July 10, 1945. E. W. AUSTIN 2,380,285

EXCAVATOR

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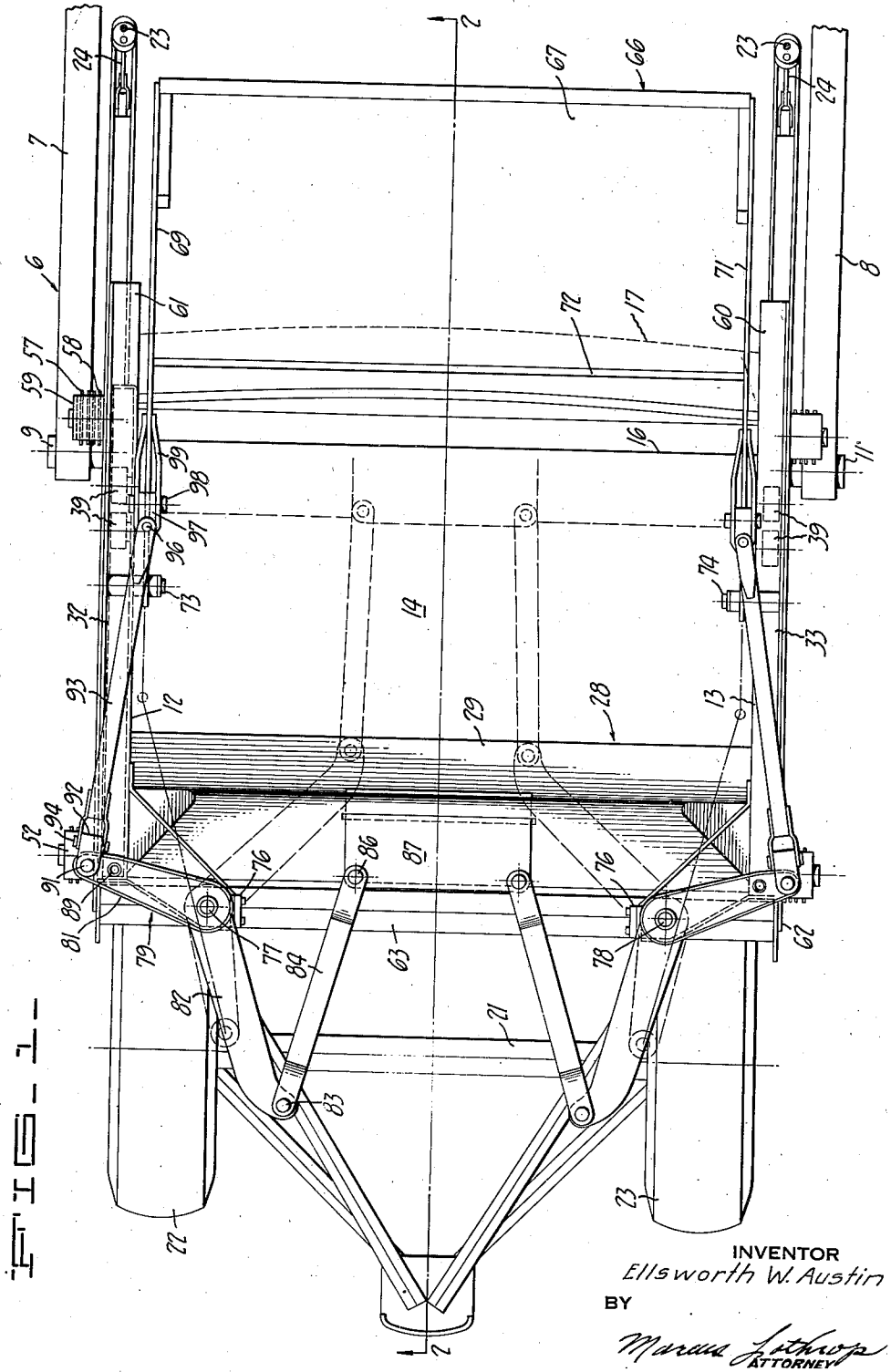


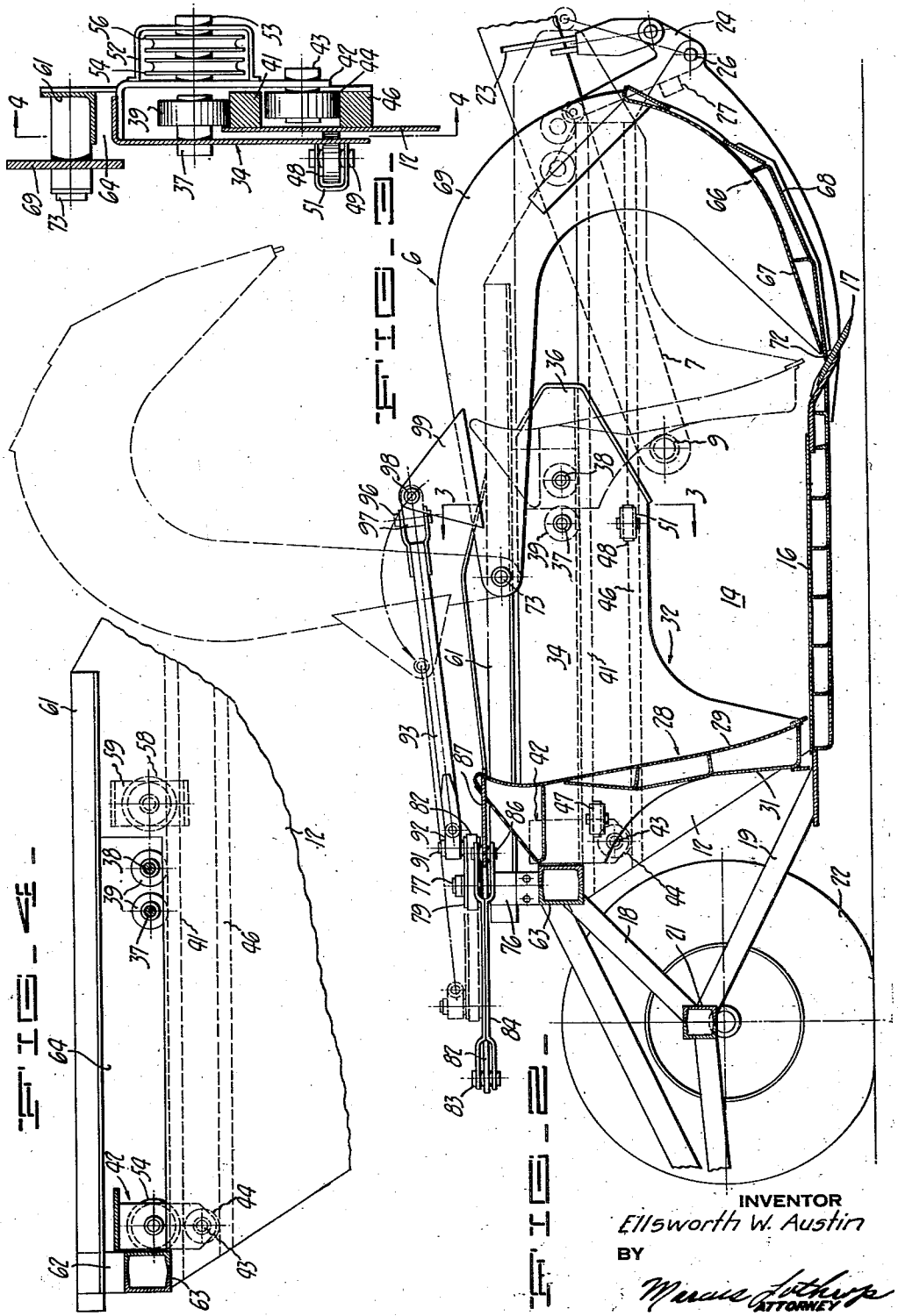
FIG. 1

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EXCAVATOR

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EXCAVATOR

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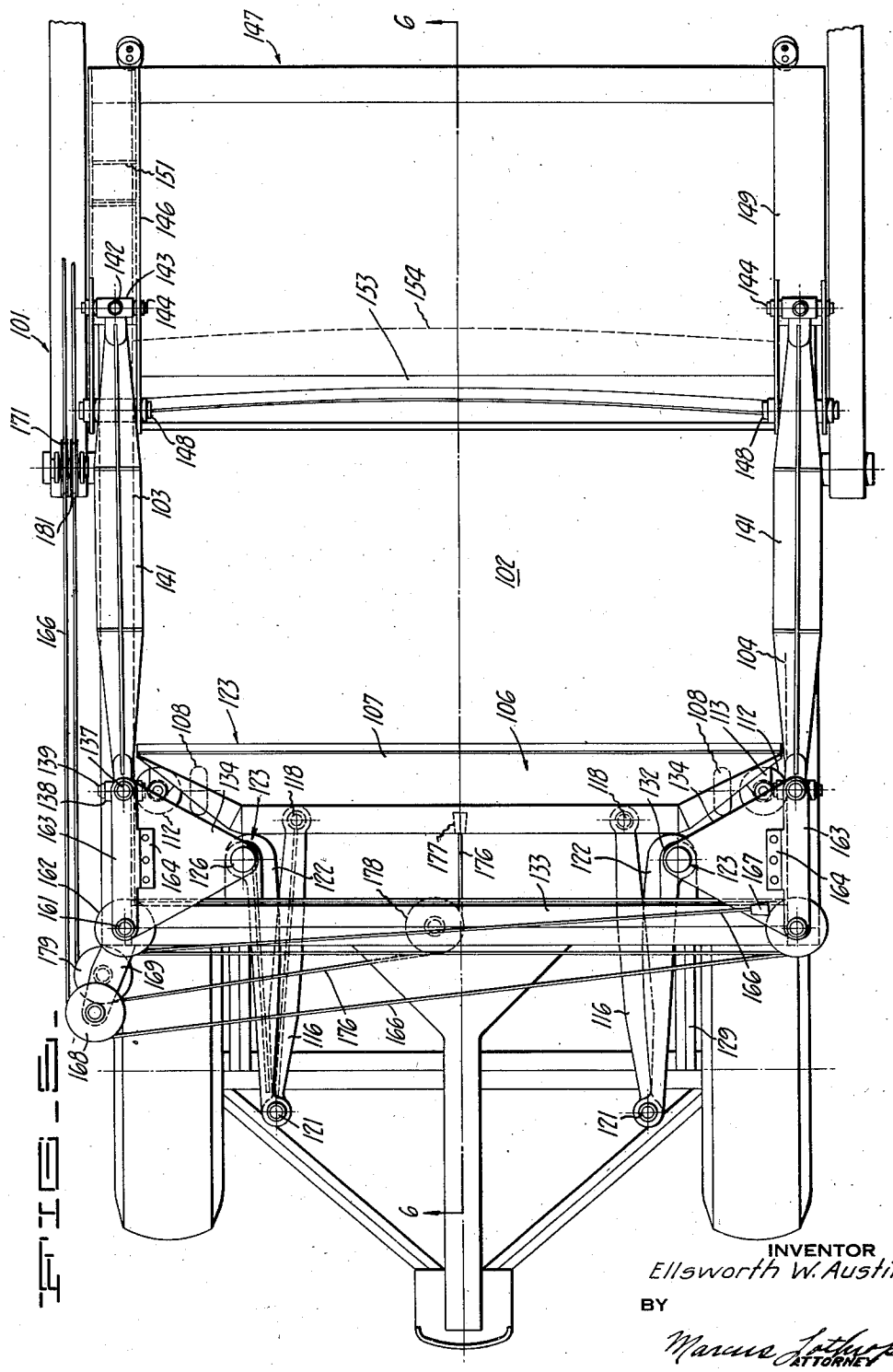


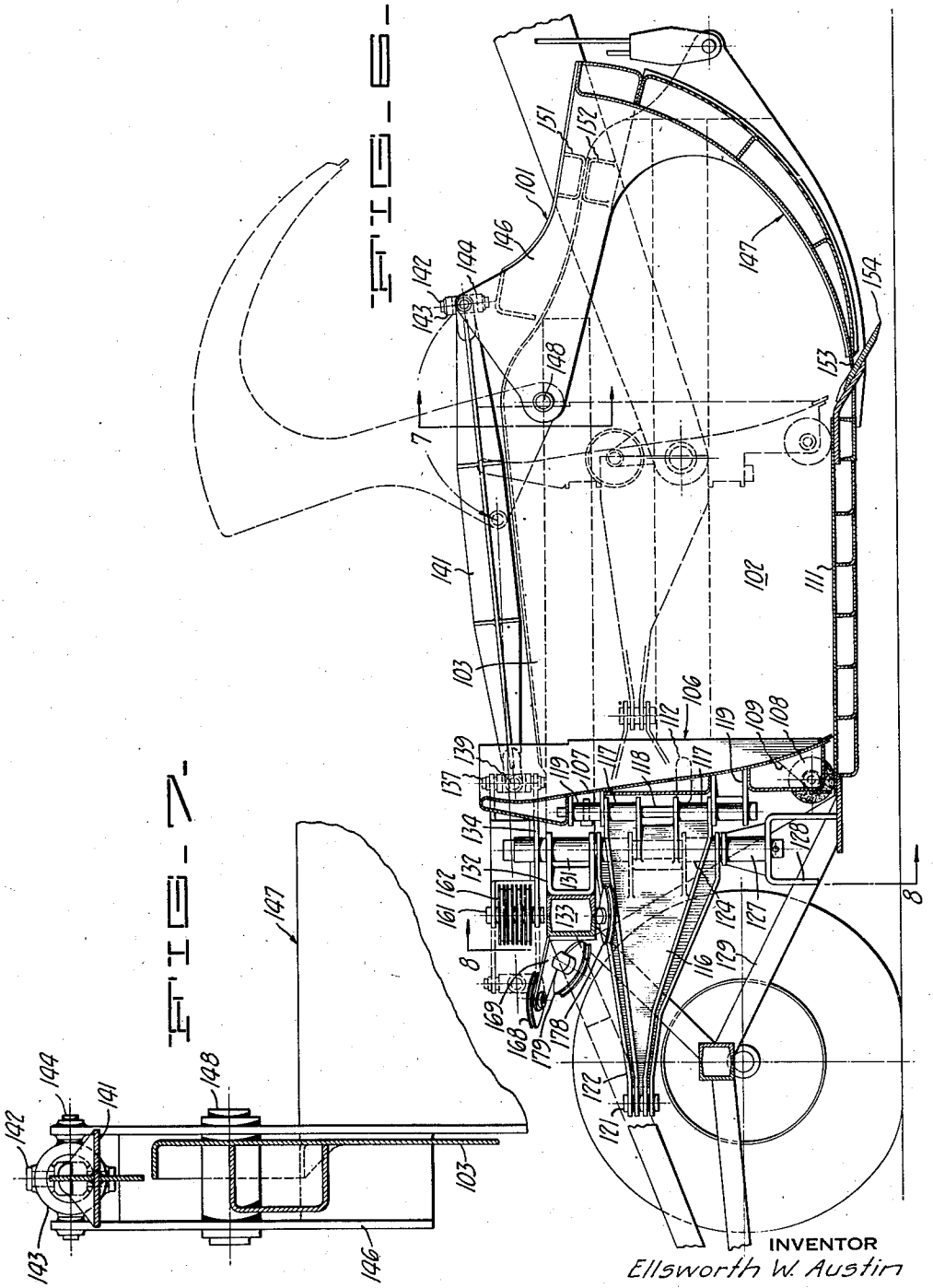
FIG. 5

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EXCAVATOR

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EXCAVATOR

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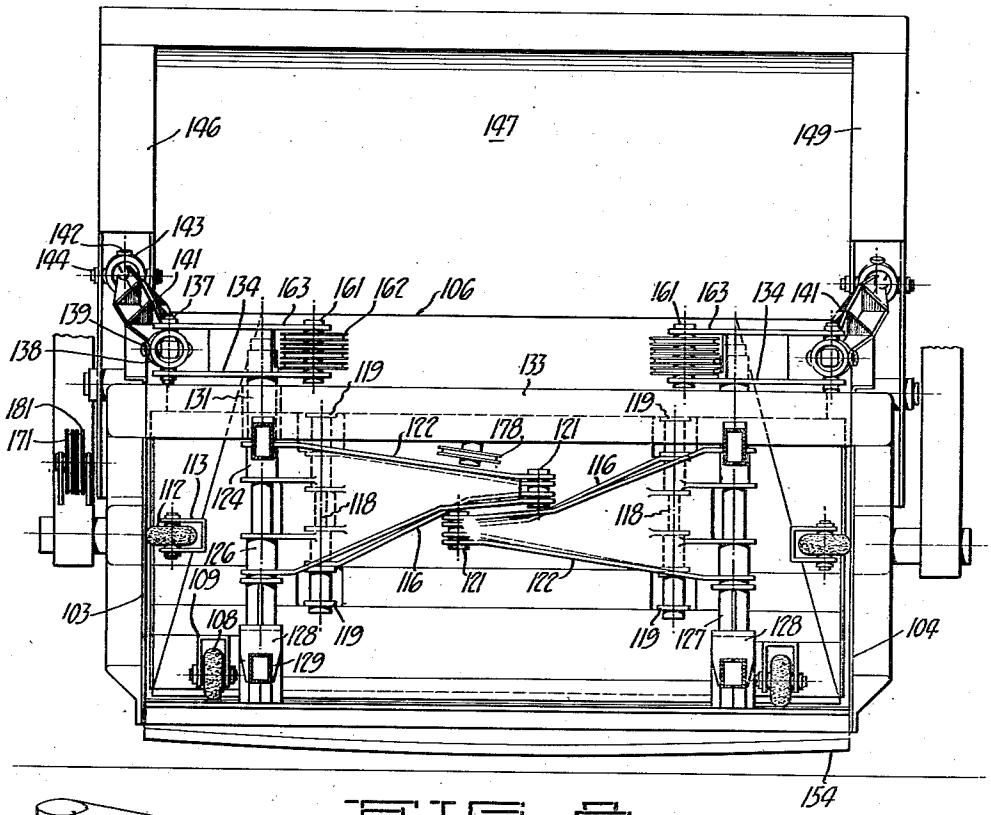


FIG. 8.

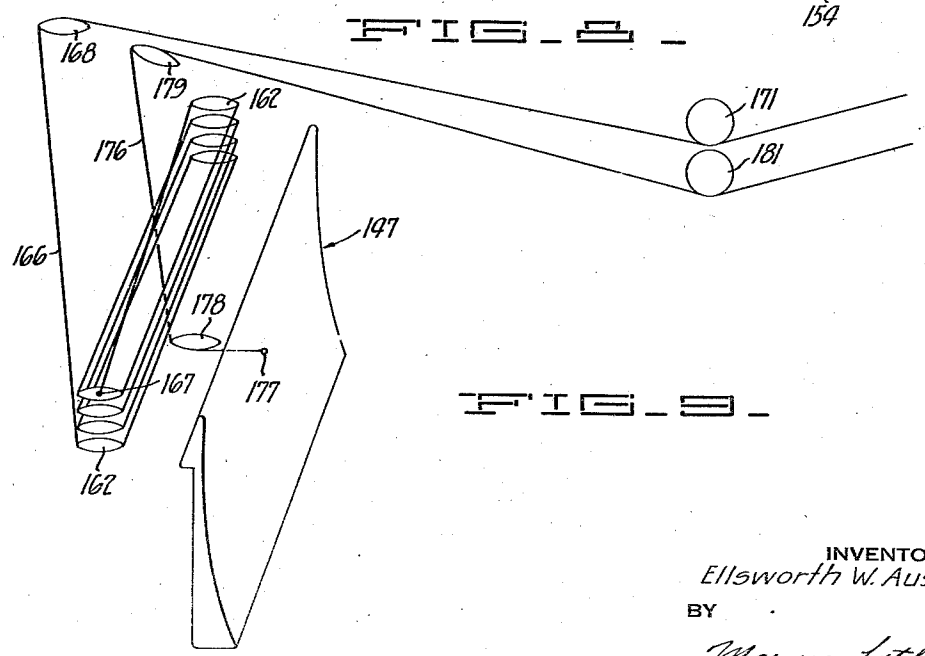


FIG. 9.

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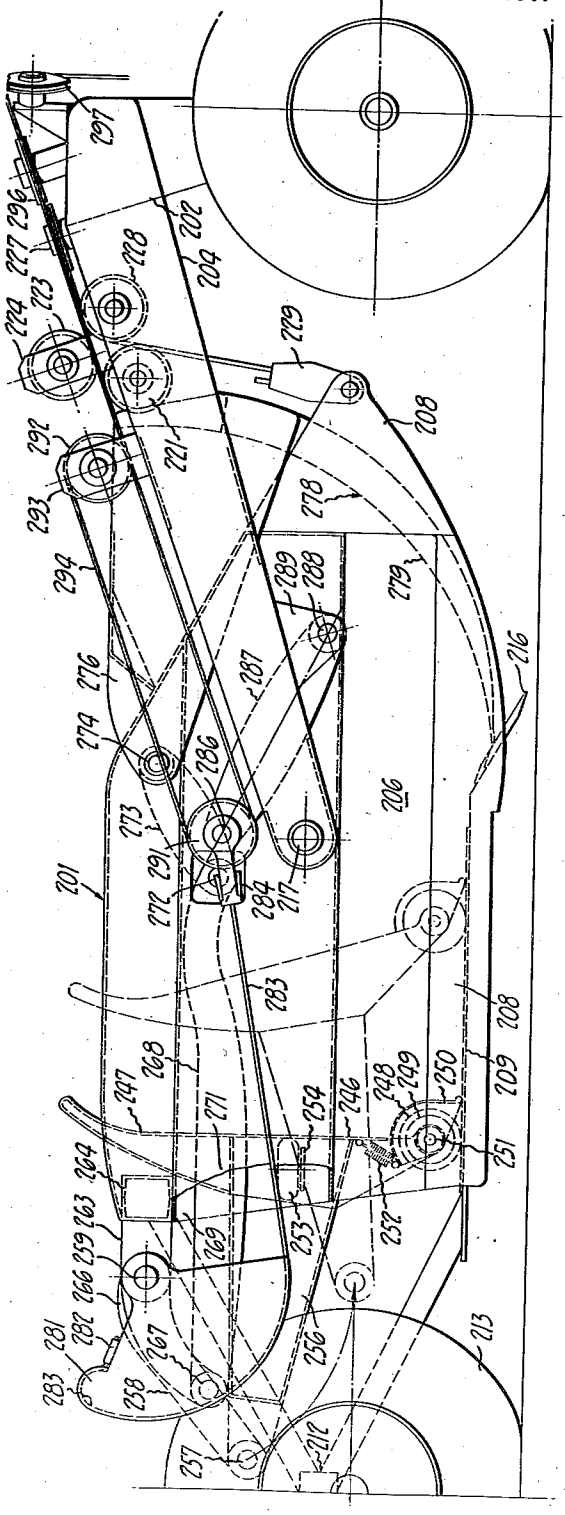


FIG. 10.

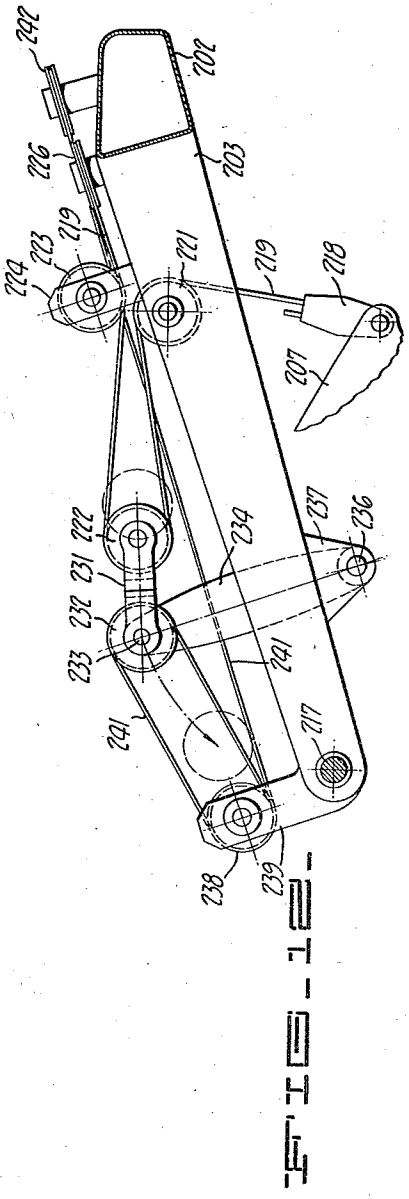


FIG. 12.

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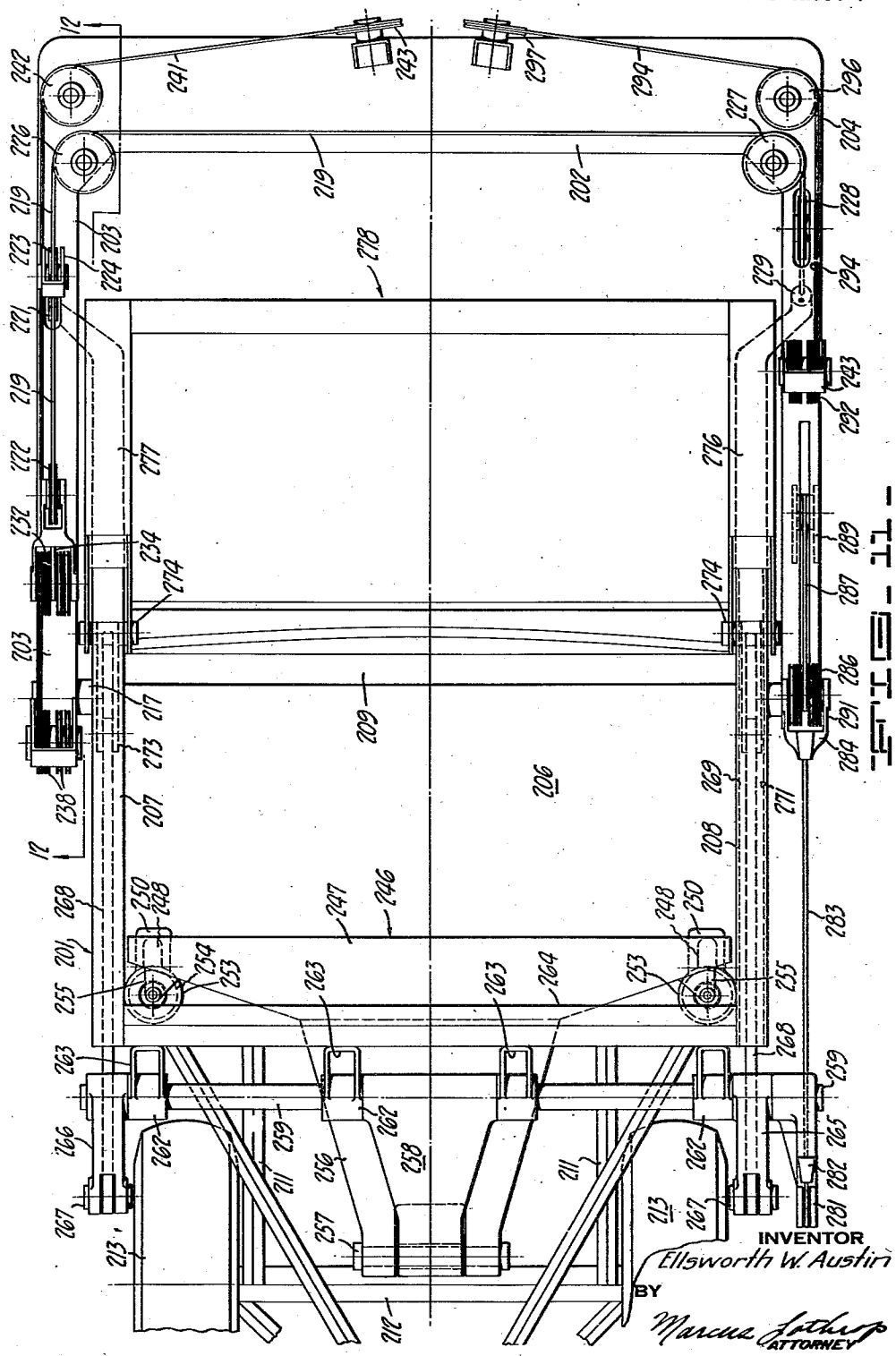


FIG. 11.

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UNITED STATES PATENT OFFICE

2,380,285

EXCAVATOR

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Application October 7, 1941, Serial No. 413,930

8 Claims. (Cl. 37—126)

My invention relates to earth and material digging and handling machinery and is concerned with the type of machine disclosed generally in my Patent No. 2,329,448. In such apparatus there is provided a drawn vehicle intended to be propelled by an attached tractor and including a main earth containing bowl, the forward portion of which is closed by a front apron for retaining earth and the rear portion of which is closed by a pusher forming the rear wall. When the contained material is to be discharged, cable mechanism attached to the pusher is tautened and the pusher is advanced through the bowl at the same time that the front apron is swung upwardly to open the front end of the bowl. One of the characteristics of such mechanism is that the pusher and the front apron have no mutually independent movement, but are connected together by means such as a link pivoted at its opposite ends to the pusher and front apron respectively. The material being handled is usually slightly compressible, but not to a great extent, although whatever compression of the material is accomplished requires substantial power. With the pusher and front apron directly linked together it is always a problem to provide a substantial apron opening to afford room for expelling the material before the pusher has accomplished so much of its forward travel as to result in serious compression.

It is therefore an object of my invention to provide an excavator in which the linkage between the pusher and front apron affords advantageous mutual movement of the pusher and front apron.

Another object of my invention is to provide a linkage between the pusher and front apron which affords opportunity for considerable variation in layout and flexibility in design.

Another object of my invention is to provide an excavator in which the actuating force for the pusher and front apron is advantageously applied.

Another object of my invention is to provide an excavator which in general is an improvement over excavators heretofore known.

The foregoing and other objects are attained in the embodiment of the invention illustrated in the drawings in which—

Fig. 1 is a plan of one form of excavator constructed in accordance with my invention, the forward portion of the mechanism being broken away to reduce the size of the figure.

Fig. 2 is a cross-section on the line 2—2 of Fig. 1 which is in the central longitudinal vertical plane.

Fig. 3 is a detailed cross-section the plane of which is indicated by the line 3—3 of Fig. 2.

Fig. 4 is a detailed cross-section the plane of which is indicated by the line 4—4 of Fig. 3.

Fig. 5 is a plan similar to Fig. 1 but showing a modified form of excavator in accordance with my invention.

Fig. 6 is a cross-section on a central vertical longitudinal plane as indicated by the line 6—6 of Fig. 5 through the modified form of excavator.

Fig. 7 is a detailed cross-section the plane of which is indicated by the line 7—7 of Fig. 6.

Fig. 8 is a cross-section the planes of which are indicated by the lines 8—8 of Fig. 6.

Fig. 9 is a diagram in isometric perspective showing the cable arrangement of the modified form of excavator in Figs. 5 to 8 inclusive.

Fig. 10 is a side elevation of a further modified form of excavator in accordance with my invention, a portion being broken away to disclose the interior construction.

Fig. 11 is a plan of the further modified form of excavator disclosed in Fig. 10.

Fig. 12 is a detailed cross-section the plane of which is indicated by the line 12—12 of Fig. 11.

In its preferred form the excavator of my invention includes a main frame having a main bowl incorporated therewith and a front apron mounted to swing from a position closing the front of said main bowl into another position opening the front of said bowl, as well as a pusher incorporating a transverse wall in one position closing the rear end of said main bowl and being designed to move through the main bowl. A rocker mounted on the frame and provided with an actuating mechanism is connected to the front apron and to the pusher in order to move the front apron and pusher simultaneously from their closed and rearward positions respectively, into their open and forward positions respectively.

In the first form of my invention disclosed herein, as illustrated in Figs. 1 to 4 inclusive, there is provided a frame, generally designated 6. This frame has a front yoke portion (not shown but disclosed in my application above-identified) which extends rearwardly by means of a pair of side beams 7 and 8 respectively. The side beams terminate at their rearward ends in aligned pivot bearings 9 and 11 respectively, which are journalled on side walls 12 and 13 respectively of a main bowl, generally designated 14. The sides 12 and 13 are united with a bottom plate 16 so that in effect the main bowl is a

trough-like structure open at its forward end and open at its rearward end.

The forward end of the bottom 16 is merged with a cutting edge 17 for dislodging material being excavated, and the rearward portion of the walls 12 and 13 and of the bottom 16 is secured to a number of frame members 18 and 19 which connect with a rear axle 21 at the extremities of which ground-engaging wheels 22 and 23 are mounted. The main frame 6 therefore includes not only the members 7 and 8 and all of the yoke frame which at its forward end is mounted on ground-engaging wheels (not shown), but likewise includes the main bowl 14 and its connections to the rear wheels 22 and 23. Hence the main bowl has two capacities; namely, that of a frame portion and that of an earth confining portion. It is correct to consider that the frame includes the main bowl as one of its components.

As more fully disclosed in my application above mentioned, the members 7 and 8 are made relatively movable with respect to the main bowl 14 in order that the cutting edge 17 can be raised and lowered. This motion is accomplished primarily by lifting cables 23 extending to a suitable hoist mechanism (not shown) and fastened to bell cranks 24, themselves connected by pivots 26 to the forwardly extending portions of the side walls 12 and 13, and normally urged rearwardly against suitable stops 27. By appropriately manipulating the cables 23 the cutting edge 17 is lowered to an excavating position, raised partially to a leveling or low carrying position, or raised a maximum amount into a high carrying position.

Adapted to close the rear end of the main bowl 14, is an earth pusher, generally designated 28, constituted primarily by a transversely extending wall plate 29 provided with reinforcements 31 and at its opposite ends merging with carriage structures 32 and 33 respectively. These carriages are substantially symmetrical so that the description of one of them applies to both. Included in each carriage is a side plate 34 slightly spaced from but parallel to the adjacent side wall 12, for example, at its rearward end fastened as by welding to the pusher wall 29. Along its forward edge the side plate 34 is beveled as at 36 to fit slidably against the side wall of the main bowl.

The carriage is designed to run on a track structure included with the adjacent side wall 12, for example, and hence is provided with a plurality of stub shafts 37 and 38 carrying rollers 39 resting upon a rail 41 fastened on the side wall 12. In addition to the rollers 39 and to assist in supporting the weight of the carriage and pusher, the plate 34 is provided with a bracket 42 which extends over the top of the side wall 12 and depends on the outside thereof to carry a stub shaft 43 on which a roller 44 is mounted. This roller runs beneath the rail 41 but on top of a rail 46 secured to the side wall 12, so that not only is some of the weight of the pusher appropriately borne, but also in the event of accidental dislodgement of the pusher it cannot rise more than the slight clearance between the roller 44 and the top rail 41. The weight of the pusher is very substantial and there is little likelihood of any rising motion, but it is advisable to provide the arrangement shown in order that the pusher can be confined to a substantially true rectilinear path of translation.

To take care that the pusher runs always parallel to itself and does not tend to twist about a central vertical axis nor to run unduly to one side or the other, the side plate 34 is provided with a pair of rollers 47 and 48 respectively which are arranged to run on vertical shafts 49 mounted within shrouds 51 to protect against earth. The rollers 47 and 48 engage the side walls 12 directly to limit the transverse freedom or side play of the pusher 28.

To advance the pusher from its rearmost position, as shown in Fig. 2 in full lines, to its forward position, as shown in broken lines in that figure, any suitable propulsion mechanism is afforded, in this instance a cable scheme being utilized. While the cables are not illustrated herein in detail since they are shown in my above-mentioned patent, their operation is clearly discernible from the provision on the brackets 42 of the sheave block 52 which assists in supporting the shaft 53 on which a pair of sheaves 54 and 56 are freely mounted. These sheaves are in substantial alignment with a pair of sheaves 57 and 58 mounted between a bracket 59 and the side wall 12. A cable reeved over the respective sheaves when tautened is effective to advance the pusher 28 and when slackened permits the pusher 28 to return in a rearward direction. With this arrangement by appropriately manipulating cables engaged with the respective sheaves, the pusher 28 can be advanced and retracted throughout its travel in the main bowl 14, the pusher being adequately guided by the carriage structure.

Somewhat to increase the earth retaining capacity of the main bowl 14, I provide on each side an additional side wall 61 preferably constituted of a structural shape. At its forward end the wall 61 is secured to the forward portion of the upstanding side wall 12, for example, and at its rearward end it is connected by a bracket 62 to a crossbeam 63 bracing the rearward portions of the side walls 12 and 13. In effect, the additional side walls 61 are substantially coplanar with the side walls 12 and 13. Each affords an elongated aperture 64 within which the rollers 39 and associated carriage structure have free motion. Since the aperture 64 is substantially closed against escape of earth by the upstanding plate 34 of the carriage, the capacity of the main bowl is increased considerably over what it would be if the side wall 12 terminated adjacent the rail 41. In effect, a very high side wall is afforded with the pusher carriage operating through an aperture in the wall, yet with the aperture shielded by the carriage against escape of earth.

In accordance with my invention I preferably close the front of the main bowl 14 by a front apron, generally designated 66. This member is comprised of a transversely extending curved plate 67 suitably reinforced by structural shapes 68 and at its opposite ends is secured preferably by welding to front apron side arms 69 and 71 respectively. These apron arms are approximately crescent shaped plates and extend just inside the side walls 12 and 13 when the front apron is in its closed position. In such position the lower end 72 of the apron is in approximate abutment with the cutting edge 17. Appropriately to mount the front apron, the side arms 69 and 71 extend rearwardly to pivots 73 and 74 which are mounted on the side wall extensions 60 and 61. By this mounting the front apron 66 is free to swing in an arc about the aligned pivots 73 and 75 as an axis from the full lined position, as shown in Fig. 2, into the broken line

position therein illustrated. From its upper position the front apron can return to its closed position under the force of gravity and this force is utilized to assist in restoring the pusher 28 to its rearmost position.

In order appropriately to join the front apron 66 and the pusher 28 for conjoint motion, yet in a fashion which will afford substantial front apron opening before there has been a great deal of pusher advancement, and to afford considerable freedom and choice in design, I preferably mount on the crossbeam 63 supports 76 for the reception of pivot shafts 77 and 78 on which symmetrical mechanisms are mounted. A description of one of these mechanisms applies to both. A rocker 79 is journalled on the shaft 77, for example, and has two arms 81 and 82 respectively. The arm 82 extends generally rearwardly and is connected by a pivot 83 to a link 84 serving as means for connecting the rocker to the pusher 28. This is effected by a pivot 86 at the forward end of the link 84 which also engages a plate 87 extending from the pusher 28.

The arm 81 is provided with a pair of apertures 89 into one of which extends a pin 91 connected to a universal joint 92. A forwardly extending link 93 is fastened to the universal joint 92 by a pivot pin 94 and is similarly connected by a pivot pin 96 to a universal joint 97 joined by a pivot pin 98 to a bracket 99 upstanding from the side arm 69 of the front apron 66.

With this arrangement, when the cables engaging the sheaves 54, 56, and 57, 58 are tightened, the pusher 28 is drawn forwardly, the force is transmitted through the plate 87 and the links 84 to the rockers 79, the arms 81 of which draw upon the links 93 so that the brackets 99 are effective to lift the front apron 66. The pivot points for the rockers and the relative disposition of the links 84 and 93 is such that the desired mutual motions of the pusher 28 and of the front apron are afforded. Thus, the front apron moves from its closed position into its open position as the pusher moves from its rearmost position into its foremost position. On the return motion the weight of the front apron 66 is effective to draw upon the link 93, to assist in rotating the rocker 79 to draw upon the link 84 and thus to retract the pusher 28. In addition to this gravital return, a return cable can be secured to the pusher 28 as disclosed in my above-identified application.

By the use of selected ones of the apertures 89 the relative motion of the pusher and front apron can be varied. If the aperture not utilized in Fig. 1 is connected with the pin 91 the principal change is a lesser total travel of the front apron 66. Although the closed position remains the same, the open position is somewhat lower. With this arrangement, therefore, mechanical advantages and numerous variable leverages to produce the desired motions can readily be afforded, yet the mechanism is well out of the area occupied by earth in the main bowl.

In the modified form of my excavator shown in Figs. 5 to 9 inclusive, the general arrangement is approximately the same with a main frame, generally designated 101, including a main bowl 102 having side walls 103 and 104. Within the main bowl is a pusher, generally designated 106, which is constituted primarily by a transverse wall plate 107 turned at the opposite ends for additional rigidity. The ends of the wall are not connected by any carriage structure, a carriage being entirely omitted in this instance. The principal weight or load on the pusher 106 is borne by a pair of pneumatic tired wheels 108 secured in suitable brackets 109 extending rearwardly from the pusher 106 and designed to engage the bottom wall 111 of the main bowl 102. Lateral movement of the pusher 106 is limited by a similar pair of pneumatic tired wheels 112 secured in brackets 113 projecting rearwardly from the pusher 106 and designed to engage the side walls 103 and 104.

Additional stability is imparted to the pusher and motion is given it by a pair of symmetrical links 116, the description of one applying to both. The links are mounted in mutually inverted relationship, so that the parts can be duplicated on opposite sides of the machine. The forward end of the link 116 is bifurcated to form a pair of bearings 117 receiving a pivot bearing shaft 118 mounted in brackets 119 secured on the pusher 106.

The rearward portion of the link 116 is connected by a pivot pin 121 to one arm 122 of a rocker, generally designated 123. The arm 122 at its hub is bifurcated to provide a pair of bosses 124 secured to a pivot shaft 126. This shaft at its lower end is journalled in a hub 127 mounted on a bracket 128 supported on frame members 129, while at its upper end the shaft 126 turns in a journal 131 supported in a bracket 132 fastened to a crossbeam 133 extending between the side walls 103 and 104. Rotation of the shaft 126 produces comparable rotation of the arm 122.

Included with the arm 122 and the shaft 126 in the rocker 123 is an arm plate 134 of generally triangular shape which is fast on the top of the shaft 126. Upstanding from the plate 134 is a pin 137 forming part of a universal joint 138, the other pin 139 of which is secured to the rear of a link 141 extending forwardly. This link is preferably braced in the central portion to preclude whipping and vibration which might otherwise be present due to its length.

At its forward end the link 141 is connected by a pivot pin 142 to a universal joint 143 joined by a pin 144 to the side arm 146 of a front apron, generally designated 147. The side arm 146 is connected by a pivot pin 148 to the side wall 103 and a comparable side arm 149 included in the front apron 147, is similarly connected to the side wall 104. The side arms 146 and 149 are preferably of double wall construction straddling the side walls 103 and 104 respectively and carry abutment stops 151 engaging similar abutments 152 on the upper edge of the respective side walls in order that the front apron can be limited in its lowering motion to avoid heavy impact of the trailing edge 153 of the front apron 147 against the cutting edge 154 of the bowl bottom 111.

In order to move the pusher 106 and the front apron 147 I preferably apply force not to the pusher 106 which is relatively slow moving in its initial travel and hence affords a relatively poor mechanical advantage, but rather apply the actuating force to the rockers 123. Each of the triangular levers 134 carries a stub shaft 161 on which a plurality of sheaves 162 are separately journalled. To reinforce the shaft 161 as well as the pin 137, I join the pin and shaft at their upper end by a tiestrap 163 connected by a fastening bracket 164 to the plate 134. An operating cable 166 is connected by a fastening 167 to one of the plates 134, is then reeved successively about the various sheaves 162, and extends to a corner sheave 168 mounted on a bracket 169 on the crossbeam 133. Then the cable 166 extends

forwardly around a guide sheave 171 and to a suitable cable actuating device.

Tension on the cable 166 causes the various sheaves 162 on one of the rockers 123 to tend to approach the corresponding sheaves on the other of the rockers. The relatively approaching movement is the same for both of the rockers since they are constrained to equivalent motion through the medium of the links 141 both of which connect to the front apron 147, itself a substantially rigid structure acting as a crosstie. Thus, the rockers 123 both rotate in unison and the links 122 rotate in opposite directions on their respective shafts, but in strict unison. The links 116 are advanced simultaneously and the pivot pins 118 on the pusher 106 always move substantially in the same transverse plane.

Because of the presence of the four pivots 118 and 121, however, there is a possibility of transverse movement of the pusher plate 107, and if the side walls 103 and 104 were not present the pusher plate could have a very material transverse movement. However, the rubber wheels 112 bearing against the side walls respectively, serve to limit the transverse movement permitted by the connections between the pusher and the rockers 123. With this arrangement, therefore, it is not necessary to have any guide carriage, but the main bowl side walls and bottom are utilized for that purpose.

The pusher is moved by application of force to the rockers 123 from its full line position, as shown in Fig. 6, at the same time that the front apron is being moved from its full line position in that figure. When the parts are to be restored the weight of the front apron can be counted upon to provide all or a major portion of the restoring force exerting tension through the links 141, the rockers 123 and the arms 122 and links 116 to retract the pusher 106. In addition, there is provided a retracting cable 176 connected by a fastening 177 to the rear of the pusher 106 and extending around a sheave 178 mounted on the crossbeam 133. The cable 176 passes around a corner sheave 179 mounted on the bracket 169 and extends thence forwardly around a guide sheave 181 and to any appropriate cable handling mechanism. With this arrangement, the pusher and front apron partake of the desired mutual movement and because of the interposition of the rockers 123, the selection of lever arm lengths and pivot point positions affords a wide range to the designer in the relative motions of these parts. In addition, the imposition of force on the rockers rather than on the other elements permits the stress of the cables to be lessened and the omission of the carriage structure.

A further modified form of my excavator is disclosed in Figs. 10, 11 and 12 and includes substantially the same general arrangement. The main frame 201 includes a front yoke frame 202 having side beams 203 and 204 respectively, and includes also a main bowl, generally designated 206, which is provided with side walls 207 and 208 joined by a bottom wall 209. The main bowl at its rear end terminates in frame portions 211 joined to a rear axle 212 at the extremities of which ground-engaging wheels 213 are located. At the forward end of the main bowl bottom 209 is a cutting edge 216 and in order to raise and lower the cutting edge with respect to the ground the rear portion of the main frame 201 is moved with respect to the front portion 202 about the axis of pivotal connections 217 by a cable structure.

To the side walls 207 (Fig. 12) is pivoted a cable anchor 218 securing one end of a heavy cable 219. This cable extends through a suitable aperture and around a sheave 221 journalled in the side beam 203. Thence, the cable extends around an equalizing sheave 222 and around a guide sheave 223 mounted on an upstanding bracket 224 on the side arm 203. Then the heavy cable 219 is turned around a corner sheave 226 upstanding from the frame 202, extends across to and around a corner sheave 227, then over a guide sheave 228 journalled in the side beam 204 and finally downward to an anchor 229 connected by a pivot to the side wall 204. With this arrangement, movement of the sheave 222 exerts equal lifting force on both of the side walls 207 and 208.

The equalizing sheave 222 is mounted in a yoke 231 which straddles a plurality of sheaves 232 journalled on the same shaft 233 as the yoke at the upper end of a guide lever 234. This lever at its lower end passes through a suitable aperture in the side beam 203 and is connected by a pivot pin 236 to brackets 237 depending from the side beam 203. A plurality of aligned sheaves 238 are journalled in upstanding brackets 239 at the end of the side beam 203. A light actuating cable 241 is anchored at an appropriate spot, is trained around the various sheaves 232 and 238 and extends thence around a corner sheave 242 and a central sheave 243 both upstanding from supports on the frame portion 202, and is controlled by a suitable mechanism (not shown). When the cable 241 is tensioned, the lever 243 is rocked toward the left, as seen in Fig. 12, and the cutting edge 216 is raised. When the light cable 241 is slacked the lever 234 rotates toward the right, as seen in Fig. 12, and the cutting edge 216 lowers by gravity.

Adapted in one position to close the rear end of the main bowl 206 is a pusher, generally designated 246, which is partially constituted by a transversely extending pusher wall 247. Substantially in the general plane of the wall 247 are the axes of a pair of pneumatic wheels 248, with each of which is associated a metal wheel 249 of lesser diameter, effective only in the event the pneumatic wheel should become seriously under-inflated. Each of the wheels 248 is protected by a movable shroud 250 mounted to turn on the wheel axle 251 with respect to the pusher 246 and urged by a spring 252, engaging the shroud and the pusher, into a close contact with the bottom wall 209 of the main bowl, so that in effect the forward portion of the shroud acts as a scraper to maintain a relatively clear path for the wheel 248. Transverse motion of the pusher is limited to a very minor amount by lateral pneumatic wheels 253 adjacent the side walls 207 and 208 respectively. The wheels 253 are provided with metal wheels 254 effective only on the event the pneumatic wheels become seriously deflated and are journalled in suitable brackets 255 extending from the pusher.

Extending rearwardly from the pusher wall is a connecting brace 256 in the form of a stiffening box which merges with the construction of the pusher, and at its rearward end carries a pivot pin 257 with which is rather loosely hinged a lever 258 of box construction and fast on a transverse shaft 259. The loose connection between the connector 256 and the lever 258 permits a slight transverse movement of the pusher as restrained by the pneumatic wheels 254. The effect is to permit some slight transverse motion of the pusher but in general to keep it guided in its path by the side walls of the main bowl.

The lever 258 and the shaft 259 are constrained to a rotary motion by a plurality of bearings 262 mounted in brackets 263 extending from a cross-beam 264 joined at its opposite ends to the side walls 207 and 208 respectively. At the opposite ends of the shaft 259 and included with the shaft and the lever 258 to constitute a rocker mechanism, are identical arms 265 and 266 respectively. Since the structure at this point is identical on both sides of the machine, the description of one applies to both. The arm 265 at its lower end is bifurcated to receive a pin 267 affording a pivotal connection to the rear end of a link 268 which extends forwardly between the spaced plates 269 and 271 of the double side wall 208 of the main bowl and at its forward end the link 268 is connected by a pivot pin 272 to the lower end of a lever 273 fast on a stub shaft 274 journalled in the plates 269 and 271 and projecting outwardly from opposite sides thereof.

On the opposite end of the stub shaft 274 extend the dual side plates of one of the two arms 276 and 277 of the front apron generally designated 278. The major portion of the front apron is constituted of a plurality of curved plates 279 extending transversely of the main bowl. Since the arms 276 and 277 are fast to their respective stub shafts 274 onto which the levers 273 are likewise fast, the front apron 278 and the pusher 246 are connected together by linkage so that they partake of a mutual movement.

To produce the movement, the force is preferably applied directly to the rocker. For this purpose one end of the shaft 259 is provided with a grooved quadrant 281 which is fast on the shaft so that they turn in unison. Connected by a cable anchor 282 to the quadrant 281, is a heavy cable 283 lying within the quadrant groove and extending to a yoke 284, straddling a pin 286 at the upper end of a guide lever 287 which passes through the side beam 204 and is mounted by a pivot pin 288 within brackets 289 extending from such side beam. The pin 286 likewise serves as a mounting for a plurality of sheaves 291 in substantial alignment with a similar plurality of sheaves 292 mounted in a bracket 293 upstanding from the side beam 204. A light cable 294, suitably anchored, is reeved around the various sheaves 291 and 292, extends thence forwardly around a corner sheave 296 and around a center sheave 297, the latter of which are mounted in suitable brackets on the yoke frame 201, and finally to a suitably controlled cable operator (not shown).

With this arrangement operation of the cables 294 is effective to cause the sheaves 291 and 292 to approach each other, thereby drawing upon the heavy cable 283, rotating the rocker and impelling the pusher to advance and at the same time through the links 268 swinging the front apron 278 from its closed position to its open position. The return movement is accomplished primarily by gravity due to the weight of the front apron, but if desired, there can be provided a retracting cable as shown in a previous modification herein. In this arrangement the pusher is guided but without a carriage, the structure is substantially simplified, most of the operating parts are kept from the influence of the earth being carried, the yoke frame is relatively free of mechanism across the central portion in order to minimize obstruction to view rearwardly of an operator on a draft tractor, and the linkage is such that the pusher and front apron are very advantageously related. This is especially apparent by an examination of Fig. 10 in which it is shown that the pusher in its intermediate position has advanced at the bottom portion far more than at the top portion. Since the bottom portion of the load is free to discharge sooner as the front apron rises, while the upper portion is still somewhat confined, this linkage reduces the compression of the load and is well suited to the direct connection of the pusher and the front apron.

I claim:

1. An excavator comprising a frame including a main bowl open at both ends, a front apron mounted to open and close one end of said bowl, an earth pusher adapted to close the other end of and to move through said main bowl, a rocker pivoted on said frame behind said main bowl, means extending longitudinally of said frame for connecting said rocker to said front apron, and means extending longitudinally of said frame for connecting said rocker to said pusher.

2. An excavator comprising a frame including a main bowl, a front apron mounted to swing in a vertical arc to open and close one end of said bowl, an earth pusher adapted to close the other end of and to move through said main bowl, a rocker pivotally mounted on said frame to swing in a horizontal arc, a link connected by universal joints to said rocker and to said front apron, and means for connecting said rocker to said pusher.

3. An excavator comprising a frame including a main bowl, a front apron mounted to swing in a vertical arc to open and close one end of said bowl, an earth pusher adapted to close the other end of and to move through said main bowl, a pair of rockers pivoted on said frame to swing in horizontal arcs, a pair of links connecting said rockers to said front apron, and means movable in horizontal planes for connecting said rockers to said pusher.

4. An excavator comprising a frame including a main bowl, a front apron mounted to swing in a vertical arc to open and close one end of said bowl, an earth pusher adapted to close the other end of and to move through said main bowl, a pair of rockers pivoted on said frame to swing in horizontal arcs, a pair of links one extending along each side of said main bowl and by means of universal joints connecting said rockers to said front apron, and means for connecting said rockers to said pusher.

5. An excavator comprising a frame including a main bowl, a front apron mounted to swing toward and away from the front end of said bowl, an earth pusher mounted to close the rear end of said bowl and to move into said bowl, a rocker pivoted on said frame behind said pusher, a link extending forwardly from said rocker to said front apron, and connecting means extending forwardly from said rocker to said pusher.

6. An excavator comprising a frame including a main bowl, an upstanding side wall on said main bowl having a longitudinal aperture therein, a pusher movable within said main bowl between a rearward position and a forward position, a carriage included with said pusher and in the rearward position thereof adapted to overlie said aperture, means on said pusher extending through said aperture, and means mounted on said extending means for moving said pusher.

7. In an excavator having a front apron and an earth pusher movably mounted on a frame, linkage connecting said pusher and said front apron including a rocker pivoted intermediate

its ends to said frame at a point to the rear of said pusher, and means applied to said rocker for actuating said pusher and said front apron.

8. An excavator comprising: a frame including a main bowl; a pusher mounted within said bowl for movement between the rear and forward ends of said bowl; a front apron movably mounted on said frame for closing the forward end of said bowl; a rocker pivoted to said frame at a point to the rear of said pusher; and means for connecting said pusher and front apron respectively to the opposed arms of said rocker, so that movement of either said pusher, front apron or rocker is imparted to the other two members.

ELLSWORTH W. AUSTIN.