Dec. 17, 1940. A. E. LUNDBYE 2,225,481

ROAD PAVER

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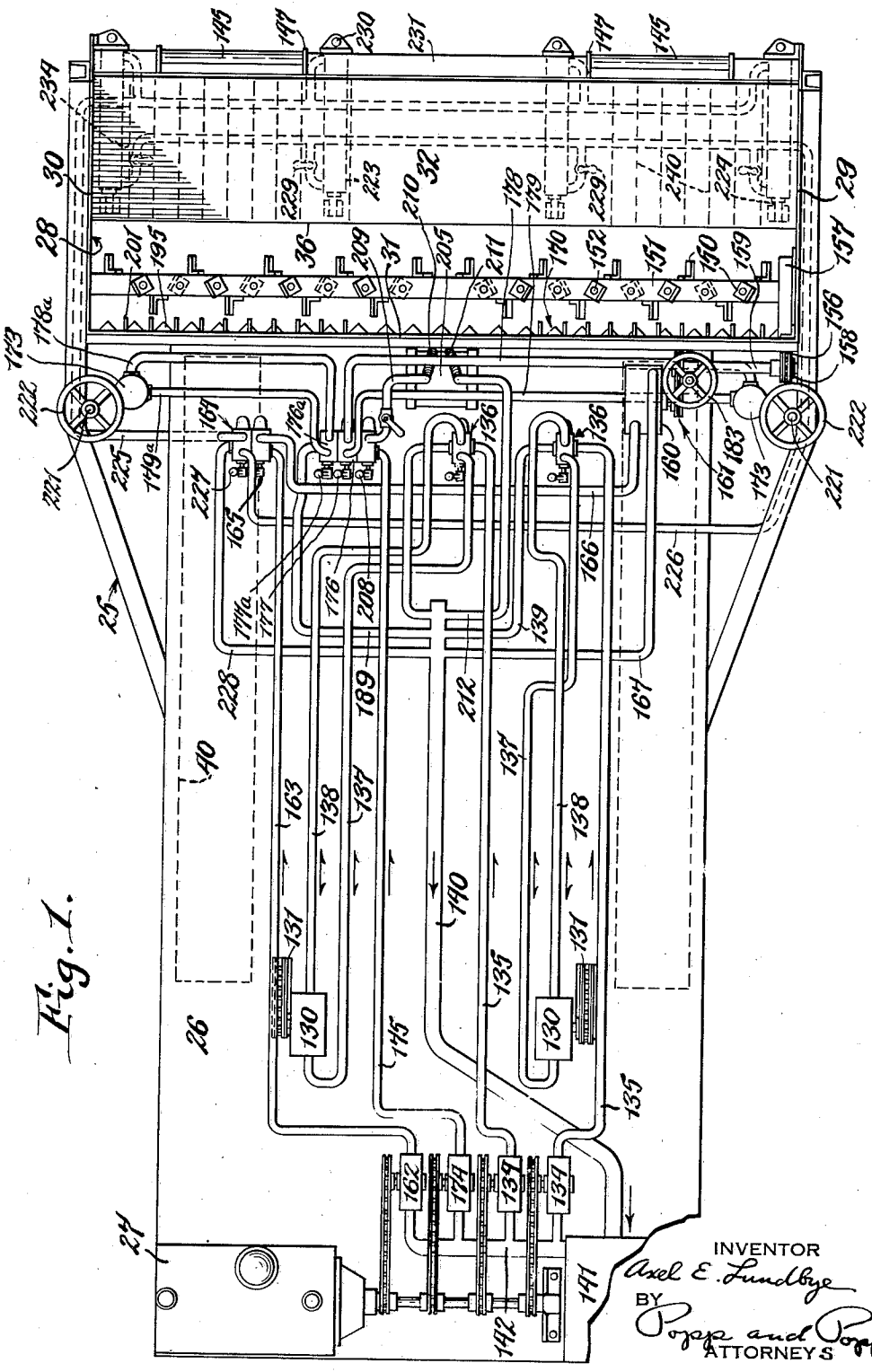


Fig. 1.

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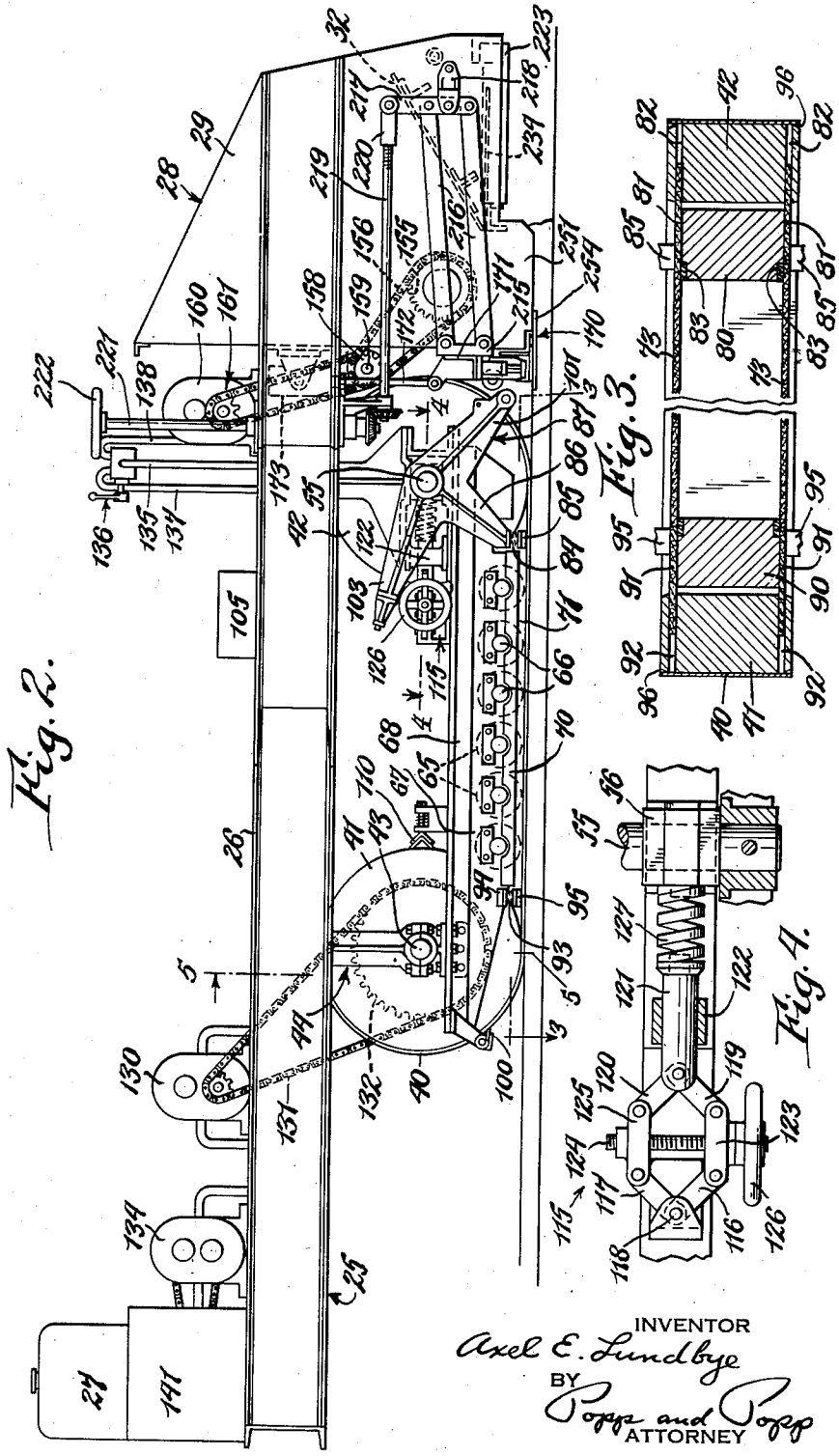


Fig. 2.

Fig. 3.

Fig. 4.

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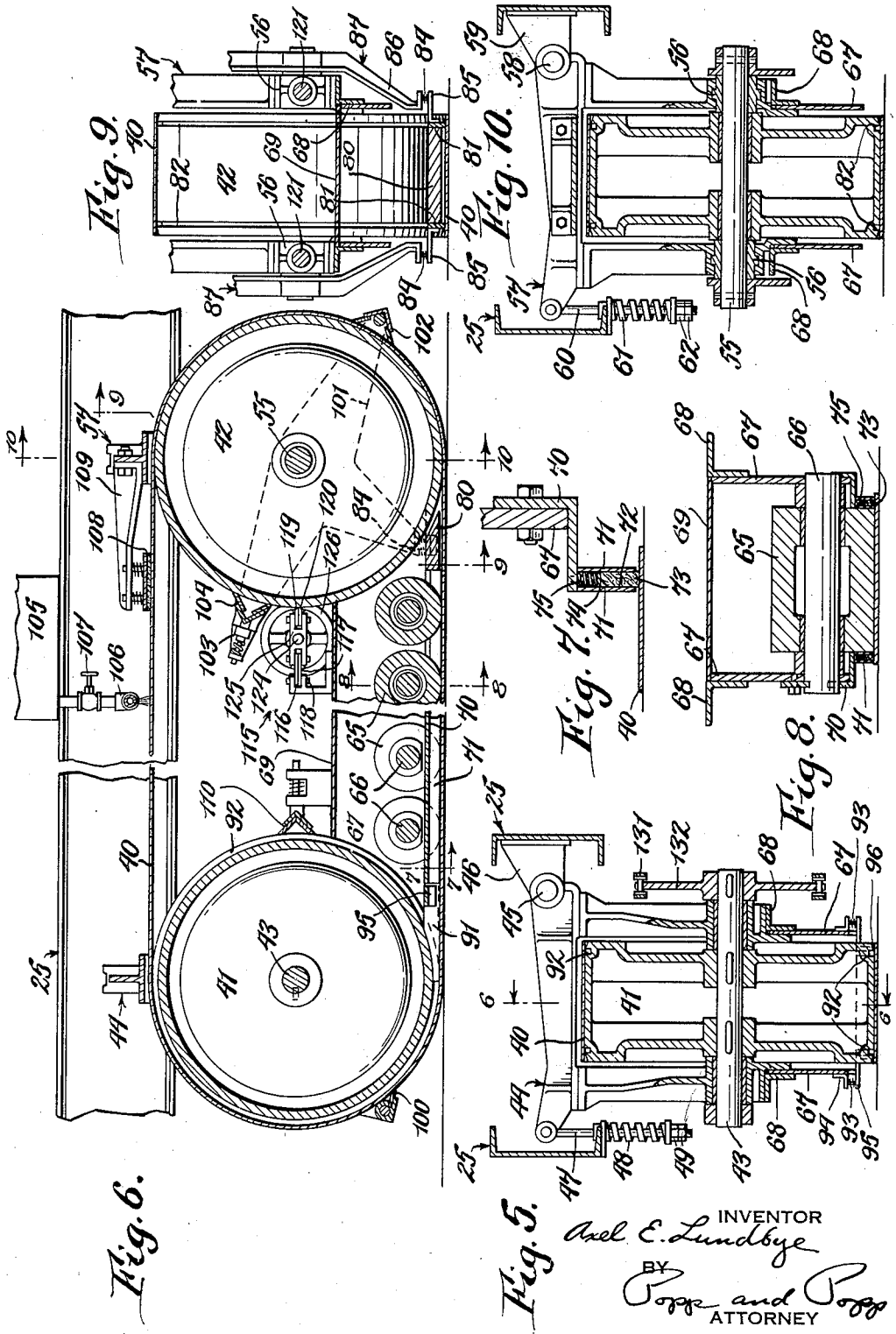


Fig. 9.

Fig. 10.

Fig. 7.

Fig. 8.

Fig. 6.

Fig. 5.

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ROAD PAVER

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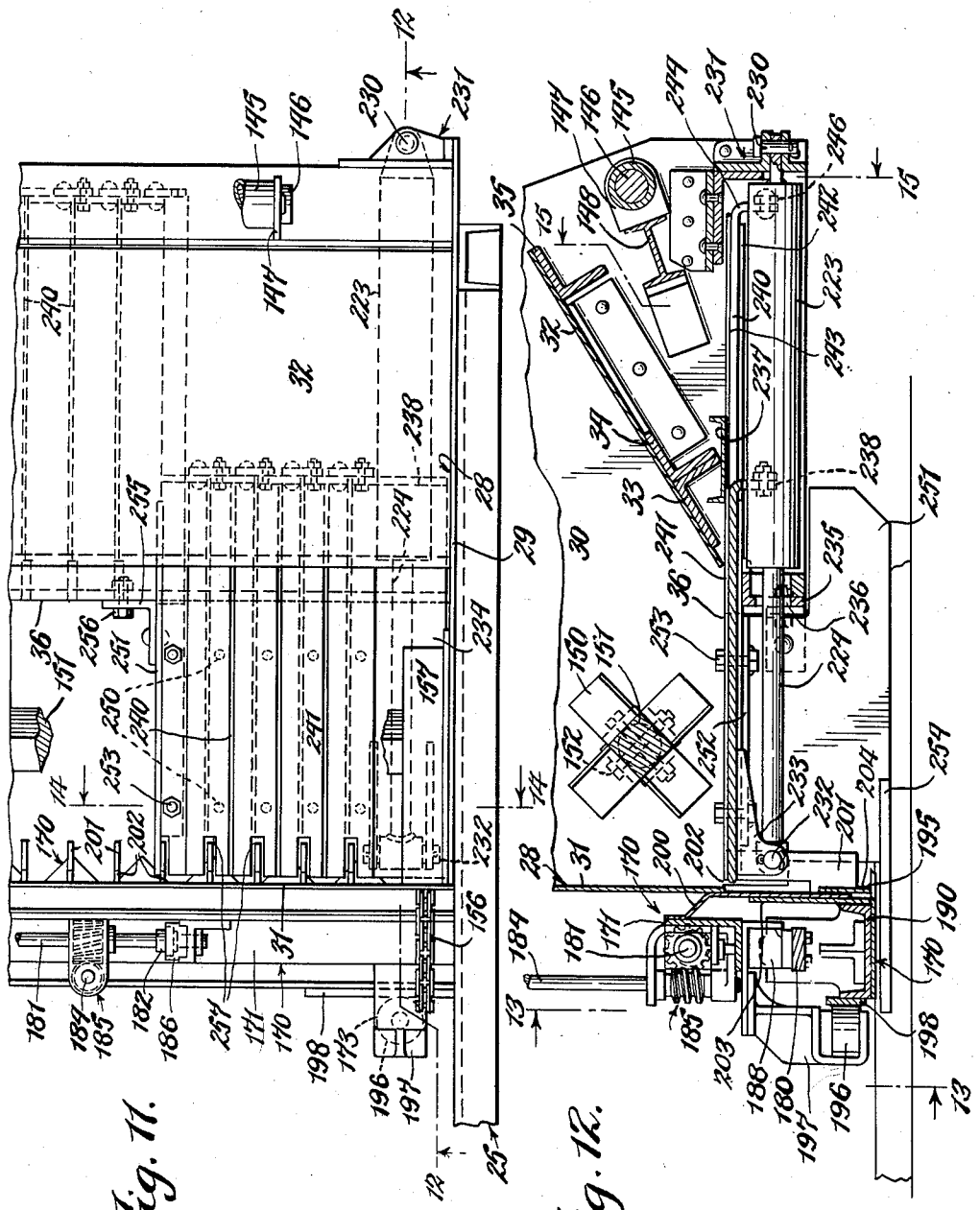


Fig. 11.

Fig. 12.

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ROAD PAVER

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Fig. 13.

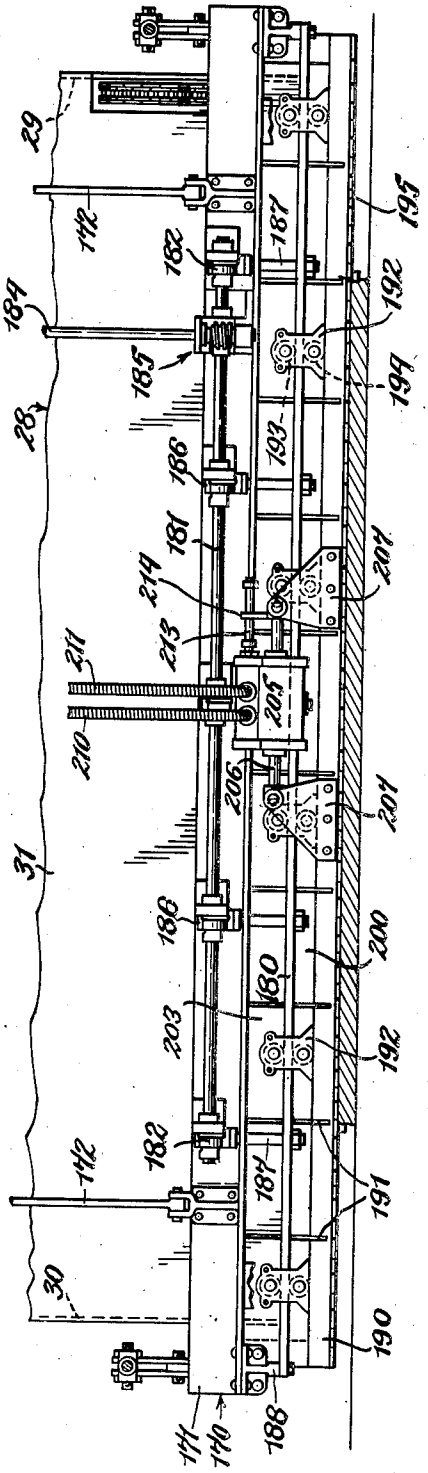


Fig. 15.

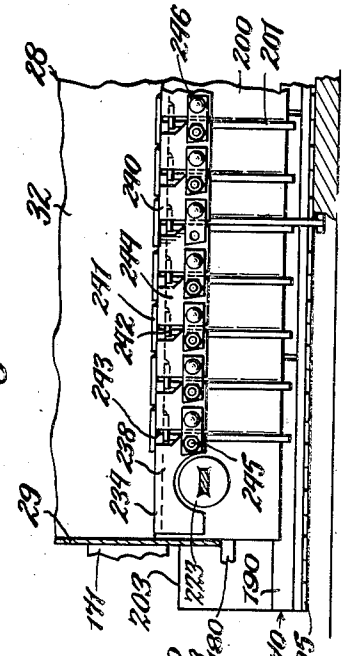
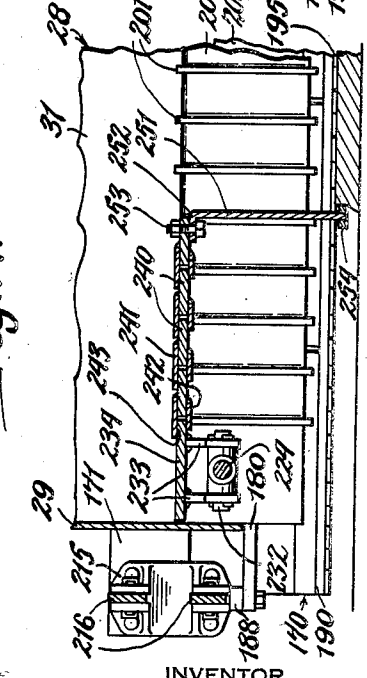


Fig. 14.



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ROAD PAVER

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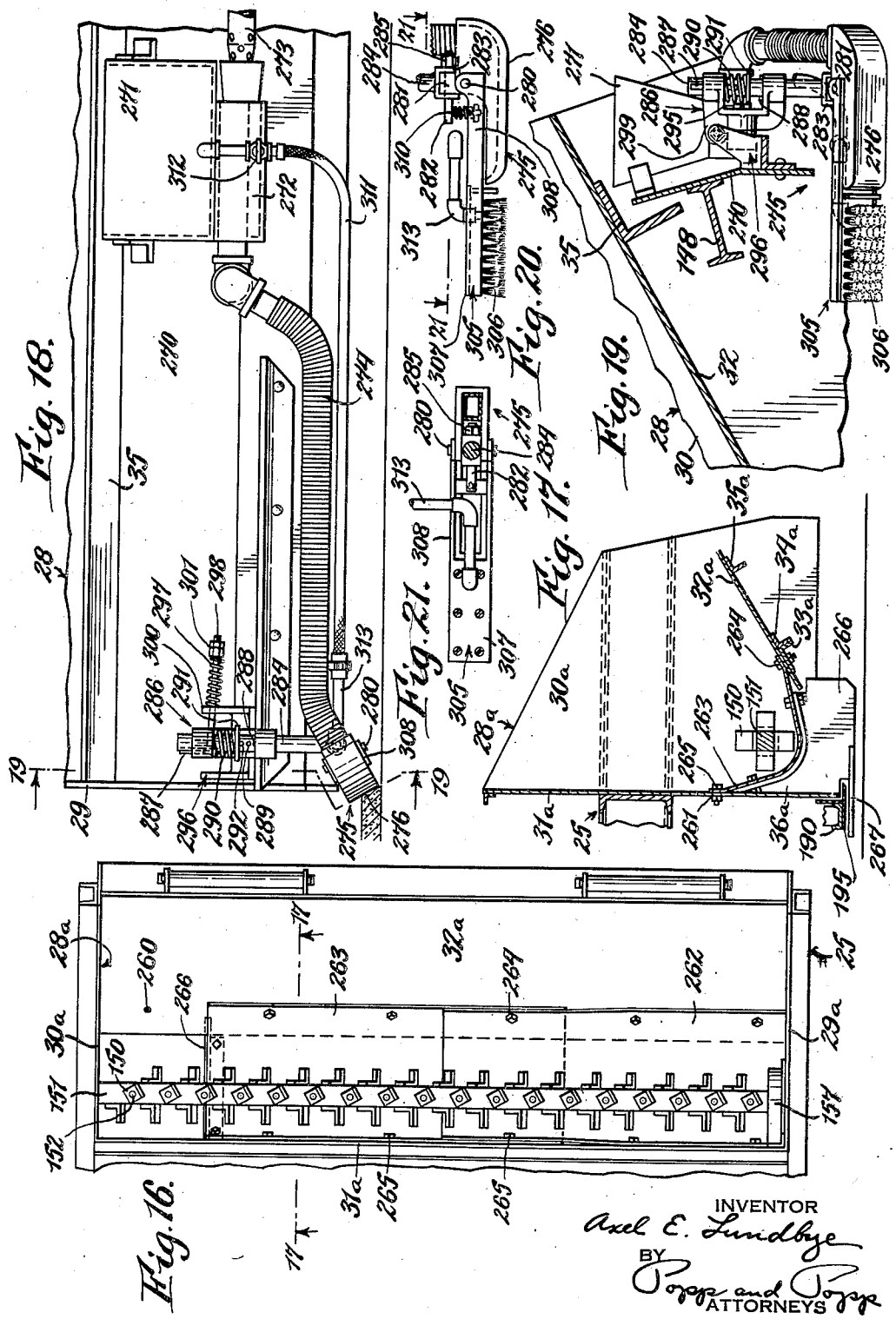


Fig. 18.

Fig. 19.

Fig. 20.

Fig. 21.

Fig. 16.

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Patented Dec. 17, 1940 2,225,481

UNITED STATES PATENT OFFICE

2,225,481

ROAD PAVER

Axel E. Lundbye, Nunda, N. Y.

Application November 19, 1937, Serial No. 175,480

25 Claims. (Cl. 94—46)

This invention relates to a road paver and more particularly to a machine for laying and grading stone and asphalt mixes upon roadways and resurfacing the same or in providing an original surface or base for the road. The machine can be used for laying and grading either cold mixes of stone, asphalt and solvent or hot mixes of asphalt and aggregate.

In laying and grading asphalt and stone mixes on a roadway considerable difficulty has been encountered by reason of the fact that the stone and asphalt mix is very heavy and difficult to handle and lay to an accurate surface. It is the principal object of this invention to provide a machine which lays and grades heavy mixes of asphalt and stone or the like; which will handle large quantities of such mixes and rapidly and accurately grade the same to provide the smooth and uniform surface desired; and which accomplishes this without requiring any handling of the asphalt, the mix being dumped directly into the hopper of the machine from the trucks used for transporting the mix to the job.

Another object of the invention is to provide such a machine which is supported in whole or in part on the surface laid by the machine to obtain a smooth and uniformly surfaced roadway and in which the weight of the machine is carried by a large area of supporting surface so that the machine has a minimum tendency to displace the freshly paved material. This is particularly important in laying such materials as asphalt and sand which are laid as a very soft body and which, before hardening, are easily indented. To this end the machine is supported by a pair of continuous steel belts or tracks which pass around large rollers at the rear end of the machine and under supporting rollers between these main rollers, each of these steel belts thereby providing a smooth continuous surface for supporting the machine on an extended area of the freshly paved material.

Another object of the invention is to provide means for preventing paving material from accidentally becoming lodged on the inside of the belt and thereby being crushed between the belt and the rollers as the machine is propelled.

Another object is to provide a shoe at each end of each belt which provides a solid backing for the belt in the space between each large roller and the adjacent supporting roller, these shoes thereby providing a solid backing across this gap which would otherwise be unsupported.

Another object is to provide a mounting for the endless belt and roller assembly which permits the entire assembly to tip and thereby adapt itself to any crown in the strip of pavement being laid.

Another object is to provide a simple and effective adjustment for the spacing of the main rollers, this adjustment adjusting the tension of the endless steel belt and the friction between the belt and the driving roller.

Another purpose is to provide a simple means for keeping the outer surface of each endless belt free from adhering lumps of asphalt or other material and also to provide a simple and effective means for oiling the outer surface of each belt so as to reduce the tendency of the belt to pick up any material.

Another aim of the present invention is to provide a self-propelled paver having a hydraulic drive, the motor driving a hydraulic pump which is employed to propel the paver.

Another object of the invention is to provide such a hydraulic drive which includes a separate hydraulic motor for each side of the machine, the adjustment of these motors thereby permitting of steering the machine.

Another aim of the invention is to provide such a paver which includes a hopper mounted at the front end together with a raker bar in the hopper and a reciprocating cutter bar at the bottom of the hopper which cuts off the column of material in the hopper to provide a paved surface having the desired thickness and crown, both the raker bar and the reciprocating cutter bar being driven by hydraulic motors.

Another aim of the present invention is to provide a hydraulic lift for the cutter bar assembly, this hydraulic lift permitting of readily adjusting the cutter bar to provide a paved strip of the desired thickness.

Another aim of the invention is to provide such a paver which is supported exclusively on the freshly laid surface and in which the cutter bar can be adjustably inclined with reference to the line of movement of the paver, this adjustment being provided so that the paver can be made to follow dips and rises in the roadway being surfaced, the cutter bar having its front end tipped downwardly when passing over a rise in the roadway and having its front end tipped upwardly when passing beyond the center of a dip in the roadway.

Another object of the invention is to provide a power operated cut-off in the bottom of the hopper for rendering all or any part of the hopper inoperative, thereby to lay a strip of any desired width or to close off the hopper discharge entirely when it is desired, for example, to cross an in-

tersecting road and not do any paving. In the preferred embodiment of this cut-off the cut-off is operated hydraulically and can be adjusted to lay a strip of any desired width within close dimensions. To this end the power cut-off consists of a plurality of narrow plates which can be coupled together in any desired number and are shifted by a hydraulic piston to a position under the hopper opening in which they operated to reduce the effective width of the hopper or close it off completely or are retracted to an inoperative position.

Another object is to provide a simple and effective edger plate for the last plate forming part of the power operated closure, the cutter bar coacting with this edger plate to provide a square shoulder at the corresponding side of the strip being laid.

Another object is to provide a combined heated shoe and brush for heating and brushing a bonding material against the shoulder of a strip against which the strip is being laid. In laying roadways of substantial width it is frequently necessary to lay the roadway in a plurality of parallel contiguous strips. In order to secure a firm bond between the successive trips the present invention proposes a heater which rides along the shoulder of the strip already laid and heats this shoulder and also a bonding material applied to the shoulder so that when the paving material is paved up to and against this shoulder a firm bond is obtained.

In the accompanying drawings:

Fig. 1 is a top plan view of a paver embodying the invention, the hydraulic piping between the different pumps and the different hydraulic motors being represented diagrammatically.

Fig. 2 is a side elevation thereof.

Fig. 3 is a horizontal fragmentary section, taken on line 3—3, Fig. 2.

Fig. 4 is a similar section, taken on line 4—4, Fig. 2.

Fig. 5 is a fragmentary vertical transverse section, taken on line 5—5, Fig. 2.

Fig. 6 is a fragmentary vertical longitudinal section, taken on line 6—6, Fig. 5.

Figs. 7, 8, 9 and 10 are vertical, fragmentary transverse sections, taken on the correspondingly numbered lines on Fig. 6.

Fig. 11 is an enlarged fragmentary top plan view of the hopper at the front end of the paver.

Fig. 12 is a fragmentary vertical longitudinal section, taken on line 12—12, Fig. 11.

Fig. 13 is a fragmentary vertical transverse section, taken on line 13—13, Fig. 12.

Fig. 14 is a vertical fragmentary transverse section, taken on line 14—14, Fig. 11.

Fig. 15 is a vertical fragmentary transverse section, taken on line 15—15, Fig. 12.

Fig. 16 is a view similar to Fig. 11 showing a modified form of means for blocking off portions of the hopper to vary its effective width.

Fig. 17 is a fragmentary vertical longitudinal section, taken on line 17—17, Fig. 16.

Fig. 18 is a fragmentary front elevation of the machine showing a heating shoe and brush mounted thereon, together with the heating means associated with the heating shoe, this shoe being used to condition the shoulder of a strip already laid to secure a bond between it and the strip being laid.

Fig. 19 is a vertical longitudinal section, taken on line 19—19, Fig. 18.

Fig. 20 is a top plan view of the heating shoe and brush.

Fig. 21 is a generally horizontal section, taken on line 21—21, Fig. 20.

The main frame 25 of the carriage is shown as being composed of a plurality of longitudinal channel beams suitably connected by cross channels to support the various working parts of the paver. On this frame is mounted an operator's platform 26 on the rear end of which is mounted a gas engine 27 which provides the motive power for propelling the paver and operating its continuously moving parts as well as certain of the controls as hereinafter described. At its front end the carriage 25 supports a hopper 28 including side walls 29 and 30, a vertical rear wall 31 and an inclined front wall 32, this front wall 32 being supported by suitable angles 33, 34 and 35 connecting the side walls 29 and 30. The materials are dumped into this hopper and pass out through the opening 36 in the bottom thereof, this material being leveled to a predetermined height and crown, as hereinafter described, as the paver travels along. The paver is shown as supported exclusively on the freshly laid surface formed as the material passes out of the hopper and in order to support the paver on a broad area and thereby minimize any tendency of the paver to sink into the freshly laid material, the paver is supported at its opposite sides by an endless steel tread or belt, the lower stretch of which rides on the freshly laid pavement and provides a broad bearing support for the entire machine. The supporting or tractor structures at the opposite sides of the machine are identical in construction and operation and hence a description of one will be deemed to apply to both.

The numeral 40 represents an endless steel belt or track, this belt passing around a driving roll 41 at the rear of the machine and a front roll 42 at the front of the machine. The endless steel belt or track 40 is preferably made of a band of saw steel, the ends being welded to form an endless track, this track forming, of course, a smooth continuous traction surface.

The rear driving roll 41, as best shown in Fig. 5, is fast to an axle 43, the opposite ends of which are journaled in the depending legs of a U-shaped bracket 44. This bracket is connected at its inner upper corner by a pivot pin 45 to a stationary bracket 46, this stationary bracket being suitably secured to one of the longitudinal channel beams constituting the main frame 25 of the carriage. A vertical rod 47 is pivotally connected to the outer upper corner of the bracket 44 and extends downwardly through the adjacent outermost longitudinal channel of the paver, a compression spring 48 being interposed between the bottom of this channel and a pair of nuts 49 at the bottom of the rod 47. The front roll 42 is mounted in a somewhat similar manner, this front roll being rotatably mounted on a stationary axle 55, this axle being carried at its opposite ends in a pair of blocks 56, 56, each of which is slidably mounted in one of the depending arms of a U-shaped bracket 57. The blocks 56, 56 are slidable lengthwise of the paver for the purpose of adjusting the tension of the steel belt or track 40 as hereinafter described. The inner upper corner of the U-shaped bracket 57 is connected by a pivot pin 58 with a bracket 59, this bracket being suitably secured to the main frame of the machine and the opposite corner of the bracket 57 being supported by a rod 60 pivotally connected thereto, this rod extending downwardly through the outermost channel of the frame and being supported by a compression spring 61 interposed between the

bottom of this channel and a pair of nuts 62 at the lower end of the rod 60.

It will be seen that this mounting for the rolls 41, 42 permits the tractor assembly at each side of the paver to move about an axis extending longitudinally of the paver and thereby tip slightly and adapt itself to any crown in the strip being laid.

In order to render the lower stretch of the steel belt 40 completely effective as a bearing surface throughout its length, this stretch is backed by a plurality of small rollers 65 under which the steel belt 40 passes, as best shown in Fig. 6, these rollers being provided in a row extending from the large front roll 42 to the rear driving roll 41. Each of these rollers 65, as best shown in Fig. 8, are rotatably mounted on a supporting pin 66, the opposite ends of which are suitably mounted in plates 67, 67 extending lengthwise of the machine and alongside the large front and rear rolls 42, 41, as best shown in Fig. 2. An angle bar 68 is secured to and extends along the upper edge of the plates 67, 67, the rear ends of these angle bars 68 being secured to the underside of the depending legs of the bracket 44 which carries the rear roll 41, as best shown in Fig. 5, and the front ends of these angle bars being secured to the underside of the depending legs of the bracket 57 supporting the front roll 42, as best shown in Fig. 10. It will therefore be seen that the mounting for the small rollers 65 is rigid with the mountings for the front and rear main rolls 42, 41 and that the small rollers 65 thereby provide an antifriction backing support for the lower stretch of the belt 40. Paving material is prevented from falling between the plates 67 and hence onto the rollers 66 and the inside of each belt 40 by a top plate 69 connecting each pair of angle bars 68 and extending from the front roll to the rear roll as best shown in Fig. 6.

It is, of course, highly undesirable for pieces of road paving material to fall over the edge of the belt to a position where they would be crushed between the belt 40 and the rolls 41, 42 and the rollers 65. To prevent this a felt seal is provided at each side of each tractor assembly between each side plate 67 and the adjacent edge of the steel belt 40, this felt seal extending into the front and rear rolls 41 and 42 so as to completely prevent stone or asphalt from running over the edge of the belt and, of course, that part of the belt traversed by the rollers 65. For this purpose an angle bar 70 is secured along the lower edge of each of the side plates 67, the lower flange of each of these angle bars 70 extending to a point adjacent the corresponding faces of the rollers 65. Each of these angle bars, as best shown in Fig. 7, has welded thereto a pair of depending metal strips 71 which form a longitudinal downwardly facing channel 72. In this channel is arranged a felt strip 73 which is backed by a small metal strip 74. The felt strip 73 is pressed against the upper face of the lower stretch of the steel belt 40 by a plurality of small compression springs 75 arranged alongside the upper or inner part of the channel and bearing downwardly against the metal strip 74. The front end of each of the felt strips 73, as best shown in Fig. 3, terminates adjacent the side of a shoe 80. At each side of this shoe 80 a felt strip 81 is mounted thereon, the felt strip 81 forming a continuation of the felt strips 73 and the front ends of the felt strips 81 entering grooves 82 provided in the periphery and near the edge of the front roll 42. Preferably an additional seal 83 is provided across the joint of each of the felt strips 73 and 81. Each of the shoes 80 is supported, and its felt strip 81 held yieldingly in engagement with the upper surface of the steel band 40 by springs 84 which bear downwardly against arms 85 projecting outwardly from opposite sides of each shoe 80. The upper ends of each of the springs 84 bear against the arm 81 of a bracket 87, the brackets 87 being secured to the stationary front axles 55, as best shown in Fig. 10.

A similar shoe 90 is arranged under the rear roll 41 and carries a pair of felt strips 91 which project into peripheral grooves 92 provided at the opposite sides of the rear roll 41. The felt strips 91 form a continuation of the long strips 73 and are held in sealing engagement with the steel band 40 by compression springs 93 which are interposed between ears 94 mounted on the side plates 67 and arms 95 projecting out from the opposite sides of each shoe 90.

It will be seen that the felt strips 73, 81 and 91 completely fill the space between each plate 67 and the adjacent edge of the steel band 40 and that these strips extend from the front roll 42 to the rear roll 41 and into grooves provided in these rolls so that no stone or paving material can roll over the edge of the steel band 40 and be crushed between the band and the rollers 65 or the main rolls 41, 42. It will further be noted that the shoulders of each roll 41 and 42 are beveled, as indicated at 96, the bevels 96 removing any road paving material which becomes lodged on the extreme edges of the lower stretch of the steel band 40.

In order to keep the traction surface of the steel band free from material a scraper 100 is mounted in any suitable manner at the extreme rear ends of the angle bars 68 and removes any material adhering to the steel band 40. Additionally each of the castings 87 is formed to provide a forwardly projecting arm 101, these arms 101 carrying scrapers 102 which also engage and scrape the outer surface of the steel band 40.

Each of the castings 87 is also preferably provided with the rearwardly extending arm 103, these arms carrying spring loaded scrapers 104 which engage and scrape the surface of the front roll 42, the purpose of the scrapers 104 being to remove any material which accidentally gets on the inside of the belt 40 and is transferred to the front roll 42. Similarly each of the rear rolls is preferably scraped by spring loaded scrapers 110 which are suitably mounted on the top plate 69 at each side of the paver in any suitable manner. The scrapings from the scrapers 104 and 110 fall upon the top plates 69, as best shown in Fig. 6, from which they can be conveniently removed.

In order to reduce the tendency of the steel band 40 to pick up road paving material it is preferably oiled. For this purpose an oil tank 105 is provided having discharge pipes 106 which distribute oil over the upper stretch of each steel belt 40 under control of a valve 107. This oil is spread over the surface of each steel band 40 by a spring loaded felt pad 108 carried by an arm 109 which is mounted on and projects rearwardly from the corresponding U-shaped bracket 57, as best shown in Fig. 6.

Means are also provided for adjusting the tension of the steel bands 40. For this purpose each of the sliding blocks 56 which carry the front axles of the machine is mounted for sliding movement fore and aft of the machine and each of these blocks is movable by an adjusting device, indicated generally at 115, as best shown in

Fig. 4. Each of these adjusting devices includes a pair of links 116 and 117 pivotally connected to one another and to the main frame 25 as indicated at 118, and a second pair of links 119, 120 pivotally connected to one another and to a rod 121 which is guided for movement lengthwise of the machine by a bearing bracket 122. The ends of the links 116 and 119 are connected by a link 123 and a screw 124 extends through the link 123 and threadingly engages a link 125 which connects the links 117 and 120. An adjusting wheel 126 is secured to the end of each of the screws 124 and bears against the link 123 so that upon turning the hand wheel 126 in the proper direction the links 123 and 124 are brought together and the rod 121 moved toward the front end of the paver. The front end of each of the rods 121 is connected by a compression spring 127 with the adjacent sliding block 56 and it will therefore be seen that by adjusting the hand wheels 126 the tension of the steel belt 40 can be regulated.

The paver is hydraulically propelled by a pair of hydraulic motors 130, each of which drives a chain 131 passing around a large sprocket 132 keyed to the end of the corresponding rear axle 43. Fluid under pressure is supplied to each of these motors by a pump 134 which is driven by the gas engine 27, as best illustrated in Fig. 1. The outlet line 135 of each of the pumps 134 connects with a manually adjustable valve 136 which can be set to deliver any desired amount of the fluid to the motor 130 either through a line 137 or a line 138. If the fluid is supplied through the line 137, the line 138 serves as a return line, the return fluid passing through the valve 136 and through a line 139 to a common discharge 140. This common discharge leads to a fluid supply tank 141 from which the fluid is withdrawn through a manifold 142 which supplies all of the hydraulic pumps driven by the motor 27. It will be seen that each valve 136 can be adjusted to deliver fluid to the corresponding motor 130 in either direction thereby rendering the paver capable of being propelled either forwardly or backwardly. It will also be seen that by the relative adjustment of the two valves 136 the paver can be steered since driving one of the steel belts 40 faster than the other will necessarily turn the paver in a corresponding direction.

The trucks supplying the paving material to the machine are backed up against the hopper 28 with the rear wheels of the truck against rollers 145 each of which is rotatably mounted on a shaft 146 carried by brackets 147, these brackets being mounted on an I-beam 148 which extends across the machine immediately below the front hopper wall 32. The I-beam 148 can be secured at its ends to the side walls 29 and 30 of the hopper in any suitable manner. As the paver is propelled along it slowly pushes the truck ahead thereby permitting of gradually dumping the road paving material into the hopper as the paving operation proceeds. The material in the hopper is broken up and distributed by the blades 150 of a raker bar 151, the ends of this raker bar being journaled in the side walls 29 and 30 of the hopper in any suitable manner. Preferably the raker bar is square in cross section and the blades 150 are of L-shaped form and connected to the square sides of the raker bar by bolts 152 so that the pitch of the blades 150 can be adjusted to obtain any desired spreading or distributing effect, depending upon the type of material being laid. The raker bar is driven by a sprocket 155 and a chain 156, these being arranged in a suitable housing 157 and the chain being driven by a sprocket 158 mounted on the jack shaft 159. This jack shaft 159 is driven by a hydraulic motor 160 through a chain and sprocket drive 161. Fluid for driving the hydraulic motor 160 is supplied by a pump 162 driven by the motor 27. The outlet line 163 from the pump 162 connects with a valve 164 having a handle 165 which can be moved to deliver fluid through a line 166 to the hydraulic motor 160 and thereby operate the rotary raker bar 151. The return line 167 from the motor 160 leads to the common return 140.

As the paver moves along the column of material contained within the hopper 28 is cut off at a predetermined height by a reciprocating cutter bar assembly indicated generally at 170. This cutter bar assembly includes a toothed cutter bar which is reciprocated transversely of the paver to smoothly cut off the paving material to the desired grade; the cutter bar assembly is vertically adjustable to provide a strip of pavement of the desired thickness; the assembly is also capable of being adjustably tilted to follow the long undulations of the road and lay a strip of uniform depth and the cutter bar is also capable of being crowned so as to lay a strip having any desirable crown.

To this end the cutter bar assembly includes an angle bar 171 which extends the full width of the machine and is located immediately in rear of the rear hopper wall 31. Each end of the main supporting bar 171 is supported by a piston rod 172 which is pivotally connected to the corresponding end of the bar 171 in any suitable manner. Each piston rod 172 forms part of a hydraulic lifting jack 173. These hydraulic lifting jacks are independently supplied with fluid under pressure delivered by a pump 174 which is driven by the gas engine 27. To this end, the outlet 175 of this pump 174 connects with a valve 176 having a handle 177 which can be set to deliver any desired amount of fluid through either an outlet line 178 connecting with one end of one of the jacks 173 or a line 179 connecting with the other end of this jack 173. Similarly, the pump outlet line 175 also connects with a valve 176*a* having a handle 177*a* which can be set to deliver any desired amount of fluid through either an outlet line 178*a* connecting with the other jack 173 or a line 179*a* connecting with the other end of this last jack. The valve 176 is so constructed that in one position it connects the pressure line 175 with, say, the line 179 and at the same time connects the other line 178 with a line 189 leading to the common return line 140. Similarly, the valve 176*a* is so constructed that in one position it connects the pressure line 175 with, say, the line 179*a* and at the same time connects the other line 178*a* with the line 189 leading to the common return line 140. It will therefore be seen that by adjusting the handles 177 and 177*a* fluid can be admitted to either or both the jacks 173 to positively either raise or lower either or both ends of the cutter bar assembly of which the cross bar 171 forms the main supporting member.

The bar 171 carries a track 180 which is so mounted as to be adjustably crownable. For this purpose, as best shown in Fig. 13, a cam or eccentric shaft 181 is mounted on the supporting bar 171 and on this shaft are mounted a plurality of eccentrics 182 in spaced relation therealong. This shaft is adjustably rotated by turning a hand wheel 183 fixedly mounted on the upper end

of a rotatable post 184, the lower end of this post being operatively connected with the cam shaft 181 by a worm and worm gear drive 185. Each cam 182 is embraced by a yoke 186 fixed to the upper end of a post 187. These posts extend through openings provided in the horizontal flange of the angle bar 171 and at its lower end each is fixed to the curvable track 180. The opposite ends of the track 180 are suitably supported by brackets 188 at the opposite ends of the angle bar 171. The cams 182 are so set that by manually adjusting the cam shaft 181 the posts 187 are moved to crown the track 180 to a greater or less degree as may be desired.

The cutter bar, as best shown in Figs. 12 and 13, includes a channel bar 190 which is arranged with its flanges projecting upwardly directly under the track 180. At intervals the flanges of the channel 190 are notched as indicated at 191 to secure greater flexibility of the channel in following the curvature of the track 180. At spaced intervals brackets 192 are mounted on and project upwardly from the channel 190, these brackets carrying a pair of rollers 193, 194 which ride on the upper and lower surfaces of the track 180. The cutting of the material is effected by a plurality of plates 195 which are replaceably secured to the underside of the channel 190 and are formed to provide pointed ends which project forwardly under the rear wall 31 of the hopper 28 so as to cut off the column of material in the hopper to a predetermined height as the hopper moves along. Rearward displacement of the channel 190 is prevented by a roller 196 at each side of the machine, each of these rollers being carried by a bracket 197 suitably secured to the main supporting angle beam 171 and bearing against a wear plate 198 on the rear flange of the channel 190. It will be seen that the rollers 196 hold the channel 190 against rearward displacement and at the same time permit this channel to be reciprocated back and forth. In order to permit a large amount of vertical adjustment of the cutter assembly by the jacks 173 the rear wall 31 of the hopper terminates a substantial distance short of the ground and a plate 200 is secured at its upper edge to the upper edge of the main supporting angle bar 171 of the cutter bar assembly. This plate 200 extends forwardly into engagement with the rear face of the rear wall 31 of the hopper and turns downwardly to a point below the upper edge of the channel bar 190. It will therefore be seen that this plate 200 tends to prevent the material from flowing over the top of the channel bar and at the same time moves up and down with the cutter bar assembly. The plate 200 is shown as having welded to its lower front face a plurality of spaced forwardly projecting plates 201, the purpose of these plates being to in part support the load of the material within the hopper and also to insure that no large sized lumps of material or rocks strike the teeth of the cutter bar. Since the plate 200 is mounted on a non-reciprocating part of the cutter bar assembly the plates 201 remain stationary. In order to permit of a high lift of the entire cutter bar assembly each plate 201 is formed to provide a slot 202 between its upper part and the plate 200, the rear wall 31 of the hopper entering these slots 202 as the cutter bar assembly is raised. The plates 201 also function in conjunction with the power cutoff, as hereinafter described, to relieve the power cutoff of a part of the load.

Additional means are also preferably provided to prevent paving material from flowing over onto the cutter bar assembly. To this end a plurality of vertical, upstanding plates 203 are welded to the front face of the channel bar 190, as best shown in Fig. 12, and extend upwardly along the back of the plate 200 in closely spaced relation thereto. The plates 203 are spaced the entire width of the hopper and the spaces between these plates are coincident with the notches 191 provided in the flanges of the channel bar 190, as best shown in Fig. 13, so as not to interfere with the flexing of the channel bar 190 in laying a crowned roadway. As an additional precaution a plate 204 is welded to the upper faces of the forwardly projecting teeth 195 in advance of each plate 203 and in advance of the cross plate 200, as best shown in Fig. 12. It will therefore be seen that to escape passing under the cutter bar teeth 195, the paving material in the hopper would be required to flow over the plates 204, under the plate 200 and over the plates 203. In actual practice this baffling arrangement provides a seal which effectively prevents the escape of the paving material over the cutter bar assembly.

The channel bar 190 is reciprocated by a hydraulic motor 205 which can be of any suitable construction and preferably includes a piston rod 206 which extends outwardly from the opposite end heads of the motor and is connected at each end with a bracket 207, these brackets being secured to the sides of the channel bar 190, as best shown in Fig. 13. The fluid for operating the motor 205 is supplied from the pump 174 through line 175 and is delivered, under control of a valve handle 208, to a line 209 connected by a flexible tube 210 to the motor 205. The fluid from the motor is returned through a flexible conduit 211 to a line 212 leading to the common return line 140. The reciprocation of the piston rod 206 can be effected by any suitable manner as by the provision of a valve rod 213 which admits the fluid alternately to opposite sides of the piston and is shifted by an arm 214 carried by one of the brackets 206.

Since the paver is supported exclusively on a strip of pavement already laid it will be appreciated that it is necessary for the operator to adjust the position of the cutter bar when going up and down grades. Otherwise, when once started on an upgrade, the paver would tend to continue going on an upgrade when, for example, reaching the top of a rise in the road. To permit of readily adjusting the cutter bar to follow the course of the subgrade or road being paved and lay a strip of uniform thickness, means are provided at each side of the paver for tilting the cutter bar assembly which means are preferably constructed as follows:

Mounted at each end of the main angle bar 171 of the cutter bar assembly is a bracket 215 to the upper and lower ends of which are pivotally connected a pair of links 216 which extend forwardly in parallel relation. These links are of the same length and at their forward ends are pivotally connected to a lever 217. This lever is pivotally connected by means of a bracket 218 to the corresponding side wall of the hopper, the pivotal connection between each lever 217 and the bracket 218 being halfway between the pivotal connections between the lever 217 and the links 216. It will be seen that the parallel links 216 permit of the vertical adjustment of the cutter bar assembly by means of the hydraulic jacks

173 and that by tilting the lever 217 forwardly or backwardly the cutter bar assembly is tilted correspondingly. The means for so tilting each lever 217 comprise a rod 219 which has threaded engagement with a sleeve 220 which is pivotally connected to the extreme upper end of the lever 217. The rod 219 is suitably journalled at its rear end on the main frame and is operatively connected to the vertical post 221 by means of a pair of bevel gears. The post 221 is turned by means of a hand wheel 222. It will be understood that instead of having separate hand wheels 222 at the opposite sides of the paver, only one such hand wheel could be provided to simultaneously adjust the levers 217 at opposite sides of the machine.

In the form of the invention shown in Figs. 1–15, a power cutoff is provided by means of which the effective width of the hopper can be reduced to any desired degree. The power cutoff is actuated by a piston within each of a plurality of cylinders 223, each of these pistons actuating a piston rod 224. These power cutoff pistons are double acting, the front ends of the cylinders being supplied with and relieved of fluid under pressure through a common pipe 225 and the rear ends of the cylinders being supplied with and relieved of pressure through a common pipe 226. The pipes 225 and 226 connect with the valve 164 and the operation of the pistons is controlled by a valve handle 227 which can be operated to admit fluid under pressure from the line 162 to either the pipe 225 or the pipe 226, that pipe which is not so connected with the supply line 162 being connected with a return line 228 which discharges into the common return line 140. Any one of the cylinders 223 can be cut into or out of operation by means of a hand valve 229.

The front end of each of the pistons 223 is pivotally connected, as indicated at 230 to a build up cross bar 231, this cross bar connecting the side walls 29 and 30 of the hopper at their extreme lower front corners as best shown in Fig. 12. Each cylinder 223 extends forwardly to a point adjacent the rear edge of the inclined front wall 32 of the hopper and its piston rod 224 is pivotally connected, as indicated at 232, to a pair of ears 233 fast to the underside of the front end of a sliding plate 234. Each of these plates 234 is retractible from a position in which its rear edge is arranged adjacent the lower end of the rear hopper wall 31 to a position in which its rear edge is arranged adjacent the lower edge of the front hopper wall 32 whereby the plates 234 serve as a part of the means for blocking off the hopper opening 36. The plates 234 slide upon a cross bar 235 which is provided with openings 236 for the piston rods 221 and the rear end of each of the plates 234 is held down by engagement with a channel 237 which extends from one side of the hopper to the other under the front hopper wall 32.

Each of the plates 234 is bent downwardly at its rear end as indicated at 238 so as to form a flange to which a series of cutoff plates can be connected in tandem so as to move with the plates 234. Any number of these plates can be so connected thereby to adjust the effective width of the hopper. As best shown in Figs. 11, 14 and 15 each of these plates 240 is in the form of a long narrow strip arranged parallel with the plates 234 and to each is welded an upper plate 241 and a lower plate 242, these plates extending beyond one edge of the plates 240 so as to form a groove 243. The rear end of each of the plates 240 is bent downwardly to form a flange 244 and the plates are arranged in series each plate 234 having one edge fitting into the groove 243 of the next plate 240 and this plate 240 having its edge fitting into the groove of the next succeeding plate 240 and so on.

To couple the plates 234 and 240 the rear flange of the plate 234 is provided with a hole receiving a bolt 245, this bolt also extending through a tie bar 246 riveted to the rear flange 244 of the adjacent plate 240. Each of the plates 240 is provided with a tie bar 246 which is adapted to be attached to the next preceding plate 240 by means of a bolt. It will be seen that by this arrangement any number of plates 240 can be tied to its plate 234 and that this can be readily accomplished while the cutoff is in a partly retracted position, at which time the tie bars 246 are readily accessible from the front end of the paver.

Each of the plates 240 has a pair of holes 250. These holes are so positioned as to be covered by the plates 241 and 242 in the assembled condition of the plates 240 and therefore only the holes 250 of the last plate 240 of each series is exposed. These holes are employed for securing an edger plate 251 at the end of the hopper opening. For this purpose, as best shown in Fig. 14, the edger plate 251 is provided at its upper edge with a flange 252 which is bolted through the holes 250 by bolts 253. The lower edge of this edger plate, as best shown in Figs. 12 and 14, carries a pair of rearwardly projecting bars 254 which project under the cutter bar 190. These bars 254 serve to mold a square shoulder at the corresponding edge of the strip being laid, the cutter bar reciprocating in close proximity to the upper edges of these bars. If desired the edger plate 251 may be additionally strengthened by the provision of an angle 255 which can be secured by means of a bolt 256 in one of the series of holes provided in the cross bar 235. The front end of each of the plates 240 is also slotted as indicated at 257 so as to clear the plates 201 and completely close off the hopper.

In the modified form of the invention shown in Figs. 16 and 17 a different form of means for blocking off variable amounts of the hopper is shown. The hopper is of substantially the same construction as that disclosed in Figs. 1–15 and the same reference numerals have therefore been employed and distinguished by the suffix "*a*". As shown in Figs. 16 and 17 the front wall 32*a* of the hopper is provided with a series of holes 260 near its lower edge and the rear wall 31*a* of the hopper is provided with a series of corresponding holes 261. The hopper is blocked off by a pair of telescopic plates 262 and 263, the plate 263 sliding under the plate 262, as best shown in Fig. 16, and forming an extension thereof. Each of the plates 262 and 263 is trough shaped and its front edge is secured through the holes 260 to the front wall 32*a* of the hopper by means of bolts 264. The rear edge of the plates 262 and 263 is secured through the holes 261 to the rear wall 31*a* of the hopper by bolts 265. It will be seen that by this construction the plates 262 and 263 can be made of comparatively light material so that the bolts 264 and 265 draw the edges of the trough shaped blocking off plates tightly into engagement with the respective hopper walls. Further it will be seen that by removing the bolts the plate 263 can be moved along the hopper to provide any desired width

of hopper opening. The holes 260 and 261 can, of course, be provided in any spacing to vary the degree of adjustability. The end plate 263 is also preferably provided with an edger plate 266 generally similar to the edger plate 251 in the preferred construction, this plate and its extensions 267 serving to mold a square corner at the edge of the strip.

In laying a series of parallel strips of pavement it is, of course, highly desirable to secure a firm bond between the edges of the successive strips. It has been found that this bond can be improved by heating the edge of the strip already laid just before the succeeding strip is laid against it and at the same time applying to this edge a coating of hot asphalt. To this end the paver can be equipped with a heating shoe and brush applying device shown in Figs. 18–20. As there shown the I-beam 148 supports a generally vertical plate 270 which extends from one hopper wall 29 to the opposite hopper wall 30.

Near the center of this plate 270 is mounted a small tank 271 which is adapted to be filled with asphalt and a chamber 272 is provided on the underside of this tank 271 through which the flame of a blow torch 273 is projected. The exhaust line from the chamber 272 includes a flexible tube 274, the other end of which connects and discharges into a shoe 275. This shoe is provided with a flat bottom or ironing face 276 which merges into rounding ends and side walls, the side opposite the ironing face 276 being open. The gases from the flexible conduit 274 are discharged into the shoe at the front end thereof and are directed by the rounding front wall against the ironing face 276, these gases escaping through the opening back of the shoe. The shoe is connected by a generally vertical pivot pin 280 with a fitting 281 which carries a horizontal stud 282. This fitting is supported by ears 283 at the lower end of a post 284. The stud 282 projects through the ears 283 and a nut 285 is provided which clamps the fitting 281 in fixed relation to the post 284 so that the ironing face 276 of the shoe 275 is held at a fixed angle which can, however, be changed by loosening the nut 285. The post 284 is carried by the ends of two horizontally extending arms of a yoke 286, the post 284 being vertically movable relative to the yoke 286 but being held against turning by a key 287. The downward limit of movement of the post 284 with reference to the yoke 286 is limited by a pin 288 which can be inserted in one of a plurality of holes 289 thereby to adjust the elevation of the shoe 275. The post 284 and shoe 275 are yieldingly held in the extreme downward position permitted by the pin 288 by a compression spring 290 interposed between the upper arm of the yoke 286 and a washer 291, this washer being in turn supported by a pin 292 in one of the holes 289.

The yoke 286 is carried by a stud 295 fixed to and projecting outwardly from a bracket 296. The stud 295 is horizontally disposed and the bracket 286 is free to rotate thereon so that the shoe 275 is free to move toward and away from the center of the machine and thereby adapt itself to irregularities in the shoulder of the strip which it heats and irons. The shoe 275 is yieldingly held against this shoulder by a compression spring 297 which surrounds a rod 298. This rod is secured at one end to an ear 299 which projects rearwardly from the bracket 298 and extends through an opening provided in an ear 300 projecting upwardly from the bracket 296. The compression spring 297 is interposed between the ear 300 and a nut 301 at the end of the rod 298, this nut adjusting the tension of the spring 296 and thereby the pressure at which the shoe 275 is held against the shoulder of the strip already laid.

The shoe 275 is followed by a brush 305 which applies hot asphalt from the tank 271 to the heated and ironed shoulder of the strip already laid. This brush includes bristles 306 mounted in a hollow brush back 307, this back 307 having arms 308 each of which is pivotally connected to the shoe 275 as indicated at 280 so that the brush 305 is movable toward and from the shoulder of the strip already laid independently of the shoe 275. A compression spring 310 is interposed between the stud 282 and the brush 305 so as to yieldingly hold the brush in engagement with the shoulder, as best illustrated in Fig. 20. The brush is supplied with asphalt from the tank 275 by a flexible line 311 under control of a valve 312. This flexible line 311 discharges into a pipe 313 which extends through the brush 305 and distributes the hot asphalt among the bristles 306 for application to the shoulder of the strip already laid.

Operation

In laying a road with the paver the operator starts the motor 27, this motor driving the pumps 162, 174 and 134 for propelling the machine and operating the different hydraulic mechanisms. If the strip to be laid is less than the total width of the hopper, the operator then couples as many of the plates 240 to the plate or plates 234 as may be required to reduce the effective width of the hopper. He does this by securing the tie plates 246 of as many plates 240 as may be needed, in tandem, to the plate or plates 234. This compels the corresponding plates 240 to slide in unison with the plate 234. If only a small part of the paver is to be blocked off only one of the plates 234 is employed and a suitable number of the plates 240 secured in tandem to it. Under these circumstances the valves 226 controlling the operation of the other three cylinders 223 are closed so as to render all of the other plates 234 inoperative. If, however, a greater amount of the hopper is to be blocked off than that controlled by one plate 234, one or more of the other cylinders 223 are rendered operative by opening the corresponding valve or valves 229. Thereafter the operator turns the valve handle 227 to admit fluid from the pump 126 to the line 225. This conducts fluid under pressure to the operative cylinders 223 and moves the corresponding piston rod or rods 224 rearwardly. This thereby shifts the corresponding plate or plates 234 rearwardly carrying along the corresponding attached blocking off plates 240. At the extreme stroke of the pistons these plates are all disposed across the bottom opening of the hopper and supported by the cross bars 235 and 237. The operator then attaches the blocking off plate 251 to the endmost of the plates 234 by means of the bolts 253 which pass through the upper flange of the blocking off plate 251 and through the holes 250 of the last plate 240. This edger plate 251 serves to mold a square corner at the corresponding side of the comparatively narrow strip being laid, its extensions 254 extending under the cutter bar.

The operator then turns the post 184 to obtain the desired crown in the strip of pavement being laid. Turning this post, as shown in Fig. 13, turns

the cam shaft 181 thereby rotating the cams 182 which are so disposed as to crown the track 189 to a greater or less degree as the cam shaft 181 is rotated, these cams being operatively connected with the track by means of the yokes 186 at the upper ends of the posts 187. The crowning of the track effects a similar crowning of the channel 190 which reciprocates along this track and hence effects a corresponding crown in the strip of pavement being laid since the teeth 195 which cut off the column of material falling through the hopper to a predetermined height are mounted directly on the underside of this channel 190. The operator then turns the valve handle 177 and 177a to elevate or depress either or both ends of the cutter bar assembly to provide the desired thickness in either side of the strip being laid. The turning of this handle 177 admits fluid under pressure from the pump 174 to either the line 178 or the line 179, this being under control of the operator through the handle 177. This admits fluid to the upper or lower end of the hydraulic jack 173 at the right hand side of the paver and therefore either raises or lowers the links 172 at the same side of the machine accordingly. Similarly the manipulation of the valve handle 177a admits fluid to either the line 178a or 179a and operates the jack 173 at the left hand side of the paver. The links 172 support the opposite ends of the main bar 171 of the cutter bar assembly and it will therefore be seen that this manipulation of the valve handles 177 and 177a adjusts the elevation of the opposite ends of the cutter bar 190 as may be desired.

The operator then throws the valve handle 165 to start the rotary raker bar 151. Opening the valve controlled by the handle 165 admits fluid from the pump 162 through the line 163 and thence through the line 166 to the hydraulic motor 60, the spent fluid being returned through the line 167 to the common return 140. The motor 160, as best shown in Fig. 2, is connected by a pair of chain drives 161 and 156 with the rotary raker bar 151 and hence rotates this bar. The operator then throws the valve handle 208 to start the reciprocation of the cutter bar. Throwing this handle admits fluid from the pump 174 through the line 175 to the line 209 connected by means of the flexible conduit 210 with the motor 205 which reciprocates the raker bar 190, the spent fluid being returned through the flexible conduit 211 and line 212 to the common return 140. As the piston rod 206 of the cutter bar motor moves the angle bar 190 to one extreme of its movement the finger 214 shifts the valve 213 so as to cause the motor 205 to move the piston rod 206 back to its other extreme position, the valve 213 thereby serving to secure uniform reciprocation of the cutter bar 190 which carries the cutting teeth 195.

A truck load of paving material is then brought up to the paver and dumped into the hopper. This material is broken up and distributed by the rotary raker bar and forms a column supported by the roadway. The operator then opens the valves 136 to propel the paver forwardly. Opening the valves 136 admits fluid from the tractor pumps 134 through the lines 135 and 137 to both of the hydraulic motors 130, the spent fluid being returned through the lines 138, valves 136 and lines 139 to the common return 140. Adjusting the valves 136 to deliver different amounts of fluid permits of steering the mechanism and reversing these valves effects a reverse movement of the paver. The hydraulic motors 130, through the chains 131, drive the rear rolls 41 at the opposite sides of the machine. The steel belts 40 pass tightly around these rolls and the corresponding front rolls 42 and hence these steel belts are advanced and the paver propelled forwardly. As the paver moves forwardly the teeth 195 of the cutter bar 190 cut off the base of the column of paving material contained within the hopper and the steel belts 40 ride up on this material. After the required thickness of material is being deposited on the roadway the height of the cutter bar assembly can be adjusted through the jacks 173, to maintain this desired thickness, the steel belts 40 riding on the finished material and supporting the entire paving machine. When a rise in the roadway is encountered the operator turns the hand wheels 222 so as to rotate the screws 219 and tilt the lever 217 rearwardly. This tilts the entire cutter bar assembly 170 so that the teeth 195 toe up. This adjustment causes the cutting line to follow up the grade and hence continue the laying of a strip of uniform thickness instead of cutting into the sub-grade as would otherwise be the case. Assuming a long rise is then to be followed, the operator adjusts the hand wheels 222 so as to bring the cutting teeth 195 of the cutter bar assembly back into parallelism with the roadway. Assuming that then the crest of the rise is reached, the operator adjusts the hand wheels 222 so as to cause the teeth 195 of the cutter bar assembly to toe downwardly. This adjustment causes the paver to follow over the crest after which the teeth 195 can be brought back into parallelism. It will be seen that the simple adjustment of the hand wheels 222 permits of applying a layer of paving material of uniform thickness over dips and rises in the road being laid without disturbing the general adjustment of the height of the cutter bar assembly.

As the paver moves along it is supported not merely by the front and rear rolls 41, 42 but also by the intermediate stretches of the steel belts 40, each of these intermediate stretches being backed by the rollers 65 which in turn support a structure connected and supporting the main axles of the machine. Further, material is prevented from falling over on top of the lower stretch of each belt 40 by the felt seal which extends the full length of each side of each roller stretch of the belts 40 and enters the grooves 82 and 92 provided in the front and rear rolls. This prevents pieces of aggregate from falling onto the inside of the belt and becoming crushed by the rollers 65. Further, it will be noted that the edges of the main rolls 41 and 42 are beveled so that any material falling over on the extreme edge of either belt is forced out by the beveled edges of the rollers.

In order to prevent the belts 40 from picking up material, oil is sprayed thereon from the pipe 106, as best illustrated in Fig. 6, this oil being distributed by the felt pad 108. Further, the exterior of this belt is scraped by the scrapers 100 and 102 which remove any material which does adhere. By making the treads in the form of endless steel belts they are readily kept clean and are supported on a broad area of the freshly laid pavement so that the paver can be used in laying very soft material into which a paver without a broad supporting area would sink and leave track marks in the finished surface.

From the foregoing it is apparent that the present invention provides a paver which is very simple in construction, considering the function which it performs, which is easily adjustable in

its operation from the operator's platform, particularly by the provision of the various hydraulic adjustments, which is supported exclusively on the finished surface thereby assuring that the strip of pavement laid is smoothly and uniformly surfaced and not responsive to irregularities in the sub-grade and which at the same time is readily manoeuvered so as to lay a strip of uniform thickness.

I claim as my invention:

1. In a road paver of the character described, a carriage, a hopper at the front end of said carriage and having an opening in its bottom extending transversely of the line of movement of said carriage, means mounted on said carriage for grading the paving material discharged from said hopper opening and means in rear of said hopper opening and grading means for supporting the entire weight of said carriage exclusively on the freshly laid strip of paving material.

2. In a road paver of the character described, a carriage, a hopper at the front end of said carriage and having an opening in its bottom extending transversely of the line of movement of said carriage, means mounted on said carriage for grading the paving material discharged from said hopper opening, means for adjustably raising and lowering said grading means, means for reciprocating said grading means transversely of the line of movement of said carriage and means in rear of said hopper opening and grading means for supporting the entire weight of said carriage exclusively on the freshly laid strip of paving material.

3. In a road paver of the character described, a carriage, a hopper at the front end of said carriage and having an opening in its bottom extending transversely of the line of movement of said carriage, means mounted on said carriage for grading the paving material discharged from said hopper opening and means in rear of said hopper opening and grading means for supporting the entire weight of said carriage exclusively on the freshly laid strip of paving material comprising a front roll and a rear roll, an endless tread passing around said rolls and means for driving one of said rolls.

4. In a road paver of the character described, a carriage, a hopper at the front end of said carriage and having an opening in its bottom extending transversely of the line of movement of said carriage, means mounted on said carriage for grading the paving material discharged from said hopper opening and grading means in rear of said hopper opening and grading means for supporting said carriage on the freshly laid strip of paving material comprising a tractor assembly at each side of the carriage consisting of a front roll, a rear roll and an endless tread passing around said rolls, means pivotally connecting at least one of said tractor assemblies to said carriage and permitting said tractor assembly to tilt about a horizontal axis extending in the direction of movement of the carriage, and spring means yieldingly resisting the said tilting movement of said tractor assembly, said tilting movement permitting said tractor assembly to adapt itself to any crown formed in the strip being laid.

5. In a road paver of the character described, a carriage, a hopper at the front end of said carriage and having an opening in its bottom extending transversely of the line of movement of said carriage, means mounted on said carriage for grading the paving material discharged from said hopper opening and means in rear of said hopper opening and grading means for supporting said carriage on the freshly laid strip of paving material, comprising a tractor assembly at each side of the carriage consisting of a front roll, a rear roll and an endless tread passing around said rolls, means pivotally connecting at least one of said tractor assemblies to said carriage and permitting said tractor assembly to tilt about a horizontal axis extending in the direction of movement of the carriage, spring means yieldingly resisting the said tilting movement of said tractor assembly, said tilting movement permitting said tractor assembly to adapt itself to any crown formed in the strip being laid and means for adjusting the effective pressure exerted by said spring means.

6. In a road paver of the character described, a carriage, a hopper mounted at the front end of said carriage and having an opening in its bottom extending transversely of the line of movement of said carriage, means mounted on said carriage for grading the paving material discharged from said hopper opening, means for adjustably varying the crown of said grading means to provide a corresponding crown in the strip being laid and means in rear of said hopper opening and grading means for supporting said carriage on the freshly laid strip of paving material comprising a tractor assembly at each side of said carriage consisting of front and rear brackets, an axle supporting each of said brackets, a roll carried by each of said axles and an endless tread passing around said rolls, the said brackets of at least one of said tractor assemblies being pivotally connected at one side to said carriage to tilt about a common axis extending along the line of movement of said carriage and a spring connecting the opposite side of each of said brackets with said carriage to permit said tractor assembly to tilt and adapt itself to the crown being provided in the strip of paving material being laid.

7. In a road paver of the character described, a carriage, a hopper mounted at the front end of said carriage and having an opening in its bottom extending transversely of the line of movement of said carriage, means mounted on said carriage for grading the paving material discharged from said hopper opening, means for adjustably varying the crown of said grading means to provide a corresponding crown in the strip being laid and means in rear of said hopper opening and grading means for supporting said carriage on the freshly laid strip of paving material comprising a tractor assembly at each side of said carriage consisting of front and rear brackets, an axle supporting each of said brackets, a roll carried by each of said axles and an endless tread passing around said rolls, the said brackets of at least one of said tractor assemblies being pivotally connected at one side to said carriage to tilt about a common axis extending along the line of movement of said carriage and a spring connecting the opposite side of each of said brackets with said carriage to permit said tractor assembly to tilt and adapt itself to the crown being provided in the strip of paving material being laid and each of said tractor assemblies also including a bar connecting its front and rear brackets and a plurality of spaced rollers mounted on said bar and engaging the upper face of the lower stretch of said tread and forming a backing therefor.

8. In a road paver of the character described, a carriage, a hopper at the front end of said carriage and having an opening in its bottom ex-

tending transversely of the line of movement of said carriage, means mounted on said carriage for grading the paving material discharged from said hopper opening and means in rear of said hopper opening and grading means for supporting said carriage on the freshly laid strip of paving material, comprising a front roll and a rear roll having substantially cylindrical peripheries, an endless integral smooth steel belt passing around said rolls and means for driving one of said rolls, each of said rolls having the extremities of its periphery beveled thereby to repel paving material accidentally lodging on the edges of the lower stretch of said belt and passing between said belt and either of said rolls.

9. In a road paver of the character described, a carriage, a hopper at the front end of said carriage and having an opening in its bottom extending transversely of the line of movement of said carriage, means mounted on said carriage for grading the paving material discharged from said hopper opening and means in rear of said hopper opening and grading means for supporting said carriage on the freshly laid strip of paving material, comprising a front roll and a rear roll having substantially cylindrical peripheries, an endless integral smooth steel belt passing around said rolls, means for driving one of said rolls and spring means for yieldingly urging said rolls apart.

10. In a road paver of the character described, a carriage, a hopper at the front end of said carriage and having an opening in its bottom extending transversely of the line of movement of said carriage, means mounted on said carriage for grading the paving material discharged from said hopper opening and means in rear of said hopper opening and grading means for supporting said carriage on the freshly laid strip of paving material, comprising a front roll and a rear roll having substantially cylindrical peripheries, an endless integral smooth steel belt passing around said rolls, means for driving one of said rolls, and means for adjusting said rolls toward and from one another to adjust the tension of said belt comprising a horizontally sliding mounting for one of said rolls, a pair of toggle links extending generally lengthwise of the line of movement of the paver and connected at one end to said sliding mounting and at its other end to a fixed part of the carriage, and a transverse screw operatively connected to said toggle linkage to extend and retract the links thereof.

11. In a road paver of the character described, a carriage, a hopper at the front end of said carriage and having an opening in its bottom extending transversely of the line of movement of said carriage, means mounted on said carriage for grading the paving material discharged from said hopper opening and means in rear of said hopper opening and grading means for supporting said carriage on the freshly laid strip of paving material, comprising a front roll and a rear roll having substantially cylindrical peripheries, an endless integral smooth steel belt passing around said rolls, means for driving one of said rolls and means for adjusting said rolls toward and from one another to adjust the tension of said belt comprising a horizontally sliding mounting for one of said rolls, two pairs of toggle links extending generally lengthwise of the line of movement of the paver and each pair connected at one end to said sliding mounting and at its other end to a fixed part of the carriage and a screw connecting said pairs of toggle links and adapted when turned to move said pairs of toggle links toward and from one another to extend and retract the links thereof.

12. In a road paver of the character described, a carriage, a hopper at the front end of said carriage and having an opening in its bottom extending transversely of the line of movement of said carriage, means mounted on said carriage for grading the paving material discharged from said hopper opening and means in rear of said hopper opening and grading means for supporting said carriage on the freshly laid strip of paving material, comprising a front axle and a rear axle, front and rear rolls mounted on said axles, an endless tread passing around said rolls, a bearing bracket supported by each of said axles and supporting said carriage, a bar connecting said brackets, a plurality of spaced rollers mounted on said bar and engaging the upper face of the lower stretch of said tread and forming a backing therefor and means for yieldingly urging said rolls apart comprising a bearing block slidably mounted in one of said brackets and carrying the corresponding axle, a pair of toggle links extending generally lengthwise of said bar and pivotally connected at one end thereto, a spring connection between the other end of said toggle linkage and said sliding block and a transverse screw operatively connected to said toggle linkage to extend and retract the links thereof.

13. In a road paver of the character described, a carriage, a hopper at the front end of said carriage and having an opening in its bottom extending transversely of the line of movement of said carriage, means mounted on said carriage for grading the paving material discharged from said hopper opening and means in rear of said hopper opening and grading means for supporting said carriage on the freshly laid strip of paving material comprising a front roll and a rear roll having substantially cylindrical peripheries, an endless integral smooth steel belt passing around said rolls, means for driving one of said rolls and means for preventing paving material from flowing over onto the upper face of the lower stretch of said belt, comprising a pair of flexible strips arranged lengthwise of the line of movement of the paver and along the opposite edges of the lower stretch of said belt and means yieldingly holding said strips and urging said strips downwardly into engagement with the upper face of said lower stretch.

14. In a road paver of the character described, a carriage, a hopper at the front end of said carriage and having an opening in its bottom extending transversely of the line of movement of said carriage, means mounted on said carriage for grading the paving material discharged from said hopper opening and means in rear of said hopper opening and grading means for supporting said carriage on the freshly laid strip of paving material comprising a front roll and a rear roll having substantially cylindrical peripheries, an endless integral smooth steel belt passing around said rolls, means for driving one of said rolls and means for preventing paving material from flowing over onto the upper face of the lower stretch of said belt, comprising a pair of flexible strips arranged lengthwise of the line of movement of the paver and along the opposite edges of the lower stretch of said belt and means yieldingly holding said strips and urging said strips downwardly into engagement with the upper face of said lower stretch, the opposite ends

of said strips entering peripheral grooves provided in the peripheries of said rolls.

15. In a road paver of the character described, a carriage, a hopper at the front end of said carriage and having an opening in its bottom extending transversely of the line of movement of said carriage, means mounted on said carriage for grading the paving material discharged from said hopper opening and means in rear of said hopper opening and grading means for supporting said carriage on the freshly laid strip of paving material, comprising a front axle and a rear axle, front and rear rolls mounted on said axles, an endless tread passing around said rolls, a bearing bracket supported by each of said axles and supporting said carriage, a bar connecting said brackets, a plurality of spaced rollers mounted on said bar and engaging the upper face of the lower stretch of said tread and forming a backing therefor, and means for preventing paving material from flowing over onto the upper face of the lower stretch of said belt, comprising a pair of flexible strips arranged lengthwise of the line of movement of the paver and along the opposite edges of said lower stretch of said belt and spring means interposed between said bar and said strips for yieldingly urging said strips downwardly into engagement with the upper face of said lower stretch.

16. In a road paver of the character described, a carriage, a hopper at the front end of said carriage and having an opening in its bottom extending transversely of the line of movement of said carriage, means mounted on said carriage for grading the paving material discharged from said hopper opening and means in rear of said hopper opening and grading means for supporting said carriage on the freshly laid strip of paving material, comprising a front roll and a rear roll having substantially cylindrical peripheries, one of said rolls being mounted on a fixed axis and the other being movable lengthwise of the line of movement of the paver, an endless integral steel belt passing around said rolls, means for driving that roll mounted on a fixed axis, spring means for yieldingly urging said rolls apart and means movable with the non-driving roll for cleaning the exterior surface of said belt.

17. In a road paver of the character described, a carriage, a hopper on said carriage and having an opening in its bottom extending transversely of the line of movement of said carriage, a flat cutter bar arranged adjacent and parallel with said opening and arranged to grade the paving material discharged from said opening, means for reciprocating said cutter bar longitudinally, means for adjusting said cutter bar vertically and means providing a fine adjustment for the effective elevation of said cutter bar comprising means providing a tilting mounting for said cutter bar and permitting said cutter bar to tilt about an axis generally parallel and eccentric to its cutting edge and extending transverse of the line of movement of the paver and means for adjustably tilting said cutter bar about said axis to vary the effective elevation of said cutting edge along its entire length.

18. In a road paver of the character described, a carriage, a hopper on said carriage and having an opening in its bottom extending transversely of the line of movement of said carriage, a flat cutter bar arranged adjacent and parallel with said opening and arranged to grade the paving material discharged from said opening, means for reciprocating said cutter bar longitudinally, means for supporting said cutter bar, means for adjusting said supporting means vertically with reference to said carriage and means providing a fine adjustment for the elevation of said cutter bar comprising a link pivotally connected to said supporting means and extending forwardly therefrom generally parallel with the line of movement of the paver, means pivotally supporting the front end of said link on said carriage, and means for adjustably rotating said supporting means about its pivotal connection with said link thereby to adjust the vertical position of the cutting edge of said cutter bar.

19. In a road paver of the character described, a carriage, a hopper on said carriage and having an opening in its bottom extending transversely of the line of movement of said carriage, a flat cutter bar arranged adjacent and parallel with said opening and arranged to grade the paving material discharged from said opening, means for reciprocating said cutter bar longitudinally, means for supporting said cutter bar, means for adjusting said supporting means vertically relative to said carriage and means providing a fine adjustment for the effective elevation of said cutter bar comprising a bracket secured to said supporting means, a pair of substantially parallel links arranged in different horizontal planes and pivotally connected at one end to said bracket, a bracket pivotally connecting the other ends of said links, means pivotally supporting said second bracket on said carriage and means for adjustably rotating said second bracket to effect a tilting movement of said first bracket and a corresponding vertical movement of the cutting edge of said cutter bar.

20. In a road paver of the character described, a carriage, a hopper mounted on said carriage and having an opening in its bottom extending transversely of the line of movement of said carriage, a supporting bar arranged in rear of said hopper and extending transversely of the line of movement of said carriage, a cutter bar arranged parallel with said supporting bar and arranged to grade the paving material discharged from said opening, supporting means carried by said cross bar and supporting said cutter bar and permitting longitudinal reciprocation thereof, means for adjusting said supporting bar vertically relative to said carriage and means for reciprocating said cutter bar comprising a motor cylinder mounted on said supporting bar, a piston in said cylinder, a piston rod connected to said piston and extending outwardly from said cylinder, means operatively connecting said piston rod with said cutter bar and means controlled by the reciprocation of said cutter bar for alternately introducing fluid under pressure into said cylinder at opposite sides of said piston to effect reciprocation of said piston.

21. In a road paver of the character described, a carriage, a hopper mounted on said carriage and having an opening in its bottom extending transversely of the line of movement of said carriage, a cross bar arranged in rear of said hopper and parallel with said opening, a cutter bar arranged parallel with said cross bar and arranged to grade the paving material discharged from said hopper opening, means for supporting said cutter bar from said cross bar and permitting longitudinal reciprocation of said cutter bar, means on said cross bar for reciprocating said cutter bar and means for independently raising and lowering the opposite ends of said

cross bar comprising a hydraulic jack arranged at each side of said carriage and operatively connected with the corresponding end of said cross bar and means on said carriage for selectively admitting fluid under pressure to said hydraulic jacks.

22. In a road paver of the character described, a carriage, a hopper mounted on said carriage and having an opening in its bottom extending transversely of the line of movement of said carriage, means connected with said carriage for grading the paving material discharged from said hopper opening, a tractor assembly supporting each side of said carriage and each including front and rear rolls and an endless tread connecting said rolls, and means for propelling the paver comprising a prime mover mounted on said carriage, a hydraulic pump driven by said prime mover, a hydraulic motor operatively connected to one roll of each tractor assembly and manually operated means for selectively delivering fluid under pressure from said pump to said motors thereby to permit of steering the paver.

23. In a road paver of the character described, a carriage, a hopper mounted on said carriage and having an opening in its bottom extending transversely of the line of movement of said carriage, means connected with said carriage for grading the paving material discharged from said hopper opening, a tractor assembly supporting each side of said carriage and arranged in rear of said hopper opening and grading means and supporting the entire weight of said carriage exclusively on the freshly laid strip of paving material, each of said tractor assemblies including front and rear rolls and an endless tread connecting said rolls, and means for propelling the paver comprising a prime mover mounted on said carriage, a hydraulic pump driven by said prime mover, a hydraulic motor operatively connected to one roll of each tractor assembly and means for selectively delivering fluid under pressure from said pump to said motors thereby to permit of steering the paver.

24. In a road paver of the character described, a carriage, a hopper on said carriage and having an opening in its bottom extending transversely of the line of movement of said carriage, a cutter bar arranged adjacent the rear wall of said hopper and serving to grade the material being discharged therefrom, means for reciprocating said cutter bar, means for adjusting the elevation of said cutter bar and means for preventing the paving material in said hopper from escaping over said cutter bar, comprising an upstanding plate secured to said cutter bar extending lengthwise thereof and arranged immediately to one side of the plane of the rear wall of said hopper and sealing the opening therebetween.

25. In a road paver of the character described, a carriage, a hopper on said carriage and having an opening in its bottom extending transversely of the line of movement of said carriage, a cutter bar arranged adjacent the rear wall of said hopper and serving to grade the material being discharged therefrom, means for reciprocating said cutter bar, means for adjusting the elevation of said cutter bar and means for preventing the paving material in said hopper from escaping over said cutter bar, comprising a pair of upstanding plates secured to said cutter bar extending lengthwise thereof and arranged on opposite sides of the plane of the rear wall of the hopper and sealing the opening therebetween.

AXEL E. LUNDBYE.