United States Patent

Gagne

[15] 3,647,003

[45] Mar. 7, 1972

[54] SLIT TRENCHING MACHINE AND CABLE LAYER

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[21] Appl. No.: 17,261

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[51] Int. Cl. A01b 63/32, E02f 5/02

[58] Field of Search 61/72.1, 72.5, 72.6; 172/40; 37/193

[56] References Cited

UNITED STATES PATENTS

3,286,476	11/1966	Maclay	61/72.6
3,326,009	6/1967	Gagne	61/72.6
3,326,010	6/1967	Gagne	61/72.6
3,363,423	1/1968	Davis	61/72.6
3,390,533	7/1968	Gremillion	62/72.6
3,503,456	3/1970	Larson	61/72.1 X
3,515,222	6/1970	Kank	61/72.6 X

FOREIGN PATENTS OR APPLICATIONS

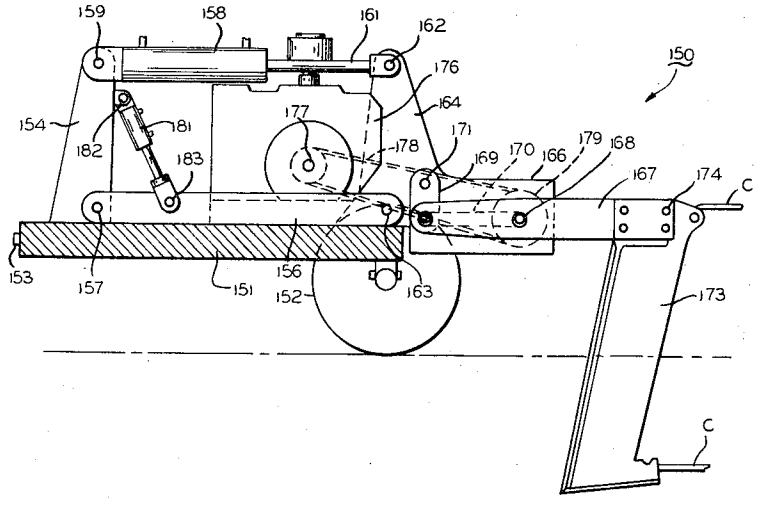
2,000,368	9/1969	France	172/40

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Assistant Examiner—David H. Corbin
Attorney—Richard C. Lindberg

[57] ABSTRACT

A cable plow including a ground-engaging vehicle having a plow member extending into the ground where it is driven orbitally to form a slit trench. Cable-laying means feed a flexible cable or the like into the slit trench as it is formed by movement of the vehicle over the ground surface.

3 Claims, 14 Drawing Figures



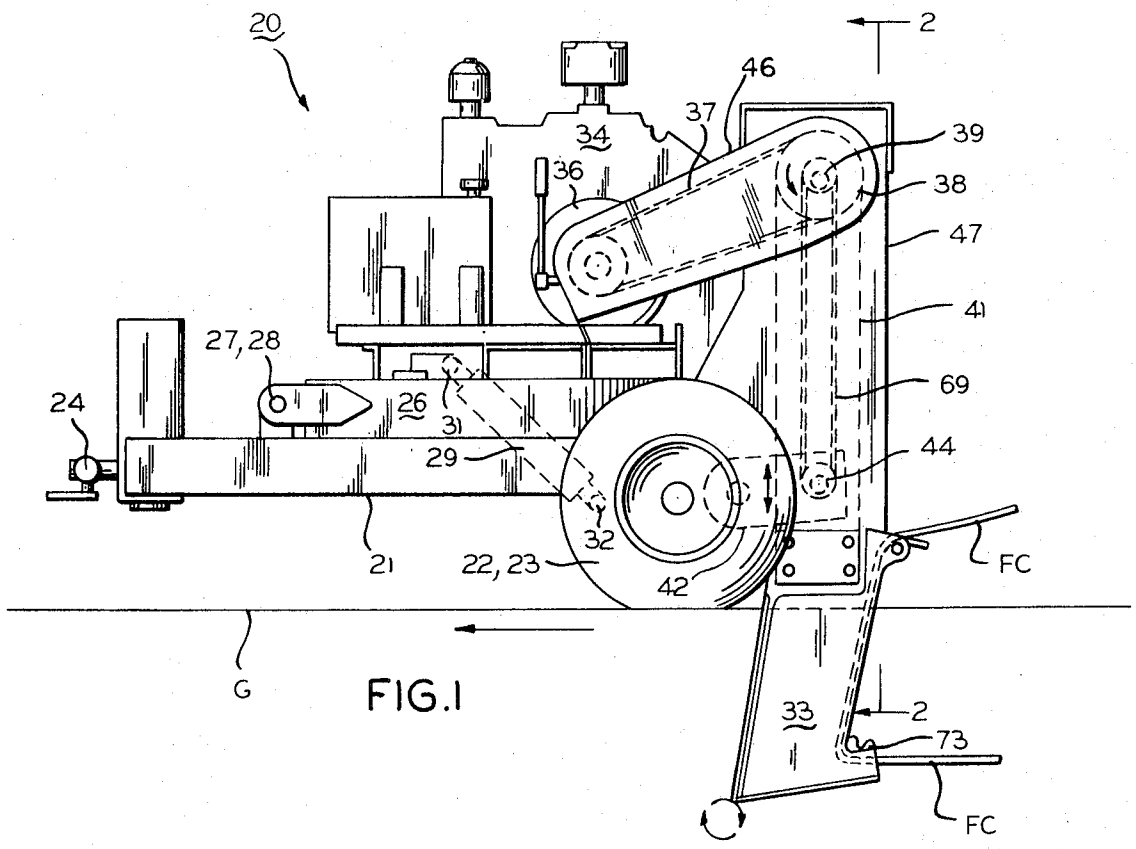


FIG.1

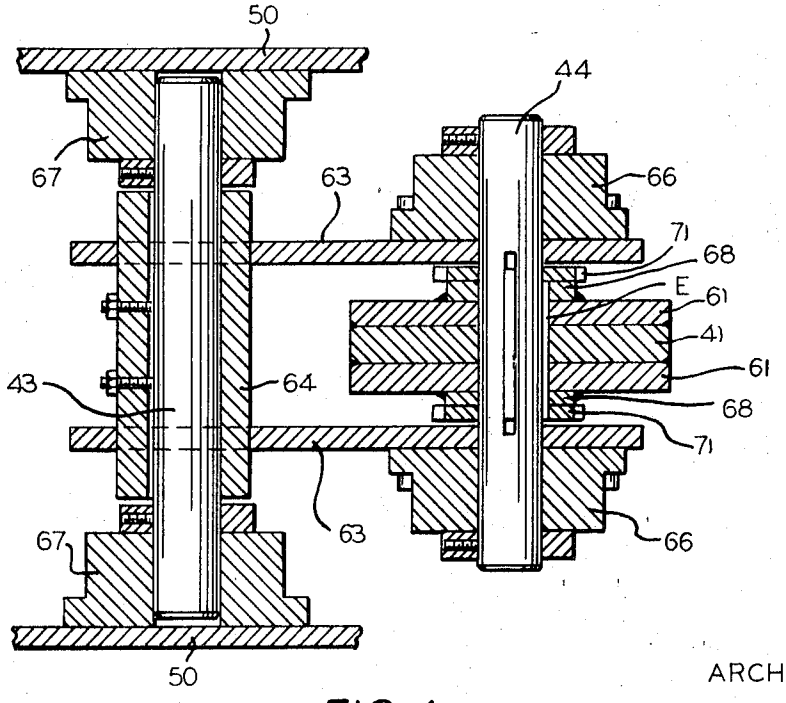


FIG.4

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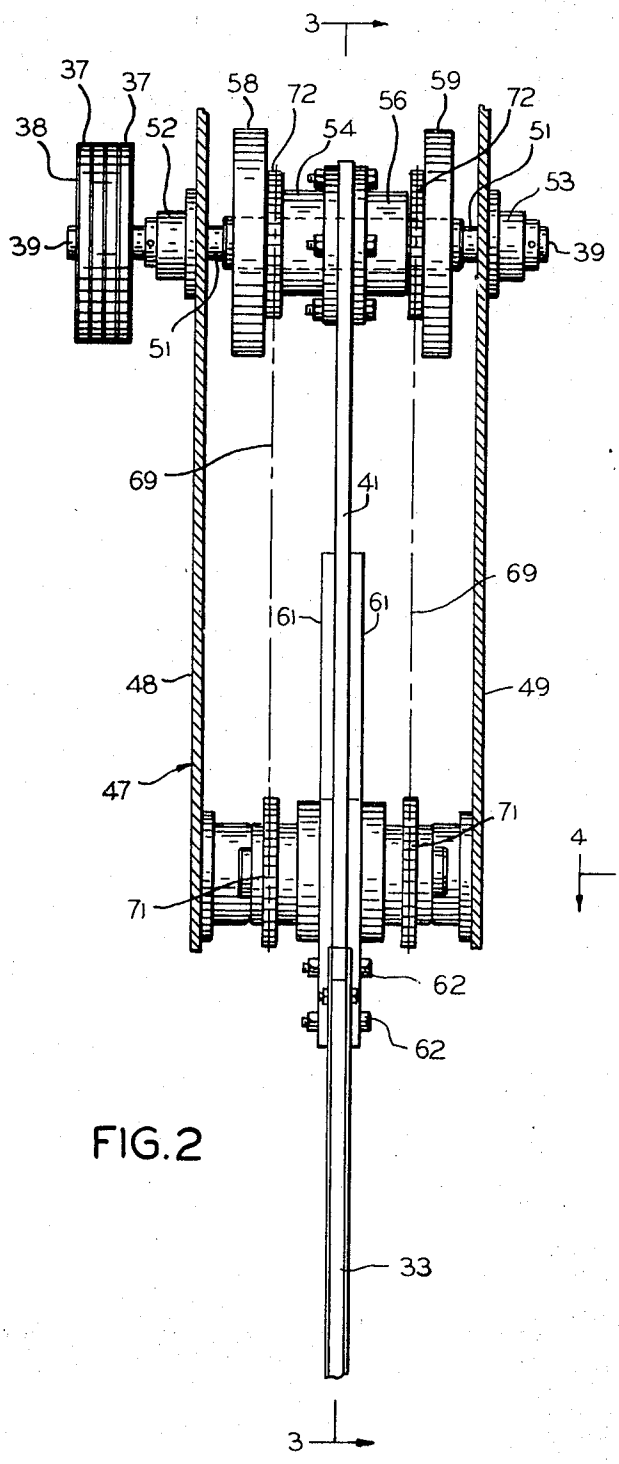


FIG.2

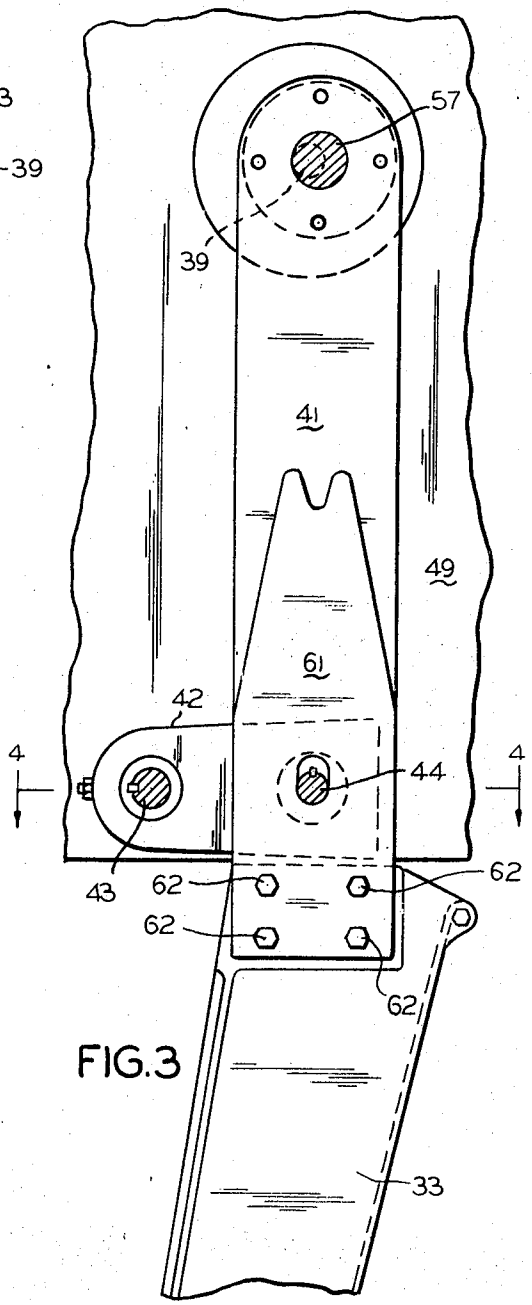


FIG.3

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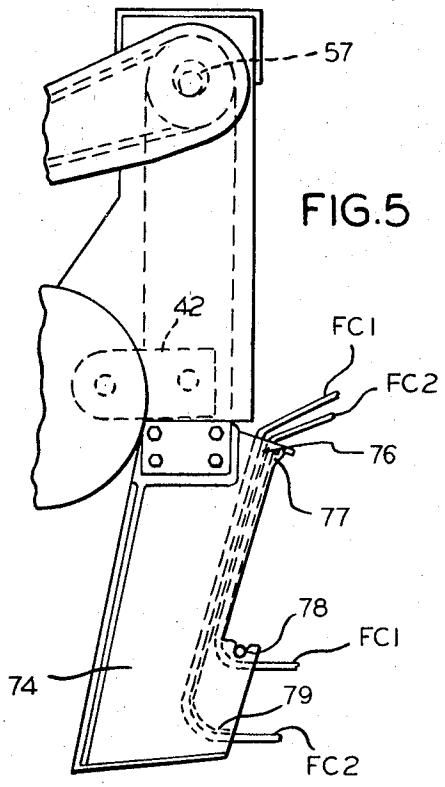


FIG.5

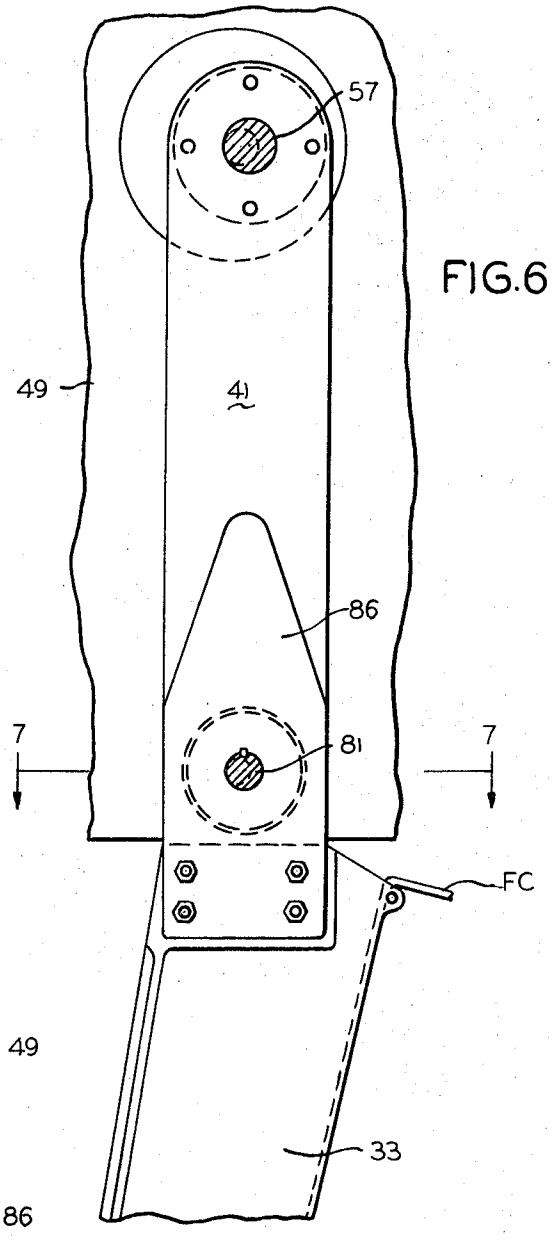


FIG.6

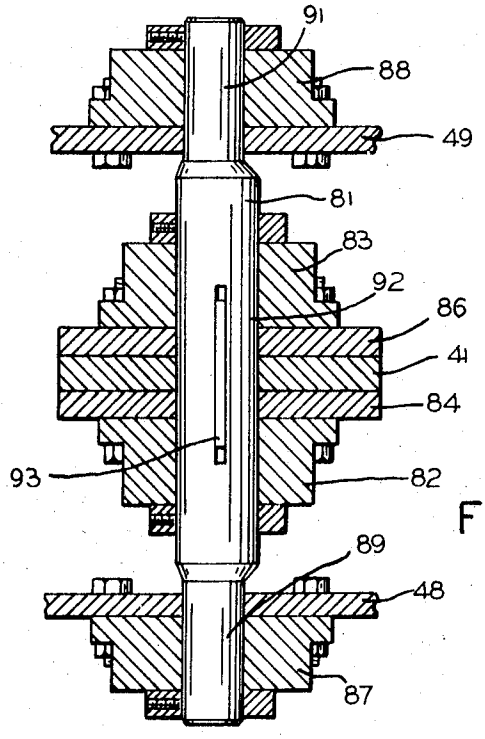


FIG.7

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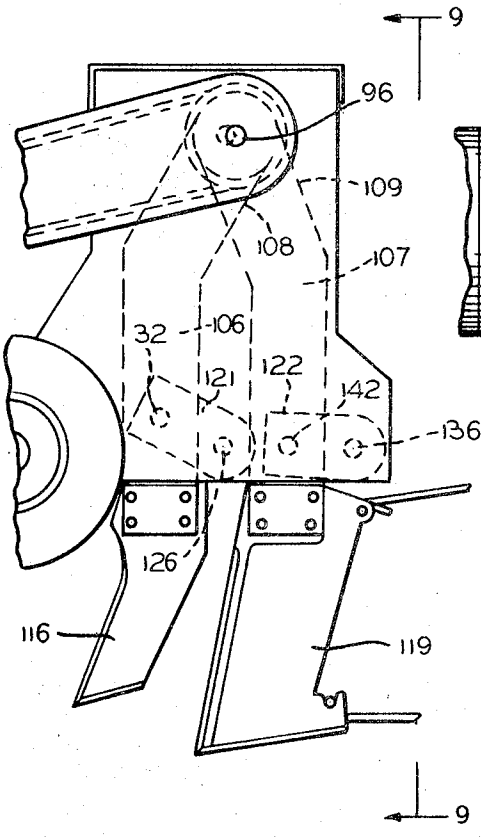


FIG.8

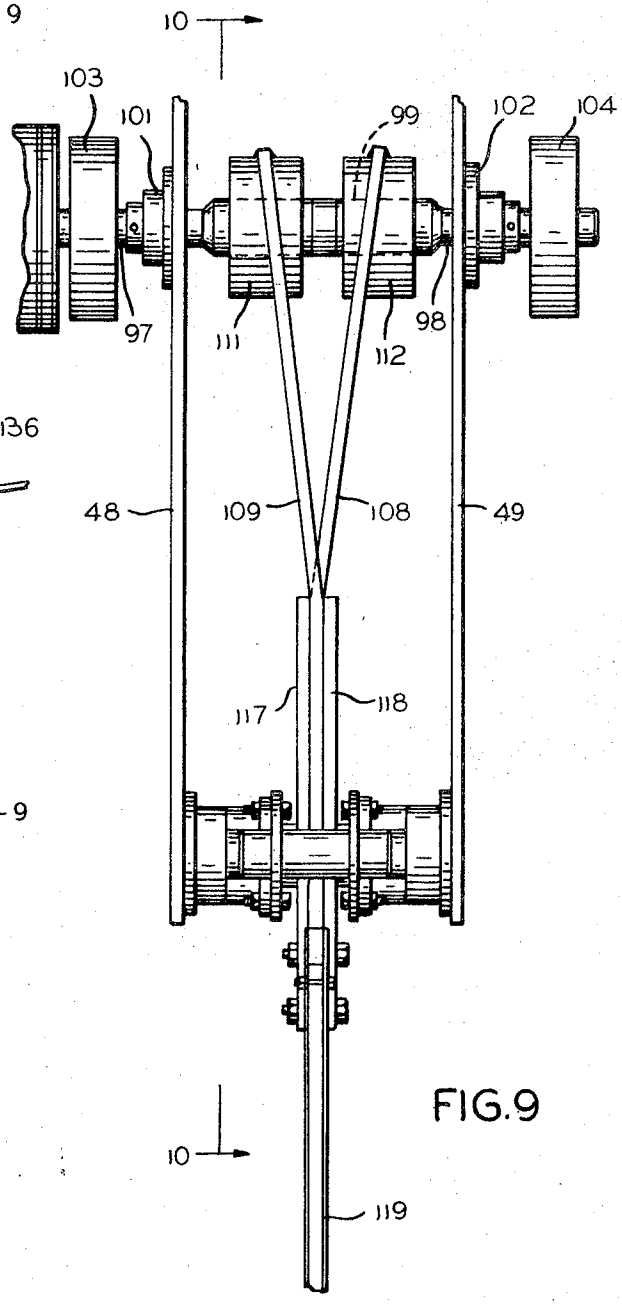


FIG.9

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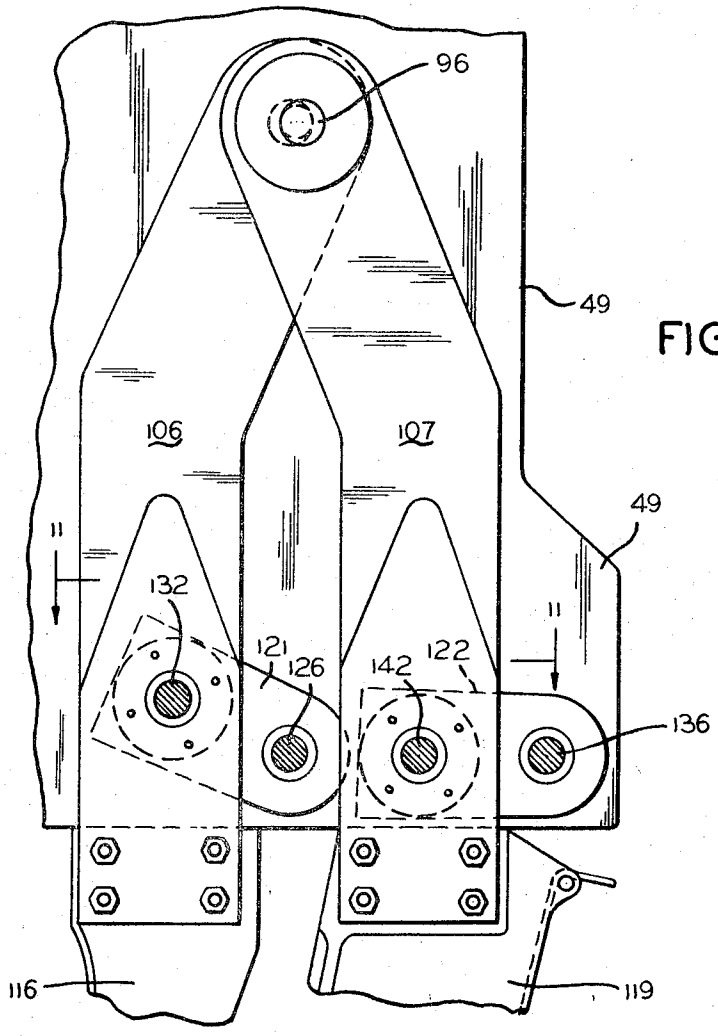


FIG.10

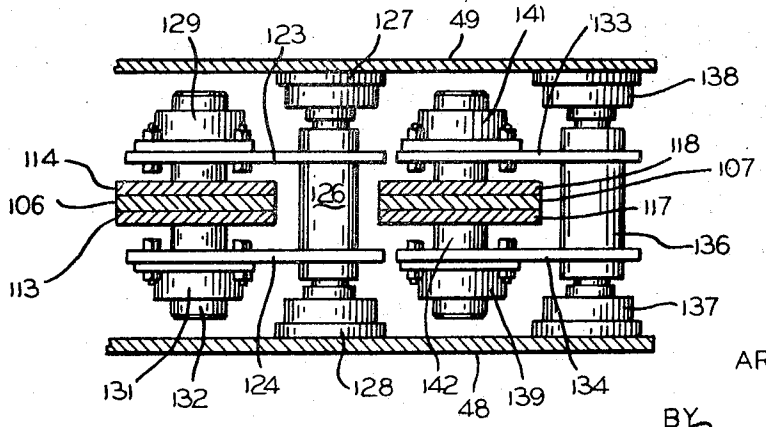


FIG.11

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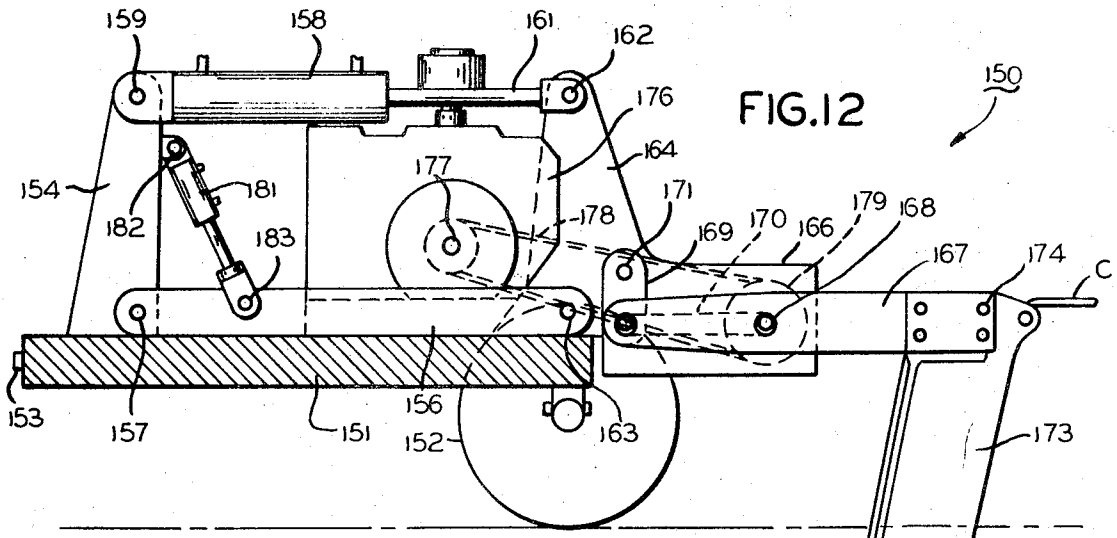


FIG.12

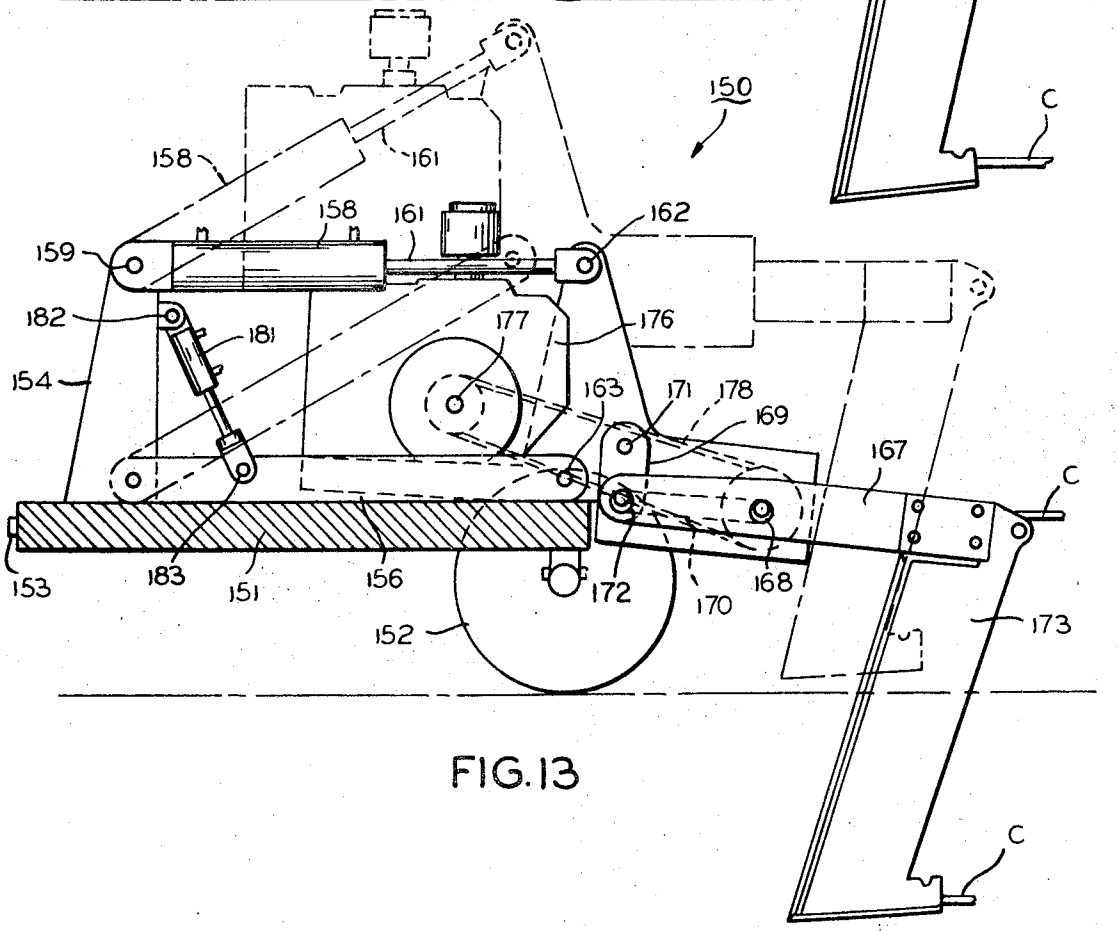


FIG.13

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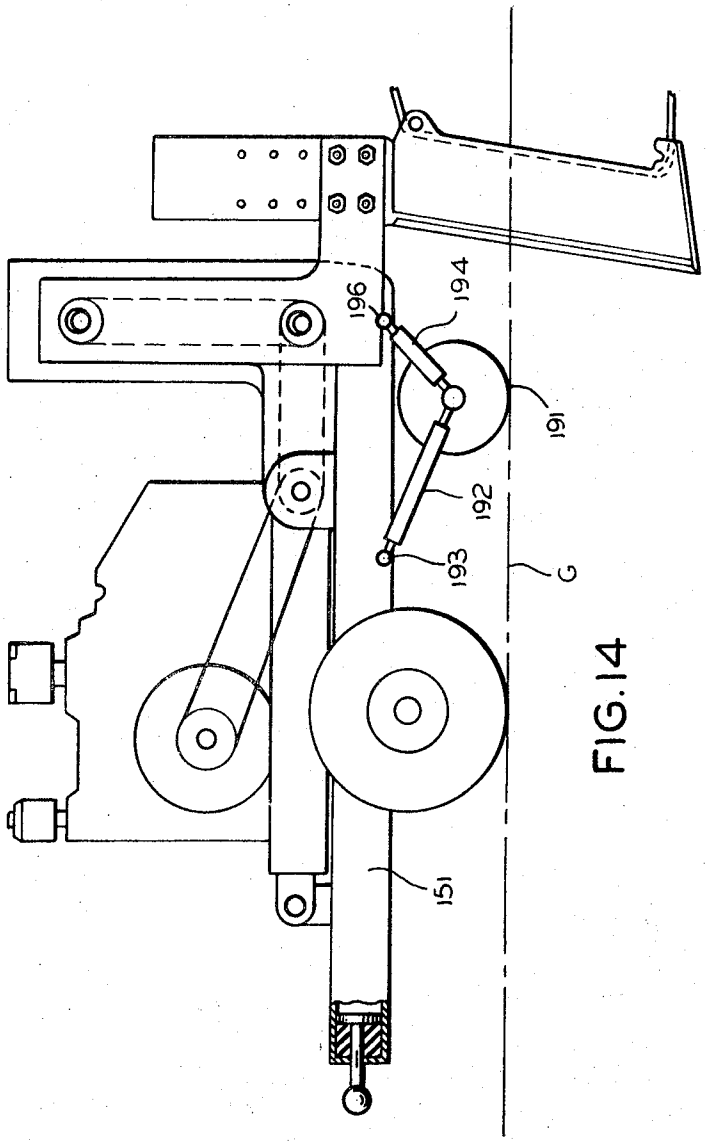


FIG. 14

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SLIT TRENCHING MACHINE AND CABLE LAYER

This invention represents an improvement over devices shown in Gagne U.S. Pat. Nos. 3,326,009, and 3,326,010.

It is an object of the present invention to provide an improved driving structure for imparting a unique orbital action to a trench-forming plow member thereby reducing the power requirements necessary to operate the plow and the power and traction requirements for the ground-engaging vehicle which carries the plow member.

Another object is to provide an improved plow structure for forming a slit trench and for controlling the movement thereof.

THE DRAWINGS

FIG. 1 is a side elevational view of a cable plow constructed in accordance with one embodiment of the present invention;

FIG. 2 is an enlarged vertical sectional view taken substantially along the line 2—2 of FIG. 1 looking in the direction of the arrows, showing the manner of mounting and driving a plow of the apparatus of FIG. 1;

FIG. 3 is a vertical sectional view taken approximately along the line 3—3 of FIG. 2 looking in the direction of the arrows;

FIG. 4 is an enlarged horizontal sectional view taken along the line 4—4 of FIG. 3 looking in the direction of the arrows, showing structure for controlling orbital movement of the plow member;

FIG. 5 is a fragmentary elevational view of another form of plow member, showing the manner in which a pair of flexible cables may be laid at different elevations in a common slit trench;

FIG. 6 is a fragmentary elevational view showing another embodiment of the invention;

FIG. 7 is an enlarged horizontal sectional view taken substantially along the line 7—7 of FIG. 6 looking in the direction of the arrows;

FIG. 8 is a fragmentary elevational view of still another embodiment of the invention where a pair of plow members are disposed in tandem relationship and are driven from a common eccentric shaft;

fIG. 9 is an enlarged end elevational view, partly broken away, looking in the direction of the arrows 9—9 of FIG. 8;

FIG. 10 is an enlarged fragmentary vertical elevational view of the embodiment seen in FIG. 8.

FIG. 11 is a horizontal sectional view taken substantially along the line 11—11 of FIG. 10 looking in the direction of the arrows;

FIG. 12 is a side elevational view, partly in section, showing still another embodiment of the present invention;

FIG. 13 is a view similar to FIG. 12 showing the plow member in solid lines in its lowered position, and the same in dash lines in its raised position;

FIG. 14 is a view similar to FIG. 1 showing an embodiment capable of being used on a side slope.

Referring now to the drawing, FIG. 1 shows a slit trenching machine and cable layer denoted generally by the reference numeral 20. It comprises a lower frame 21 mounted at one end on a pair of wheels 22, 23. Structure 24 is provided at its forward end for hitching frame 21 to a tractor or the like. An upper frame 26 is pivotally connected to lower frame 21 by a pair of pivot pins 27,28 and is pivotally movable about pins 27,28 between a lowered position seen in FIG. 1 and a raised position (not shown) by an hydraulic cylinder assembly 29. Cylinder 29 is connected at 31 to upper frame 26 and to lower frame 21 at 32.

Cable layer 20 is adapted to move over a ground surface G, and has a plow member 33 disposed thereon to project into the ground a desired distance when the upper frame 26 is in its lowered position. Plow member 33 may be raised above the ground surface G when not in use by actuating the hydraulic cylinder 29 to raise upper frame 26.

The latter has a prime mover 34 mounted thereon, which includes a drive pulley 36 acting through a V-belt 37 to drive a pulley 38 and an eccentric drive shaft 39. The latter serves to

impart orbital movement to a vertical drive arm 41 connected in turn at its lower end rigidly to plow member 33. Orbital movement of the plow 33 is controlled in part by a link 42 pivotally connected to lower frame 21 at 43 and pivotally connected at its other end to the drive arm 41 at 44. A housing 46 protects V-belt 37, and a housing 47 may protect drive arm 41.

A flexible cable FC is conducted down through the hollow plow member 33 to extend rearwardly from the lower end thereof, automatically to be placed in a slit trench formed by cable layer 20.

Referring to FIGS. 2 to 4, the plow member 33 and drive arm 41 are driven orbitally, and are supported in housing 47 which comprises spaced side plates 48 and 49. The latter are rigidly connected to the upper frame 26 in any convenient manner, so as to be a part thereof. Drive shaft 39 has its ends 51 supported in spaced bearings 52 and 53 secured to the side plates 48 and 49 respectively. A pair of bearing assemblies 54 and 56 are arranged in facing relationship and are secured to opposite sides of the upper end of the drive arm 41. An eccentric 57 fast with drive shaft 39 turns within bearing assemblies 48 and 49 and through the upper end of the drive arm 41. Spaced counterweights 58 and 59 are fast on drive shaft 39 to counterbalance the eccentric forces set up by rotation of shaft 39 in imparting orbital motion to the upper end of drive arm 41.

Drive arm 41 is flanked by a pair of support plates 61 welded thereto at its lower end, and plow member 33 has its upper end disposed between support plates 61, and is rigidly secured thereto by a plurality of through bolts 62.

Orbital movement of plow member 33 is accomplished in part by a pivotal link 42 which is connected to the drive arm 41 by an eccentric shaft 44 and to housing 48, 49 by pin shaft 43. Link 42 comprises a pair of spaced arms 63 which are welded at one end to a sleeve 64. A pair of pillow bearings 66 are bolted to the ends of arms 63 remote from sleeve 64 to support shaft 44 at the lower end thereof. Spaced bearing members 67 are secured to the inner walls of spaced side plates 50 and in facing relationship to support the ends of pin shaft 43, plates 50 extend from frame 21. A pair of spaced hubs 68 confine therebetween drive arm 41 and support plates 61 and is keyed to shaft 44 at the eccentric portion E thereof.

Shaft 43 extends through sleeve 64 and has its ends supported in the bearing members 67, thereby pivotally connecting one end of the link 42 to the housing 48,49. The other shaft 44 extends through drive arm 41 and through link arms 63,63 and the bearing hubs 66,66 mounted thereon, so as to pivotally connect the opposite end of link 42 to drive arm 41.

Eccentric shaft 44 is rotated by a pair of timing belts 69, each being trained about one of a pair of sprockets 71, each of which flanks a hub 68. The timing belts 69 are trained at their upper ends about sprockets 72 fast on the shaft 39 for upper eccentric 57. The two eccentrics 57 and E are timed in their rotation by belts 69 in such a fashion that plow member 33 has the orbital motion shown.

Pivot links 63 control the movement of drive arm at the location of shaft 44 so as to maintain orbital movement of the lower end of plow member 33.

FIG. 1 shows a cable FC fed directly through the plow member 33 which is hollow. Cable FC is conducted down into the upper end of plow 33 and extends out of the lower end of plow past a guide 73 at the rear thereof. When plow 33 moves downwardly its orbital movement in a path approximating a circle, guide 73 forces cable FC down into the slit trench formed by plow 33.

FIG. 5 shows another embodiment having substantially the same components as shown in FIG. 1 except that a plow member 74 is provided with a pair of guides 76 and 77 at its upper end and a pair of guides 78 and 79 at its lower end for accommodating a pair of flexible cables FC_1 and FC_2. The two separate cables are fed into the upper end of the hollow plot member 74 and are guided out the lower end thereof so as to be disposed approximately in a common vertical plane but

with one cable disposed a predetermined distance above the other. Such an arrangement is suited for the laying of a pair of cables or the like at different heights in a common slit trench.

FIGS. 6 and 7 disclose a further embodiment of the present invention where the link 42 is eliminated and an eccentric idler shaft 81 is substituted therefore. The latter operates as a rock arm and cooperates with the eccentric 57 in a manner as will be described. In the embodiment of FIGS. 6 and 7, a pair of pillow blocks 82 and 83 are bolted to drive arm support plates 84 and 86, and a second pair of pillow blocks 87 and 88 are bolted to the outer faces of housing side plates 48 and 49. Eccentric shaft 81 extends through drive arm 41 and hub members 82 and 83 which are fast thereto by key 93. The ends of shaft 81 are journaled in the blocks 87 and 88 and are supported by housing side plates 48 and 49.

As the eccentric drive shaft 76 rotates, the upper end of the drive arm 41 is given a circular motion, and eccentric shaft 41 will rock to and fro much as a crank.

FIGS. 8 to 11 show a still further embodiment which includes a pair of plow members disposed approximately in the same vertical plane, and driven from a common eccentric drive shaft 96 having end portions 97 and 98 and an eccentric intermediate portion 99. The ends 97 and 98 are journaled in bearings 101 and 102 bolted to the sides of the housing side plates 48 and 49. A pair of counterweights 103 and 104 are fast on the shaft ends 97 and 98. A pair of drive arms 106 and 107 have their lower ends in substantially coplanar relationship. The upper ends 108 and 109 thereof are inclined out of the plane of the lower ends thereof so as to be laterally spaced, and are secured at their upper ends to eccentric followers 111 and 112. Arm 106 has a pair of support plates 113 and 114 welded thereto, and a plow blade 116 is rigidly bolted to the lower ends of support plates 113 and 114. In a like fashion, drive arm 107 has a pair of support plates 117 and 118 welded thereto, and a plow blade 119 is rigidly bolted to the lower ends of support plates 117 and 118.

As seen in FIG. 11, a link member 121 is connected with drive arm 106, and a second link member 122 is connected with drive arm 107. Link 121 comprises a pair of arms 123 and 124 which are connected to a dead shaft 126 supported at its ends in pillow blocks 127 and 128 bolted to the frames 48 and 49. Arms 123 and 124 are flanked by pillow blocks 129 and 131 secured thereto and shaft 132 extends through a drive arm 106 and has its ends journaled in the pillow blocks 127 and 128.

In a like manner, link 122 includes a pair of arms 133 and 134 connected to a sleeve 136 journaled in blocks 137 and 138 supported in frame members 48 and 49. Bearings 139 and 141 are secured to the outer sides of arms 133 and 134, and a shaft 142 extends through drive arm 107 and has its ends journaled in the bearings 139 and 141.

As with the embodiment of FIG. 1, it is preferred that the pivotal link 121 be attached to the drive arm 106 below the midpoint between drive shaft 96 and lower end of ripper blade 116, and that pivotal link 122 be attached to drive arm 107 below midpoint between drive shaft 134 and lower end of plow member 119. This arrangement provides an orbital path of movement of both the ripper blade 116 and plow member 117 substantially in the general configuration of an ellipse having a vertical major axis. Such reduces the power requirements for the apparatus and improving the operation of the plow member in laying a cable C within the slit trench. In the embodiment of FIGS. 8 to 11 the ripper blade 116 is disposed in front of the plow member 119 and is approximately coplanar therewith, while the blade and the plow member are driven at their upper ends from the common drive shaft 96. With such an arrangement the leading blade 116 will perform a major part of the work of forming the slit trench, while the trailing plow member 119 will complete the formation of the slit trench and will function to lay the flexible cable therein.

FIGS. 12 and 13 show a further modification of the present invention referred to generally by the reference numeral 150. It comprises a lower frame 151 mounted on a pair of wheels 152. A hitch 153 is provided at its forward end for connecting the same to a suitable towing vehicle. Lower frame 151 includes an upright frame member 154 having a first and lower link 156 pivotally connected thereto by a pivot pin 157. An hydraulic cylinder 158 is pivoted at 159 to the upper end of frame member 154 and has a piston rod 161 extending therefrom. Link 156 and piston rod 161 are connected pivotally at 162 and 163 to a movable frame member 164 including a generally horizontal frame portion 166.

A drive arm 167 is supported by frame member 164 and extends generally horizontally. It is driven in an oscillatory fashion intermediate its ends by an eccentric drive shaft 168 journaled on frame member 164. A link 169 extends vertically and has one end pivotally connected to an eccentric 171. The other end of link 169 is pivotally connected at 1172 to the forward end of arm 167. Eccentrics 168 and 171 are connected by a timing chain 170, so that the two eccentrics rotate in synchronism the two eccentrics 168 and 171 are journaled at noneccentric end portions thereof in the frame 164. A hollow plow member 173 is rigidly connected to the rear end of drive arm 167 by a plurality of bolts 174, and a flexible cable C is fed downwardly through hollow plow member 173 so as to extend rearwardly out the lower end thereof. A prime mover 176 is mounted on upper frame 164 and acts through a pulley 177, a drive belt 178 and a driven pulley 179 to rotate eccentric drive shaft 168.

Plow member 173 extends approximately perpendicularly to drive arm 167 so as to be oriented generally vertically, and thereby extend downwardly therefrom, whereby when upper frame 164 is in its lowered position as shown in FIG. 12, the plow 173 will project down into the ground for the purpose of forming a slit trench therein. The horizontal movement of lower end of the plow member 173 will be equal to the horizontal component of movement imparted to the drive arm 167 by eccentric drive shaft 169. Since the two eccentrics 168 and 171 are connected, the arm 167 will have circular orbital movement.

It is important to understand that an advantage of the embodiment of FIG. 12 is that it provides a low center of gravity for the overall cable layer apparatus. In other words, by disposing the drive arm 167 in a generally horizontal position, and locating same in a lowered position proximate the lower frame 151, the center of gravity as well as the profile of cable layer 150 is lower substantially.

FIG. 13 illustrates the manner in which the upper frame 164 can be raised in order to raise the plow member 173 above the ground surface G. An hydraulic cylinder assembly 181 has one end connected to the upright frame 154 by pin 182 and its other end connected to the lower link 156 by pin 183. It will be understood that when hydraulic cylinder 181 is operated to raise link 156 to the position shown in dash lines in FIG. 13, the upper frame 158, and various components mounted thereon including the plow member 173, will be raised to the dash line positions of FIG. 13, thereby raising plow member above the ground surface. Because of the parallelogram-type mounting arrangement afforded by members 156 and 158, the raising of the upper frame 164 does not alter the orientation thereof, this being in contrast with the embodiment of FIG. 1, where the upper frame is pivotally mounted to the lower frame member.

However, frame 164 can be tilted from the vertical if desired by operation of cylinder 158 to retract piston rod 161 thereof, at which time frame 164 can be tilted from the vertical.

In FIG. 14 there is shown another form of the invention, somewhat similar to the form of FIGS. 12 and 13, but characterized by structure for correcting the attitude of the apparatus in irregular terrain, such as when the apparatus is operated on the side hill. In this form of the invention ground engaging wheels 191 are mounted at the ends of trailing arms 192 pivotally connected at 193 to frame 151. A fluid operated cylinder 194 is pivotally connected at 196 to frame 151 and at 197 to trailing arm 192. Upon extension of cylinder 194 the

position of ground engaging wheel **191** with respect to frame **151** may suitably be varied.

I claim:

1. In a machine for laying cable in a slit trench, first frame means equipped with wheels for rolling along the ground surface, second frame means carrying a plow assembly comprising a drive arm for forming a slit trench in the ground, a pair of parallel members each of which has one end pivotally connected to said first frame means and its opposite end pivotally connected to said second frame means, said second frame means thus being movable with said parallel members relative to said first frame means between an upper position wherein said plow member is disposed above the ground surface and a lowered position wherein said plow member extends beneath the ground surface to form a slit trench therein, said drive arm being carried by said second frame means in a generally horizontal position and having drive means including an eccentric drive shaft having noneccentric end portions thereof journaled in said second frame means for imparting orbital movement to said drive arm, and said plow member being disposed approximately perpendicular to said drive arm so as to extend downwardly therefrom and being connected to said drive arm adjacent the rearward end thereof the angular orientation of said plow member remaining constant during movement between said upper and lower positions under the control of said parallel members, and power means carried by said first frame means for moving said second frame means between said upper and lower positions.

2. The invention of claim 1 where one of said parallel members is adjustable in length for the purpose of adjusting the position of said plow member.

3. A machine according to claim 1 where said eccentric drive shaft is connected to said horizontal drive arm intermediate the ends thereof.

* * * * *