Dec. 14, 1965 A. A. JONES ETAL 3,223,006

MACHINE FOR FORMING INTEGRAL SIDEWALKS AND CURBS

Filed Nov. 6, 1961 4 Sheets-Sheet 1

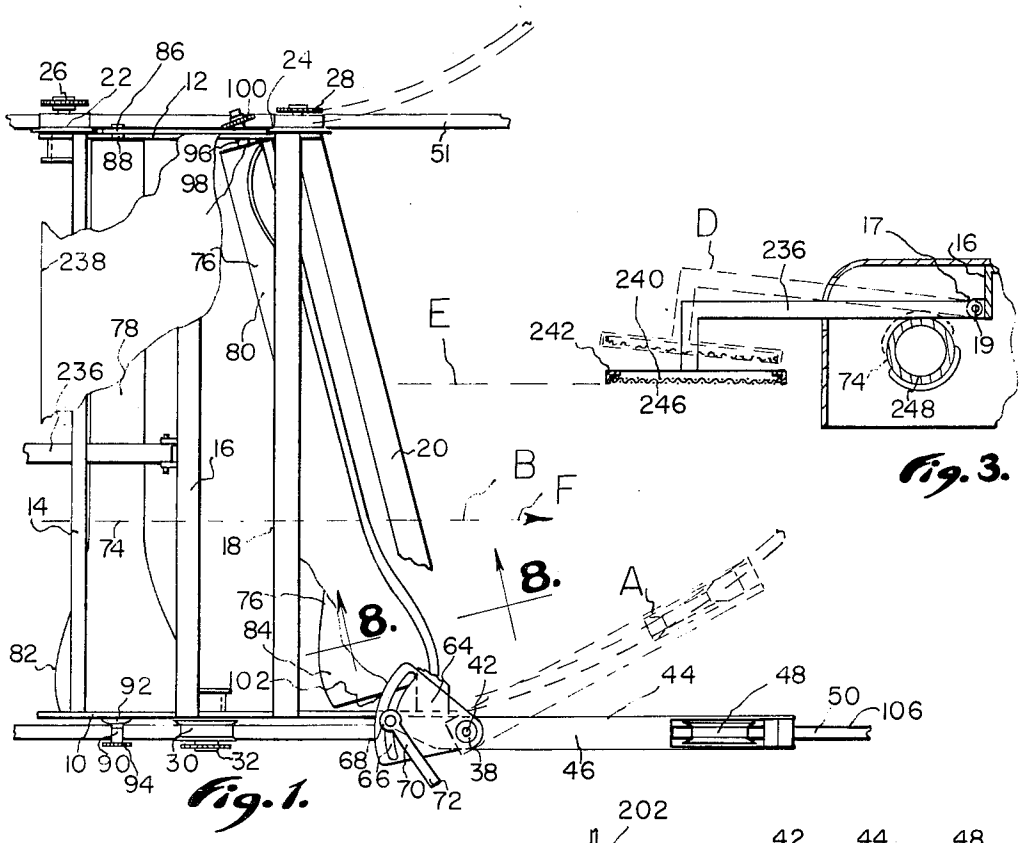
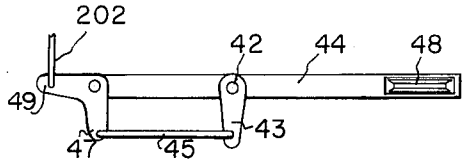


Fig. 1.

Fig. 3.



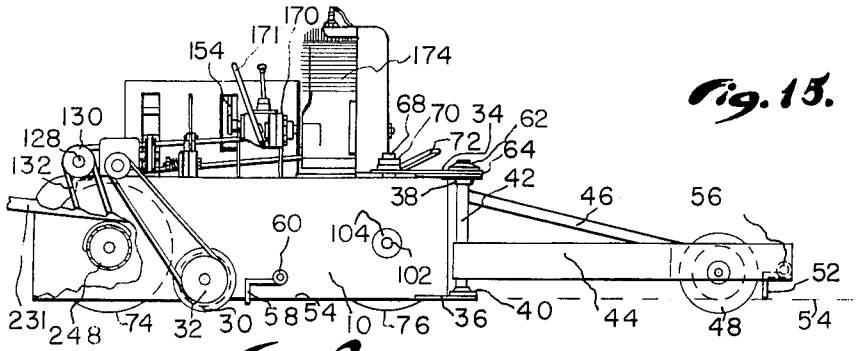


Fig. 2.

Fig. 15.

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MACHINE FOR FORMING INTEGRAL SIDEWALKS AND CURBS

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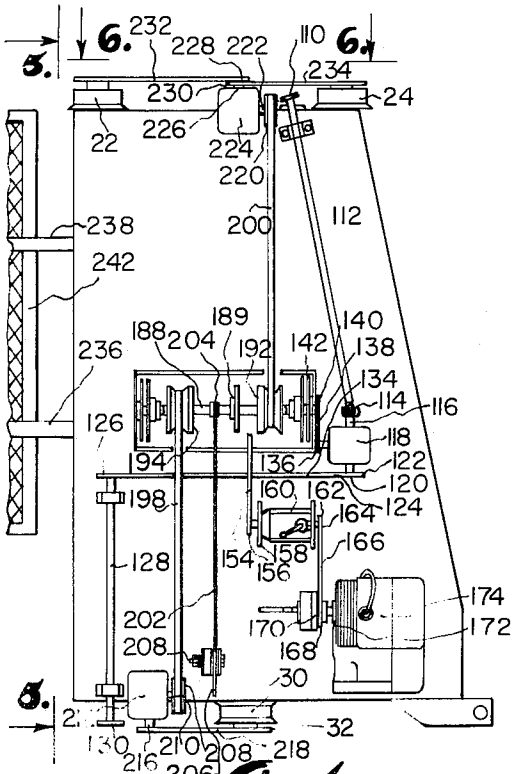


Fig. 1.

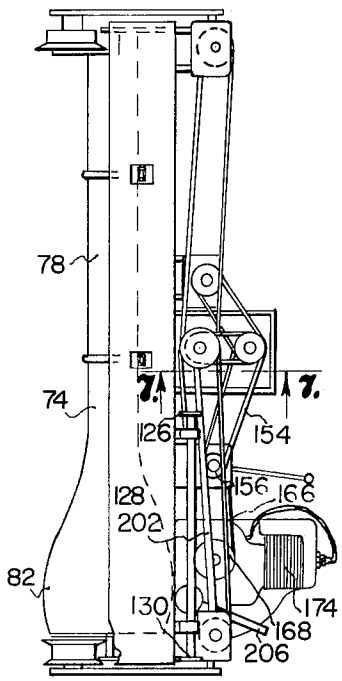


Fig. 5.

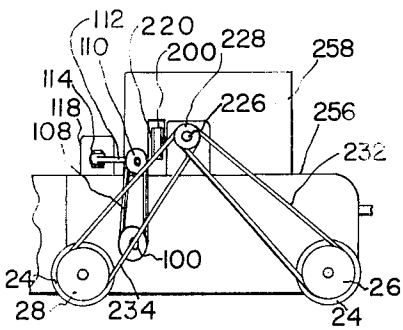


Fig. 6.

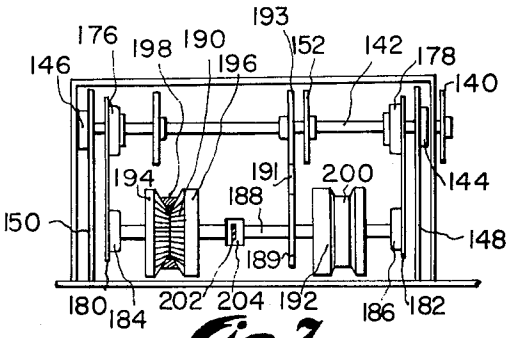


Fig. 7.

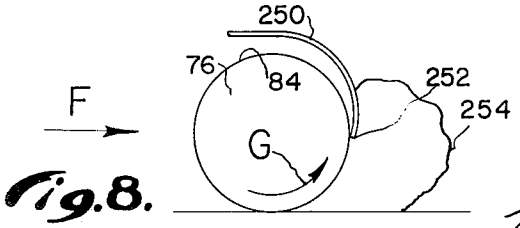


Fig. 8.

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Fig. 9.

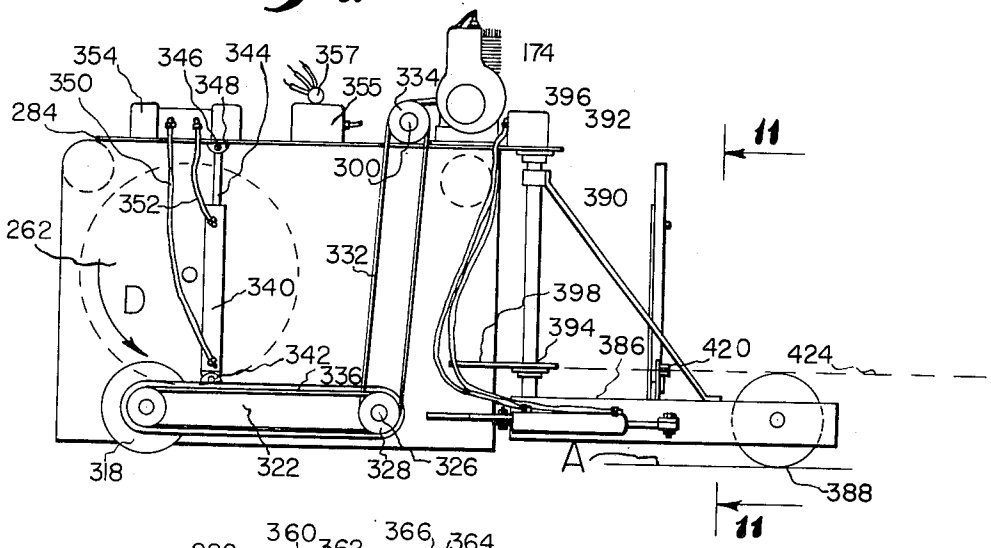


Fig. 10.

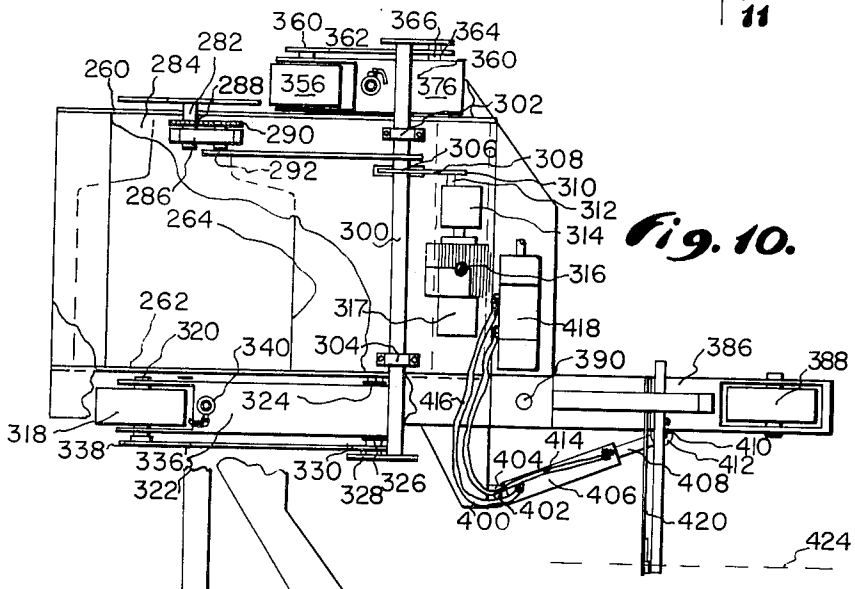
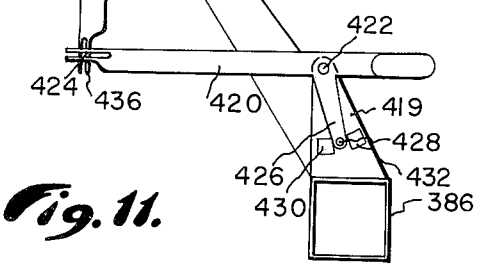


Fig. 11.



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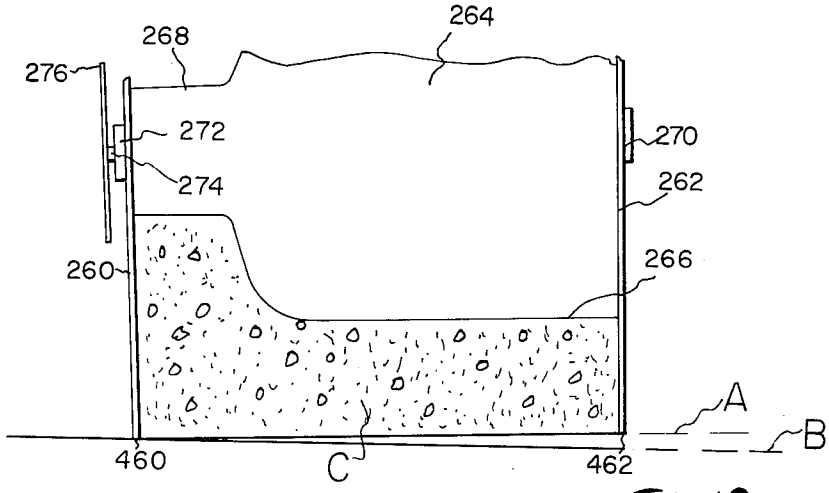


Fig. 12.

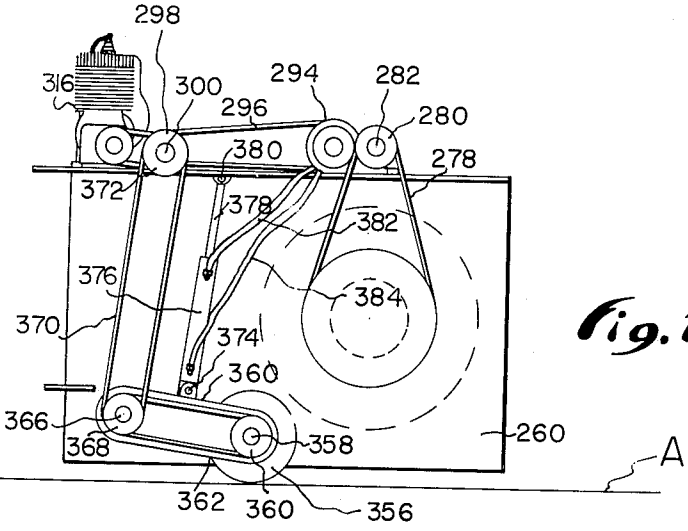


Fig. 13.

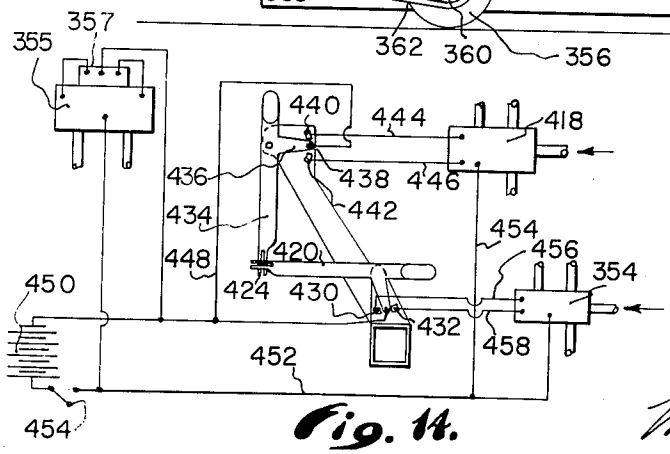


Fig. 14.

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United States Patent Office 3,223,006
Patented Dec. 14, 1965

3,223,006

MACHINE FOR FORMING INTEGRAL SIDEWALKS AND CURBS

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Filed Nov. 6, 1961, Ser. No. 150,364
3 Claims. (Cl. 94—45)

This invention relates to a machine for shaping, striking off, screeding and otherwise forming and finishing various shapes and contours of concrete curbs or sidewalks (or integrally constructed curbs and sidewalks) or concrete curb constructed separately or integrally with concrete roadway pavement and more specifically to a versatile machine capable of being adjusted to varying widths of horizontal surface and area and curb face heights, making possible and feasible to obtain the desired cross section, shape or contour by interchangeable roller designs and patterns, a few of which are shown in the accompanying drawings. The machine of the present invention will eliminate many of the cost consuming operations formerly necessary when using conventional methods, such as setting forms to hold the vertical or sloping curb face to shape until the initial setting of the concrete, moving, spreading and striking off or screeding of surface areas with shovels and hand tools all of which renders the possibility of much savings in cost.

The machine of the present invention will also control the line and grades more accurately than can be accomplished by the conventional method. The process may be followed by conventional hand troweling, nose and cove tooling, score marking, brooming, sacking or other methods to obtain the desired texture and/or finish.

In conventional practice, integral sidewalls and curbs are formed by conventional manual troweling operations following the rough pouring of the concrete mix between substantially parallel wooden or steel forms. This conventional manual troweling procedure is preceded by considerable manual labor utilized to shovel and move the concrete about between the forms so that it is evenly distributed and substantially at a level comparable with conventional tamping and troweling operations.

Such conventional manual construction of integral sidewalk and curb structures is costly and consumes considerable time. Additionally, the manual operations either require a large number of workers or a transit mix concrete truck must spend considerable time unloading wet concrete between the forms which is thereby costly of the time of such important equipment.

The manual forming of integral sidewalk and curb structures requires considerable skill to produce uniform symmetrical curved transitions between the sidewalk level and the street level. Consequently, it is difficult to attain accuracy and uniformity of such structures without a considerable amount of costly labor.

Accordingly, it is an object of the invention to provide a machine for forming integral sidewalks and curbs which save a considerable amount of time and labor and which very accurately and uniformly produces integral sidewalks and curbs at a very rapid rate.

Another object of the invention is to provide a machine for forming integral sidewalks and curbs which saves time of tranisit mix trucks and operators.

Another object of the invention is to provide a machine for forming integral sidewalks and curbs which is self-motivating and thereby propels itself along forms between which integral sidewalks and curbs are produced thereby.

Another object of the invention is to provide a machine for forming integral sidewalks and curbs having a novel differential drive mechanism disposed to power

the traction wheels of said machine, which runs on adjacent parallel forms, whereby the machine is provided proper traction for traveling around curved sections of the forms by merely adjusting the differential drive so that one set of traction wheels on one form operates at a greater linear rate than the traction wheels on the other form.

Another object of the invention is to provide a means for automatically steering the machine of the invention; said means comprising an automatic differential drive steering means disposed to drive the traction wheels at different speeds in response to a pivoted steering wheel engageable with forms or in response to means engaging a taut line.

Another object of the invention is to provide a machine of this class which comprises concrete forming rollers having varying diameter portions longitudinally thereof which may be used or adapted for use in forming integral sidewalks and curbs, integral curbs and roadway pavement or various combinations thereof as desired.

Another object of the invention is to provide a machine for forming integral sidewalks and curbs having novel concrete spreading rollers, each comprising a straight cylindrical section for forming a sidewalk portion and having an adjacent section of enlarged diameter contoured and faired into the straight cylindrical section whereby the enlarged diameter portion forms contoured curved curb portions which fair into the sidewalk portion formed by the straight cylindrical section and which also fair into a street level at the lower portion of the curb section.

Another object of the invention is to provide a machine for forming integral sidewalks and curbs having a novel drive mechanism for motivating the machine along forms and around curves therein and also for driving concrete forming rollers which concurrently form integral sidewalk and curb structures of concrete between the forms on which the machine motivates itself.

Another object of the invention is to provide a machine for forming integral sidewalks and curbs having a novel combination of machine-motivating mechanism; concrete forming rollers and sidewalk surface tamping mechanism whereby the machine of the invention motivates itself longitudinally of forms automatically to spread and form concrete therebetween and to finish tamp concrete as the machine passes thereover.

Another object of the invention is to provide a very simple means for adjusting a differential drive of the machine whereby it drives itself around curves on forms, one of which is disposed at a longer radius than the other.

Another object of the invention is to provide a novel combination of a concrete forming roller operating between side plates at opposite ends of the roller whereby the curbs and integral sidewalks and curbs, or roadways and curbs, etc., may readily be formed of concrete poured in position to be advanced upon by the concrete forming roller of the machine between the side plates of the machine at opposite ends of the roller.

Another object of the invention is to provide a novel machine for forming concrete which motivates itself and follows a taut line to guide it over graded terra firma so that curbs or integral sidewalks and curbs, or pavement and curbs may be formed by the machine without the use of preset forms for guiding the machine and retaining the concrete material.

Another object of the invention is to provide a machine for forming integral sidewalks and curbs, pavement and curbs, or curbs individually, wherein novel control means is provided for guiding the machine and controlling elevation of the concrete formed thereby when a forming roller of the machine rotates as the machine moves longitudinally of the area in which an integral sidewalk and curb

is being formed or in which a curb structure is being formed.

A further object of the invention is to provide a machine for forming integral sidewalks and curbs which generally economizes in labor; which generally improves the quality of integral sidewalks and curbs and which saves considerable time in the construction thereof.

Further objects and advantages of the invention may be apparent from the following specification, appended claims, and accompanying drawings, in which:

FIG. 1 is a fragmentary top or plan view of a machine for forming integral sidewalks and curbs, in accordance with the invention, and showing portions thereof broken away and omitted to simplify the illustration of the machine frame and concrete forming rollers and further showing by broken lines, curved forms and portions of the machine conforming therewith;

FIG. 2 is a fragmentary side elevational view of a machine for forming integral sidewalks and curbs, in accordance with the present invention;

FIG. 3 is a fragmentary sectional view of the rear end of a machine for forming integral sidewalks and curbs showing the tamper mechanism of the present invention therein and illustrating, by broken line, the varying positions thereof;

FIG. 4 is a fragmentary top or plan view of a machine for forming integral sidewalks and curbs showing the motor and drive mechanism on the upper side thereof;

FIG. 5 is a fragmentary rear sectional view of the machine taken from the line 5—5 of FIG. 4;

FIG. 6 is a fragmentary side elevational view of the machine of the invention taken from the line 6—6 of FIG. 4;

FIG. 7 is an enlarged fragmentary sectional view taken from the line 7—7 of FIG. 5, showing principal mechanism of the differential drive for motivating the traction wheels of the machine around curved forms;

FIG. 8 is an enlarged fragmentary sectional view taken from the line 8—8 of FIG. 1, showing one of the concrete forming rollers of the machine and its screed with respect to concrete material being formed by the roller;

FIG. 9 is a side elevational view of a modified form of a machine, in accordance with the present invention; said machine being adapted to form curb structures without the use of preset forms, and being adapted to follow a taut line to guide the machine in two planes;

FIG. 10 is a top or plan view of the modification shown in FIG. 9 and illustrating portions broken away to amplify the illustration;

FIG. 11 is an enlarged fragmentary sectional view taken from the line 11—11 of FIG. 9;

FIG. 12 is a transverse sectional view of a concrete forming roller disposed between a pair of movable side plates which permit operation of the present machine in its modified form as shown in FIGS. 9 and 10 of the drawings, without the use of conventional preset forms;

FIG. 13 is a side elevational view of the machine as shown in FIG. 9 of the drawings, but showing the opposite side of said machine;

FIG. 14 is a diagrammatic view of the control system of the modified machine, as shown in FIGS. 9 and 10 of the drawings, whereby said machine may be controlled by a taut line to operate longitudinally of a curb or sidewalk structure being formed and to maintain movement and control of the machines in two planes; and

FIG. 15 is a fragmentary plan view of a front portion of the machine showing a modification thereof including linkage to effect automatic differential drive steering of the machine.

Attention is directed to FIG. 1 of the drawings, wherein the upper cover of the machine is broken away thereby omitting the drive mechanism thereof. Thus, FIG. 1 simply discloses elements of the machine frame and the concrete forming rollers with some of the related mechanism.

As shown in FIG. 1 of the drawings, the machine is provided with side plates **10** and **12** interconnected by horizontal frame members **14**, **16**, **18** and **20**. These structures may be welded, or otherwise secured together, as desired.

Rotatably mounted on the side plate **12** by suitable axles and bearings are form-following traction wheels **22** and **24**. Coupled to these wheels **22** and **24** are drive sprockets **26** and **28**, respectively, which drive these form-following wheels, as will be hereinafter described.

Rotatably mounted on the side plate **10** is a form-following wheel **30**, which is rotatably mounted on suitable bearings carried by the plate **10**. Connected to this wheel **30** is a drive sprocket **32** disposed to drive the same, as will be hereinafter described. Connected to the side plate **10** and the machine frame, are bearing plates **34** and **36**, supporting bearings **38** and **40**, carrying a normally vertical shaft **42** which is pivoted about a vertical axis in the bearings **38** and **40**. Mounted on this shaft is an arm **44** having a brace **46** interconnecting it and the shaft **42**.

Rotatably mounted on the arm **44** is a wheel **48** disposed to roll on a form **50** which is also engaged by the wheel **30**.

The arm **44**, at its lowered end, carries a pivotally mounted scraper **52** which travels ahead of the wheel **48** and scrapes the upper surface **54** of the form **50**. This scraper **52** is mounted on a pin **56** carried by the arm **44**.

A similar scraper **58** is pivotally mounted on a pin **60** carried by the side plate **10**. This scraper **58** scrapes the upper surface **54** of the form **50** ahead of the wheel **30**, all as shown best in FIG. 2 of the drawings.

Connected to the shaft **42** at its normally upper end, is a boss **62** to which is fixed a locking plate **64** having an arcuate slot **66** therein. This arcuate slot **66** receives a bolt **68** which is stationary and extends upwardly from the frame of the side plate **10**. This bolt **68** is screw-threaded, and screw-threadably engaged therewith is an internally screwthreaded hub **70** of a locking arm **72**. This locking arm **72**, when rotated with respect to the plate **64**, screw-threadably tightens the plate **64** relative to the frame of the machine and fixes the position of the shaft **42** and the arm **44**.

When the locking arm **72** is rotatably loosened relative to the screw-threaded bolt **68**, the arm **44** may be pivoted about the axis of the shaft **42**, and the slot **66** of the plate **64** traverses about the bolt **68**, all as indicated by broken lines A in FIG. 1 of the drawings.

Rotatably mounted between the side plates **10** and **12** are concrete forming rollers **74** and **76**. These rollers are provided with respective straight cylindrical sections **78** and **80** disposed to form horizontal portions of sidewalks while integral enlarged diameter portions **82** and **84** of the respective rollers **74** and **76** are disposed to form sloping curbs integral with the horizontal sidewalk sections.

The concrete forming roller **74** is provided with a stub shaft **86** supported by a bearing **88** mounted on the side plate **12**. The opposite end of the roller **74** is provided with a stub shaft **90** mounted in a bearing **92** carried by the side plate **10**. Mounted on the outer end of the stub shaft **90** is a sprocket **94**, as will be hereinafter described.

The concrete forming roller **76** is mounted so that its axis is disposed at acute angles to the side plates **10** and **12**.

One end of the roller **76** is provided with a stub shaft **96** supported on a bearing **98** on the side plate **12** and connected to this stub shaft **96** outwardly of the bearing **98** is a drive sprocket **100**, as will be hereinafter described.

The opposite end of the roller **76** is provided with a stub shaft **102** which is mounted in a bearing **104** carried by the side plate **10**.

It will be seen that a broken line B in FIG. 1 of the drawings is located substantially at a transition between

the straight cylindrical sections 78 and 80 of the rollers 74 and 76, respectively, and their respective enlarged diameter contoured portions 82 and 84. Thus, the broken line B is at a location at the edge of a sidewalk to be formed by the rollers 74 and 76. The enlarged diameter portions 82 and 84 of the rollers 74 and 76 fair into the straight cylindrical portions of these rollers to form a neat curved curb portion of the sidewalk being formed so that the curb portions slopes in a smooth curved configuration downwardly to the street level with which the enlarged diameter portions 82 and 84 are disposed to coincide when forming a sidewalk curb. These enlarged diameter portions 82 and 84 are curved and faired so that the outer portions of the curve, adjacent the street, are formed contiguous to an inner side 106 of the form 50 whereby the concrete adjacent the form 106 will be at street level.

As shown in FIGS. 1, 4 and 6 of the drawings, the sprocket 100, which drives the concrete forming roller 76, is engaged by a chain 108 which also engages another sprocket 110 on an outer end of a shaft 112 which is coupled by means of a universal joint 114 to an output shaft 116 of a gear box 118. This gear box 118 is provided with another output shaft 120 having a sprocket 112 thereon driving a chain 124 running over another sprocket 126 on a shaft 128 having a sprocket 130 on its opposite end.

This sprocket 130 drives a chain 132 which runs over the sproket 94 in driving relationship with the concrete forming roller 74. The gear box 118 is provided with an input shaft 134 having a sprocket 136 thereon. This sprocket 136 is engaged by a chain 138 on a sprocket 140 mounted on a shaft 142 journaled in bearings 144 and 146 supported by plates 148 and 150 carried by the frame of the machine. These plates 148 and 150 are stationary with respect to the machine frame.

The shaft 142 is provided with a sprocket 152 engaged by a chain 154 which engages another sprocket 156 on an output shaft 158 of a transmission 160. This transmission 160 is provided with an input shaft 162 carrying a sprocket 164 engaged by a chain 166 driven by a sprocket 168 in connection with a clutch mechanism 170 on a shaft 172 of an engine 174.

Pivotally mounted on the shaft 142 are bearings 176 and 178 carrying brackets 180 and 182 which support bearings 184 and 186, respectively. Rotatably mounted on these bearings 184 and 186 is a shaft 188 driven by a sprocket 189 engaging a chain 191 engaging a sprocket 193 on the shaft 142. Mounted on the shaft 188 are variable diameter spring loaded pulleys 190 and 192. These variable diameter spring loaded pulleys are conventional pulleys operable in connection with standard V-belts whereby tightening of the belts thereon tends to spread the pulleys and reduce their diameter whereas loosening of the belts permits the spring loaded ends of the pulleys to pull together and increase the effective diameters of the pulleys.

The pulley 190, for example, is provided with a pair of pulley sections 194 and 196 which are spring loaded toward each other and which may be spread apart by pressure of a belt 198 thereon.

The pulley 192 is a similar type of pulley engaged by a belt 200.

A link 202 is connected to the shaft 188 by a sleeve bearing 204 and this link 202 is coupled to a control lever 206 having a friction clutch 208 for holding this lever in position. The link 202 is thus disposed to be actuated so that the shaft 188 may be swung about the axis of the shaft 142 by pivoting the levers 180 and 182 thereabout. Movement of the shaft 188 in one direction causes a reduction in diameter of the pulley 190 while permitting an increase in diameter of the pulley 192 and vice versa.

The belt 198 is engaged with a pulley 209 on an input shaft 210 of a gear box 212 having an output shaft 214 which drives a sprocket 216 engaging a chain 218 which passes over the sprocket 32, hereinbefore described, to drive the wheel 30.

The belt 200 passes over a pulley 220 on an input shaft 222 of a gear box 224 which is provided with an output shaft 226. As shown in FIGS. 4 and 6 of the drawings, this output shaft 226 carries sprockets 228 and 230 engaging chains 232 and 234 which pass over the sprockets 26 and 28, hereinbefore described, for driving the wheels 22 and 24, respectively.

Mounted on the cross member 16 are clips 17 having pivot pins 19 extending therethrough. Pivotally connected to the pivot pins 19 are arms 236 and 238 of a tamper 240 which is composed of a rectangular frame 242 and a screen 246. The arms 236 and 238 are each engageable by a respective cam 248 on the concrete forming roller 74 whereby each revolution of this roller 74 causes the tamper to be raised upward, as indicated by dash lines D in FIG. 3 of the drawings, whereupon, as the shaft rotates further, the tamper 246 drops on an upper surface E of a formed sidewalk as indicated in FIG. 3 of the drawings.

Contiguous to the peripheral surface of the concrete forming roller 76 is a scraper 250 having a scraping edge 252 disposed to scrape excess concrete 254 from the peripheral surface of the roller 76 when operating in a direction as indicated by arrows in FIG. 8 of the drawings. This rotational direction corresponds with the forward direction of the machine as indicated by the arrow F. This arrow F indicates the direction which the machine moves while the concrete forming rollers 74 and 76 operate in the direction of the arrows G, whereby excess concrete is moved forward between the forms 50 and 51 during the formation of an integral sidewalk and curb.

The machine is provided with a sheet metal cover 256 which covers the frame members 14, 16, 18 and 20 and an additional cover 258 is disposed over the shafts 142 and 188 and also the respective pulleys and sprockets carried thereon.

The operation of the machine of the invention is substantially as follows.

The forms 50 and 51, as shown in FIG. 1 of the drawings, are first set to establish the location and configuration of the sidewalks whether they be straight or curved or a combination of both. These forms 50 and 51 may be conventional wooden forms or they may be steel forms, as desired. The wheels 22, 28, 30 and 48 of the machine, are engaged with the upper surface of the forms 50 and 51 thereby supporting the machine on the forms.

A transit mix truck is disposed ahead of the machine and located to dump wet concrete material between the forms 50 and 51 whereupon a small amount of labor is used to roughly spread the concrete around between the forms 50 and 51. The engine 174 of the machine may then be started whereupon a manually operable lever 171 is pivotally actuated to engage the clutch 170 and cause the chain 166 to drive the transmission 160 so that its output sprocket 156 drives the chain 154, which is coupled to drive the sprocket 152 and the shaft 142.

The shaft 142, by means of its sprocket 140 and a chain 138 drives the gear box 118 having output shafts 116 and 120 which drive the shaft 112 and the chain 124. The shaft 112 by means of the chain 108, drives the concrete forming roller 76 while the chain 124, sprocket 126, shaft 128, sprocket 130 and chain 132 running over the sprocket 94 drives the concrete forming roller 74. The rollers 74 and 76 rotate in a direction of the arrow G, as shown in FIG. 8 of the drawings, while the machine moves forward in a direction of the arrow F.

The concrete forming rollers 74 and 76 operate at a higher linear rate than the traction wheels 22, 24 and 30 which are driven by the mechanism, as will be hereinafter described.

It will be appreciated that the mechanism which drives the traction rollers 22, 24 and 30 must provide for the difference in linear travel with respect to the opposite sides of the machine when it traverses curved forms. For example, when the forms 50 and 51 are curved, the form 50 has a greater linear length than the form 51. Thus, the traction roller 30 must operate over a greater linear distance than the rollers 22 and 24 during movement of the machine around the curved forms.

Accordingly, the lever 206 is actuated to move the link 202 in connection with the sleeve 204 and to swing the shaft 188 about the axis of the shaft 142, which causes differential operation of the variable diameter pulleys 192 and 194. For example, when it is desired to motivate the machine about the curved forms as indicated by broken lines in FIG. 1 of the drawings, it is necessary to operate the traction wheel 30 at a greater speed than that of the wheels 22 and 24. Thus, the lever 206 will be actuated to move the shaft 188 toward the gear box 212 which causes a spreading of the pulley 192 and consequent reduction in effective diameter thereof while the spring loaded portion of the pulley 194 automatically operates to increase the effective diameter of this pulley. Thus, the ratio between the pulley 194 and the pulley 208 increases so that the gear box 212 is driven at a greater speed and consequently the traction wheel 30 is driven at a greater speed. At the same time, a reduction in diameter of the pulley 192 reduces its ratio with respect to the pulley 220 and thereby reduces the input speed to the gear box 224 and the resultant output speed of the chains 232 and 234 which drive the traction wheels 22 and 24. In this manner, the speed of the traction wheels 22 and 24 is reduced while the speed of the traction wheel 30 is increased thereby compensating for the additional linear travel of the traction wheel 30 about the curved form 50 with respect to the linear travel of the traction wheels 22 and 24 about the curved form 51 disposed at a shorter radius than that of the form 50.

Reverse operation of the differential drive mechanism may be accomplished when the curvature of the forms 50 and 51 is in the opposite direction from that shown in FIG. 1 of the drawings.

It will be appreciated that the guide wheel 48 is pivotally adjustable about the axis of the shaft 42 and may be pivoted to the right or the left to act as a guide wheel when the forms 50 and 51 are curved in either direction to the right or to the left.

As the machine moves forward in the direction of the arrow F the concrete forming rollers 74 and 76 rotate in the direction of the arrow G at a greater linear speed than the traction wheels 22, 24 and 30. The scraper 250, at its edge 252, scrapes concrete from the periphery of the roller 76 so that this roller pushes the excess concrete 254 ahead of it while the transit mix truck constantly dumps a sufficient supply of concrete ahead of the roller 76 by depositing wet concrete between the forms 50 and 51.

As the machine moves forward in the direction of the arrow F, the cams 248 engage the arms 236 to raise and drop the tamper 240 which tamps the upper surface of the horizontal portion of the sidewalk and curb structure and brings the fines to the top so that finish troweling may readily be accomplished, as desired.

It will be appreciated that the rotational speed of the concrete forming rollers 74 and 76 is such that the tamper will be raised and dropped several times before it is moved forward in connection with the machine a distance equal to its overall width.

The modified machine of the invention, as shown in FIG. 9 of the drawings, is provided with side plates 260 and 262 between which a concrete curb forming roller 264 is rotatably mounted. The plates 260 and 262, at opposite ends of the roller 264, serve as form plates. These form plates are moved longitudinally of a curb being formed and operate as slip forms while the roller 264 forms the contour of a curb structure, for example.

The roller 264, as shown in FIGS. 10 and 12 of the drawings, is particularly adapted to form a face curb structure and this roller is provided with an enlarged diameter portion 266 adjacent the frame plate 262 while the roller, near its opposite end, is provided with a reduced diameter portion 268 which operates adjacent to the frame plate 260. A bearing 270, mounted on the side plate 262, rotatably supports one end of the roller 264 while another bearing 272, supported on the side plate 260, rotatably supports the opposite end of the roller 264.

A shaft 274, of the roller 264, carries a sprocket 276 which engages a chain 278 driven by another sprocket 280 fixed to a jack shaft 282 mounted on a top plate 284 of the machine frame. This jack shaft 282 is supported in a bearing 286 on said top plate 284, and connected to the shaft 282 is a gear 288 meshing with another gear 290 driven by a short shaft 292, also mounted in the bearing structure 286. This shaft 292 carries a sprocket 294 engaging a chain 296 passing over another sprocket 298 driven by a shaft 300. This shaft 300 is mounted in bearings 302 and 304 supported on the top plate 284 of the machine frame. Secured to the shaft 300 is a sprocket 306 engaged by a chain 308 which also engages a sprocket 310 coupled to an output shaft 312 of a gear box 314 driven by an engine 316 all supported on the top plate 284 of the machine frame.

This top plates 284 is coupled to the upper edges of the slip form side plates 260 and 262, all as shown best in FIGS. 9 and 10 of the drawings.

On one side of the machine, adjacent the slip form side plate 262, is a traction wheel 318 secured to an axle 320 which is rotatably mounted in a bifurcated bracket 322. This bracket is pivotally mounted on a trunnion shaft 324 fixed to the side plate 262.

Rotatably mounted on an extending portion 326 of the trunnion shaft 324, outwardly of the bracket 322, is a sprocket 328 fixed to another sprocket 330. Thus, these sprockets 328 and 330 rotate together about the axis of the shaft portion 326 which is fixed to the side plate 262. The sprocket 328 is engaged by a chain 332 driven by a sprocket 334 on the shaft 300. The sprocket 330 is engaged by a chain 336 which also passes over a sprocket 338 fixed to the shaft 320 for driving the traction wheel 318. It will be understood that this traction wheel 318, due to its mounting on the bifurcated bracket 322 and its pivotal support on the trunnion shaft 324, is vertically movable about the axis of the trunnion shaft 324 to control elevation of the machine, as will be hereinafter described. As shown in FIG. 9 of the drawings, a hydraulic actuating cylinder 340 is pivotally mounted to the bifurcated arm 322, by means of a pin 342. This hydraulic actuating cylinder 340 is provided with an extendable plunger 344 pivotally connected by a pin 346 to a bracket 348 which is fixed to the side plate 262 of the machine frame.

Coupled to the cylinder 340 are hydraulic conduits 350 and 352 which conduits are coupled to a solenoid valve 354. This solenoid valve 354 is controlled by switching means as will be hereinafter described, to cause extension or retraction of the plunger 344 to thereby lower or raise the wheel 318 with respect to the machine frame due to its pivotal mounting about the axis of the trunnion shaft 324.

Adjacent the side plate 260 of the machine frame is a second traction wheel 356. This traction wheel 356, like the traction wheel 318, is adapted to operate on a graded surface and is vertically adjustable with relation to the frame of the machine in order to maintain proper elevation of the concrete forming roller 264, as will be hereinafter described in detail.

The traction wheel 356 is mounted on a shaft 358 rotatably mounted in a bifurcated arm 360 similar to the hereinbefore described arm 322. Secured to the shaft

358 is a sprocket 360 engaged by a chain 362 driven by another sprocket 364 rotatably mounted on an extending trunnion shaft 366 similar to the shaft 324, hereinbefore described. This shaft 366 is coupled and fixed to the side plate 260 and pivotally supports the bifurcated arm 360.

Coupled to the sprocket 364 is another sprocket 368 which is also rotatable around the trunnion shaft 366. Engaging the sprocket 368 is a chain 370 which is driven by another sprocket 372 on one end of the shaft 300, hereinbefore described.

Pivotally connected to the bifurcated arm 360, by means of a pin 374, is a hydraulic actuating cylinder 376 having a plunger 378 stationarily pivotally mounted on the side plate 260 by means of a pivot pin 380. Thus, the actuating cylinder 376 is similar to the hereinbefore described cylinder 340. This cylinder 376 is provided with a pair of hydraulic conduits 382 and 384 coupled to a valve 355.

A conventional mercury level switch 357 is mounted on the solenoid valve 355 and this level switch 357 is mounted transversely of the machine parallel to the axes of the wheels 318 and 356 in order to maintain lateral leveling control of the machine.

This switch 357 responds to tilted condition of the machine in order to actuate the solenoid valve 355 which supplies pressure fluid to the cylinder 376 to control up and down movement of the plunger thereof and corresponding up and down adjustment of the wheel 356 in order to maintain the machine level laterally thereof, so that any unevenness of the ground laterally of the machine is compensated for in order to maintain the machine level and consequently maintain a level condition of the roller 264.

Pivotally connected to the frontal portion of the machine frame is an azimuth steering arm 386. Rotatably mounted on this arm 386 is a ground-engaging wheel 388 which is disposed at the forward end of the machine.

The steering arm 386 is pivotally mounted about the axis of a shaft 390 which is supported in bearings 392 and 394 carried by brackets 386 and 398 of the machine frame. The arm 386 is fixed to the lower end of the shaft 390 and the arm projects forwardly of the machine and thus serves as a steering arm.

A bracket 400 of the machine frame, as shown in FIG. 10 of the drawings, is provided with a clevis portion 402 carrying a pin 404 on which a hydraulic cylinder 406 is pivotally mounted. This hydraulic cylinder 406 is provided with a plunger 408 pivotally mounted on a pin 410 in a bracket 412 fixed to the arm 386.

It will be seen that extension or retraction of the plunger 408 with respect to the cylinder 406 will pivot the arm 386 about the axis of the shaft 390 and thus cause lateral steering of the machine.

It will be obvious to those skilled in the art that the hydraulic cylinders 340, 376 and 406, together with their respective solenoid valves 354, 355 and 418, may be supplied with hydraulic pressure fluid by a pump 317 driven by the engine 316.

The hydraulic cylinder 406 is provided with a pair of conduits 414 and 416. These conduits are coupled to a solenoid valve 418 which is controlled by switch means, hereinafter described.

As shown in FIG. 11 of the drawings, the arm 386 carries a bracket 419 on a switch arm 420 is pivotally mounted by means of a pin 422. One end of the arm 420 is bifurcated and adapted to engage a taut line 424, which may be any suitable wire drawn tightly above the grade on which the traction wheels 318 and 356 operate. This taut line or wire 424 is precisely set at the proper elevation and proper lateral disposition with respect to a sidewalk or curb structure to be formed. Thus, the wire acts as a guide for the modified machine of the invention to follow and to thereby automatically adjust itself to the graded surface in order accurately, to form a sidewalk or curb structure between the slip form side plates 260 and 262.

It will be seen that the arm 420 is provided with a lever portion 426 having an electrical contact 428 alternately engageable with contacts 430 and 432 which are coupled to the solenoid valve 354 in order to energize the hydraulic cylinder 340, either to extend or retract its plunger, whereby the wheel 318 may be extended downwardly or retracted upwardly according to the disposition of the machine frame with respect to the taut line 424. Thus, the machine frame, also controlled by the level switch 357 as hereinbefore described, at all times, follows the level of the taut wire 424 with respect to elevation.

The azimuth control of the machine is effected by an arm 434 having a bifurcated portion 436 at its end engaged with the taut line 424. The arm 434 is similar to the arm 420, as shown in FIG. 14 of the drawings. This arm 434 is provided with an extending lever portion 436 having a contact 438 alternately engageable with contacts 440 and 442 for energizing the solenoid valve 418 alternately to conduct fluid to the hydraulic cylinder 406 to extend or retract the plunger 408 thereof. This causes steering of the arm 386 about the axis of the shaft 390 to maintain lateral control of the machine of the invention with respect to the disposition of the taut line 424. This taut line 424 may be supported at any suitable manner by stakes which may be successively moved as the machine proceeds longitudinally of the taut line 424.

Coupled to the contacts 440 and 442 are conductors 444 and 446, respectively, which are connected to the solenoid valve 418. The contact 438 is coupled to a conductor 448 which is connected to one terminal of a battery 450. The opposite terminal of the battery 450 is coupled to a conductor 452 having a switch 454 therein which may be manual connect and disconnect switch. A conductor 454 couples the conductor 452 with the solenoid valve 418. It will be seen that the conductor 452 is also coupled to the solenoid valve 354 while conductors 456 and 458 are coupled to the contacts 432 and 430, respectively. Thus, the modified machine of the invention is guided by the taut line 424 and the solenoid valve 354 and 418 control azimuth and elevation movements of the machine so that the concrete forming roller 264 may be held at a proper elevation at all times regardless of unevenness of a graded surface A on which the machine is operated. Further, the steering arm 386 together with the wheel 388 provides for azimuth control of the machine while the engine 316 rotating the shaft 300 and the traction wheels 318 and 356, causes the machine to move along over the graded surface A. Concrete poured ahead of the machine passes between the slip form side plates 260 and 262 while the roller 264 forms the cross-sectional shape of the concrete, as shown in FIG. 12 of the drawings.

It will be understood that this particular disclosure is related to a face curb while the same principle of operation may be devoted to the formation of integral sidewalks and curbs, if desired.

The lower edges 460 and 462 of the slip form side plates 260 and 262 operate adjacent to the graded surface A, so that the formed concrete C, as shown in FIG. 12 of the drawings, is supported while the roller operating between the side plates 260 and 262 forms the cross-sectional configuration of the concrete. As the roller passes along with the side plates, it is rotated in a direction of an arrow D in FIG. 9 of the drawings, operating similarly to the rotation of the roller 76, as disclosed in FIG. 8 of the drawings.

Thus, the modified machine of the invention operates independently of any forms. It provides its own side plate slip forms, namely, the side plates 260 and 262, which move along with the machine and intermediate

which the forming roller **264** forms the cross-sectional shape of the concrete.

A transit mix truck or other conveyance is used to deposit wet concrete ahead of the machine of the invention in an area which will be in the path of the machine between the side plates **260** and **262**.

In the modification of the machine steering mechanism, as shown in FIG. 15 of the drawings, the arm **44** carrying the steering wheel **48**, is pivoted to the frame about the axis of the shaft **42** and fixed to the upper end of this shaft **42** is a lever **43** having a link **45** pivotally connected thereto. The opposite end of this link **45** is pivotally connected to a bell crank **47** which is pivotally connected at **49** to the link **202** which adjusts the differential traction wheel drive mechanism, hereinbefore described. It will be seen that the arm **44**, as shown in the modification in FIG. 15 of the the drawings, is free to pivot about the axis of the shaft **42** and is not provided with a fixing quadrant **64** and arm **72**. Thus, the arm **44**, as shown in FIG. 15, freely pivots about the axis of the shaft **42** thereby moving the bell crank **43**, link **44**, bell crank **47** and the differential mechanism adjusting link **202** automatically to adjust the differential drive between the traction wheels on opposite sides of the machine so that the machine will automatically follow curved sections of the forms **50** and **51**.

This mechanism may readily be applied to the modified machine shown in FIGS. 9 and 10 of the drawings, since the taut line **424** guides the steering arm **386** through the medium of hydraulic switches, solenoid valves and the hydraulic cylinder **406**, as hereinbefore described. It will be obvious to those skilled in the art that the differential drive mechanism shown in FIGS. 1 to 7 of the drawings, may readily be applied to the machine shown in FIGS. 9 and 10 of the drawings, and that the structure shown in FIG. 15 of the drawings, may be used automatically to control the differential drive mechanism to vary the driving speeds of the traction wheels on opposite sides of the machine whether the machine is used to follow forms or whether the machine runs on a graded surface such as the surface A disclosed in FIG. 9 of the drawings.

It will further be recognized that the concrete forming rollers disclosed in the various modifications of the invention may be adapted to form integral sidewalks and curbs including contoured and faced curbs as well as integral curbs and roadway pavement, or the like.

It will be obvious to those skilled in the art that various modifications of the present invention may be resorted to in a manner limited only by a just interpretation of the following claims.

We claim:

1. In a machine for forming integral sidewalks and curbs, the combination of: a frame; side portions on said frame; traction wheels supporting said frame; an engine supported on said frame; ratio differential drive mechanism driven by said engine and coupled to said traction wheels, whereby a traction wheel engaging one of said forms may be rotated at a greater speed than a traction wheel supported on the other of said forms, thereby permitting said traction wheels accurately and uniformly to move said machine on curved portions of said forms; and concrete forming roller means rotatably mounted on said frame and extending laterally between said side portions thereof; peripheral portions of said concrete forming roller means disposed to form concrete between said forms; and drive means for rotatably driving said concrete forming roller means; said differential drive mechanism comprising a power operated shaft; a second shaft swingably supported from the axis of said power operated shaft; said second shaft having a pair of axially spring loaded variable diameter belt pulleys thereon; a belt engaging each of said pulleys; first means coupled to one of said belts disposed to drive a traction wheel engaging one of said forms and second means coupled to the other of said belts and disposed to drive a traction wheel engaging the other of said forms, whereby swinging movement of said second shaft about said power operated shaft causes enlargement of one of said pulleys and corresponding reduction of the other of said pulleys to thereby increase the operating speed of said traction wheel on one of said forms and to thereby decrease the operating speed of said traction wheel on the other of said forms.

2. In a machine for forming integral sidewalks and curbs, the combination of: a frame; side portions on said frame; traction wheels supporting said frame; an engine supported on said frame; ratio differential drive mechanism driven by said engine and coupled to said traction wheels, whereby a traction wheel engaging one of said forms may be rotated at a greater speed than a traction wheel supported on the other of said forms, thereby permitting said traction wheels accurately and uniformly to move said machine on curved portions of said forms; and concrete forming roller means rotatably mounted on said frame and extending laterally between said side portions thereof; peripheral portions of said concrete forming roller means disposed to form concrete between said forms; and drive means for rotatably driving said concrete forming roller means; a guide wheel arm pivotally mounted on a vertical axis on said frame and extending in a forwardly direction thereon; a guide wheel rotatably mounted on said arm and engagable with a form on which said machine runs; and means for locking said arm and said guide wheel in various angular positions about said vertical axis with respect to said frame.

3. In a concrete forming machine for forming concrete structures on a graded surface, the combination of: a machine frame comprising spaced slip form slide plates; a concrete forming roller therebetween and having a rotating axis disposed at an angle thereto, said roller having variations in diameter from one end to its other end; traction wheels supporting said frame and means carried by said frame and disposed to drive said traction wheels and to rotate said concrete forming roller, whereby said traction wheels operate on a graded surface to move said frame therealong, and whereby said concrete forming roller operates between said slip form side plates to form concrete while the side plates form the outer portions thereof independently of preset forms; means for vertically adjusting said traction wheels relative to said frame; switch means adapted to be responsive to a taut line; and power operated means responsive to said switch means for energizing said power operated means for vertically adjusting said traction wheels, whereby said concrete forming roller is maintained at a proper elevation with respect to said taut line by said switch means, said power operated means and said means for vertically adjusting said traction wheels and whereby the elevation of said traction wheels are adjusted with respect to uneveness of the graded surface on which said machine is operated; an azimuth steering wheel pivotally mounted on said frame and disposed forwardly thereof on a substantially vertical axis; and rotatable about a substantially horizontal axis so that the periphery of the wheel may operate on a substantially horizontal graded surface; second switch means engageable by said taut line; and means responsive thereto for pivoting said azimuth steering wheel about said substantially vertical axis for guiding said machine frame laterally on a horizontal plane with respect to said taut line.

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