extended axis of the digging element and whereby one of the rear wheels may travel beyond the discharge from the conveyor.

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