March 21, 1967 F. C. KINKADE 3,309,799

LEVELLING SCRAPER FOR A TRENCH TRACTOR

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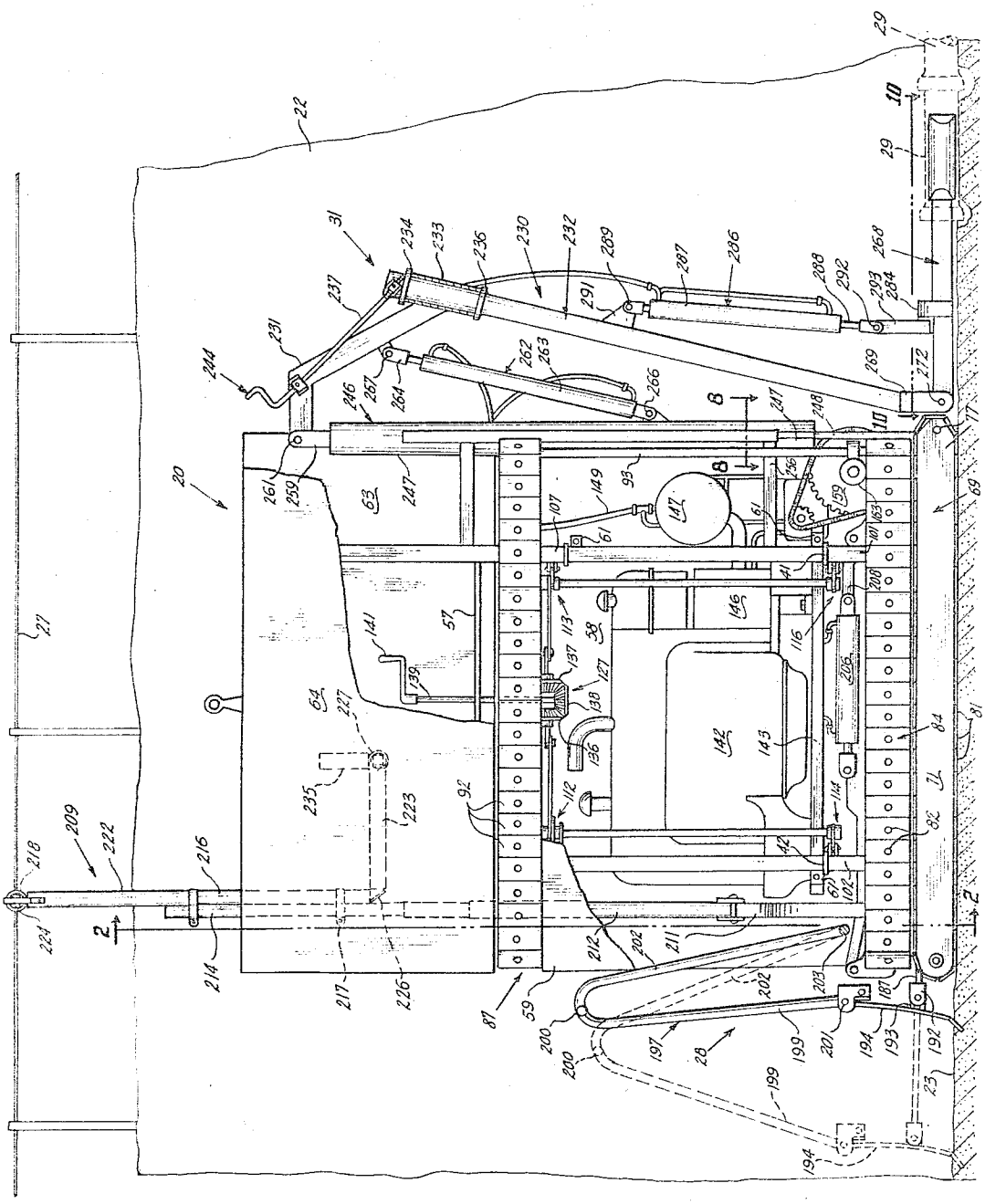


FIG. 1

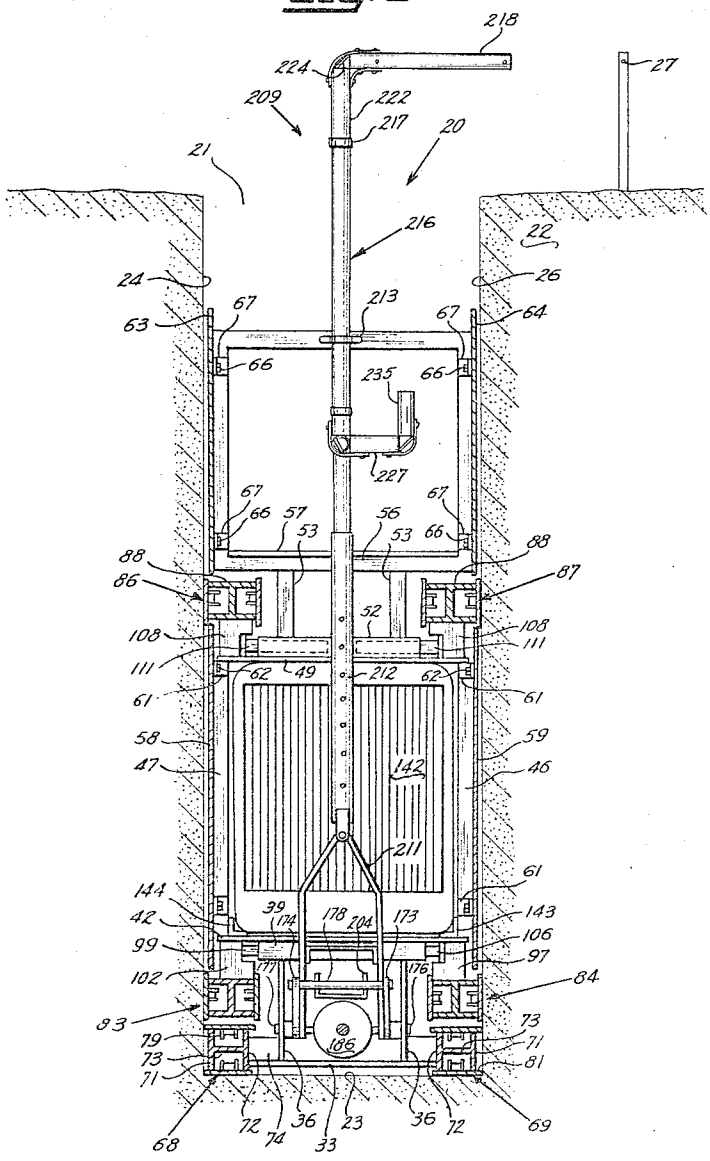
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LEVELLING SCRAPER FOR A TRENCH TRACTOR

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FIG. 2



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Fig. 3

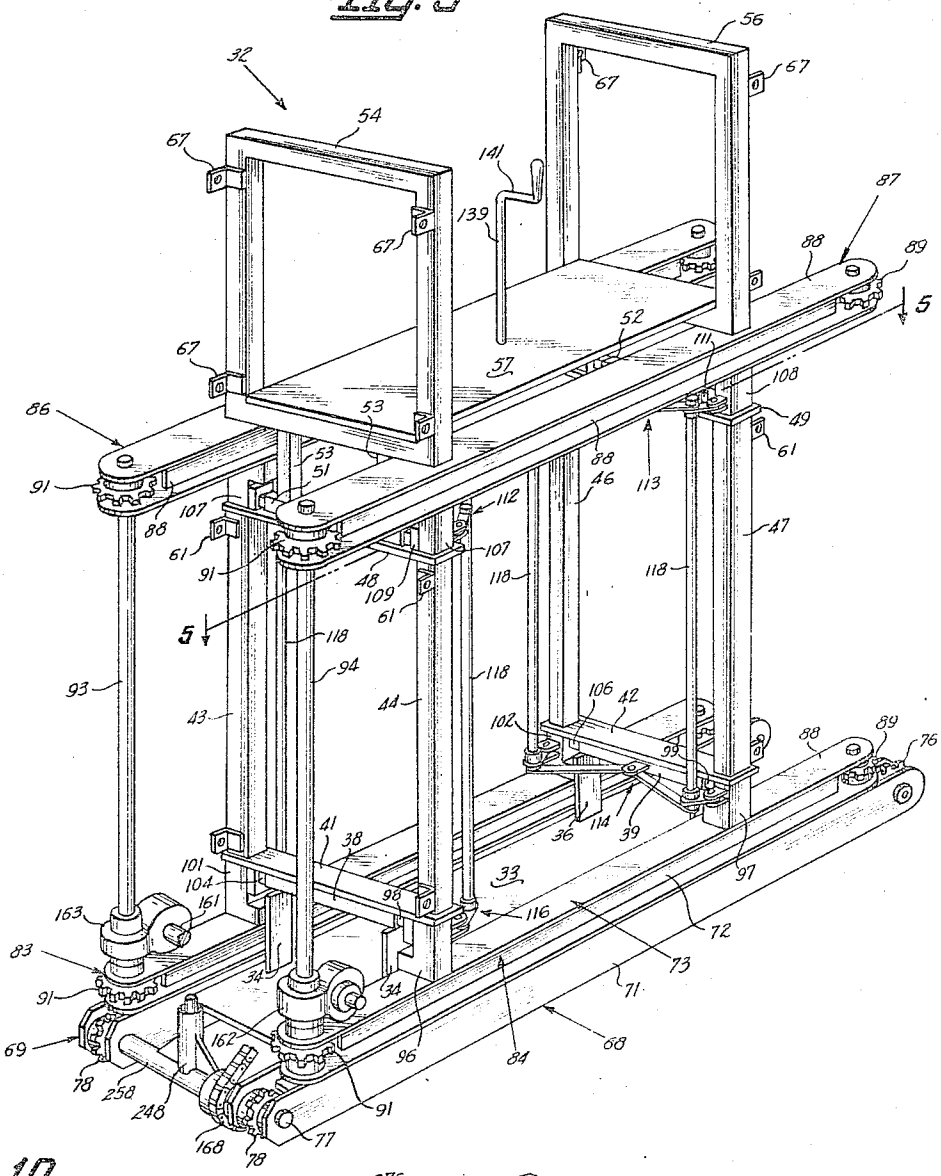
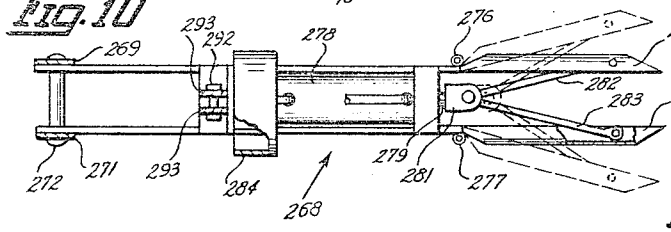


Fig. 10



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FIG. 4

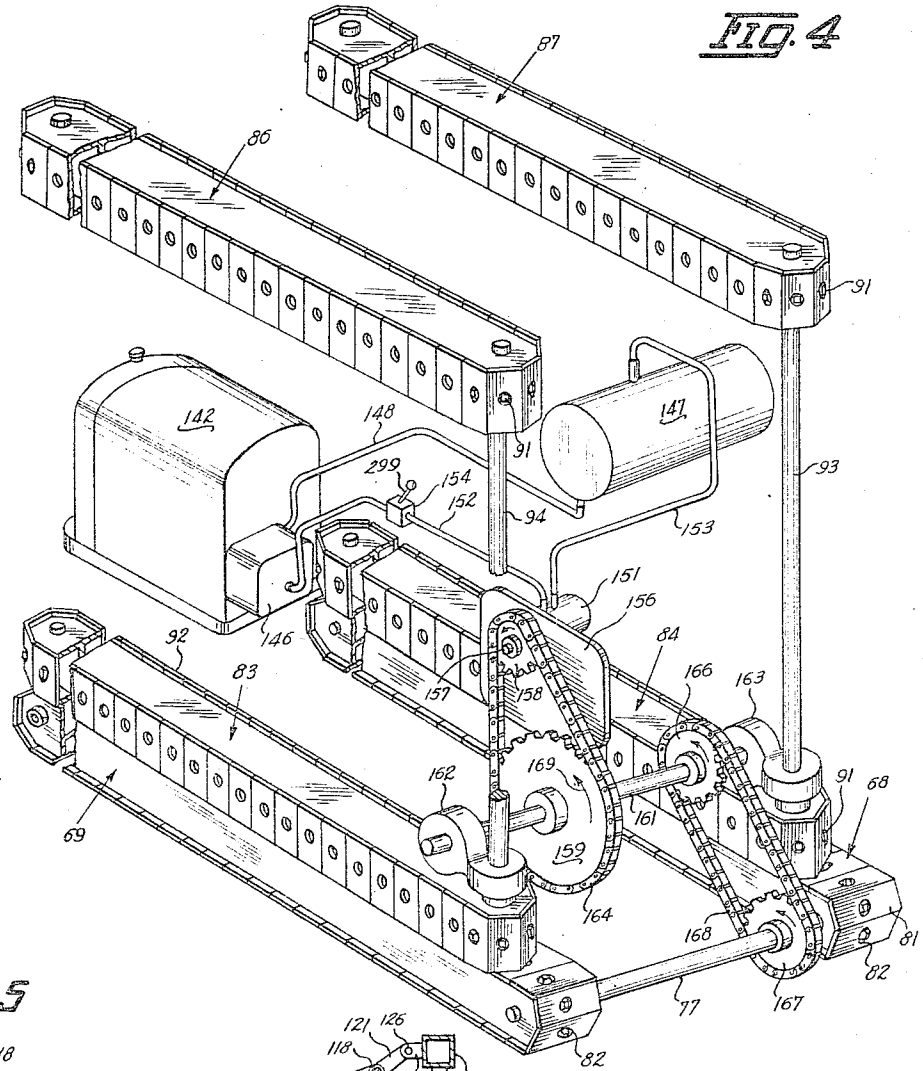
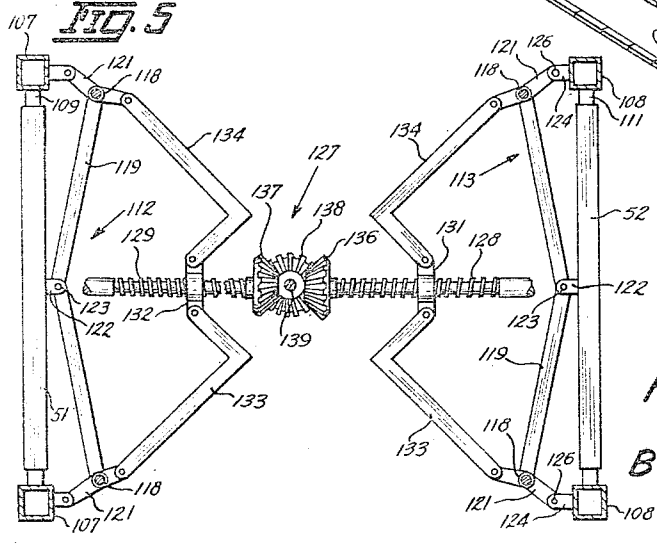


FIG. 5



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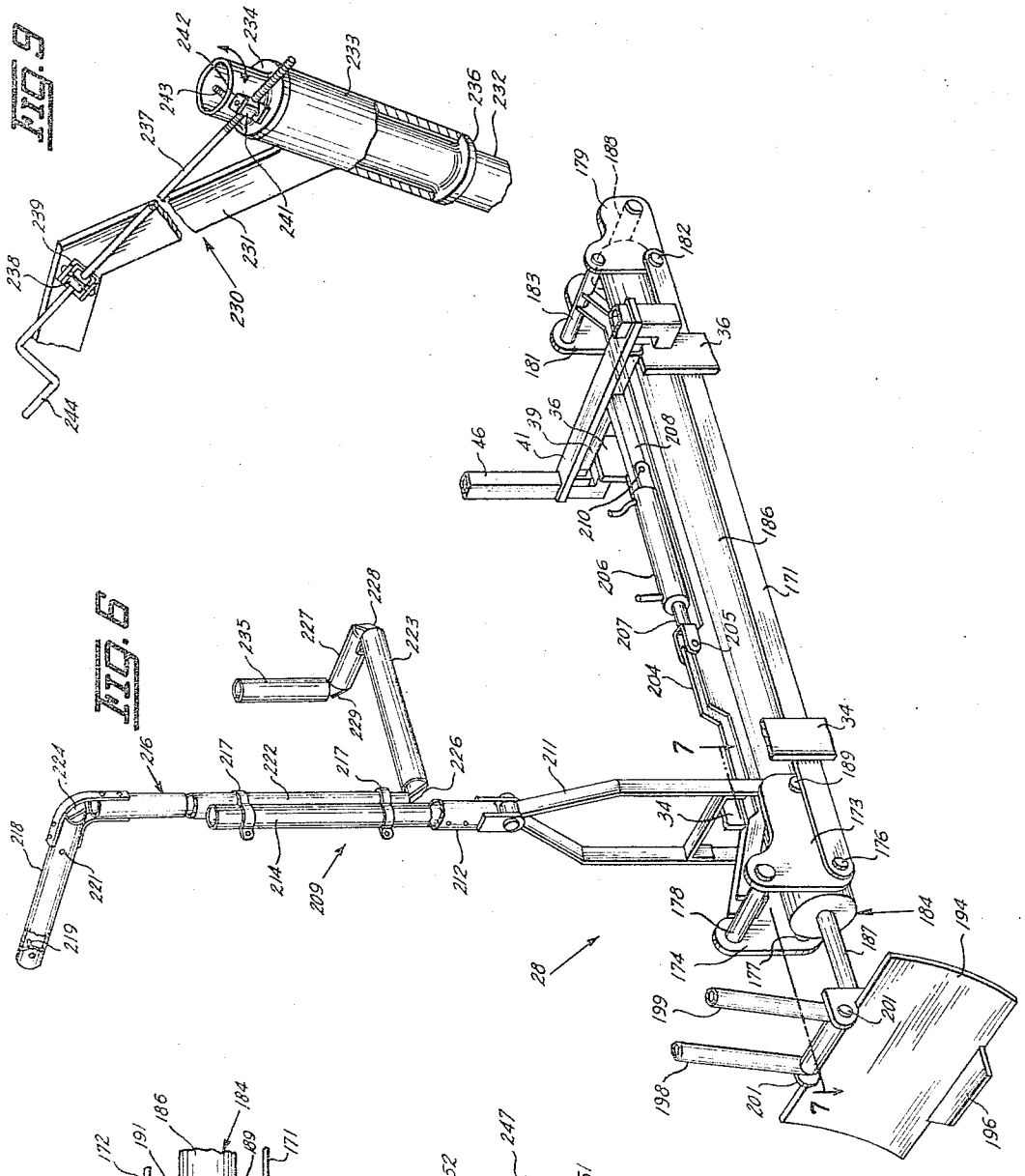


FIG. 9

FIG. 6

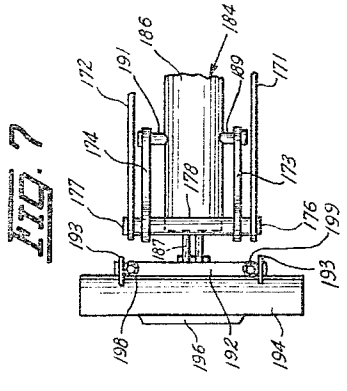


FIG. 7

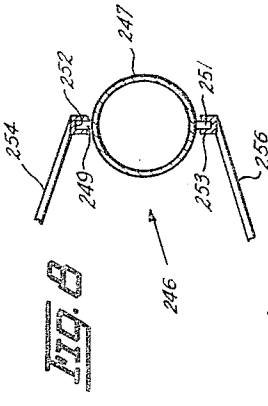


FIG. 8

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FIG. 13

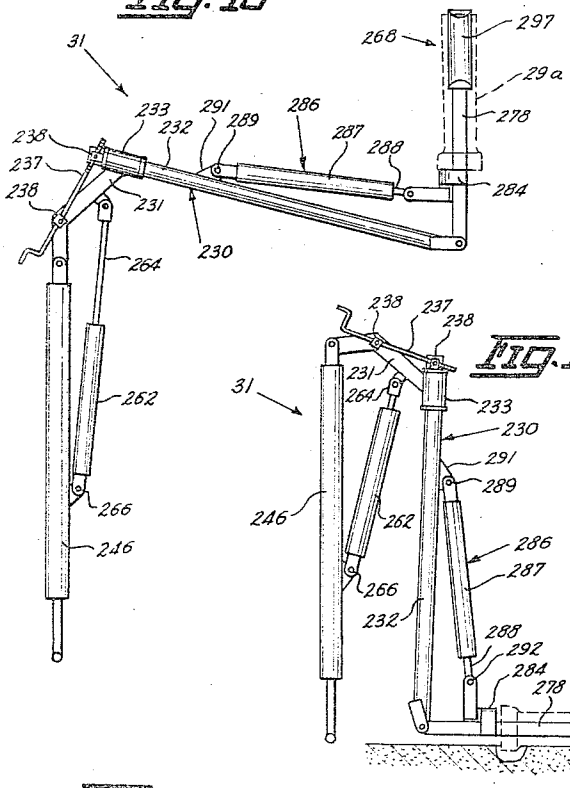


FIG. 12

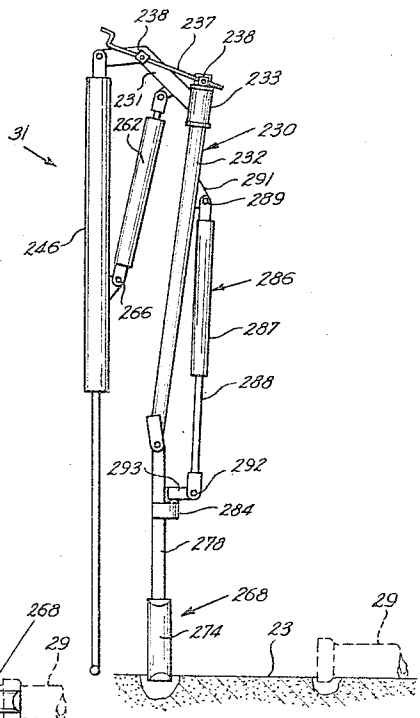
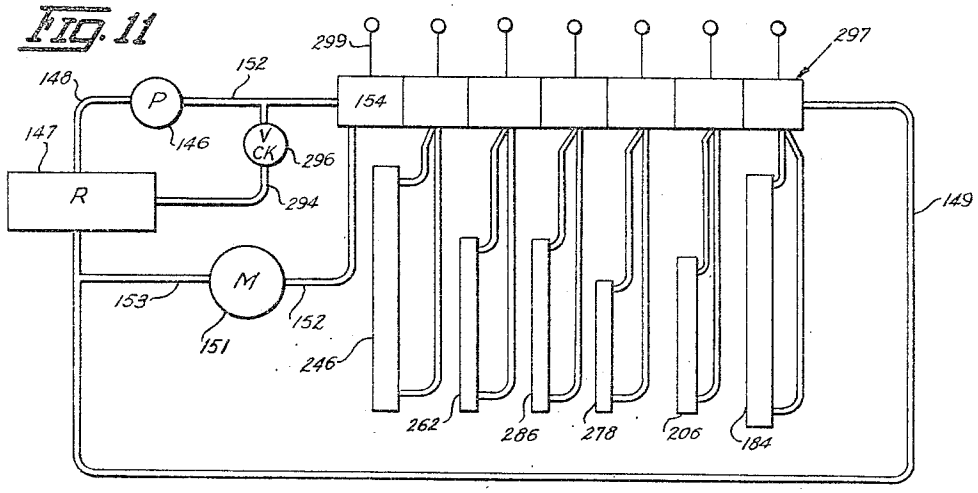


FIG. 14

FIG. 11



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3,309,799

LEVELLING SCRAPER FOR A TRENCH TRACTOR

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Filed Nov. 12, 1963, Ser. No. 323,018
8 Claims. (Cl. 37—80)

This invention relates to a motor vehicle and more particularly to a track-type trench tractor equipped with a scraper blade implement and a movable boom having digging jaw members usable to lay tile in a trench.

It is the object of this invention to provide an improved self-propelled vehicle which is operable in a previously dug ditch to lay tile.

Another object of the invention is to provide a trench vehicle with side drive track means which are adjustable to accommodate trenches of varying widths.

A further object of the invention is to provide a trench vehicle which provides lateral support for the opposite side walls of a trench during movement of the vehicle along the trench.

Still another object of the invention is to provide an earth working implement for a trench tractor which is operable to level the bed of a trench in accordance with a predetermined grade line.

A further object of the invention is to provide a trench tractor with mechanism operable to pick up earth and to lay tile.

An additional object of the invention is to provide a safe and versatile trench tractor which is durable in construction, easy to operate, and efficient in operation.

These and other objects and advantages of this invention will be readily apparent from the following description and accompanying drawing, wherein:

FIG. 1 is a side elevational view of the trench tractor equipped with the scraper blade implement and the tile laying mechanism of this invention positioned in a ditch;

FIG. 2 is a sectional view taken along the line 2—2 of FIG. 1;

FIG. 3 is a perspective view of the frame assembly of the tractor of FIG. 1;

FIG. 4 is a perspective view of the track assembly and drive therefor of the tractor of FIG. 1;

FIG. 5 is a sectional view taken substantially along the line 5—5 of FIG. 3 showing the side track assembly adjusting means;

FIG. 6 is a perspective view of the scraper blade implement of the trench tractor of FIG. 1;

FIG. 7 is an enlarged sectional view taken along the line 7—7 of FIG. 6;

FIG. 8 is an enlarged sectional view taken along the line 8—8 of FIG. 1;

FIG. 9 is a fragmentary perspective view of the lateral control mechanism for the boom of the tile laying mechanism;

FIG. 10 is an enlarged plan view of the mandrel unit of the tile laying mechanism taken along the line 10—10 of FIG. 1;

FIG. 11 is a diagrammatic view of the hydraulic system of the trench tractor of FIG. 1;

FIG. 12 is a diagrammatic view of the tile laying mechanism with the mandrel unit in a digging position;

FIG. 13 is a view similar to FIG. 12 showing the mandrel unit in a tile receiving position; and

FIG. 14 is a view similar to FIG. 13 showing the mandrel unit in a tile laying position.

Referring to the drawing, there is shown in FIGS. 1 and 2, a trench tractor 20 positioned in a previously dug ditch or trench 21 formed in the ground 22. The trench 21 has a bed 23 and upright side walls 24 and 26. The depth of the trench 21 varies along its length in accordance with the general slope of the ground 22. A grade

line 27 is used to gauge the elevation of the bed 23 of the trench to provide uniform fall over the length of the trench.

The tractor 20 rests on the trench bed 23 and has a scraper blade implement 28 attached to the forward and bottom portions of the tractor. The scraper blade implement 28 is engageable with the trench bed 23 and reciprocates longitudinally of the tractor 20 as shown by the broken lines in FIG. 1. The reciprocating motion of the scraper blade implement 28 levels the trench bed 23 to an elevation which is correlated with the grade line 27.

A series of cylindrical members 29, such as sewer or drainage tile, are laid in end-to-end relationship on the trench bed 23 by a tile laying mechanism indicated generally by the number 31. The tile laying mechanism 31 operates independently of the scraper blade implement 28 and is manipulatable to remove earth from the bed and side walls of the trench. In addition, the mechanism 31 is operable to lay the tile 29 on the trench bed 23 and subsequently lay each succeeding tile into abutment with the preceding laid tile to form a continuous string of tile.

The frame assembly 32 of the tractor 20 is illustrated in FIG. 3 and comprises a horizontal bottom plate 33 extended longitudinally of the tractor. Secured to the top surface of the plate 33 adjacent the opposite end sections thereof are a front pair of upwardly projected plates 34 and a rear pair of upwardly projected plates 36. Secured to the top sections of the plates 34 and 36 are transverse square tubular guide members 38 and 39 upon which are secured transversely aligned horizontal plates 41 and 42, respectively. The opposite ends of the plates 41 and 42 carry upwardly projected tubular posts 43, 44, 46, and 47. The upper ends of the transversely aligned posts are connected with horizontal plates 48 and 49. Secured to the upper side of the plates 48 and 49 are tubular guide members 51 and 52. A pair of upwardly projected legs 53 are secured to the opposite end sections of each of the tubular members 51 and 52. Square shape upright frames 54 and 56 are attached to the top ends of each pair of legs 53. A horizontal plate 57 rests on the lower transverse portion of the frames 54 and 56 and functions to maintain the longitudinal spaced relationship between the frames 54 and 56. The plate 57 also serves as a platform for the operator of the tractor.

As illustrated in FIG. 2, upright side plates 58 and 59 are positioned adjacent the outside of the legs 46 and 47 and extend vertically between the plates 42 and 49. A pair of brackets 61 secured to each of the posts coact with nut and bolt assemblies 62 to secure the side plates 58 and 59 to the respective posts. A second pair of side plates 63 and 64 are positioned adjacent the opposite sides of the square frames 54 and 56 and are secured thereto by nut and bolt assemblies 66 which coact with brackets 67 attached to the frames 54 and 56. The side plates 58, 63 and 59, 64, are positioned in a contiguous relationship with respect to the opposite side walls 24 and 26 of the trench 21 and prevent earth from falling into the engine area and operator area of the tractor.

As seen in FIG. 2, the entire frame assembly 32 is carried by a pair of track units 68 and 69 secured to the opposite sides of the horizontal bottom plate 33. Each track unit has a pair of upright plates 71 and 72 which are laterally spaced with respect to each other and interconnected at their facing mid-sections by a horizontal plate 73. The plates 71, 72, and 73 form a beam having an H-shaped cross section. The inside upright plate 72 is secured to the horizontal bottom plate 33 and by a square gusset 74 to the adjacent upright plate 34.

As shown in FIG. 3, the track unit **68** has an upright idler sprocket **76** positioned between and rotatably mounted on the forward sections of the upright plates **71** and **72**. A transverse drive shaft **77** extends through and is rotatably mounted in the rear sections of the track units **68** and **69**. The opposite end portions of the drive shaft **77** carry drive sprockets **78** which are in longitudinal alignment with the idler sprockets **76**. An endless link chain **79** (FIG. 2) extends about the sprockets **76** and **78** of each track unit. The separate links of the chain **79** carry flat track shoes **81**. Each track shoe **81** has a centrally disposed hole **82** to permit the flow of earth from the interior of the respective track units. The track unit **69** is substantially identical in construction with the track unit **68**.

As shown in FIG. 2, a first pair of side track units **83** and **84** are disposed on opposite sides of the tractor immediately above corresponding track units **68** and **69**. A second pair of track units **86** and **87** are positioned on the opposite sides of the machine between upper and lower side plates **63** and **58** and **64** and **59**. Each pair of side track units project laterally from the upright planes of the side plates **58**, **63** and **59**, **64** to space the side plates from the side walls of the trench. Each of the side track units is substantially identical in construction and as shown in FIGS. 3 and 4 has a horizontal H-shaped beam **88** carrying a horizontally disposed idler sprocket **89** at the forward end thereof and a horizontally disposed drive sprocket **91** on the rear end section thereof. An endless chain carrying a plurality of side-by-side track shoes **92** is positioned about the sprockets **89** and **91**. An upright drive shaft **93** connects the drive sprockets **91** of the track units **83** and **86** and an upright drive shaft **94** connects the drive sprockets **91** of the track units **84** and **87**.

The first or bottom pair of side track units **83** and **84** are slidably mounted for transverse movement on the frame assembly **32**. As shown in FIG. 3, a pair of L-shaped blocks **96** and **97** are secured to the top member of the H-beam **88** in alignment with the horizontal plates **41** and **42**. Inwardly extended tubular rods **98** and **99** are secured to the blocks **96** and **97**, respectively, and are positioned within the tubular guide members **38** and **39**. Blocks **101** and **102** are secured to the top surface of the H-beam of the track unit **83**. The blocks **101** and **102** carry inwardly extended tubular rods **103** and **104** which are positioned within the tubular guide members **38** and **39** and thereby support the track unit **83** for transverse movement on the frame unit **32**. The sliding or telescopic connection between the rods **98** and **99**, and **104** and **106** provides the lower pair of track units **83** and **84** with lateral movement for the purpose of accommodating trenches of varying widths.

As seen in FIG. 3, the lower section of the beams of the second or top pair of track units **86** and **87** have downwardly projected pairs of L-shape blocks **107** and **108** which are in alignment with the opposite ends of the plates **48** and **49**. Inwardly extended tubular rods **109** and **111** are secured to the blocks **107** and **108**, respectively, and project into the tubular guide members **51** and **52** thereby mounting the track units **86** and **87** for transverse movement on the frame assembly **32**.

The lateral adjustment of the respective side track units is effected by four pairs of toggle-link assemblies **112**, **113**, **114**, and **116**. As shown in FIGS. 1 and 3, a pair of toggle link assemblies extend transversely of the tractor frame assembly **32** adjacent each of the transverse tubular members which slidably receive the support rods for the first and second pair of side track units. Upright tubular members **118** connect vertically sligned toggle link assemblies. The opposite ends of the tubular members **118** pivotally connect the long link **119** with the short link **121** of each toggle link assembly.

As shown in FIG. 5, the inner end of the links **119** of each pair of toggle link assemblies are pivotally connected

to the mid-section of the tubular guide members **51** and **52**. This pivotal connection is formed by an ear **122** secured to each tubular member **52** and a pin **123** which extends through an ear and the adjacent ends of the links **119**. The short link **121** is pivotally connected to each track unit supporting block **107** and **108** by an ear **124** secured to each block and a pin **126** extended through the ear and the outer end of the link **121**.

A change in the angular position of a short link **121** with respect to a long link **119** moves the track supporting rods **109** and **111** into and out of their associated tubular guide members **51** and **52**. This angular position is maintained and adjusted by a manually operated screw assembly **127** which comprises a pair of longitudinally extended screw shafts **128** and **129** rotatably supported on the frame assembly. Threadably received on each of the screw shafts **128** and **129** are nut units **131** and **132**. Opposite side portions of each nut unit **131** and **132** are connected to the adjacent upright tubular members **118** by right angular shaped link members **133** and **134**.

Each of the screw shafts **128** and **129** carry driven bevel gears **136** and **137** which are in driving engagement with a drive bevel gear **138**. An upright shaft **139** (FIGS. 3 and 5) having a hand crank **141** is connected to the bevel gear **138**. The shaft **139** extends through the horizontal platform **57** making the hand crank readily accessible to the operator of the tractor.

On rotation of the hand crank **141** the bevel gear **138** simultaneously rotates the driven bevel gears **136** and **137** turning the screw shafts **128** and **129** relative to their associated nut units **131** and **132**. When the direction of rotation of the screw shafts **128** and **129** is such that the nut units **131** and **132** move toward the toggle link assemblies the right angle link members **133** and **134** apply an outward force component which results in the spreading apart of the side track units to accommodate an increase in the width of the trench. Reversing the direction of rotation of the screw shafts **128** and **129** moves the nut units **131** and **132** away from the toggle link assemblies with the result that the link members **133** and **134** shorten the effective length of the pairs of toggle link assemblies so as to move the side track units **83**, **84**, **86**, and **87** inwardly toward each other. The adjusted position of the side track units is thus determined by the position of the nut units **131** and **132** on the respective screw shafts **128** and **129**. In addition the nut units **131** and **132** function to maintain the adjusted transverse positions of the side track units.

As shown in FIGS. 1 and 2, an internal combustion engine **142** is mounted on the transverse frame plates **41** and **42** by longitudinal beams **143** and **144**. The engine **142** is drivably coupled to a hydraulic pump **146**. A hydraulic fluid supply for the pump **146** is contained in a reservoir **147** connected to the pump inlet by a hose **148** with the pump outlet having a fluid return means including a line connected to the top of the reservoir.

As shown in FIG. 4, the pump **146** is coupled to a fluid drive motor **151** by a hose **152**. Hydraulic fluid flows from the motor **151** through a hose **153** back to the reservoir **147**. A manually operated control valve **154** interposed in the hose **152** controls the flow of fluid to the motor **151**. An upright plate **156** secured to the frame assembly carries the motor **151**. Extended laterally from the plate **156** is a motor drive shaft **157** carrying a drive sprocket **158**. A relatively large driven sprocket **159** is in alignment with the drive sprocket **158** and is secured to a transverse shaft **161**. The opposite ends of the shaft **161** extend through gear drives **162** and **163** drivably connected to the upright drive shafts **93** and **94** for the side track units. The gear drives **162** and **163** are movable on the ends of the transverse drive shaft **161** so as not to inhibit the transverse adjustment of the side track units. The roller link chain **164** connects the fluid motor drive sprocket **158** with the driven sprocket **159** on the transverse shaft **161**. Carried on the transverse shaft

161 adjacent the gear drive 163 is a sprocket 166 which is in alignment with a sprocket 167 carried on the drive shaft 77 of the track units 68 and 69. The roller link chain 168 drivably connects the sprockets 166 and 167.

When the fluid motor 151 is supplied with hydraulic fluid under pressure the motor drive sprocket 158 is rotated driving the chain and driven sprocket 159 in the direction of the arrow 169 (FIG. 4). The transverse drive shaft 161 transmits power to the gear drives 162 and 163 which in turn rotate the upright shafts 93 and 94 in opposite directions to effect rearward movement of the outside runs of the track chains of the first and second pair of side track units 83, 84 and 86, 87. The link chain 168 transmits the driving force from the transverse shaft 161 to the drive shaft 77 for the bottom track units 68 and 69.

The scraper blade implement 28 is mounted on the tractor frame between the track units 68 and 69 and has a pair of longitudinal beams 171 and 172 which are secured to the upright front and rear plates 34 and 36 (FIG. 6). A front pair of flat crank members 173 and 174 are pivotally connected by pins 176 and 177 to the front end sections of the beams 171 and 172, respectively. Each crank member 173 and 174 has upwardly extended portions which are interconnected by a rod 178 which is rotatable relative to the crank members.

A pair of rear crank members 179 and 181 are pivotally connected by pins 182 and 183 to the rear end sections of the beams 171 and 172. The crank members 179 and 181 have upwardly extended portions which are connected by a rotatable transverse rod 183. Positioned between the crank members 173 and 174 and 179 and 181 is a double acting fluid motor 184, illustrated as a piston and cylinder assembly, having a cylinder 186 into which is slidably disposed a piston (not shown) having a piston rod 187. The head end of the cylinder 186 is secured to a transverse rod 188 which has its opposite ends pivotally mounted in the rear portions of the crank members 179 and 181. As shown in FIG. 7, the crank members 173 and 174 have rearwardly extended portions which are pivotally connected by transversely projected stub axles 189 and 191 to opposite portions of the cylinder 186.

The forward end of the piston rod 187 (FIG. 1) carries a clevis 192 which is connected to a scraper blade supported bracket 193. The scraper blade 194 is convexly curved and has a forwardly and downwardly projected digging tooth 196 secured to its lower edge. A foldable link mechanism 197 for stabilizing the blade 194 comprises a first pair of transversely spaced tubular members 198 and 199 the forward ends of which are pivotally mounted to the top section of the blade 194 by a hinge assembly 201 (FIGS. 1 and 6). The opposite ends of the tubular members 198 and 199 are pivotally connected at 200 to a second pair of tubular members 202 (one of which is shown in FIG. 1). The rear end sections of the tubular members 202 are connected to a transverse tubular member 203 which is pivoted at its opposite ends to the side plates 58 and 59 by inwardly extended rods (not shown) mounted on the side plates.

The rods 178 and 183 which connect the adjacent upward portions of the front and rear pair of crank members (FIG. 6) are connected by an upwardly open channel beam 204 which is positioned under the tubular guide members 38 and 39 in a clearance relationship therewith. The front and rear pair of crank members pivotally interconnect the cylinder 186 with the channel beam 204 so that longitudinal movement of the channel beam 204 results in varying the elevation of the cylinder 186 while maintaining the cylinder in a horizontal position. This movement of the channel beam 204 is effected by a double acting fluid motor 206, such as a piston and cylinder assembly, which has a piston rod 207 pivotally connected at 205 to the mid-section of the channel beam 204 and a cylinder pivoted at 210 to an arm 208 secured to the tubular guide member 39.

In order to vary the elevation of the blade 194 in accordance with a predetermined grade line 27 a visual sighting unit 209 is used in conjunction with the fluid motor 206. The unit 209 (FIG. 6) comprises an upright A-frame 211 which is pivotally connected to the stub axles 189 and 191. The upper end of the A-frame 211 (FIG. 2) carries an upright tubular member 212 which slidably extends through a ring 213 carried by the upper transverse cross member of the frame 54. The second tubular member 214 telescopes with the first tubular member 212 with the relative positions between the tubular members being adjustable to control the height of the sighting unit 209.

As shown in FIG. 6, a sight assembly 216 is secured to the second tubular member 214 by a pair of ring clamps 217. The sight assembly 216 has a horizontal first tube member 218 provided with a pair of spaced cross hairs 219 and 221. A second upright tube member 222 is connected at one of its ends to the first member 218 and at its opposite end to a third horizontal tube member 223. A mirror 224 reflects light from the first tube member 218 into the second tube member 222 and a mirror 226 reflects light from the second tube member 222 into the third tube member 223.

Connected at a right angle to the third tube member 223 is a tubular member 227 with a mirror 228 between the members 223 and 227 reflecting light from the member 223 into the member 227. Located at the end of the tube member 227, remote from the tube member 223, is an observation mirror 229 which reflects light in an upward direction for observation by the operator of the tractor through an upright tube member 235.

In the operation of the scraper blade implement 28 the blade 194 is reciprocated along the bed of the trench by the action of the double acting fluid motor 184 (FIG. 6). The moving blade will either dig into the bed or fill in low sections thereof according to the elevation of the fluid motor 184. The working level of the blade 194 is adjusted to an elevation which is established by the grade line 27. This is accomplished by using the visual sight assembly 216 to align the cross hairs 219 and 221 with the grade line 27 through the operation of the fluid cylinder 206. The sight assembly 216 will raise or lower depending upon the angular position of the front and rear crank members 173, 174 and 179, 181, which are angularly adjusted by the fluid cylinder 206.

The tile laying mechanism 31 shown in FIG. 1 comprises a boom 230 which includes an obtuse angle beam 231 and a rotatable tubular spindle 232. The upper end of the spindle 232 is positioned within a sleeve 233 secured to the end of a beam 231. Collars 234 and 236 secured to the spindle on opposite sides of the sleeve maintain the spindle in the sleeve. The rotational movement of the spindle is controlled by a screw drive 237 connected to the beam 231 by swivel blocks 238 pivotally mounted on a U-shaped bracket 239 (FIG. 9). The end of the screw drive 237 is threaded through a swivel block 241 which is pivotally mounted on a U-shaped member 242. A bolt 243 is secured to the base of the U-member 242 and extends diametrically through the spindle 232. The screw drive 237 has a crank handle 244 which is manually rotatable providing for relative movement between the screw drive 237 and the swivel block 241 which movement effects angular movement of the spindle 232.

The forward end of the beam 231 is pivotally mounted on the top of a double acting fluid motor 246 (FIG. 1) which comprises a cylinder 247 in which is slidably disposed a piston having a piston rod 248. As shown in FIG. 8, the cylinder 247 has diametrically opposed radial flanges 249 and 251 which are slidably disposed in grooved guides 252 and 253 which are retained in an upright position by horizontal members 254 and 256 secured to the frame assembly 32 of the tractor. As seen

in FIG. 3, the end of the piston rod **248** carries a cross head **258** positioned about the drive shaft **77**. A pair of upwardly projected arms **259** (FIG. 1) are secured to the top end of the cylinder **247** and retain a transverse pin **261** which pivotally connects the beam **231** to the cylinder **247**.

The boom **230** is angularly moved about the transverse pivot connection **261** with respect to the cylinder **247** by a double acting fluid motor **262** having a cylinder **263** and a piston with a piston rod **264**. The lower end of the cylinder **263** is pivoted to the cylinder **247** by a pin **266** and the end of the piston rod **264** is pivoted to the beam **231** by pin **267**.

Pivotally mounted to the lower end of the spindle **232** is a mandrel unit **268** which is adapted to be positioned along the bed **23** of the trench. The lower end of the spindle **232** has a pair of downwardly projected legs **269** and **271** (FIG. 10) which extend adjacent the forward end of the mandrel unit **268**. A pin **272** pivotally connects the mandrel unit with the legs **269** and **271**.

As shown in FIG. 10, the mandrel unit **268** has a pair of shovel tools **273** and **274** pivotally mounted by hinge assemblies **276** and **277** to the rear end section thereof. The shovel tools **273** and **274** have an arcuate shape in cross section and taper inwardly at the opposite ends thereof. The angular position of the shovel tools **273** and **274** is controlled by a double acting fluid motor **278** which is mounted in the mandrel unit **268** and has a piston rod **279** extendable between the shovel tools **273** and **274**. The outer end of the piston rod **279** carries a head **281** to which is pivotally mounted links **282** and **283**. The link **282** is pivotally connected to the shovel tool **273** and the link **283** is pivotally connected to the shovel tool **274**. The fluid motor **278** is operable to move the head **281** longitudinally between the shovel tools **273** and **274** pivoting these tools to an open position as shown by the broken lines in FIG. 10. Pivotal action of the shovel tools **273** and **274** may be successively repeated by operating the fluid motor **278** in opposite directions.

A semicircular collar **284** is secured to the mandrel unit **268** and provides a bearing surface for the bell section of a sewer tile. The longitudinal position of the collar **284** with respect to the mandrel **268** may be adjusted to accommodate tiles of varying length.

The angular position of the mandrel unit **268** with respect to the spindle **232** is controlled by a double acting fluid motor **286** (FIG. 1) which comprises a cylinder **287** in which is slidably disposed a piston (not shown) having a piston rod **288**. The upper end of the cylinder **287** is pivotally connected by a pin **289** to a bracket **291** secured to the mid-section of the spindle **232**. The lower end of the piston rod **288** is pivotally secured by pin **292** to upwardly extended legs **293** secured to the mandrel **268**.

The hydraulic system of the tractor **20** and the scraper blade implement **28** and the tile laying mechanism **31** is illustrated in FIG. 11. The pump **146** draws hydraulic fluid from the reservoir **147** and discharges fluid under pressure to the hose **152**. A by-pass line **294** having a pressure relief check valve **296** connects the line **152** with the reservoir **147**. The check valve **296** functions to maintain pressure in the line **152** at a safe level. The line **152** is connected to a valve unit **297** having valve assemblies which are equal in number to the number of fluid motors in the scraper blade implement and the tile laying mechanism. A fluid return line **149** connects the valve unit **297** to the reservoir **147**.

Each valve assembly of the valve unit **297** has an operator control lever **299** positioned above the plate platform **57** and readily accessible to the operator of the tractor. With this arrangement each of the double acting fluid motors **184** and **206** of the scraper blade implement **28** and the fluid motors **246**, **262**, **278**, and **286** of the tile laying machine is independently operable in opposite directions in response to manipulation of their associated

control levers **299**. The valve unit **297** includes the valve **154**, shown in FIG. 4, which connects the fluid pressure to the vehicle drive motor **151**.

In use, the tractor **20** carrying the scraper blade implement **28** and the tile laying mechanism **31** is lowered into a pre-dug trench by a crane or like machine. With the engine **142** operating, the pump **146** establishes a hydraulic pressure which is directed to the fluid drive motor **151** by the valve **154**. The fluid motor **151** through the drive mechanism shown in FIG. 4 simultaneously moves the shoes of the side track units and the bottom track units in a rearward direction so as to propel the tractor **20** along the trench **21**.

The sight **216** is aligned with the grade line **27** by the operation of the double acting fluid motor **206** which changes the elevation of the fluid motor **186** by rotating the crank members **173**, **178** and **179**, **181**. The elevation of the blade **194** follows the fluid motor **186**. With this arrangement the sight **216** moves in a vertical direction in response to the change in elevation of the blade **194** and thus is used to gauge the vertical position of the blade **194** with respect to the grade line **27**. The actuation of the fluid motor **184** reciprocally moves the scraper blade **194** along the bed **23** of the trench as indicated in broken lines in FIG. 1 in a path in accordance with the grade line **27**.

Referring to FIG. 1, as the scraper blade **194** moves over the bed **23** of the trench it will dig into the bed if the elevation of the bed is above that established by the grade line **27** or it will fill in the bed if the elevation of the bed is below that established by the grade line **27**. This reciprocating operation of the blade **194** is repeated as the tractor **20** moves along the trench.

As shown in FIG. 1, the tiles **29** are positioned on the bed **23** back of the trench tractor **20** in an end-to-end relationship. The bell section of each tile is seated in a recess formed in the bed of the trench so that the line of tiles rests in substantial axial alignment. The tile laying mechanism **31** is operable to sequentially position the tile **29** on the bed **23** of the trench.

The sequential operation of the tile laying mechanism **31** is illustrated in FIGS. 1, and 12 to 14. After the tile has been placed in its proper position, as shown in FIG. 1, the trench tractor **20** is advanced along the trench to remove the mandrel unit **268** from the last tile.

As illustrated in FIG. 12, the tile laying mechanism is used to form the next recess for the bell section of the next tile. In the formation of this recess, the fluid motor **246** is moved to an expanded position raising the entire tile laying mechanism **31**. The mandrel unit **268** is moved in substantial longitudinal alignment with the spindle **231** by the expansion of the fluid motor **286**. In this position the mandrel unit **268** extends downwardly toward the bed **23** of the trench. The entire tile laying mechanism **31** is reciprocated in a vertical direction by the opposite actuation of the double acting fluid motor **246** with the result that the shovel tools **274** are driven into and out of the bed **23**. This action is coupled with the operation of the fluid motor **278** which moves the shovels **274** to open and closed positions, as shown in FIG. 10. Thus, the shovel tools **273** and **274** effect a scooping action on the earth in the bed of the trench. These shovel tools when moved to a contracted position pick up dirt from the bed of the trench when the fluid motor **246** is in an expanded position.

The mandrel unit **268** is moved rearwardly from the tractor **20** by the expansion of the fluid motor **262** which pivots the boom **230** and the fluid motor **246**. With the spreading of the shovel tools **273** and **274** by the expansion of the fluid motor **278** the earth carried thereby is dumped onto the previously laid tile. This sequence of operation is repeated until the recess in the bed **23** has the desired depth and width.

When the mandrel unit **268** is positioned longitudinally in the trench above the previously laid tile, additional amounts of earth may be placed on these tiles by changing the angular position of the spindle **232**. This operation is accomplished by turning the screw drive **237** to rotate the spindle **232** relative to the boom **231**. The rotation of the spindle **232** angularly moves the mandrel unit **268** placing the shovel tools **273** and **274** in alignment with one of the side walls of the trench. Actuation of the fluid motor **262** drives the shovel tools into and out of the aligned side wall thereby causing earth to fall on the previously laid tiles.

After the recess in the trench **23** has been dug the tile laying mechanism **31** is moved to a tile receiving position shown in FIG. 13. In this position the mandrel unit **268** extends in an upward direction for receiving an additional tile **29***a*. When the mandrel **268** is in the upright position, the fluid motor **246** has been returned to a contracted position and the fluid motor **262** has been moved to an expanded position. This actuation of the motors **246** and **262** pivots the boom **230** about the fluid motor **246** with the result that the mandrel unit **268** extends upwardly out of the trench. With the mandrel unit **268** in this position a tile **29***a* is placed over the shovel tools with the bell of the tile resting on the semicircular collar **284**.

The tile laying mechanism **31** lowers the tile **29***a* into the trench and positions the tile on the bed **23** in alignment with the previously laid tiles **29** as shown in FIG. 14. This operation is accomplished by the contraction of the fluid motor **262** which rotates the boom **230** in a downward direction placing the mandrel unit **268** adjacent the bed **23** of the trench. The tile **29***a* is forced into the bell section of the previously laid tile **29** by rearward movement of the mandrel unit **268**. This is achieved by the simultaneous expansion of the fluid motors **262** and **286** to move the mandrel unit **268** rearwardly along the bed of the trench. The collar **284** on the mandrel unit **268** functions as a stop for tile **29***a* limiting the relative movement of the tile **29***a* onto the mandrel unit **268**.

After the tile **29***a* has been placed in alignment with the tile **29** with its bell section in registration with the recess in the bed **23** the mandrel unit **268** is moved from the tile **29***a*. This may be accomplished by moving the trench tractor **20** forward along the trench or by the simultaneous contraction of the fluid motors **262** and **286**. The tile laying mechanism **31** may now be moved to the digging position shown in FIG. 12 to commence the operation for laying the next succeeding tile. This operation is repeated as the trench tractor **20** is sequentially moved along the trench.

In summary the trench tractor **20** has bottom and side track units which are in a driving engagement with the bed and side walls of the trench propelling the tractor along the trench. The side track units of the tractor are laterally adjustable to accommodate trenches of varying widths.

Attached to the lower portion of the tractor and extended in a forward direction is a scraper blade implement **28** which operates to level the bed of a trench immediately forward of the tractor at an elevation which is determined by a preselected grade line **27**. A sighting unit **209** is coupled to the scraper blade implement to provide a direct visual reading indicating the elevation of the scraper blade with respect to the grade line **27**.

Operatively connected to the rear section of the trench tractor **20** is a tile laying mechanism **31** which has a mandrel unit **268** constructed to receive tile and is movable to a vertical position to receive tile and to a substantially horizontal position adjacent the bed of the trench to place the tiles in and end-to-end relationship.

While there have been shown, described, and pointed out the fundamental novel features of the invention, it

is to be understood that various omissions, substitutions, changes in form, and details of the apparatus illustrated may be made by those skilled in the art, without departing from the spirit of the invention which is intended to be limited only as indicated by the scope of the following claims.

I claim:

1. A scraper blade implement for a tractor having a frame and a pair of laterally spaced drive units comprising:

(a) a first double acting fluid motor means having a forwardly projected horizontally extended member drivable in opposite directions,

(b) means mounting the first fluid motor means on the frame between the spaced drive units for vertical movement relative to the frame with said projected member horizontally extended longitudinally of the frame,

(c) a second fluid motor means connected to the mounting means and to the frame operable to vertically move the mounting means and first fluid motor means relative to the frame, and

(d) scraper blade means connected to the forwardly projected member whereby the vertical position of the blade means follows the vertical position of the first double acting fluid motor means, said blade means, in a vertically moved position, being horizontally driven in opposite longitudinal directions by the first fluid motor means.

2. The implement defined in claim **1** including:

(a) sight means connected to a portion of the first motor means and movable therewith in a vertical direction relative to the frame for comparing the position of the blade means with a predetermined grade line.

3. A scraper blade implement for a tractor having a frame and a pair of laterally spaced drive units comprising:

(a) double acting fluid motor means having a forwardly projected horizontally extended member drivable in opposite directions,

(b) means mounting the motor means on the frame between the spaced drive units for vertical movement relative to the frame with said projected member horizontally extended longitudinally of the frame, and

(c) scraper blade means attached to the forwardly projected member for horizontal movement in opposite longitudinal directions at a vertically moved position of said fluid motor means.

4. The implement defined in claim **3** including:

(a) linkage means pivotally connected to the tractor and blade means and operable to stabilize the blade means during movement thereof in opposite longitudinal directions.

5. An earth working implement for a tractor having a frame and a source of fluid pressure comprising:

(a) first and second crank members spaced from each other longitudinally of the tractor frame, each crank member having a mid-section and a pair of angularly disposed arms,

(b) means connected to the mid-section of each crank member for pivotally mounting the crank member on the tractor frame,

(c) first double acting fluid motor means connected to the source of fluid pressure and having a cylinder, a piston disposed within the cylinder, and a forwardly extended piston rod attached to the piston,

(d) pivot means connecting opposite end sections of the cylinder to one of the arms of the first and second crank members,

(e) beam means extended substantially parallel to the cylinder and pivotally connected at the opposite ends thereof to the other of the arms of the first and second crank members,

(f) second double acting fluid motor means connected to the source of fluid pressure and pivotally connected to the tractor frame and to the beam means, said second fluid motor operable to reciprocate the beam means to angularly move the first and second crank members thereby changing the elevation of the first motor means, and

(g) blade means attached to the forward end of the piston rod of the first motor means whereby the elevation of the blade means follows the elevation of the first fluid motor, said blade means being driven in opposite longitudinal directions by the first fluid motor means.

6. The implement defined in claim **5** including:

(a) sight means connected to a portion of the first fluid motor means for comparing the elevation of the blade means with a predetermined grade line.

7. An earth working implement for a tractor having a frame comprising:

(a) fluid motor means having a stationary member and a movable member which travels in a horizontal path toward and away from the tractor,

(b) means mounting the fluid motor means on the frame for movement in a vertical direction to adjusted positions with said movable member horizontally extended longitudinally of the frame,

(c) means connected to the mounting means and frame

for vertically moving the fluid motor means to an adjusted vertical position relative to the frame, and

(d) earth working tool means connected to the movable member whereby the vertical position of the tool means follows the vertical position of the fluid motor means, said tool means, in a vertically moved position, being driven in said path by the fluid motor means.

8. The implement defined in claim **7** including:

(a) sight means connected to said fluid motor means and movable therewith in a vertical direction relative to the frame for visually comparing the vertical position of the tool means with a predetermined grade line.

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