

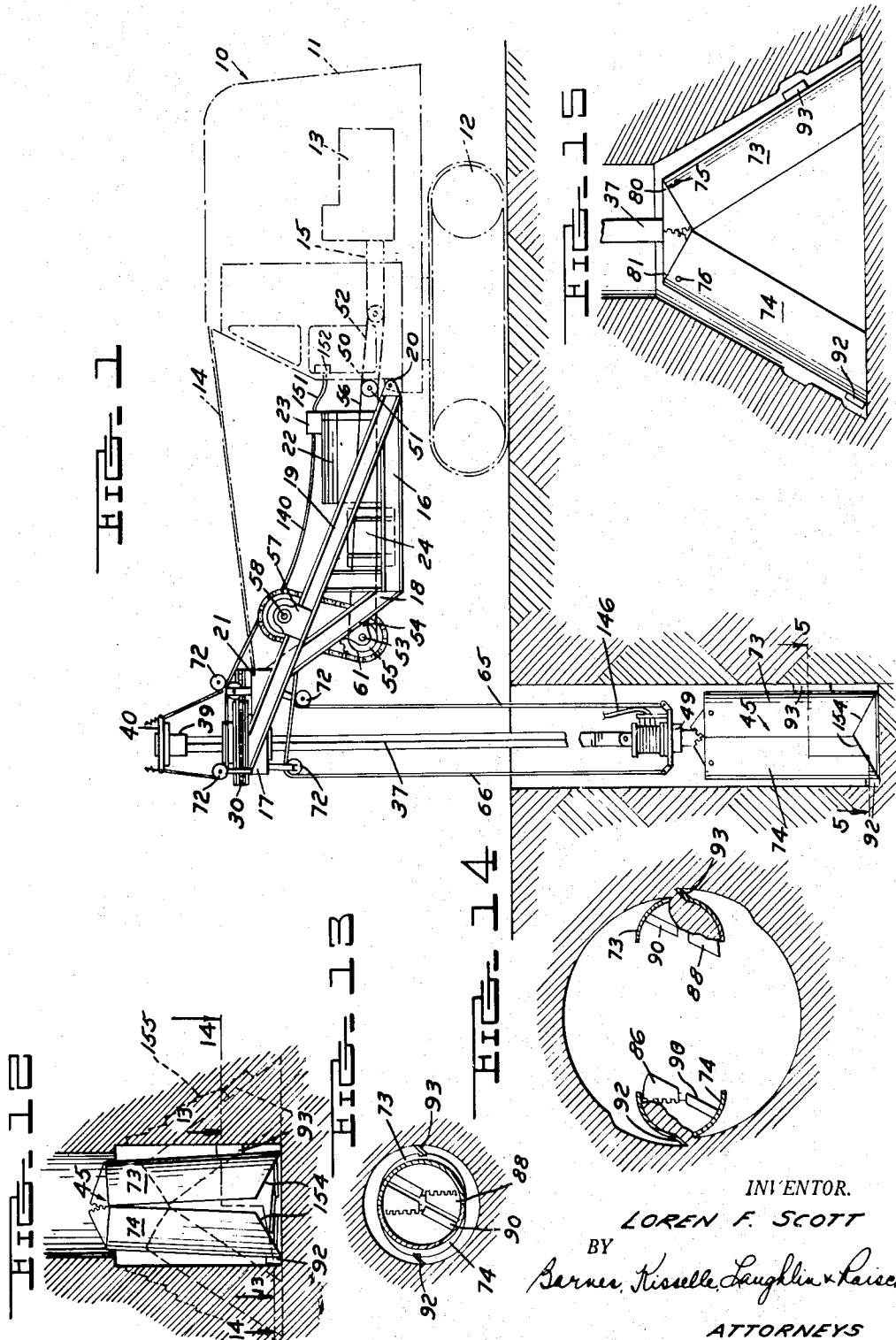
May 1, 1956

L. F. SCOTT
EXCAVATING APPARATUS

2,743,904

Filed Nov. 7, 1950

6 Sheets-Sheet 1



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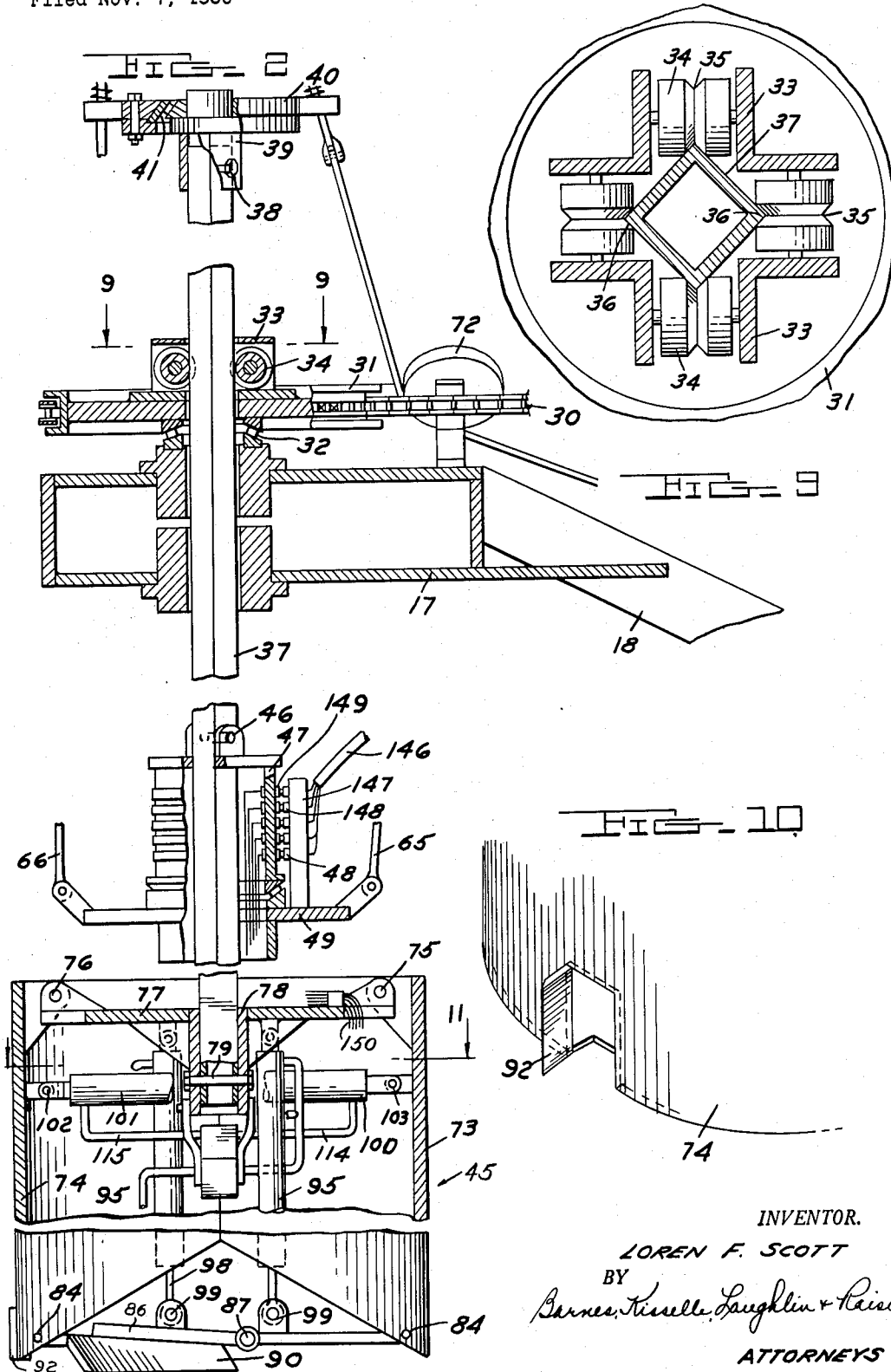
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6 Sheets-Sheet 2



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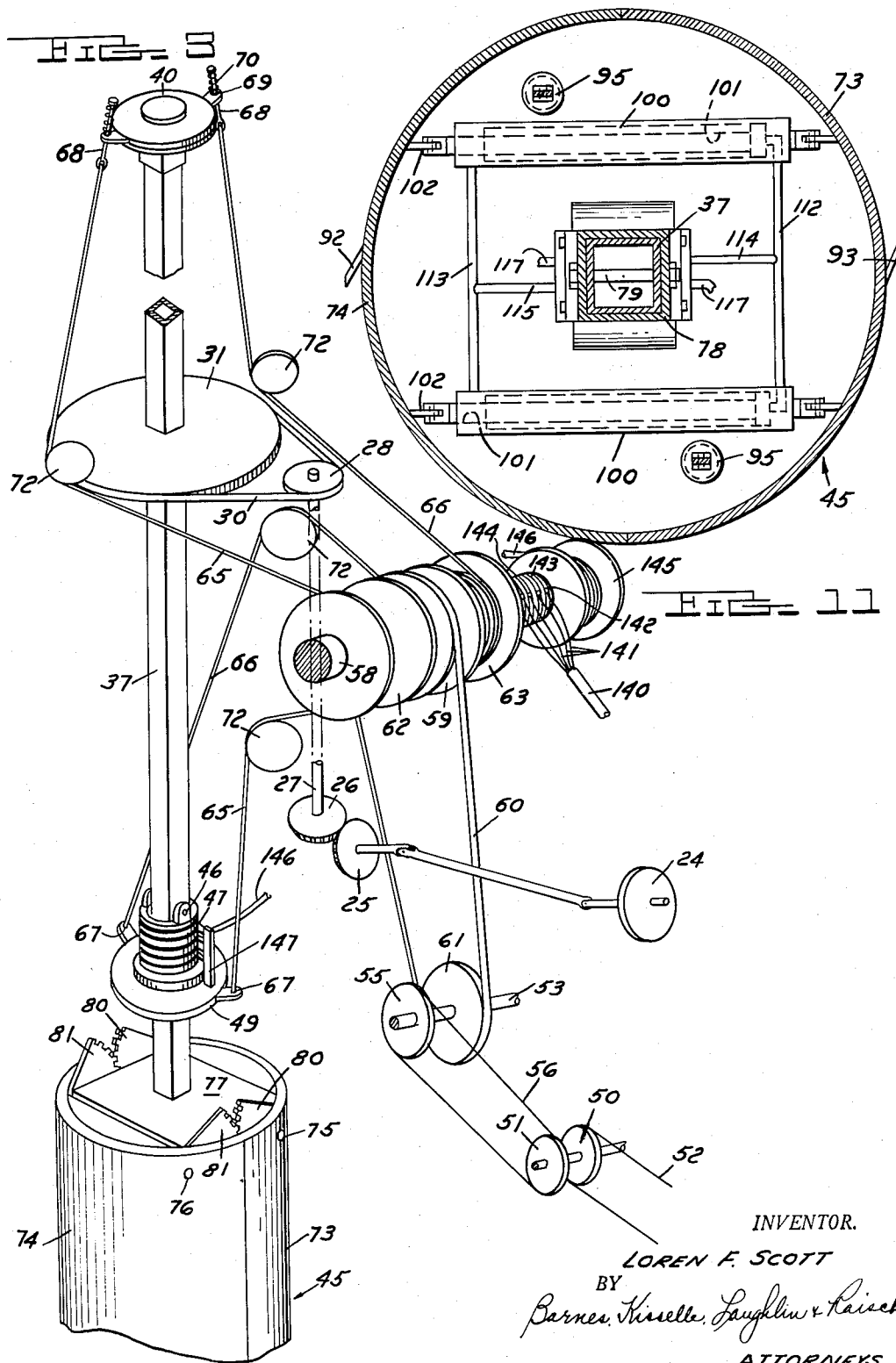
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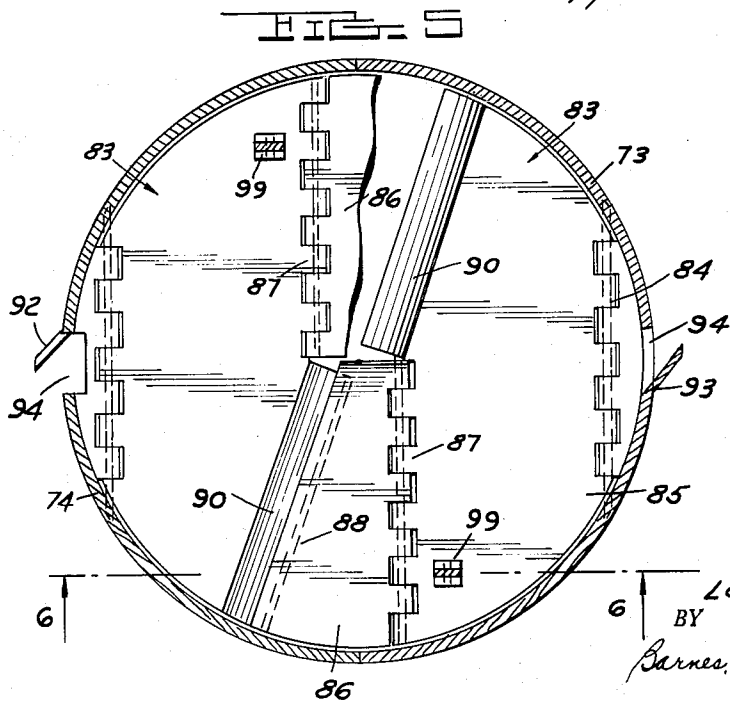
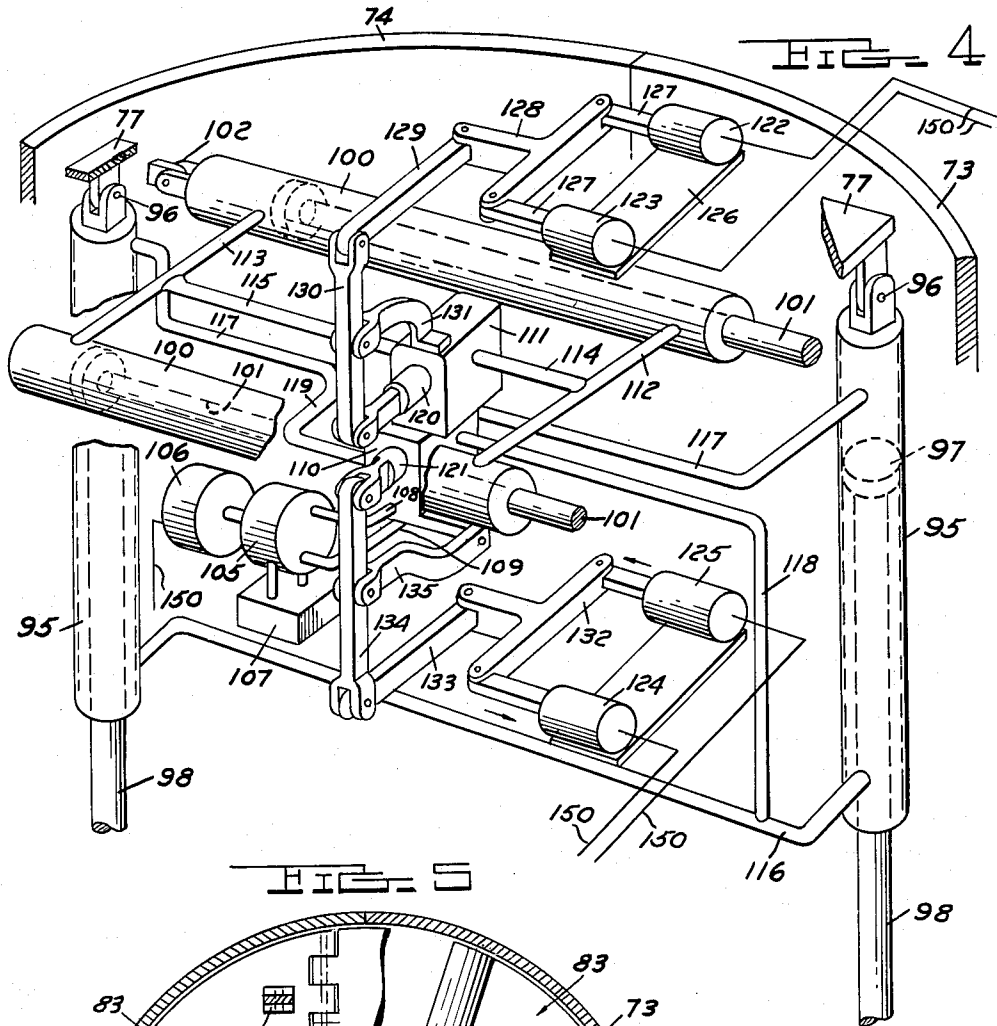
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2,743,904

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6 Sheets-Sheet 5

FIG. 7

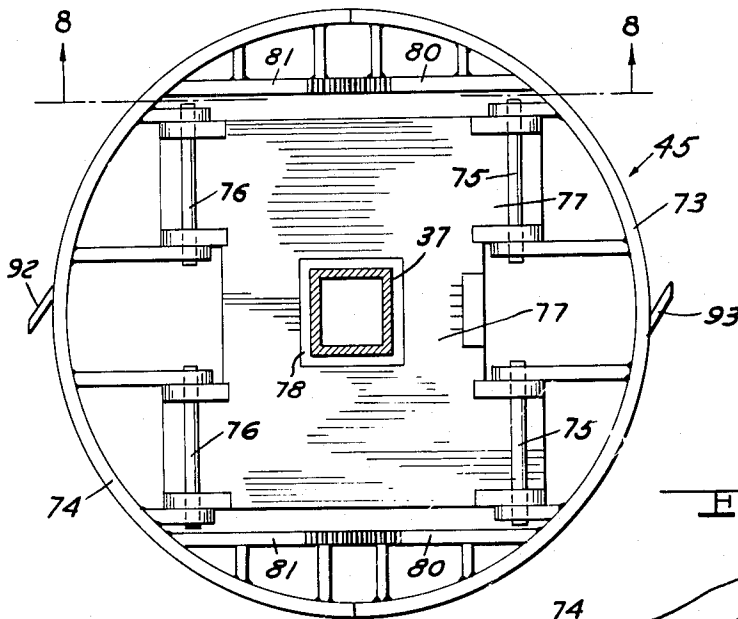


FIG. 8

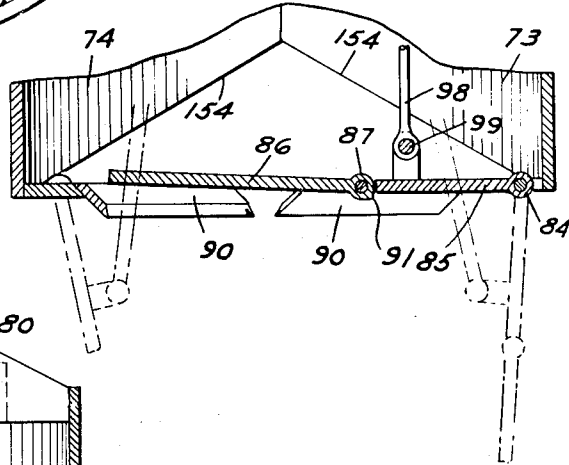
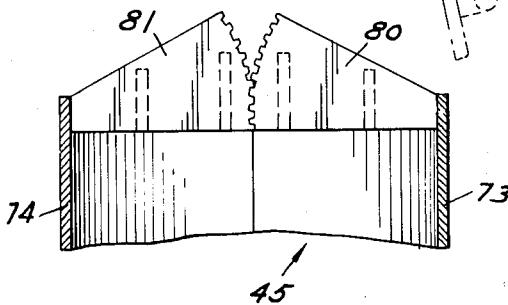


FIG. 9



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FIG. 16

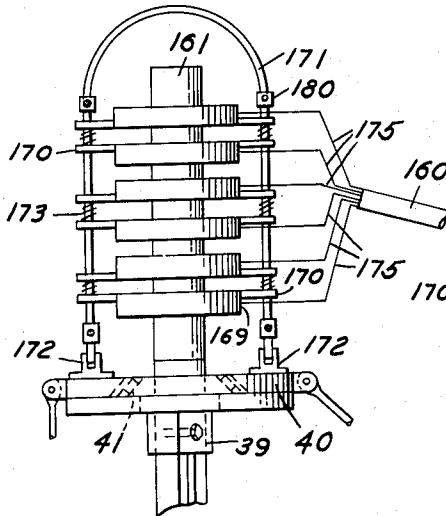


FIG. 17

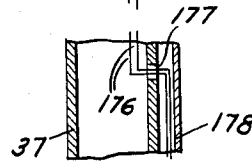
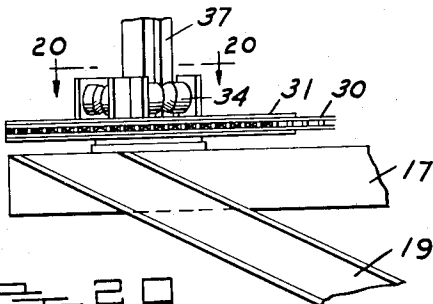
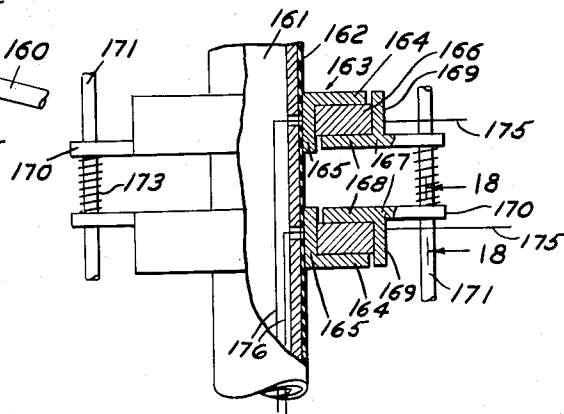
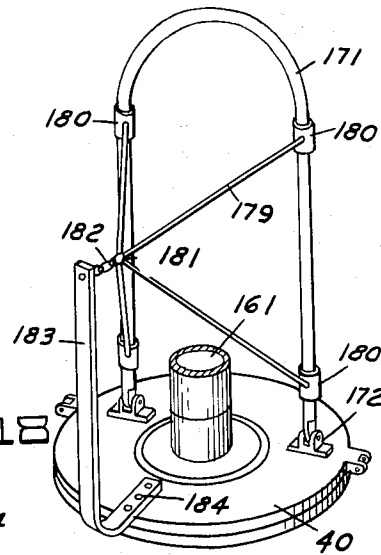
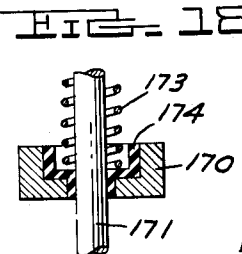
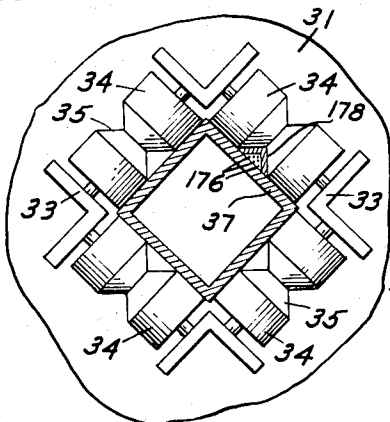


FIG. 19

FIG. 20



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2,743,904

EXCAVATING APPARATUS

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Application November 7, 1950, Serial No. 194,482

11 Claims. (Cl. 255—19)

This invention relates to excavating apparatus and more particularly to a machine for digging holes for bell-shaped footings.

In the construction of large structures, the desirability of forming the concrete footings of bell shape, that is, a generally circular footing below the ground which is wider at the base than at the top, has long been recognized. One of the factors which has been responsible for the limited use of footings of this type has been the inability to economically dig holes of this general bell shape below the ground. A cylindrical hole having a diameter corresponding to the diameter of the base of the bell-shaped footing may be excavated without too much difficulty but, with such cylindrical holes, forms must be employed to produce a bell-shaped footing and the use of such forms materially increases the cost of such footings. Aside from cost, however, an even greater objection to forming footings in this manner is the fact that, after the footing is poured and the forms removed, the excavation must be filled with earth, and loose earth applied in this manner does not have nearly the strength of the solid, undisturbed earth surrounding a hole which is originally formed with a bell shape. In order to obtain the maximum strength with the type of footings under consideration, the footings are usually excavated as a cylindrical hole having a diameter corresponding with the diameter of the top of the footing and thereafter the side walls of the bottom portion of the hole are undercut manually to produce the desired bell-shaped hole which in itself serves as the form for the footing. This procedure is, of course, relatively expensive, since it requires considerable manual labor.

It is an object of this invention to produce a mechanically operated apparatus for boring bell-shaped holes for footings.

A further object of this invention resides in the provision of a boom attachment for a basic crane unit which adapts the crane for digging bell-shaped footing excavations.

More specifically the invention contemplates a boom attachment for a basic crane unit which supports a rotatable and vertically adjustable shaft which in turn carries at its lower end a split bucket. The bucket is preferably in the form of a pair of semi-cylindrical half sections which are pivotally connected together at their upper ends. Within the bucket there is arranged an electrically operated hydraulic power unit for bellling out the half sections of the bucket and for operating doors at the lower end of the bucket, the doors being provided with blades for digging. The side walls of the bucket are also provided with blades. The current for operating the electrical mechanism within the bucket is conducted from the stationary to the rotating structure of the device by means of brushes and slip rings. This simple arrangement enables operation of the bucket from the cab of the crane by simply manipulating various manual switches on a control panel within the cab.

In the drawings:

Fig. 1 is a side elevation of the boom attachment of this invention mounted on a basic crane unit.

Fig. 2 is a fragmentary sectional view of the boom attachment.

Fig. 3 is a diagrammatic perspective view illustrating the arrangement employed for rotating and actuating the bucket vertically.

Fig. 4 is a diagrammatic perspective view showing the hydraulic mechanism within the bucket for bellling out the half sections of the bucket and for controlling the operation of the bottom doors of the bucket.

Fig. 5 is a sectional view of the bucket along the lines 5—5 in Fig. 1.

Fig. 6 is a sectional view along the lines 6—6 in Fig. 5. Fig. 7 is a top view of the bucket.

Fig. 8 is a sectional view along the lines 8—8 in Fig. 7. Fig. 9 is a fragmentary sectional view along the lines 9—9 in Fig. 2.

Fig. 10 is a fragmentary perspective view of the lower portion of the bucket showing the cutting blade in the side wall thereof.

Fig. 11 is a sectional view along the lines 11—11 in Fig. 2.

Fig. 12 is a diagrammatic view illustrating the manner in which the bucket may be manipulated to produce a bell-shaped hole.

Fig. 13 is a sectional view along the lines 13—13 of the solid lines showing in Fig. 12.

Fig. 14 is a sectional view along the lines 14—14 of the broken lines showing in Fig. 12.

Fig. 15 shows the bucket fully belled out in the completely excavated hole.

Fig. 16 is a fragmentary view showing another form of brush arrangement for conducting current from the power unit on the boom attachment to the electrical devices within the bucket.

Fig. 17 is an enlarged detail, partly in section, of the brush arrangement illustrated in Fig. 16.

Fig. 18 is a sectional view along the lines 18—18 in Fig. 17.

Fig. 19 is a fragmentary view in perspective of the support for the brushes illustrated in Fig. 16.

Fig. 20 is a fragmentary sectional view along the lines 20—20 in Fig. 16 showing a modified form of drive for the main shaft which supports the bucket.

The boom attachment of this invention may be designed for use with any basic crane unit or prime mover, and for the purpose of illustration there is shown in the drawings a conventional crane 10 which includes a cab 11 mounted for horizontal swinging movement on a base provided with caterpillar tracks 12. A power unit 13 within the cab provides the motive power for the crane such as for swinging the cab, actuating the tracks 12, reeling and unreeling the boom cable 14, and for operating the crowd drive 15.

The boom attachment preferably comprises two horizontally spaced platforms or frames 16 and 17 which are rigidly connected by inclined frame members 18 and 19. Frame members 19 are spaced apart at their lower ends to permit the boom attachment to be pivotally mounted on the crane as at 20. Boom cable 14 connects with the boom attachment as at 21 so that the boom attachment can be pivoted about the connection 20 to the desired inclination.

On the platform 16 there is supported a power unit 22, preferably a gasoline engine, having a direct current generator 23 operatively connected therewith. Motor 22 also drives a fluid coupling unit 24. Fluid coupling 24 in turn drives a bevel gear 25 (Fig. 3) which meshes with a similar bevel gear 26 at the lower end of a vertically arranged shaft 27 which is journaled on platform 17.

The upper end of shaft 27 carries a small sprocket 28 which drives through the medium of a chain 30 a large sprocket 31. Sprocket 31 is supported on its underside by a bearing 32 (Fig. 2) for rotation in a horizontal plane on platform 17. On the top face of sprocket 31 there is secured, as by welding, a frame 33 on which are supported four rollers 34 which are spaced apart 90° from each other. Rollers 34 are disposed concentrically with respect to the axis of rotation of sprocket 31 and are each provided with a V-shaped peripheral groove 35 which engages with the corner portions 36 of a vertically extending shaft 37 having a square cross section. It will be noted that rollers 34 not only guide the vertical travel of shaft 37 but also serve to rotate shaft 37 when sprocket 31 is rotated.

To the upper end of shaft 37 there is secured, as by a bolt 38, a bearing cap 39. A top plate 40 is rotatably supported on bearing cap 39 by a bearing 41. At the lower end of shaft 37 there is attached a bucket 45 which will be more fully described hereinafter. Spaced above the upper end of bucket 45 there is secured to shaft 37, as by a pin 46, a cylindrical sleeve 47 which is rotatably supported, as by a bearing 48, on a bottom bearing plate 49.

Referring more particularly to Figs. 1 and 3, there is illustrated the arrangement for raising and lowering shaft 37 and the bucket 45 at the lower end thereof. At the rear end of platform 16 there is journaled a pair of sprockets 50 and 51. A chain 52 connects sprocket 50 with the crowd drive 15 arranged to be driven by the power unit 13 of the crane. A shaft 53 which is mounted on bearing brackets 54 which are fixed to frame members 18 supports a small sprocket 55 which is connected with sprocket 51 by a chain 56. On frame members 19 there are mounted a pair of bearing brackets 57 in which a shaft 58 is journaled. To the shaft 58 there is keyed a sprocket 59 having a chain drive 60 with a second sprocket 61 keyed to shaft 53, the arrangement being such that when the crowd is driven in either one direction or the other, shaft 58 is rotated in either a clockwise or a counter-clockwise direction.

Shaft 58 also supports a pair of cable drums 62 and 63. Drums 62 and 63 are keyed to shaft 58 to rotate therewith. A cable 65 wraps around drum 62 and a cable 66 wraps around drum 63. One end of each cable 65 and 66 is connected with bearing plate 49 at diametrically opposed points as at 67. The other end of each cable is provided with an eyebolt 68 which passes upwardly through diametrically opposed ears 69 fixed on top plate 40. Eyebolts 68 are backed by springs 70 which serve to take up any slack that might occur in the cables.

The cable and drum arrangement is such that when the crowd is driven in one direction, the drums 62 and 63 wind up the lower portions of the cables and unwind the upper portions of the cables so that shaft 37 and bucket 45 are elevated. When the crowd is operated in the opposite direction the upper portions of the cables are reeled in and the lower portions are unreel so that the shaft 37 and bucket 45 are driven downwardly. Suitable guide pulleys 72 are mounted on platform 17 for guiding cables 65 and 66. It will also be noted that the pivotal mounting of top plate 40 and of bottom bearing plate 49 enables shaft 37 to be rotated and elevated or driven downwardly at the same time.

Bucket 45 comprises a pair of semi-cylindrical half sections 73 and 74 which are pivotally supported as at 75 and 76 on a top supporting plate 77. Plate 77 has secured thereto a central sleeve 78 which is keyed to the lower end of shaft 37 as by a bolt 79. The semi-cylindrical sections 73 and 74 have welded at the upper ends thereof toothed quadrants 80 and 81 which progressively intermesh when the bucket is opened and closed. At their lower ends half sections 73 and 74 are, each provided with a bottom door 83 (Fig. 5) which is hinged

to its respective section as at 84 on an axis parallel to the pivotal axes 75 and 76. Each bottom door 83 comprises two pivotally connected portions 85 and 86 which are hinged together as at 87. The hinge portion 86 extends substantially half way across bucket 45 with its free edge 88 being generally radially disposed. A blade 90 which is fixed to the hinge portion 85 in a downwardly inclined position extends in a generally radial direction from the center of the bucket to the side wall thereof as a continuation of the free edge 88 of hinge portion 86. It will be observed that with this arrangement the blades 90 on the bottom walls 83 provide a cutting edge which extends substantially entirely across the diameter of bucket 45. Along its hinged edge the portion 86 is provided with an abutment or heel 91 (Fig. 6) which limits the pivotal movement of the portion 86 in a downward direction to substantially the plane of the hinge portion 85. The bucket 45 is also provided with a plurality of outwardly extending blades 92 and 93 on the side walls of sections 73 and 74. Blades 92 and 93 are vertically spaced and are disposed adjacent openings 94 in the bucket side walls. Blade 92 is preferably disposed at the lower end of one of the bucket sections, and blade 93 is disposed diametrically opposite at a higher level on the other bucket section.

The means employed for bellling out the half sections 73 and 74 and for operating the bottom doors 83 of the bucket are illustrated in a diagrammatic way in Fig. 4. It is preferred to control operation of the bucket by electrically actuated hydraulic means. Various hydraulic arrangements for controlling the doors 83 and the bucket sections 73 and 74 will occur to those skilled in this art. The arrangement preferably includes a pair of cylinders 95 which extend vertically in the bucket and which are pivotally connected at their upper ends as at 96 with top supporting plate 77. Within each cylinder 95 there is slidably arranged a piston 97 connected with a rod 98, the rods 98 being pivotally connected at their lower ends with the hinge portion 85 of the bottom doors 83 as at 99. Cylinders 95 and pistons 98 control the operation of bottom doors 83.

A pair of similar cylinders 100 and piston rods 101 control the opening and closing of the bucket sections 73 and 74. Cylinders 100 are pivotally connected as at 102 to bucket section 74, and piston rods 101 are pivotally connected with bucket section 73 as at 103. Fluid under pressure is supplied to the cylinders by means of a pump 105 which is driven by a motor 106. Pump 105 is connected with a reservoir 107 and is also connected as by conduits 108 and 109 with a pair of valve blocks 110 and 111, respectively. Cylinders 100 are connected together at corresponding ends by conduits 112 and 113. Conduit 112 is connected by a branch conduit 114 with one side of valve block 111, and conduit 113 is connected by a branch conduit 115 with the other side of valve block 111. Likewise, cylinders 95 are connected together at corresponding ends by conduits 116 and 117. Conduit 116 is connected by a branch conduit 118 with one side of valve block 110, and conduit 117 is connected by a branch conduit 119 with the other side of valve block 110.

The flow of liquid through valve blocks 110 and 111 is controlled by spools 120 and 121. Valve blocks 110 and 111 are conventional 4-way valves such as those manufactured by Vickers, Inc., of Detroit, Michigan. Briefly stated, the valves operate such that when spool 120 of valve block 111, for instance, is pushed inwardly, fluid under pressure is directed from pump 105 through the conduits 114 and 112 to the cylinders 100 and 101 on one side of the pistons therein and when the spool 120 is pulled outwardly, fluid under pressure is admitted to the opposite ends of cylinders 100 and 101 through conduits 115 and 113. It will be understood, of course, that when fluid under pressure is admitted to one end of the cylinders so that the pistons are moved axially within the bore of the cylinders, the fluid on the opposite side of the piston is discharged from the cylinders and back

to reservoir 107 through the conduits at the opposite ends of the cylinders.

For the purpose of controlling the operation of valve blocks 110 and 111 there are provided solenoids 122, 123, 124 and 125. Solenoids 122 and 123 are arranged as a pair and are fixed on a supporting plate 126. Solenoids 122 and 123 each have a reciprocable armature 127 loosely connected with a double bell crank lever 128 which is in turn connected by a link 129 to one end of a lever 130. Lever 130 is pivotally connected at its other end with spool 120 and is pivotally supported intermediate its ends as by a bracket 131. Solenoids 124 and 125 are similarly connected with spool 121 by a double bell crank lever 132, a link 133, and a lever 134 which is pivotally supported intermediate its ends as by a bracket 135. The solenoid arrangement is such that when solenoid 122 is energized, its armature is pulled inwardly to pivot crank 128 clockwise, as viewed in Fig. 4, about the outer end of the armature of solenoid 123. This in turn causes bell crank 130 to pivot in a clockwise direction and thereby pull spool 120 in a direction outwardly of valve block 111. When solenoid 123 is energized the action is the opposite of that just described, and spool 120 is pushed inwardly of valve block 111. The operation of solenoids 124 and 125 is, of course, the same as that described with respect to solenoids 122 and 123.

The valve blocks, pump 105, motor 106, and the solenoid arrangements associated therewith are all supported directly or indirectly within bucket 45 and at the upper end thereof on supporting plate 77. The arrangement illustrated in Fig. 4 has been somewhat exploded for the purposes of illustration. The mechanism is actually very compact so that the greater portion of the interior of the bucket may fill with dirt when the bucket is operated.

It is necessary, of course, to conduct current to the solenoids 122, 123, 124 and 125 and to the motor 106. The current for actuating these devices is conducted from generator 23 by a cable 140 which includes a plurality of individual conductors 141, one for each of the electrical devices mentioned. The conductors 141 are connected at their ends with brush elements 142 which are arranged to slidably contact a plurality of slip rings 143 insulatively mounted on a bushing 144 fixed on shaft 58. Adjacent bushing 144 there is mounted on shaft 58 a cable reel 145 on which is wound a cable 146. Cable 146 comprises a group of five conductors, the inner ends of which are connected with the slip rings 143. Cable 146 extends through a suitable guide pulley on platform 17 (not shown) downwardly to an upright post 147 fixedly mounted on bottom bearing plate 49. The conductors of cable 146 are insulated from post 147 and are connected with a series of brushes 148. Brushes 148 slidably contact the corresponding series of spaced slip rings 149 insulatively supported on the cylindrical sleeve 47 (Fig. 2).

Solenoids 122, 123, 124 and 125 and motor 106 are connected with the individual slip rings 149 by conductors 150. Cable 140 from the generator 23 has a branch portion 151 which extends to a switch panel 152 within the cab 11, the switch panel 152 being provided with suitable switches (not shown) so that the solenoids and motor can be selectively operated from the cab. Any suitable circuit from the generator 23, through switch panel 152, and to the solenoids may be employed and need not be further described.

When it is desired to dig a bell-shaped footing excavation, the boom attachment on the crane is operated such that the bucket 45 is disposed vertically above the desired location of the footing. Motor 22 is set in operation to rotate shaft 37 and bucket 45 in the desired direction, that is, in a counter-clockwise direction as viewed in Fig. 5. It is first necessary to bore a cylindrical hole of the desired depth; and therefore the bucket sections 73 and 74 are closed and doors 83 are positioned, by means of switches on switch panel 152, so that they are disposed

generally horizontally. The crowd drive 15 is then operated to drive bucket 45 downwardly. As the bucket rotates and is fed downwardly, the blades 90 cut into the earth in the manner of an auger; and the earth thus excavated accumulates within the bucket.

It will be noted that the hinge portions 86 of the bottom doors 83 are free to pivot upwardly and therefore provide the desired access openings through which the dirt is guided as the bucket rotates. At the same time, the vertically disposed blades 92 and 93 cut into the side walls of the cylindrical hole being formed. It will be noted, however, that blades 92 and 93 are vertically offset and are disposed on opposite sides of the bucket. This arrangement of side blades is desirable, since the circumferential wall of the bucket tends to rub against the side wall portions of the hole being dug and thereby prevents the blades 92 and 93 from digging a hole much larger than the diameter of the bucket. In other words, the cylindrical side walls of the bucket actually guide the bucket downwardly so that the hole dug will be only slightly greater than the diameter of the bucket.

After the bucket has been filled or substantially filled with dirt, the rotation of the crowd drive 15 is reversed to elevate the bucket 45 and shaft 37 by cables 65 and 66. The crane is then swung horizontally, and the proper switches on switch panel 152 are actuated to open the half sections of the bucket and to pivot the bottom doors 83 downwardly. The toothed quadrants 80 and 81 control the pivotal movement of the bucket sections 73 and 74 so that they open and close in unison and to the same extent. The construction permitting opening of the bucket and of the bottom doors is highly desirable, since it facilitates emptying the bucket. Many types of soils have a tendency to pack quite firmly within the bucket and the soil thus packed would not simply fall out of the bucket when the bottom doors are opened. However, when the bucket sections are belled out and the bottom doors opened, I have found that the bucket contents are invariably discharged even though the earth might be packed very tightly in the bucket when it is closed.

The crane is then swung back to a position where the bucket overlies the hole being excavated, and the crowd drive 15 is operated to drive the bucket downwardly. After a cylindrical hole is dug in this manner to the desired depth, the bell-shaped excavation at the lower end of the hole may be started. This bell-shaped excavation is preferably formed by lowering the bucket to the lower end of the cylindrical hole and then gradually bellying out the bucket sections 73 and 74 while the bucket is rotating. During this phase of the operation, the excavating is done primarily by the side blades 92 and 93. As the bucket rotates and is gradually belled out, blades 92 and 93 cut into the side walls of the hole being formed and the dirt falls down into the bottom of the hole. After considerable dirt is cut away from the side walls in this manner (the solid line showing in Fig. 12) the bucket is gradually closed while it is being rotated, and the bottom doors serve to pick up the loose dirt at the bottom of the hole and deposit it in the bucket so that when the bucket is entirely closed, the bottom of the hole is quite clean. The bucket is then emptied, and the operation is repeated until the bucket has been belled out to the size of hole desired (Fig. 15 and the broken line showing in Fig. 12). I have found that, although blades 92 and 93 are located at the lower end of the bucket, in most types of soils the side walls of the bucket sections 73 and 74 above these blades serve to rub away the soil along the upper portions of the bucket to form the bell-shaped hole. When digging very firm soils the upper portion of the bell-shaped hole may be formed by gradually raising the bucket while partially belled so that the finished excavation has a somewhat stepped side wall as indicated at 155.

The lower end of the side wall of each bucket is cut away at an angular inclination as at 154 so that when

the bucket is belled out to the size of the finished bell-shaped excavation, these angularly inclined edges 154 are substantially horizontally disposed (Fig. 15). It will be appreciated, of course, that as the bucket is belled out, the bottom doors 83 are correspondingly pivoted gradually upwardly so that the final hole excavated will have a substantially flat bottom wall. Bottom doors 83 are actuated by the operator such that, while the bucket is digging, these doors are positioned substantially horizontal.

In Figs. 16 through 20 there is shown another arrangement for conducting current from generator 23 to the bucket. In this instance a cable 160 is extended directly from generator 23 to the upper end of shaft 37. A sleeve 161 is extended upwardly from bearing cap 39 through bearing 41. Sleeve 161 is of round cross section and is covered with a layer of insulation 162. At spaced points along sleeve 161 there are secured brush retainers 163 which are of annular shape and provided with a radial flange 164 and an axially extending flange 165. Retainers 163 are arranged in pairs with the retainers in each pair being oppositely disposed one with the flange 165 extending downwardly and the other having the flange 165 extending upwardly. Three pairs of such retainers are arranged along the sleeve 161. Within each retainer 163 there is arranged an annular brush member 166 which is retained in place by retainer caps 167 formed similarly to retainers 163 as annular members having a radial flange 168 and an axially extending flange 169. Brushes 166 are dimensioned to space retainers 163 and caps 167 apart around their adjacent edges. Retainer caps 167 are each provided with diametrically opposed lugs 170 which are vertically aligned and held in place by a U-shaped yoke 171 which passes through lugs 170 and pivotally connects with top plate 40 as at 172. The retainer caps in each pair are biased apart towards their respective retainers by compression springs 173 which surround the portions of yoke 171 extending between each set of caps 167. Springs 173 are seated at each end within insulated sockets 174 in lugs 170.

Cable 160 comprises six individual conductors 175 which are connected one with each retainer cap 167. Each retainer 163 is similarly connected with a conductor 176 which extends through sleeve 161, downwardly through bearing 41 and bearing cap 39, then outwardly through a suitable aperture 177 in shaft 37 downwardly along the shaft enclosed within an angle member 178 which is welded to one face of shaft 37. The conductors 176 are connected at their lower ends one with each of solenoids 122, 123, 124, 125 and motor 106. One of the conductors 176 provides a ground connection for the circuit.

Yoke 171 is supported in an upright position on top plate 40 by four rigid links 179 which are extended from bushings 180 fixed to yoke 171 and are connected together at a common point 181 which is in turn loosely connected as by a chain link 182 with an upright post 183 fixed to top plate 40 as at 184.

In this form of construction I prefer to arrange the square shaft 137 with the rollers 34 engaging the side faces of shaft 137 rather than the corner portions of the shaft as illustrated in the previous form of construction described. I have found that by arranging the rollers 34 having the central notch 35 so as to engage the flat faces of shaft 37 the shaft wears only slightly and relatively uniformly along the side faces of the shaft at each corner.

In the arrangement illustrated in Figs. 16 through 20 the current is conducted from each conductor 175 to the retainer caps 167. The current passes from retainer caps 167 through brushes 166 to retainers 163 to which the conductors 176 are connected. It will be noted that sleeve 161 is fixed on and rotates with shaft 37. Caps 167, on the other hand, are secured to the relatively stationary top plate 40, the arrangement being such that retainers 163 rotate with shaft 37, and caps 167 remain

stationary. Cable 160 is suspended freely between the upper end of shaft 37 and generator 23 so that, as the shaft is lowered, the cable is slackened and, as the shaft is raised, the cable is extended. In this manner a single brush assembly may be employed in place of the two brush assemblies illustrated in the previous form of construction described.

I claim:

1. In an apparatus for digging footing excavations, a cylindrical bucket which is split axially into two generally semi-cylindrical half sections pivotally connected at their upper ends for pivotal movement about an axis perpendicular to the axis of the bucket, said bucket sections each having at its lower end a bottom wall, said bottom walls being provided with blades for cutting into the ground when the bucket is rotated on its axis and driven downwardly, said bottom walls being pivotally connected with the side walls of said bucket sections, and hydraulic means for pivoting said bottom walls upwardly and downwardly and said two bucket sections radially towards and away from each other.

2. The combination set forth in claim 1 wherein said hydraulic means include a cylinder within said bucket and connected with one of said half sections and a piston operatively associated with said cylinder and connected with the other half section of the bucket, said piston and cylinder assembly extending across the bucket adjacent and below the pivotal connection between said bucket half sections.

3. The combination set forth in claim 1 wherein said hydraulic means include a pair of cylinders connected with said bucket adjacent the upper end thereof and pistons operatively associated with said cylinders and connected with said bottom walls.

4. In an apparatus for digging bell-shaped footing excavations, a supporting frame, an upright shaft mounted for rotation and for vertical travel on said supporting frame, a cylindrical bucket at the lower end of said shaft, said bucket being split axially into two generally cylindrical half sections and including a supporting plate adjacent the upper end thereof, said half sections each being pivotally connected at its upper end with said supporting plate for pivotal movement about an axis perpendicular to the axis of the bucket, means within said bucket for pivotally actuating said half sections so that the bucket can assume a bell shape, said half sections each having a pivotally supported bottom wall at the lower end thereof, said bottom walls being provided with blades for cutting into the earth as the bucket is rotated and shifted downwardly.

5. The combination set forth in claim 4 including means forming apertures on the side walls of the bucket, cutting blades extending along one side of said apertures and projecting outwardly on the side walls of said bucket.

6. The combination set forth in claim 4 including means for pivoting said bottom walls upwardly and downwardly from a position disposed substantially perpendicular to the plane of the cylindrical side walls of the bucket, the lower edges of said half sections being oppositely inclined upwardly towards each other such that when the bucket sections are pivoted outwardly away from one another into bell shape, said lower edges define a plane perpendicular to the axis of the bucket.

7. In an apparatus for digging footing excavations, a tubular bucket which is split axially into two generally semi-cylindrical half sections, a support adjacent the upper end of said bucket, said half sections each being pivotally connected at their upper ends on said support, means within said bucket for pivoting each of said bucket sections outwardly on said support on an axis perpendicular to the axis of the bucket so that the bucket assumes a bell shape, each of said bucket sections having a bottom wall provided with a cutting blade, the side walls of said bucket sections having openings therein, and blades on

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said side walls adjacent said openings and extending outwardly of the side walls of the bucket.

8. In an apparatus for digging footing excavations, a cylindrical bucket which is split axially into two generally semi-cylindrical half sections, a support adjacent the upper end of said bucket, said half sections each being pivotally connected at their upper ends on said support, means within said bucket for pivoting each of said bucket sections outwardly on said support on an axis perpendicular to the axis of the bucket so that the bucket assumes a bell shape, said bucket sections each having at its lower end a bottom wall, said bottom walls being provided with blades for cutting into the ground when the bucket is rotated on its axis and driven downwardly, said bottom walls being pivotally connected with the side walls of said bucket sections, and means within said bucket for pivoting said bottom walls upwardly and downwardly from a position wherein the bottom walls are disposed in a plane substantially perpendicular to the plane of the cylindrical side walls of the bucket.

9. The combination called for in claim 4 including a power unit mounted on said supporting plate, said power unit comprising an electric motor and a hydraulic pump driven by the motor, said means for pivotally actuating said half sections comprising a cylinder piston assembly connected with said pump and acting between said two half sections of the bucket.

10. The combination called for in claim 4 including

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two piston and cylinder assemblies connected at one end with said supporting plate and at the opposite end one with each of said bottom walls and means for supplying fluid under pressure to said piston and cylinder assemblies.

11. The combination called for in claim 4 including a piston and cylinder assembly extending across said bucket adjacent and below said supporting plate, said assembly having its opposite ends connected one with each of said half sections of the bucket and means for supplying fluid under pressure to said piston and cylinder assembly.

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