Feb. 23, 1932. G. G. POWELL 1,846,902

TRENCH EXCAVATOR FOR DIGGING AND PREPARING TRENCHES

Original Filed Oct. 6, 1926 3 Sheets-Sheet 1

Fig 1.

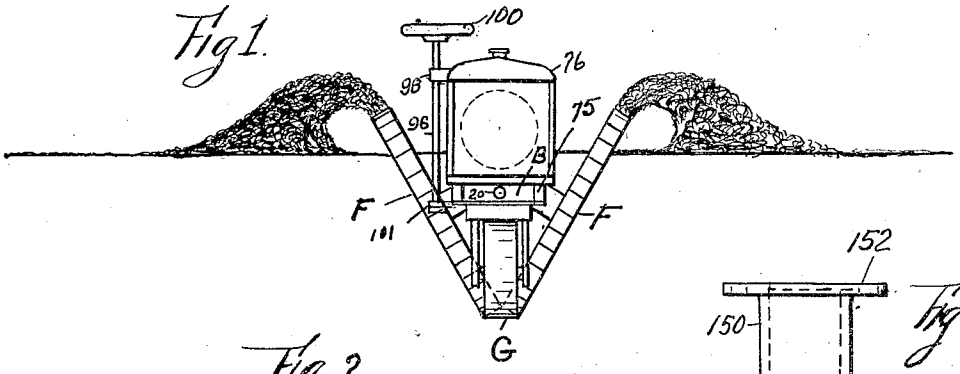


Fig 2.

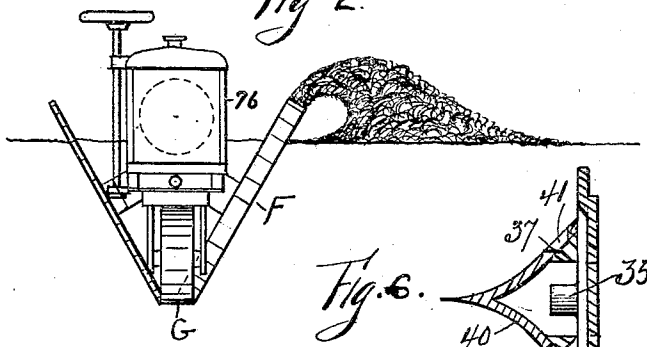


Fig 7

Fig 8

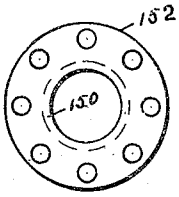


Fig. 6.

Fig 3

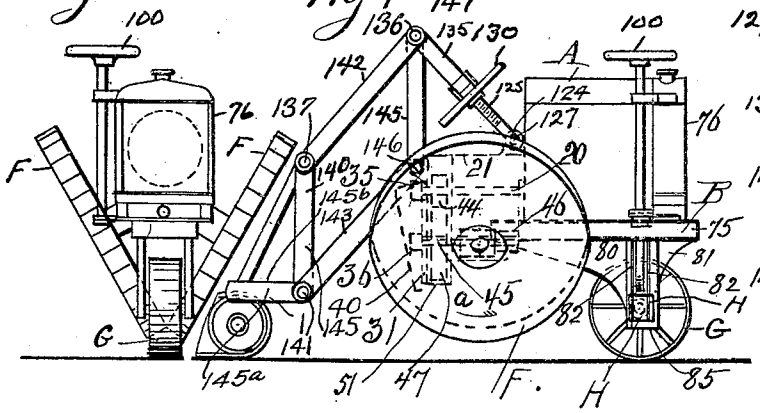
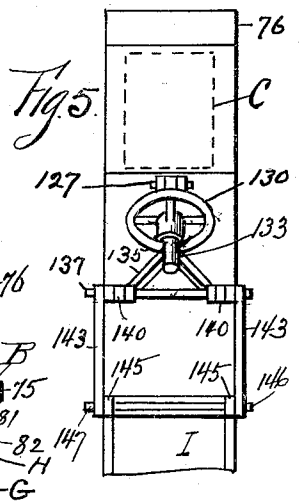


Fig 4

Fig 5.



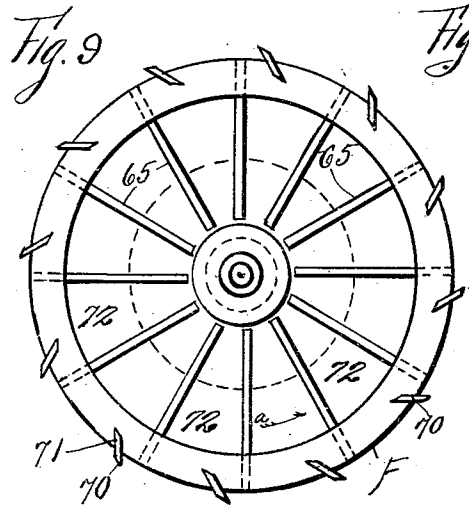
Witnesses:

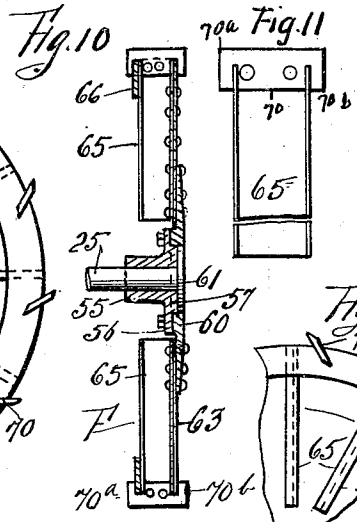
Inventor
George G. Powell

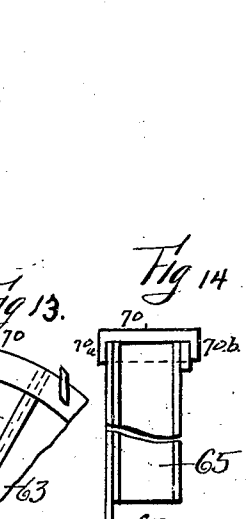
Feb. 23, 1932. G. G. POWELL 1,846,902

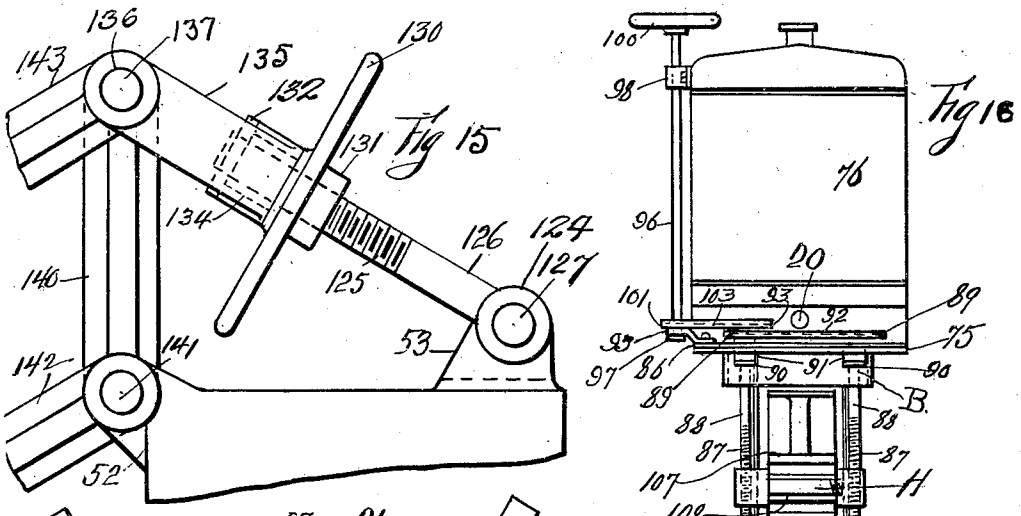
TRENCH EXCAVATOR FOR DIGGING AND PREPARING TRENCHES

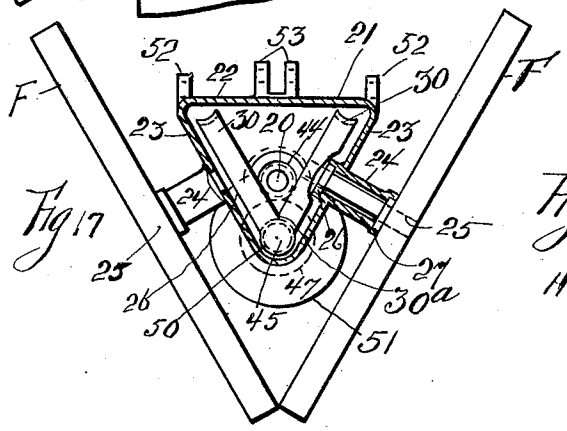
Original Filed Oct. 6, 1926 3 Sheets-Sheet 2











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TRENCH EXCAVATOR FOR DIGGING AND PREPARING TRENCHES

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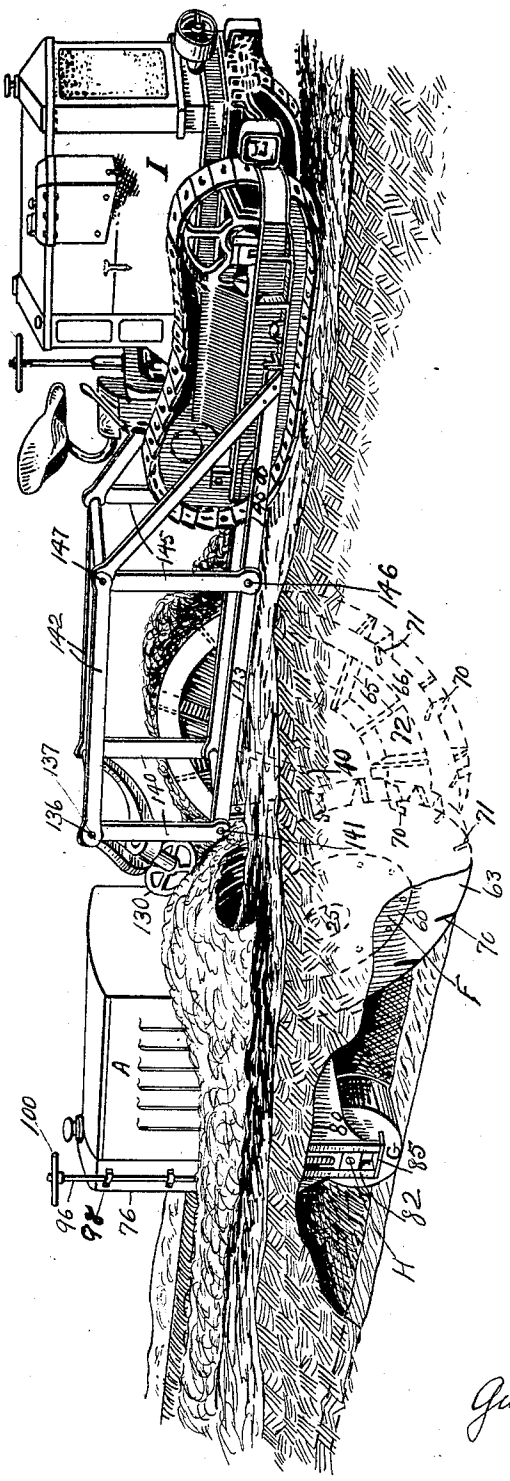
Fig. 12.



INVENTOR
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Patented Feb. 23, 1932 1,846,902

UNITED STATES PATENT OFFICE

GEORGE G. POWELL, OF NEW YORK, N. Y.

TRENCH EXCAVATOR FOR DIGGING AND PREPARING TRENCHES

Application filed October 6, 1926, Serial No. 139,886. Renewed November 30, 1931.

This invention relates to a trench excavator and the method of digging and preparing a trench.

The first object of the invention is the production of an excavator for cutting trenches and the like and delivering the material excavated therefrom upon both banks of the trench. The second object of the invention is the production of a trench excavator comprising self contained cutting and delivery mechanisms. The third object of the invention is the production of an excavator, whereby the material excavated is discharged therefrom by centrifugal force. The fourth object of the invention is the production of a trench excavator, whereby all the material excavated can be delivered to one or both banks of the trench produced. The fifth object of the invention is the production of means whereby small volumes of material are handled rapidly and continuously to obtain a large working capacity. The sixth object of the invention is the production of a trench excavator whereby the width and depth of the trench produced may be varied. A seventh object of the invention is the provision of means whereby clearance for the cutter and delivery wheels of the excavator, is provided to permit the excavator to cut its way at a declination from the surface, to the depth of trench to be maintained and means to restore the said wheels to their normal position. An eighth object of the invention is the provision of means, whereby the trench excavator can cut its way to the surface of the ground from a trench at an inclination. A ninth object of the invention is the provision of means for gauging and maintaining the trench excavator at a desired depth. The tenth object of the invention is the production of means whereby the bottom and sides of the trench are compacted and hardened. An eleventh object of the invention is the provision of means to support the trench excavator upon a single supporting and gauge wheel. A twelfth object of the invention are the means to maintain the trench excavator in its proper horizontal and lateral position, and at the same time allow an unrestricted and controlled vertical movement of the same. The thirteenth object of the invention is the production of means in a trench excavator whereby the entire trench face, several times the combined area of the faces of the cutting and delivery means, is delivered to the banks of the trench direct by the said cutting, conveying and delivery means. A fourteenth object is the provision of means whereby the inclined cutter wheels under cut the trench face, parallel with the line of the trench. A fifteenth object is the production of means integral with the cutting mechanism to deliver the excavated material of a trench to one or both banks thereof at the speed of the tractor. A sixteenth object is the provision of means whereby the width of the trench to be cut may be increased or decreased for a determined depth. A seventeenth object of the invention is the provision of means whereby the undercut face of a trench is forced equally into the delivery mechanism. An eighteenth object of the invention is the provision of means to cut grooves in the sides and bottom of a trench being excavated whereby the entire contents of the same are undercut parallel with the line of the trench being an entire outline of the said trench. The nineteenth object of the invention refers to the method of digging and the steps in preparing a trench. A twentieth object of the invention is the production of a trench excavator whereby all the supporting and operating mechanism thereof is confined within the outer lines of the cutting, conveying and delivery means thereof, at any depth at which the said excavator may be operating. A twenty-first object of the invention comprises a trench excavator, mounted upon its individual truck, with a supporting gauge wheel traveling upon the bottom of the completed trench, said trench excavator being operated from its individual motor, independently of the power of the standard type of tractor, that travels upon the surface of the ground in advance of the trench excavator, the tractor preferably of the crawler type, provides traction and support for the forward end of the trench excavator to which it is detachably connected.

Other objects will be apparent from the following specification and claims.

In the drawings:

Fig. 1 represents a rear end elevation of the trench excavator throwing the material excavated to both banks thereof; Fig. 2 indicates a similar view and modification showing the excavator throwing the material to but one bank; Fig. 3 shows a rear end view of the excavator with the wheels F, raised above the ground surface; Fig. 4 represents a side elevation of Fig. 3; Fig. 5 indicates a plan view of the truck tilting element; Fig. 6 a horizontal section of the displacing blade and of the casing cover; Figs. 7 and 8 indicate a side and top view of the wheel spacers; Fig. 9 shows a plan view of the inside or top of the wheels F; Fig. 10 a section through the center of Fig. 9; Fig. 11 is a detail; Fig. 12 indicates a perspective view of the complete machine with its tractor attached, and in operation; Figs. 13 and 14 comprise details of Fig. 9; Fig. 15 is a side elevation of Fig. 5 on an enlarged scale; Fig. 16 represents a rear end view of the excavator showing details and section of the wheel G; Fig. 17 represents a section through the gear casing and main shaft bearings, and Fig. 18 is a detail of Fig. 16.

The organization of the invention comprises a housing indicated in its entirety by the letter A, supported upon a truck indicated in its entirety by the letter B. Within the housing A is located a motor having the shaft 20. A gear casing 21 extends from the front lower end of the housing A. The said gear casing 21 is triangular in cross section and is indicated with the top wall or roof 22 and the inclined side walls 23. From each of the walls 23 extend the similar journal bearings 24 for the inclined main shafts 25. Roller bearings 26 and 27 are seated in the journal bearings 24 for the shafts 25. At the upper ends of the shafts 25 are fastened the worm wheels 30. The worm wheels 30 have formed therewith the normally vertical edges 30*a*, which are in rolling contact during their revolution and maintain them in proper position. A detachable cover 31 is fastened to the front end of the gear casing 21. Journal bearings 35 and 36 are formed with the cover 31. Lugs 37 extend from the cover 31 and support the V shaped displacing blade 40 centrally disposed on the forward faces thereof by means of the screws 41. The shaft 20 is journaled at one end in the journal bearing 35 and has fastened thereto the pinion 44. A worm shaft 45 is located in the gear casing 21 and has its ends journaled in the journal bearings 36 and 46 in the gear casing 21. A spur gear 47 is fastened to the worm shaft 45 and meshes with the pinion 44. A worm 50 is integral with the worm shaft 45 and meshes with the worm wheels 30. An enlargement of the casing 21 is indicated at 51 which encloses the spur gear 47. Lugs 52 and the pair of lugs 53 extend from the top wall 22 of the gear casing 21. At the lower ends of the shafts 25 are fastened the hubs 55, each having the flange 56. To each of the flanges 56 is fastened a cutting and delivery wheel F. Each wheel F comprises the similar disc 60 having the central opening 61, which forms a seat for the projection 57. To the inside face of the disc 60, is riveted the annular plate 63. Channel bars 65 radially extend from the inner face of the annular plate 63. A reinforcing ring 66 is fastened to the outer ends of the channel bars 65. Inclined knives 70 are supported in inclined slots 71 formed in the ring 66 and the annular plate 63. The outer ends of the knives 70 are all located in a circle struck from the center of the shaft 25, and extend beyond the ring 66 and the plate 63 as indicated at 70*a* and 70*b*. The bars 65 with the plate 63 form the compartments 72. The truck B comprises the platform 75 which supports the housing A, the motor C, having the radiator 76 and the gear casing 21 already described. Two pairs of brace plates 80 and 81 extend from the lower face of the platform 75. Pairs of angle irons 82 extend from the platform 75 and are fastened to the plates 80 and 81. Each pair of angle irons 82 are connected at their lower ends by the closing bar 85. A cross bar 86 is supported upon the platform 75. A pair of vertical screws 87 are shown with the shanks 88. The shanks 88 extend through the openings in the cross bar 86. To the upper ends of the shanks 88 are fastened the sprocket wheels 89. Collars 90 are formed with the shanks 88 and support the roller bearing cages 91, having roller bearings not shown. A sprocket chain 92 connects the sprocket wheels 89. A bracket 95 extends from the cross bar 86. An operating shaft 96 has its lower end journaled in the bracket 95 and at its lower end has fastened thereto the collar 97. A bracket 98 extends from the upper portion of the radiator 76 for the shaft 96. An operating hand wheel 100 is fastened to the top end of the shaft 96. A sprocket wheel 93 is fastened to the upper end of one of the shanks 88, and a sprocket chain 103 connects the wheels 101 and 93.

A gauge wheel is indicated in its entirety by the letter G. It is indicated with the hub 107 in which are located the roller bearings 108. An axle indicated in its entirety by the letter H, is supported in said roller bearings. The shaft H comprises the male body portion 111 having the threaded end 112 and has formed therewith the guide bracket 113. The bracket 113 is provided with the opposite guide faces 114, the projecting flanges 115, the guide lugs 116 and the threaded opening 118 and the annular recess 119. The female body portion of the shaft is indicated at 120 which sleeves over

the male body portion 111 and engages the recess 119. With the portion 120 is formed a bracket 113*a* similar to 113, having guide faces 114*a* similar to 114, projecting flanges 115*a* similar to 115, the guide lugs 116*a* similar to 116 and the threaded opening 118*a* similar to 118 is in threaded engagement with the bracket 113*a*. Two pairs of angle irons 82 bear against the guide faces 114 and 114*a*, and the screws 87 are in threaded engagement with the threaded openings 118 and 118*a*.

An eyebolt 124 is indicated with the threaded portion 125 and shank 126. The said bolt 124 is hinged to the lugs 53 by means of the pin 127. An operating hand wheel 130 is indicated with the interiorly threaded hub 131 and the latter has extending therefrom the flanges 132. The said hub is in threaded engagement with the screw 125. A Y shaped bracket is indicated with the single longitudinal member 133 having the openings 134 and the cross member 135 having the openings 136. The member 133 engages the flange collar 132. A pin 137 engages the openings 136. H shaped spacer bars are indicated at 140 which at their lower ends are hinged to the lugs 52 by means of the pin 141. On the outer ends of the pin 141 are hinged one end of the pair of parallel bars 142 and at the outer ends of the pin 137 are hinged one end of the pair of parallel bars 143 similar to 142. To the front ends of the pairs of bars 142 and 143 are hinged a spacer bar 145 similar to 140, by means of the pins 146 and 147. The spacer bars 145 form part of a standard tractor I and are attached to the rear end of the frame 145*a*, and supported by the brace 145*b*, fastened by the bolts 145*c* and pins 146 and 147 to the tractor frame 145*a*, forming a triangular truss.

In Figs. 7 and 8 is indicated a spacer, one of which may be used for each of the cutting and delivery wheels, to space the wheels different distances apart to produce trenches of different width. Each spacer in this instance is indicated to comprise the sleeve 150 with the male flange 151 at one end and the female flange 152 at the other end. The spacers are located in position by separating the annular plate 60 from the hub 55. The female flange is bolted to the flange 56 of the hub 55 and the male flange 151 is bolted to the plate 60. By the use of the said spacers, wheels F larger in diameter may be used.

It will be noted that the circular plate or disc 60 to which is riveted the annular plate 63, is smooth and its outer edges are tapered in a manner to bring them almost flush with the annular plate 63, it will be noted that the outer extension 70*a* of the knives 70 are within the line of the said disc 60. The purpose of this arrangement is that the said discs 60 fit snugly into the trench as excavated by the said wheels F, and rotate with the said wheels F being integral with the same. By this means the truck B is steadied and held firmly in position and due to the rotation of the said discs 60 the banks of the trench as cut are smoothed and compressed, and where moisture is present, the said banks are puddled and compacted due to this rotation and to the side thrust and stresses transmitted to the wheels F, and to the discs 60 thereof by the reason of the threshing about of the tractor I, on the more or less uneven ground upon the surface of which the tractor I which is partially shown in Figs. 4 and 5, travels in advance of the trench excavator, and said stresses transmitted laterally by the superposed parallel bars 142 and 143. The gauge wheel G compacts and puddles the bottom of the trench, thereby the said trench is prepared to prevent erosion, etc. Where sufficient moisture may not be present to puddle the sides and bottom of the trench, water may be supplied for the purpose, after the wheels F have dug in to the desired level, the gauge wheel G may be manipulated to increase the weight on the wheels F, that are partly supported upon the rotating discs 60 thereof. The said gauge wheel G may be flanged on its sides to assist in compacting the lower portions of the trench walls, making the trench more efficient for irrigation and drainage purposes. The plates 60 may be adjusted to increase or decrease its bearing upon, or not to touch the sides of the trench as and when cut.

To operate the trench excavator it is brought in proper operative position by means of the tractor I, which travels upon the surface of the ground in advance of the trench excavator, and provides support for the front end of the trench excavator and traction for the same. In this instance the Fig. 4 of the drawings show a side view of the entire device, the wheels F shown raised above the surface of the ground and suspended between the gauge wheel in the rear and the tractor I at its forward end, the rear portion only of the tractor I being shown. It will be noted that the tractor I provides support and traction for the device, the mechanism of the trench excavator being operated by its individual motor C.

The hand wheel 130 is turned to shorten the distance between the pins 127 and 137, by means of which the truck B is inclined, swinging on the axis of axle H. By this means the wheels F are swung down forwardly. The motor C is now started which revolves the wheels F, the hand wheel 100 is now turned which raises the gauge wheel G until the wheels F reach and enter the ground. The tractor I is now started and the hand wheel 100 further manipulated to bring the bottoms of the wheels F in alignment with the gauge wheel G, and in parallel relation with the inclination of the frame 75 of the truck B. This arrangement provides for a maximum

entrance angle of the wheels F to enter or cut their way into the ground until the desired depth of trench is reached. The wheels F controlled by the gauge wheel G will cut into the ground at a less angle than described, but not at a greater. When the desired depth is reached, the wheel 130 is turned to bring the truck B and its frame 75 to their normal horizontal position, and at the same time, the hand wheel 100 is turned to bring the bottoms of the wheels F and the wheel G into horizontal alignment, and the truck B with its appurtenances will cut a horizontal trench at a level, or at any desired grade by means of the gauge wheel G being manipulated or set for such level or grade.

It will be noted that the parallel bars 142—143 attach the tractor I to the forward end of the truck B. By means of the spacer bars 140 and 145 that are similar and are supported as shown. The said spacer bars are always maintained in parallel vertical relation to each other, and the said parallel bars 142—143 allow an unrestricted vertical movement of the truck B and its appurtenances, at the same time maintaining the said truck B with its frame 75 in a horizontal position, irrespective of any changing depth while cutting a trench at a maximum depth, or when the said truck is upon the surface of the ground as shown respectively in Figs. 3 and 4.

When it is desired to cut out of a trench, from the depth at which the excavator has been operating, the hand wheel 100 is turned to bring the gauge wheel G below the bottom of the wheels F and the wheels F and the truck B of which they are a part, cuts its way to the surface of the trench in a gradually narrowing trench as the wheels F near the surface, and in reverse to their entrance, which was in a trench more narrow in the rear and widening as it descended. In riding out of a trench, no manipulation of the wheel 130 is necessary, nor is the angle of ascent restricted, except by that of the power of the tractor to draw the truck B and its cutting loads up this incline. The cutting and delivery wheels F are suspended between the tractor I forward, and upon the single gauge wheel G in the rear, the said wheel G controls the raising and lowering of the truck B and its appurtenances. The said wheel G rides in the center of the trench in the rear of the wheels F. The said wheels F due to their inclination and the cutters at right angles, leave a low inverted V shaped ridge of earth in the center of the trench bottom, this ridge the wheel G rides down, thereby compressing, compacting and consolidating the trench bottom, and where any moisture is present, the bottom of the trench is thoroughly puddled as well, making the trench a more efficient water carrier where it is to be used for that purpose. The cutter and delivery wheels F are bolted to the flanges 56 of the hubs 55 of the main shafts 25. The hubs 55 are fastened to the shafts and are not removed, the said wheels F in this manner may be readily and quickly placed and replaced without disturbing any other portion of the excavator. Spacers may be interposed between the flanges 56 of the hub 55 and the wheels F to widen the trench when needed or to cut trenches of varying width at a definite depth. The wheels F each comprise the annular disc 60 which bolts to the flange 56 of the hub 55, the annular plate 63 riveted to the inner face of the discs 60, the channel bars 65 radially disposed upon the inner face of the annular plate 63 and riveted thereto, the reinforcing ring 66 riveted to the outer ends of the channel bars 65 and the knives 70 seated and fastened in the inclined slots 71 in said ring 66 and annular plate 63 and that over hang the said plate 63 at 70*a* and the ring 66 at 70*b*.

The wheels F revolve in the direction of the arrow *a* in Figs. 4 and 9, that is from the bottom of the trench to the surface of the ground. The tractor I draws the truck B against the cutting action of the knives 70 of the wheels F and the material cut falls into the open compartments 72. The wheels F cut grooves the width of the knives 70 at each side of the trench being cut, and due to the inclination of the wheels and their converging at their bottoms, the trench is completely outlined and the central portion thereof is left unsupported and falls into the open faces of the wheels F and into the compartments 72 mingle with the cuttings of the knives 70 and are carried to the surface of the ground and due to the velocity of the wheels F the material slides upon the web of the channels 65, and when the said channels reach the surface of the ground the said material is thrown by centrifugal force upon both banks of the trench. In the event that the material of the central uncut portion of the trench face be tenacious and not fall by its own weight in the time interval necessary, a dividing or displacing blade 40, is fastened vertically and centrally to the front of the plate 31 of the gear casing 21. This blade is V-shaped in cross section and forces the uncut central portion of the trench face equally into the compartments 72.

The cutter and delivery wheels F are of a diameter that their upper portion protrude above and overhang the banks of the maximum depth, and due to their inclination the material is thrown at a distance from each bank by the centrifugal force. The distance thrown depends entirely upon the velocity of the wheels F, and the velocity of the wheels F depends solely upon the power of the motor C that drives the same. It is proposed that the motor C utilize its power in revolving the wheels F, and that the tractor

I be devoted to traction purposes alone. These may be combined and the whole excavator may be driven from but one motor.

The Y bar 135 and eyebolt 124 with their portions 125, 126, 131, 133 and 134 maintain the said spacer bar 140 in its position at right angles to the casing 21. The hand wheel 130, when it is desired to cut into a trench, shortens the distance between the pins 127 and 137, as before described. It will be understood that the spacer bar 140 still remains in its upright position and parallel with the similar bar 145 by reason of the parallel bars 142—143 and that the truck alone is inclined. The said parallel bars maintain the truck B in alignment with the tractor I, and in its proper lateral upright position and supported upon the single wheel G, and at the same time allowing an unrestricted vertical movement of the said truck B with its appurtenances as before described.

In Fig. 2 is shown a modification where one of the wheels F have been removed as before described and a plain disc wheel substituted. In this modification the said disc is provided with narrow knives 70 sufficient to allow the said disc to cut its way along the side of the trench, but is not provided with conveying means hence the material of the whole trench is diverted to the remaining wheel F and the whole of the material is delivered to but one bank. In the above modification shown in Figs. 11 and 12, the knives 70, are fastened to the bent portion 71 of the web of the channels 65 and the material excavated, etc., has to slide over the knives 70, to be delivered by centrifugal force. The gear casing 21 contains the speed reducing gears and shaft bearings to maintain them in operative contact and is water and oil tight to allow all bearings and contacts to operate in an oil bath. The trench excavator is designed to function at the normal traction speed of the tractor I, and to handle small quantities of material rapidly and continuously to produce a very large capacity. The parts of the wheels F, are integral with one another, and cut and deliver the material from a trench, direct to the banks of the trench, without the intervention of any auxiliary mechanism being interposed between said cutting means, conveying means and the said delivery means, all such means being solidly and componently a part of the wheels F, with no hinged or articulated parts to any element whatsoever of the said wheels F, nor necessary for their complete functioning. While the inclined cutting wheels normally overtop the maximum trench, the wheels will cut a trench and deliver the material where the said wheels barely reach the surface.

Having described my invention what I desire to secure by Letters Patent and claim is:

1. A trench excavator comprising a truck and its frame, a rearwardly disposed supporting gauge wheel for the truck and frame, opposed, inclined, cutting, conveying and centrifugal delivery wheels mounted rotatively upon the said truck, means with their appurtenances to rotate the said opposed inclined wheels, all the elements of the said excavator comprised between the outermost sides of the said opposed inclined wheels, and cutters extending beyond the circumferential edges and sides of the said inclined wheels.

2. A trench excavator comprising a truck and its frame, a supporting gauge wheel centrally and rearwardly disposed for the said truck, a gear casing, a motor with its casing secured to the said gear casing with its shaft extending through said gear casing, appurtenences within said casing to rotate opposed, inclined, cutting, conveying and delivery wheels the shafts of which are journaled in said casing and supported upon said truck, the forward end of said gear casing and truck yieldingly connected to the rear end of a tractor by means of superposed parallel bars, with the said wheels suspended between the tractor and the said supporting gauge wheel, and means to raise and lower the said supporting gauge wheel.

3. A trench excavator comprising a truck with its frame, a centrally and rearwardly disposed supporting gauge wheel for the truck, means to raise and lower the said gauge wheel, opposed, inclined, cutting, conveying and delivery wheels journaled in a gear casing upon said truck, a motor with its casing fastened removably secured to said casing and means connecting said motor within the said casing to rotate the said inclined wheels, the said wheels being detachably connected to flanged hubs of their respective inclined shafts in a manner to facilitate their quick placing and removal without disturbing other portions of the excavator.

4. A trench excavator comprising a truck, its frame and supporting gauge wheel, a gear casing with a motor and its casing removably secured thereto with its shaft extending into and journaled in the said casing, reducing gears within said casing connecting said motor shaft with inclined opposed shafts journaled in the walls of the casing, cutting, conveying and delivery wheels detachably connected to said inclined shafts, cutters disposed about the circumferential edge and sides of the said wheels and disposed to deliver their cuttings into the upper rearward portion of compartments formed in said wheels, the partitions of said compartments forming the conveying and delivery elements of the said wheels.

5. A trench excavator, the mechanism for which comprises two inclined opposed cutting, conveying and delivery wheels operatively and rotatively suspended upon a truck between a supporting gauge wheel in its cen-

tral lower rear, and detachably and adjustably supported upon a tractor at the forward end of said truck means to raise and lower the supporting gauge wheel, and said gauge wheel serving to compact, compress and harden the bottom and sides of the trench simultaneously with its digging.

In testimony whereof I hereby affix my signature.

GEORGE G. POWELL.