March 26, 1957 R. E. TODD 2,786,284

MARSH DITCHER

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Fig. 1

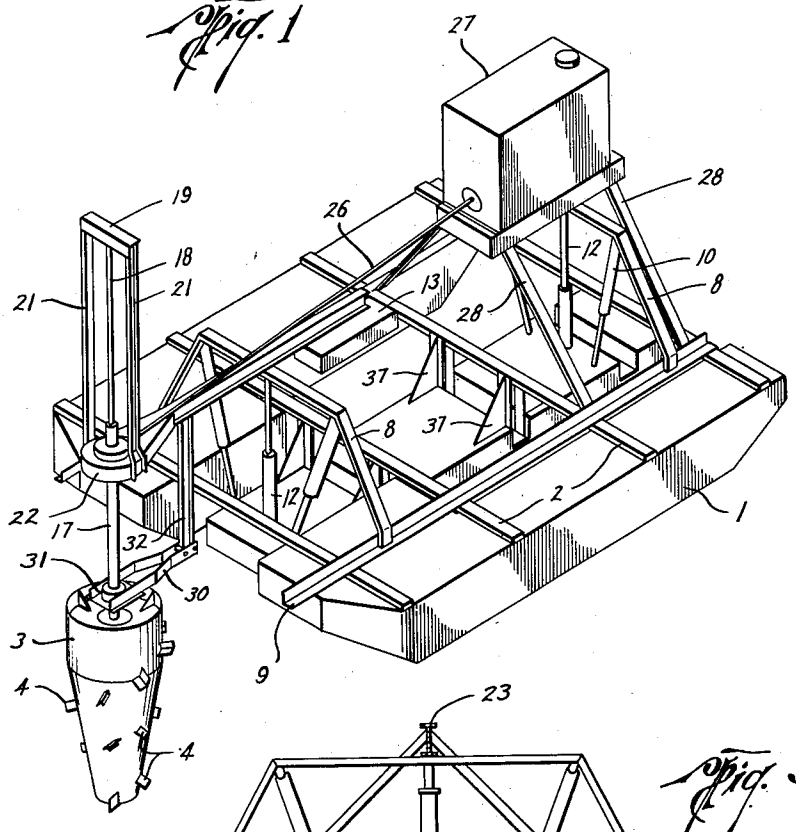
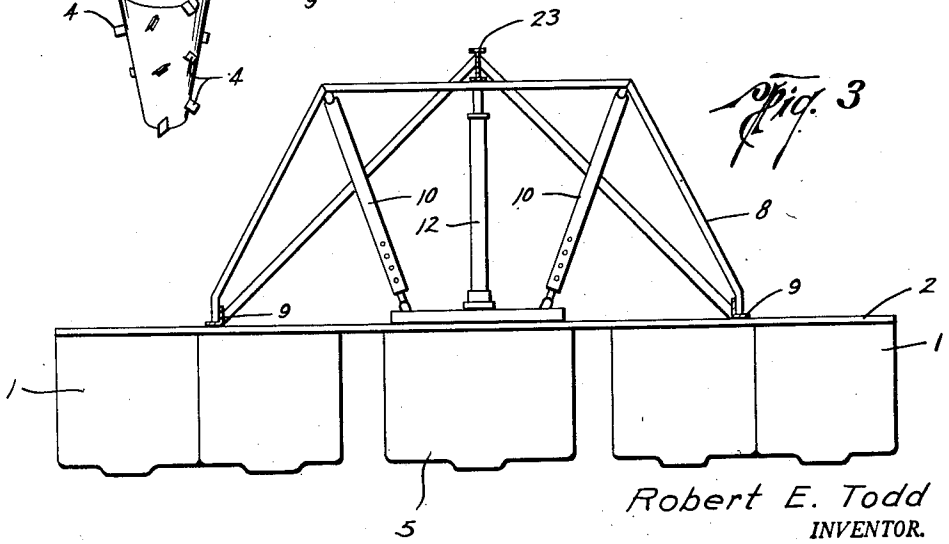


Fig. 3



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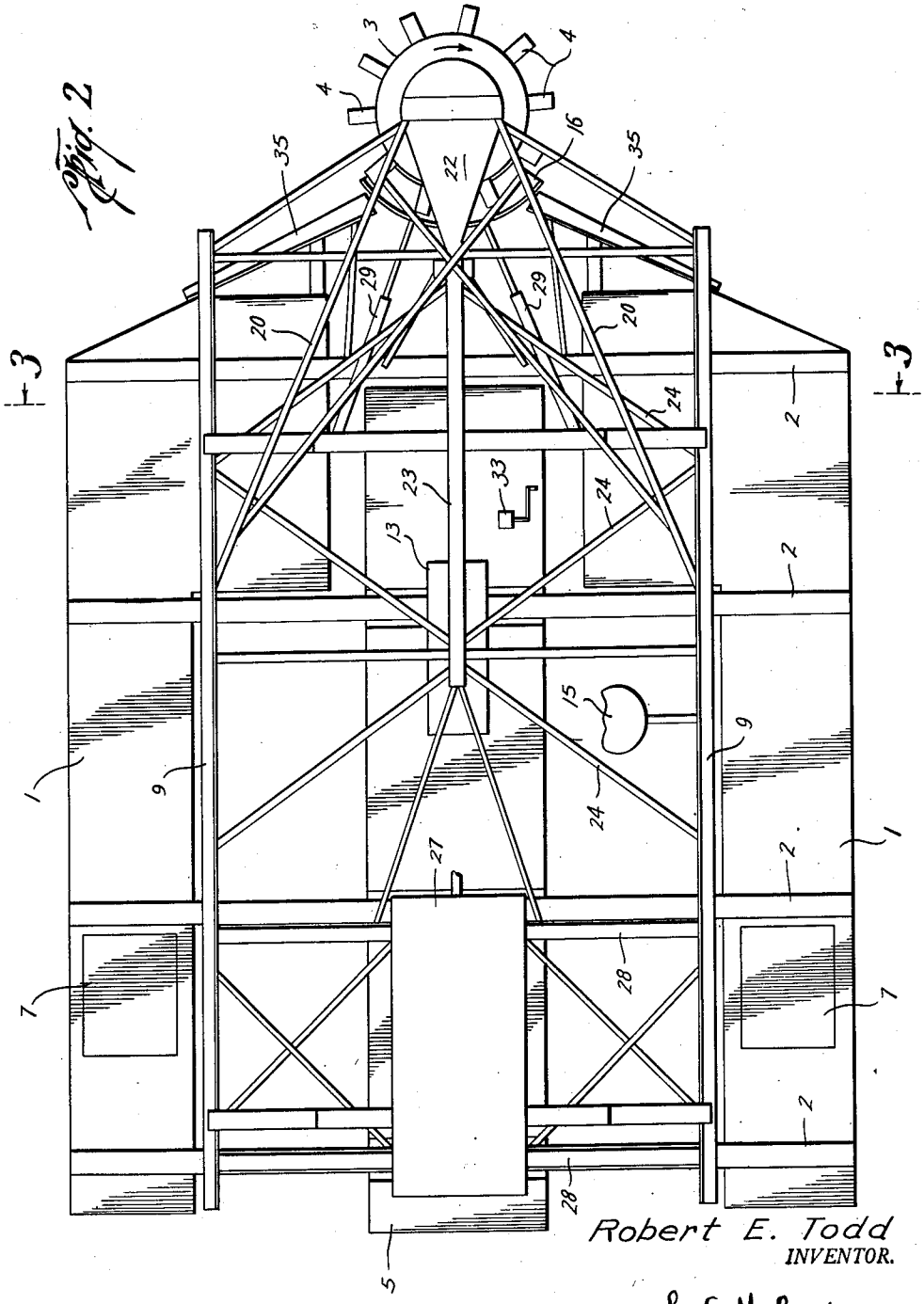
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MARSH DITCHER

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Fig. 2



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MARSH DITCHER

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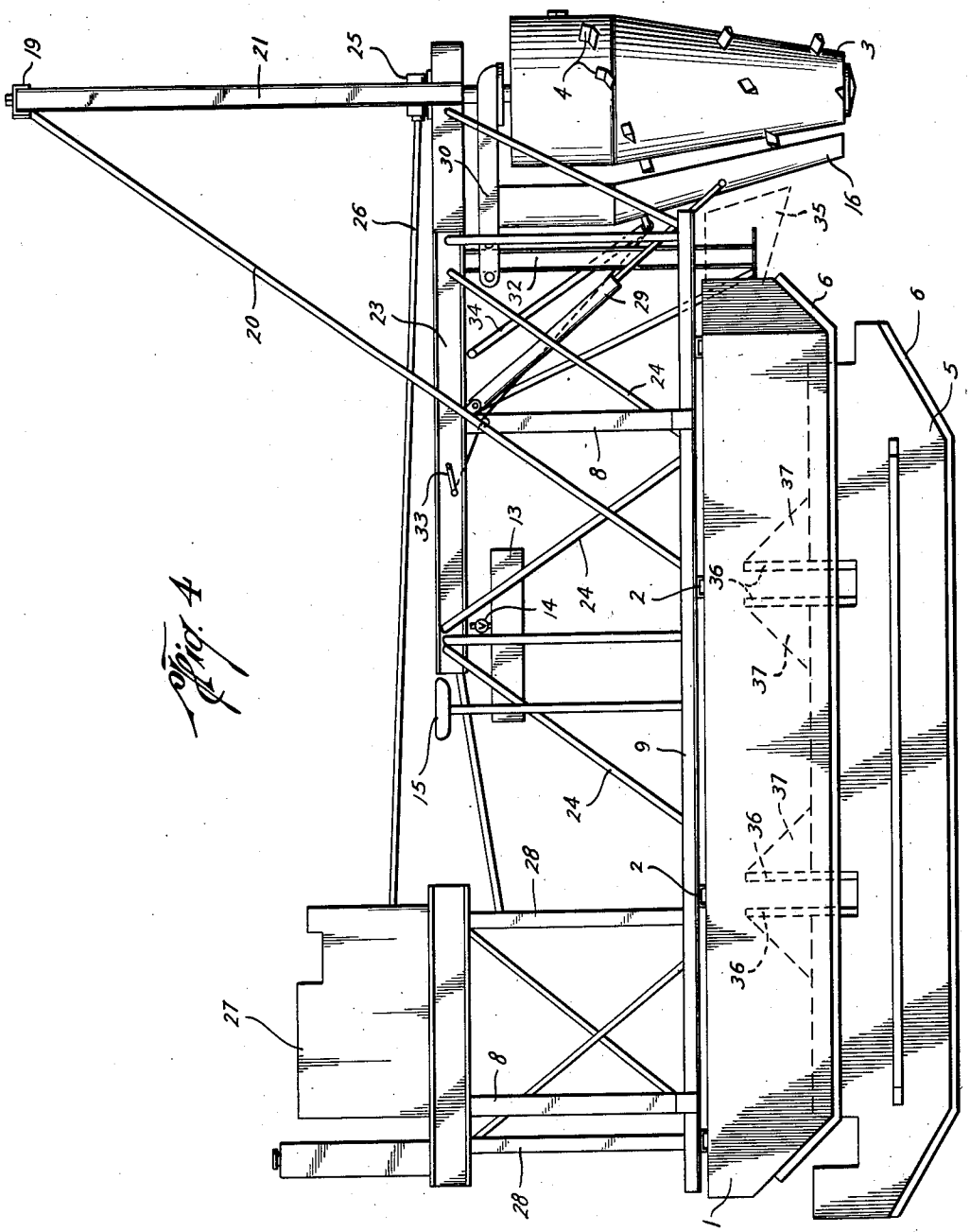


Fig. 4

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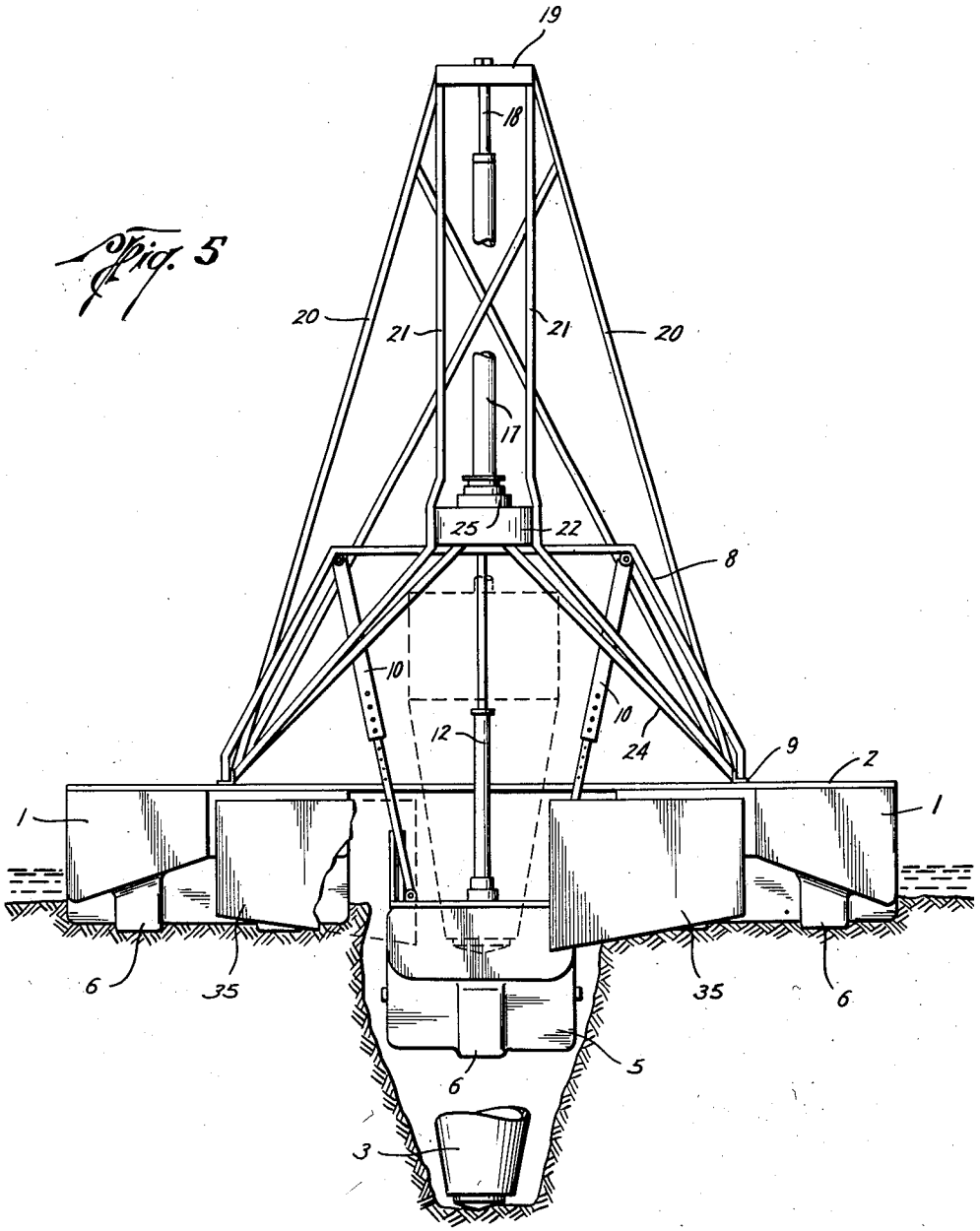
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March 26, 1957 R. E. TODD 2,786,284

MARSH DITCHER

Filed Oct. 30, 1953 4 Sheets-Sheet 4

Fig. 5



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2,786,284

MARSH DITCHER

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Application October 30, 1953, Serial No. 389,300

5 Claims. (Cl. 37—81)

This invention relates to mechanism for cutting a trench through the surface of the earth and more particularly to a power driven rotary high speed spinning digger mounted on a forwardly traveling carriage at a given depth below the ground line to cut through the earth as the carriage advances and to elevate the cuttings above the ground line and to throw them outwardly by centrifugal action.

The apparatus has been designed especially for operating in soft soil such as marsh and swamp land to form a cross-country pipe line receiving trench, but it will find utility in other uses. Oil and gas transportation conduits are usually buried a few feet below the surface and much difficulty has been encountered in forming an open ditch through marsh country because heavy equipment bogs down and is unsuited for operation in occasional strips of open shallow water and because of the tendency for the mucky trench walls to give in. The latter occurs in part because equipment heretofore used has often pulled out roots of vegetation which otherwise would give support and hold loose or spongy formation.

It is an object of the present invention to provide improved mobile equipment for cutting a trench at a rapid rate with a clean shearing of vegetation to leave roots undisturbed in the side walls beyond the opening and which equipment travels along continuously whether on ground or through shallow water and accurately follows a predetermined line under control of a small crew of workmen.

A further object of the invention is to provide a pontoon skid arrangement for supporting the traveling carriage in trench straddling relation with an additional vertically adjustable pontoon-like keel or stabilizer in longitudinal traveling relation with the spinning earth auger mounted at the front of the carriage so that the stabilizer pontoon is received within the trench for keying co-operation with its side walls in resisting torque or other side deflecting forces and maintaining the longitudinal axis of the carriage in the desired line of carriage travel direction.

Another object of the invention is to provide a rotary digger to cut a trench whose side walls taper downwardly to a narrow bottom width only slightly greater than the diameter of the pipe to be installed thereby eliminating removal of excess bottom material while providing ample working clearance near the top and also affording better side wall support against collapse and sloughing off. For a downwardly narrowing trench, the rotary digger is in the form of a downwardly tapered barrel or drum whose peripheral speed is less at the bottom and greater at the top and which carries outwardly projecting blades to cut into and shear the earth and embedded rootings and which blades are arranged in spaced succession in one or more spiral paths to raise the cuttings to the surface and then fling them outwardly beyond the trench where they will be unlikely to wash or slide back into the open trench before the fluid conduit or pipe line is lowered into position.

A further object is to provide a spinning cutter with a back shield to close off the previously dug trench and co-operate with the inclined elevating blades in raising the cuttings to the surface.

A still further object of the invention is to provide pontoon skids of increased size near the digger location for greater resistance to downward pull during the trenching operation inasmuch as the cutter, while normally not acting as an auger bit in the usual sense of boring a hole axially of its length, does have its blades of spiral lead for raising the cuttings and thus tends to pull downwardly.

Other objects and advantages will become apparent during the course of the following specification having reference to the accompanying drawings wherein Fig. 1 is a perspective view of the carriage and blade spinner, the co-operating back shield and certain other structural elements being omitted for clarification; Fig. 2 is a top plan view of the complete machine assembly; Fig. 3 is a front elevation of the pontoon skids with the carriage frame work and keel pontoon adjustable suspension as viewed substantially on line 3—3 of Fig. 2; Fig. 4 is a side elevation of the assembly and Fig. 5 is a front elevation with parts broken away.

Referring to the drawing, a pair of supporting pontoon skids 1—1 are tied together in transversely spaced apart relation by the carriage superstructure which includes a series of longitudinally spaced transverse channel beams 2—2 welded or bolted to the top walls of the pontoon skids 1. The pontoons as shown are large hollow box-like tanks running the length of the assembly. For approximately a third of their length and at the front ends they are of double width to afford greater flotation or supporting area in the end region adjacent the trench cutting digger 3. This aids against and resists downward nosing of the carriage assembly as the inclined or spirally directed blades 4 shear through the ground and elevate the cuttings.

In the space between the two supporting pontoon skids is a third longitudinally disposed hollow tank or pontoon 5, adjustably suspended from the carriage frame structure. Each pontoon is flat bottomed throughout its major area with ramped or upwardly inclined opposite ends. They are faced underside with one or more wear-resistant and longitudinally extending skid straps or wide runners 6 whose forward ends preferably carry tow-hooks for detachable connection with a cable harness through which the carriage is pulled by a traction vehicle, such as the conventional swamp buggy. A towing vehicle is preferred to the incorporation in the carriage assembly itself of self propulsion mechanism although the latter might be feasible for certain types of operation.

Sealed hatch doors 7 are located in the upper walls of the hollow pontoons and allow access to tool storage compartments and also enable water to be introduced as ballast to be later pumped out with a hand bilge pump. Water ballast of varying amount in any one or more of the pontoons will be helpful at times to control the degree of flotation when operating in water covered ground. The depth of ground overlying water, due to temporary conditions or otherwise, in relation to the desired trench depth may at times necessitate complete submergence of the pontoons.

Insofar as concerns operation of the rotary drum cutter or bladed spinner 3, the spinner with its axis normal to the direction of carriage travel, may be suspended anywhere along the length of the assembly, but as shown in the drawing, its location is at the forward end and the third pontoon 5 is in trailing relation for extension into the newly cut open trench as best seen in Fig. 5. During forward advance the pontoon 5 co-operates throughout its length as a slide key with the side walls of the open

trench in guiding the path of carriage travel. While the direction of travel is controlled primarily by the towing traction vehicle, the flexible tow cables cannot control side wise deflection or skid or angular skewing of the towed vehicle and the dependent pontoon 5 serves as a traveling key for maintaining carriage travel on a straight line.

The adjustable suspension for the pontoon or guide key 5 is from the carriage overhead framing and includes front and rear transverse arches 8—8 whose lower ends rest on and are welded to longitudinal angle irons 9 laid on and welded to the transverse tie channels 2. Forward and rearward pairs of downwardly and inwardly inclined slings or suspension rods 10—10 have either trunnion or ball and socket joints at opposite ends with the arches 8 and to the top of pontoon 5 along its sides. Each suspension rod 10 comprises a pair of telescopic tubes or bars having longitudinal spaced apart openings for selective alignment between fully extended and fully contracted relations, to receive a removable retaining or cotter pin. The principal adjustment setting will be for depth of the pontoon within the trench. By relative length adjustment of the several telescopic rods 10 the key pontoon may be shifted in position both horizontally and vertically. In addition to the depth position, the pontoon can be longitudinally slanted either forwardly or rearwardly and it can be shifted laterally from the transversely centered position illustrated.

For power actuation, front and rear hydraulic jacks or piston and cylinder motors 12 extend vertically between and are jointed at opposite ends with the center of the arches 8 and pontoon 5. Each is coupled for pressure fluid actuation by suitable piping leading from a pressure fluid source. The fluid lines will form a part of a hydraulic system, including an engine driven liquid pump and a pressure tank 13 with suitable control valving, one valve being shown at 14 adjacent the operator station or seat 15 near the top of the frame superstructure. An adjustment will be effected when the carriage is stationary by directing liquid pressure to one or both of the piston and cylinder motors 12 after the retaining pins have been removed from the suspension bars 10, the pins being replaced after adjustment. The suspension bars and hydraulic motor illustrated could be replaced by a set of hydraulic jacks which would effect adjustment and hold the pontoon in selected position, and furthermore, would enable adjustment to be effected during transit. However, for practical purposes the adjustable suspension bar is preferred inasmuch as there is infrequent need for pontoon adjustment.

In the lowered position illustrated in the Figs. 4 and 5 the key pontoon 5 is at an extreme low position which would call for a tie chain or cable harness between the pontoon and the supporting frame to resist horizontal displacement of the pontoon. Ordinarily, the key pontoon 5 will be lowered no more than about two feet and at a depth above that illustrated in the drawing, so as to be located fore and aft by spaced pairs of vertical guide plates 36, each braced by a gusset plate 37 and arranged to slidably abut a co-operating portion of an adjacent transverse frame channel 2.

The downwardly tapered blade spinner 3 is an internally braced hollow drum or barrel and, as seen in the drawing, includes a lower frusto-conical portion whose upper end merges into a cylindrical portion. Its diameter and length will depend on the width and the depth of the trench to be dug. In normal working conditions the tapered portion will usually be below ground surface and the cylindrical upper portion will extend above the ground line. The cutting teeth or blades 4 are welded at inner ends to the surface of the drum so as to extend outwardly and they are in circumferentially spaced apart relation. More particularly it is proposed to have the spaced teeth arranged in three spiral rows, although the spiral succession may be varied so long as the teeth are staggered as to height and shear through the ground with upper inclined faces to propel or push the cuttings upwardly.

For co-operation with the cutting blades a curved back shield 16 is located concentrically and immediately behind the auger spinner and is of a width from top to bottom to correspond substantially with the shape of the trench. It extends vertically from the lower tip of the auger bit to a point above the top of the cylinder upper drum portion. In co-operation with the uncut earth ahead and on each side of the rotary auger bit, the back shield 16 provides an encircling tunnel in which the cuttings rise to the surface. The cutting blades 4 above the surface or those which are carried by the upper cylindrical portion of the barrel, have upwardly directed lips or plates along their trailing edges which afford shovel deflectors to impel and throw the earth particles and water and mud forcibly outwardly of the trench under centrifugal force. Since the top of the drum has the largest diameter, the peripheral speed of the uppermost blades 4 is greater and causes the raised material to be thrown away faster than the lower blades can raise it. This prevents dirt piling up at the top of the auger. It may here be stated that auger rotation will preferably be in a high range and spinning speeds as high as 500 R. P. M. are contemplated. The speed will be varied according to the type of ground being worked and in some instances the bit rotation may be as low as 25 R. P. M.

The softer the ground the faster can be the rotational speed and also the rate of forward carriage travel. Sustained forward travel in excess of twenty feet per minute has been run with a removal of earth at a rate of six cubic feet per minute. While the apparatus has not been operated and may not be feasible for use in hard or rocky ground it would have utility in clearing a previously dug ditch in which water collects and freezes to hinder placement of the pipe line. For travel on firm ground, a wheeled or endless track suspension may be preferred over skid runners.

The suspension of the rotating bit is from its upwardly extending drive shaft 17 which is mounted in the frame superstructure. This shaft is a vertically slidable cylinder to telescope with a piston rod 18 whose upper end is fixed to the cross-bar 19 of a supporting mast. The mast includes diagonal braces 20—20 and a pair of vertical channel beams 21 connected at their upper ends to the cross-bar 19. The lower ends of the diagonal braces 20 are bolted to the base angle straps 9 and the lower ends of the channels 21 are bolted to a mounting head 22 secured at the front end of a main frame beam 23 carried by the forward framing arch 8 and braced by a series of diagonal bars 24. Hydraulic pressure is supplied to the cylinder and piston motor 17—18 to raise and lower the cutting bit and the pressure fluid is delivered from the previously mentioned pressure tank 13 under control valving at the operator seat 15.

The drive shaft 17 is exteriorly splined or of polygonal shape for a slide key or drive slip fit with a rotatable collar enclosed within a gear casing 25 on top of the support head 22. In this Kelley type drive the rotary collar will include a ring gear to be driven by a pinion coupled to a power shaft 26 which extends rearwardly to a power plant 27 such as an internal combustion engine. The engine 27 which has a power take off for the hydraulic system pump, is mounted at an elevated position upon a pair of transverse arches 28 which form a part of the carriage superstructure, and is at the rear end of the carriage for good weight distribution. Engine elevation and operator seat location are above the water line for such water depth usage as is likely to be made.

As in the case of the stabilizer or key pontoon 5, there will be seldom need to adjust vertical position of the cutting drum or bit except at the initiation of the trenching operation and upon infrequent occasions when the depth of the trench needs to be varied or when a grade

ditch is to be dug. Accordingly, the back shield normally is rigidly braced by a pair of fixedly adjustable rearwardly and upwardly divergent telescopic tubes or rods 29 pivoted at their upper ends to the frame structure and at their lower ends to the shield at a point midway of its height. The braces will carry a series of openings which can be selectively aligned for the reception of a detachable coupling pin.

At the upper end of the drum, its drive shaft 17 is held in alignment with the piston rod 18 and Kelley drive by a pair of co-operating thrust resisting bars 30 which at their forward ends carry a housing 31 (see Fig. 1), enclosing a double adjustable cone bearing for the drive shaft 17. The back shield depends from and is fixed at its upper end to bars 30 intermediate their ends. At their rearward ends, the bars 30 have a pair of spaced rollers to ride or track on opposite faces of an I-beam 32 extending in vertical parallelism with the axis of the shaft 17. This provides a brace for the shaft in all vertical positions of adjustment. When the vertical position of the cutter bit is to be changed the locking pins for the shield braces 29 must be removed and, in order to relieve the bars 30 from the weight of the shield and which otherwise would tilt the thrust bars 30 and impose strain on the cone bearings in the housing 31, a hand winch 33 is manipulated to keep taut a flexible cable 34 which operates on suitable pulleys and is connected with the shield 16 midway of its width. This cable will suspend the weight of the shield and by control of the winch 33 during the raising and lowering of the auger bit, the supporting bars 30 will move up or down without tendency to become cocked.

At the front of the frame assembly, immediately ahead of the side pontoons 1—1 and closing the space between the pontoons and the curved back shield, are a pair of rearwardly diverging plates 35 which serve as mud guards to deflect and shove dirt thrown outwardly by the bit to keep such dirt from moving into the open trench.

An operating crew of two men will be needed, one to drive the swamp buggy and the other to ride the digger. The ditch is cut by the combined action of forward travel and cutter spinning rotation and the shearing through the ground will cut off plant rootings to leave smooth side walls and undisturbed earth outwardly of the ditch walls

While only a preferred embodiment has been disclosed, it will be understood that various modifications can be made as come within the scope of the appended claims.

What is claimed is:

1. A traveling marsh digger including a pair of transversely spaced pontoon skids of greater width at the front than at the rear, a framework supported by the pontoon skids, a rotary earth auger mounted by the framework in alignment with the space between said pontoon skids and adjacent the wider front end of the pontoon skids to cut a trench and elevate the cuttings during forward travel, a ditch closing shield behind the auger and of substantially the width and height of the auger for co-operation therewith in elevating the cuttings, and a centralizing trench guided pontoon of a width substantially corresponding with the width of the auger and its shield and carried by the framework behind the shield and in the space between said pontoon skids in downwardly projecting relation for sliding bearing on the side walls of the trench excavated by the auger.

2. A traveling marsh digger, including a carriage, a pair of transversely spaced pontoon skids supporting the carriage, an earth cutting trencher supported by the carriage in the space between said pontoon skids, power means to drive the trencher during continuous forward travel of the carriage and a pontoon adjustably suspended

from the carriage in the space between the pontoon skids and in trailing relation to the trencher, said pontoon being adapted to be received within and of a width and length to bear on the side walls of the cut trench as the sole means to compel straight line travel of the carriage.

3. A traveling trench cutting machine, including power driven trench cutting mechanism, a carriage therefor, a pair of longitudinally extended carriage supporting combined skid and pontoon devices transversely spaced on opposite sides of the trench cutting mechanism and operable both for ground surface engagement and for water flotation according to earth surface conditions encountered during travel, and a pontoon device of substantially the width of the trench cutting mechanism and located in the space between the first mentioned devices and projectible into the cut trench behind said cutting mechanism to bear on the sides of the cut trench and thereby resist reaction of the trench cutting mechanism transmitted through the carriage and guide the path of forward machine travel.

4. In a trenching machine, a traveling carriage, a trench cutting knife carrying drum spinner, means mounting the spinner on the carriage for rotation on a vertical axis and for vertical adjustment in the direction of its axis to set cutting depth for a given trench, a thrust resisting brace having rotatable bearing connection with the drum at one end and slidably mounted on the carriage for vertical adjustment with the drum, a back shield enclosing the trench side of the drum for co-operation with said drum in directing cuttings upwardly and being fastened at its upper end to said brace, and an adjustable connection guiding the lower end of the shield from the carriage including take-up mechanism operative during drum vertical adjustment to furnish support for the shield and said slidable brace to which the shield is fastened.

5. In a marsh digger, a traveling carriage, a pair of transversely spaced carriage supporting pontoon skids, a rotary earth cutting spinner device for operation below the ground line and centrally of said transversely spaced pontoon skids, fluid pressure responsive mechanism connected with the spinner device and mounted on the carriage to regulate the operating depth of the spinner, a carriage traveling direction stabilizer pontoon longitudinally aligned with the spinner device in trailing relation therewith in the space between said supporting pontoon skids and of a width substantially corresponding with the width of said spinner for the sliding bearing engagement of its side walls with the side walls of the trench cut by said spinner, and fluid pressure responsive mechanism connecting the stabilizer pontoon with the carriage and operative to raise and lower the stabilizer in the trench cut by said spinner device independently of the operating depth of the spinner.

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