Aug. 24, 1948. E. D. EKENSTAM 2,447,571

DITCH PAVING MACHINE

Filed Jan. 20, 1945 8 Sheets-Sheet 1

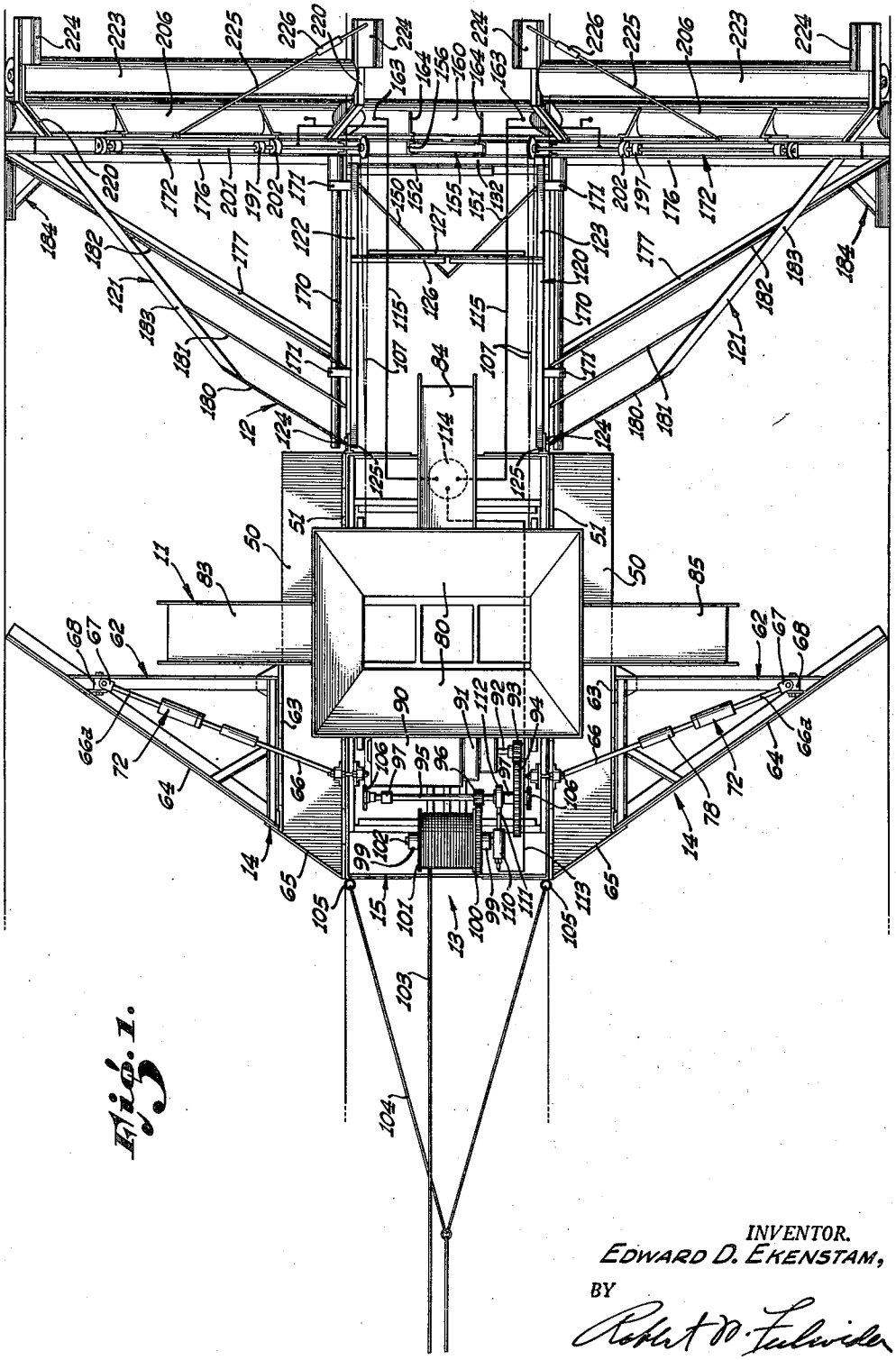


Fig. 1.

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DITCH PAVING MACHINE

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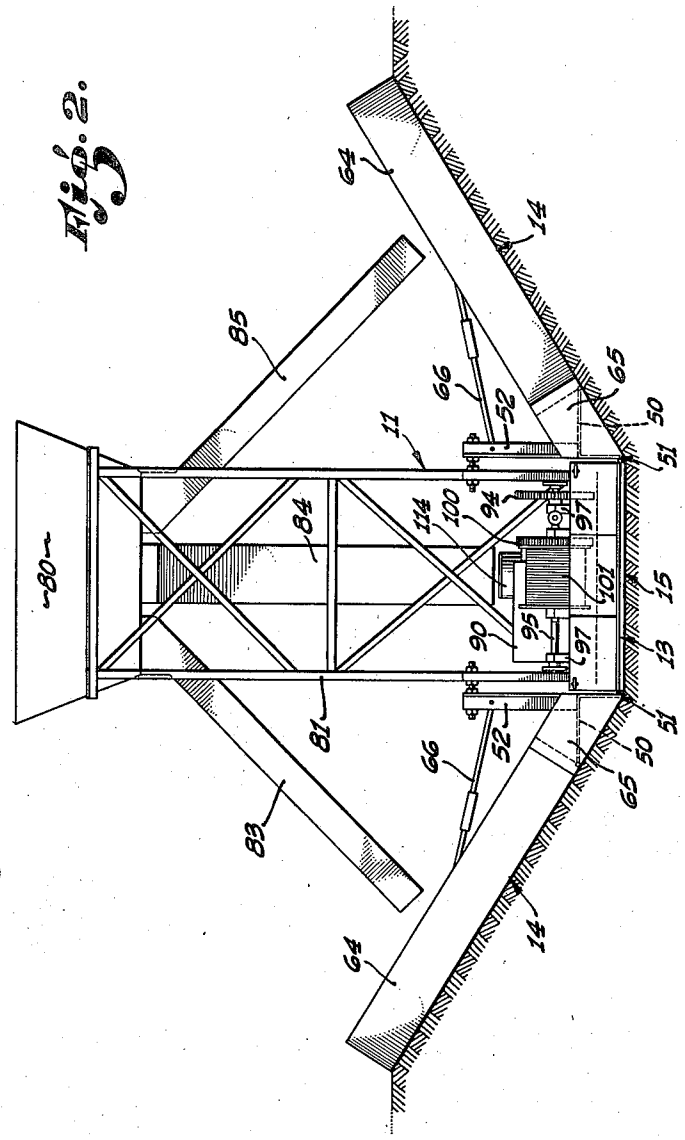


Fig. 2.

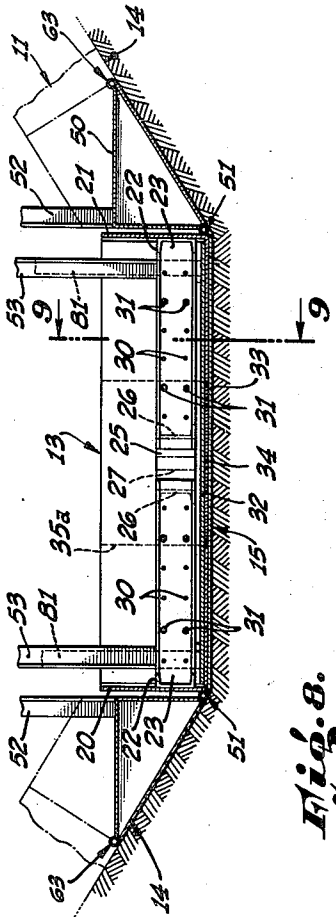


Fig. 3.

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Filed Jan. 20, 1945 8 Sheets-Sheet 3

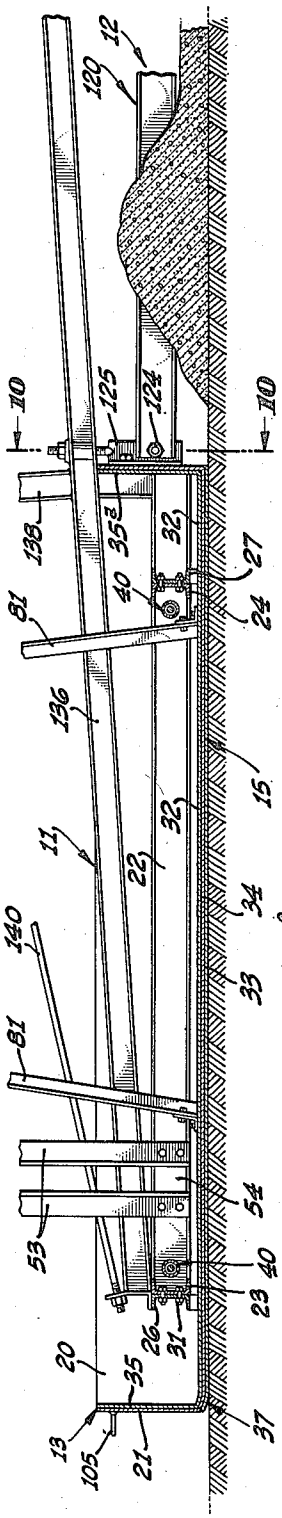


Fig. 9.

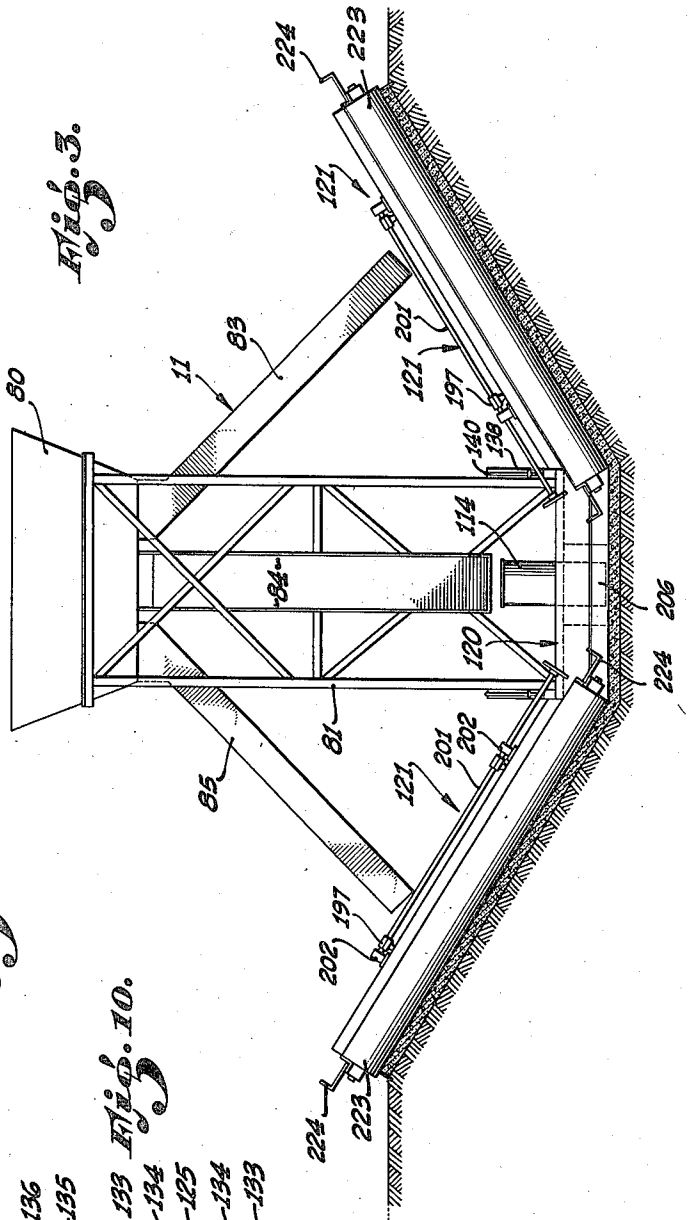


Fig. 8.

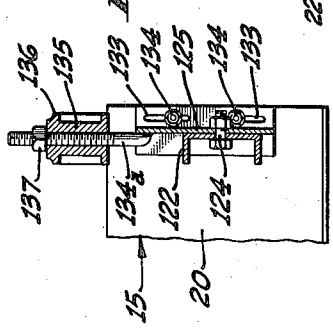


Fig. 10.

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DITCH PAVING MACHINE

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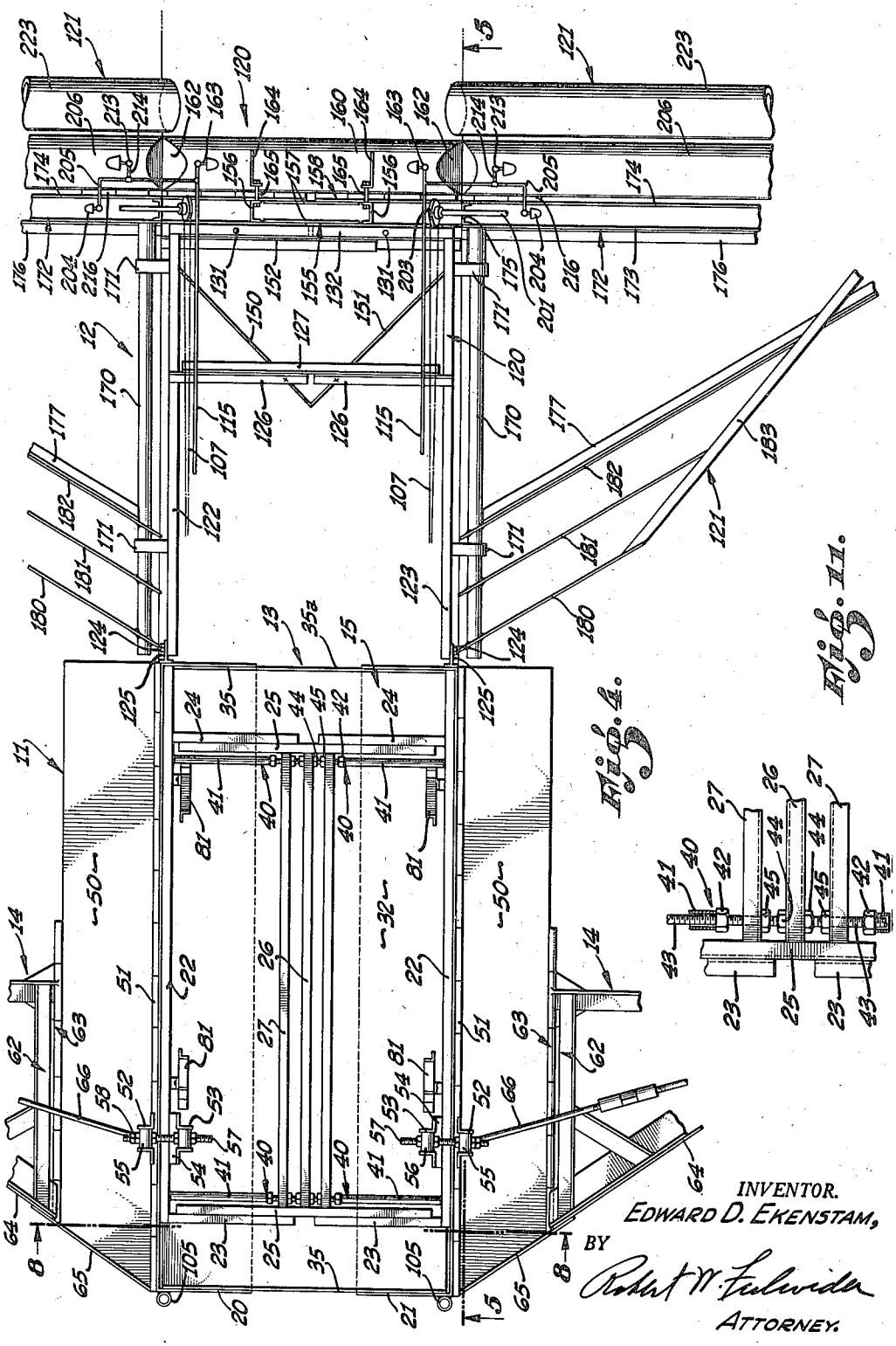


Fig. 4.

Fig. 4A.

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DITCH PAVING MACHINE

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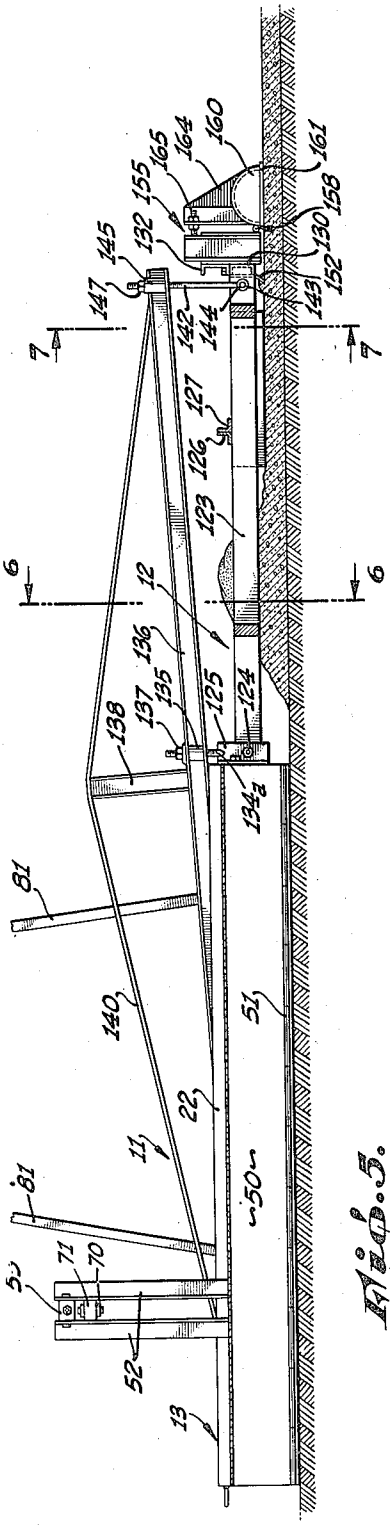


Fig. 5.

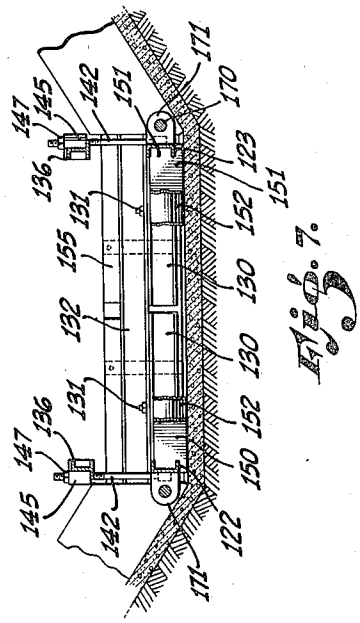


Fig. 7.

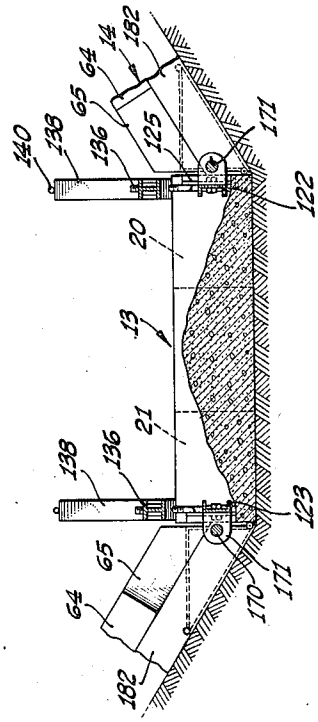


Fig. 6.

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DITCH PAVING MACHINE

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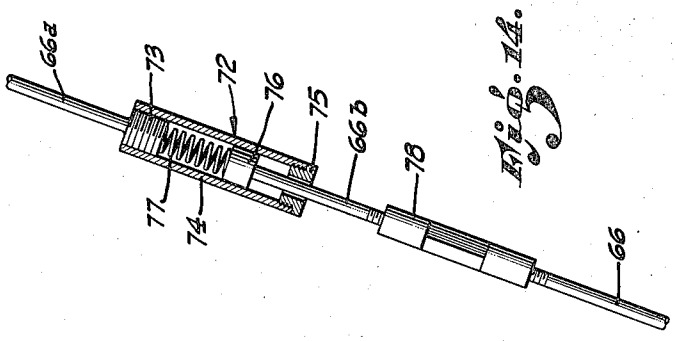


Fig. 14.

Fig. 12.

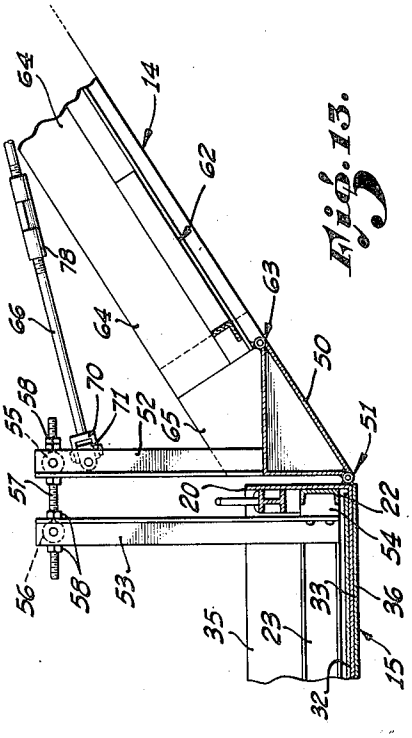


Fig. 13.

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DITCH PAVING MACHINE

Filed Jan. 20, 1945 8 Sheets-Sheet 7

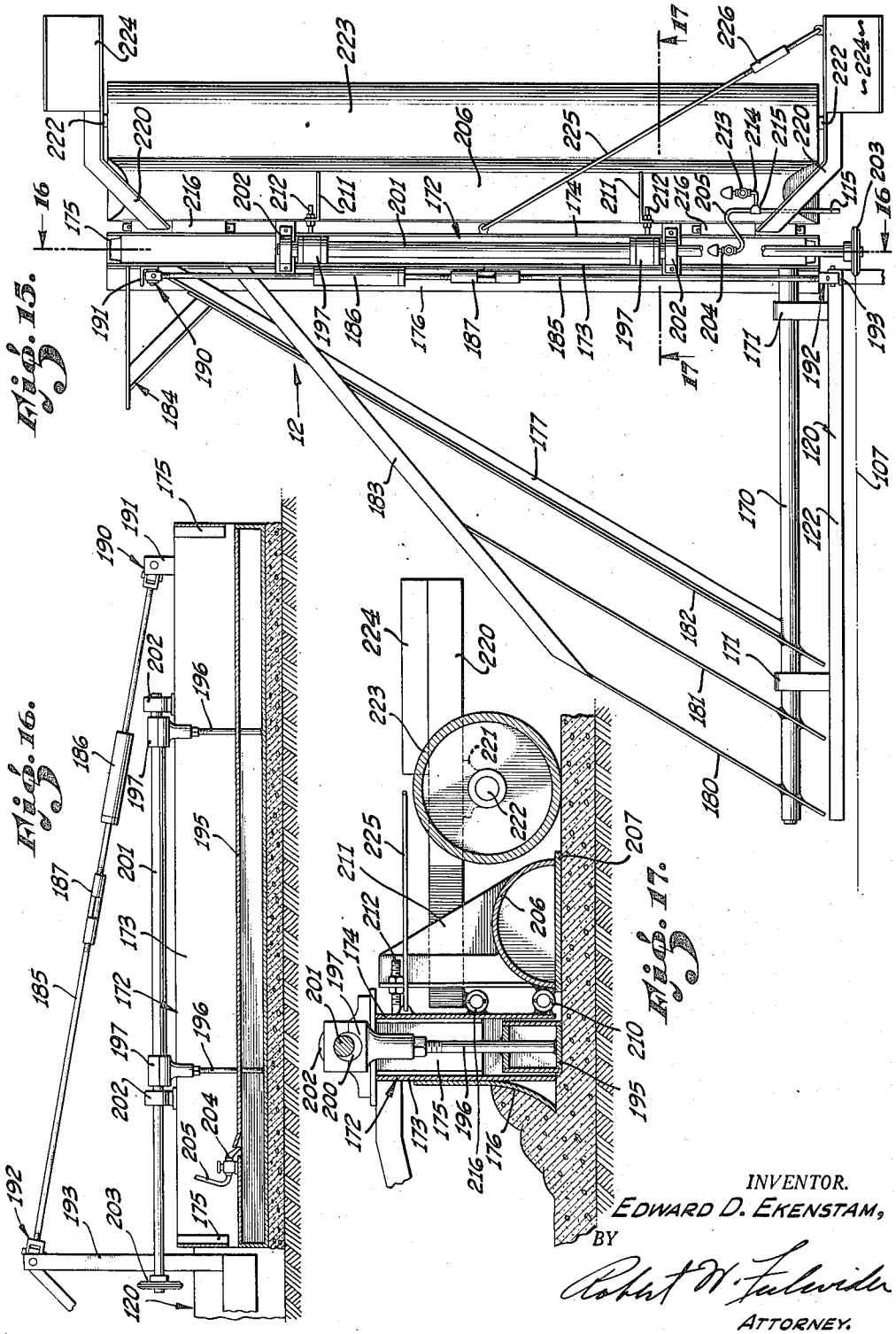


Fig. 15.

Fig. 16.

Fig. 17.

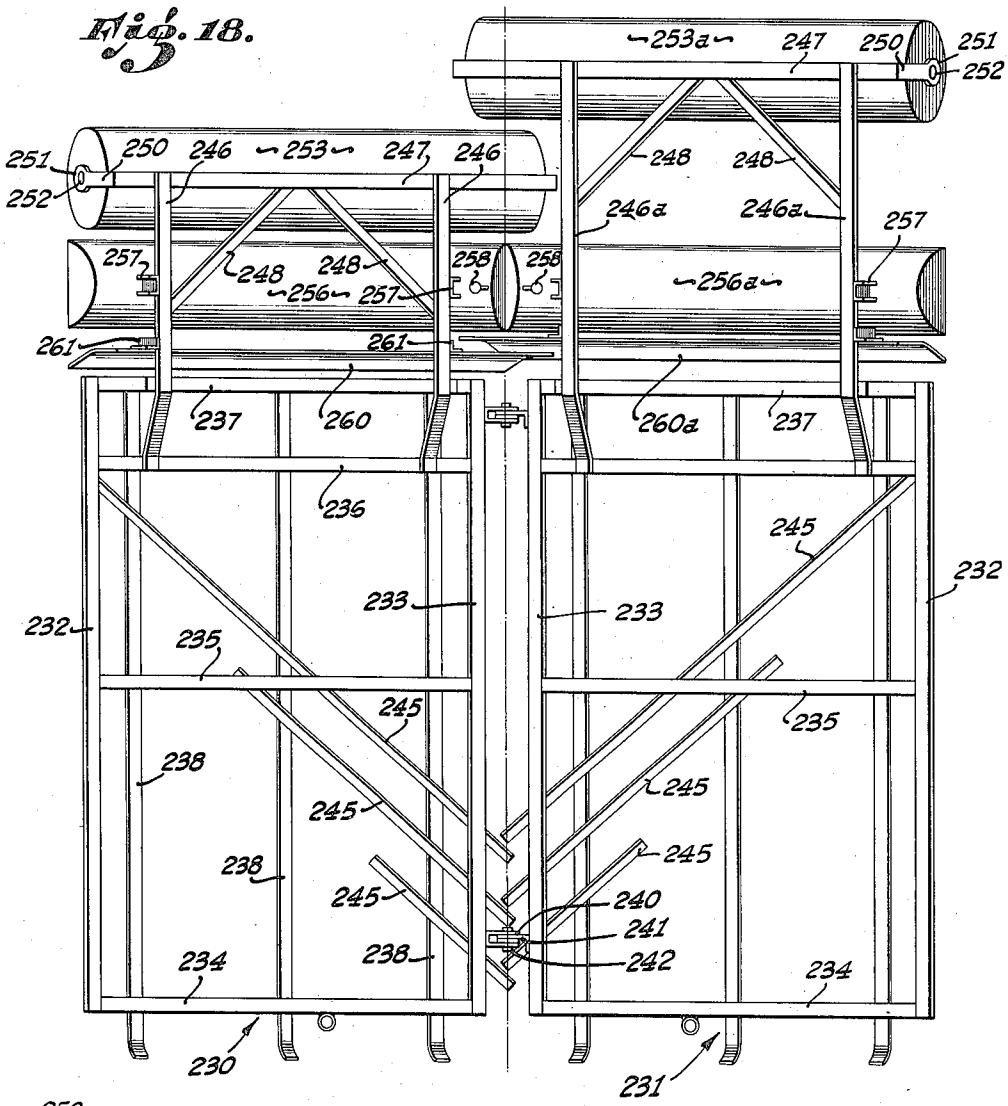
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DITCH PAVING MACHINE

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Fig. 18.



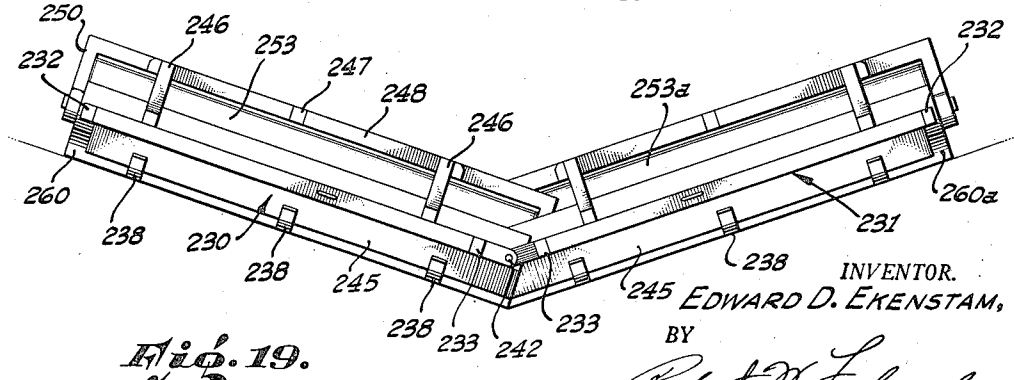


Fig. 19.

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Patented Aug. 24, 1948 2,447,571

UNITED STATES PATENT OFFICE

2,447,571

DITCH PAVING MACHINE

Edward D. Ekenstam, Los Angeles, Calif., assignor of one-half to Southwest Paving Company, a corporation of California

Application January 20, 1945, Serial No. 573,652

24 Claims. (Cl. 61—63)

1

The present invention relates to ditch paving machines for the construction of drainage or irrigation ditches in regions where the soil is loose or sandy and subject to rapid erosion, or where the supply of water is scant and the loss by seepage is excessive. Where such conditions exist, it is necessary to line the sides and bottom of the ditch with an impervious and erosion-resistant layer of asphalt or other material, and machines heretofore employed for this purpose have been constructed to travel on header boards or tracks which are laid along the surface of the ground at the edges of the ditch. There are several disadvantages in this system, among them being the added cost of grading the surface to make the header boards level with the ditch bottom, and of laying and taking up the header boards. Another objection to the use of header boards is that it precludes the use of such a machine in paving ditches which are asymmetric, such as on turns where the outer wall must be higher than the inner wall.

It may be stated that the primary object of the present invention is to provide a novel and improved ditch paving machine which does not require the use of header boards or tracks in its operation and which is, therefore, not subject to the limitations and objections of such header boards.

Another object of the invention is to provide a machine adapted for operation in all types of terrain and soil, and which is capable of paving either a V-shaped or a trapezoidal ditch at a relatively high rate of speed in one operation, producing a dense, uniform paving with a smooth surface.

Another object of the invention is to provide a mobile machine capable of being quickly and easily folded or dismantled for transportation from one job to another on flat bed trucks.

A further object of the invention is to provide a flexible machine adapted to accommodate changes in grade along the ditch, and capable of adjustment to meet a wide variety of ditch shapes and sizes.

Other objects and advantages of the present invention will become apparent to those skilled in the art in reading the following detailed description of a preferred embodiment thereof, reference being had to the drawings, in which:

Fig. 1 is a top plan view of a machine constructed according to the principles of my invention;

Fig. 2 is a front elevational view of the same;

Fig. 3 is a rear elevational view of the same;

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Fig. 4 is an enlarged top plan view of the frame structure with the super-structure and certain other equipment removed for the purpose of showing more clearly certain details of construction;

Fig. 5 is a sectional view taken along the line 5—5 in Fig. 4;

Fig. 6 is a sectional view taken along the line 6—6 in Fig. 5;

Fig. 7 is a sectional view taken along the line 7—7 in Fig. 5;

Fig. 8 is a sectional view taken along the line 8—8 in Fig. 4;

Fig. 9 is an enlarged sectional view taken along the line 9—9 in Fig. 8;

Fig. 10 is an enlarged sectional view taken along the line 10—10 in Fig. 9;

Fig. 11 is an enlarged fragmentary elevational view of the means for adjusting the width of the pan or center section of the front unit;

Fig. 12 is an enlarged elevational view of one of the side sections on the front unit of the machine;

Fig. 13 is an enlarged sectional view taken along the line 13—13 in Fig. 12;

Fig. 14 is an enlarged, partially sectioned view of the cushioning device by which the side unit is supported;

Fig. 15 is an enlarged top plan view of one of the side sections on the rear unit of the machine;

Fig. 16 is a sectional view through the tamper; taken along the line 16—16 in Fig. 15;

Fig. 17 is an enlarged sectional view taken along the line 17—17 in Fig. 15;

Fig. 18 is a top plan view of another embodiment of my invention for paving V-shaped ditches; and

Fig. 19 is a front elevational view of the same.

The machine of the present invention is intended for use in paving the sides and bottom of a ditch which has already been prepared by any of the well known ditch digging machines, and is adapted to be set up in the ditch and thereafter to be drawn along the length thereof, performing in one traverse the operations of finish grading the subgrade, spreading the asphalt mix to a uniform depth over the sides and bottom of the ditch, and compacting the asphalt to a smooth, dense layer so that no further operations need be performed to finish the job.

Referring now to Figs. 1 to 17, inclusive, of the drawings, the machine comprises, in general, a front unit 11 and rear unit 12 which are connected together for relative vertical adjustment. The primary function of the front unit 11 is to

provide support for the weight of the machine on the ditch bottom and to guide the machine on its course. Strike-off blades are also carried by the front unit to finish grade the side walls of the ditch. The rear unit 12 is carried by the front unit at the required height above the ground in order to produce an asphalt layer of the desired thickness, and its function is to distribute the asphalt over the sides and bottom of the ditch and to compact and smooth the layer of asphalt.

The front unit 11 consists of a center section 13 and two side sections 14 which are supported thereon in upwardly diverging relationship corresponding in slope to the side walls of the ditch. The center section 13 is in the nature of a sled, preferably taking the form of a flat bottomed rectangular pan or skid 15 which rests on and slides along the bottom of the ditch, the broad bearing area of the pan bottom enabling the machine to travel on soft, sandy soil without sinking in to any appreciable extent. The pan is preferably built up of steel plate in a telescopic construction permitting extension to any desired width up to the maximum allowed, and comprises right and left shells 20 and 21 which are arranged side by side (see Fig. 4). Each of the shells 20 and 21 has a bottom, with front and rear end walls and one side wall, all welded or otherwise suitably joined together to form a rigid, boxlike construction. Fore and aft extending channel irons 22 are welded or riveted to the side walls of the shells 20, 21 and have laterally inwardly extending channel irons 23 and 24 welded thereto near their ends. The channel irons 23 and 24 lie alongside and are secured to the outer ends of transverse frame members 25 which are welded to the front and rear ends of a central fore and aft extending box beam 26 and a pair of laterally spaced channel irons 27 on opposite sides thereof. A plurality of bolt holes 30 are provided in the web of each of the channels 23 and 24, and bolts 31 are passed through certain of these holes and through corresponding holes in the members 25. This arrangement permits alignment of the bolt holes in channels 23, 24 with those in members 25 for any desired range of pan widths, and adjustment of the pan is accomplished by removing the bolts 31, spreading the two shells 20, 21 apart to the desired width, and reinserting the bolts in the newly aligned holes.

The shells 20 and 21 are telescopically associated with a center member comprising top and bottom plates 32 and 33 having a relatively narrow spacer plate 34 disposed centrally between them (see Fig. 8), said plates being welded or otherwise suitably joined together to form a unitary structure. The bottoms of the shells 20, 21 are inserted in the gap between the top and bottom plates 32, 33 of the center member and are slidable in and out for the purpose of width adjustment. The top plate 32 has upturned front and back ends 35 and 35a (see Fig. 9) which lie against the front and rear end walls of the shells 21, 21, to close the gap between adjacent edges thereof. The bottom plate 33 is flat and is bent up slightly at its leading edge to form a prow 37 which tends to ride up over soft sand or obstacles in the ditch instead of digging in.

The sides of the pan 15 are spread apart or drawn together by means of screw jacks 40, each of which comprises a transversely extending pipe 41 welded at its outer end to the frame member 22. A nut 42 is welded to the inner end of the pipe, and threaded into the nut is a screw shaft 43 which extends loosely into the pipe substantially to the outer end thereof. The shaft 43 passes through a hole in the web of channel iron 27 and has a nut 44 welded to its inner end, said nut serving as a head for the screw shaft, whereby the latter can be turned by a wrench. A lock nut 45 is threaded onto the shaft 43 and bears against the inside surface of the web of channel iron 27 to lock the screw shaft against turning after it has been adjusted. When the lock nut 45 has been loosened and the screw shaft 43 is turned, the pipe 41 is moved outwardly or inwardly, as the case may be, by the nut 42, spreading the shells 20, 21 apart or drawing them together. The head 44 bears against the outside of the center beam 26 to spread the shells apart, while the lock nut 45 bears against the inside of the web of channel iron 27 to draw the shells together, in which case the lock nut and head must be turned together to prevent the lock nut from binding.

The side sections 14 each include a guide member 50 which is preferably in the form of a triangular box beam constructed of steel plate and extending along the side of the pan 15 from front to rear, said member being connected by a piano hinge 51 to the bottom edge of its associated shell 20, 21. The bottom surface of the guide member 50 slopes upwardly and outwardly and is adapted to engage and bear against the sloping side walls of the ditch to guide the machine along its course. In order to accommodate variations in the slope of the ditch walls, means are provided for adjusting and maintaining the angle of the guide member relative to the pan, said means comprising a pair of fore and aft spaced, vertical angle iron posts 52 which are welded to the horizontal top plate of the guide member. Fixed to the pan 15 alongside the angle irons 52 is a second pair of parallel vertical angle irons 53, the lower ends of which are welded to a spacer block 54 which is welded, in turn, to the channel iron 22. Arranged between and journaled in the upper ends of the posts 52 is a trunnion block 55, while a second trunnion block 56 is journaled between the upper ends of posts 53. A threaded tie rod 57 extends through aligned holes in the trunnion blocks 55 and 56, and nuts 58 are threaded onto the tie rod on both sides of the trunnions. Angular adjustment of the guide member 50 is obtained by backing off the nut 58 on one side of either trunnion and advancing the nut on the other side, which has the effect of increasing the length of tie rod between the trunnion blocks.

A generally triangular frame 62 of angle irons is supported along the outer edge of the guide member 50 for vertical swinging by a piano hinge 63, and carried on the leading edge of this frame is a grading blade, or subgrade strike-off 64, the function of which is to scrape the sides of the ditch to the finish grade. A short length of strike-off blade 65 is mounted on the front end of the guide member 50 and overlies the inner end of blade 64, said blades being free to slide or move relative to one another as the frame 62 swings up or down about the hinge 63.

Each of the frames 62 is yieldingly held down against the ground by means of a link or tie rod 66 which is connected at its outer end to the frame by a yoke 67 and trunnion block 68. The tie rod 66 is also provided at its inner end with a similar yoke 70 and trunnion block 71, the latter of which is disposed between and journaled in the angle irons 52 just below the trunnion 55. A spring shock strut 72 is incorporated in the tie rod 66 and acts to urge the frame 62 down against the ground, said shock strut being yieldable to

allow the frame to rise over rocks or other obstacles. In order to accommodate the shock strut 72, the tie rod 66 is broken, and a screw threaded plug 73 is fixed to the end of the outer section 66a (see Fig. 14). One end of cylinder 74 is screwed onto the the plug 73, and threaded into the other end of the cylinder is a bushing 75. The inner section 66b of the tie rod extends through and is slidable in the bushing 75, and fixed to its end within the cylinder is a plug 76. A compression spring 77 is arranged between the plug 76 and member 73 which exerts a yielding force tending to extend the length of the tie rod and thereby press the frame 62 down against the ground. Adjustment of the tension in the spring 77 is obtained by means of a turnbuckle 78 which is threaded onto adjacent ends of the rod 66 in the usual manner to enable the length of the rod to be varied.

Mounted on the center section 13 is an elevated asphalt hopper 80 which serves to receive the asphalt mix from power shovels and to discharge the same onto the bottom and sides of the ditch behind the strike-off blades 64 and center pan 15, where the material is spread and packed by elements carried on the rear unit 12 of the machine. The hopper 80 is supported on a frame 81, which is mounted on the top plate 33 of the pan 15. Material carried by the hopper is discharged through its bottom and is carried by three chutes 83, 84, and 85, to their respective points of delivery. Chutes 83 and 85 are inclined downwardly and laterally to deliver the material to the sides of the ditch, while chute 84 is inclined downwardly and rearwardly to deliver the material to the ditch bottom.

Mounted on the pan 15 is a gasoline engine 90 or other suitable source of power having a gear transmission 91 at one end thereof. A drive shaft 92 projects from the transmission housing, and mounted on this shaft is a pinion 93 which meshes with a large gear 94 fixed on a transversely extending jack shaft 95. The jack shaft 95 is journallel in bearings 97 which are mounted in any suitable manner on the pan 15, and fixed to the jack shaft is a pinion 96 which meshes with a large gear 100 fixed to one end of a winch drum 101. The winch drum 101 is mounted on a shaft 102 journalled in bearings 99 on the pan 15, and a cable 103 is attached to and wrapped around the winch drum 101, extending forwardly therefrom to a fixed point some distance ahead of the machine. Preferably, the fixed point is a sheave wheel or pulley (not shown) mounted on a tractor or truck, and the cable 103 is trained around the sheave wheel and extends back to the machine, being attached to a halter 104 which is fastened to two hitch rings 105 at opposite sides of the center pan 15. From the foregoing description, it will be readily understood that as the cable is wound onto the winch drum 101, the machine is pulled forwardly along the ditch. When the machine has pulled itself up to the tractor or truck acting as a dead man, the said tractor or truck then moves ahead to a new location at a considerable distance ahead of the machine, while the cable 103 is paid out from the winch drum 101.

Sprocket wheels 106 are also mounted on the ends of the jack shaft 95, and trained around these sprockets are drive chains 107 which extend rearwardly therefrom to drive the tampers carried on the rear unit 12. An air pump 110 mounted on the frame 89 has a connecting rod 111 which is driven from an eccentric 112 on the jack shaft 95, and the output of the pump 110 is delivered through a pipe 113 to a pressure fuel tank 114 mounted on the rear of the pan 15 beneath the chute 84. Pressure built up within the fuel tank 114 forces oil through lines 115 to burner jets in hot smoothing irons and tampers carried on the rear unit, which will be described in more detail presently.

The rear unit 12 comprises, in general, a horizontal center section 120 and two side sections 121 mounted on the opposite sides of the center section and extending outwardly and upwardly therefrom in diverging relationship. The center section 120 consists of a frame made up of two laterally spaced, fore and aft extending channel iron members 122 and 123 which are pivotally connected at their front ends by bolts 124 to brackets 125 on the rear end of the pan 15. Connecting the side members 122 and 123 near their midpoints are channel irons 126 which are welded at their outer ends to the side members and extend inwardly toward each other. A channel iron member 127 lies along the rear side of members 126 and is adjustably secured thereto in the same manner that members 23 and 26 of the front unit are joined together so that the frame can be extended in width to correspond to the width of the pan 15. The rear ends of the members 122, 123 are likewise joined together by an extensible cross member comprising channel irons 130 which are adjustably secured by bolts 131 to an overlying member 132.

The brackets 125 are adjustable vertically with respect to the pan 15, and to this end, vertical slots 133 are provided in the brackets 125, and bolts 134 are passed through the slots and through aligned holes in the rear walls of the shells 20, 21. The brackets 125 are raised or lowered relative to the pan 15 by means of upwardly extending threaded rods 134a which are welded to the brackets, each of said rods passing through a sleeve or boss 135 formed integrally with a fore and aft extending beam 136. Vertical adjustment is obtained by means of a nut 137 threaded on the upper end of rod 134a and bearing against the top of the beam 136.

Each of the beams 136 is attached at its front end to member 23 in the front unit and extends rearwardly and upwardly therefrom over the back wall of the pan 15 to a point substantially directly above cross member 132. A vertical post 138 is welded to member 136 intermediate its ends, and a tension rod 140 which is attached to the ends of member 136 passes over and is welded to the top of post 138. Depending from the rear end of member 136 is a link 142 having an eye 143 at the lower end thereof through which is passed a bolt 144 connecting the link 142 to the frame member 122, 123. The upper end of the link 142 passes through an apertured boss 145 in member 136 and is threaded to receive a nut 147 which bears on the top of the boss.

Fixed to the frame members 122, 123 and to the cross members 126 are diagonally disposed asphalt sweeps 150 and 151 which function to distribute the asphalt mix uniformly over the bottom of the ditch. When the center section 120 is closed to the minimum width, the asphalt sweeps 150 and 151 converge forwardly to a point, but when the center section is extended, it is necessary to insert an additional section of sweep (not shown) into the space between the front ends of the sweeps 150 and 151 in order to close the gap.

Extending across the full width of the frame

of the center section 120 and mounted on the front side of the members 130 is an asphalt strike-off blade or moldboard 152 which serves to strike off the level of the relatively loose material so that the smoothing iron which follows will exert a uniform pressure over the entire area of the ditch bottom. Preferably, the moldboard 152 is made up of two overlapping sections which are bolted together, said sections being extensible with the frame of the center section 120.

A transversely arranged rectangular beam 155 is fixed to the rear side of members 130 and 132 and comprises front and back walls joined together by a plurality of vertical channel irons 156. The beam 155 is divided midway between its ends into two halves which are joined by overlapping plates 157 (see Fig. 4) in a manner permitting extension of the beam with the frame of the center section 120. A hinge 158 is provided along the back of beam 155 along the bottom edge thereof, and supported on this hinge is a hot smoothing iron 160. The smoothing iron 160 is preferably in the form of a half cylinder of steel plate, with a flat bearing plate 161 (see Fig. 5) across the bottom thereof which runs on the asphalt.

The ends of the cylinder are closed by downwardly and outwardly inclined end plates 162, and mounted on top of the cylinder near the ends thereof are burner jets 163 which are connected to the fuel lines 115. The jets 163 project into the interior of the cylinder and are directed in toward the center so that the entire length of the smoothing iron is uniformly heated to a sufficiently high temperature to seal the surface of the asphalt layer. A fuel valve (not shown) is also incorporated into the jet 163 so that the fuel can be cut off when the iron has reached the desired temperature, after which the temperature is maintained by the heat of the asphalt mix. A pair of laterally spaced brackets 164 are fixed to the top of the smoothing iron, and these are connected by bolts 165 to the channel irons 156 for the purpose of adjusting the position of the smoothing iron relative to the beam 155. The smoothing iron 160 may be made telescopic, if desired, but I have found it more convenient to replace the smoothing iron with another of appropriate length when the frame 120 is extended in width.

The side sections 121 each consist of a fore and aft extending tubular member 170 lying alongside the members 122, 123 and pivotally supported thereon by means of bearing brackets 171. Fixed to the rear end of and extending laterally outwardly from the tubular member 170 is a long rectangular tamper housing 172 formed of front and back plates 173 and 174 which are joined together at their ends by channel irons 175. A moldboard 176 is mounted on the front plate 173 of the housing for the purpose of striking off the level of the loose asphalt mix so that the compacting elements which follow will have a uniform layer of material upon which to act. A bracing member 177 is welded to the outer end of the tamper housing 172 and extends forwardly and inwardly to a point immediately behind the front bearing bracket 171 where it is welded to the tubular member 170.

Outwardly and rearwardly extending asphalt sweeps 180, 181 and 182 are welded at their front or inner ends to the tubular member 170 and are supported at their outer ends by a diagonal member 183 which is fixed at its rear end to the tamper housing 172. The rear sweep 182 is fixed to the front of the bracing member 177 for its entire length, and mounted on the outer end of the sweeps 182 and members 177 are cut off members 184 which serve to prevent the asphalt from being spread out beyond the ends of the side sections 121. The cut-off members 184 are also supported on the moldboards 176 and are preferably adjustable along the length thereof so that the height of the paving along the ditch walls may be varied.

The side sections 121 are also yieldingly held down against the ground in the same manner as the side sections of the front unit by means of tie rods 185 (see Figs. 16 and 17) in which are incorporated spring shock struts 186 and turnbuckles 187. The outer ends of the tie rods 185 are secured by universal joint connections 190 to posts 191 which are fixed to and extend upwardly from the tamper housing 172, while the inner ends of the tie rods are similarly connected by universal joints 192 to posts 193 on the center section 120.

Disposed within the tamper housing 172 is a vertically reciprocable tamper 195 which is in the form of a rectangular box beam having its ends closed (see Figs. 16 and 17). A pair of laterally spaced vertical posts 196 are fixed at their lower ends to the bottom plate of the box beam and extend upwardly through holes in the top plate and are welded thereto. Threaded onto the upper ends of the posts 196 are eccentric boxes 197 which are journaled on eccentric wheels 200 mounted on shafts 201. Each of the shafts 201 is arranged parallel to and slightly above the top of the tamper housing 172 and is journaled in bearing blocks 202 on the housing. The inner end of the shaft 201 projects inwardly beyond the end of the tamper housing, and has a sprocket 203 fixed thereto, around which is trained the driving chain 107. A fuel valve and burner jet 204 is mounted on top of the tamper 195 near its inner end and is connected by a flexible hose 205 to the fuel line 115. The nozzle of the jet 204 projects through an opening in the top of the tamper and is directed laterally outwardly so that its flame traverses the length of the tamper to heat the same more or less uniformly from end to end.

Carried on the back of each of the tamper housings 172 is a hot smoothing iron 206 which, like the center smoothing iron 160, is constructed of a half cylinder having a flat plate 207 welded to its bottom. The smoothing iron 206 is connected to the bottom edge of the tamper housing by means of a hinge 210, and has upwardly extending brackets 211 welded to its top surface which are connected by bolts 212 to the top of the tamper housing. This arrangement permits angular adjustment of the smoothing iron relative to the tamper housing so that the pressure exerted on the asphalt by the smoothing iron can be regulated. A fuel valve and burner jet 213 is mounted on top of the smooting iron near its inner end, with the jet nozzle projecting through a suitable opening into the interior of the smoothing iron for heating the same. The burner 213 is connected by a flexible hose 214 and T-connection 215 to the fuel line 205.

Swingably supported on the back of the tamper housing 172 near the ends thereof by hinges 216 are yoke arms 220 which extend rearwardly over the top of the smoothing iron 206. Fixed to the under sides of the yoke arms 220 are bearing blocks 221, and journaled in these bearing blocks are stub shafts 222 which are fixed to the ends

of a roller 223. The roller 223 trails over the asphalt behind the smoothing iron 206 and smoothes out any remaining irregularities in the surface thereof. Ballast trays 224 are fixed to the rear extremities of the yoke arms 220 so that if additional pressure on the asphalt is required, bags of sand or other suitable weights can be placed in the trays. Tension links 225 are connected to the rear ends of the inner yoke arms 220 and to the tamper housing 172 near its midpoint, and a turnbuckle 226 is incorporated in the link so that any desired proportion of the ballast can be applied to the tamper housing to press the smoothing iron 206 down onto the asphalt.

The operation of the ditch paving machine is believed to be apparent from the preceding description. In order to transport the machine from one job to another on flat bed trucks, the link 66 bracing the side sections 14 of the front unit, and links 185 bracing the side sections of the rear unit are disconnected at one of their ends, and the side sections are swung up to a vertical position where they are secured in any suitable manner. If necessary, the asphalt hopper and its supporting frame can be removed and transported separately, as can the rear unit 12 of the machine. Upon arrival at the job, the machine is assembled and set up on the ground, and any necessary width adjustment of the center sections of front and rear units is made. The machine is then lifted and set down into the bottom of the ditch by means of a crane, and a truck or tractor having a sheave wheel is placed in position at an appreciable distance ahead of the machine. The cable 103 is then unreeled from the winch drum 101 and is trained around the sheave wheel on the truck, the halter 104 at the end of the cable being attached to hitch rings 105 on the center section of the front unit. The burner nozzles in the tampers 195 and on the smoothing irons 160 and 206 are then opened and the fuel ignited to heat the tamper and smoothing irons to operating temperature. When the smoothing irons have become sufficiently hot, the fuel valves are turned off and the asphalt mix is dumped into the hopper 80 by means of clam-shell shovels. The motor 90 is then started and the machine is thereafter pulled along the ditch by the winch drum 101. Asphalt from the hopper 80 is discharged through chutes 83, 84, and 85 onto the sides and bottom of the ditch where it is spread to a uniform depth by the asphalt sweeps. The moldboards 153 and 176 strike off the levels of the loose asphalt, after which the reciprocating tampers 195 compact the layer of asphalt to the desired density. The hot smoothing irons compact the asphalt additionally to a certain extent and seal the surface thereof, while the rollers trailing behind the smoothing irons smooth out any irregularities in the surface of the asphalt layer. A mechanical roller follows the machine to compact and roll the flat bottom of the ditch, although if it is desired to eliminate such rolling operation, the housing 155 can be modified slightly to receive a reciprocating tamper, and a central roller can be added by means of a suitable yoke connected to the housing 155. It will be appreciated that such a central roller, if added to the machine, would necessarily be offset rearwardly behind the rollers 223 so as to clear the ends of the latter.

Another embodiment of the machine which is intended for use in V-type ditches having no flat bottoms is illustrated in Figs. 18 and 19, to which reference is now directed. In this embodiment of the machine, the center section has been omitted and the mechanism is carried on two laterally spaced, angularly related frames 230 and 231, each of which comprises a pair of spaced, fore and aft extending frame members 232 and 233 which are connected by cross members 234, 235, 236, and 237. The frame 230 is mounted on fore and after sled runners 238 having upturned front ends which tend to ride up over soft sand or obstructions. Companionate hinge fittings 240 and 241 are fixed to adjacent edges of the frame members 233 near the front and rear ends thereof, and these fittings are connected by hinge pins 242 which permit vertical swinging movement of the two frames relative to one another. This arrangement enables the machine to accommodate any range of slope to the side walls of the ditch, as well as to variations in slope along the length of a given ditch.

Mounted on the frames 230, 231, and extending diagonally rearwardly and outwardly from the center line of the machine are asphalt sweeps 245 which serve to distribute the asphalt mix uniformly over the sides of the ditch. The inner ends of the asphalt sweep on the frame 230, 231 overlap, or are staggered, as shown, so that their bottom corners are disposed in a common line and thus are enabled to reach down to the bottom of the ditch.

Mounted on the rear ends of the frames 230, 231 and extending rearwardly therefrom are laterally spaced beams 246 and 246*a* which are fixed at their rear ends to transverse yoke members 247. Diagonal brace members 248 are fixed to the midpoint of member 247 and to the beams 246 and 246*a* to add rigidity to the structure. The ends of the yoke member 247 extend beyond beams 246, 246*a* and have downwardly extending arms 250 having bearing portions 251 at their lower ends. Stud shafts 252 on the ends of rollers 253 and 253*a* are journaled in the bearing portions 251. As clearly shown in Fig. 18, the beams 246*a* of section 231 are longer than their corresponding parts on section 230, so that the roller 253*a* is offset rearwardly from roller 253. This enables both rollers to reach down into the apex formed by the junction of the ditch walls.

Disposed ahead of the rollers 253 and 253*a* are hot smoothing irons 256 and 256*a* which are connected to their respective beams by means of bracket members 257. The smoothing irons 256 and 256*a* are identical in construction to those of the preceding embodiment, and are provided at their inner ends with burner jets 258 which are adapted to be coupled to a fuel line at the beginning of the run so that the irons can be heated to operating temperature, after which the temperature is maintained by the heat of the asphalt mix. The beveled ends of the smoothing irons enable them to be placed in line without being offset, as with the other elements.

Ahead of the smoothing irons are moldboards 260 and 260*a* which are connected to their respective beams by bracket members 261, said moldboards being staggered to enable them both to reach down into the apex of the ditch.

The operation of this embodiment of my invention is believed to be sufficiently similar to that of the preceding embodiment to require little additional description. The grading blades have been omitted, inasmuch as they are not required on V-type ditches. Hot asphalt mix is dumped through the open frames 230, 231 onto the sides of the ditch just ahead of the asphalt sweeps 245

which then act to distribute the asphalt uniformly over the sides of the ditch. The moldboards 260, 260a strike off the level of the asphalt, and the following smoothing irons and rollers compact the asphalt layer and smooth off its surface.

While I have shown and described in some detail the preferred embodiment of my invention, it is to be understood that such details are not restrictive and that various changes in design, structure and arrangement may be made without departing from the spirit and scope of the appended claims.

I claim:

1. An asphalt ditch paving machine comprising, in combination, a flat bottomed pan adapted to bear on and slide along the flat bottom of a ditch, guide means mounted on said pan and having a broad bearing surface disposed to engage the sloping sides of the ditch to hold said pan on its course, and means carried on said pan at the rear end thereof for distributing asphalt mix uniformly over the sides and bottom of the ditch and thereafter compacting and smoothing said asphalt.

2. An asphalt ditch paving machine comprising, in combination, a flat bottomed sled adapted to bear on and slide along the bottom of a ditch, guide means carried along the sides of said sled and adapted to engage the ditch sides for holding said sled centerd in the ditch, grading means carried on said sled and operable to bring the sides of the ditch to finish grade, spreading means carried on said sled for distributing asphalt mix to a substantially uniform depth over the sides and bottom of the ditch, and asphalt finishing means arranged to the rear of said spreading means for compacting and smoothing the asphalt on the sides and bottom of the ditch.

3. An asphalt ditch paving machine comprising, in combination, a flat bottomed pan adapted to bear on and slide along the flat bottom of a ditch, guide means mounted on said pan and having a broad bearing surface disposed to engage the sloping sides of the ditch to hold said pan on its course, a hopper mounted on said pan and operative to deliver asphalt mix to the sides and bottom of the ditch, means carried on said pan to the rear of said hopper for distributing the asphalt mix uniformly over the surface of the ditch, and means for compacting and smoothing said asphalt.

4. An asphalt ditch paving machine comprising, in combination, a flat bottomed pan adapted to bear on and slide along the flat bottom of a ditch, guide means mounted on said pan and having a broad bearing surface disposed to engage the sloping sides of the ditch to hold said pan on its course, means on said pan for moving the same along the length of the ditch, means for delivering asphalt mix to the sides and bottom of the ditch, means for spreading the mix to a uniform depth, and means for compacting and smoothing the asphalt.

5. An asphalt ditch paving machine comprising, in combination, a flat bottomed pan adapted to bear on and slide along the flat bottom of a ditch, guide means arranged on opposite sides of said pan and mounted thereon for angular adjustment to accommodate different slopes of ditch walls, said guide means being adapted to engage the ditch sides to hold the machine on its course, means supported on said pan and adjustable angularly with respect thereto for finish grading the sides of the ditch, and means carried by said pan for spreading asphalt mix uniformly over the sides and bottom of the ditch and thereafter compacting and smoothing the asphalt.

6. An asphalt ditch paving machine for use in a ditch having sloping side walls, said machine comprising a pair of interconnected upwardly diverging frame structures adapted to be positioned parallel to the side walls of said ditch and having hinged support connections to accommodate variations in the slope of said side walls, longitudinally extending sled means engaging the ground within the ditch for supporting the weight of the machine directly on the ground and for guiding the machine on its course, means carried by said frame structures for distributing the asphalt mix uniformly along the sides of said ditch, and means for applying heat and pressure to the layer of asphalt for smoothing and compacting the same.

7. An asphalt ditch paving machine for use in a ditch having sloping side walls, said machine comprising a pair of interconnected, upwardly diverging frames adapted to be positioned parallel to the side walls of said ditch and having hinged support connections to accommodate variations in the slope of said side walls, broad surfaced sled means on said frames bearing directly on the side walls of the ditch for supporting the weight of the machine and for guiding the machine along its course, means carried by said frames for distributing asphalt uniformly over the surface of the ditch, and means including a transversely disposed hot smoothing iron carried by said frames to the rear of said distributing means for compacting and smoothing the layer of asphalt.

8. An asphalt ditch paving machine for use in a ditch having sloping side walls, said machine comprising a pair of frames pivotally connected together for relative angular movement and adapted to be positioned parallel to the side walls of said ditch, longitudinally extending sled means on said frames bearing directly on the sides of said ditch for supporting the machine, means carried by said frames for distributing asphalt uniformly over the surface of the ditch and means including a roller carried by said frames to the rear of said distributing means for compacting and smoothing the layer of asphalt.

9. An asphalt ditch paving machine comprising a pair of interconnected, angularly related frames, an asphalt sweep mounted on each of said frames for spreading the paving mix uniformly over the sides of the ditch, a tamper mounted on said frame behind said sweep for compacting the relatively loose material, a hot smoothing iron arranged to the rear of said tamper for sealing the surface of the tamped asphalt, and a roller journaled on said frame behind said smoothing iron for rolling said asphalt.

10. An asphalt ditch paving machine comprising a pair of interconnected, angularly related frames, an asphalt sweep mounted on each of said frames for spreading the paving mix uniformly over the surface of the ditch walls, a hot smoothing iron carried on said frame behind said sweep, and a roller journaled on said frame to the rear of said smoothing iron to trail over and compact the asphalt layer.

11. An asphalt ditch paving machine comprising a pair of sections arranged side by side in angular relationship whereby said sections are adapted to travel on and pave the sloping sides of a ditch, means connecting said sections together and providing for angular adjustment therebetween, each of said sections comprising a frame, an asphalt sweep mounted on said frame

near the front end thereof for spreading the paving mix uniformly over the surface of the ditch walls, a tamper carried on said frame to the rear of said sweep, a hot smoothing iron mounted on said frame behind said tamper, and a roller journaled on said frame to trail over the asphalt behind said smoothing iron to compact the asphalt into a dense, smooth layer.

12. An asphalt ditch paving machine comprising, in combination, a flat bottomed pan adapted to bear on and slide along the flat bottom of a ditch, a pair of guide members mounted on opposite sides of said pan for vertical swinging movement and engageable with the sloping sides of the ditch to hold said pan on its course, means connecting said guide members with said pan for adjusting the angular relationship between them, grading means supported on said guiding members for vertical swinging movement, means for yieldingly urging said grading means against the sides of the ditch, and means connected with said pan at the rear end thereof for spreading asphalt mix uniformly over the sides and bottom of the ditch and thereafter compacting and smoothing the asphalt layer.

13. An asphalt ditch paving machine comprising, in combination, a flat bottomed pan adapted to bear on and slide along the bottom of a ditch, a pair of guide members mounted on opposite sides of said pan and engageable with the sloping sides of the ditch for holding said pan on its course, a center frame supported on the rear end of said pan and adjustable vertically with respect thereto, means on said frame for distributing asphalt mix uniformly over the bottom of the ditch, means mounted on said frame to the rear of said distributing means for compacting and smoothing the layer of asphalt, a pair of side frames mounted on opposite sides of said center frame for vertical swinging movement, means for yieldingly urging each of said side frames down against the sides of the ditch, means carried on each of said side frames for distributing asphalt mix uniformly over the side walls of the ditch, and means mounted on each of said side frames to the rear of said spreading means for compacting and smoothing the asphalt layer.

14. An asphalt ditch paving machine comprising a front unit and a rear unit connected together for relative vertical adjustment, said front unit comprising a center section and two side sections supported thereon in upwardly diverging relationship, said center section including a flat pan adapted to bear on and slide along the flat bottom of the ditch, means carried on said pan for moving the machine along the ditch, said side sections each consisting of a guide member mounted on the side of the pan and engageable with the sides of the ditch for holding the machine on its course, a frame mounted on said guide member, grading means carried by said frame for scraping the sides of said ditch to final grade, an elevated asphalt hopper mounted on said center section and adapted to discharge asphalt mix onto the sides of the ditch behind said grading means and onto the bottom of the ditch behind said pan, said rear unit of the machine comprising a center section and two side sections supported thereon in upwardly diverging relationship, said center section including a frame adjustably supported from the center section of the front unit at a predetermined height above the surface of the ditch bottom, an asphalt sweep mounted on the frame to distribute the asphalt mix to a substantially uniform depth over the bottom of the ditch, means on the frame behind said sweep for striking off the asphalt to a predetermined level, and a hot smoothing iron carried by said frame behind said strike-off means for compacting and sealing the asphalt layer, said side sections of the rear unit each comprising a frame pivotally connected to the center section for vertical swinging movement to follow the contour of the ditch side walls, an asphalt sweep mounted on said frame for distributing the asphalt mix uniformly over the surface of the ditch side walls, a tamper mounted on said frame behind said asphalt sweep for compacting the relatively loose material, a hot smoothing iron carried on the frame behind said tamper for sealing the surface of the tamped asphalt, and a roller journaled on the frame to trail over the asphalt behind said smoothing iron for rolling the asphalt into a dense, smooth layer.

15. An asphalt ditch paving machine comprising a pair of frames arranged side by side and connected together for vertical swinging movement, a plurality of fore and aft extending runners mounted on said frames for engaging the side walls of the ditch to support and guide the machine, means on said frames for spreading asphalt mix uniformly over the side walls of the ditch, a hot smoothing iron mounted on each of said frames to the rear of said distributing means for compacting and sealing the asphalt layer, and a roller journaled on said frame behind said hot smoothing iron to roll the asphalt.

16. An asphalt ditch paving machine comprising a main supporting structure having ground engaging bearing surfaces of sufficient area to support the weight of the machine on the ground without sinking in appreciably, hinged sled means on said supporting structure adapted to engage the side walls of the ditch for guiding the machine on its course, and means carried by said structure for distributing asphalt to a uniform depth over the surfaces of the ditch and thereafter compacting and smoothing said asphalt to a dense, smooth layer.

17. An asphalt ditch paving machine comprising, in combination, a flat bottomed sled adapted to bear on and slide along the flat bottom of a ditch, guide means arranged on opposite sides of said sled and hingedly mounted thereon for angular adjustment to accommodate different slopes of ditch walls, said guide means being adapted to engage the sides of the ditch to hold the machine on its course, and means carried on said sled for distributing asphalt mix to a uniform depth over the surfaces of said ditch and thereafter compacting said asphalt.

18. An asphalt ditch paving machine comprising, in combination, a supporting structure having ground engaging bearing surfaces of sufficient area to support the weight of the machine on the ground without sinking in appreciably, guide means mounted on said structure and having a broad articulated bearing surface adapted to engage the bottom and sloping sides of the ditch to hold the machine on its course, and means carried on said structure for distributing asphalt mix uniformly over the sides and bottom of the ditch and thereafter compacting the asphalt.

19. An asphalt ditch paving machine comprising, in combination a center section and two side sections supported thereon in upwardly diverging relationship, said center section including a flat bottomed pan adapted to bear on and slide along the flat bottom of a ditch, guide means

mounted on the sides of said pan and adapted to engage the sloping side walls of the ditch to guide the machine along its course, grading means carried by said side sections for scraping the sides of the ditch to final grade, and means for distributing asphalt mix on the ditch surfaces and thereafter smoothing and compacting the same.

20. An asphalt ditch paving machine comprising, in combination a center section and two side sections supported thereon in upwardly diverging relationship and adjustable angularly with respect thereto, means for adjusting the position of said side sections relative to said center section, said center section including a flat bottomed pan adapted to bear on and slide along the flat bottom of a ditch, guide means mounted on the sides of said pan and adapted to engage the sloping side walls of the ditch to guide the machine along its course, grading means carried by said side sections for scraping the sides of the ditch to final grade, and means for distributing asphalt mix on the ditch surfaces and thereafter smoothing and compacting the same.

21. An asphalt ditch paving machine comprising, in combination a center section and two side sections, supported thereon in upwardly diverging relationship, said center section including a flat bottomed pan adapted to bear on and slide along the flat bottom of a ditch, guide means mounted on the sides of said pan and adapted to engage the sloping side walls of the ditch to guide the machine along its course, grading means carried by said side sections for scraping the sides of the ditch to final grade, a supply hopper mounted on said pan and adapted to distribute asphalt mix to the sides of the ditch behind said grading means and to the bottom of the ditch behind said pan, and means for distributing the asphalt mix uniformly over the ditch surface and thereafter smoothing and compacting the same.

22. An asphalt ditch paving machine comprising, in combination, a center section frame, a pair of side section frames arranged along the sides of said center section frame and extending upwardly and outwardly therefrom in diverging relationship, distributing means carried on each of said frames for spreading the asphalt mix uniformly over the ditch surfaces, and means on each of said frames to the rear of said distributing means for compacting and smoothing the layer of asphalt.

23. An asphalt ditch paving machine comprising in combination, a center section frame, a pair of side section frames arranged along the sides of said center section frame and extending upwardly and outwardly therefrom in diverging relationship, said side section frames being connected to said center section frame for angular movement with respect thereto whereby said side sections are permitted to follow the contour of the ditch side walls, distributing means carried on each of said frames for spreading the asphalt mix uniformly over the ditch surfaces, and means on each of said frames to the rear of said distributing means for compacting, smoothing, and rolling the layer of asphalt.

24. An asphalt ditch paving machine comprising, in combination, a center section frame, a pair of side section frames arranged along the sides of said center section frame and extending upwardly and outwardly therefrom in diverging relationship, distributing means carried on each of said frames for spreading the asphalt mix uniformly over the ditch surfaces, a tamper, hot smoothing iron, and roller carried by each of said side section frames for compacting and smoothing the asphalt layer on the side walls of the ditch, and a hot smoothing iron carried by said center section frame for compacting and smoothing the asphalt layer on the bottom of the ditch.

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