United States Patent [19]

Smith

[11] **3,779,662**

[45] **Dec. 18, 1973**

[54] **CURB SLIP FORM APPARATUS**

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[22] Filed: **July 12, 1971**

[21] Appl. No.: **161,628**

[52] **U.S. Cl.** **404/98**

[51] **Int. Cl.** **E01c 11/28**

[58] **Field of Search** ..... 94/46 R, 46 AC; 404/84, 98

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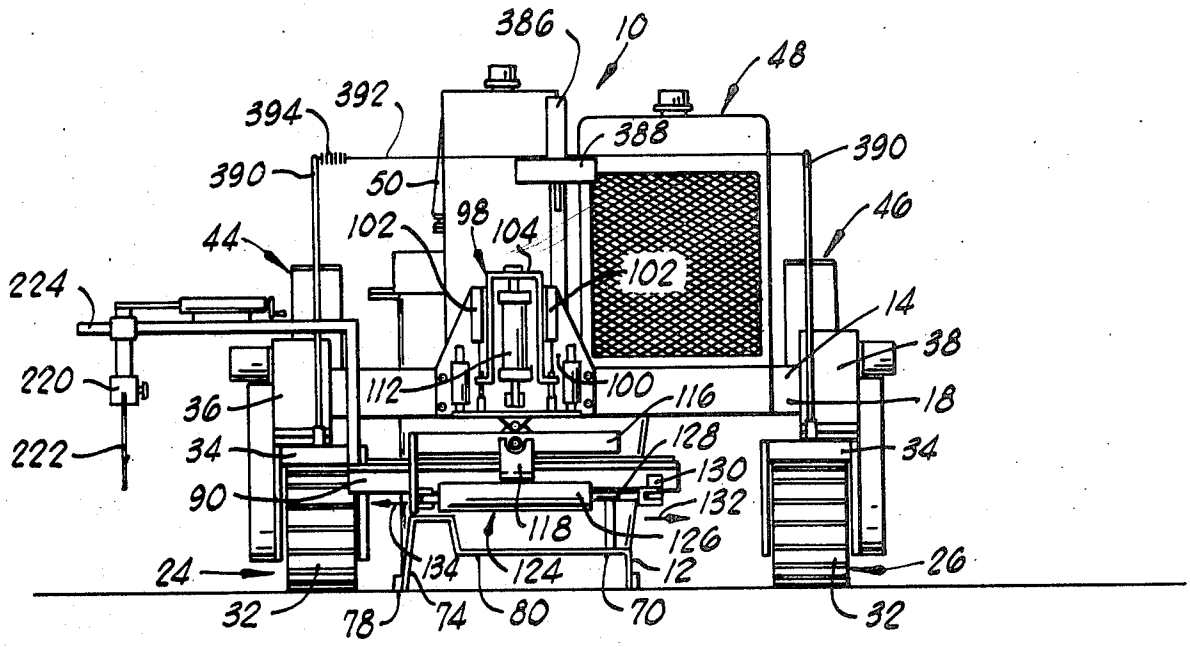
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[57] **ABSTRACT**

An improved curb slip form apparatus for forming a predetermined, formed configuration of a concrete material or the like on a surface generally along a predetermined survey line, having a form member which is pivotally connected to a support frame, the formed configuration being extruded from the form member, in an operating position of the form member and in a driven position of the support frame. The curb slip form apparatus includes, a form steering assembly which is connected to the form member and constructed to sense the position of the form member relative to a predetermined control line to automatically maintain the alignment of the form member relative to the predetermined survey line; and a track steering control, a cross slope control and an elevation control, each of which are connected to the support frame and constructed to sense the position of the support frame relative to a control line to automatically maintain the curb slip form apparatus in a predetermined aligned position; and an improved apparatus for constructing a control line along a predetermined survey.

28 Claims, 18 Drawing Figures



PATENTED DEC 18 1973

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SHEET 1 OF 7

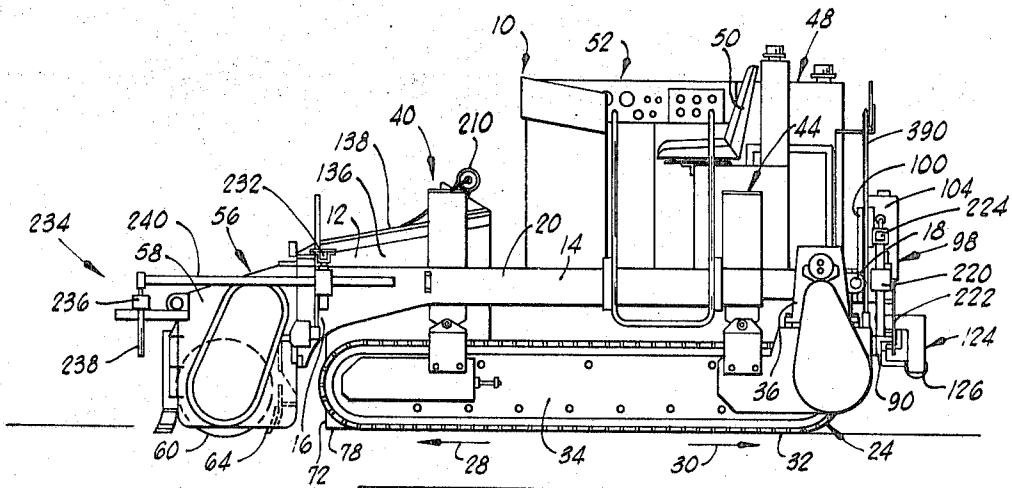


FIG. 1

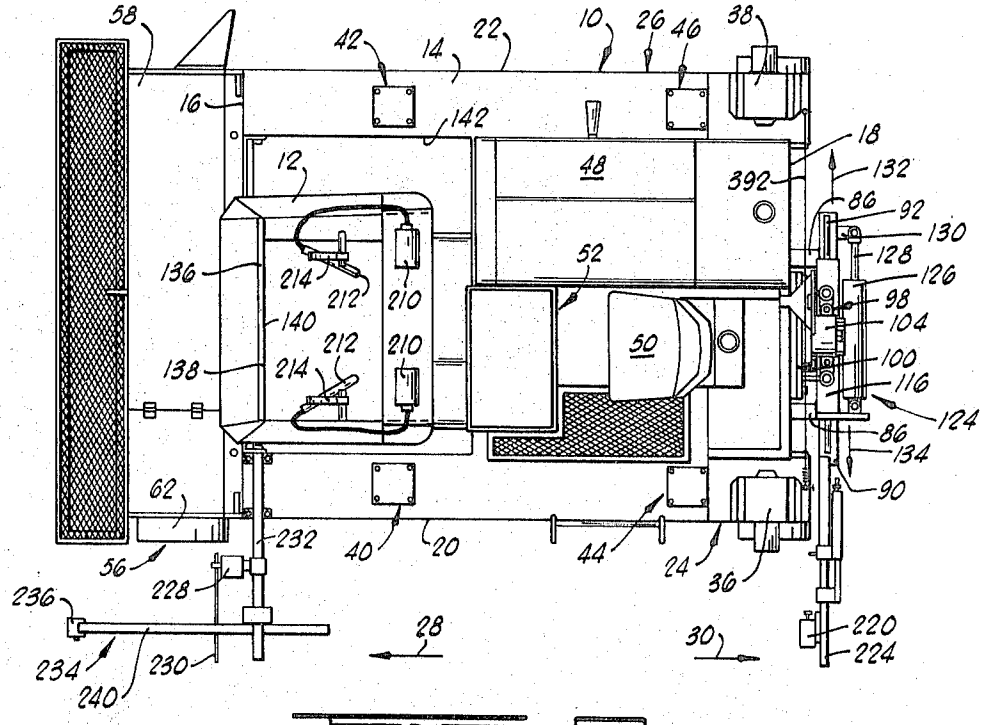


FIG. 2

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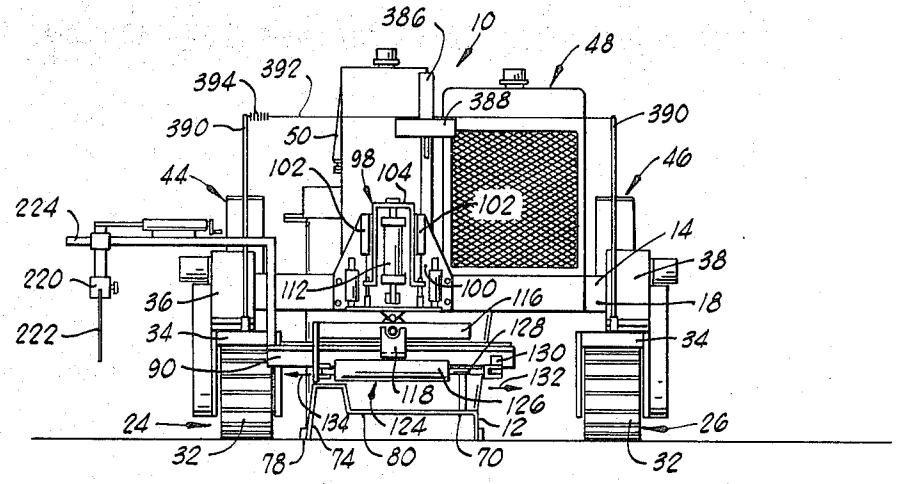


FIG. 3

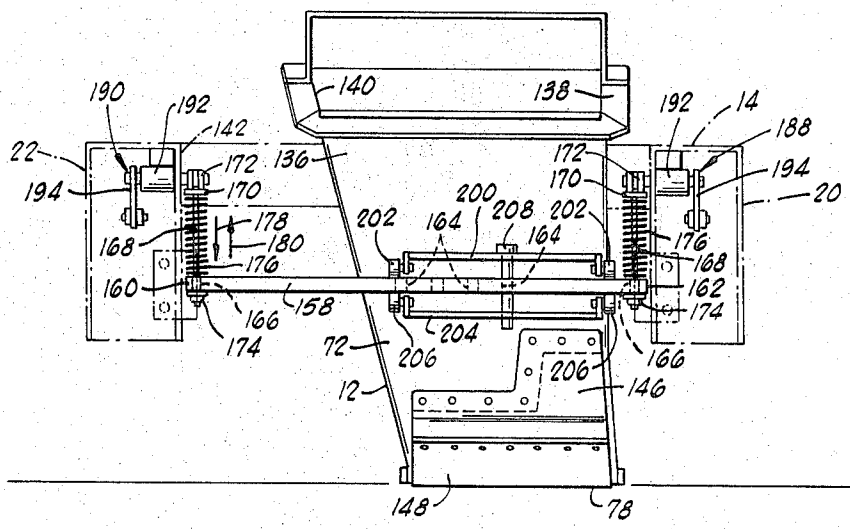


FIG. 4

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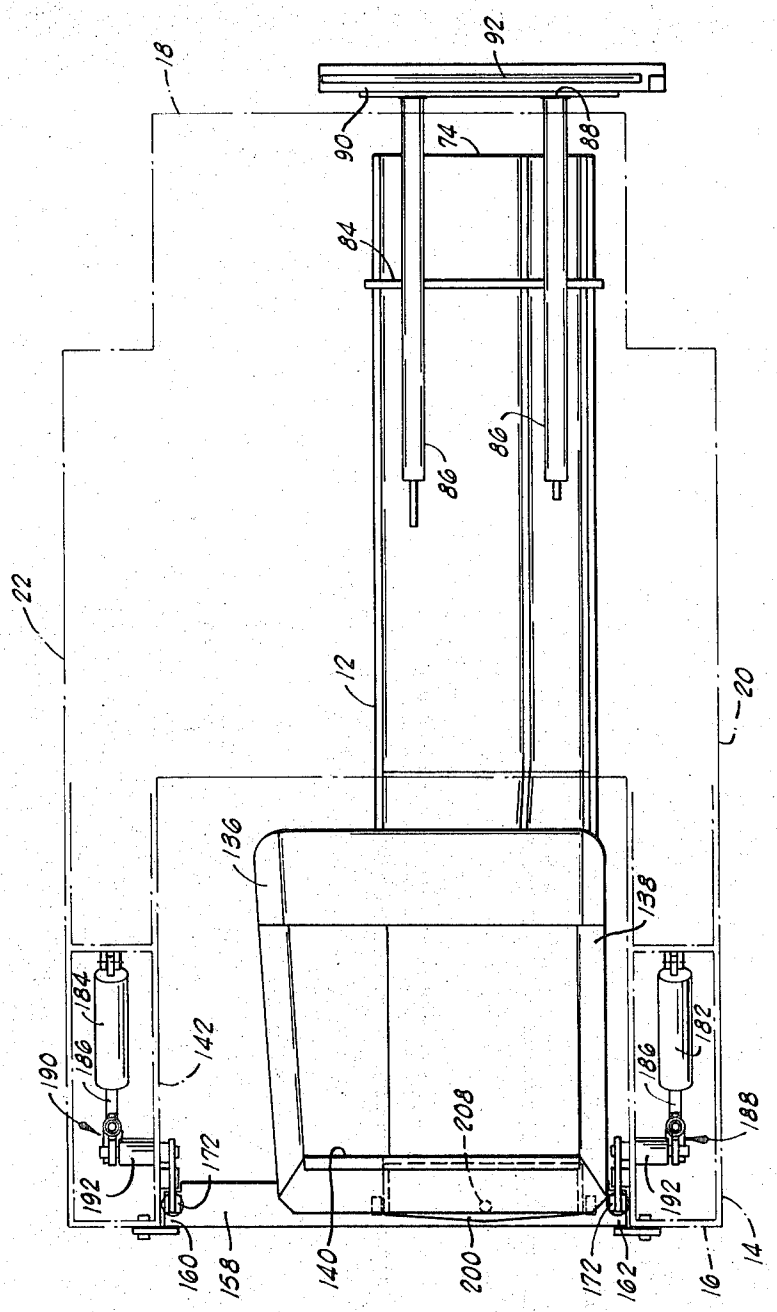


FIG. 3

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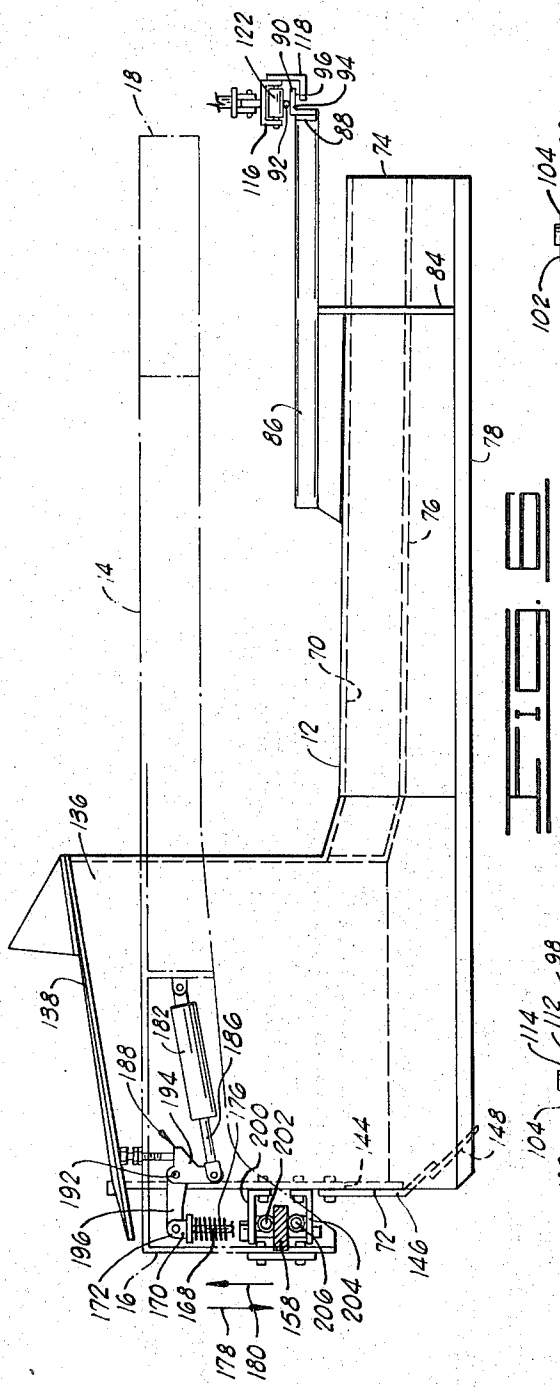


FIG. 5

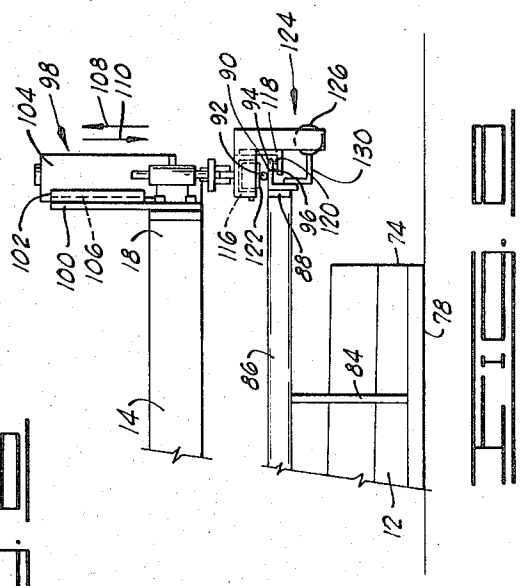


FIG. 8

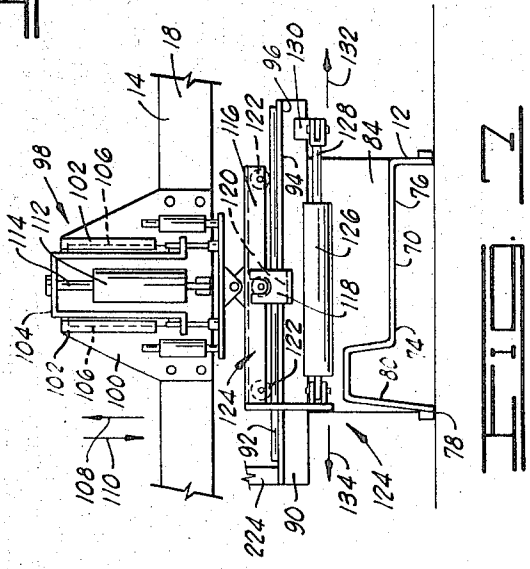


FIG. 7

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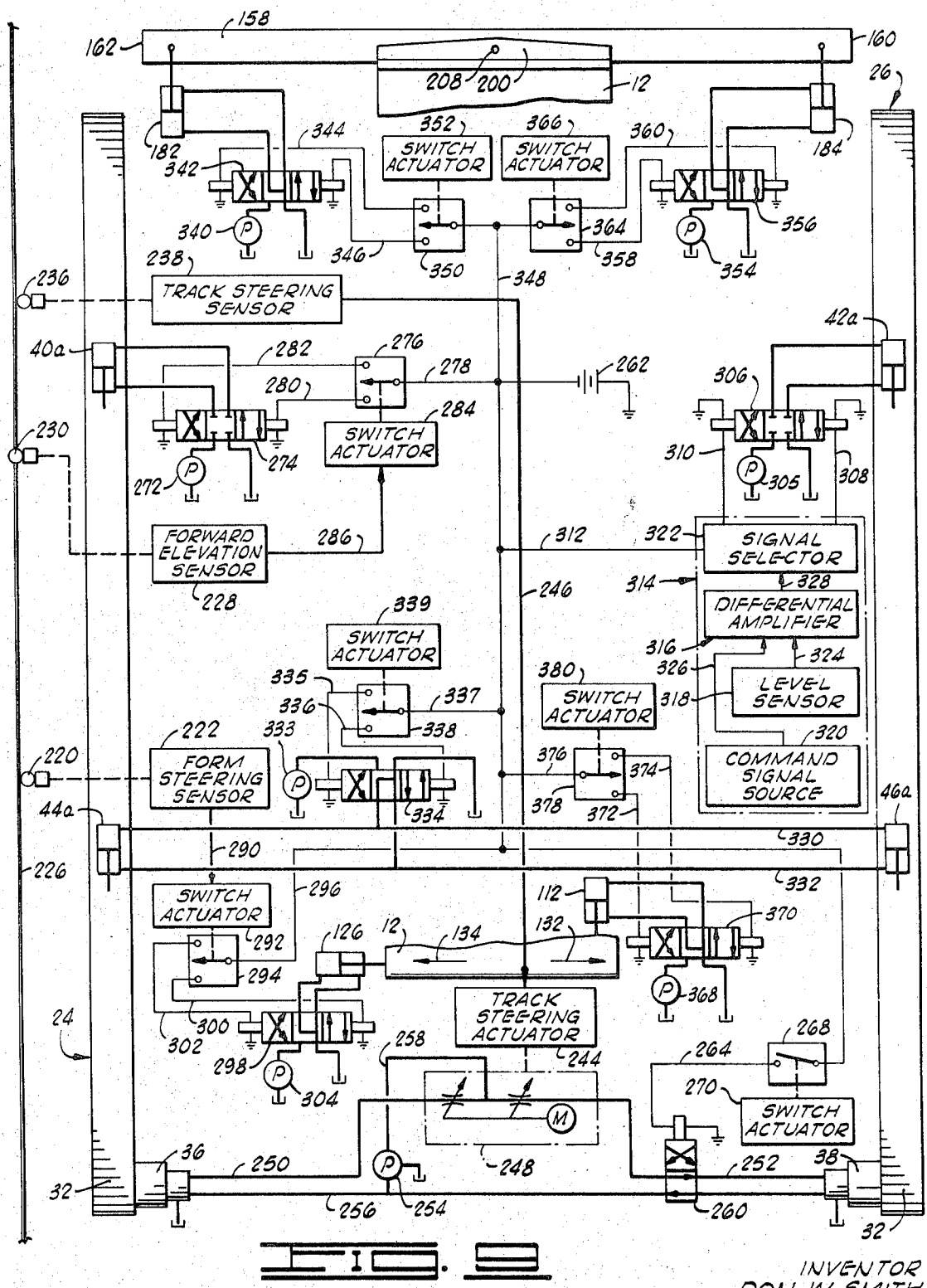


FIG. 10

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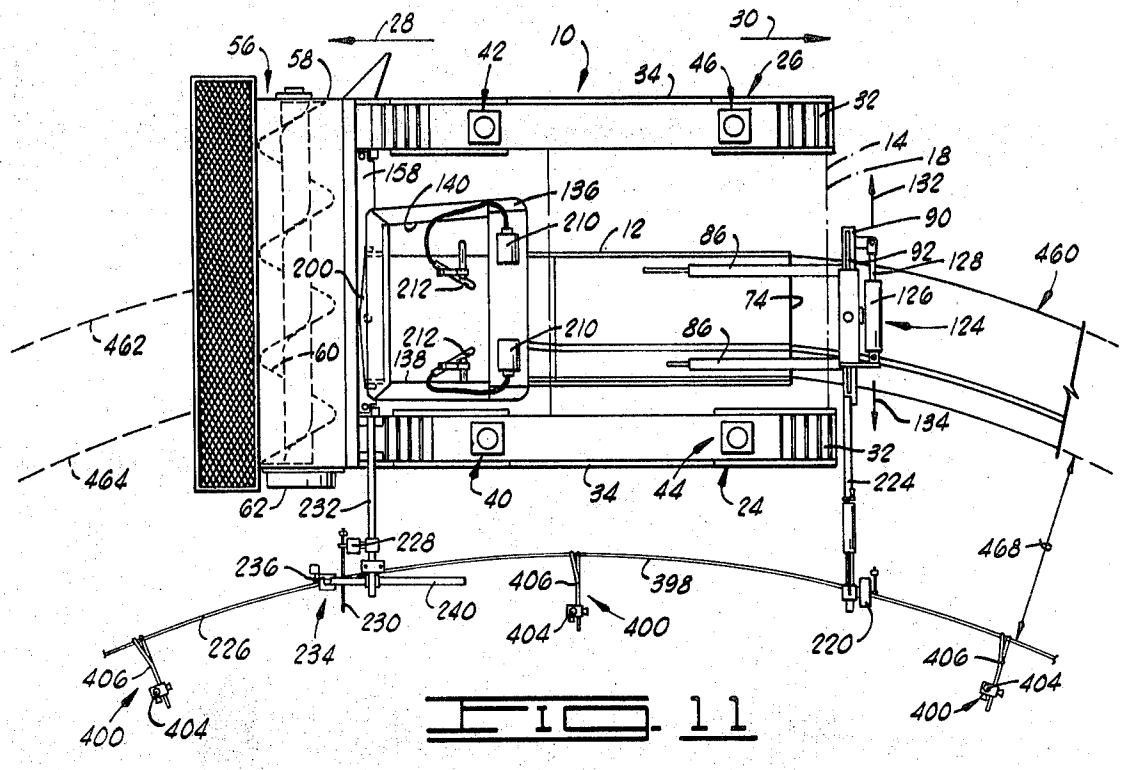


FIG. 11

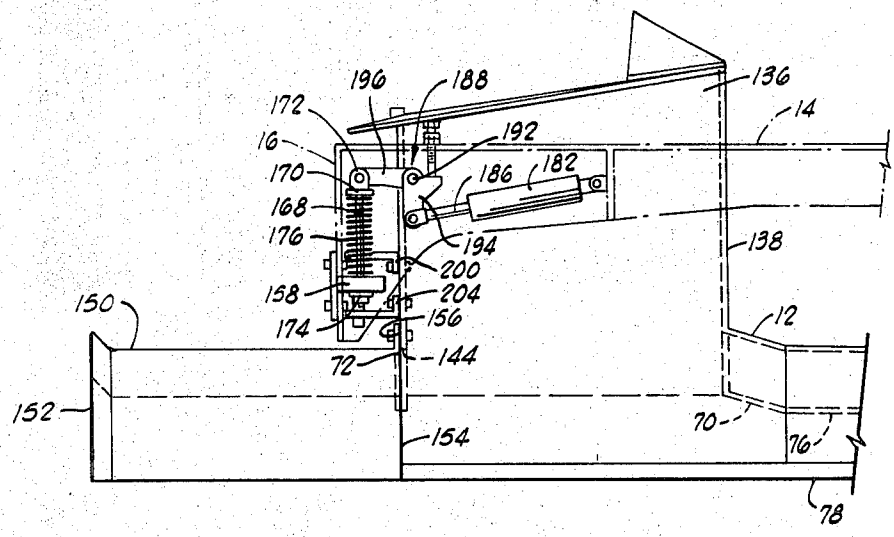


FIG. 10

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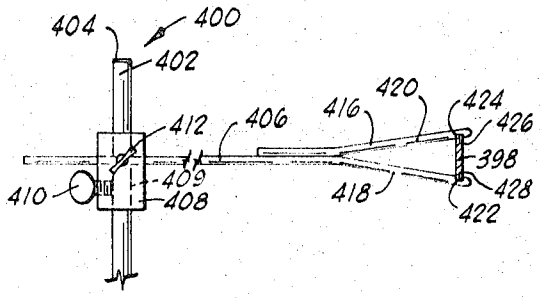


FIG. 12

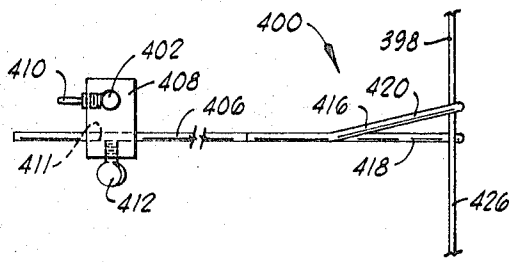


FIG. 13

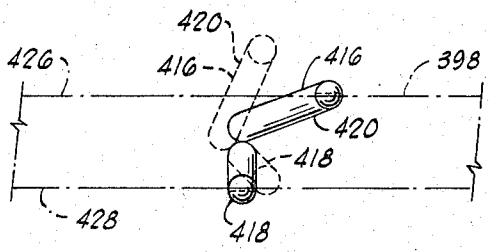


FIG. 14

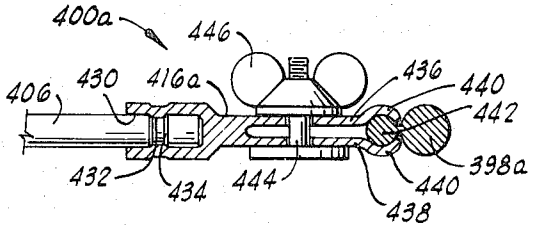


FIG. 15

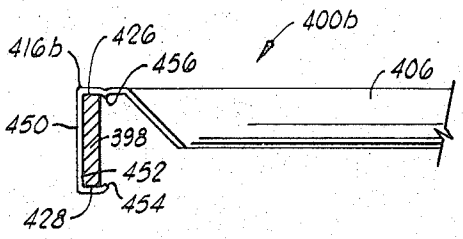


FIG. 17

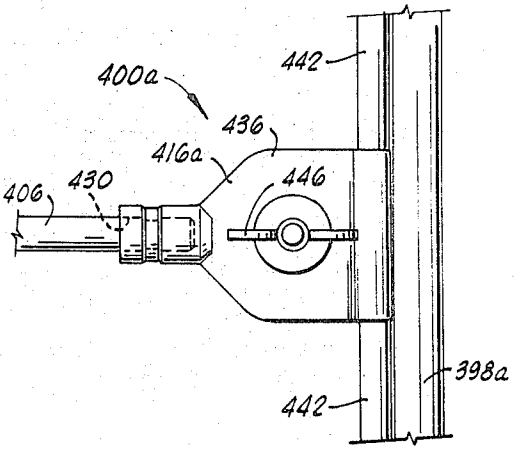


FIG. 16

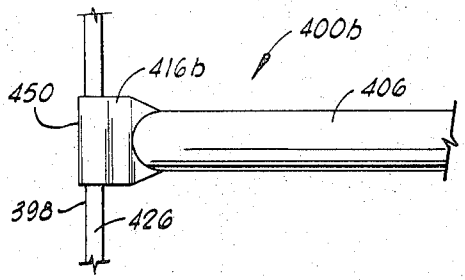


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CURB SLIP FORM APPARATUS

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to improvements in material forming apparatus and, more particularly, but not by way of limitation, to a curb slip form apparatus for extruding a predetermined, curb-shaped, formed configuration in alignment with a predetermined survey line.

2. Description of the Prior Art

In the construction of highways, streets, roadways, and the like, it becomes necessary in many applications to provide various formed configurations constructed of a concrete material or the like. A common formed configuration has been the curb portion of the roadway which, in the past, has been formed utilizing stationary form members and a variety of hand finishing techniques. The many disadvantages associated with the use of stationary forms and hand finishing techniques has lead to many attempts, in the past, to construct some type of apparatus capable of forming a curb-shaped, formed configuration utilizing a slip form technique along a predetermined path or survey line.

Some of the apparatus of the type mentioned above has been constructed to be moved along rail-type members, the rail-type members being affixed in position, generally aligned with the survey line, thereby tending to maintain the forming apparatus aligned therewith. In some instances the rail-type members were also positioned and utilized to provide a portion of the curb form per se.

The utilization of rail-type members, as generally described above, still required stationary form members to be installed and subsequently removed, and thus provided only a partial solution to the many problems involved in forming such configurations. It should also be noted that machines constructed to be operated along such rail-type members were also basically limited to the forming of such curb-shaped configurations generally along a relatively straight path or at least, the radius of curvature of such a path was inherently limited.

Some of the above-mentioned problems were partially solved by the development of machines having a curb-shaped form supportedly driven by tracks or wheels. It has been found, however, that such track driven apparatus has a tendency to wobble or, in other words, to have some back and forth, sideways movement while being driven in a forward direction. This wobbling effect has been found to produce a formed configuration which, of course, was not aligned with the predetermined survey line or path, but rather a formed configuration which followed the wobbling movement of the machine.

The problem of maintaining the alignment of a machine to form curb-shaped, configurations becomes even more complicated and complex when forming curb configurations along curved paths or survey lines. It has been found that as the front end portion of the machine moves to maintain the alignment thereof with the curved survey line, the rearward end of the machine tends to move or deviate from an aligned position, and essentially crosses over the path of travel aligned with the predetermined survey line, thereby forming a finished curb which substantially deviates from the predetermined survey.

SUMMARY OF THE INVENTION

One object of the invention is to provide an apparatus for fomring curb-shaped, configurations of a concrete material or the like wherein the alignment of the formed configuration is maintained relative to a predetermined survey line.

Another object of the invention is to provide an apparatus for forming curb-shaped configurations in a more positive and efficient manner.

One other object of the invention is to provide an apparatus for preparing a surface and forming a curb-shaped configuration thereon in a more economical and efficient manner.

An additional object of the invention is to provide an apparatus capable of forming curb-shaped configurations wherein reinforcing, rod-like bars or expansion joints are spaced at predetermined positions in the formed configuration.

Another object of the invention is to provide a curb slip form apparatus for forming curb-shaped configurations of a concrete material or the like which is economical in construction and operation thereof.

Another object of the invention is to provide an apparatus for forming a control line which is aligned with a predetermined, curved survey line.

Yet another object of the invention is to provide an apparatus for forming a control line aligned with a predetermined survey line which is economical in the construction and operation thereof.

One other object of the invention is to provide an apparatus for forming a control line wherein the control line can be quickly and efficiently constructed and disassembled.

Other objects and advantages of the invention will be evident from the following detailed descripton when read in conjunction with the accompanying drawings which illustrate the preferred embodiment of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevational view of a curb slip form apparatus.

FIG. 2 is a top plan view of the curb slip form apparatus of FIG. 1.

FIG. 3 is an end elevational view of the curb slip form apparatus of FIG. 1.

FIG. 4 is an end elevational view of the form member of the curb slip form apparatus of FIG. 1, and showing a portion of the interconnection between the form member and the support frame.

FIG. 5 is a top plan view of the form member of FIG. 4.

FIG. 6 is a side elevational view of the form member of FIG. 4.

FIG. 7 is an enlarged end elevational view of a portion of the curb slip form apparatus of FIG. 1, showing a portion of the interconnection between the support frame and the form member.

FIG. 8 is an enlarged side elevational view of a portion of the curb slip form apparatus showing a portion of the interconnection between the support frame and the form member.

FIG. 9 is a partial schematic, partial diagrammatial view of some of the control apparatus of the curb slip form apparatus of FIG. 1.

FIG. 10 is a fragmentary, side elevational view of the form member of FIGS. 4, 5, 6, 7 and 8 having a portion of the forward end thereof removed and a forward form extension member secured thereto.

FIG. 11 is a diagrammatical view of the curb slip form apparatus of FIG. 1, showing the operation thereof to form a curb-shaped configuration aligned with a predetermiend control line. FIG. 12 is an enlarged, fragmentary, side elevational view of the control line holder of FIG. 11.

FIG. 13 is a top plan view of the control line holder of FIG. 12.

FIG. 14 is a front end elevational view of the control line holder of FIG. 12.

FIG. 15 is an enlarged, fragmentary, side elevational view of a modified control line holder, similar to the control line holder of FIG. 12.

FIG. 16 is a top plan view of the modified control line holder of FIG. 15.

FIG. 17 is an enlarged, fragmentary, side elevational view of another modified control line holder, similar to the control line holder of FIG. 12.

FIG. 18 is a top plan view of the modified control line holder of FIG. 17.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings in general, and to FIGS. 1, 2 and 3 in particular, shown therein and designated by the general reference numeral 10 is a curb slip form apparatus, which includes: a form member 12 movably supported on a support frame 14; the support frame 14 having a forward end 16, a rearward end 18, a left side 20 and a right side 22. The curb slip forms apparatus 10 is constructed to form a predetermined, formed configuration of a concrete material or the like on a surface, generally along a predetermined survey line, the predetermined formed configuration being, more particularly, defined with respect to the present invention as curb-shaped. The curb slip form apparatus 10 includes various control assemblies and apparatus which are adapted to sense the position of the support frame 14 and the position of the form member 12 relative to a predetermined control line, and to automatically position the support frame 14 and the form member 12 to maintain the extruded, formed configuration aligned with the predetermined survey line, in a manner which will be described in greater detail below.

It should be initially noted that the term "survey" is used above and below to indicate a position on the surface of the earth along which the curb or other formed configuration is to be disposed, a position or line being determined in most instances by a survey, in a manner well known in the art. The term "control line" is used above and below to indicate a constructed line, generally parallel to the "survey line", which is disposed a predetermined distance from the "survey line" and constructed to provide a sensing guide to cooperate in maintaining the movment of the curb slip form apparatus 10 and the form member 12 aligned with the "survey line", during the operation thereof. It should also be noted that, in a preferred form, the "control line" is also disposed in a predetrmined horizontal plane or, in other words, at a predetermined elevation, to provide an additional sensing guide to cooperate in maintaining the elevation of the curb slip form apparatus 10 relative to a predetermined, surveyed elevation, during the operation of the curb slip form apparatus 10, in a manner which will be made more apparent below.

The support frame 14 is drivingly supported via a left track assembly 24 and a right track assembly 26, the left track assembly 24 and the right track assembly 26 moving the support frame 14 in a generally forward direction 28 and a generally rearward direction 30, in a driven position of the left track assembly 24 and the right track assembly 26. As shown more clearly in FIG. 1, the left track assembly 24 is connected to the support frame 14, generally near the left side 20 thereof, and extends generally between the forward end 16 and the rearward end 18 of the support frame 14. The right track assembly 26, as indicated in FIGS. 2 and 3, is connected to the suport frame 14, generally near the right side 22 thereof, and extends generally between the forward end 16 and the rearward end 18 of the support frame 14.

The left track assembly 24 and the right track assembly 26 each include an endless track member 32 which is drivingly supported via a track support member 34. More particularly, the left track assembly 24 is driven via a left hydraulic motor 36 and the right track assembly 26 is driven via a right hydraulic motor 38, the driving interconnection between the left hydraulic motor 36 and the left track assembly 24, and between the right hydraulic motor 38 and the right track assembly 26 to drivingly move the endless track members 32 being well known in the art, and a detailed description of the various interconnecting components and the operation thereof is not required herein.

The curb slip form apparatus 10 includes a forward elevation positioning assembly 40, a cross-slop positioning assembly 42, a left rearward elevation positioning assembly 44 and a right rearward elevation positioning assembly 46. The forward elevation positioning assembly 40 is, more particularly, disposed generally near the left side 20 and generally near the forward end 16 of the support frame 14 and has a portion connected to the track support member 34 of the left track assembly 24 and another portion connected to the suport frame 14 to raise the suport frame 14 in a generally vertically upwardly direction, in an actuated raising position thereof, and to lower the support frame 14 in a generally vertically downwardly direction, in an actuated lowering position thereof. The cross-slope positioning assembly 42 has a portion thereof connected to the track support member 34 of the right track assembly 26 and another portion thereof connected to the support frame 14, generally near the right side 22 and generally near the forward end 16 of the support frame 14, to raise the support frame 14 in a generally vertically upwardly direction, in an actuated raising position thereof, and to lower the support frame 14 in a generally vertically downward direction in an actuated lowering postion thereof. The left rearward elevation positioning assembly 44 has a portion connected to the track support member 34 of the left track assembly 24 and another portion connected to the support frame 14 generally near the left side 20 of the support frame 14 and generally near the rearward end 18 of the suport frame 14, the left rearward elevation positioning assembly 44 raising the support frame 14 in a generally vertically upwardly direction, in an actuated raising position thereof and lowering the support frame 14 in a generally vertically downwardly direction, in an actuated lowering position thereof. The right rearward ele-

vation positioning assembly **46** has a portion connected to the track support member **34** of the right track assembly **26** and another portion connected to the support frame **14** generally near the right side **22** of the support frame **14** and generally near the rearward end **18** of the support frame **14,** the right rearward elevation positioning assembly **46** being constructed to raise the support frame **14** in a generally vertically upwardly direction, in an actuated raising position thereof, and to lower the support frame **14** in a generally vertically downwardly direction, in an actuated lowering position thereof, for reasons and in a manner to be made more apparent below.

More particularly, the forward elevation positioning assembly **40,** the cross slope positioning assembly **42,** the left rearward elevation positioning assembly **44** and the right rearward elevational positioning assembly **46** each include a double-acting hydraulic cylinder having a reciprocating piston (not shown) mounted in a cylinder (not shown), each hydraulic cylinder having a portion thereof connected to a portion of the one of the track support members **34** and another portion thereof connected to the support frame **12.** Each hydraulic cylinder is constructed and disposed to raise and lower the support frame **14,** to position the support frame **14** in predetermined grade and slope positions, in a manner to be made more apparent below.

The primary driving impetus for the curb slip form apparatus **10** is provided by a power unit **48,** which is supported on the support frame **14** generally near the rearward end **18** thereof, as shown more clearly in FIGS. **1** and **2.** The power unit **48** includes a power fluid reservoir (not shown) which is sized to retain a predetermined amount of power fluid for utilization in the hydraulic control portion of the curb slip form apparatus **10** (to be described in greater detail below). The power unit **48** may be of a conventional design such as, for example, a diesel powered engine, and the construction and operation of such a power unit, including the various interconnecting components and operation thereof to drivingly connect the power unit to the various operating components and assemblies of the curb slip form apparatus **10,** are well known in the art and a detailed description thereof is not required herein.

An operator seat **50** is supported on the support frame **14** and is disposed generally near a control console **52,** as shown more clearly in FIGS. **1** and **2.** In a preferred form, the control console **52** contains substantially all of the manually-operated, control actuating elements to control the various aspects of the curb slip form apparatus **10,** such that an operator can easily control the curb slip form apparatus **10** during the operation thereof, which will be described in greater detail below.

As shown more clearly in FIGS. **1** and **2,** the curb slip form apparatus **10** also includes an earth engaging assembly **56,** having an auger frame **58** which is removably secured to the forward end portion **16** of the support frame **14** and supported thereby. An auger **60** is rotatingly supported on the auger frame **58** and is drivingly connected to an auger hydraulic motor **62** (schematically shown in FIG. **10**). As shown more clearly in FIG. **1,** a moldboard **64** is also supported on a portion of the auger frame **58,** and the moldboard **64** being interposed generally between the auger **60** and the forward end **16** of the support frame **14.** The auger **60** and the moldboard **64** are each disposed to excavatingly engage a portion of earth in a driven position of the auger **60** and in a driven position of the support frame **14,** to prepare a portion of the earth for the formed configuration to be disposed thereon during one aspect of the operation of the curb slip form apparatus **10,** in a manner to be described in greater detail below.

Referring more particularly to the form member **12,** the form member **12** is shaped to formingly engage the concrete material or the like to form such material to a predetermined form configuration, in an operating position of the form member **12** and in a driven position of the support frame **14.** The form member, as shown more clearly in FIGS. **4, 5** and **6,** is disposed generally between the left side **20** and the right side **22** of the support frame **14** and extends lengthwise generally between the forward end **16** and the rearward end **18** of the support frame **14,** in an assembled position of the form member **12.**

More particularly, the form member **12** is shaped to provide a form cavity **70** which extends through a major portion of the form member **12,** intersecting a portion of a forward end **72** and a rearward end **74** of the form member **12,** as shown more clearly in FIGS. **4, 5** and **6.** A surface portion **76** of the form member **12** defines the form cavity **70,** and the surface portion **76** formingly engages the concrete material or the like to form such material to the predetermined form configuration or, more particularly, to the predetermined, curb-shaped form configuration, during the operation of the curb slip form apparatus **10,** as will be made more apparent below.

The form member **12** has a lower most end **78** which slidingly engages the surface of the earth, in an operating position of the form member **12,** as shown more clearly in FIG. **3.** In an operating position of the form member **12,** the form cavity **70** thus encompasses an adjacent portion of the earth's surface to retain the concrete material or the like generally within the form cavity **70,** the formed configuration being furnishingly engaged by the surface portion **76** and extruding generally from a rearward opening **80** formed in the rearward end **74** of the form member **12** by the form cavity **70,** during the operation of the curb slip form apparatus.

As shown more clearly in FIGS. **3, 5** and **6,** a reinforcing structure **84** is secured about a portion of the form member **12** to increase the structural integrity of that portion of the form member **12** shaped to provide form cavity **70,** and to provide additional structural support for the positioning elements connected to the form member **12.** More particularly, a pair of form extension members **86** are secured to a portion of the form member **12** and to a portion of the reinforcing structure **84,** and each form extension member **86** extends a distance beyond the rearward end **74** of the form member **12,** terminating with an outer most end portion **88** thereof. A brace **90** is secured to the outer most end **88** of each form extension member **86,** and a rod member **92** is secured to the upper most end of the brace **90,** the rod member **92** extending generally between the two form extension members **86.**

A lip portion **94** is formed on the rearward end of the form member **12** or, more particularly, on the brace **90.** The lip portion **94** extends a distance from the form member **12** providing a downwardly facing surface **96,**

extending a distance generally along the brace **90**, for reasons which will be made more apparent below.

As shown more clearly in FIGS. **3**, **7** and **8**, a rearward form positioning assemlby **98** is connected to the support frame **14**, generally near the rearward end **18** and generally between the left side **20** and the right side **22** thereof. The rearward form positioning assembly **98** is constructed to engage a portion of the form member **12** to lower the form member **12**, in an actuated lowering position of the rearward form positioning assembly **98**, and to raise the form member **12** in an actuated raising position of the rearward form positioning assembly **98**, in a maner to be described in greater detail below.

As shown more clearly in FIGS. **7** and **8**, the rearward form positioning assembly **98**, more particularly, includes a support housing **100** having a pair of channels **102** formed through a portion thereof. A connecting member **104**, having a pair of vertically extending flanges **106** formed thereon, is slidingly connected to the support housing **100**, and, more particularly, each of the flanges **106** is slidingly disposed in one of the channels **102** such that the connecting member **104** can be slidingly moved in a vertically upwardly direction **108** and in a vertically downwardly direction **110**, for reasons which will be made more apparent below.

A double-acting hydraulic cylinder **112**, having a rod portion **114** reciprocatingly disposed therein, is secured to the support frame **12**, generally near the rearward end **18** thereof. The rod portion **114** of the hydraulic cylinder **112** is secured to a portion of the connecting member **104**, as shown more clearly in FIG. **7**. The hydraulic cylinder **112** has an actuated raising position and an actuated lowering position, and is thus secured to the connecting member **104** to move the connecting member **104** in a vertically upwardly direction **108**, in an actuated raising position thereof and to move the connecting member **104** in a vertical downwardly direction **110**, in an actuated lowering position thereof.

A U-shaped channel member **116** is connected to the support frame **14**, generally near the rearward end **18** thereof and, more particularly, the connecting member **104** is secured to a central portion of the channel member **116**, as shown more clearly in FIG. **7** and **8**. A flange portion **118** is secured to a central portion of the channel member **116**, the flange portion **118** extending a distance generally vertically downwardly from the channel member **116**. A portion of the flange **118**, generally near the lower most end thereof, is formed at a right angle, thereby providing an upwardly facing surface **120**. The flange portion **118** is disposed on the channel member **116** in close proximity to the lip portion **94** of the form member **112**, such that the upwardly facing surface **120** of the flange **118** is spaced a distance from the downwardly facing surface **96** of the lip **94**, in an operating position of the form member **12**, and such that the upwardly facing surface **120** of the flange **118** will retainingly engage a portion of the downwardly facing surface **96** of the lip **94** in an actuated raising position of the rearward form positioning assembly **98**. The flange portion **118** cooperates with the lip portion **94** so that the form member **12** can be raised to a storage position or, in other words, to a position wherein the lower most end **78** of the form member **12** is raised a distance vertically above the earth's surface, for reasons which will be made more apparent below.

A plurality of rollers **112** are rollingly supported on the channel member **116**, as shown in FIG. **7** and **8**. Each roller **122** is disposed to rollingly engage the rod member **93** on the brace **90** of the form member **12** to reduce the sliding friction between the form member **12** and the support frame **14**, when the form member **12** is being pivoted to an aligned position, as will be described in greater detail below.

The curb slip form apparatus **10** includes, a form steering assembly **124** which is connected to the form member **12** to pivotally move the form member **12** to maintain the alignment thereof relative to a predetermined survey line, thereby maintaining the alignment of the formed configuration relative to the predetermined survey line. The form steering assembly **124** includes, a form steering member **126** which, in a preferred form and as shown more clearly in FIGS. **7** and **8**, is a double-acting hydraulic cylinder having a rod portion **128** reciprocatingly disposed therein.

The cylinder portion of the form steering member **126** is pivotally secured to the support frame **14** and more particularly, is pivotally secured to the brace **90**. The rod portion **128** is pivotally connected to the form member **12** or, more particularly, to a flange extension **130** which is secured to a portion of the reinforing structure **84** of the form member **12**. The form steering member **126** is connectd to the form member **12** to pivotally move the form member **12** in a first pivot direction **132** generally toward the right side **22** of the support frame **14**, in one actuated position of the form steering member **126**, and to pivotally move the form member **12** in a second pivot direction **134** generally toward the left side **20** of the support frame **14**, in one other actuated position of the form steering member **126**, in a manner which will be described in greater detail below.

As shown more clearly in FIGS. **5**, **6** and **7**, the form member **12** also includes, a concrete receiving portion **136** formed on an upper portion of the form member **12**, generally near the forward end **62** thereof. The concrete receiving portion **136** extends generally vertically upwardly from the surface portion **76** of the form member **12**, terminating with an upper end **138** forming an opening **140** therethrough. As shown more clearly in FIG. **4**, the concrete receiving portion **136** of the form member **12** funnels outwardly toward the upper end **138** thereof, generally on one side thereof, thereby increasing the size of the opening **140** generally near the upper end **138** to provide an adequate area for receiving the concrete material or the like, during the operation of the curb slip form apparatus **10**.

In an assembled position of the form member **12**, as shown more clearly in FIGS. **1** and **2**, a portion of the concrete receiving portion **136** of the form member **12**, generally near the upper end **138** thereof, extends vertically upwardly through a form opening **142** formed through a portion of the support frame **14**. In a preferred form and as shown more clearly in FIG. **5**, the form opening **142** in the support frame **14** is formed therethrough generally between the left side **20** and the right side **22** thereof, and intersects a portion of the forward end **16** of the suport frame **14**. The form opening **142** is formed through the suport frame **14** in such a manner that the concrete receiving portion **136** of the form member **12** can be passed through the instersec-

tion of the form opening 142 with the forward end 16 of the supporrt frame 14 to facilitate the moving of the support frame 14 to a disengaged position with respect to the form member 12 and the moving of the support frame 14 to an engaging or an assembled position with respect to the form member 12, in a manner and for reasons which will be described in greater detail below.

As shown more clearly in FIGS. 6 and 10, and in a preferred form, the form cavity 70 extends through and intersects a portion of the forward end 72 of the form member 12, thereby forming a forward opening 144 in the forward end 72. It should be particularly noted that although the forward opening 144, in a preferred form as indicated in FIGS. 6 and 10, is shaped similar to the rearward opening 80 of the form member 12, it is not necessary that the forward opening 144 be so shaped, but rather is only necessary that the forward opening 144 be of a sufficient size to pass expansion joints, reinforcing rods or the like therethrough, in a driven position of the curb slip form apparatus 10 and during one aspect of the operation thereof, as will be made more apparent below.

As shown more clearly in FIGS. 4 and 6, a cover 146 is removably secured to the forward end 72 of the form member 12, generally near the forward opening 144. In a preferred form, the lowermost end portion of the cover 146 is curved inwardly, generally toward the rearward end 74 of the form member 12, and a resilient flange 148 is secured thereon. The resilient flange 148 extends a distance downwardly from the cover 146 and, in a preferred form, is sized to overlappingly engage an adjacent portion of the earth's surface in an operating position of the form member 12, for reasons which will become more apparent below.

It should also be particularly noted that, in the other form, the form member 12 cam be constructed having a solid forward end 72; that is without the forward opening 144 therethrough; however, as shown more clearly in FIG. 10, the forward opening 144 in the form member 12 is provided to cooperate with a form extension section 150 to retain the concrete material generally within the surveyed path to be finishingly contacted by the form member 12. The form extension section 150 has a forward end 152 and a rearward end 154. A flange 156 is formed about a portion of the rearward end 154, the flange 156 being constructed to be removably and boltingly interconnected to the forward end 72 of the form member 12, during one aspect of the operation of the curb slip form apparatus 10, as will be made apparent below.

The form extension section 150 is connected to the forward end 72 of the form member 12, generally about the forward opening 144, and extends a predetermined distance therefrom, the precise distance being determined by the particular size of the form member 12, the rate of speed at which the curb slip form apparatus 10 is driven during the operation, and the volume and characteristics of the concrete material being utilized to form the pre-determined formed configuration. During the operation of the curb slipform apparatus 10, the concrete material is poured into the opening 140 of the concrete receiving portion 136, and is funneled therethrough into a position of the finishingly engaged by the surface 76 of the form memmber 12. If the cover 146 and the resilient flange 148 have been removed, some of the concrete material will be moved generally out of the form member 12 through the forward opening 144, since the curb form apparatus 10, is generally driven at a relatively slow rate of speed. The form extension section 150 thus retains that portion of the concrete material generally within a path to be subsequently engaged by the finising surface 76 of the form member 12, thereby substantially preventing the over-flow of concrete material.

It should also be noted that, although the form extension section 150 is shown in FIG. 10 as having a shaped configuration similar to the curb-shaped configuration of the form member 12, it is not essentil that the form extension section 150 be so shaped. As will be apparent from the foregoing, it is only necessary that the form extension section 150 be shaped to retain a predetermined amount of the concrete material to substantially prevent the over-flow thereof through the forward opening 144.

As shown more clearly in FIGS. 4, 5 and 6, a tow bar 158, having opposite ends 160 and 162, is connected to the support frame 14, generally near the forward end 16 thereof, and extending generally between the left side 20 and the right side 22 of the support frame 14. The tow bar 158 has a plurality of pivot apertures 164 formed therethrough, the tow bar 158 being disposed and constructed to provide the pivotal interconnection between the support frame 14 of the form member 12, in a manner which will be described in greater detail below.

As shown more clearly in FIG. 4, a pair of pin apertures 166 are formed through the tow bar 158, one of the pin apertures 166 being formed through the tow bar 158 generally near the end 160 thereof, and the other pin aperture 166 being formed through the tow bar 158 generally near the end 162 thereof. A pin 168 is slidingly journaled through each pin aperture 166. A flange portion 170 is fomred on one end of each pin 168, and a U-shaped support 172 is formed on each flange 170.

A retaining ring 174 is adjustably secured to the end of each pin 168, opposite the end thereof having the flange 170 formed thereon. Each retaining ring 174 engages an adjacent portion of the tow bar 158 to limit the movement of the pin 168 connected thereto, in a generally vertically upwardly direction through the pin apertures 166, via an adjusting nut, for reasons which will be made more apparent below.

As shown more clearly in FIG. 4, a spring 176 is disposed about each pin 168 and positioned thereon such that a portion of each spring 176 engages a portion of the tow bar 158 and another portion thereof engages the flange 170 formed on one of the pins 168. Thus, the tow bar 158 is positioned and disposed generally between the retaining rings 174 and the springs 176, such that each spring 176 generally biases the tow bar 158 against the retaining ring 174 in a generally vertically downwardly direction 178 toward an opening operating position of the form member 12, to absorb limited movement of the tow bar 158 and the form member 12, in a generally vertically upwardly direction 180 toward a storage position of the form member 12, and yet maintain the form member 12 in an operating position, for reasons and in a manner which will be made more apparent below.

As shown more clearly in FIGS. 5 and 6, a first hydraulic cylinder 182 is secured to the support frame 14, generally near the left side 20 thereof and a second hydraulic cylinder 184 is secured to the support frame 14

generally near the right side 22 thereof. The first hydraulic cylinder 182 and the second hydraulic cylinder 184 each include a rod portion 186 which is reciprocatingly disposed therein. Each hydraulic cylinder 182 and 184 is pivotally connected to the flange portion 170 of one of the pins 168 via a first crank 188 and a second crank 190, respectively.

The first crank 188 and the second crank 190 are each constructed similar and each include, a shaft 192 having one arm member 194 secured to one end of the shaft 192 and one other arm member 196 secured to the opposite end of the shaft 192. The shaft 192 is bearingly and journally supported in a portion of the support frame 14, and each arm member 194 is pivotally connected to one arm of one of the rod portions 186, and each arm member 196 is pivotally connected to the U-shaped support 172 formed on one of the flange portions 170. The first crank 188 and the second crank 190 are each constructed to translate the reciprocating movement of the first hydraulic cylinder 182 and the second hydraulic cylinder 184 connected thereto to raise the form member 12 in a generally vertically upwardly direction 180, in an actuated raising position of the first hydraulic cylinder 182 and the second hydraulic cylinder 184, and to lower the form member 12 in an actuated lowering position of the first hydraulic cylinder 182 and the second hydraulic cylinder 184. The first hydraulic cylinder 182 and the second hydraulic cylinder 184 thus raise and lower the tow bar 158 and the forward end portion of the form member 12 pivotally connected thereto.

As shown more clearly in FIGS. 4 and 6, an upper flange 200 is removably secured to the forward end 72 of the form member 12, the upper flange 200 extending a distance generally perpendicularly therefrom and extending a distance thereacross. A roller 202 is rollingly secured to and supported on each end portion of the upper flange 200, each roller 202 being disposed to rollingly engage the upper surface of the tow bar 158 to reduce the sliding friction between the upper flange 200 and tow bar 158 during the pivotal movement of the form member 12.

A lower flange 204 is removably secured to the forward end 72 of the form member 12, the lower flange 204 extending a distance generally perpendicularly from the form member 12 and extending a distance generally thereacross. A roller 206 is rollingly secured to and supported on each end portion of the lower flange 204, each roller 206 being dispoed to rollingly engage a portion of the lower surface of the tow bar 158 to reduce the sliding friction between the lower flange 204 and the tow bar 158 during the pivotal movement of the form member 12, in a manner similar to the rollers 202, described above.

As shown more clearly in FIG. 4, a pin 208 is journaled through an aperture formed in the upper flange 200 and in the lower flange 204 (not shown) and through one of the pivot apertures 164 to provide the pivotal interconnection between the form member 12 and the support frame 14. The pin 208 is secured in this position via such means as a "cotterpin" or other such suitable retaining means. It should be noted that the additional pivot apertures 164 are formed through the tow bar 158, in a preferred form, are provided to permit the form member 12 to be adjustably disposed between the left side 20 and the right side 22 of the support frame 14, which may be desired in some instances such as, for example, when utilizing a single support frame 14 to selectively accomodate a plurality of different shaped form members 12 and a variety of different sizes of the form member 12 to meet various job specifications, the form members 12 being removably connected and disconnected to the support frame 14, in a manner to be described in greater detail below.

As shown more clearly in FIG. 2, a pair of motors 210 are supported on the upper end portion 138 of the concrete engaging portion 136, and each motor 210 is connected to a vibrator 212 to provide the driving impetus to vibratingly drive the vibrator 212 connected thereto. Each vibrator 212 is securely supported within a central portion of the concrete receiving portion 136 of the form member 12 via a clamp 214, having a portion thereof secured to the concrete receiving portion 136, and each vibrator 212 is disposed to vibratingly engage the concrete material or the like being poured through the concrete receiving portion 136, during the operation of the curb slip form apparatus 10, which will be described in grater detail below.

The form steering assembly 124, mentioned before, also includes a form steering sensor 220 having a sensor arm 222 connected thereto, and extending generally vertically downwardly therefrom, as shown more clearly in FIG. 3. The form steering sensor 220 is adjustably supported on an outer end of a support bar 224, the form steering sensor 220 being adjustingly positioned on the support bar 224 such that the sensor arm 222 sensingly engages a control line 226 (the control line 226 being shown in FIGS. 10 and 11).

The support bar 224 is secured to the form member 12, generally near the rearward end 74 thereof and, more particularly, the support bar 224 is secured to a portion of the brace 90, as shown more clearly in FIGS. 2, 3 and 7. Since the support bar 224 is securely affixed to the rearward end 74 of the form member 12, the form steering sensor 220 and the sensor arm 222 thereof will sense the position of the rearward end portion of the form member 12 relative to the control line 226, and will provide an output signal responsive thereto to control the position of the rearward end 74 of the form member 12 relative to a predetermined survey line, in a manner which will be made more apparent below.

As shown more clearly in FIGS. 1, 2 and 11, the forward elevational positioning assembly 40 also includes an elevation sensor 228 having a sensor arm 230 connected thereto, and extending horizontally therefrom. The elevation sensor 228 is adjustably supported on an outer end of a support bar 232, the elevation sensor 228 being adjustably positioned on the support bar 232 such that the sensor arm 230 sensingly engages an upper portion of the control line 226.

The support arm 230 is secured to the support frame 14 of the curb slip form apparatus 10, generally near the forward end 16 and generally near the left side 20 thereof. Since the support bar 232 is securely affixed to the support frame 14, the elevation sensor 228 and the sensor arm 230 thereof will sense the position of the support frame 14 relative to the predetermined elevation of the control line 226 to maintain the elevation of the support frame 14 relative to a predetermined control elevation, as will be made more apparent below.

The curb slip form apparatus 10 also includes a track steering assembly 234 which includes a track steering sensor 236 having a sensor arm 238 connected thereto

and extending generally vertically downwardly therefrom, as shown more clearly in FIGS. **1, 2** and **11.** The track steering sensor **236** is adjustably supported on an outer end of a support bar **240** which is connected on one end thereof to the support bar **232** of the forward elevation positioning assembly **40,** the track steering sensor **236** being thus connected to the support frame **14** generally near the forward end **16** and generally near the left side **20** thereof via the interconnection between the support bar **240** and the support bar **232.** The track steering sensor **236** and the sensor arm **238** thus cooperate to sense the position of the support frame **14** relative to the control line **226** and, cooperate to steeringly align the support frame **14** relative to the predetermined survey line, in a manner which will be made more apparent below.

The utilization of sensors such as the form steering sensor **220,** the elevation sensor **228** and the track steering sensor **236,** described above, which are constructed to provide an output signal responsive to a sensed position, are well known in the art, such sensors, for example, being described in U.S. Pat. No. 3,423,859 entitled "Road Construction Methods and Apparatus", assigned to the assignee of the present invention. Therefore, a detailed description of the various components and the cooperation of those components to provide a responsive output signal, such as described above, is not required herein.

As diagrammatically and schematically shown in FIG. **9,** the track steering assembly **234** includes, a track steering actuator **244** which is contructed to receive an output signal **246** from the track steering sensor **236,** the output signal **246** being responsive to the sensed position of the support frame **14** relative to the control line **226,** as mentioned before. The track steering actuator **244** is connected to a flow divider valve **248** to position the flow divider valve **248** for controlling the flow of power fluid therethrough. Flow divider valves, such as the flow divider valve **248** diagrammatically shown in FIG. **9,** and the interconnection thereof with an actuator such that the actuator controls the flow of power fluid through the flow divider valve are well known in the art and a detailed description thereof is not required herein.

The flow divider valve **248** is connected to the left hydraulic motor **36** via a conduit **250,** and to the right hydraulic motor **38** via a conduit **252.** The left hydraulic motor **36** and the right hydraulic motor **38** are each connected to a power fluid source or, in other words, a pump **254** via a conduit **256,** the pump **254** being connected to the flow divider valve **248** via a conduit **258.** The flow divider valve **248** is thus interposed between the pump **254** and the left hydraulic motor **36** and the right hydraulic motor **38.**

The pump **254** is thus connected to the left hydraulic motor **36** and to the right hydraulic motor **38** via the flow divider valve **248,** the pump **254** providing power fluid to drive the left hydraulic motor **36** and the right hydraulic motor **38** in a driven position of the pump **254,** and in a position wherein the pump **254** is in fluidic communication with the left hydraulic motor **36** and the right hydraulic motor **38.** The flow divider valve **248** controls the flow of fluid from the pump **254** to the left hydraulic motor **36** and from the pump **254** to the right hydraulic motor **38** via a pair of variable orifices (diagrammatically shown in FIG. **9**). More particularly, the track steering actuator **244** is connected to the variable orifices, the track steering actuator **244** thereby controlling the flow of fluid to the left hydraulic motor **36** and to the right hydraulic motor **38** to steeringly drive the left track assembly **24** and the right track assembly **26** in response to the output signal **246** of the track steering sensor **236** during the operation of the curb slip form apparatus **10,** as will be described in greater detail below.

A solenoid-operated control **260** is interposed in the conduits **252** and **256** generally between the right hydraulic motor **38** and the pump **254.** The control valve **260** is connected to an energizing power supply **262** via a conductor **264,** and a switch **268** is interposed in the conductor **264** to provide electrical communication between the control valve **260** and the power supply **262** in a closed position of the switch **268,** thereby energizing the control valve **260.** In the energized position of the control valve **260,** the flow of power fluid from the pump **254** to the right hydraulic motor **38** is reversed, as diagrammatically shown in FIG. **9,** thereby driving the right track assembly **26** in a reverse direction with respect to the driven direction of the left track assembly **24** to allow the curb slip form apparatus **10** to be "spot-turned" or, in other words, turned about while maintaining a relatively stationary position. As shown in FIG. **9,** the switch **268** is opened and closed via a switch actuator **270** which, in a preferred form, is disposed on the control console **52.**

As mentioned before, the forward elevation positioning assembly **40** includes a hydraulic cylinder which is connected to the support frame **14** and to the left track assembly **24,** the hydraulic cylinder being diagrammatically shown in FIG. **9** and designated therein by the reference numeral **40***a*. The hydraulic cylinder **40***a* is connected to a pump **272** via a solenoid-operated control valve **274.** As diagrammatically indicated in FIG. **9,** the control valve **274** is constructed to provide fluidic communication between the pump **272** and one portion of the hydraulic cylinder **40***a* to actuate the hydraulic cylinder **40***a* to an actuated raising position thereof, and to provide fluidic communication between the pump **272** and one other portion of the hydraulic cylinder **40**a to actuate the hydraulic cylinder **40***a* to an actuated lowering position thereof.

The control valve **274** is connected to the energizing power supply **262** via a switch which is operated by a switch actuator **278.** It should be particularly noted that, in a preferred form, the control valve **274** is, more particularly, a proportional-type, solenoid-operated control valve so that power fluid is provided via the pump **272** proportionally to the hydraulic cylinder **40**a to raise and lower the elevation of the support frame **14** in a more uniform manner, the "on" - "off" type of switch **276** being diagrammatically shown in FIG. **9** merely for the purpose of clarity of description. The switch **276** is thus schematically shown in FIG. **9** as providing an electrical communication between the power supply **262** and the control valve **274** via conductors **278** and **280,** in one position of the switch **276,** thereby energizing the control valve **274** to a position wherein fluidic communication is established between the pump **272** and the hydraulic cylinder **40***a* to position the hydraulic cylinder **40***a* in an actuated raising position thereof; and to provide electrical communication between the power supply **262** and the control valve **274** via the conductor **278** and a conductor **282** to energize the control valve **274** to a position wherein fluidic com-

munication is established between the pump **272** and the hydraulic cylinder **40***a* to actuate the hydraulic cylinder **40***a* to an actuated lowering positioning thereof.

The switch **276** is connected to a switch actuator **284**, the switch actuator **284** being constructed to receive an output signal **286** from the forward elevation sensor **228**, the output signal **286** being responsive to the sensed position of the support frame **14** relative to a predetermined, controlled elevation of the control line **226**, as mentioned above.

The form steering sensor **220**, as schematically shown in FIG. **9**, provides an output signal **290** responsive to the sensed position of the form member **12**, as mentioned above. A switch actuator **292** is constructed to receive the output signal **290** from the form steering sensor **220**, and the switch actuator **292** is connected to a switch **294** to position the switch **294** in response to the received output signal **290** from the form steering sensor **220**.

The switch **294** in connected to the energizing power supply **262** via a conductor **296**, and the switch **294** is connected to a control valve **298** via a pair of conductors **300** and **302**. The control valve **298** is interposed between the form steering member **126** and the power fluid source **304** or, in other words, a pump **304** to provide fluidic communication therebetween, such that the form steering member **126** is actuated to move the form member **12** in a pivot direction **132** when the control valve **298** is energized via the conductor **300** and move the form member **12** to pivot direction **134** when the control valve **298** is energized via the conductor **302**, as diagrammatically shown in FIG. **9**. The form steering sensor **220** thus provides an output signal **290** responsive to the sensed position of the form member **12** relative to the control line **226** to actuate the switch actuator **292**, thereby positioning the switch **294** to energize the control valve **298** to a position wherein the form steering member **126** moves the form member **12** in a pivot direction **132** and **134** to maintain the alignment of the form member **12** relative to the sensed position of the form member **12** with respect to the control line **226**, thereby maintaining the position of the form member **12** relative to the predetermined survey line.

The cross-slope positioning assembly **42** is diagrammatically and schematically shown in FIG. **9**, and the hydraulic cylinder associated therewith to elevate the support frame **14** to maintain a predetermined cross-slope position of the curb slip form apparatus **10** is diagrammatically shown in FIG. **9** and designated therein by the reference numeral **42***a*. The hydraulic cylinder **42***a* is fluidically connected to a power fluid source **305**, sometimes referred to below simply as a pump, via a solenoid-operated control valve **306**. The control valve **306** is, in a preferred form, a proportional valve constructed to provide fluidic communication between the pump **305** and the hydraulic cylinder **42***a* to position the hydraulic cylinder **42***a* in an actuated raising position and in an actuated lowering position, similar to the control valve **274** described above.

The control valve **306** is connected to the energizing power supply **262** via conductors **308**, **310** and **312**. As shown in FIG. **9**, a switch **314** is interposed generally between the control valve **306** and the energizing power supply **262**. The switch **314** has a disconnect position wherein the electrical communication between the energizing power supply **262** and the control valve **306** is interrupted, thereby de-energizing the control valve **306**; a first position wherein electrical communication is established between the energizing power supply **262** and the control valve **306** via the conductors **312** and **308** to energize the control valve **306** to provide fluidic communication between the pump **305** and the hydraulic cylinder **42***a* to actuate the hydraulic cylinder **42***a* to an actuated raising position thereof; and a second position wherein electrical communication is established between the energizing power supply **262** and the control valve **306** via the conductors **312** and **310** to energize the control valve **306** to provide fluidic communication between the pump **305** and the hydraulic cylinder **42***a* to position the hydraulic cylinder **42***a* in an actuated lowering position thereof, as diagrammatically shown in FIG. **9**. The switch **314**, more particularly, and, in a preferred form, includes a differential amplifier **316**, a level sensor **318**, a command signal source **320** and a signal selector **322**.

The level sensor **318** is positioned and supported on the support frame **14**, and is constructed to sense the slope position of the support frame **14** with respect to a predetermined horizontal plane, and to provide an output signal **324** responsive to the sensed slope position of the support frame **14**. The command signal source **320** is constructed to be preset to a predetermined slope level or position of the support frame **14**, and has an output signal **326** response to the preset slope position.

The differential amplifier **316** is constructed to receive and compare the output signals **324** and **326** from the level sensor **318** and the command signal source **320**, respectively, and the differential amplifier **316** has an output signal **328** which is responsive to the comparison of the output signals **324** and **326** of the level sensor **318** and the command signal source **320**, respectively. The signal selector **322** is constructed to receive the output signal **328** from the differential amplifier **318** and to be switchingly positioned in a disconnect position, a first position and a second position, as described above, in response to the received output signal **328** from the differential amplifier **316**. As shown in FIG. **9**, the signal selector **322** is interposed between the energizing power supply **262** of the control valve **306**.

In one form, for example, the command signal source **320** consists of a potentiometer connected to a power supply, such that by adjusting the potentiometer the voltage level of the output signal **326** can be adjusted to a determinable level corresponding to a particular slope level setting of the support frame **14**. The level sensor **318** can be of the pendulum-type having a portion connected to a potentiometer and a power supply in such a manner that as the pendulum is moved to indicate a change in the slope level or position of the support frame **14**, the voltage level of the output signal **324** is correspondingly changed. The differential amplifier is of a type well known in the art, the output signal **328** thereof corresponds or is responsive to the comparison of the two output signals **324** and **326**.

The signal selector **322**, in one form, can include a pair of transistor operated type switches, one such switch being connected to the differential amplifier **316** to provide electrical communication between the power supply **262** and the control valve **306**, to energize the control valve **306** to the first position thereof, and one such switch being connected to the differential

amplifier 316 to provide electrical communication betwee the power supply 262 and the control valve 306 to energize the control valve 306 to the second energized position thereof. The switches are, of course, connected to selectively energize the control valve 306 in the first energized position and the second energized position in response to the output signal 328 of the differential amplifier 316.

The left rearward positioning assembly 44 includes a hydraulic cylinder, as mentioned before, the hydraulic cylinder being diagrammatically shown in FIG. 9 and designated therein by the reference numeral 44a. The right rearward elevation positioning assembly 46 also includes a hydraulic cylinder, as mentioned before, the hydraulic cylinder being diagrammatically shown in FIG. 9 and designated therein by the reference numeral 46a. The upper portion of the hydraulic cylinder 44a is connected to the upper portion of the hydraulic cylinder 46a via the conduit 330, and the lower portion of the hydraulic cylinder 44a is connected to the lower portion of the hydraulic cylinder 46a via the conduit 332.

The conduits 330 and 332 are connected to a power fluid source 333, sometimes referred to below simply as the pump 333, via a solenoid-operated control valve 334. The control valve 334 is constructed to provide fluidic communication between the pump 333 and the upper portions of the hydraulic cylinders 44*a* and 46*a* in one energized position of the control valve 334, and to provide fluidic communication between the pump 333 and the lower portions of the hydraulic cylinders 44*a* and 46*a* in one other energized position of the control valve 334, to actuate the hydraulic cylinders 44*a* and 46*a* to an actuated raising position and to an actuated lowering position thereof. The hydraulic cylinders 44*a* and 46*a* are thus connected in hydraulic parallel via the conduits 330 and 332, thereby raising an lowering the support frame 14 relative to a single predetermined control position, which is located in the hydraulic center, midway between the hydraulic cylinder 44*a* and the hydraulic cylinder 46*a*. Since the support frame 14 is automatically raised and lowered by the hydraulic cylinder 40*a* and by the hydraulic cylinder 42*a* , and further since the support frame 14 is automatically raised and lowered relative to a single, predetermined control position via the hydraulic cylinders 44*a* and 46*a*, the support frame 14 is vertically and automatically positionable about three predetermined control positions; one control position being located generally at the hydraulic cylinder 40*a*, one control position being located generally at the hydraulic cylinder 42*a*, and the third control position being located generally between the hydraulic cylinders 44*a* and 46*a*, and yet the support frame 14 of the curb slip form apparatus 10 is supported generally at the four-corner positions thereof. Thus, the forward elevation positioning assembly 40, the cross-slope positioning assembly 42, the left rearward positioning assembly 44 and the right rearward positioning assembly 46 cooperate to automatically control the support frame 14 about three predetermined control positions to provide the maximum postionability for the support frame 14 without incurring a loss of supporting integrity.

As shown in FIG. 9, a pair of conductors 335 and 336 and a conductor 337 connect the control valve 334 to the energizing power supply 262 via a switch 338. The switch 338 is connected to a switch actuator 339 which is constructed to position the switch 338 in one position wherein electrical communication is established between the control valve 334 and the power supply 262 via the conductors 335 and 337 energizing the control valve 334 to establish fluidic sommunication between the pump 333 and the hydraulic cylinders 44*a* and 46*a* to actuate the hydraulic cylinders 44*a* and 46*a* to an actuated lowering position; and to position the switch 338 in one other position wherein electrical communication is established between the control valve 334 and the power supply 262 via the conductors 336 and 337 energizing the control valve to establish fluidic communication between the pump 333 and the hydralic cylinders 44*a* and 46*a* to actuate the hydraulic cylinders 44*a* and 46*a* to an acutated raising position thereof. The hydraulic cylinders 44*a* and 46*a* are thus actuated to raise and lower the support frame 14, the support frame 14 being thereby locked to a predetermined grade position.

The first hydraulic cylinder 182 and the second hydraulic cylinder 184 are each connected to the tow bar 158 to raise the form member 12 to a storage position, and to lower the form member 12 to an operating position, as described before. As schematically and diagrammatically shown in FIG. 9, the first hydraulic cylinder 182 is connected to a power fluid source 340 via a solenoid-operated control valve 342. The control valve 342 is constructed to provide fluidic communication between the pump 340 and the first hydraulic cylinder 182 to actuate the first hydraulic cylinder 182 to an actuated raising position, in one energized position of the control valve 342, and to provide fluidic communication between the pump 340 and the first hydraulic cylinder 182 to actuate the first hydraulic cylinder 182 to an actuated lowering position, in one other energized position of the control valve 342.

The control valve 342 is connected to the energizing power supply 262 via conductors 344, 346 and 348, and a switch 350 is interposed between the energizing power supply 262 and the control valve 342. The switch 350 is connected to a switch actuator 352, as shown in FIG. 9. The switch actuator 352 is constructed to position the switch 350 in one position wherein electrical communication is established between the control valve 342 and the energizing power supply 262 via the conductors 348 and 344, thereby providing fluidic communication between the pump 340 and the first hydraulic cylinder 182 to actuate the first hydraulic cylinder 182 to an actuated raising position thereof, and to position the switch 350 in a position wherein electrical communication is established between the energizing power supply 262 and the control valve 342 via the conductors 348 and 346, thereby establishing fluidic communication between the pump 340 and the first hydraulic cylinder 182 to actuate the first hydraulic cylinder 182 to an actuated lowering position thereof.

As schematically and diagrammatically shown in FIG. 9, the second hydraulic cylinder 184 is connected to a power fluid source 354 via a solenoid-operated control valve 356. The control valve 356 is constructed to provide fluidic communication between the pump 354 and the second hydraulic cylinder 184 to actuate the second hydraulic cylinder 184 to an actuated raising position, in one energized position of the control valve 356, and to provide fluidic communication between the pump 354 and the second hydraulic cylinder

184 to actuate the second hydraulic cylinder 184 to an acutated lowering position, in one other energized position of the control valve 356.

The control valve 356 is connected to the energizing power supply 262 via conductors 358, 360 and 348, and a switch 364 is interposed between the energizing power supply 262 and the control valve 356. The switch 364 is connected to a switch actuator 366, as shown in FIG. 9. The switch actuator 366 is constructed to position the switch 364 in one position wherein electrical communication is established between the control valve 356 and the energizing power supply 262 via the conductors 358 and 348, thereby providing fluidic communication between the pump 354 and the second hydraulic cylinder 184 to actuate the second hydraulic cylinder 184 to an actuated lowering position thereof, and to position the switch 356 in a position wherein electrical communication is established between the energizing power supply 262 and the control valve 356 via the conductors 348 and 360, thereby establishing fluidic communication between the pump 354 and the second hydraulic cylinder 184 to actuate the second hydraulic cylinder 184 to an actuated raising position thereof.

In one form, the switch 350 and the switch actuator 352 connected thereto, and the switch 364 and the switch actuator 366 connected thereto can be a single, toggle-type switch, the single toggle-switch actuating the control valves 342 and 356 simultaneously. It should also be noted, that in one form of the invention utilizing the single, toggle-switch, as described above, a single control valve could be interposed between a power fluid supply and the hydraulic cylinders 182 and 184 in lieu of the two control valves 342 and 356.

As schematically and diagrammatically shown in FIG. 9, the hydraulic cylinder 112 is connected to a power fluid source 368 via a solenoid-operated control valve 370. The control valve 370 is constructed to provide fluidic communication between the pump 368 and the hydraulic cylinder 112 to actuate the hydraulic cylinder 112 to an actuated raising position, in one energized position of the control valve 370, and to provide fluidic communication between the pump 368 and the hydraulic cylinder 112 to actuate the hydraulic cylinder 112 to an actuated lowering position, in one other energized position of the control valve 370.

The control valve 370 is connected to the energizing power supply 262 via conductors 372, 374 and 376, and a switch 378 is interposed between the energizing power supply 262 and the control valve 370. The switch 378 is connected to a switch actuator 380, as shown in FIG. 9. The switch actuator 380 is constructed to position the swtich 378 in one position wherein electrical communication is established between the control valve 370 and the energizing power supply 262 via the conductors 372 and 376, thereby providing fluidic communication between the pump 360 and the hydraulic cylinder 112 to actuate the hydraulic cylinder 112 to an actuated lowering position thereof, and to position the switch 378 in a position wherein electrical communication is established between the energizing power supply 262 and the control valve 370 via the conductors 374 and 376, thereby establishing fluidic communication between the pump 368 and the hydraulic cylinder 112 to actuate the hydraulic cylinder 112 to an actuated raising position thereof.

As shown more clearly in FIG. 3, a scale 386 is secured on the rearward end portion 18 of the support frame 14, generally between the left side 20 and the right side 22 thereof, the scale 386 extending in a generally vertically upwardly direction from the support frame 14. In a preferred form, the scale has a plurality of gradation marks etched thereon, and an indicator 388 is slidingly positionable on the scale 386 to be moved in a vertically upwardly and a vertically downwardly direction on the scale 386, and positioned thereon relative to one of the gradation marks to indicate a predetermined elevation of the rearward end portion 18 of the support frame 14.

A pair of support stands 390 are secured to the track support members 34, as shown in FIG. 3, and, more particularly, one of the support stands 390 is secured to the track support member 34 of the left track assembly 24 and extends generally vertically upwardly therefrom, and the other support stand 390 is secured to the track support member 34 of the right track assembly 26 and extends generally vertically upwardly therefrom. A string line 392 is connected on one end thereof to the end of one of the support stands 390, opposite the end of thereof connected to the track support member 34, and the opposite end of the string line 392 is connected to the end of the other support stand 390, opposite the end thereof connected to the track support member 34.

In a preferred form, and, as shown in FIG. 3, a tension spring 394 is interposed between one end of the string line 392 and the connection thereof to one of the support stands 390 and, more particularly, the spring 394 provides the interconnection between one end of the string line 392 and one of the support stands 390. The string line 392 is thus supportedly connected to the left track assembly 24 and to the right track assembly 26 such that the string line 392 extends generally across the rearward end portion 18 of the support frame 14 and such that a portion of the string line 392 is disposed generally near the scale 386. The position of the string line 392 with respect to the gradations on the scale 386 thus indicates the elevation of the rearward end portion 18 of the support frame 14.

Utilizing the scale 386 and the string line 392, described above, the operator can set the indicator 388 on the scale 386 to a predetermined position, indicating the support frame 14 has been elevated by the left rearward elevation assembly 44 and the right elevation assembly 46 to a predetermined elevation. In this manner, should it become necessary to raise or lower the support frame 14 via the left rearward elevation positioning assembly 44 and the right rearward elevation positioning assembly 46 during the operation of the curb slip form apparatus 10, the operator can subsequently reposition the support frame 14 or, more particularly, the rearward end portion 18 of the support frame 14 to a predetermined elevation by actuating the left rearward elevation positioning assembly 44 and the right rearward elevation positioning assembly 46 to align the string line 392 with the indicator 388. It should also be noted that the gradation on the scale 386 can be disposed to indicate various scaled elevations for the rearward end portion 18 of the support frame 14, and the operator can elevatingly position the rearward end portion 18 of the support frame 14 to a predetermined position by merely actuating the left rearward elevation positioning assembly 44 and the right rearward elevation positioning assembly 46 to a posi-

tion wherein the string line **392** is aligned to a predetermined gradation mark on the scale **386.**

In one respect, the present invention also includes an improved control line **226** for positioning a predetermined distance from the predetermined survey line to provide a guide for maintaining the alignment of vehicles or the like relative to the survey line or, more particularly for maintaining the alignment of the curb slip form apparatus **10,** described before. More particularly, the control line **226** includes a flexible, semi-rigid band **398** constructed of a metal or a reinforced plastic material which is supported in an operating position via a plurality of spaced band supports **400,** as shown in FIGS. **11, 12, 13** and **14.**

As shown more clearly in FIGS. **12, 13** and **14,** each band support **400** includes, a stake **402** constructed to be securedly driven into a portion of the earth and extending a distance generally vertically upwardly therefrom terminating with an uppermost end **404.** A band support arm **406,** sometimes referred to below simply as a rod **406,** is connected on one end thereof to the stake **402** generally near the upper end **404** thereof via a arm connector **408.**

As shown more clearly in FIGS. **12** and **13,** each arm connector **408** has a stake aperture **409** extending therethrough sized to slidingly receive the stake **402,** such that the arm connector **408** can be slidingly moved in a vertically upwardly and a vertically downwardly direction on the stake **402.** A set screw **410** extends through a portion of each arm connector **408,** intersecting the stake aperture therein, each set screw **410** is sized to engage an adjacent portion of the stake **402** to secure the arm connector **408** at a predetermined elevation on each stake **402.**

As shown in FIGS. **12** and **13,** an arm aperture **411** is formed through each arm connector **408,** each arm aperture **411** being sized to slidingly receive one end portion of one of the band support arms **406,** such that the band support arm **406** can be slidingly positioned in the arm aperture **411.** A set screw **412** extends through each arm connector **408,** a portion of each set screw **412** intersecting the arm aperture **411** formed in the arm connector **408** associated therewith. Each set screw **412** is sized to engage an adjacent portion of the band support arm **406** to secure the band support arm **406** in a predetermined position within the arm connector **408.**

Each band support arm **406,** as shown more clearly in FIGS. **12** and **13,** has a band connector **416** formed on one end of the band support arm **406,** generally opposite the end of the band support arm **406** which is securedly positioned within the arm connector **408.** The band connector **416,** more particularly, includes a, lower arm **418** and an upper arm **420.** A notched portion **422** is formed in a portion of the lower arm **418** and a notched portion **424** is formed in a portion of the upper arm **420,** as shown more clearly in FIG. **12.** Each notched portion **422** and **424** is sized to retainingly engage a portion of the band **398** and, more particularly, the notched portion **422** retainingly receives a portion of the band **398** generally near an upper end **426** thereof, and the notched portion **424** retainingly engages a portion of the band **398** generally near a lower end **428** thereof.

As shown more clearly in FIG. **12,** the lower arm **418** is angularly disposed with respect to the upper arm **420** in a side elevational view of the band connector **416,** or, in other words, in a vertical plane. The lower arm **418** is also angularly disposed with respect to the upper arm **420** in a top plan view or, in other words, in a horizontal plane of the band connector **416,** as shown more clearly in FIG. **13.** The lower arm **418** is thus disposed with respect to the upper arm **420** such that the distance between each notched portion **422** and **424** is greater than the distance between the upper end **426** and the lower end **428** of the band **398** in one position of the upper arm **420** and the lower arm **418,** as shown in dashed-lines in FIG. **14,** for receiving the band **398** therebetween. The notched portions **422** and **424** of the upper arm **420** and the lower arm **418** retainingly engaging the band **398** in one other position of the upper arm **420** and the lower arm **418,** as shown in solid lines in FIG. **14.**

Thus, the band support arm **406** can be quickly and easily rotated to a position wherein the lower arm **418** and the upper arm **420** are spaced a sufficient distance apart for the band **398** to be inserted therebetween, and the band support arm **406** can then be rotated to a position wherein the band connector **416** securedly and retainingly engages the band **398** or, more particularly, to a position wherein a portion of the lower arm **418** formed by the notched portion **422** retainingly engages a portion of the band **398** and a portion of the upper arm **420** formed by the notched portion **424** therein retainingly engages a portion of the band **398.** In this position, the band support arm **406** is secured within the arm connector **408** by turning the set screw **412** to retainingly engage an adjacent portion of the band support arm **406.**

The band support arm **406** is thus constructed and connected to the arm connector **408** such that the band support arm **406** can be easily and quickly rotated to a position for receiving the band **398** between the lower arm **418** and the upper arm **420** thereof; and subsequently rotated to a position securedly locking the band **398** between the lower arm **418** and the upper arm **420.** The elevation of the upper end **426** of the band **398** can also be positioned in a quick and efficient manner by simply loosening the set screw **410** and moving the arm connector **408** vertically upwardly and vertically downwardly on the stake **402.** The control line **226** constructed in a manner, as described above, can thus be assembled in an operating position and disassembled therefrom in a fast, secure, positive and efficient manner.

It should be particularly noted that the control line **226** and, particularly the band supports **400** provide a quick, secure and efficient manner for positioning a flexible, semi-rigid band **398** in a predetermined control position. It has been found, that constructing a control line utilizing the band **398** is particularly desirable when constructing a control line formed on a radius, since the band **398** provides a continuous control line which is more uniformly spaced from the predetermined survey line at each point generally along the control line **226.** Thus, the control line **226,** not only provides a control line which more uniformly corresponds to the predetermined survey line at each point therealong, but also provides a control line which can be quickly and easily constructed and disassembled, thereby increasing the efficiency of the curb forming operation.

Shown in FIGS. **15** and **16** is a modified band connector **416a** which can be secured on the band support arm

406, in a manner similar to that described before with respect to the band connector 416 of FIGS. 12, 13 and 14. As shown more clearly in FIG. 15, the band connector 416a has a recess 430 formed in one end thereof having an annular ridge 432 extending about a central portion thereof. The recess 430 is sized to receive the end of the rod 406, generally opposite the end of the rod 406 secured in the arm connector 408, the annular ridge 432 being disposed in an annular recess formed about a portion of the rod 406 to provide the interconnection between the rod 406 and the band connector 416*a*.

The band connector 416 includes an upper arm 436 and a lower arm 438, each arm 436 and 438 having a curved portion 440 formed on the outermost end thereof. The upper arm 436 is spaced a distance from the lower arm 438, and further the band connector 416a is constructed such that the upper arm 436 can be further seperated a distance from the lower arm 438 to receive a portion of a modified band 398*a* therebetween, as shown in FIGS. 15 and 16.

The modified band 398*a* has a generally circular shape cross-section, as shwon more clearly in FIG. 15, having a connecting band 442 formed on one end thereof. The connecting band 442 also has a circular shaped cross-section, the diameter of the connecting band 442 being smaller than the diameter of the band 398*a*, in a preferred form.

In an assembled position, as shown in FIGS. 15 and 16, the connecting band 442 of the band 398*a* is disposed between the upper arm 236 and the lower arm 438 of the band connector 416a and, more particularly, retainingly engaged by the curved portions 440 of the upper arm 436 and the lower arm 438. In this position, the upper arm 436 and the lower arm 438 are secured in a retaining position wherein the curved portions 440 of the upper arm 436 and the lower arm 438 are clamped about the connecting band 422 via a retaining member 444 which extends through the upper arm 436 and the lower arm 438 and is secured in an assembled position by a nut 446 threadedly disposed on one end thereof.

It will be apparent from the foregoing, that the band connector 416*a* and the band 398*a* are each constructed such that the control line can be assembled and disassembled in a quick, positive and efficient manner, similar to the band connector 416 and the band 398, described before. The band connector 416*a* is also constructed to be removable and yet securedly connected to the rod 406, thereby facilitating the replacement thereof, and thus providing a construction which, in some instances, may be constructed in a more economical manner.

Shown in FIGS. 17 and 18 is yet another modified band connector 416b which is constructed to retainingly engage and positionably secure the band 398 in a predetermined position. The modified band connector 416b includes a U-shaped bracket 450 which is secured on the end of the band support arm 406, generally opposite the end of the band support arm 406 securedly connected to the arm connector 408.

The U-shaped bracket 450 defines an opening 452 which is sized to receive the band 398. A portion 454 on one end of the U-shaped bracket 450 is formed to retainingly engage a portion of the band 398 generally near the lower end 426 thereof, in an assembled position of the band 398 and the band connector 416b, as shown in FIG. 17 and 18. A flange portion 456 is formed on another portion of the U-shaped bracket 450, the flange portion 456 being sized and disposed such that the band 398 can be snapped into the opening 452. The flange portion 456 retainingly engages a portion of the band 396, generally near the upper end 426 thereof, in an assembled of the band 396 and the band connector 416*b*, as shown in FIGS. 17 and 18.

The U-shaped bracket 450 of the band connector 416*b* is thus constructed such that the band 396 can be angularly disposed, and a portion thereof generally near the lower end 428 can be inserted within the opening 452 in a partially assembled position. In this position of the band 396, the band 396 can then be moved to an assembled position, as shown in FIGS. 17 and 18, by snapping a portion of the band 396 generally near the upper end 426 thereof past the flange 456 and into the opening 452 of the U-shaped bracket member 450. The modified band connector 416*b* thus retains most of the advantages of the band connector 416 and the band connector 416*a*, described before, and yet provides a construction which may be more economical in manufacture, in some instances.

OPERATION OF THE CURB SLIP FORM APPARATUS

The curb slip form apparatus 10 is constructed for forming a predetermined, formed configuration of a concrete material or the like on the earth's surface, generally along a predetermined survey line, in such a manner that the formed configuration is extruded from the form member 12 in an aligned position with the survey line at all points therealong. More particularly, the formed configuration extruded from the form member 12 is curb-shaped, and the curb slip form apparatus 10 is more particularly, constructed to extrude a curb-shaped configuration, the curb-shaped configuration being diagrammatically shown in FIG. 11 and designated by the reference numeral 460, which is aligned with the predetermined survey line at all points therealong.

Diagrammatically shown in FIG. 11 are two survey lines 462 and 464, each survey line 462 and 464 being determined via a previously performed survey of the earth's surface and in accordance with a particular job specification. More particularly, the survey lines 462 and 464, as shown in FIG. 11, indicate the surveyed position where the formed, curb-shaped configuration 460 is to be disposed, the curb-shaped configuration 460 being disposed between the two survey lines 462 and 464. It should be particularly noted that the survey lines 462 and 464 have been shown in FIG. 11 merely for the purpose of clarity of description, and it is not necessary that both survey lines 462 and 464 be surveyed, since the width of the curb-shaped configuration 460 is predetermined via a particular job specification. It should also be noted that although the survey lines 462 and 464 have been diagrammatically shown in FIG. 11 as being aligned with the outer periphery and with the inner periphery, respectively, of the curb-shaped configuration 460, it is not essential that the survey lines utilized in a particular application be so disposed, but rather that a reference survey line be determined.

The control line 226 is then constructed utilizing the band 398 or the band 398*a*, the band 398 being shown in FIG. 11. The band 398 is, more particularly, secured

and positioned via the band supports **400** such that the band **398** is disposed a consistent, predetermined distance **468** from the survey line **464.** Since the band **398** is constructed of a semi-rigid, relatively flexible material, as described before, and further since the band is securedly supported via a plurality of spaced band supports **400,** the distance **468** between the band **398** and the survey line **464** can be maintained in a more uniformed manner in those instances where the control line **226** is to be constructed on a radius or curvature, as shown in FIG. **11.** Again, it should be noted that the distance **368** has been shown in FIG. **11** relative to the survey line **464,** for the purpose of clarity of description, the important consideration being that the band **398** is disposed a predetermined, consistent distance from a known survey line at all points along such survey line.

The arm connectors **408** of each arm band **400** are then adjustingly slid on the stake **402** associated therewith to a position wherein the upper end **426** of the band **398** is disposed at a predetermined elevation along the control line **226.** The elevation of the upper end **426,** in a particular application, being determined via a previously conducted survey and in accordance with a particular job specification so that the curb-shaped formed configuration **460** is disposed on the earth's surface in a predetermined elevational position along the survey lines **462** and **464.**

The curb slip form apparatus **10** is then maneuvered to an initial or a starting position, wherein the curb slip form apparatus **10** is disposed relatively near the control line **226** and the rearward end **74** of the form member **12** is aligned with the survey lines **462** and **464** in such a manner that the curb-shaped, formed configuration **460** will be extruded therefrom and disposed on the earth's surface in an aligned position within the survey lines **462** and **464.** In this position of the curb slip form apparatus **10** and the form member **12,** the form steering sensor **220** is adjustingly positioned on the support bar **224,** to a position wherein the sensor arm **222** thereof sensingly engages the control line **226;** the elevation sensor **228** is adjustingly positioned on the support bar **232** such that the sensor arm **230** thereof sensingly engages the upper end **426** of the control line **226;** and the track steering sensor **236** is adjustingly positioned on the support bar **240** such that the sensor arm **238** thereof sensingly engages the control line **226.** The command signal source **320** of the cross-slope positioning assembly **42** is set to a position wherein the output signal **326** therefrom corresponds to a predetermined cross-slope, in accordance with the job specifications of the particular application.

The switch actuator **339** is then actuated to energize the control valve **334** of the left rearward elevation positioning assembly **44** and the right rearward elevation positioning assembly **46** to raise and lower the rearward end portion **18** of the support frame **14** to a predetermined position, the predetermined position being set by the operator utilizing the scale **386,** the indicator **388** and the string **392,** in one form of the invention, as described above.

The switches **350, 364** and **378,** as schematically shown in FIG. **9,** are then each actuated via the switch actuators **352, 366** and **380,** connected thereto, to energize the control valves **342, 356** and **370,** in electrical communication therewith, to a position wherein power fluid is provided to the hydraulic cylinders **182, 184** and **112** to actuate each hydraulic cylinder **182, 184,** and **112** to an actuated lowering position. In an actuated lowering position of the hydraulic cylinders **182, 184,** the tow bar **158** is lowered in a vertically downwardly direction **178,** as shown in FIGS. **4** and **6,** thereby lowering the forward end portion **72** of the form member **12** to an operating position. In an actuated lowering position of the hydraulic cylinder **112,** the portion of the form member **12** generally near the rearward end **74** thereof will be lowered in a vertically downwardly direction **110,** as shown more clearly in FIG. **7,** thereby lowering the rearward end portion **74** of the form member **12** to an operating position. Thus, in an operating position of the form member **12,** the forward end **72** and the rearward **74** of the form member **12** are each lowered to a position wherein the lower most end **78** of the form member **12** slidingly engages an adjacent portion of the earth's surface, the form cavity **70** of the form member **12** encompassing an adjacent portion of the earth's surface and cooperating therewith to define the formed configuration to be extruded from the form member **12,** during the operation of the curb slip form apparatus **10.**

The operator will then start the motors **210** to vibratingly drive the vibrators **212,** and the pouring of the concrete material or the like into the form member **12** via the opening **140** formed through the concrete receiving portion **136** thereof is commenced. The auger hydraulic motor **62** is then actuated, thereby driving the auger **60** of the earth engaging assembly **56.** After a sufficient amount of the concrete material has been poured into the form member **12,** the operation of the pump **254,** as shown in FIG. **9,** is initiated, the pump **254** thus providing power fluid to the left hydraulic motor **36** and to the right hydraulic motor **38** to drive the endless track member **32** connected thereto to move the curb slip form apparatus **10** in a forward direction **28.**

As the curb slip form apparatus **10** is driven in a forward direction **28,** the auger **60** and the moldboard **64** will initially and excavatingly engage the earth's surface to provide a surface excavated in accordance with a predetermined grade and slope, and the form member **12** will follow to extrude the curb-shaped configuration **460** on the excavatingly prepared earth's surface. In the driven position of the curb slip form apparatus **10,** the sensor arm **230** will continually sense the position of the support frame **14** relative to a predetermined elevational position, determined by the upper end **426** of the control line **226,** and the output signal **286** of the forward elevation sensor **228** will actuate the switch actuator **284** to energize the control valve **274** via the switch **276** to raise and lower the support frame **14,** such that the elevation of the support frame **14** is maintained relative to the predetermined control elevation formed by the upper end **426** of the control line **226.** The level sensor **318** of the cross-slope positioning assembly **42** continually senses the cross-slope position of the support frame **14,** in a driven position of the support frame **14,** the signal selector **322** energizing the control valve **306** such that the hydraulic cylinder **42***a* raises and lowers the support frame **14** to maintain the cross-slope position of the support frame **14** relative to a predetermined cross-slope position set by the command signal source **320.**

The sensor arm **236** of the track steering assembly **234** sensingly engages the control line **226,** as the curb

slip form apparatus **10** is moved in a forward direction **28**, and the flow divider valve **248**, as schematically shown in FIG. **9**, is automatically positioned via the track steering actuator **244** in accordance with the output signal **246** received from the track steering sensor **238** to control the flow of power fluid to the left hydraulic motor **36** and to the right hydraulic motor **38**. The rate of speed at which the left track assembly **24** and the right track assembly **26** are driven is thus controlled by the track steering assembly **234** to automatically and steeringly maintain the curb slip form apparatus **10** in substantial alignment with the control line **226**. More particularly, since the track steering assembly **234** is supported generally near the forward end **16** of the support frame **14**, as described before, the track steering assembly **234** automatically and steeringly maintains the forward end portion **16** of the support frame **14** in substantial alignment with the control line **226**.

It should be particularly noted that, although the track steering assembly **234** automatically and steeringly maintains the alignment of the support frame **14** relative to the control line **226**, the maintaining of the alignment of the support frame **14** relative to the control line **226** in this manner has been found to be inadequate to assure that the formed configuration **460** extruded from the form member **12** is accordingly aligned relative to the predetermined survey lines **462** and **464**, during the operation of the curb slip form apparatus **10**. More particularly, in those instances where the control line **226** is relatively straight, it has been found that there is a certain degree of back and forth movement or wobble of the support frame **14**, as the support frame **14** is being driven in the forward direction **28**, the wobble of the support frame **14** resulting in a non-uniformally positioned formed configuration relative to the control line **226**. It has also been found that, when the curb slip form apparatus **10** is being driven in a forward direction **28** and steeringly controlled from a control line **226** which is formed on a radius, as shown in FIG. **11**, the track steering assembly **234** does tend to substantially maintain th alignment of the forward end portion **16** of the support frame **14** relative to the control line **226**; however, as the left track assembly **24** and the right track assembly **26** are steeringly driven to maintain the alignment of the support frame **14**, the position of the rearward end portion **18** of the support frame **14** relative to the control line **226** deviates substantially from an aligned position with respect to the survey lines **462** and **464**. The curb slip form apparatus **10** thus has a tendency to "cross-over" the predetermined path of travel defined by the survey lines **462** and **464**. Thus, particularly with respect to control lines defining a curved survey path, it has been found that the distance **468** between the control line **226** and the survey line **464** varies substantially along the curved control line **226**.

As described above, the form member **12** is pivotally connected to the support frame **14** generally near the forward end **16** of the support frame **14**, and the position of the rearward end **74** of the form member **12** is automatically controlled via the form steering assembly **124** to maintain the alignment of the formed configuration **460** extruded therefrom relative to the control line **226** or, in other words, to maintain the distance **468** between the control line **226** and the survey line **464** substantially constant as the curb slip form apparatus **10** is being driven in a forward direction **28** about a curved control line **226**. It should also be noted that the form steering assembly **124** maintains the alignment of the rearward end **74** of the form member **12** in such a manner that the predetermined formed configuration **460** is aligned with the survey lines **462** and **464** as the curb slip form apparatus **10** is being driven in a forward direction **28** along a control line **226** defining a relatively straight path of travel, thereby eliminating alignment deviations of the formed configuration **460** resulting from the wobbling movement of the curb slip form apparatus **10**, mentioned above.

More particularly, the sensor arm **222** of the formed steering assembly **124** continually senses the position of the rearward end portion **74** of the form member **12** relative to the control line **226**, the output signal **290** being indicative to the sensed position and acting to energize the control valve **298** via the switch **294** and the switch actuator **292** connected thereto to provide power fluid to the form steering member **126** in such a manner that the form steering member **226** pivotally moves the form member **12** in the pivot direction **132** and the pivot direction **134**, thereby pivotally moving the rearward end portion **74** of the form member **12** to maintain the alignment of the rearward portion **74** of the form member **12** relative to the control line **226**. In this manner, the curb-shaped, formed configuration **460** is extruded from the rearward end portion **74** of the form member **12** in an aligned position relative to the survey lines **462** and **464**, and the distance **468** between the control line **226** and the survey line **464** is maintained constant along the control line **226**, independent of the movement of the rearward end portion **18** of the support frame **14**.

It should also be noted that the springs **176** between the hydraulic cylinders **182** and **184** and the tow bar **158** will absorb limited movement of the form member **12** in a vertically upwardly direction during the operation of the curb slip form apparatus **10**. This limited absorbing of the movement of the form member **12** prevents the form member **12** from raising the curb slip form apparatus **10** off of its supporting track assemblies **24** and **26** when the form member **12** engages a relatively high spot or during the automatic operation of the forward elevation positioning assembly **40** and the cross-slope positioning assembly **42**.

In some applications, it becomes necessary to place expansion joints or reinforcing rods along the surveyed path generally between the survey line **462** and **464**, the curb-shaped, formed configuration **460** being, in this instance, formed over such expansion joints and reinforcing rods. In this particular type of application, the hydraulic cylinders **182**, **184** and **112** are each actuated to move the form member connected thereto in a vertically upwardly direction to a storage position of the form member **12** wherein the lowermost end **78** of the form member **12** is disposed in a horizontal plane vertically above the earth's surface.

The earth engaging assembly **56** of the curb slip form apparatus **10** is then actuated and the curb slip form apparatus **10** is driven in a forward direction **28**, the earth engaging assembly **56** and, more particularly, the auger **60** and the moldboard **64** thereof excavatingly engaging the earth's surface, in a manner similar to that described before. In this aspect of the operation of the curb slip form apparatus **10**, the forward elevation positioning assembly **40**, the cross-slope positioning assem-

bly 42 and the track steering assembly 234 operate in a manner as described before to maintain the curb slip form apparatus 10 aligned with the control line 226 and maintain the support frame in predetermined grade and slope positions. The form steering assembly 124 is moved or switched to a non-operating position, since the form member 12 is not functioning to extrude a formed configuration in this aspect of the operation with the curb slip form apparatus 10.

After the earth has been excavatingly prepared, as described above, the reinforcing rods and the expansion joints can then be placed along the prepared surface generally between the survey lines 462 and 464. The earth engaging assembly 56 is then removed from the support frame 14, by unbolting the auger frame 58 therefrom, and the cover 146 and the resilient flange 148 are removed from about the form opening 142 in the forward end 72 of the form member 12. The form extension section 150, as shown in FIG. 10, is then moved into a position generally adjacent the forward end 72 of the form member 12 and in a position wherein the cavity formed through the form extension section 150 is substantially aligned with the opening 142 in the forward end 72 of the form member 12. In this position of the form extension section 150 the form extension member 150 is boltingly secured to the forward end 72 of the form member 12 in a position wherein the lowermost end of the form extension section 150 is substantially aligned with the lowermost end 78 of the form member 12. The form extension section 150 is thus positioned on the form member 12 such that the cavity formed through the form extension section 150, the opening 142 formed through the forward end 72 of the form member 12 and the form cvaity 70 formed through the form member 12 are each substantially aligned, and each is sized to passingly receive the expansion joints or reinforcing rods as the curb slip form apparatus 10 is driven over the survey path, in an operating position of the form member 12 and in a position wherein the curb-shaped, formed configuration 70 is being extruded from the form member 12 over the expansion joints and reinforcing rods, in a manner described before.

The various dimensions and the shape of the formed configuration 460 may vary depending on the particular job specification. In view of the variance of the desired formed configuration, it is desirable to have a form member which can be easily removed and easily and quickly replaced by other form members having the requisite dimensions and shapes, in such manner that the same support frame 14 and the various components disposed thereon can be utilized in cooperation with such other form members. The curb slip form apparatus 10 is thus constructed such that the form member 12 can be easily and quickly removed and a subsequent form member can be quickly and efficiently connected in an operating position to the support frame 14.

More particularly, if it is desired to remove one of the form members 12 and replace such form member 12, the earth engaging assembly 56 will initially be boltingly removed from the forward end portion 16 of the support frame 14. As shown more clearly in FIGS. 2 and 5, when the earth engaging assembly 56 is removed from the support frame 14, convenient and easy access is obtained to the forward end portion 72 of the form member 12 and the interconnection therebetween with the tow bar 158 via the form opening 142 through the support frame 14.

In a preferred form, the upper flange 200 and the lower flange 204 are each boltingly removed from the forward end 72 of the form member 12, thereby disconnecting the forward end portion 72 of the form member 12 from the support frame 14. The form steering assembly 124 is then removed from the rearward end portion 72 of the form member 12 by disconnecting the rod portion 128 from the form steering member 126 from the channel member 116, thereby disengaging the rearward end portion 74 of the form member 12 from the support frame 14. The curb slip form appatatus 10 is then driven in a rearward direction 30 to a position wherein the curb slip form apparatus 10 is remotely positioned with respect to the form member 12, the concrete receiving portion 136 of the form member 12 passing through the intersection of the form opening 142 in the support frame 14 as the curb slip form apparatus 10 is driven in the rearward direction 30.

The new or subsequent form member to be connected to the curb slip form apparatus 10 is then positioned generally in front of the support frame 14, and the curb slip form apparatus 10 is driven in a forward direction 28 over the new form member to a position wherein the concrete receiving portion of the new from member is disposed generally within the form opening 142 in the support frame 14. In this position of the support frame 14 and the new form member, the upper flange 200 and the lower flange 204 which were removed from the form member 12 can be boltingly secured to the new form member and the rod portion 128 of the form steering member 126 can be pivotally secured to the channel member of the new form member, in a manner similar to that described before with respect to the form member 12. It should be particularly noted that the plurality of pivot apertures 164 through the tow bar 158 allow the various form members to be pivotally connected to the support frame 14 at various positions between the left side 20 and the right side 22 of the support frame 14, which may be particularly desirable when utilizing the curb slip form apparatus 10 in combination with subsequent form members.

The curb slip form apparatus 10, described above, thus provides a curb slip form having an earth engaging assembly which can be utilized to excavatingly prepare a portion of the earth's surface and which can be utilized to extrude a predetermined, curb-shaped configuration on the prepared surface, the form member 12 and the form extension section 150 cooperate such that the curb-shaped configuration can be extruded on a prepared portion of the earth's surface having a plurality of expansion joints and reinforcing rods spaced therealong and subsequently disposed in the formed configuration. The forward elevation positioning assembly 40, the cross-slope positioning assembly 42, the left rearward positioning assembly 44 and the right rearward elevation positioning assembly 46 cooperate to maintain the curb slip form apparatus 10 in predetermined grade and slope positions during the operation thereof; and the form steering assembly 124 being connected to the form member 12 to assure the alignment of the extruded, formed configuration relative to a predetermined control line and in alignment with the predetermined survey lines.

The curb slip form apparatus **10** is also constructed such that various form members may be utilized in cooperation with a single support frame thereby allowing a maximum flexibility of the curb slip form apparatus **10** and substantially reducing the operating costs incurred during the construction of such formed configurations.

The various forms of the control line **226,** described above provide a control line which can be constructed and disassembled in a positive, quick and efficient manner, and a control line wherein the distance between the control line and the survey line is maintained constant along the control line even in those situations wherein the control line is formed along a curved path or, in other words, is formed on the radius.

Changes may be made in the construction and the arrangement of the various parts or elements of the various embodiments as disclosed herein without departing from the spirit and scope of the invention as defined in the following claims.

What is claimed is:

1. Apparatus for forming a predetermined formed configuration of a concrete material or the like on a surface, generally along a predetermined survey line, comprising:

a support frame having a forward end, a rearward end, a left side and a right side;

means having a portion connected to the support frame supporting the support frame and moving the support frame in a driven position thereof;

a shaped form member pivotally connected to the support frame, the form member formingly engaging the concrete material of the like to form such material to the predetermined formed configuration, in an operating position of the form member and in a driven position of the support frame; and

form steering means sensing the position of the form member relative to the predetermined survey line, having one portion connected to the form member and connected to the support frame pivotally moving the form member relative to the support frame in response to the sensed position of the form member relative to the predetermined survey line maintaining the alignment of the form member relative to the predetermined survey line, thereby maintaining the alignment of the formed configuration relative to the predetermined survey line, comprising:

a form steering member, having one portion connected to the support frame and another portion connected to the form member, the form steering member pivotally moving the form member in generally lateral pivot directions with respect to the support frame in an actuated position of the form steering member;

form steering sensor means having one portion connected to the form member generally near the rearward end portion of the form member and one portion sensing the position of the rearward end portion of the form member relative to the predetermined survey line and providing an output signal responsive thereto; and

means, having a portion connected to the form steering sensor means and a portion connected to the form steering member receiving the output signal of the form steering sensor means and actuating the form steering member in response thereto.

2. The apparatus of claim **1** wherein the form member includes, a forward end and a rearward end, the form member being pivotally connected to the support frame generally near the forward end of the form member, the formed configuration being extruded generally from the rearward end portion of the form member in a driven position of the support frame.

3. The apparatus of claim **2** wherein the form member is disposed generally between the left side and the right side of the support frame and extends generally between the forward end and the rearward end of the support frame, the forward end of the form member being disposed generally near the forward end of the support frame and the rearward end of the form member being disposed generally near the rearward end of the support frame.

4. The apparatus of claim **2** wherein the form member includes: a form cavity extending therethrough intersecting the rearward end of the form member, the portion of the form member defining the form cavity formingly engaging the concrete material or the like to form such material to the predetermined formed configuration, a portion of the form member slidingly engaging the surface in an operating position thereof.

5. The apparatus of claim **2** defined further to include:

a tow bar means, having opposite ends, connected to the support frame generally near the forward end thereof and extending generally between the left side and the right side of the support frame;

a flange means secured to the forward end portion of the form member and extending a distance therefrom, the flange means pivotally secured to the tow bar means to pivotally support the form member generally near the forward end thereof; and

forward form positioning means connected to the support frame and having a portion thereof connected to the tow bar means to lower the tow bar means in an actuated lowering position thereof, there-by lowering the form member to an operating position and to raise the tow bar means in an actuated raising position thereof, thereby raising the form member to a storage position.

6. The apparatus of claim **5** defined further to include:

spring means interposed between the forward form positioning means and the tow bar means to absorb limited movement of the support frame relative to the tow bar means and the form member.

7. The apparatus of claim **5** defined further to include:

a pair of pin means, each pin means having a flange portion formed on one end thereof, one pin means slidingly journaled through the tow bar means generally near one end thereof and the other pin means slidingly journaled through the tow bar means generally near the opposite end thereof;

a retaining means adjustably secured to the end of each pin means, opposite the end thereof having the flange portion formed thereon, each retaining means engaging the tow bar means to limit the movement of the pin means connected thereto in one direction; and

a spring means disposed about each pin means, each spring means having a portion engaging the tow bar

means and another portion engaging the flange portion of one of the pin means, the tow bar means being disposed between the retaining means and the spring means, each spring means cooperating to absorb limited movement of the tow bar means and the form member in a direction toward a storage position thereof yet maintaining the form member in an operating position.

8. The apparatus of claim **7** wherein the forward form positioning means is defined further to include:

a first hydraulic cylinder means, having a rod portion reciprocatingly disposed therein, connected to the support frame generally near the left side thereof;

a first crank rotatingly supported on the support frame having one arm portion connected to the rod portion of the first hydraulic cylinder means and one other arm portion connected to the flange portion of one of the pin means, the first crank translating the reciprocating movement of the first hydraulic cylinder means to raise and lower the form member in a generally vertically upwardly and down-wardly direction;

a second hydraulic cylinder means, having a rod portion reciprocatingly disposed therein, connected to the support frame generally near the right side thereof; and

a second crank rotatingly supported on the support frame having one arm portion connected to the rod portion of the second hydraulic cylinder means and one other arm portion connected to the flange portion of one of the pin means, the second crank translating the reciprocating movement of the second hydraulic cylinder means to raise and lower the form member in a generally vertically upwardly and downwardly direction.

9. The apparatus of claim **1** defined further to include:

rearward form positioning means connected to the support frame and having a portion thereof connected to the form member generally near the rearward end thereof, to lower the form member in an actuated lowering position thereof to an operating position of the form member, and to raise the form member in an actuated raising position thereof to a storage position of the form member.

10. The apparatus of claim **1** wherein the means for drivingly supporting the support frame is defined further to include:

left track means, having a portion thereof connected to the support frame, generally near the left side thereof, moving the support frame in a forward direction and in a rearward direction in a driven position thereof;

right track means, having a portion thereof connected to the support frame, generally near the right side thereof, moving the support frame in a forward and a rearward direction in a driven position thereof;

track steering sensor means connected to the support frame and having one portion thereof sensing the position of the support frame relative to the predetermined survey line and providing an output signal responsive thereto;

left hydraulic motor means connected to the left track means driving the left track means in a driven position thereof;

right hydraulic motor means connected to the right track means driving the right track means in a driven position thereof;

pump means connected to the left hydraulic motor means and to the right hydraulic motor means providing fluid thereto to drive the left hydraulic motor means and the right hydraulic motor means when in communication therewith;

flow divider valve means interposed between the pump means and the left hydraulic motor means and the right hydraulic motor means, the flow divider valve means controlling the flow of fluid from the pump means to the left hydraulic motor means and from the pump means to the right hydraulic motor means to steeringly drive the left track means and the right track means; and

control means receiving the output signal from the track steering sensor means and being connected to the flow divider valve means, the control means positioning the flow divider valve means to control the flow of fluid from the pump means to the left hydraulic motor means and from the pump means to the right hydraulic motor means in response to the output signal received from the track steering sensor means.

11. The apparatus of claim **10** wherein the track steering sensor means is further defined as being connected to a support frame generally near the forward end thereof, the track steering sensor means thereby sensing the position of the forward end portion of the support frame relative to the predetermined survey line.

12. The apparatus of claim **1** defined further to include:

left track means, having a portion thereof connected to the support frame, generally near the left side thereof, moving the support frame in a forward direction and in a rearward direction in a driven position thereof;

right track means, having a portion thereof connected to the support frame, generally near the right side thereof, moving the support frame in a forward and a rearward direction in a driven position thereof;

forward elevation positioning means, having a portion connected to the left track means and another portion connected to the support frame, generally near the left side thereof and generally near the forward end thereof, the forward elevation positioning means raising the support frame in a generally vertically upwardly direction in an actuated raising position thereof, and lowering the support frame in a generally vertically downwardly direction in an actuated lowering position thereof; and

means sensing the elevation of the support frame relative to a predetermined control elevation, connected to the forward elevation positioning means and actuating the forward elevation positioning means to an actuated raising position and to an actuated lowering position thereof in response to the sensed elevation of the support frame, to maintain the elevation of the support frame relative to the predetermined control elevation.

13. The apparatus of claim **12** defined further to include:

a cross-slope positioning means having a portion thereof connected to the right track means and an-

other portion thereof connected to the support frame generally near the right side thereof and generally near the forward end thereof, to raise the support frame in a generally vertically upwardly direction in an actuated raising position thereof, and to lower the support frame in a generally vertically downwardly direction in an actuated lowering position thereof; and

means to sense the cross-slope position of the support frame relative to a predetermined control cross-slope and to actuate the cross-slope positioning means to an actuated raising position and to an actuated lowering position in response to the sensed cross-slope position of the support frame, to maintain the cross-slope position of the support frame relative to the predetermined control cross-slope position.

14. The apparatus of claim **12** defined further to include:

left rearward elevation positioning means having a portion connected to the left track means and another portion connected to the support frame generally near the left side thereof and generally near the rearward end thereof, raising the support frame in a generally vertically upwardly direction in an actuated raising position thereof and lowering the support frame in a generally vertically downwardly direction in an actuated lowering position thereof;

right rearward elevation positioning means having a portion connected to the right track member and another portion connected to the support frame generally near the right side thereof and generally near the rearward end thereof raising the support frame in a generally vertically upwardly direction in an actuated raising position thereof, and lowering the support frame in a generally vertically downwardly direction in an actuated lowering position thereof; and

means actuating the left and the right rearward elevation positioning means to actuated raising positions and to actuated lowering positions.

15. The apparatus of claim **2** wherein the form member includes, a concrete receiving portion generally near the forward end thereof, having an upper end forming an opening for receiving the concrete material or the like to guide such material to a position to be formingly engaged by the form member.

16. The apparatus of claim **15** wherein the form member includes, an opening in the forward end thereof to pass expansion joints, reinforcing rods or the like therethrough in a driven position of the support frame, the expansion joints, reinforcing rods or the like being disposed within the formed configuration extruded from the form member.

17. The apparatus of claim **16** defined further to include:

a form extension section having a forward end and a rearward end, the rearward end thereof removably connected to the forward end of the form member generally about the opening therein and extending a predetermined distance therefrom, the form extension section retainingly engaging a portion of the concrete material or the like in a position to be formingly engaged by the form member.

18. The apparatus of claim **16** defined further to include a cover removably secured to the forward end of the form member substantially closing the opening in the forward end of the form member to cooperatingly guide the concrete material or the like to a position to be formingly engaged by the form member.

19. The apparatus of claim **15** wherein the support frame includes, a form opening therethrough; and wherein the concrete receiving portion of the form member is defined further as extending a distance generally vertically upwardly, a portion thereof generally near the upper end thereof extending through the form opening in the support frame.

20. The apparatus of claim **19** wherein the form member is further defined as being removably connected to the support frame; and wherein the form opening is defined further as being formed through the support frame generally between the left side and the right side thereof and intersecting the forward end of the support frame to pass the concrete receiving portion therethrough to move the support frame to a disengaged position with respect to the form member and to move the support frame to an engaging position with respect to the form member.

21. The apparatus of claim **15** defined further to include:

an earth engaging assembly connected to the forward end of the support frame for excavatingly engaging the earth and preparing same for the formed configuration to be extrudingly disposed thereon, comprising:

an auger frame connected to the forward end of the support frame;

an auger means rotatingly supported on the auger frame to excavatingly engage the earth in a driven position thereof;

means to rotatingly drive the auger means; and

a moldboard means disposed generally between the auger means and the support frame and supported on the auger frame to finishingly engage the earth in a driven position of the support frame.

22. Apparatus for forming a predetermined formed configuration of a concrete material or the like on a surface generally along a predetermined survey line, comprising:

a support frame having a forward end, a rearward end, a left side and a right side;

means for drivingly supporting the support frame to move the support frame in a driven position thereof, comprising:

left track means having one portion connected to the support frame, generally near the left side thereof, moving the support frame in a forward direction and in a rearward direction in a driven position thereof; and

right track means having one portion connected to the support frame, generally near the right side thereof, moving the support frame in a forward direction and in a rearward direction in a driven position thereof;

left rearward positioning means having one portion connected to the left track means and another portion connected to the support frame generally near the left side of the support frame and generally near the rearward end on the support frame, the left rearward elevation positioning means raising the support frame in a generally vertically upwardly direction in an actuated raising position thereof and lowering the support frame in a gener-

ally vertically downwardly direction in an actuated lowering position thereof;

right rearward elevation positioning means having a portion connected to the right track means and another portion connected to the support frame generally near the right side thereof and generally near the rearward end thereof raising the support frame in a generally vertically upwardly direction in an actuated raising position of the right rearward elevation positioning means and lowering the support frame in a generally vertically downwardly direction in an actuated lowering position of the right rearward elevation positioning means;

means connected to the left and the right rearward elevation positioning means actuating the left and the right rearward elevation positioning means to actuated raising positions in one position thereof and to actuated lowering positions in one other position thereof;

a scale, having gradation marks thereon, supported on the rearward end portion of the support frame and extending generally vertically upwardly therefrom;

a string line supportedly connected to the left track means and to the right track means, the string line extending generally across the rearward end portion of the support frame and disposed generally near the scale, the position of the string line with respect to the gradation marks on the scale indicating the elevation of the support frame generally near the rearward end thereof;

a shaped form member pivotally connected to the support frame formingly engaging the concrete material or the like and forming such material to a predetermined formed configuration in an operating position of the form member and in a driven position of the support frame; and

form steering means connected to the form member and pivotally moving the form member maintaining the alignment of the form member relative to the predetermined survey line, thereby maintaining the alignment of the formed configuration relative to the predetermined survey line.

23. A control line for positioning a predetermined distance from a survey line to provide a guide for maintaining the alignment of vehicles or the like relative to the survey line, comprising:

a flexible, semi-rigid band having a generally rectangularly shaped cross-section, an upper end and a lower end; and

means for supporting the band a predetermined distance from the survey line at a predetermined elevation, comprising:

a band support arm; and

a band connector formed on one end of the band support arm, having an upper arm and a lower arm, the upper arm and the lower arm each having a notched portion formed therein, the upper arm being angularly disposed with respect to the lower arm in a vertical and in a horizontal plane, the distance between each notched portion being greater than the distance between the upper and the lower end of the band in one position of the upper arm and the lower arm for receiving the band therebetween, the notched portions of the upper arm and the lower arm retainingly engaging the band in one other position of the upper and the lower arm.

24. A control line for positioning a predetermined distance from a survey line to provide a guide for maintaining the alignment of vehicles or the like relative to the survey line, comprising:

a flexible, semi-rigid band having a generally rectangularly shaped cross-section, an upper end and a lower end; and

means for supporting the band a predetermined distance from the survey line at a predetermined elevation, comprising:

a band support arm; and

a U-shaped bracket formed on one end of the band support arm defining an opening for receiving the band, one end portion of the U-shaped bracket retainingly engaging a portion fo the band in an assembled position thereof and a flange portion formed on one end of the U-shaped bracket, the band being snapped into the opening over the flange portion and the flange portion engaging the band to retain the band supported in the opening of the U-shaped bracket.

25. A control line for positioning a predetermined distance from a survey line to provide a guide for maintaining the alignment of vehicles or the like relative to the survey line, comprising:

a flexible, semi-rigid band having a generally circular-shaped cross-section;

a connecting band formed on a portion of the band, the connecting band having a generally circular-shaped cross-section; and

means for supporting the band a predetermined distance from the survey line at a predetermined elevation, comprising:

a band support arm;

a band connector formed on one end of the band support arm having an upper arm and a lower arm, the upper and the lower arms each having a curved portion formed on one end retainingly engaging a portion of the connecting band in one position of the upper arm and the lower arm, the curved portions of the upper arm and the lower arm being spaced for receiving the connecting band therebetween; and

means to secure the upper arm and the lower arm in a position wherein the curved portions thereof retainingly engage a portion of the connecting band disposed therebetween.

26. Apparatus for forming a predetermined formed configuration of a concrete material or the like on a surface generally along a predetermined survey line, comprising:

a support frame having a forward end, a rearward end, a left side and a right side;

means having a portion connected to the support frame supporting the support frame and moving the support frame in a driven position thereof;

a shaped form member having a forward end and a rearward end, the form member pivotally connected to the support frame generally near the forward end of the form member, the form member formingly engaging the concrete material or the like to form such material to a predetermined formed configuration in an operating position of the form member and in a driven position of the support frame, the formed configuration being ex-

truded generally from the rearward end portion of the form member in a driven position of the support frame; and

form steering means sensing the position of the form member relative to the predetermined survey line, having one portion connected to the form member and connected to the support frame pivotally moving the form member relative to the support frame in response to the sensed position of the form member relative to the predetermined survey line maintaining the alignment of the form member relative to the predetermined survey line, thereby maintaining the alignment of the formed configuration relative to the predetermined survey line, comprising:

hydraulic cylinder means having one portion connected to the support frame and a rod portion reciprocatingly disposed therein, the rod portion of the hydraulic cylinder means pivotally and securedly connected to the rearward end portion of the form member pivotally moving the form member in an actuated position of the hydraulic cylinder means;

a power fluid source connected to the hydraulic cylinder means providing power fluid thereto actuating the hydraulic cylinder means when in communication therewith;

form steering sensor means having one portion connected to the form member generally near the rearward end of the form member and one portion sensing the position of the rearward end portion of the form member relative to the predetermined survey line and providing an output signal responsive thereto;

control valve means interposed between the hydraulic cylinder means and the power fluid source providing communication therebetween in an actuated position of the control valve means; and

valve actuator means connected to the control valve means receiving the output signal of the form steering sensor means and actuating the control valve in response thereto.

27. Apparatus for forming a predetermined formed configuration of a concrete material or the like on a surface generally along a predetermined survey line, comprising:

a support frame having a forward end, a rearward end, a left side and a right side;

means having a portion connected to the support frame supporting the support frame and moving the support frame in a driven position thereof;

a shaped form member having a forward end and a rearward end pivotally connected to the support frame generally near the forward end of the form member, the form member formingly engaging the concrete material or the like to form such material to a predetermined formed configuration in an operating position of the form member and in a driven position of the support frame, the formed configuration being extruded generally from the rearward end portion of the form member in a driven position of the support frame;

form steering means sensing the position of the form member relative to the predetermined survey line, having one portion connected to the form member and connected to the support frame pivotally moving the form member relative to the support frame in response to the sensed position of the form member relative to the predetermined survey line maintaining the alignment of the form member relative to the predetermined survey line, thereby maintaining the alignment of the formed configuration relative to the predetermined survey line;

tow bar means, having opposite ends, connected to the support frame generally near the forward end thereof and extending generally between the left side and the right side of the support frame;

flange means secured to the forward end portion of the form member extending a distance therefrom, the flange means pivotally secured to the tow bar means to pivotally support the form member generally near the forward end thereof, comprising:

an upper flange connected to the form member;

roller means rollingly supported on the upper flange, the roller means rollingly engaging the tow bar means to reduce friction between the upper flange and the tow bar means in a pivoted position of the form member;

a lower flange connected to the form member; and

roller means rollingly supported on the lower flange, the roller means rollingly engaging the tow bar means to reduce friction between the lower flange and the tow bar means in the pivoted position of the form member; and

forward form positioning means connected to the support frame having a portion thereof connected to the tow bar means lowering the tow bar means in an actuated lowering position thereof thereby lowering the form member to an operating position and raising the tow bar means in an actuated raising position thereof thereby raising the form member to a storage position.

28. Apparatus for forming a preformed configuration of a concrete material or the like on a surface, generally along a predetermined survey line, comprising:

a support frame having a forward end, a rearward end, a left side and a right side;

means having a portion connected to the support frame supporting the support frame and moving the support frame in a driven position thereof;

a shaped form member, having a forward end, a rearward end and a lip portion formed on the rearward end thereof, the form member pivotally connected to the support frame generally near the forward end of the form member and formingly engaging the concrete material or the like to form such material to a predetermined formed configuration in an operating position of the form member in a driven position of the support frame, the formed configuration being extruded generally from the rearward end portion of the form member in a driven position of the support frame;

form steering means sensing the position of the form member relative to the predetermined survey line, having one portion connected to the form member and connected to the support frame pivotally moving the form member relative to the support frame in response to the sensed position of the form member relative to the predetermined survey line maintaining the alignment of the form member relative to the predetermined survey line, thereby maintaining the alignment of the formed configuration relative to the predetermined survey line;

a channel member connected to the support frame generally near the rearward end thereof, having a flanged portion formed thereon, the flange portion being disposed near the lip portion of the form member and spaced a distance therefrom in an operating position of the form member;

roller means rollingly supported on the channel member, the roller means rollingly engaging a portion of the form member to reduce the friction therebetween in a pivoted position of the form member; and

rearward form positioning means connected to the support frame and having a portion thereof connected to the form member generally near the rearward end thereof lowering the form member in an actuated lowering position thereof to an operating position of the form member and raising the form member in an actuated position thereof to a storage position of the form member, the rearward form positioning means being connected to the channel member and the flange portion of the channel member engaging the lip portion of the form member raising the form member to a storage position in an actuated raising position of the rearward form positioning means.

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