United States Patent [19]

Allen

[11] **3,870,427**

[45] **Mar. 11, 1975**

[54] **SURFACE FINISHING METHOD AND APPARATUS**

[75] Inventor: **Thomas E. Allen,** Mustank, Okla.

[73] Assignee: **CMI Corporation,** Oklahoma City, Okla.

[22] Filed: **July 26, 1972**

[21] Appl. No.: **275,232**

[52] **U.S. Cl.** **404/103**

[51] **Int. Cl.** **E01c 19/28**

[58] **Field of Search** 404/96, 83, 72, 98, 101, 404/105, 118, 119, 120, 122

[56] **References Cited**

UNITED STATES PATENTS

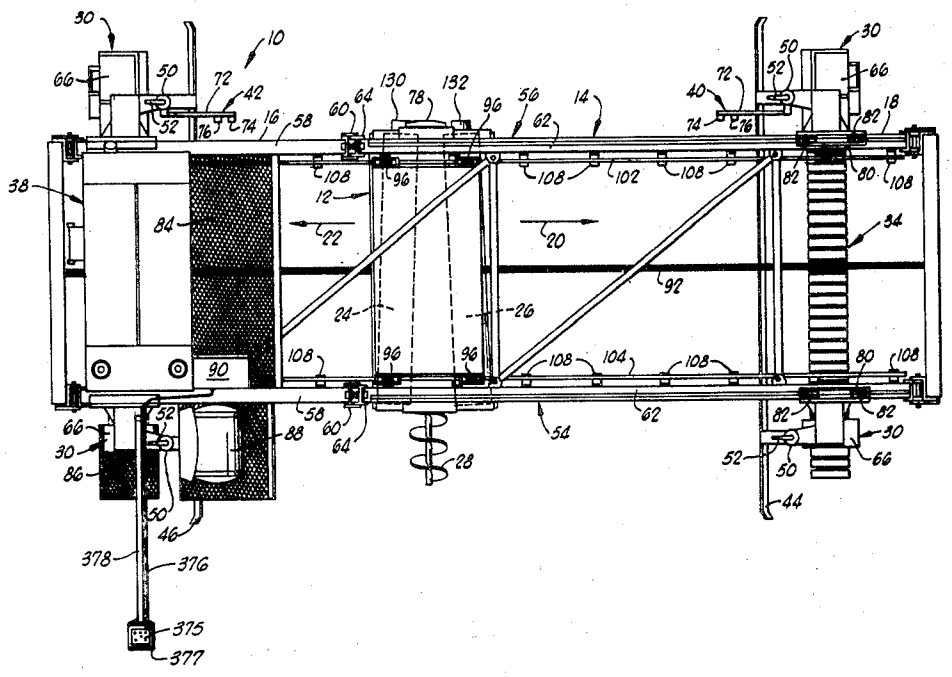
1,467,243	9/1923	Fitzgerald	404/98
1,987,398	1/1935	Gardiner	404/101
2,084,068	6/1937	Vinton	404/119
2,138,103	11/1938	Jorgensen	404/118 X
2,334,717	11/1943	Long	404/101
2,543,966	3/1951	Heltzel	404/119
2,583,108	1/1952	Lewis	404/101
2,603,132	7/1952	Miller	404/119
3,094,048	6/1963	Hudis	404/96
3,251,281	5/1966	Iannetti	404/120
3,270,634	9/1966	Borges	404/122
3,528,348	9/1970	Rowe	404/120
3,541,931	11/1970	Godberson	404/122

Primary Examiner—Nile C. Byers, Jr.
Attorney, Agent, or Firm—Dunlap & Codding

[57] **ABSTRACT**

A method and apparatus for finishing concrete surfaces or the like having a first and a second surface finisher transversely movable between predetermined positions across the surface to be finished, pivotally movable into sequential engagement with the surface to be finished, and a pair of augers having a portion rotatingly supported between the first and the second surface finishers, the surface finishers angularly oriented in a vertical plane such that the forward ends thereof are disposed slightly below the horizontal plane of the finished surface. Vibrators are disposed near the slip forms, and a vibrator is angularly and pivotally disposed in the surface to be finished near each surface finisher. A remote controller is positioned such that the operator controls the transverse, pivotal and rotational movement of surface finishers and augers from a remote position wherein the finishing operation is observable via the operator. A drive apparatus moving the surface finishers between the predetermined positions is connected to pivot the surface finishers and provide the driving impetus for rotatingly driving the surfaces finishers.

28 Claims, 18 Drawing Figures



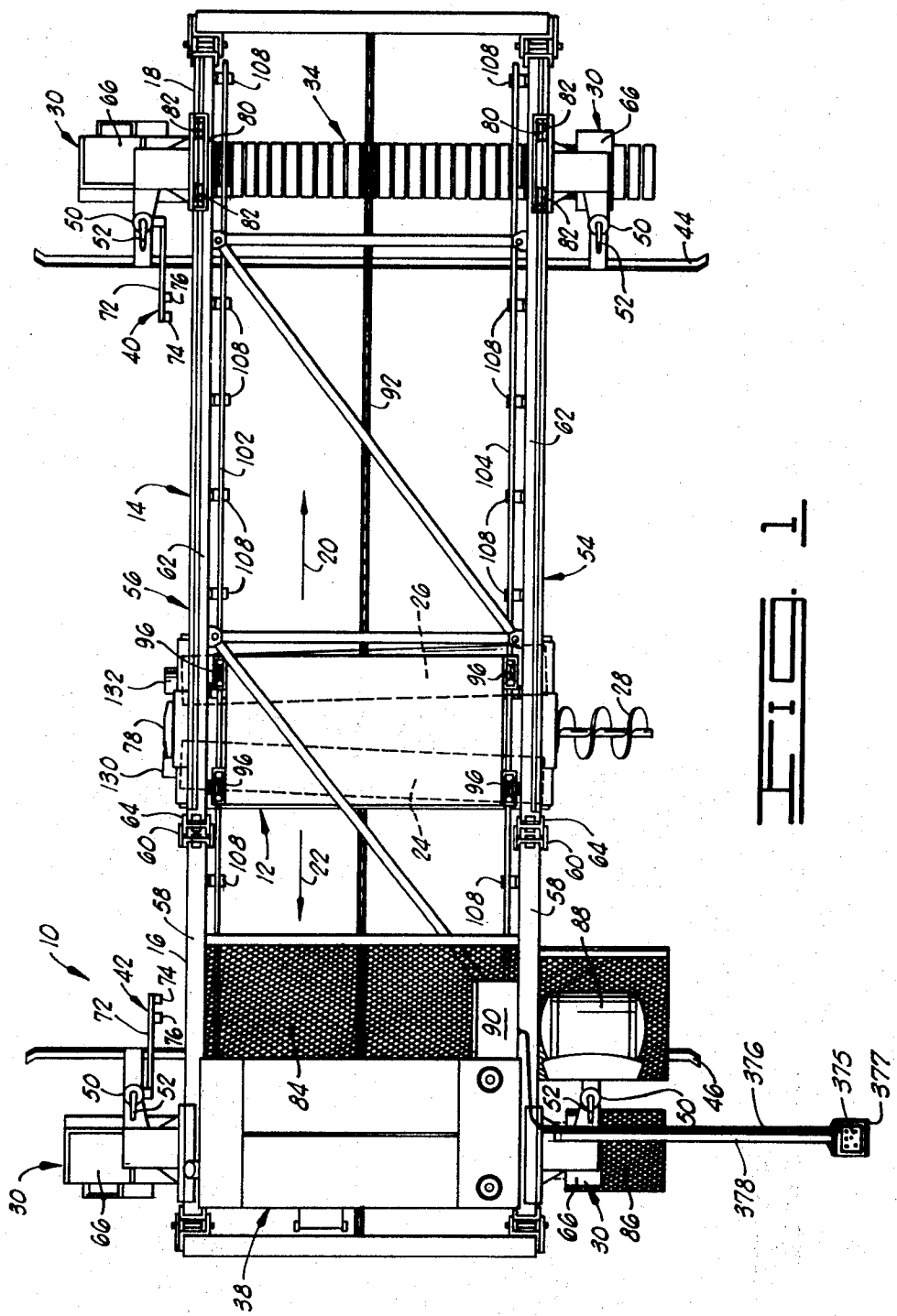


FIG. 1

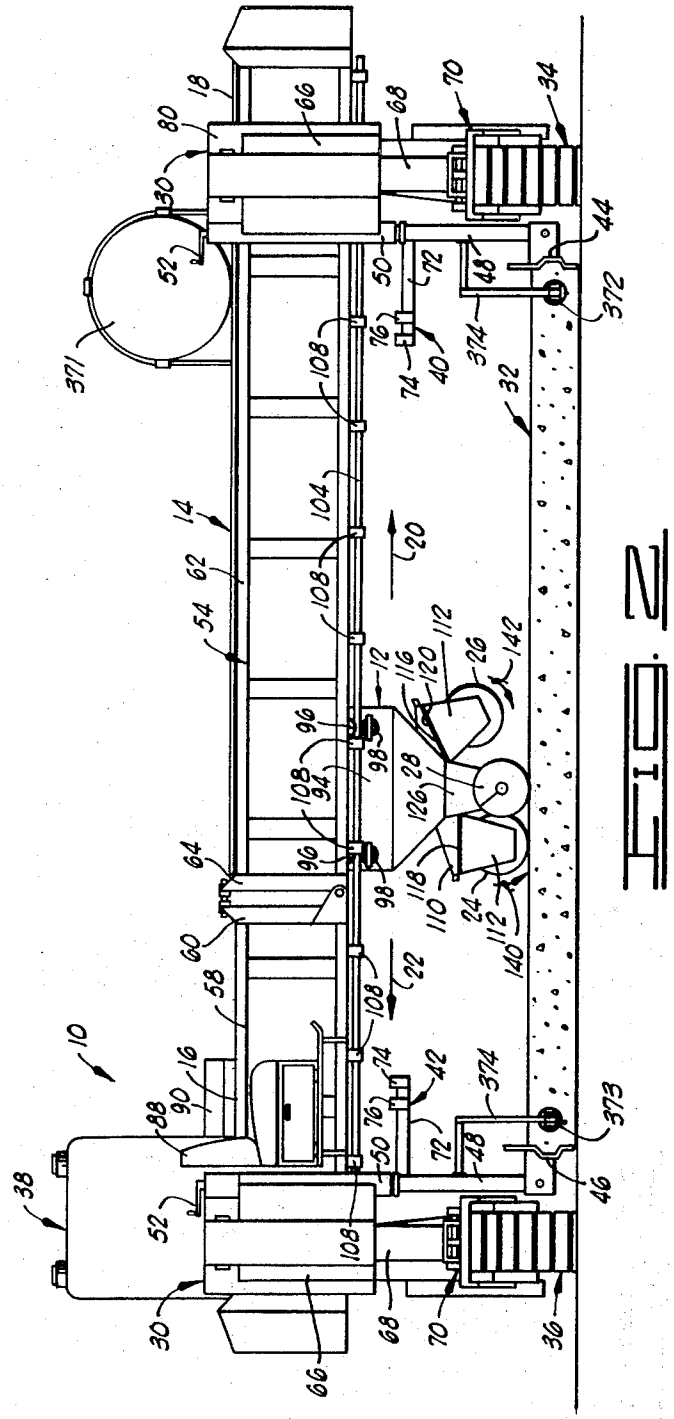


FIG. 2

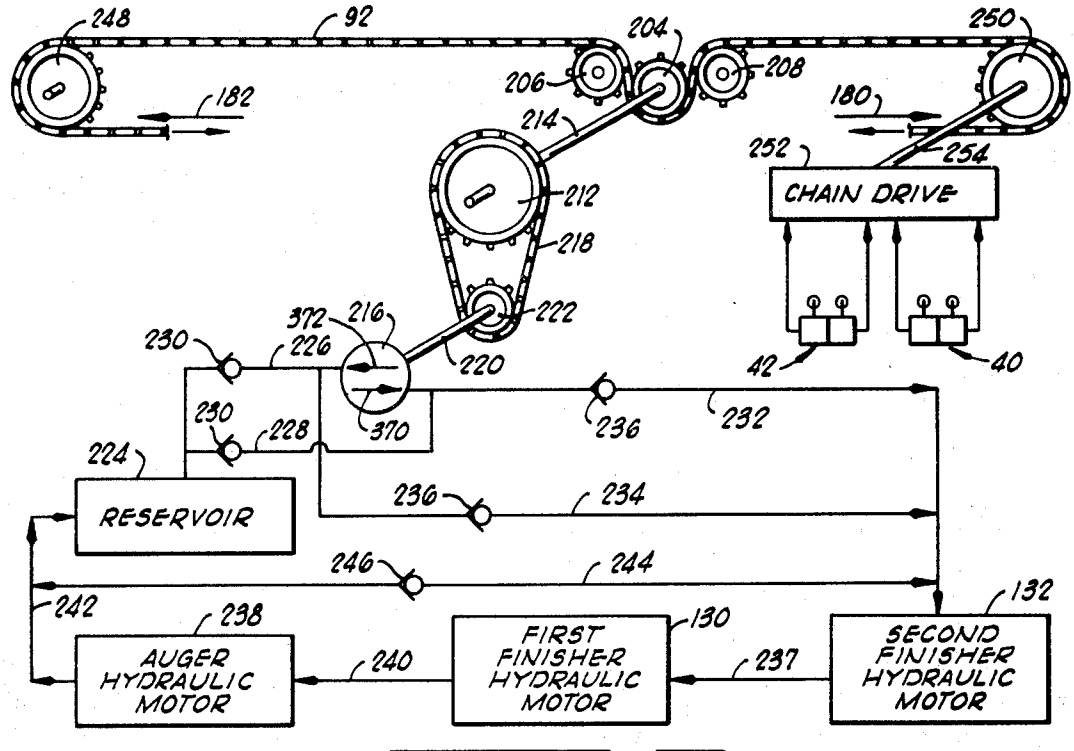

248
92
204
250
182
206
208
180
214
252
254
CHAIN DRIVE
212
218
222
372
216
230
226
220
42
40
230
228
370
236
232
224
RESERVOIR
236
234
246
244
242
132
238
130
AUGER HYDRAULIC MOTOR
240
FIRST FINISHER HYDRAULIC MOTOR
237
SECOND FINISHER HYDRAULIC MOTOR

FIG. 5

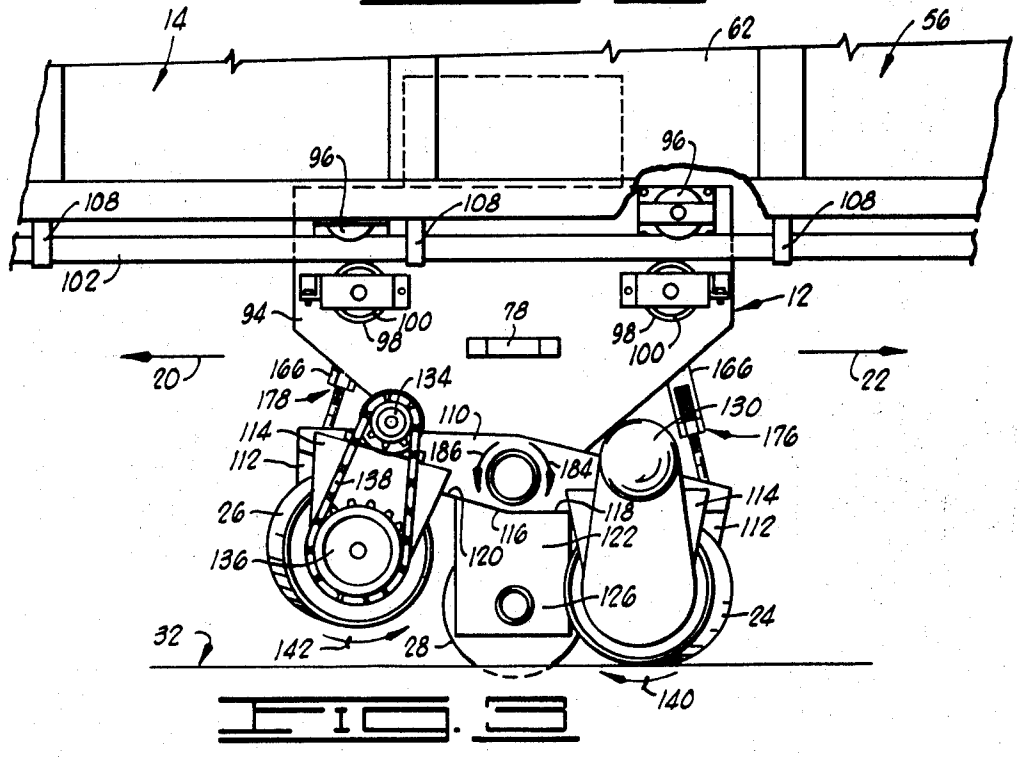

14
62
56
96
96
108
108
108
102
94
100
98
78
98
100
12
20
22
166
178
134
110
166
130
176
114
112
186
184
138
114
112
26
118
116
122
120
136
126
24
32
142
28
140

FIG. 3

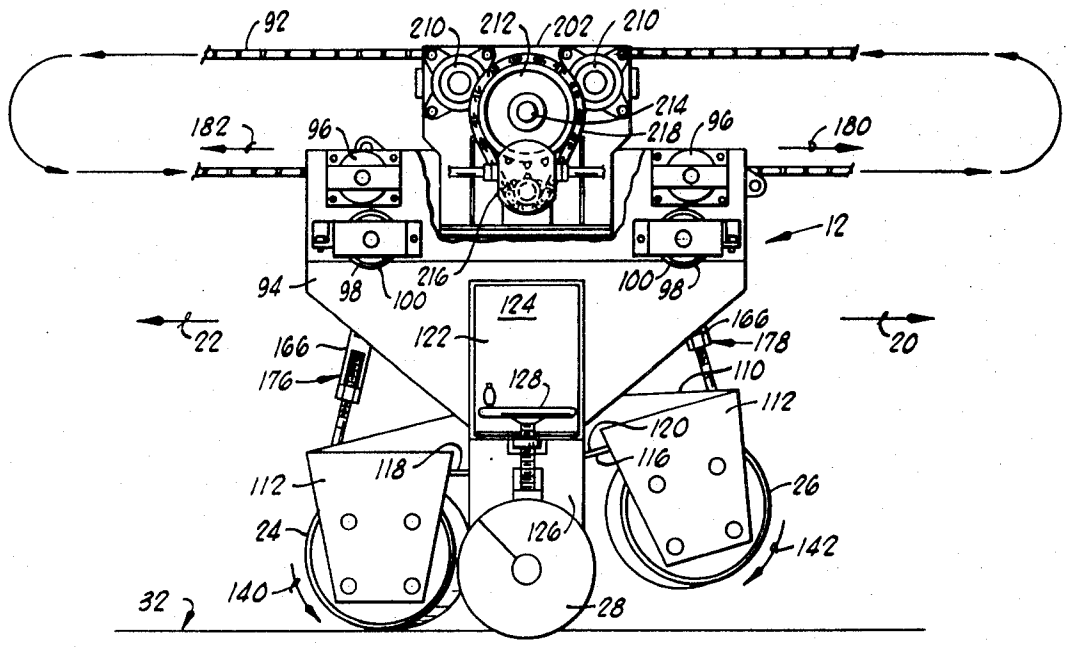

92
210
212
202
210
214
218
96
96
182
180
12
94
98
100
216
100
98
124
122
166
178
110
112
120
116
26
142
166
176
128
22
20
112
118
24
126
140
32
28

FIG. 4

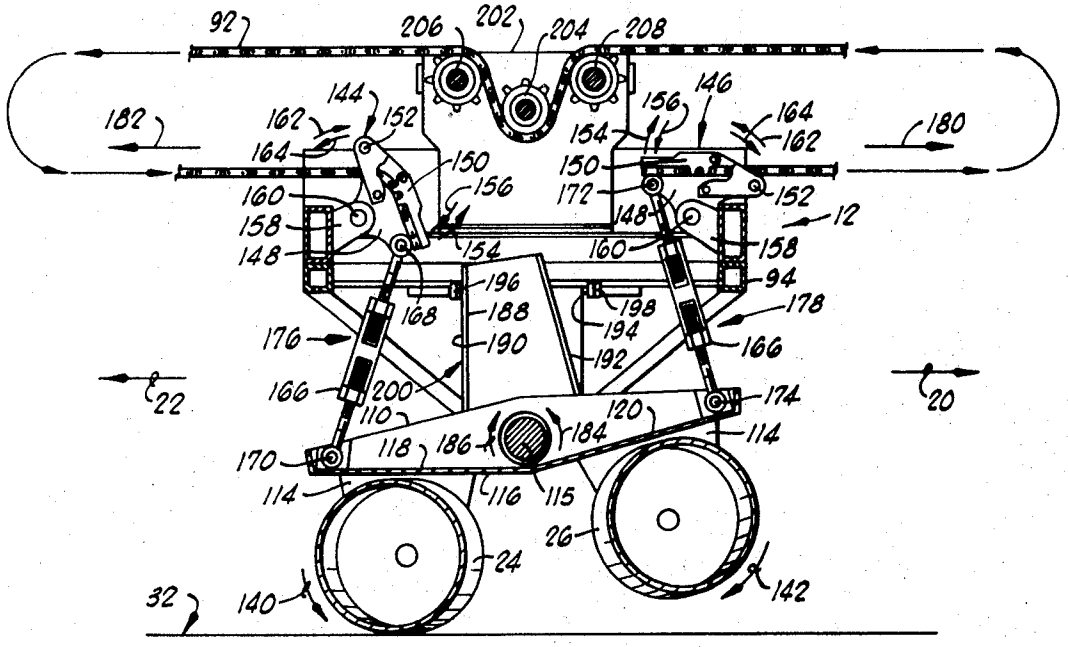

92
206
202
204
208
144
152
162
164
182
180
146
156
164
162
154
150
150
172
152
160
158
148
12
148
154
160
158
94
196
198
178
168
188
194
176
190
192
166
166
200
174
22
20
110
120
184
114
170
118
186
114
116
115
26
24
142
32
140

FIG. 5

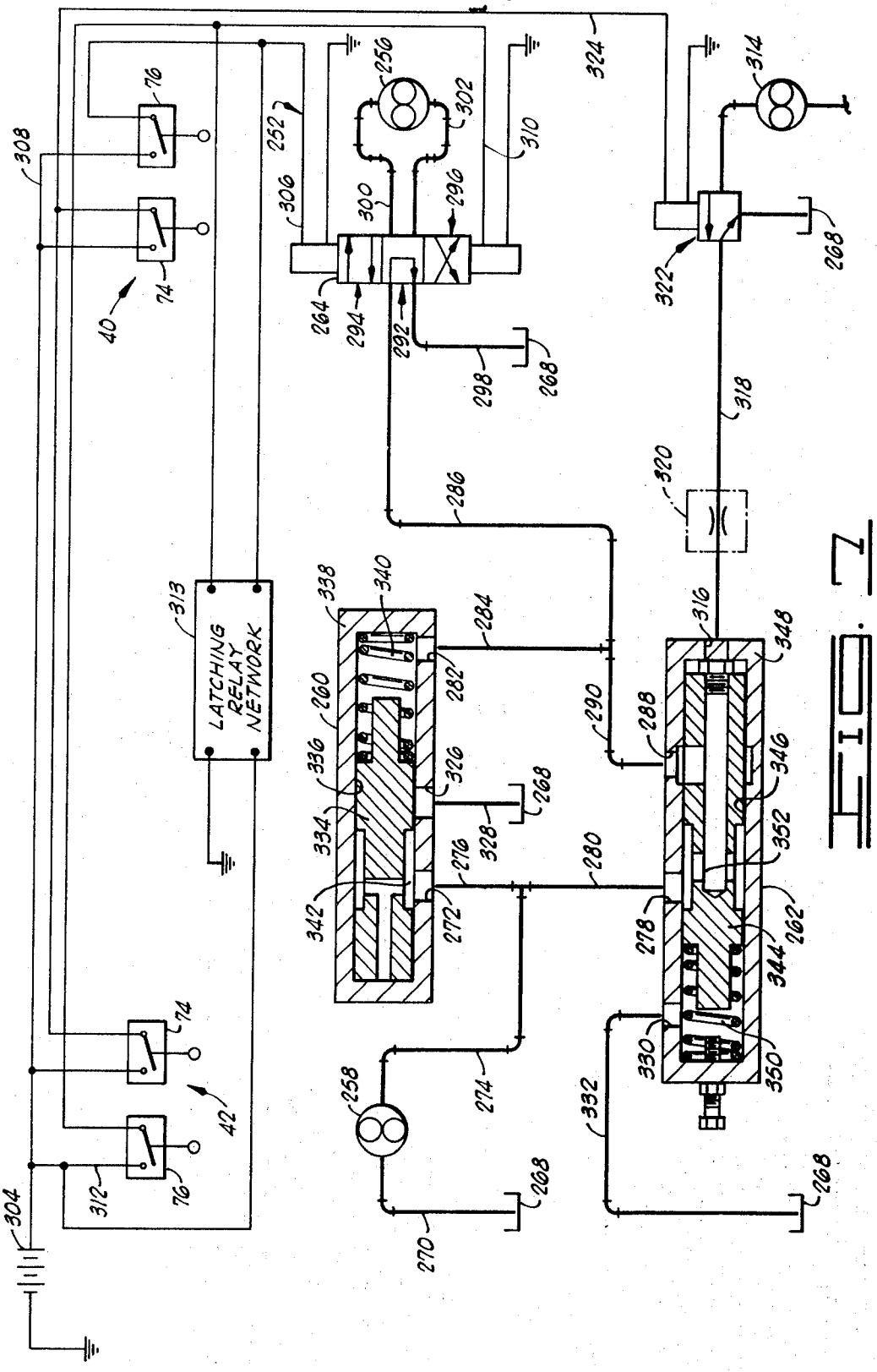

LATCHING RELAY NETWORK
313
40
42
74
76
252
256
258
260
262
264
268
270
272
274
276
278
280
282
284
286
288
290
292
294
296
298
300
302
304
306
308
310
312
314
316
318
320
322
324
326
328
330
332
334
336
338
340
342
344
346
348
350
352

FIG. 7

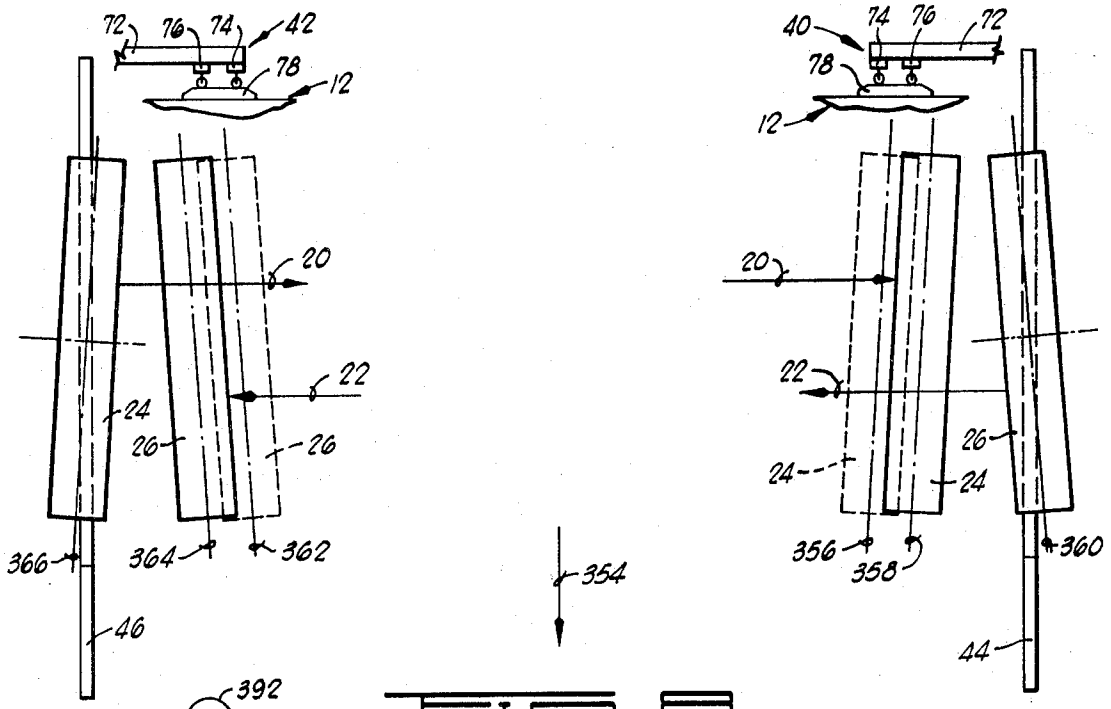

72
76
74
42
78
12
20
22
24
26
26
366
364
362
46
40
74
76
72
78
12
20
22
26
24
24
356
358
360
44
354

FIG. 1

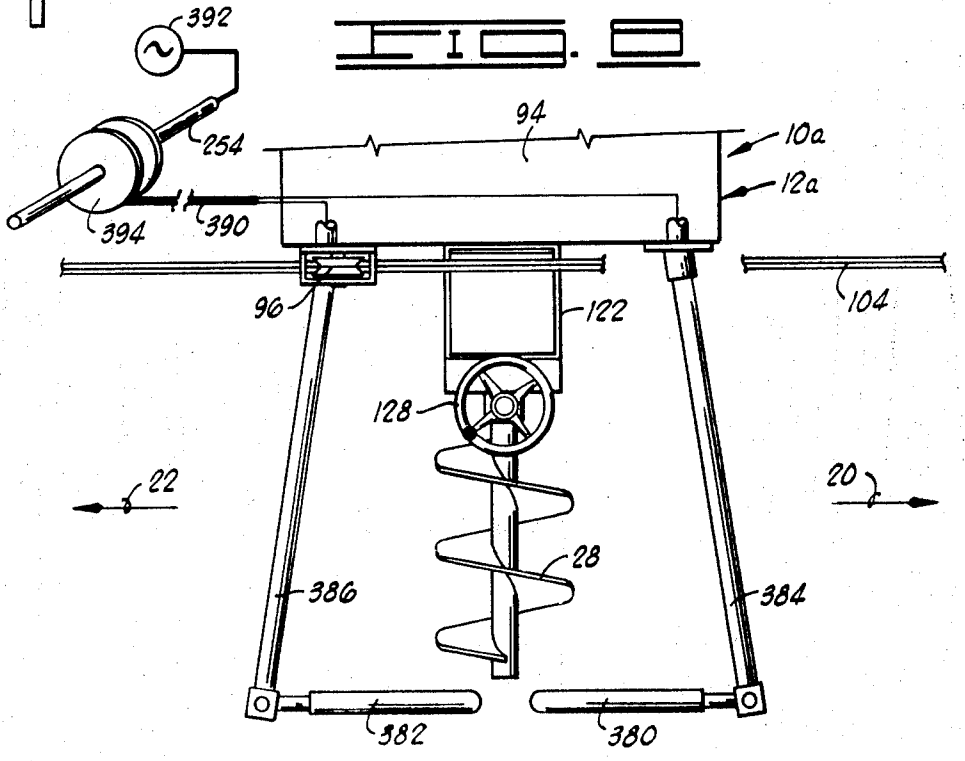

392
254
394
390
94
10a
12a
96
122
104
128
22
20
28
386
384
382
380

FIG. 2

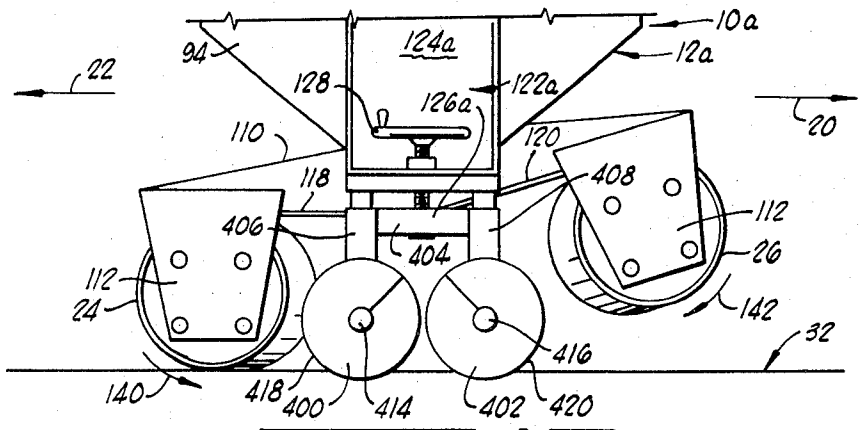


FIG. 10

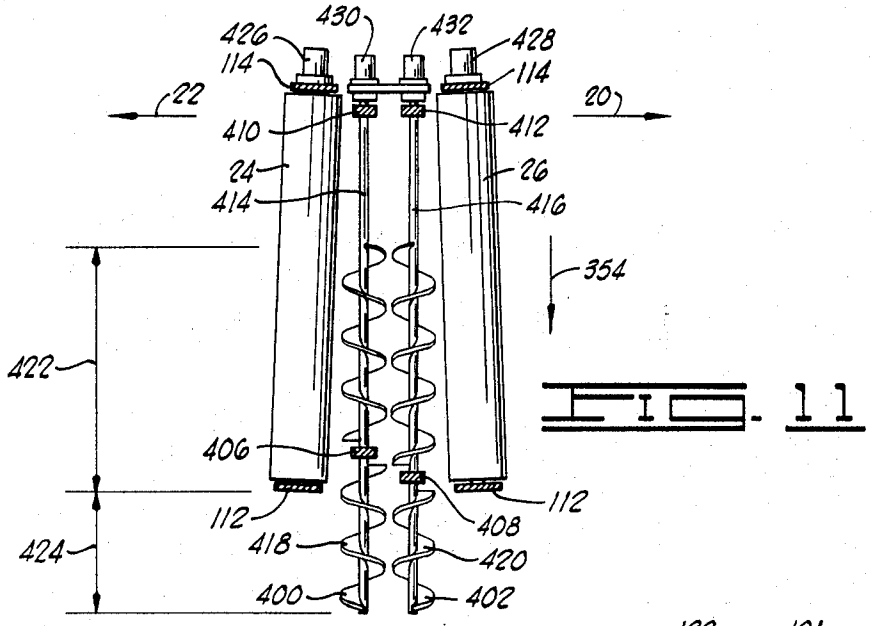


FIG. 11

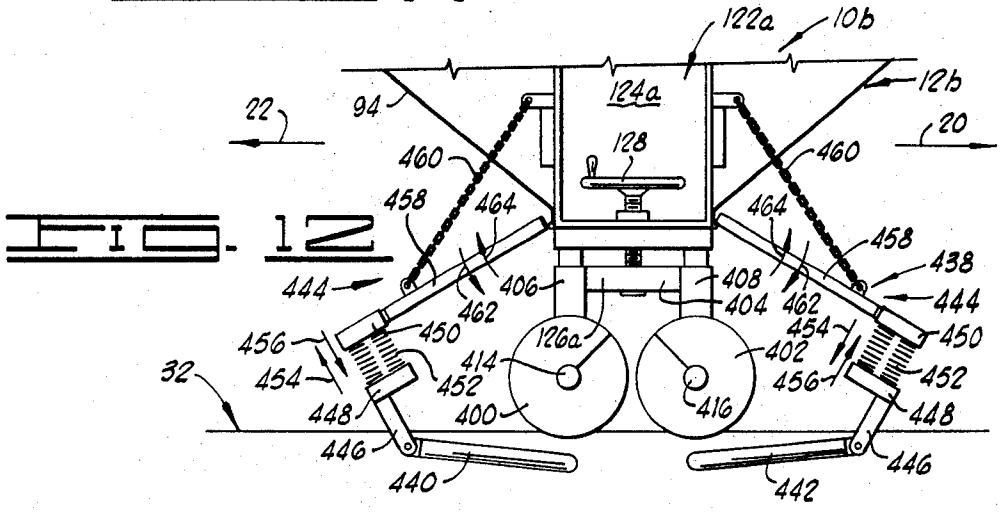


FIG. 12

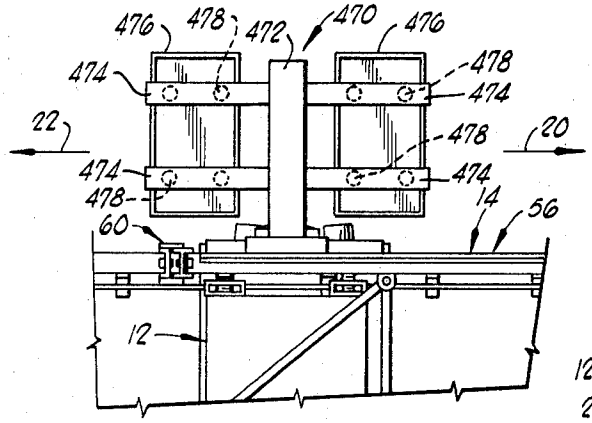


FIG. 13

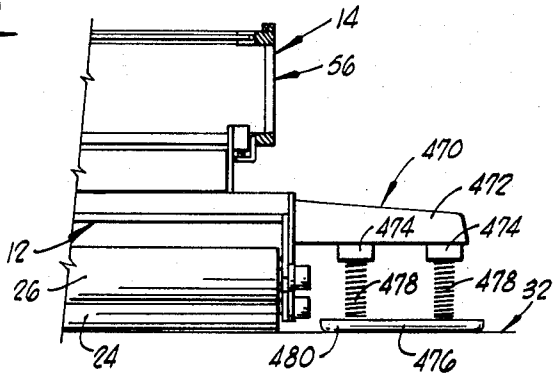


FIG. 14

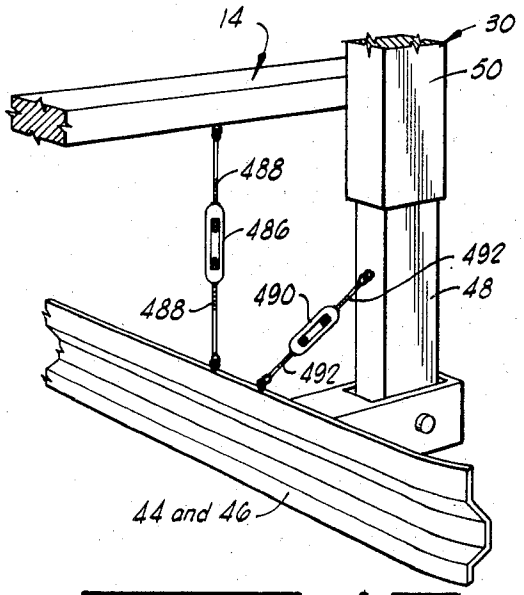


FIG. 15

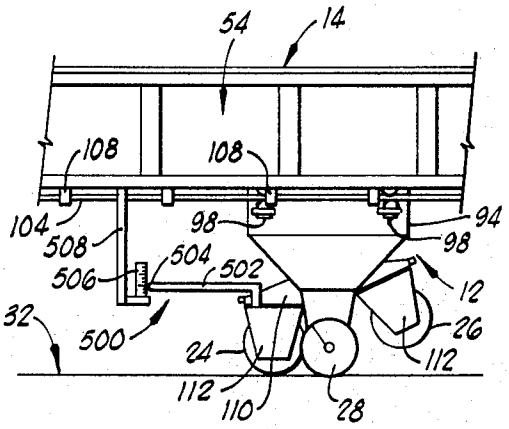


FIG. 16

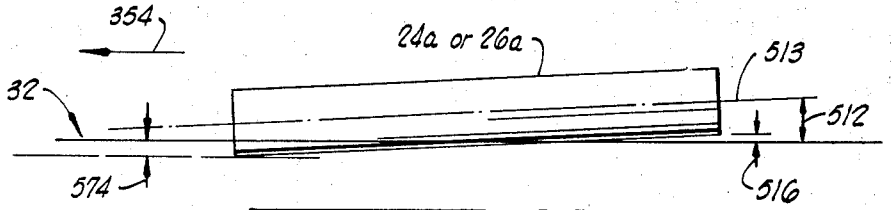


FIG. 17

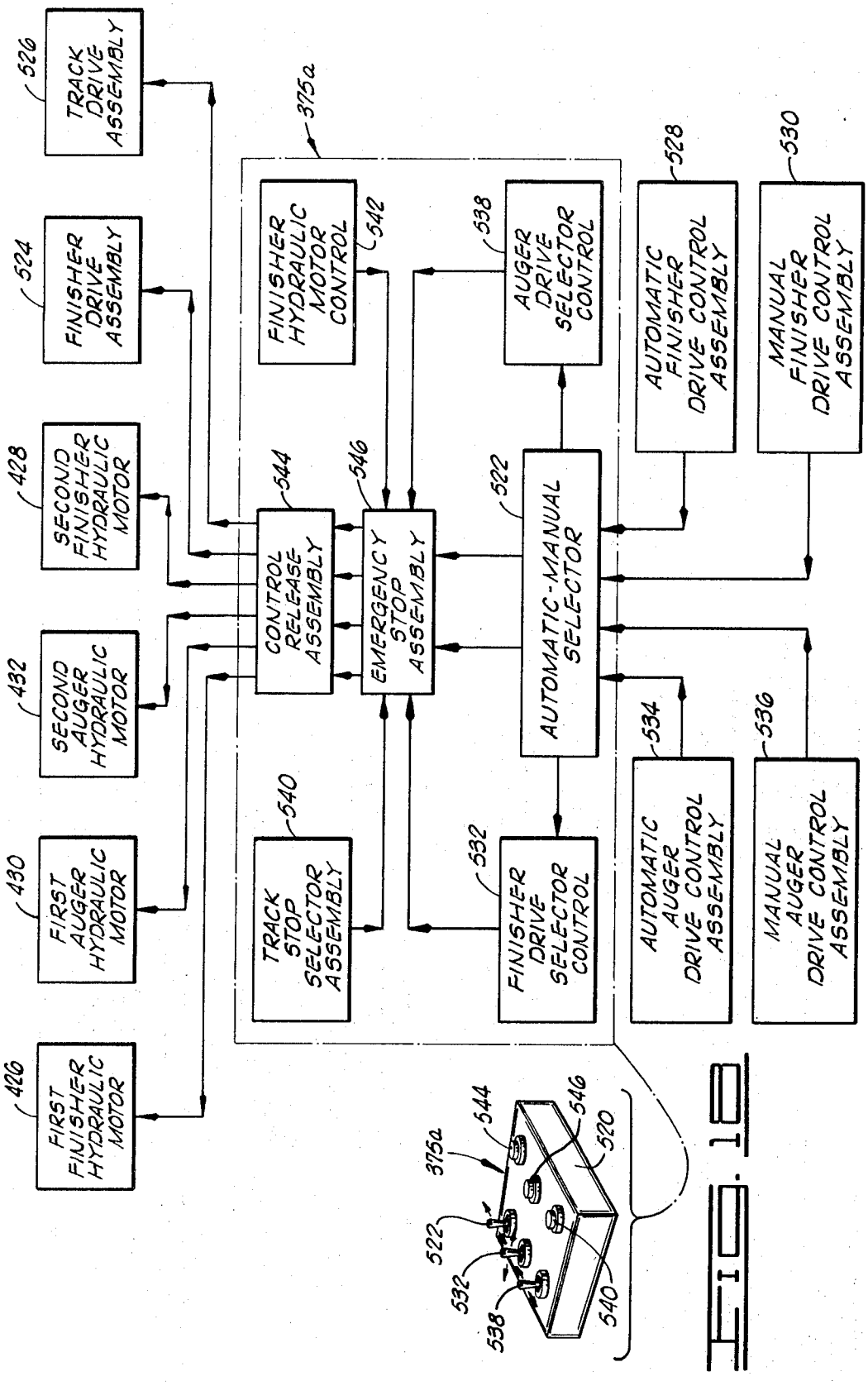

526
TRACK DRIVE ASSEMBLY
524
FINISHER DRIVE ASSEMBLY
428
SECOND FINISHER HYDRAULIC MOTOR
432
SECOND AUGER HYDRAULIC MOTOR
430
FIRST AUGER HYDRAULIC MOTOR
426
FIRST FINISHER HYDRAULIC MOTOR
375a
544
CONTROL RELEASE ASSEMBLY
546
EMERGENCY STOP ASSEMBLY
542
FINISHER HYDRAULIC MOTOR CONTROL
538
AUGER DRIVE SELECTOR CONTROL
522
AUTOMATIC-MANUAL SELECTOR
528
AUTOMATIC FINISHER DRIVE CONTROL ASSEMBLY
530
MANUAL FINISHER DRIVE CONTROL ASSEMBLY
540
TRACK STOP SELECTOR ASSEMBLY
532
FINISHER DRIVE SELECTOR CONTROL
534
AUTOMATIC AUGER DRIVE CONTROL ASSEMBLY
536
MANUAL AUGER DRIVE CONTROL ASSEMBLY
375a
544
546
520
522
532
538
540

FIG. 18

SURFACE FINISHING METHOD AND APPARATUS

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to improvements in apparatus for moving assemblies between predetermined positions and, more particularly, but not by way of limitation, to a method and an apparatus for finishing concrete surfaces or the like wherein a pair of surface finishers are movable transversely across the surface to be finished.

2. Description of the Prior Art

In the past there have been various types of apparatus constructed to effect a predetermined surface finish to roadways constructed of a concrete material or the like. The concrete has been generally poured between two slip forms, and the apparatus has then been moved into finishing engagement with the concrete.

There have been constructed, in the past, some finishing machines having a carriage member transversely movable across the surface wherein a rotating finishing member was secured to a portion of the carriage member. In one instance, the axis of rotation of the finishing member was angularly oriented with respect to the longitudinal axis of the slab or, in other words, with respect to the direction of travel of the machine. A surface finisher of this type was disclosed in the U.S. Pat. No. 3,541,931, issued to Godbersen, this patent disclosing a pair of finishing members, in one embodiment. The U.S. Pat. No. 3,450,011, issued to Godbersen, disclosed a similar type of surface finishing apparatus.

Some of the finishing machines of the type referred to above have included a drive mechanism to move the carriage over the surface to be finished. In some instances, the drive mechanism has consisted of a plurality of motor driven wheels, the wheels being drivingly supported on a portion of the finishing apparatus.

Some of the salient problems which have existed with respect to apparatus constructed to finish concrete surfaces or the like have been to construct a finishing apparatus capable of finishing substantially the entire transverse width of the surface generally between the two slip forms, and to control and monitor the surface finish being effected.

SUMMARY OF THE INVENTION

An object of the invention is to increase the efficiency of a surface finishing apparatus for finishing concrete surfaces or the like.

Another object of the invention is to provide a surface finishing apparatus wherein the surface to be finished is finishingly engaged by a surface finisher apparatus across substantially the entire transverse width of the surface.

A further object of the invention is to provide a more efficient means for moving a surface finisher apparatus between predetermined positions generally transversely over a surface to be finished.

A still further object of the invention is to provide a more efficient and economical apparatus for drivingly moving apparatus between predetermined positions.

Another object of the invention is to provide a finishing apparatus having more than one surface finisher, wherein each surface finisher sequentially engages the surface to be finished in a manner assuring that substantially the entire transverse width of the surface is finishingly engaged by a finisher member.

One other object of the invention is to provide a finishing apparatus capable of finishingly engaging the edges of a surface to be finished in a manner assuring the structural integrity of the finished surface.

A still further object of the invention is to provide an improved finishing apparatus wherein the operator controls the various finishing apparatus from a position wherein the surface being finished is operator-observable.

One other object of the invention is to provide an improved control of the surface material of the surface being finished.

Yet another object of the invention is to provide a finishing apparatus which is economical in construction and operation.

Another object of the invention is to provide a more efficient and economical method for finishing concrete surfaces or the like wherein the surface is finishingly engaged across substantially the entire transverse width thereof.

Other objects and advantages of the invention will be evident from the following detailed description when read in conjunction with the accompanying drawings which illustrate the various embodiments of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a top elevational view of a finishing apparatus constructed in accordance with the present invention.

FIG. **2** is a side elevational view of the finishing apparatus of FIG. **1.**

FIG. **3** is an enlarged partially fragmentary, side elevational view of the finisher assembly of the finishing apparatus of FIG. **1,** having portions thereof cut away to show the driving connection between the hydraulic motors and the surface finishers and to show the movable connection between the finisher assembly and the transverse frame assembly.

FIG. **4** is an enlarged, end elevational view of the finisher assembly of FIG. **3,** showing the end of the finisher assembly generally opposite the end thereof shown in FIG. **3,** and having a portion thereof cut away to show the disposition of some of the apparatus supported on the finisher assembly.

FIG. **5** is a sectional view of the finisher assembly of FIGS. **3** and **4,** showing the gearing connection between the chain and the finisher assembly, and the connection of the chain to the finisher assembly to pivot the finisher assembly to a first pivot position and to a second pivot position.

FIG. **6** is a partial diagrammatic, partial schematic view showing the connection between the chain and the hydraulic pump to provide power fluid to drive the various hydraulic motors on the finisher assembly and the connection of the control sensors to the chain drive to controllingly move the finisher assembly of the finishing apparatus of FIG. **1** between predetermined positions.

FIG. **7.** is a partial sectional, partial schematic view showing the control connections between the chain drive, the power fluid supply and the control sensors of the finishing apparatus of FIG. **1** to control the movement of the finisher assembly between the predetermined positions.

FIG. 8 is a diagrammatic-schematic view showing the operational sequence of the surface finishers of the finishing apparatus of FIG. 1.

FIG. 9 is a top elevational view of a modified finisher assembly, constructed similar to the finisher assembly of the finishing apparatus of FIG. 1, but having vibrators secured thereon and diagrammatically showing one preferred connection between the power supply and the vibrators.

FIG. 10 is an enlarged, end elevational view, similar to FIG. 4, but showing another modified finisher assembly.

FIG. 11 is a diagrammatical, top elevational view of the surface finishers and augers of the modified finisher assembly of FIG. 10.

FIG. 12 is an enlarged, partial end elevational view of yet another modified finisher assembly, similar to the modified finisher assembly of FIG. 10, but showing a pair of vibrators and vibrator support assembly, the surface finishers not being shown for the purpose of clarity.

FIG. 13 is an enlarged, partial top elevational view of a modified finishing apparatus, similar to the finishing apparatus of FIG. 1, but showing a final finish assembly attachable to the finishing apparatus of FIG. 1.

FIG. 14 is an enlarged, partial side elevational view of the modified finishing apparatus of FIG. 13.

FIG. 15 is a partial, enlarged perspective view of a modified slip form support for utilization with the finishing apparatus of FIG. 1.

FIG. 16 is a partial, enlarged side elevational view of the finishing apparatus of FIG. 1 showing a removable surface finisher member positioning assembly.

FIG. 17 is an enlarged, diagrammatical side elevational view showing a modified surface finisher disposition.

FIG. 18 is a diagrammatical, schematic view of a remote controller for utilization with the finishing apparatus of the present invention and, more particularly, the finishing apparatus of FIGS. 10, 11 and 12.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the drawings in general, and the FIGS. 1 and 2, in particular, shown therein and designated by the general reference character 10 is a finishing apparatus which generally includes a finisher assembly 12 movably supported on a transverse frame assembly 14, having a power end portion 16 and an adjustable end portion 18, such that the finisher assembly 12 is movable across the transverse frame assembly 14 in a first transverse direction 20, generally toward the adjustable end portion 18 of the transverse frame assembly 14, and in a second transverse direction 22 generally toward the power end portion 16 of the transverse frame assembly 14. The finisher assembly 12 generally includes a first surface finisher 24, a second finisher 26 and an auger member 28, each of which are rotatingly supported on a portion of the finisher assembly 12, in a manner to be described in greater detail below.

As shown more clearly in FIG. 1, the finishing apparatus 10 also includes four support assemblies 30, the support assemblies 30 being disposed generally at four-corner supporting positions about the transverse frame assembly 14. The support assemblies 30 are constructed and connected to the transverse frame assembly 14 to adjustably support the transverse frame assembly 14 in a predetermined horizontal plane in such a manner that the transverse frame assembly 14 extends generally transversely over a surface to be finished (the surface to be finished being shown in FIG. 2 and designated therein by the general reference numeral 32). Two of the four support assemblies 30 are also connected on one end thereof to an endless track member 34 and the other two support assemblies 30 are connected to one other endless track member 36, for reasons to be made more apparent below.

The endless track member 36 is drivingly connected to a power unit 38, which is supported generally between the two adjacent support assemblies 30 near the power end portion 16 of the transverse frame assembly 14. The power unit 38 is sized to provide the primary operating power for the finishing assembly 10, and is drivingly connected to the endless track member 36 to controllingly and rotatingly drive the endless track member 36 in a forward direction. and a reverse direction. The power unit 38 thus provides the driving impetus to move the finishing apparatus 10 in a forward direction and in a reverse direction along the roadway. The power unit 38 may be of a conventional design such as, for example, a diesel powered engine, and the construction and operation of such a power unit, and the various interconnecting components and operation thereof to drivingly connect the power unit 38 to the endless track member 36 are well-known in the art and a detailed description thereof is not required herein.

A first sensor assembly 40 is secured to one of the support assemblies 30, generally near the adjustable end portion 18 of the transverse frame assembly 14, and a second sensor assembly 42 is connected to one of the support assemblies 30, generally near the power end portion 16 of the transverse frame assembly 14. The first sensor assembly 40 has a portion thereof which is disposed to sense a portion of the finisher assembly 12 and to actuatingly control the movement of the finisher assembly 12 in the first transverse direction 20, and the second sensor assembly 42 has a portion thereof which is disposed to sense a portion of the finisher assembly 12 and to actuatingly control the movement of the finisher assembly 12 in the second transverse direction 22. In one sense, the first sensor assembly 40 and the second sensor assembly 42 define predetermined positions, the finisher assembly 12 being controllingly moved therebetween in a manner which will be described in detail below.

As shown in FIG. 1 and 2, the finishing apparatus 10 also includes a first slip form 44 and a second slip form 46. The first slip form 44 and the second slip form 46 are each adjustably secured to two of the support assemblies 30 via an adjustable member 48 which is reciprocatingly disposed in a stationary member 50. The horizontal disposition of each slip form 44 and 46 is adjustably controlled via a hand crank 52 such that by turning the hand cranks 52 the operator can cause the first slip form 44 and the second slip form 46 connected thereto to be moved in a vertically downwardly and in a vertically upwardly direction. Each slip form 44 and 46 is constructed to form one of the edges of the roadway being finished and to retain the surface material therebetween during the surface finishing operation, which will be described in greater detail below.

The finishing apparatus 10 which has been generally described above, and which will be described in greater detail below, is constructed to finishingly engage the

surface to be finished **32** and to finish that surface to a predetermined specification. Although the apparatus of the present invention will be described below, more particularly with respect to a finishing apparatus, it should be particularly noted that, in one aspect, the present invention contemplates an apparatus for moving hydraulically operated components between predetermined positions and providing operating power fluid therefor in a more efficient and more economical manner, as will become more apparent below.

It should be initially noted that the various directions of movement and the relative positions of the various components and assemblies of the finishing apparatus **10**, as generally described above and as will be described in greater detail below, are, more particularly, described with reference to a horizontal plane formed by the surface to be finished **32**. Thus, a direction or a position referred to above and below as being "vertically upwardly" and "vertically downwardly" refers to a direction or a position in a plane generally perpendicular to the surface to be finished **32**, for example. A direction and a position referred to above and below as "forward" refers, more particularly, to a direction or a position moving generally from a finished portion of the surface toward an unfinished surface, and a "reverse" direction or a position refers, more particularly, to a direction or a position generally opposite that described above with respect to a forward direction or a position. The term "lengthwise along the roadway" will be used below to generally designate a movement or a direction generally along the length of the surface to be finished **32**. The term "transversely" is used above and below to designate a direction of movement or a position generally transverse to the length of the roadway or, in other words, a movement or a direction generally across the width of the roadway or the surface to be finished **32** generally between the edges thereof.

Broadly speaking, the finishing apparatus **10** is utilized to finish surfaces of a roadway constructed of a concrete material in a faster, more efficient, and more positive manner. In the operation of the finishing apparatus **10**, which will be described in greater detail below, the concrete is initially poured generally between the first slip form **44** and the second slip form **46**, in a manner well-known in the art. After the concrete has been poured, the finisher assembly **12** is actuated to sequentially move in a first transverse direction **20** and in a second transverse direction **22** generally across the transverse width of the surface to be finished **32**.

During the operation of the finishing apparatus **10**, the auger member **28** will engage a portion of the unfinished surface material and provide an initial, rough finishing or smoothing prior to that portion being finishingly engaged by the first surface finisher **24** and the second surface face finisher **26** to provide a final, predetermined surface finish thereto. As the finisher assembly **12** is moved in a first transverse direction **20** and a second transverse direction **22** across the surface to be finished **32**, the first surface finisher **24** and the second surface finisher **26** are sequentially pivoted into finishing engagement with the surface to be finished **32** in a controlled, predetermined manner so that the entire transverse width of the surface to be finished **32** generally between the first slip form **44** and the second slip form **46** is finishingly engaged, in a manner which will be described in greater detail below.

Referring more particularly to the details of construction of the finishing apparatus **10**, described generally above, the transverse frame assembly **14** has a forward side **54** and a rearward side **56**, as shown in FIG. **1** and **2**. The forward side **54** and the rearward side **56** each include a stationary structural member **58**, one end of each stationary structural member **58** being securedly connected to one of the support assemblies **30**, generally near the power end portion of the transverse assembly **14**.

The end of each stationary structural member **58**, opposite the end thereof secured to one of the support assemblies **30**, has a flange adaptor **60** secured thereto, as shown in FIG. **1** and **2**. Each flange adaptor **60** is constructed to cooperatingly provide the interconnection between each of the stationary structural members **58** and a movable structural member **62**. A flange adaptor **64** is securedly connected to one end of each movable structural member **62** and, in an assembled position as shown in FIGS. **1** and **2**, each flange adaptor **60** is boltingly connected to the flange adaptor **64** of one of the movable structural members **62**.

Since each side of the transverse frame assembly **14** is basically constructed utilizing a pair of boltingly connected structural members, as described above, the length of the transverse frame assembly **14**, generally between the power end portion **16** and the adjustable end portion **18** thereof, can be easily, quickly and efficiently increased by adding like intermediate structural sections to the forward side **54** and the rearward side **56**, generally between eact stationary structural member **58** and the adjoining movable structural member **62**. As will become more apparent below, the only substantial modification required when increasing the length of the transverse frame assembly **14**, as described above, would be to lengthen the chain utilized to drivingly and pivotingly move the finisher assembly **12**.

Each support assembly **30** includes a housing **66** and a leg **68** which is reciprocatingly disposed therein. More particularly, one end of each leg **68** is connected to the endless track member **34** or **36** via a support structure **70**, and each leg is hydraulically disposed in one of the housing **66**. Thus, each housing **66** and the respective leg **68** thereof basically comprises a hydraulic cylinder arrangement connected and controlled such that each leg **68** can be controllingly moved in a vertically outwardly or vertically inwardly direction with respect to the housing **66** connected thereto. Each support assembly **30** is thus constructed to be of an independently variable length, such that the horizontal disposition of the transverse frame assembly **14** with respect to the endless track members **34** and **36** and with respect to the surface to be finished **32** is controllable via the four support assemblies **30**.

In one form each support assembly **30** or, in an alternate form, some of the support assemblies **30** can be controllingly connected to control sensor arms which are adapted to sense the position of the finishing apparatus **10** relative to a string-line, and automatically adjust the horizontal disposition of the transverse frame assembly **14** relative thereto. In this manner, the engagement of the finisher assembly **12** with the surface to be finished **32** is controllingly adjusted to maintain a predetermined grade and slope. Control sensing arms and the cooperation and the interconnection thereof with the hydraulically actuated type support assem-

blies, such as the support assemblies **30**, has been described in detail in U.S. Pat. No. 3,423,859, which is assigned to the assignee of the present invention, and therefore a detailed description of the interconnection and operation thereof is not required herein.

As shown in FIGS. **1** and **2**, the first sensor assembly **40** and the second sensor **42** are each, more particularly, secured to one of the stationary members **50** via a support extension **72**. A first trip switch **74** and a second trip switch **76** are secured to each support extension **72**. Each support extension **72** is shaped and constructed to support one of the first trip switches **74** and one of the second trip switches **76** in a predetermined vertical plane and in a predetermined horizontal plane so that, in the assembled position of the finishing apparatus **10**, as shown in FIGS. **1** and **2**, the first trip switches **74** and the second trip switches **76** are each disposed to engage an actuating boss **78** formed on one end of the finisher assembly **12**, when the finisher assembly **12** is moved to predetermined positions on the surface to be finished **32**, for reasons and in a manner to be made more apparent below.

It should also be noted that the first trip switch **74** and the second trip switch **76** are disposed on the first sensor assembly **40** such that the actuating boss **78** of the finisher assembly **12** will initially, actuatingly engage a portion of the first trip switch **74** as the finisher assembly **12** is moved in a first transverse direction **20** across the surface to be finished **32**. The first trip switch **74** and the second trip switch **76** are disposed on the second sensor assembly **42** such that the actuating boss **78** of the finisher assembly **12** will actuatingly, initially engage a portion of the first trip switch **74** of the second sensor assembly **42** as the finisher assembly **12** is moved in a second transverse direction **22** across the surface to be finished **32**. The first trip switch **74** of the first sensor assembly **40** and the first trip switch **74** of the second sensor assembly **42** are each connected to a control circuit to actuatingly slow the rate of travel of the finisher assembly **12** in the first transverse direction **20** and in the second transverse direction **22**, and the second trip switch **76** of the first sensor assembly **40** and the second trip switch **76** of the second sensor assembly **42** are each connected to a control circuit to actuatingly reverse the direction of travel of the finisher assembly **12**, for reasons and in a manner to be described in greater detail below.

Each support assembly **30** disposed generally near the adjustable end portion **18** of the transverse frame assembly **14** is, more particularly, securedly and movably connected to an adjacent portion of the transverse frame assembly **14** via a frame connector portion **80**. As shown more clearly in FIG. **2**, one frame connector **80** is secured to one of the support assemblies **30**, and one frame connector **80** is secured to the one other support assembly **30**. More particularly, each frame connector **80** is generally U-shaped and constructed to supportingly receive an adjacent portion of the transverse frame assembly **14** (only the top portion of each frame connector **80** is shown in FIG. **1**). Each frame connector **80** is adjustably connected to a portion of the transverse frame assembly **14** via a plurality of rollers **82**, each roller **82** being rollingly supported on one of the frame connectors **80**, and each roller **82** having a portion thereof in rolling engagement with an adjacent portion of the transverse frame assembly **14** (only the top two rollers being shown in FIG. **1**).

It will be apparent in those skilled in the art from the foregoing, that the forward side **54** of the transverse frame assembly **14** can be rollingly moved in the first transverse direction **20** and in the second transverse direction **22** relative to the support assembly **30** connected thereto, and the rearward side **56** of the transverse frame assembly **14** can also be rollingly moved in the first transverse direction **20** and the second transverse direction **22** relative to the support assembly **30** connected thereto. Thus, by rollingly moving the transverse frame assembly **14** in a first transverse direction **20** and in a second transverse direction **22** relative to the support assemblies **30** rollingly connected thereto, the transverse width of the finishing apparatus **10**, generally between the endless track member **34** and the endless track member **36** can be increased and decreased, respectively. Further, since the first slip form **44**, the second slip form **46**, the first sensor assembly **40** and the second sensor assembly **42** are each secured in a stationary position with respect to the support assembly **30** connected thereto, the relative positions of the first sensor assembly **40**, the second sensor assembly **42**, the first slip form **44**, and the second slip form **46** are maintained constant as the transverse width of the finishing apparatus **10** is adjustingly increased and decreased, in a manner as described above. The finishing apparatus **10** can thus be quickly and easily adjusted to be utilized to finish roadways having varying transverse widths in a manner which substantially eliminates having to adjust any of the control apparatus associated with the finishing apparatus **10**.

As shown more clearly in FIG. **1**, a platform **84** and a step platform **86** are securedly supported on a portion of the transverse frame assembly **14**, generally near the power end portion **16** thereof. The step platform **86** is positioned to assist the operator in gaining access to the platform **84** and in gaining access to an operator control seat **88** which is securedly connected to one of the support assemblies **30** and disposed generally near an operator control unit **90**. The operator control unit **90** contains the control actuating elements for the finishing apparatus **10**, and is constructed and adapted such that the operator can easily control, for example, the forward and reverse movement of the finishing apparatus **10**, and the operation of the finisher assembly **12**, in a manner which will become more apparent below.

As shown more clearly in FIG. **1**, a chain **92** is drivingly supported on a portion of the transverse frame assembly **14**, and extends generally between the power end portion **16** and the adjustable end portion **18** thereof. More particularly, the chain **92** is drivingly supported on the transverse frame assembly **14** via a pair of gears (shown in FIG. **6**), one gear being disposed generally near the adjustable end portion **18** and one gear being disposed generally near the power end portion **16**, for reasons and in a manner to be described in greater detail below.

The chain **92** has a portion thereof which is connected to the finisher assembly **12** to move the finisher assembly **12** generally between predetermined positions on the transverse frame assembly **14** in a controlled manner and in a manner sequentially pivoting the first surface finisher **24** and the second surface finisher **26** into finishing engagement with the surface to be finished **32**. A portion of the chain **92** also engages a portion of the finisher assembly **12** to provide the driving impetus for a power fluid supply to rotatingly

drive the first surface finisher **24** and the second surface finisher **26**, in a manner which will be described in detail below.

As mentioned before, the finisher assembly **12** is movably supported on the transverse frame assembly **14** to be moved generally back and forth between the power end portion **16** and the adjustable end portion **18** or, more particularly, between two predetermined positions as the first surface finisher **24** and the second surface finisher **26** sequentially and finishingly engage the surface to be finished **32**. As shown more clearly in FIGS. **3**, **4** and **5**, the finisher assembly **12**, includes a support frame **94** which is moveably connected to the transverse frame assembly **14** via a plurality of grooved wheels **96**, each grooved wheel **96** being rollingly and bearingly supported on a portion of the support frame **94**, as shown more clearly in FIGS. **1**, **2** and **3**. A retaining wheel **98** is also rollingly and bearingly supported on a portion of the support frame **94**, one retaining wheel **98** being disposed generally near each of the grooved wheels **96**, and in a horizontal plane generally below the respective grooved wheel **96** (two of the grooved wheels **96** and the two respective retaining wheels **98** associated therewith which are disposed on one side of the support frame **94** are shown more clearly in FIGS. **4** and **5**). Each retaining wheel **98** has a resilient liner **100** bonded thereto and extending about the outer periphery thereof, for reasons which will be made more apparent below.

As shown more clearly in FIG. **3**, the two grooved wheels **96** on one side of the support frame **94** rollingly, supportingly, and retainingly engage a rail **102**, which is secured to and extends generally along the rearward side **56** of the transverse frame assembly **14** generally between the power end portion **16** and the adjustable end portion **18** thereof. The two grooved wheels **96** on the opposite side of the support frame **94** rollingly, supportingly, and retainingly engage a rail **104**, which is secured to and extends generally along the forward side **54** of the transverse frame assembly **14** generally between the power end portion **16** and the adjustable end portion **18** thereof.

Each rail **102** and **104** thus extends transversely across substantially the entire width of the transverse frame assembly **14**, and the rails **102** and **104** cooperate to provide a guide path for the finisher assembly **12** as the finisher assembly **12** is moved in the first transverse direction **20** and the second transverse direction **22**, during the operation of the finishing apparatus **10**, as will be described in greater detail below.

Each rail **102** and **104** is, more particularly, secured to one side of the transverse frame assembly **14** via a plurality of L-shaped brackets **108**, as shown more clearly in FIG. **1**. In an assembled position of the finisher assembly **12**, a portion of each rail **102** and **104** is disposed generally within the grooved portion of the adjacent grooved wheels **96**, and the outer periphery of each retaining wheel **98**, formed by the resilient liners **100**, retainingly engages a portion of one of the L-shaped brackets **108**, as shown more clearly in FIG. **3**. The retaining wheels **98** thus engage a portion of the L-shaped brackets **108** to resiliently limit movement of the finisher assembly **12** in a vertically upwardly direction, during the operation of the finishing apparatus **10**, as will be described in detail below.

As shown more clearly in FIGS. **3**, **4** and **5**, the first surface finisher **24** and the second surface finisher **26** are each bearingly and rotatingly supported on a portion of a rocker support arm **110** via a pair of support plates **112** and **114**. One end of each of the support plates **112** and **114** is secured to a portion of the rocker support arm **110**, and the opposite end of each of the support plates **112** and **114** is constructed to bearingly and supportingly receive a portion of one of the shafts (not shown) extending through the first surface finisher **24** and the second surface finisher **26**, respectively. It should be noted that the first surface finisher **24** and the second surface finisher **26** are each generally cylindrically shaped and have an outer periphery shaped to finishingly engage the surface to be finished **32**.

As shown more clearly in FIG. **3**, **4**, and **5**, the rocker support arm **110** is rotatingly and pivotally secured to the support frame **94** via shaft **115**, and includes a base **116**, having a first angled portion **118** and a second angled portion **120**. In the assembled position of the finisher assembly **12**, the first surface finisher **24** is, more particularly, rotatingly and bearingly secured to the first angle portion **118** of the base **116**, and the second surface finisher **26** is, more particularly, secured to the second angle portion **120** of the base **116**, for reasons which will be made more apparent below.

The base **116** of the rocker support arm **110** is constructed such that, in the first pivot position of the finisher assembly **12** or, more particularly, the rocker support arm **110**, the first angled portion **118** of the base **116** is disposed a distance vertically above the surface to be finished **32** and in a horizontal plane substantially coplanar with the surface to be finished **32**. In the first pivot position of the finisher assembly **12**, as shown in FIG. **2**, **3**, **4** and **5**, the second angled portion **120** is angularly oriented with respect to the surface to be finished **32**, and extends generally angularly from the first angled portion **118** in a direction generally above or away from the surface to be finished **32**.

The rocker support arm **110** is also constructed such that, in the second pivot position of the finisher assembly **12**, the second angled portion **120** is disposed a distance vertically above the surface to be finished **32** and in a horizontal plane substantially coplanar with the surface to be finished **32**. In the second pivot position of the finisher assembly **12**, the first angled portion **118** is angularly disposed with respect to the surface to be finished **32** and extends generally angularly from the second angled portion **120** in a direction generally above or away from the surface to be finished **32**.

The first angled portion **118** and the second angled portion **120** are thus, more particularly, constructed and disposed on the finisher assembly **12** such that, in the first pivot position of the finisher assembly **12**, the first surface finisher **24** is disposed in finishing engagement with the surface to be finished **32** and the second surface finisher **26** is disposed in a horizontal plane a distance generally vertically above the surface to be finished **32**. In the second pivot position of the finisher assembly **12**, the second surface finisher **26** is disposed in finishing engagement with the surface to be finished **32** and the first surface finisher **24** is disposed in a horizontal plane a distance generally vertically above the surface to be finished **32**.

As shown more clearly in FIGS. **3** and **4**, the auger member **28** is, more particularly, adjustably, rotatingly and bearingly supported on an auger frame **122**. An upper portion **124** of the auger frame **122** is secured to a lower portion of the support frame **94**, as shown more

clearly in FIG. 4, and an adjustable portion 126 of the auger frame 122 is adjustably secured to the upper portion 124 via a hand wheel 128. More particularly, the hand wheel 128 is connected to the adjustable portion 126 to move the auger member 128 in a vertically upwardly and vertically downwardly direction by rotating the hand wheel 128. It will be apparent to those skilled in the art from the foregoing, that by adjusting the auger member 28 in a vertically upwardly and vertically downwardly direction, the depth of engagement of the auger member 28 with respect to the surface to be finished 32 can be controllingly adjusted, which may be desirable when finishing surfaces constructed of different materials or materials of differing constituencies.

The first surface finisher 24 and the second surface finisher 26 are rotatingly driven via a first finisher drive 130 and a second finisher drive 132, respectively, as shown in FIG. 1. The first finisher drive 130 and the second finisher drive 132 are, in a preferred form, hydraulic motors, and the first finisher drive 130 and the second finisher drive 132 are each securedly mounted on one end portion of the rocker support arm 110, generally near one of the support plates 114, as shown more clearly in FIG. 3.

The first finisher drive 130 and the second finisher drive 132 are each gearingly connected to the first surface finisher 24 and the second surface finisher 26, respectively, to rotatingly drive the surface finisher 24 or 26 connected thereto, and, as shown in FIG. 3, the first finisher drive 130 has been removed from the finisher assembly 12 to more clearly indicate the driving connection between each finisher drive 130 and 132 and one of the surface finishers 24 and 26 connected thereto. As shown in FIG. 3, the second finisher drive 132 has been removed from the finisher assembly 12, for the purpose of clarity of description, it being understood that the first finisher drive 130 is driving connected to the first surface finisher 24 in a manner similar to that shown in FIG. 3 with respect to the second finisher drive 132 and the second surface finisher 26.

The first finisher drive 130 and the second finisher drive 132 are each drivingly connected to the first surface finisher 24 or the second surface finisher 26, respectively via a pair of gears 134 and 136, the gears 134 and 136 being gearingly interconnected via an endless chain 138, as shown in FIG. 3, with respect to the second surface finisher 26 and the second finisher drive 132. The first finisher drive 130 is connected to the first surface finisher 24 to drivingly rotate the first surface finisher 24 in a rotational direction 140, and the second finisher drive 132 is connected to the second surface finisher 26 to drivingly rotate the second surface finisher 26 in a rotational direction 142, as shown more clearly in FIGS. 2 and 3.

The direction of rotation 140 of the first surface finisher 24 is generally opposed to the direction of transverse movement of the finisher assembly 12 (the first transverse direction 20), during that portion of the operation of the finishing apparatus 10 when the first surface finisher 24 is in finishing engagement with the surface to be finished 32. The direction of rotation 142 of the second surface finisher 26 is generally opposed to the direction of transverse movement of the finisher assembly 12 (the second transverse direction 22), during that portion of the operation of the finishing apparatus 10 when the second surface finisher 26 is in finishing engagement with the surface to be finished 32.

As shown more clearly in FIG. 5, one end portion of the chain 92 is secured to the support frame 94 via a first pivoting jaw assembly 144, and the opposite end portion of the chain 92 is secured to the support frame 94 via a second pivoting jaw assembly 146. Each jaw assembly 144 and 146 includes a base member 148 and a jaw member 150, each jaw member 150 being pivotally secured to one of the base member 148 via a connecting pin 152.

Each jaw member 150 is constructed and connected to one of the base members 148, such that each jaw member 150 can be pivoted in a release direction 154 to releasingly position each jaw member 150 with respect to the base member 148 connected thereto, and such that each jaw member 150 can be pivoted in a lock direction 156 to securedly and lockingly position each jaw member 150 with respect to the base member 148 connected thereto. As shown in FIG. 5, each jaw member 150 has been pivoted in the lock direction 156 to a locking position, that is a position wherein each jaw member 150 lockingly engages the base member 148 pivotally connected thereto to securedly position a portion of the chain 92 therebetween. It will be apparent to those skilled in the art from the foregoing, that by pivoting each jaw member 150 in a release direction 154 to a releasing position, each jaw member 150 will be positioned with respect to the base member 148 pivotally connected thereto such that a portion of the chain 92, generally near one end thereof, can be inserted generally between the base member 148 and the jaw member 150 or removed therefrom.

Each base member 148 is pivotally connected to a flange 158 via a connecting pin 160. Each flange 158 is secured to a portion of the support frame 94 of the finisher assembly 12, such that the first jaw assembly 144 and the second jaw assembly 146 are each pivotable in a finisher engaging direction 162 and in a finisher disengaging direction 164, for reasons and in a manner which will be made more apparent below.

As shown more clearly in FIG. 5, the first jaw assembly 144 and the second jaw assembly 146 are each connected to a portion of the rocker support arm 110 via an adjustable connector 166. More particularly, one end of one of the adjustable connectors 166 is pivotally secured to one end of the base member 148 of the first jaw assembly 144 via a connecting pin 168, and the opposite end of that adjustable connector 166 is pivotally secured to the first angled portion 118 of the rocker support arm 110 via a connecting pin 170. One end of the other adjustable connector 166, more particularly, is pivotally secured to one end portion of the base member 148 of the second jaw assembly 146 via a connecting pin 172, and the opposite end of that adjustable connector 166 is pivotally secured to the second angled portion 120 of the rocker support arm 118 via a connecting pin 174. The first jaw assembly 144 and the second jaw assembly 146 and the adjustable connectors 166 pivotally connected thereto will sometimes be referred to below as a first pivot linkage 176 and a second pivot linkage 178, respectively, for the purpose of clarity of description.

The chain 92 is disposed on the transverse frame assembly 14 and connected to the finisher assembly 12 or, more particularly, the first pivot linkage 176 and the second pivot linkage 178, and the first pivot linkage 176 and the second pivot linkage 178 are each connected to the rocker support arm 110 such that, as the

chain **92** is driven in a first rotating direction **180**, the second jaw assembly **146** is pullingly pivoted by the chain **92** in the finisher disengaging direction **164**, thereby pivoting the rocker support arm **110** in a first pivot direction **184** via the pivoting interconnection between the second jaw assembly **146** and the rocker support arm **110** provided by the adjustable connector **166** therebetween. As the rocker support arm **110** is pivoted in the first pivot direction **184**, the first jaw assembly **144** will be pullingly pivoted in the finisher engaging direction **162** via the interconnection between the first jaw assembly **144** and the rocker support arm **110** provided by the adjustable connector **166** therebetween. Thus, as the chain **94** is driven in the first rotating direction **180**, the first surface finisher **24** is pivotingly moved into finishing engagement with the surface to be finished **32** via the pivoting connection between the chain **94** and the rocker support arm **110** provided by the first pivot linkage **176** and the second pivot linkage **178**. This position of the finisher assembly **12**, when the chain **92** is being driven in the first direction **180**, is referred to generally above and below as the first pivot position of the finisher assembly **12**, for the purpose of clarity of description.

The first pivot linkage **176** and the second pivot linkage **178** are also connected to the support frame **94** and to the rocker support arm **110**, such that, as the chain **92** is driven in a second rotating direction **182**, the rocker support arm **110** will be pivoted in a second pivot direction **186** to a position wherein the second surface finisher **26** finishingly engages the surface to be finished **32**. More particularly, as the chain **92** is driven in the second rotating direction **182**, the chain **92** will pullingly pivot the first jaw assembly **144** in the finisher disengaging direction **164**, thereby pivoting the rocker support arm **110** in the second pivot direction **186** via the pivoting interconnection between the first jaw assembly **144** and the rocker support arm **110** provided by the adjustable connector **166** therebetween. The pivoting of the rocker support arm **110** in the second pivot direction **186** will pullingly pivot the second jaw assembly **144** in the finisher engaging direction **164** via the pivoting interconnection between the second jaw assembly **146** and the rocker support arm **110** provided by the adjustable connector **166** therebetween. The driving of the chain **92** in the second rotating direction **182** will thus cause the second surface finisher **26** to be pivotally moved into finishing engagement with the surface to be finished **32**, and will pivotingly move the first surface finisher **24** to a position wherein the first surface finisher **25** is disposed in a horizontal plane a distance generally vertically above the surface to be finished **32**. This position of the finisher assembly **12**, when the chain **92** is driven in the second rotating direction **182**, is referred to generally above and below as the second pivot position of the finisher assembly **12**, for the purpose of clarity of description.

As shown more clearly in FIG. **5**, a stop flange **188**, having a first stop surface **190** and a second stop surface **192**, is secured to a portion of the rocker support arm **110**. The stop flange **188** extends a distance generally vertically upwardly from the rocker support arm **116**, and an upper portion of the stop flange **188** is disposed in a pivot aperture **194** formed in a portion of the support frame **94** of the finisher assembly **12**. A first stop pad **196** is secured to the support frame **94**, generally near one end portion of the pivot aperture **194**, and a second stop pad **198** is secured to a portion of the support frame **94**, generally near the end of the pivot aperture **194** opposite the end thereof having the first stop pad **196** secured thereto.

The stop flange **188**, the pivot aperture **194** and the first and the second stop pad **196** and **198** comprise what is sometimes referred to below as "a pivot positioning assembly **200**." The pivot positioning assembly **200** is thus constructed and disposed on the finisher assembly **12** such that, as the rocker support arm **110** is pivoted in the first pivot direction **184**, the first stop surface **190** of the stop flange **188** will engage the first stop pad **196** to limit the pivotal movement of the rocker support arm **110** and positively position the rocker support arm **110** in the first pivot position thereof. The pivot position assembly **200** is also constructed and disposed on the finisher assembly **12** such that, as the rocker support arm **110** is pivoted in the second pivot direction **186**, the second stop surface **192** of the stop flange **188** will engage the second stop pad **198** to limit the pivoting movement of the rocker support arm **110** and positively position the rocker support arm **110** in the second pivot position thereof. It will be apparent from the foregoing to those skilled in the art, that the pivot positioning assembly **200** thus provides a positive means of assuring that, in the first pivot position of the finisher assembly **12**, the first surface finisher **24** is positively positioned in a predetermined horizontal plane to finishingly engage the surface to be finished **32** and a positive means of assuring that, in the second pivot position of the finisher assembly **12**, the second surface finisher **26** is positively positioned in a predetermined horizontal plane to finishingly engage the surface to be finished **32**.

As shown more clearly in FIG. **4** and **5**, a gear support frame **202** is centrally disposed in an upper portion of the finisher assembly **12** and is secured to a portion of the support frame **94**. An idler drive gear **204** is rotatingly and bearingly supported in a portion of the gear support frame **202**, as shown more clearly in FIG. **5**, and a pair of idler gears **206** and **208** are also bearingly and rotatingly supported in a portion of the gear support frame **204** via bearing supports **210** (the bearing supports **210** disposed on one side of the gear support frame **202** being shown more clearly in FIG. **4**). As shown more clearly in FIG. **5**, the idler gears **206** and **208** are disposed on opposite sides of the idler drive gear **204**, and each idler gear **206** and **208** is disposed in a horizontal plane a distance generally vertically above the idler drive gear **204**.

The idler gears **206** and **208** and the idler drive gear **204** are each constructed to gearingly engage a portion of the chain **92**, during the operation of the finishing apparatus **10**. More particularly, a portion of the chain **92** is in gearing engagement with an upper portion of each of the idler gears **206** and **208**, and a portion of the chain **92** is in gearing engagement with a lower portion of the idler drive gear **204**, as shown in FIG. **5**. The two idler gears **206** and **208** are thus disposed with respect to the idler drive gear **204** to maintain the gearing engagement between the chain **92** and the idler drive gear **204** during the operation of the finishing apparatus **10**, as will be described in greater detail below.

The idler drive gear **204** is drivingly connected to a gear **212** via a shaft **214**, the shaft **214** being bearingly and rotatingly supported in a portion of the gear support frame **202**. The gear **212** is drivingly connected to

a reversible hydraulic pump **216** via an endless chain belt **218** which connects the gear **212** to a pump input shaft **220** through a gear **222.** Thus, the driving impetus for the reversible hydraulic pump **216** is provided by the driving rotational movement of the idler drive gear **204** which is connected to the pump input shaft **220** via the interconnecting gear arrangement of the gears **212** and **222** and the endless chain belt **218** therebetween. Since the idler drive **204** is in driving engagement with the chain **92,** as described above, it will be apparent to those skilled in the art that the reversible hydraulic pump **216** will be driven to pump power fluid therefrom by the driving movement to the chain **92** in the first rotating direction **180** and in the second rotating direction **182,** in a manner and for reasons which will become more apparent below.

As diagramatically shown in FIG. **6,** both sides of the reversible hydraulic pump **216** are connected to a power fluid reservoir **224** via a pair of inlet conduits **226** and **228.** A check valve **230** is disposed in each of the inlet conduits **226** and **228,** generally between the power fluid reservoir **224** and the reversible hydraulic pump **216,** and oriented therein to allow the flow of fluid generally from the reservoir **224** toward the reversible pump **216** and to check the flow of fluid generally from the reversible pump **216** toward the reservoir **224,** for reasons which will become more apparent below.

As diagramatically shown in FIG. **6,** both sides of the reversible hydraulic pump **216** are also connected to the inlet of the second finisher drive **132** via a pair of outlet conduits **232** and **234.** A check valve **236** is disposed in each of the outlet conduits **232** and **234,** and each check valve **236** is oriented in the respective outlet conduit **232** and **234** to allow the flow of power fluid generally from the reversible hydraulic pump **216** toward the second finisher drive **132** and to check the flow of power fluid generally in the opposite direction, for reasons which will be made more apparent below.

The outlet or discharge side of the second finisher drive **132** is fluidically connected to the inlet side of the first finisher drive **130** via an interconnecting conduit **237,** and the outlet of the first finisher drive **130** is fluidically connected to the inlet of the auger hydraulic motor **238** via an interconnecting conduit **240.** The first finisher drive **130,** the second finisher drive **132** and the auger hydraulic motor **238** are thus connected in fluidic series, and the outlet of the auger hydraulic motor **238** is fluidically connected to the reservoir **224** via a conduit **242.**

It should be noted that, since the first finisher drive **130** and the second finisher drive **132** are each, in a preferred form, hydraulic motors, the first finisher drive **130** is shown in FIG. **6** and sometimes designated below as the "first finisher hydraulic motor" **130,** and the second finisher drive **132** is shown in FIG. **6** and sometimes designated below as the "second finisher hydraulic motor" **132,** for the purpose of clarity of description.

The conduit **242** is fluidically connected to the inlet of the second finisher drive **132** via a bypass conduit **244.** A check valve **246** is interposed in the bypass conduit **244,** and is oriented therein to bypass the flow of power fluid in a direction generally from the auger hydraulic motor **238** to the inlet of the second finisher drive **132,** for reasons which will be made more apparent below.

As diagramtically shown in FIG. **6,** the chain **92** is, more particularly, rotatingly supported and driven via a pair of gears **248** and **250.** In a preferred form, the gear **248** is rotatingly and bearingly supported on a portion of the transverse frame assembly **14,** genrally near the adjustable end portion **18** thereof, and the gear **250** is rotatingly supported on a portion of the transverse frame assembly **14,** generally near the power end portion **16** thereof. The gear **250** is connected to a chain drive **252** via a shaft **254.** The chain drive **252** is constructed to rotatingly drive the gear **250,** in a controlled manner, to drive the chain **92** in the first direction **180** and in the second direction **182,** as will be described in greater detail below.

As schematically shown in FIG. **6,** the first sensor assembly **450** and the second sensor assembly **42** are each connected to the chain drive **252,** such that the first trip switches **74** and the second trip switches **76,** of the first sensor assembly **40** and the second sensor assembly **42,** each provide an actuating signal to control the chain drive **252** or, in other words, to control the direction of movemnt of the chain **92,** in a manner which will be described in greater detail below. The hydraulic and electric control circuit which controlling interconnects the chain drive **252,** the first sensor assembly **40,** and the second sensor assembly **42** is schematically and diagramatically shown in greater detail in FIG. **7.** As shown in FIG. **7,** and in a preferred form, the control components of the finishing apparatus **10** basically comprise a hydraulic motor **256,** which is drivingly connected to the shaft **254** to rotatingly drive the chain **92;** a pump **258,** which is fluidically connected to the hydraulic motor **256;** and a relief valve **260,** a variable resistance valve **262** and a spring centered, three-position, four-way solenoid valve **264,** each of which are interpsoed generally between the pump **258** and the hydraulic motor **256.**

One side of the pump **258** is connected to a fluid reservoir **268** via a conduit **270,** and the other side of the pump **258** is connected to a port **272** of the relief valve **260** via a pair of conduits **274** and **276.** The conduits **274** and **276** are each connected to a port **278** in the variable resistance valve **262** via a commonly connected conduit **280.** Thus, one side of the pump **258** is connected to the relief valve **260** and to the variable resistance valve **262** via the conduits **274, 276,** and **280,** for reasons which will become more apparent below.

A port **282** in the relief valve **260** is connected to the solenoid valve **264** via a pair of conduits **284** and **286,** and a port **288** in the variable resistance valve **262** is connected to the conduits **284** and **286** via a conduit **290.** The port **282** of the relief valve **260** and the port **288** of the variable resistance valve **262** are thus each connected to the solenoid **264,** for reasons which will be made apparent below.

As shown in FIG. **7,** the solenoid valve **264** has a de-energized position **292,** a first energized position **294** and a second energized position **296.** In the de-energized position **292** of the solenoid valve **264,** as shown in FIG. **7,** the conduit **286** is connected to the fluid reservoir **268** through the solenoid valve **262** via a conduit **298.**

The solenoid valve **264** is connected to one side of the hydraulic motor **256** via a conduit **300,** and the solenoid valve **264** is connected to the other side of the hydraulic motor **256** via a conduit **302.** Thus, in the first energized position **294** of the solenoid valve **264,**

the conduits 286 and 300 are in fluidic communication and, in the second energized position 296 of the solenoid valve 264, the conduits 286 and 302 are in fluidic communication, for reasons to be made apparent below.

One coil in the solenoid valve 264 is connected to an energizing power source 304 via a pair of conductors 306 and 308. As shown in FIG. 7, the second trip switch 76 of the first sensor assembly 40 is interposed between the conductors 306 and 308 and, in the open position of the second trip switch 76, as shown in FIG. 7, the electrical continuity is interrupted between the power source 304 and the one coil of the solenoid valve 264.

The other coil of the solenoid valve 264 is connected to the energizing power source 304 via a pair of conductors 310 and 312. The second trip switch 76 of the second sensor assembly 42 is interposed between the conductors 310 and 312 and, in the open position of the second trip switch 76, as shown in FIG. 7, the electrical continuity is interrupted between the power source 304 and the one coil of the solenoid valve 264.

It will be apparent to those skilled in the art from the foregoing, and as schematically indicated in FIG. 7, that the closing of the second trip switch 76 of the first sensor assembly 40 will energize one of the coils of the solenoid valve 264 to position the solenoid valve 264 in the first energized position 294 thereof. The closing of the second trip switch 76 of the second sensor assembly 42 will energize the other coil of the solenoid valve 264 to position the solenoid valve 264 in the second energized position 296, in a manner and for reasons which will be made more apparent below.

As shown in FIG. 7, a latching relay network 313 is connected in electrical parallel with the second trip switch 76 of the first sensor assembly 40 and in electrical parallel with the second trip switch 76 of the second sensor assembly 42. The latching relay network 313 comprises a predetermined number of relays and holding coils constructed and connected such that when the second trip switch 76 of the first sensor assembly 40 or the second sensor assembly 42 is actuated to the closed position, thereby energizing one of the coils of the solenoid valve 264, the latching relay network 313 holds the electrical continuity thus established between the power source 304 and the energized coil of the solenoid valve 264 until the second trip switch 76 of the first sensor assembly 40 or the second sensor assembly 42 is subsequently actuatingly closed. Thus, when the second trip switch 76 of the first sensor assembly 40 is actuatingly closed, thereby energizing the solenoid valve 264 to the first energized position 294, the latching relay network 313 maintains the solenoid 264 in the first energized position 284 until such time as the second trip switch 76 of the second sensor assembly 42 is closed. When the second trip switch 76 of the second sensor assembly 42 is actuatingly closed, thereby energizing the solenoid 264 to the second energized position 296, the latching rellay network 313 maintains the solenoid valve 264 in the second energized postion 296 until such time as the second trip switch 76 of the first sensor assembly 40 is once again actuated, during the operation of the finishing apparatus 10, for reasons which will be made apparent below. Relay networks of the type functionally described above are well known in the art and detailed description of the various components and the interconnections therebetween is not required herein.

As shown in FIG. 7, a charge pump 314 is connected to a port 316 of the variable resistance valve 262 via a conduit 318. The suction or inlet side of the charge pump 314 is connected to a power fluid supply (not shown).

An orifice 320 and a solenoid valve 322 are each interposed in the conduit 318 generally between the charge pump 314 and the port 316 of the variable resistance valve 262. As shown in FIG. 7, the solenoid valve 322 is in a de-energized position and, in that position, the port 316 is connected to the reservoir 268 through the solenoid valve 322.

The coil in the solenoid valve 322 is connected to the energizing power source 304 via a conductor 324. The first trip switch 74 of the first sensor assembly 40 and the second sensor assembly 42 are each interposed in the conductor 324, generally between the solenoid valve 322 and the energizing power source 304, the first trip switch 74 of the first sensor assembly 40 and the second sensor assembly 42 being disposed in electrical parallel, as shown in FIG. 7. It will be apparent to those skilled in the art from the foregoing, that the actuating or closing of the first trip switch 74 of the first sensor assembly or the first trip switch 74 of the second sensor assembly 42 will establish electrical continuity between the coil of the solenoid valve 322 and the energizing power source 304, thereby energizing the solenoid valve 322. In the energized position of the solenoid valve 322, the charge pump 314 is in fluidic communication with the port 316 of the variable resistance valve 262 via the solenoid valve 322, for reasons which will be made more apparent below.

As shown in FIG. 7, a port 326 formed in the relief valve 260 is connected to the fluid reservior 268 via a conduit 328, and a port 330 formed in the variable resistance valve 262 is connected to the fluid reservoir 268 via a conduit 332.

The relief valve 260 includes a valve member 334 which is slidingly disposed in a chamber 336 of a valve body 338. A bias spring 340 is disposed in a portion of the chamber 336 in biasing engagement with a portion of the valve member 334 of the relief valve 260 to bias the valve member 334 to a spring biased position as shown in FIG. 7. In the spring biased position of the relief valve 260, the valve member 344 is disposed therein such that the ports 272 and 362 are not in fluidic communication.

An opening 342 is formed in a portion of the valve member 334. A portion of the opening 342 communicates with the port 272, the opening 342 being shaped such that fluid entering the relief valve 260 via the port 272 will bias the valve member 334 in a direction generally opposed to the biasing force of the bias spring 340. A portion of the opening 342 generally adjacent to the outer periphery of the valve member 334 is shaped to provide fluidic communication between the port 272 and the port 326 when the relief valve has been biased to a predetermined position by the pressure of the fluid entering the port 272. In other words, when the pressure of the fluid entering the relief valve 260 via the port 272 reaches a predetermined actuating pressure level, the valve member 334 is biased by the fluid to a relief position wherein the port 272 and the port 326 are in fluidic communication via a portion of the opening 342, thereby establishing fluidic communi-

cation between the conduit **276** and the fluid reservoir **268**, for reasons and in a manner to made more apparent below.

The variable resistance valve **262**, as shown in FIG. **7**, includes a valve member **344** which is slidingly disposed in a chamber **346** formed in a valve body **348**. A bias spring **350** is disposed in a portion of the chamber **346** of the variable resistance valve **262**, and a portion of the bias spring **350** biasingly engages the valve member **344** to a spring biased position, as shown in FIG. **7**. An opening **352** is formed in a portion of the valve member **344**, the opening **352** being shaped to provide fluidic communication between the port **278** and the port **288** of the variable resistance valve **262** in the spring biased position of the variable resistance valve **262**.

The variable resistance valve **262** and, more particularly, the valve member **344** disposed therein, is constructed such that fluid entering the variable resistance valve **262** via the port **316** will bias the valve member **344** in a direction generally opposed to the biasing force of the bias spring **350**. The opening **352** formed through the valve member **344** is shaped such that as the valve member **344** is biased in a direction generally opposed to bias spring **350**, fluidic communication between the ports **278** and **288** will become increasingly restricted, thereby increasing the pressure drop across the variable resistance valve **262** generally between the conduit **280** and the conduit **290**, for reasons which will be made more apparent below.

As generally mentioned above, the chain drive **252**, the first sensor assembly **40** and the second assembly **42** are each connected to the finishing apparatus **10** to control the movement of the finisher assembly **12** in the first transverse direction **20** and in the second transverse direction **22** and the controllingly pivot the finisher assembly **12** to the first pivot position when the finisher assembly **12** reaches one predetermined position and the pivot the finisher assembly **12** to the second pivot position when the finisher assembly **12** reaches one other predetermined position. In the finishing apparatus **10**, the predetermined positions are, more particularly, defined by the first slip form **44** and the second slip form **46**, and the control functions mentioned above are thus particularly adapted to move the finisher assembly **12** in the first transverse direction **20** and in the second transverse direction **22** and to controllingly pivot the finisher assembly **12** to the first pivot position and the second pivot position in such a manner that the first surface finisher **24** and the second surface finisher **26** each cooperate to finishingly engage the surface to be finished **32** across substantially the entire transverse width thereof.

A preferred arrangement of the control functions, mentioned above, is diagrammatically shown in FIG. **8** and, for the purpose of clarity of description, the various control positions of the finisher assembly **12** during the operation of the finisher apparatus **10** are described below with reference to the center lines of the first surface finisher **24** and the second surface finisher **26**, the center lines being disposed in a horizontal plane generally coplanar with the surface to be finished **32**. It should also be noted that, as diagrammatically shown in FIG. **8**, the finishing apparatus **10** is moving in a forward direction **354**, and finishingly engaging the surface to be finished **32** generally between the first slip form **44** and the second slip form **46**.

When the finisher assembly **12** is being moved in a first transverse direction **20**, the first surface finisher **24** is finishingly engaging the surface to be finished **32**, and the second surface finisher **26** is disposed a distance generally vertically above the surface to be finished **32**. The first sensor assembly **40** is disposed with respect to the finisher assembly **12**, such that when the first surface finisher **24** has been moved to a transition actuating position, generally designated in FIG. **8** by the reference numeral **356**, the actuating boss **78** of the finisher assembly **12** will actuatingly enage the first trip switch **74**, thereby causing the rate at which the chain **92** is being driven in a first rotating direction **180** to linearly decrease. The function of the various control components connected to the first trip switch **74** to linearly decrease the rate at which the chain **92** is driven will be described in greater detail below.

The finisher assembly **12** will continue to move in the first transverse direction **20** through the transition actuating position **356**, to a position wherein the first surface finisher **24** is disposed in a reverse actuating position, designated in FIG. **8** by the general reference numeral **358**. The first sensor assembly **40** is disposed with respect to the finisher assembly **12** such that, when the first surface finisher **24** is moved to the reverse actuating position **358**, the actuating boss **78** of the finisher assembly **12** will actuatingly engage the second trip switch **78** of the first sensor assembly **40**.

The second trip switch **76** is connected to the chain drive **252** in such a manner that, when the second trip switch **76** is actuatingly engaged by the actuating boss **78**, the driving impetus provided by the chain drive **252** will be reversed, thereby driving the chain **92** in the second rotating direction **182**. The reversing of the driving impetus by the chain drive **252** will cause the finisher assembly **12** to be pivoted to the second pivot position and will drivingly move the finisher assembly **12** in the second transverse direction **22** across the surface to be finished **32**.

As shown in FIG. **8**, the first surface finisher **24** is disposed a predetermined transverse distance from the first slip form **44** when the first surface finisher **24** is disposed in the reverse actuating position **358**. In the preferred form, the second surface finisher **26** is disposed on the finisher assembly **12** such that, when the first surface finisher **24** is moved to the reverse actuating position **358**, the second surface finisher **26** is disposed in a predetermined horizontal plane generally above the first slip form **44**. More particularly, the second surface finisher **26** is disposed on the finisher assembly **12** such that, when the finisher assembly **12** is pivoted to the second pivot position, the second surface finisher **26** is moved into an initial surface engaging position, designated in FIG. **8** by the general reference numeral **360**, generally over a portion of the first slip form **44**. In the initial surface engaging position **360** of the second surface finished **26** and, in a preferred form, the second surface finisher **26** is disposed such that the center lines generally therethrough intersect at a position generally over the first slip form **44**, for reasons which will be made more apparent below.

After the finisher assembly **12** has been pivoted to the second pivot position and the finisher assembly begins to move in the second transverse direction **22**, the actuating boss **78** will be moved from engagement with the first trip switch **74** and the second trip switch **76** of the first sensor assembly **40**. The finishing apparatus **10**

controls are constructed to maintain the chain drive **252** in an actuated or driving status subsequent to the trip switches **74** and **76** of the first sensor assembly **40** being actuated to continue driving the finisher assembly **12** in the second transverse direction **22**, in a manner to be described in greater detail below.

The second sensor assembly **42** is disposed with respect to the finishing apparatus **10** and with respect to a predetermined position, defined more particularly in this instance by the second slip form **46**, to initially decrease the rate at which the chain **92** is being driven by the chain drive **252** and to controllingly reverse the driving impetus of the chain drive **252**, thereby pivoting the finisher assembly **12** to the first pivot position and subsequentially moving the finisher assembly **12** in the first transverse direction **20** across the surface to be finished **32**, in a manner similar to that described before with respect to the first sensor assembly **40**. More particularly, after the finisher assembly **12** has been pivoted to the second pivot position via the first sensor assembly **40**, as described above, the finisher assembly **12** will be moved in the second transverse direction **22** across the surface to be finished **32**, the second surface finisher **26** finishingly engaging the surface to be finished **32**, in this position of the finisher assembly **12**. The finisher assembly **12** will continue to move in the second transverse direction **22** to a position wherein the second surface finisher **26** is disposed in a transition actuating position, designated in FIG. **8** by the general reference numeral **362**.

The second sensor assembly **42** is disposed with respect to the finishing apparatus **10** such that, when the second surface finisher **26** is disposed in the transition actuating position **362** thereof, the first trip switch **74** is actuatingly engaged by the actuating boss **78** of the finisher assembly **12**. The actuation of the first trip switch **74** will cause the rate at which the chain **92** is driven by the chain drive **252** in the second direction **182** to be linearly decreased, in a manner to be described in greater detail below.

The second surface finisher **26** will continue to move in the second transverse direction **22** to a position wherein the second surface finisher **26** is disposed in a reverse actuating position, designated in FIG. **8** by the general reference numeral **364**. In the reverse actuating position **364** of the second surface finisher **26**, the finisher assembly **12** will be positioned such that the actuating boss **78** thereon actuatingly engages the second trip switch **76** of the second sensor assembly **42**. The actuation of the second trip switch **76** of the second sensor assembly **42** will reverse the driving impetus of the chain drive **252**, thereby driving the chain **92** in the first rotating direction **180**. The reversing of the driving impetus provided by the chain drive **252** will cause the finisher assembly **12** to be pivoted to the first pivot position and move the finisher assembly **12** in the first transverse direction **20**, generally across the surface to be finished **32**.

In a preferred form, the first surface finisher **24** is disposed on the finisher assembly **12** such that, when the second surface finisher **26** is moved to the reverse actuating position **364**, the first surface finisher **24** is disposed in a predetermined horizontal plane generally above the second slip form **46**. More particularly, the first surface finisher **24** is disposed on the finisher assembly **12** such that, when the finisher assembly **12** is pivoted to the first pivot position, the first surface finisher **24** is moved into an initial surface engaging position, designated in FIG. **8** by the general reference numeral **366**. As shown in FIG. **8** and in a preferred form, the first surface finisher **24** is disposed on the finisher assembly **12** such that, when the first surface finisher **24** is pivoted to the initial surface engaging position **366**, the first surface finisher **24** is disposed such that the center lines therethrough generally intersect at a position above the second slip form **46**, for reasons which will become more apparent below.

After the finisher assembly **12** has been again pivoted to the first pivot position and the finisher assembly **12** begins to move in the first transverse direction **20**, the actuating boss **78** of the finisher assembly **12** will be moved from actuating engagement with the first trip switch **74** and the second trip switch **76** of the second sensor assembly **42**. The finishing apparatus **10** controls are constructed to maintain the chain drive **252** in an actuated or driving status subsequent to the trip switches **74** and **76** of the second sensor assembly **42** being deactuated to continue to drive the finisher assembly **12** in the first transverse direction **20**, in a manner to be described in greater detail below.

As shown in FIG. **2**, a water drum **371** is secured to the transverse frame **14**, generally near the adjustable end **18** thereof. The water drum **371** is constructed to retain a predetermined amount of water and, in one form, the water drum **371** is pressurized or connected to an air supply (not shown) to provide an easily dispensible, convenient water supply, which may be desirable in some applications for washing and cleaning the various components and assemblies of the apparatus **10**, particularly the components and assemblies of the finisher assembly **12**, during the operation of the apparatus **10** and prior to storage thereof (the water drum **371** being shown only in FIG. **2** for the purpose of clarity).

As shown in FIG. **2**, the finishing apparatus **10** also includes a pair of vibrators **372** and **373**; the vibrator **372** being supported generally below the surface to be finished **32** and generally near the first slip form **44**, and the vibrator **373** being supported generally below the surface to be finished **32** and generally near the second slip form **46** (the vibrators **372** and **373** being shown only in FIG. **2** for the purpose of clarity). Each vibrator **372** and **373** is removably connected to the transverse frame assembly **14** via a vibrator support **374**, each vibrator support **374** being more particularly connected to one of the adjustable members **48** supporting the slip forms **44** and **46**, thereby maintaining a predetermined disposition of each vibrator **372** and **373** relative to the slip forms **44** and **46** durinig the operation of the finishing apparatus **10**.

It should also be noted that each of the vibrators **372** and **374** is supported generally forward from the finisher assembly **12**, each vibrator **372** and **374** vibratingly engaging a portion of the surface material of the surface to be finished generally near the slip forms **44** and **46** for conditioning the surface material, enhancing and improving the finish of the surface to be finished **32** in an area generally near the slip forms **44** and **46**. It should be noted that the surface material of the surface to be finished **32** in the area generally near the slip forms **44** and **46** is generally considered to be the most difficult area to finish via an automatic apparatus, and the utilization and disposition of the vibrators **372** and **373** has been found to substantially reduce the difficul-

ties encountered in finishing the surface material in this particular area, thereby improving the quality of the finished surfaces. Each of the vibrators **372** and **373** is connected to a power supply via a cable (not shown) in a manner well-known in the art.

In those applications where only one of the slip forms **44** and **46** is to be utilized such as when finishing the surface of a slab having one side abutting a previously finished slab, the slip form **44** and **46** not in use is removed. However, the vibrator **372** or **373** generally near the slip form **44** or **46** not in use is adjusted via the vibrator support **374** to remain in vibrating engagement with the surface material generally near the one abutting edge of the finished slab to enhance and improve the finish of the surface to be finished **32** generally near the one abutting edge of the finished slab. Vibrators of the type generally referred to above with respect to the vibrators **372** and **373** are well-known in the art, and a detailed description of the construction and operation thereof is not required herein.

As shown in FIG. **1**, the finishing apparatus **10** also includes a remote controller **375** connected to the operator control unit **90** via a cable **376.** The remote controller **375** is removably supported within a controller support **377** secured to one end of a support extension **378,** the opposite end of the controller support **377** being securedly connected to a portion of the transverse frame assembly **14** and disposed to support the remote controller **375** in a horizontal disposition generally vertically above the horizontal disposition of the surface to be finished **32.**

In one preferred form, the remote controller **377** is constructed and connected to the various components and assemblies of the operator control unit **90** such that the operator, positioned forward from the finishing apparatus **10** and in a position wherein the finishing engagement between finisher assembly **12** and the surface to be finished **32** is readily observable via the operator, controls the transverse movement of the finisher assembly **12** in the transverse directions **20** and **22,** the pivotal movement of the finisher assembly **12** to the first and second pivot positions and the movement of the finishing assembly **10** in a generally forward direction **354.** Thus, the remote controller **377** allows the operator to control the various operational positions of the finishing apparatus **10** from a position forward from the finishing apparatus in an optimum position for observing the operation of the surface finishers **24** and **26** and controlling the finishing apparatus **10** in response to the observed finished condition of the surface to be finished **32** to effect a predetermined controlled surface finish. One preferred embodiment of a remote controller, similar to the remote controller **375,** is shown in FIG. **18,** and will be described in greater detail below.

OPERATION OF FIGS. 1 THROUGH 8

The finishing apparatus **10,** described above, is constructed to efficiently, effectively and positively finishingly engage the surface to be finished **32** across substantially the entire transverse width thereof and in a manner assuring the structural integrity of the finished surface material. In one aspect, the present invention provides a means for moving hydraulically operated components between predetermined positions and providing operating power fluid therefor, in a quicker, more efficient and more economical manner.

The frame connectors **80** connected to the two support assemblies **30,** generally near the adjustable end portion **18** of the transverse frame assembly **14,** are initially loosened and the forward side **54** and the rearward side **56** of the transverse frame assembly **14** are slidingly adjusted therein to a predetermined position. More particularly, the forward side **54** and the rearward side **56** are each adjustingly positioned in the frame connectors **80** to a position wherein the transverse distance between the first slip form **44** and the second slip form **46** corresponds to the predetermined width of the roadway being constructed. The horizontal disposition of the first slip form **44** and the second slip form **46** is then adjusted by turning the particular hand crank **52** connected thereto, so that the first slip form **44** and the second slip form **46** are each disposed in a predetermined horizontal plane generally below the transverse frame assembly **14.**

The power unit **38** is actuated and, after the surface material has been initially poured generally between the first slip form **44** and the second slip form **46,** the finisher assembly **12** is actuated and drivingly moved transversely back and forth across the surface to be finished **32,** the first surface finisher **24** and the second surface finisher **26** sequentially engaging the surface to be finished **32.** the finisher assembly **12** can be initially actuated by the operator manually tripping one of the second trip switches **76** of either the first sensor assembly **40** or the second sensor assembly **42** or, in a preferred form, a control lever is disposed on the control unit **90** which is connected to the controls of the finishing apparatus **10** to accomplish basically the same control function provided by actuating one of the second trip switches **76.** In either event, the second trip **76** of the first sensor assembly **40** or the second sensor assembly **42** is actuatingly closed, thereby positioning the solenoid valve **264** in the first energized position **294** or in the second energized position **296,** depending upon which second trip switch **76** is initially actuatingly closed.

The pump **258** and the charge pump **314,** as shown in FIG. **7,** are each connected to the power unit **38** in such a manner that the pump **258** and the charge pump **314** are positioned in a driven status upon actuating the power unit **38.** Since the hydraulic motor **256** is not driving the chain **92,** prior to the actuation of one of the second trip switches **76** of the power fluid from the pump **258** is circulated to the fluid reservoir **268,** via the solenoid valve **264** which is in the de-energized position **292** thereof. It should also be noted that, in this initial start-up status of the finishing apparatus **10,** power fluid is not being pumped to the variable resistance valve **262** from the charge pump **314** since, in the de-energized position of the solenoid valve **322,** the charge pump **314** is in fluidic communication with the reservoir **268,** as shown in FIG. **7.** The variable resistance valve **262** is thus in the spring biased position and the opening **352** basically provides an unrestricted flow path between the ports **278** and **288.**

For the purpose of clarity of description, it will be assumed that the finishing apparatus **10** is initially actuated by closing the second trip switch **76** of the second sensor assembly **42.** As schematically shown in FIG. **7,** the closing of the second trip switch **76** of the first sensor assembly **40** establishes electrical continuity between the power source **304** and one of the coils of the solenoid valve **264,** thereby energizing the solenoid

valve 264 to the second energized position 296. When the solenoid 264 is in the second energized position 296 thereof, power fluid is being provided from the pump 258 to the hydraulic motor 256 via the conduit 302, thereby driving the hydraulic motor 256 in one direction. The latching relay circuit 313 maintains the solenoid valve 264 in the second energized position 296, in a manner as described before.

As mentioned before, the hydraulic motor 256 is directly connected to the gear 250 via the shaft 254, as diagramatically shown in FIG. 6. More particularly, the hydraulic motor 256 is constructed and is coupled to the gear 250 such that, in the second energized position 296 of the solenoid valve 264, the hydraulic motor 256 drivingly rotates the gear 250 to move the chain 92 in the first rotating direction 180.

The driving of the chain 92 in the first rotating direction 180 will cause the rocker support arm 110 to be pivoted to the first pivot position via the connection between the chain 92 and the rocker support arm 110 provided by the first pivot linkage 176 and the second pivot linkage 178, in a manner as described before. As the chain 92 is driven in the first rotating direction 180, the chain 92 will also drivingly rotate the idler drive gear 204 via the gearing interconnection therebetween.

The rotation of the idler drive gear 204 will rotatingly drive the pump input shaft 220 of the reversible pump 216 via the interconnection therebetween provided by the shaft 214, the gears 212 and 220 and the endless chain belt 218. The chain 92 thus drives the reversible pump 216 thereby providing power fluid to the various hydraulic motors disposed on the finisher assembly 12, in a manner as described before.

For the purpose of clarity of description, it will be assumed that the chain 92 drives the reversible pump 216 in such a manner as to provide the power fluid therefrom in a general direction, designated by the general reference numeral 370 in FIG. 6, when the chain 92 is driven in the first rotating direction 180. Although it should be particularly noted that the reversible pump 216 is connected to the various hydraulic components such that power fluid provided therefrom in a direction 372, in the second rotating direction 182 of the chain 92, will also provide power fluid to the inlet of the second finisher drive 132 via the conduit 232, the first finisher drive 130, the second finisher drive 132 and the auger hydraulic motor 238 thus being driven in the same rotating direction in the first rotating direction 180 and in the second rotating direction 182 of the chain 92.

In the driven position of the reversible pump 216, as described above, the power fluid will be pumped therefrom in the direction 370 generally into the inlet side of the second finisher drive 132 via the conduit 232. In this position of the reversible pump 216, the power fluid flowing through the conduit 232 is prevented from returning to the fluid reservoir 224 by the check valve interposed in the conduit 228.

Since the first finisher drive 130, the second finisher drive 132 and the auger drive 238 are each connected in hydraulic series, the power fluid provided by the reversible pump 216 is thus utilized to drive the second finisher drive 132, the first finisher drive 130 and the auger drive 238. The power fluid is then returned or recirculated to the reservoir 224 via the conduit 242 connected the discharge side of the auger drive 238 and the reservoir 224.

In this position of the finishing apparatus 10, described generally above, the first surface finisher 24 is in finishing engagement with the surface to be finished 32, and the finisher assembly 12 is being moved in the first transverse direction 20 generally across the transverse frame assembly 14. The first surface finisher 24 is rotatingly driven via the first finisher drive 130 in the rotating direction 140, generally opposed to the first transverse direction 20. Thus, a portion of the surface material engaged by the first surface finisher 24 will be moved in a generally transverse direction generally corresponding to the first transverse direction 20, ahead of the first surface finisher 24, for reasons which will be made apparent below.

As diagrammatically indicated in FIGS. 1 and 8, when the first surface finisher 24 is in finishing engagement with the surface to be finished 32, the first surface finisher 24 is angularly disposed with reference to a plane generally corresponding to the forward direction 354. More particularly, the first surface finisher 24 is angularly disposed such that the rearwardmost end thereof forms a leading edge with respect to the forwardmost end thereof. The angular disposition of the first surface finisher 24 tends to move a grout-like portion of the surface being finished in a generally forward direction 354, such that that portion of the surface material is continually contacted and refinished or reworked by the first surface finisher 24 and the second surface finisher 26, during the operation of the finishing apparatus 10.

The finisher assembly 12 will continue to move in the first transverse direction 20 across the surface to be finished 32 to a position wherein the first surface finisher 24 is disposed in the transition actuating position 356, as shown in dashed-lines in FIG. 8. In this position, the first trip switch 74 of the first sensor assembly 40 is actuatingly engaged by the actuating boss 78 of the finisher assembly 12.

The actuation of the first trip switch 74 of the first sensor assembly 40 or, in other words, the closing of the first trip switch 74 thereof, establishes electrical continuity between the power source 304 and the solenoid valve 322, thereby moving the solenoid valve 322 to the energized position. In the energized position of the solenoid valve 322, the discharge side of the charge pump 314 is connected to the port 316 of the variable resistance valve 262 via the conduit 318. The charge pump 314 will thus pump fluid into the variable resistance valve 262 via the port 316 therethrough, the power fluid from the charge pump 314 entering the variable resistance valve 262 to bias the valve member 344 therein in a direction generally against the biasing force of the bias spring 350.

As the valve member 344 in the variable resistance valve 262 is slidingly moved against the biasing force of the bias spring 350, the port 288 will be increasingly restricted, thereby increasing the pressure drop of the power fluid through the variable resistance valve 262, generally between the conduits 280 and 290.

The increasing of the pressure drop through the variable resistance valve 262, as mentioned above, will cause the valve member 334 of the relief valve 260 to be moved in a direction generally opposed to the biasing force of the bias spring 340 therein. When the pressure drop between the conduits 280 and 290 reaches a predetermined level, the valve member 334 of the relief valve 260 will be moved to a position wherein the

opening 342 therethrough establishes fluidic communication between the port 272 and the port 326 in the relief valve 260. It will be apparent to those skilled in the art from the foregoing, that when fluidic communication is established between the ports 272 and 326 of the relief valve 260, that a portion of the power fluid from the pump 258 will be returned to the fluid reservoir 268 via the relief valve 260 or, more particularly, via the conduit 274, the conduit 276, the port 272, the opening 342, the port 326 and the conduit 328.

In this position of the hydraulic control circuit, that is, where the charge pump 314 is pumping fluid into the port 316 of the variable resistance valve 262 and the relief valve 260 has established a fluid path therethrough between the hydraulic pump 258 and the fluid reservoir 268, the rate at which the power fluid is being provided to the hydraulic pump 256 will be increasingly decreased. Since the hydraulic motor 256 is coupled to the chain 92, the driving movement of the chain 92 will also be increasingly decreased or, in other words, the rate at which the chain 92 is being driven via the chain drive 252 will be increasingly decreased, prior to the reversing of the finisher assembly 12 and prior to the changing of the pivot position of the finisher assembly 12.

The reducing of the rate of travel of the finisher assembly 12 in the first transverse direction 20 and in the second transverse direction 22 prior to reversing the direction of movement of the finisher assembly 12 has been found to reduce the load and torque requirements to effect this reversing action and thus reduce the wearing of the various components. However, in some applications of the finishing apparatus 10, it may be feasible to eliminate the initial control actuation provided by the first trip switches 74 of the first sensor assembly 40 and the second sensor assembly 42, and to merely reverse the direction of movement of the finisher assembly 12 and pivot the finisher assembly 12 to the appropriate pivot position utilizing the second trip switches 76 of the first sensor assembly 40 and the second sensor assembly 42.

It should also be noted that the orifice 320 controls the rate of flow of the fluid generally between the charge pump 314 and the port 316 of the variable resistance valve 262, thereby controlling the linear increase of pressure drop through the variable resistance valve. The orifice 320 thus controls the rate at which the chain drive 252 is increased and decreased during the transition portion of the operation of the finishing apparatus 10.

It will be apparent to those skilled in the art from the foregoing that by utilizing various orifice sizes for the orifice 320, the rate at which the speed of the hydraulic motor 256 is increased and decreased can be controlled and altered for different applications. In some applications, for example, it may be desirable to dispose a check valve in parallel with the orifice 320, the check valve being oriented such that the rate at which the power fluid is being provided from the charge pump 314 to the variable resistance valve 262 differs with respect to the rate at which the power fluid is being pumped from the variable resistance 262 to the fluid reservoir 268. In one other form, a check valve could also be interposed in the conduit 318 generally between the orifice and variable resistance valve 262 and an orifice of a different size and a check valve could be connected in parallel with the first mentioned orifice and check valve in such a manner that the rate at which power fluid is provided from the charge pump 314 to the variable resistance valve 262 and the rate at which the power fluid is dumped from the variable resistance valve 262 to the fluid reservoir 268 are each controlled via different orifice sizes.

The finisher assembly 12 will continue to move across the surface to be finished 32 in the first transverse direction 20 to a position wherein the first surface finisher 24 is disposed in the reverse actuating position 258, as diagrammatically shown in FIG. 8. In this position of the finisher assembly 12, the second trip switch 76 of the first sensor assembly 40 is actuatingly engaged by the actuating boss 78 of the finisher assembly 12. As shown more clearly in FIG. 7, the actuation or closing of the second trip switch 76 of the first sensor assembly 40 establishes electrical continuity between the power source 304 and one of the coils of the solenoid valve 294 to position the solenoid valve 294 in the first energized position 294 thereof. As mentioned before, the latching relay circuit 313, interrupts the electrical continuity between the power source and the solenoid valve 264, initially established by the actuation of the second trip switch 74 of the second sensor assembly 42 when the second trip switch of the first sensor assembly 40 is actuated.

In the first energized position 294 of the solenoid valve 264, fluidic communication is established between the pump 258 and the hydraulic motor 256 via the conduit 300. Thus, in the first energized position 294 of the solenoid valve 264, the power fluid is being provided from the pump 258 to the opposite side of the hydraulic motor 256 with respect to the side thereof being provided with the power fluid in the second energized position 296 of the solenoid valve 264. Since, in the first energized position 294 of the solenoid valve 264, power fluid is being pumped through the hydraulic motor 256 in a generally opposite direction with respect to the flow of power fluid therethrough in the second energized position 296 of the solenoid valve 264, the direction of rotation of the output drive shaft of the hydraulic motor 256 will be reversed, thereby driving the dchain 92 in the second direction 182.

The driving of the chain 92 in the second direction 182 will pivot the rocker support arm 110 of the finisher assembly in the second pivot direction 186 to the second pivot position due to the interconnection of the chain 92 and the rocker support arm 116 provided via the first pivot linkage 176 in the second pivot linkage 178, as described above. The pivoting of the finisher assembly 12 or, more particularly, the rocker support arm 110 thereof to the second pivot position will move the second surface finisher 26 to the initial surface engaging position 360, as shown in FIG. 8, in finishing engagement with the surface to be finished 32. The driving of the chain 92 in the second direction 182 will also cause the finisher assembly 12 to be moved in the second transverse direction 22 across the surface to be finished 32, generally toward the second slip form 46.

As the finisher assembly 12 moves in the second transverse direction 22, the actuating boss 78 will be disengaged from the first trip switch 74 and the second trip switch 76 of the first sensor assembly 40. The latching relay circuit 313 will maintain the electrical continuity between the solenoid valve 264 and the power source 304 previously established by the actuation of the second trip switch 76 of the first sensor assembly

40, in a manner as described before, thereby holding the solenoid valve 264 in the first energized position 264 thereof.

The disengagement of the actuating boss 78 with the first trip switch 74 of the first sensor assembly 40 will interrupt the electrical continuity between the power source 304 and the solenoid valve 322 thereby de-energizing the solenoid valve 322. In the de-energized position of the solenoid valve 322, the solenoid valve 322 provides fluidic communication between the port 316 of the variable resistance valve 262 and the fluid reservoir 268, thereby draining the fluid which was pumped into the variable resistance valve 262 by the charge pump 314 to the fluid reservoir 268.

As the fluid is drained from the one end the variable resistance valve 262 to the fluid reservoir 268 via the conduit 318, the valve member 344 of the variable resistance valve 262 will be biased to the spring-biased positioned wherein the opening 352 through the valve member 344 provides a virtually unrestricted fluid path between the port 278 of the port 288 of the variable resistance valve 262. It will be apparent to those skilled in the art from the foregoing that, when the valve member 344 of the variable resistance valve 262 is positioned in the spring-biased position, the pressure drop across the variable resistance valve 262 generally between the conduits 280 and 290 will linearly decrease.

As the pressure drop across the variable resistance valve 262 is decreased, as described above, the valve member 334 of the relief valve 260 will be moved by the bias spring 340 therein to the spring-biased position. In this position of the relief valve 260, the valve member 334 is interposed between the discharge end of the pump 258 and the fluid reservoir 268. Thus, when the variable resistance valve 262 has been returned to the position wherein the opening 352 therethrough provides a virtually unrestricted, fluidic communication between the ports 278 and 288 therein, fluidic communication is once again established between the pump 258 and hydraulic motor 256.

As mentioned before, the rate at which the fluid is drained from the variable resistance valve 262 is controlled by the orifice 320. Thus, after the finisher assembly 12 has been pivoted to the second pivot position, the rate at which the chain 92 drivingly pulls the finisher assembly 12 in the second transverse direction 22 back across the surface to be finished 32 is linearly increased to a predetermined rate of travel, the particular time required for the chain drive 252 to once again reach full speed being substantially controlled by the orifice 320.

During the period of time required for the chain drive 252 to be reversed and for the finisher assembly 12 to be pivoted to the second pivot position, the chain 92 will not be driven in either the first rotating direction 180 nor the second rotating direction 182. Thus, during this reversing cycle of operation of the finishing apparatus 10, the reversible pump 216, shown in FIG. 6, is not being driven, and thus is not providing power fluid to the various hydraulically operated apparatus disposed on the finisher assembly 12. When the reversible pump 216 is not being driven by the chain 92, the first surface finisher 24, the second surface finisher 26, and the auger member 28 are each maintained in a rotating status. The power fluid, in this instance, is being cycled through the second finisher drive 132, the first finisher drive 130 and the auger hydraulic motor 238 and back to the inlet of the second finisher drive 132 via the conduit 244, as shown in FIG. 6.

It has been found, that the rotating momentum established by the first surface finisher 24, the second surface finisher 26 and the auger member 28 during that portion of the operation of the finishing apparatus 10 wherein each were rotatingly driven via the reversible pump 216, will cause each of the hydraulically driven elements, mentioned above, to continue rotating. The recirculating of the power fluid through the second finisher drive 132, the first finisher drive 130 and the auger hydraulic motor 238 via the conduit 244 will maintain the rotating status of each of the hydraulically driven apparatus, and reduce the torque required to initiate the rotation thereof after the direction of movement of the chain 92 has been reversed and subsequent to the movement of the chain 92 providing the driving power for the reversible hydraulic pump 216. This reduction of torque required to once again establish the rotational movement of the first surface finisher 24, the second surface finisher 26 and the auger member 28 subsequent to the finisher assembly 12 reversing directions, reduces the stress forces imposed on all of the apparatus interconnecting the chain drive 252 and the hydraulically operated apparatus of the finisher assembly 12 and, thus, not only provides a smoother operation of the finishing apparatus 10 during each reversal of the movement of the finisher assembly 12, but also increases the efficiency and reduces the maintainence required for the finishing apparatus 10.

The finisher assembly 12 will continue to move in the second transverse direction 22 across the surface to be finished 32, to a position wherein the second surface finisher 26 is disposed generally in the transition actuating position 362, thereof as diagrammatically shown in FIG. 8. In the transition actuating position 362 of the second surface finisher 26, the actuating boss 78 of the finisher assembly 12 will actuatingly engage and close the first trip switch 74 of the second sensor assembly 42, thereby establishing electrical continuity between the power source 304 and the solenoid valve 322. The solenoid valve 322 will thus be moved to the energized position thereof, thereby establishing fluidic communication between the charge pump 314 and the variable resistance valve 262. The charge pump 314 will thus provide power fluid to the variable resistance valve 262, and the pressure drop through the variable resistance valve 262 generally between the conduits 280 and 290 will linearly increase, in a manner similar to that described above.

The increasing pressure drop across the variable resistance valve 262 will cause the valve member 334 of the relief valve 260 to be moved to a position wherein the opening 342 therethrough establishes fluidic communication between the pump 258 and the reservoir 268. Thus, the rate at which the power fluid is being provided to the hydraulic motor 256 will linearly decrease, in a manner similar to that described above.

The finisher assembly 12 will continue to move in the second transverse direction 22, to a position wherein the second surface finisher 26 is disposed in the reverse actuating position 364 of the second surface finisher 26, the actuating boss 78 of the finisher assembly 12 will actuatingly engage and close the second trip switch 76 of the second sensor assembly 42. The actuation of the second trip switch 76 of the second sensor assembly 42 will establish electrical continuity between the

power source **304** and one of the coils of the solenoid valve **264**, thereby energizing the solenoid **264** in the second energized position **296**.

In the second energized position of the solenoid control valve **264**, power fluid will be provided from the pump **258** through the hydraulic motor **256** via the conduit **302**, thereby reversing the direction of driving rotation of the chain drive **252** to drive the chain **92** once again in the first rotating direction **180**. The driving of the chain **92** in the first rotating direction **180** will cause the finisher assembly **12** to be pivoted again to the first pivot position.

The first surface finisher **24** is supported on the finisher assembly **12** such that as the finisher assembly **12** is pivoted to the first pivot position the first surface finisher **24** will be moved into finishing engagement with the surface to be finished in the initial surface engaging position **366**, as shown in FIG. **8**. In a preferred form, the first surface finisher **24** is disposed on the finisher assembly **12** such that, in the initial surface engaging position **366** thereof, the center lines through the first surface finisher **24**, in a plane generally horizontal to the surface to be finished **32**, intersect generally above and over a center line through the second slip form **46** which extends generally perpendicular to the transverse directions **20** and **22**, as shown in FIG. **8**.

The finisher **12** will then begin to move once again in the first transverse direction **20**, as the power fluid is drained from the variable resistance valve **262** to the reservoir **268** via the orifice **320** and the solenoid valve **322**. The variable resistance valve **262** and the relief valve **260** will thus be returned to the spring-biased position, as shown in FIG. **7**, and the hydraulic motor **256** will again be driving the shaft **254** at a predetermined, maximum rate of rotation, in a manner similar to that described before.

As the finisher assembly **12** is sequentially moved back and forth across the transverse frame assembly **14** in the first transverse direction **20** and the second transverse direction **22**, the finishing apparatus **10** is being moved in a forward direction **354** along the length of the roadway to be finished at a controlled rate of speed via the driving engagement between the power unit **38** and the endless track member **36**. As mentioned before, the auger member **28** will initially engage the surface material to provide a rough finish thereto in a manner tending to force the larger aggregates of the surface material to a position generally below the surface to be finished **32**, and the surface thus engaged by the auger member **28** will subsequently be finishingly engaged by the first surface finisher **24** and the second surface finisher **26**.

Although the apparatus of the present invention could be utilized to more efficiently and effectively move a single finishing member back and forth across a surface to be finished, in a preferred form, two finishing members are utilized finishingly to engage the entire transverse width of the surface to be finished. If only a single finishing member were utilized, when the direction of movement of the finisher assembly **12** was reversed, the direction of rotation of that one finishing member would also have to be reversed. Also, if the one finishing member were moved to a position generally overlapping the slip forms on either edge of the surface to be finished, the grout-like material which generally builds up in front of the finishing member, as the finishing member is being moved across the surface, would be moved over the side of the slip form and thus be deposited over the edge of the surface being finished. Since the grout-like material is weak and does not possess the structural integrity of the over-all surface material being utilized, it will be apparent to those skilled in the art that, the edges of a surface thus finished would begin to fracture and break away in a relatively short period of time.

However, utilizing the finishing apparatus **10** of the present invention, one finisher member is moved across the surface to be finished in one transverse direction to a reverse actuating position, a distance generally transversely from the slip forms, thereby depositing any build-up of the grout-like material on the surface to be finished a distance transversely from the slip forms **44** or **46** or, in other words, a distance from the edge of the roadway being finished. In that position, the finisher assembly **12** is pivoted to bring the second finisher member into finishing engagement with the surface material, generally over one of the slip forms **44** or **46**. The finisher member thus pivoted to finishing engagement with the surface material is then moved in a transverse direction generally away from the respective slip form **44** or **46** or the edge of the surface being finished, thereby finishingly engaging and reworking the grout-like material previously deposited. The finishing apparatus **10** is thus constructed to sequentially pivot the first surface finisher **24** and the second surface finisher **26** into finishing engagement with the surface to be finished **32** in such a manner that the entire transverse width of the surface to be finished is finishingly engaged in a manner substantially eliminating the build-up of grout-like material along the edges of the surface to be finished.

The vibrators **372** and **373** each vibratingly engage and condition the surface material of the surface to be finished **32** generally near the slip forms **44** and **46**, to be subsequently finishingly engaged via the surface finishers **24** and **26** as the finishing apparatus **10** moves in a forward direction **354** along the roadway. The vibrating, conditioning engagement of the portion of the surface material generally near the slip forms **44** and **46** prior to that portion being finishingly engaged via the surface finishers **24** and **26** has been found to further enhance and improve the surface finish effected by the finishing apparatus **10**.

The finishing apparatus **10**, as described above, is also constructed such that the power utilized to drive the finisher assembly **12** in the first transverse direction **20** and the second transverse direction **22** across the surface to be finished **32** is also utilized to provide the driving impetus for providing power fluid to the various hydraulically operated apparatus disposed on the finisher assembly **12** and to pivot the finisher assembly **12** to the first pivot position and the second pivot position thereof in a controlled, sequential manner, and such that the finishing apparatus **10** is controllable from a remote position to optimumly position the operator during the operation of the finishing apparatus **10**.

EMBODIMENT OF FIG. 9

Shown in FIG. **9** is a modified finishing apparatus **10***a* which is constructed similar to the finishing apparatus **10**, described in detail before. More particularly, the finishing apparatus **10***a* includes a pair of vibrators **380** and **382**, securedly positioned on a portion of the finisher assembly **12***a*.

One end of the vibrator **380** is, more particularly, secured to one end of a hollow support rod **384**, the opposite end of the support rod **384** being secured to the finisher assembly **12***a*. One end of the vibrator **382** is, more particularly, secured to one end of a hollow support rod **386**, the opposite end of the support rod **386** being secured to the finisher assembly **12***a*.

The support rod **384** is positioned on the finisher assembly **12***a* such that the vibrator **380** connected thereto is disposed generally on one side of the auger member **28** and in a horizontal plane, a distance slightly below the horizontal dispostion of the auger member **28**. The support rod **386** is positioned on the finisher assembly **12***a* such that the vibrator **382** connected thereto is disposed generally on the opposite side of the auger member **28** with respect to the disposition of the vibrator **280**, and is disposed in a horizontal plane, a distance slightly below the horizontal disposition of the auger member **28**. Each vibrator **380** and **382** is also disposed, in a preferred form, in a plane substantially coplanar with the first transverse direction **20** and the second transverse direction **22** or, in other words, each vibrator **380** and **382** is substantially aligned with the direction of transverse movement of the finisher assembly **12**, for reasons which will be made apparent below.

As shown in FIG. **9**, each vibrator **380** and **382** is disposed generally ahead of the auger member **28** to engage a portion of the surface being finished prior to the finishing apparatus **10***a* being moved in a forward direction to a position wherein that portion of the surface being finished is engaged by the augermember **28**. The vibrators **380** and **382** thus cooperate with the auger member **28** to initially engage and condition the surface to be finishingly engaged by the first surface finisher **24** and the second surface finisher **26**.

Vibrators of the type generally mentioned above are well-known in the art and a detailed description of the construction and operation thereof is not required herein. Many of the commercially available vibrators include a self-contained motor drive requiring electrical power for the operation thereof.

As shown in FIG. **9**, electrical operating power for the vibrators **380** and **382** is provided via a cable **390**. One end portion of the cable **390** is connected to the vibrators **380** and **382**, and the opposite end portion of the cable **390** is connected to an electrical power source **392**. A portion of the cable **390** is reeled about a reel **394** which, in a preferred form, is secured to the shaft **254**.

Thus, the direction of rotation of the reel **394** will correspond to the direction of rotation of the shaft **254**, which is drivingly connected to the chain **92**. The cable **390** is rolled about the reel **394** such that, as the shaft **254** is driven to move the finisher assembly **12** in the first transverse direction **20** generally away from the power end portion **16** of the transverse frame assembly **14**, the reel **394** is rotated to release a predetermined length of the cable **390**, and such that, as the shaft **254** is driven to move the finisher assembly **12** in the second transverse direction **22** generally toward the power end portion **16** of the transverse frame assembly **14**, the reel **394** is rotated to retrieve a predetermined length of the cable **390**. In this manner, the length of the cable **390** extending between the shaft **254** and the finisher assembly **12** is controllingly responsive to the position of the finisher assembly **12** on the transverse frame assembly **14**, thereby eliminating the possibility of the cable **390** dragging upon the surface being finished or becoming entangled and severed during the operation of the finishing apparatus **10***a*.

It should also be noted that, if the vibrators utilized in a particular application are driven by a hydraulic motor, the driving impetus for such hydraulic motors can be provided via the chain **92** in a manner similar to that described before with respect to the first finisher drive **130**, the second finisher drive **132**, and the auger hydraulic motor **238**.

OPERATION OF FIG. 9

The modified finishing apparatus **10***a* will operate in a manner similar to the operation of the finishing apparatus **10**, described in detail before. The salient difference between the operation of the finishing apparatus **10***a* and the operation of the finishing apparatus **10**, being that the finishing apparatus **10***a* includes a pair of surface material engaging vibrators **380** and **382** which are constructed and disposed on the finisher assembly **12***a* to cooperate with the auger member **28**, to initially engage and condition the surface prior to the surface being finishingly engaged by the first surface finisher **24** and the second surface finisher **26**.

It should be particularly noted that since the vibrators **380** and **382** are disposed in a plane substantially parallel to the direction of movement of the finisher assembly **12**, the frictional resistance between the vibrators **380** and **382** and the surface material will be reduced, during that portion of the operation of the finishing apparatus **10***a* when the finisher assembly **12***a* is being moved in the first transverse direction **20** and the second transverse directon **22** across the transverse frame assembly **14**. This reduction in frictional resistance between the vibrators **380** and **382** and the surface material not only reduces the twisting, torque forces, but also increases the efficiency of the finisher assembly **12***a*, since the reducton of friction results in less torque and less driving power is required to move the finisher assembly **12***a* in the first transverse direction **20** and the second transverse direction **22**.

It should be noted that even utilizing the vibrator disposition described above, it has been found that, in some instances, the vibrators **380** and **382** have been twisted during the operation of the finishing apparatus **10**, the twisting tendency being particularly applicable to the vibrator **380** and **382** oppositely oriented with respect to the transverse direction of travel of the finisher assembly **12**. The twisting or bending of vibrators **380** and **382** has resulted in the vibrators **380** and **382** being twisted vertically upwardly in a general direction toward the transverse frame assembly **14**, resulting in the tearing or ripping of a portion of the surface material engaged by the twisted vibrator **380** or **382**. In view of the foregoing, an improved and a preferred vibrator mounting assembly has been constructed and shown in FIG. **12**, the vibrator mounting assembly of FIG. **12** to be described in greater detail below.

It will be apparent to those skilled in the art from the foregoing, that the finishing apparatus **10***a* retains all of the advantages of the finishing apparatus **10**, described before, and in addition provides a finishing apparatus having vibrators mounted thereon to vibratingly engage the surface material during the operation of the finishing apparatus **10***a*. The finishing apparatus **10***a* also includes an apparatus for providing electrical power to the finisher assembly **12***a* in such a manner that the

length of the interconnecting cable is controllingly increased and decreased to maintain the cable in a predetermined horizontal plane as the position of the finisher assembly **12***a* on the transverse frame assembly **14** is varied, during the operation of the finishing apparatus **10***a*.

EMBODIMENT OF FIGS. 10 AND 11

Shown in FIGS. **10** and **11** is an improved modified finisher assembly **12***a* which is utilized in the finishing apparatus **10** of FIGS. **1** through **8**, described in detail before, in lieu of the finisher assembly **12.** The modified finisher assembly **12***a* is constructed similar to the finisher assembly **12**; but, the finisher assembly **12***a* includes: a modified auger frame **122***a*, having a modified upper portion **124***a* and a modified adjustable portion **126***a;* and a pair of screw-type auger members, a first auger member **400** and a second auger member **402.**

The adjustable portion **126***a*, more particularly, includes a transverse bar **404** having four bearing supports **406, 408, 410** and **412**; one pair of bearing supports **406** and **408** being spaced in a generally forward direction **354** from the other pair of bearing supports **410** and **412.** One end of each of the bearing supports **406, 408, 410** and **412** is secured to the transverse bar **404,** and each bearing support extends a distance vertically downwardly from the transverse bar **404,** the end of each bearing support, opposite the ends thereof secured to the transverse bar **404,** being bearingly secured to a portion of one of the auger shafts. More particularly, the bearing supports **406** and **410** bearingly support a first auger shaft **414** and the bearing supports **408** and **412** bearingly support a second auger shaft **416.**

The first auger member **400** has a left-hand auger flight **418** and the second auger member **402** has a right-hand auger flight **420,** as shown in FIG. **11,** each auger member **400** and **402** tending to move the surface material in a direction generally opposite the direction the other auger member **400** and **402** tends to move the surface material, for reasons which will be made more apparent below. The first and the second auger members **400** and **402** are each bearingly supported via the bearing supports **406, 408, 410** and **412** generally between the first surface finisher **24** and the second surface finisher **26**; each auger member **400** and **402** extending between the surface finishers **24** and **26** in a generally parallel relationship, and being supported such that a portion of each auger member **400** and **402** is disposed in a horizontal plane below the surface to be finished **32** in engagement with a portion of the surface material, in a manner similar to that described before with respect to the auger member **28.**

The bearing support **408** of the second auger member **402** is spaced a distance in a generally forward direction **354** from the bearing support **406** of the first auger member **400,** thereby offsetting the auger flight **418** of the first auger member **400** with respect to the auger flight **420** of the second auger member **402.** The offsetting relationship of the auger flights **418** and **420** in a generally forward direction permits the first auger member **400** to be supported in a non-interfering, relatively close relationship or proximity with respect to the second auger member **402** leaving a substantially minimum space between the outer peripheries formed by the auger flights **418** and **420** on a rotatingly and bearingly supported position of the auger members **400** and **402,** as shown more clearly in FIG. **11.** It should also be noted that the offsetting relationship of the bearing supports **406** and **408** provides an increased bearing area on each auger shaft **414** and **416** available for bearing support without a substantial loss of the auger flight areas of the portions of the auger flights **418** and **420** extending generally between the surface finishers **24** and **26.**

As shown more clearly in FIG. **11,** the auger flights **418** and **420** of the auger members **400** and **402** each extend a distance **422** between the surface finishers **24** and **26** and each extend a distance **424** beyond the forwardmost end portions of the surface finishers **24** and **26.** More particularly, in one application, it was found that satisfactory results were obtained when the auger flights **418** and **420** were each extended a distance **422** between the surface finishers **24** and **26** wherein the distance **422** was a length approximately equal to 60 percent of the total length of the surface finishers **24** and **26.**

It should also be noted that, in a preferred form, as shown in FIG. **11,** each surface finisher **24** and **26** is driven via a separate, individual hydraulic motor, the first surface finisher **24** being driven via a first finisher hydraulic motor **426** and the second surface finisher **26** being driven via a second finisher hydraulic motor **428.** The auger members **400** and **402** are also each driven via a separate, individual hydraulic motor, the first auger member **400** being driven via a first auger hydraulic motor **430** and the second auger member **420** being driven via a second auger hydraulic motor **432.** In this manner, the surface finishers **24** and **26** and the auger members **400** and **402** are each independently controllable which is particularly desirable during some aspects of the operation of the finishing apparatus **10***a* when the operator is controlling the operation of the finishing apparatus **10***a* utilizing the remote controller **375** or the embodiment of the remote controller shown in FIG. **18** as well as described in greater detail below.

The surface finisher **12***a* will operate similar to the surface finisher **12,** described in detail before, the salient differences being that the surface finisher **12***a* includes the two auger members **400** and **402,** each having an auger flight **418** and **420** extending a distance **422** between the surface finishes **24** and **26** and a distance **424** beyond the forwardmost ends of the surface finishers **24** and **26** to provide a more efficient and more positive control of the flow of the surface material generally between the surface finishers **24** and **26** resulting in an improved finished surface. The auger members **400** and **402,** having oppositely oriented auger flights **418** and **420**; that is, a left-hand auger flight **418** and a right-hand auger flight **420,** function to enhance and provide an improved control or metering effect with respect to the surface material engaged thereby. More particularly, it has been found that an auger member in a surface finishing application operates more efficiently to control or meter the flow of surface material engaged thereby when the auger flight of the particular auger member is oriented to screw generally against the direction of travel of the finisher assembly **12***a* as the finisher assembly **12***a* is moved transversely across the surface to be finished **32.** Thus, when the finisher assembly **12***a* is being moved in the transverse direction **20,** the first auger member **400** functions more efficiently to move the surface material engaged thereby in a generally forward direction **354,**

and, when the finisher assembly **12***a* is being moved in the transverse direction **22**, the second auger member **402** functions more efficiently to move the surface material engaged thereby in a generally forward direction **354**.

Thus, during one aspect of the operation of the finishing apparatus **10***a*, both auger members **400** and **402** are rotated via the auger hydraulic motors **430** and **432** drivingly connected thereto, one of the auger members **400** and **402** functioning more efficiently to move the surface material engaged thereby in a generally forward direction **354** as the finisher assembly **12***a* is moved in the transverse direction **20** and one of the auger members **400** and **402** functioning more efficiently to move the surface material engaged thereby in a generally forward direction **354** as the finisher assembly **12***a* is moved in the transverse direction **22**. This combined action of the auger members **400** and **402**, described above, provides an overall more efficient and more effective finisher assembly **12***a* operation substantially assuring that relatively small portions of the surface material will not be left on the finished surface; but, rather such small portions of surface material (grout) will be continually engaged by the auger members **400** and **402**, moved in a generally forward direction **354**, and subsequently engaged by the surface finishers **24** and **26** and the auger members **400** and **402** as the finishing apparatus **10***a* continues to move in a forward direction **354**.

In addition to the improved metering effect provided by disposing two auger members **400** and **402** between the surface finishers **24** and **26**, each auger member **400** and **402** is independently controllable such that only one of the auger members **400** and **402** can be rotatingly driven via the auger hydraulic motor **430** and **432** connected thereto, during certain aspects of the operation of the finising apparatus **10***a*. For example, when the finishing apparatus **10***a* is controlled via the remote controller **375** or, more particularly, the remote controller shown in FIG. **18**, the operator can actuate and rotatingly drive either of the auger members **400** and **402** and control the pivot position of the finisher assembly **12***a* to effect the desired surface finish, the control varying to accommodate changing conditions of the surface material, for example, as the finishing apparatus **10***a* moves in a forward direction **354** along the roadway to be finished. The auger members **400** and **402** and the individual drive motors **426**, **428**, **430** and **432** thus provide maximum efficiency during the completely automatic portion of the operation of the finisher assembly **12***a*, and yet provide a maximum, controlled flexibility to efficiently and economically vary the finisher assembly **12***a* operation to meet changing conditions with respect to the surface material or the particular application. It has also been found that the utilization of the two auger members **400** and **402** is more effective in moving the surface material generally away from the slip forms **44** and **46** or, more particularly, preventing surface material build-up generally near the slip forms **44** and **46**.

EMBODIMENT OF FIG. 12

Shown in FIG. **12** is a modified finisher assembly **12***b* constructed similar to the finisher assembly **12***a*, shown in FIGS. **10** and **11** and described before, the salient difference being that the finisher assembly **12***b* includes a vibrator assembly **438** having a pair of vibrators **440** and **442**, each vibrator **440** and **442** being supported in vibrating engagement with a portion of the surface material of the surface to be finished via a vibrator support assembly **444**. The vibrator support assembly **444** is constructed and shaped to support the vibrator **440** in a horizontal plane generally below the horizontal plane of the surface to be finished **32** such that the vibrator **440** extends angularly downwardly from the vibrator support assembly **444** to a position wherein the outermost end portion of the vibrator **440** is disposed generally vertically below a portion of the first auger member **400**. The vibrator support assembly **444** is also constructed and shaped to support the vibrator **442** in a horizontal plane generally below the horizontal plane of the surface to be finished **32** such that the vibrator **442** extends angularly downwardly from the vibrator support assembly **444** to a position wherein the outermost end portion of the vibrator **442** is disposed generally vertially below a portion of the second auger member **402**. Thus, the vibrator support assembly **444** supports the vibrators **440** and **442** in a disposition and orientation, similar to the disposition and orientation of the vibrators **380** and **382**, shown in FIG. **9** and described before, to substantially reduce the frictional engagement between the vibrators **440** and **442** as the finisher assembly **12***b* moves transversely across the surface to be finished **32** in the transverse directions **20** and **22**, the vibrators **440** and **442** being connected to a power source in a manner similar to that described before with respect to the vibrators **380** and **382**.

Each vibrator support assembly **444** includes an angularly oriented extension arm **446** connected on one end to one of the vibrators **440** and **442** and on the opposite end to a mounting plate **448**. A clamp **450** is secured to each mounting plate **448** via a pair of springs **452**, the springs **452** being sized to rigidly support the mounting plates **448**, the extension arms **446** and the vibrators **440** and **442** connected thereto in a manner permitting some movement in a general direction **454** angularly upwardly from the surface to be finished **32** and in a general direction **456** angularly downwardly toward the surface to be finished **32**, for reasons to be made more apparent below.

Each clamp **450** is connected to one end of a rod **458**, the opposite end of each rod **458** being pivotally connected to the finisher assembly **12***b* and, more particularly, to a portion of the support frame **94** of the finisher assembly **12***b*. One end of a chain **460** is connected to the rods **458**, the opposite end of each chain **460** being connected to a portion of the support frame **94**, generally vertically above the pivotal connections of the rods **458**.

The vibrator support assemblies **444** are thus each connected to the finisher assembly **12***b* to support the vibrators **440** and **442** such that each vibrator support assembly **444** and the vibrator **440** or **442** connected thereto are pivotally movable in pivot directions **462** and **464** generally above the pivotal connection between the rods **458** and the support frame **94**, the pivotal movement of each vibrator support assembly **444** in a pivotal direction **462** being limited via the length of the chains **460**. Thus, each vibrator support assembly **444** is pivotable downwardly in a pivot direction **462** to a position wherein the vibrators **440** and **442** are disposed in an assembled position, as shown in FIG. **12** and described above, the length of the chains **460** limit-

ing the further pivotal movement of the vibrator support assemblies **444** in the pivot direction **462.**

As generally mentioned before with respect to the vibrators **380** and **382,** shown in FIG. **9,** when the finisher assembly **12***b* is moving in the transverse direction **20,** there is relatively little tendency for the vibrator **442** to be twisted or otherwise forced from an assembled position; however, the engagement between the surface material and the vibrator **440,** in some instances, does tend to create a force on the vibrator **440** tending to twist, bend or otherwise force the vibrator **440** from an assembled position. Utilizing the vibrator support assembling **444,** when the finisher assembly **12***b* is moving in a transverse direction **20,** the forces imposed on the vibrator **440** merely tend to pivot the vibrator **440** in a pivot direction **464** generally upwardly from the surface material while the vibrator **442** remains in vibrating engagement with the surface material, thereby substantially reducing the detrimental effect of the forces acting on the vibrators **440** and **442** as the finisher assembly **12***b* moves in the transverse direction **20** across the surface to be finished **32,** such problems being particularly acute when the surfce material becomes relatively stiff or dry.

When the surface finisher **12***b* is being moved in the transverse direction **22,** the forces created via the engagement between the vibrators **440** and **442** tend to bend or twist the vibrator **442** from an assembled position, while the vibrator **440** encounters relatively little resistance. The forces acting on the vibrator **442** as the finisher assembly **12***b* moves in the transverse direction **22** tend to pivot the vibrator **442** and the vibrator support assembly **444** in a pivot direction **464,** while the virator **440** remains in vibrating engagement with the surface material, in a manner similar to that described before with respect to the movement of the finisher assembly **12***b* in the transverse direction **20.**

The spring **452** interposed in each vibrator support assembly **444** permits some limited movement of the vibrators **440** and **442** in the directions **454** and **456,** the directions **454** and **456** substantially corresponding to the pivot directions **462** and **464.** Thus, although the pivotal movement of each vibrator **440** and **442** in the pivot direction **462** is limited by the length of the connecting chains **460,** each vibrator **440** and **442** can be moved some distance further in the pivot directions **462** due to the springs **452** interposed in the vibrator support assemblies **444,** thereby maintaining the basic disposition of each of the vibrators **440** and **442** while compensating for various minor obstructions in the path of travel of the vibrators **440** and **442.** Vibrators including springs similar to the springs **452,** described before, are commercially available.

EMBODIMENT OF FIGS. 13 AND 14

In one preferred embodiment, the finishing apparatus **10, 10***a* and **10***b*, described before, includes float pan assembly **480** comprising: an extension **472** removably secured to the rearward side of the finisher assembly **12, 12***a* or **12***b* and extending rearwardly from the rearward end **56** of the transverse frame **14,** and a pair of spaced cross-members **474,** a central portion of each cross-member **474** being secured to the extension **472.** A pair of float pans **476** are each secured to the cross-members **474** via a plurality of chains **478,** as shown in FIGS. **13** and **14.**

Each float pan **476** has a lower surface **480** disposed in finishing engagement with the surface to be finished **32,** as shown in FIG. **14.** The chains **478** are each of a sufficient length that the lower surfaces **480** of the float pans **476** remain in finishing engagement with the surface to be finished **32,** the chains **478** primarily functioning to pull the float pans **476** in the transverse directions **20** and **22** following the movement of the finisher assembly **12, 12***a* or **12***b*, the float pans **476** providing a final finish to the surface augmenting the finish applied thereto via the finisher assembly **12, 12***a* or **12***b*, which may be desirable in some applications.

EMBODIMENT OF FIG. 15

In one preferred embodiment, the finishing apparatus also includes a pair of adjustable slip form supports **484** connected to the slip forms **44** and **46,** as shown in FIG. **15,** for adjustably positioning the slip forms **44** and **46** in a generally horizontal and vertical plane. More particularly, a vertical clamp **486** having a threaded bolt **488** threadingly disposed through each end thereof is interposed between the slip forms **44** and **46** and the transverse frame **14**; the end of one of the threaded bolts **488** opposite the end thereof threadingly engaging the vertical clamp **486,** being secured to a portion of the transverse frame assembly **14,** and the end of the other threaded bolt **488,** opposite the end thereof threadingly engaging the vertical clamp **486,** being secured to the upper portion of the slip forms **44** and **46.** Thus, by turning the vertical clamp **486,** the slip forms **44** and **46** can be adjustably moved vertically upwardly and downwardly to provide an additional degree of positioning for the slip forms **44** and **46.**

A horizontal clamp **490** having a threaded bolt **492** threadingly disposed through each end thereof is interposed between the slip forms **44** and **46** and the support assemblies **30**; the end of one of the threaded bolts **492,** opposite the end thereof threadingly engaging the horizontal clamp **490,** being secured to a portion of the support assembly **30,** and the end of the other threaded bolt **492,** opposite the end thereof threadingly engaging the horizontal clamp **490,** being secured to an upper portion of the slip forms **44** and **46.** Thus, by turning the horizontal clamp **490,** the slip forms **44** and **46** can be adjustably moved horizontally to provide an additional degree of positioning for the slip forms **44** and **46.**

EMBODIMENT OF FIG. 16

Shown in FIG. **16** is an alignment assembly **500** for positioning the surface finishers **24** and **26** in a horizontal plane with respect to the transverse frame assembly **14** including: a pointer rod **502** having a pointer end **504,** the end opposite the pointer end being secured to the rocker support arm **110** of the finisher assembly **12.** The pointer rod **502** is, more particularly, secured to the rocker support arm **110** such that the pointer rod **502** extends a distance from the rocker support arm **110** in a generally horizontal plane in the first pivot position of the rocker support arm **110** wherein the first surface finisher **24** has been moved into finishing engagement with the surface to be finished **32.** It should be noted that the alignment assembly **500** is constructed to be utilized with the various finishing apparatus described herein, including the various modifications.

The pointer rod **502** extends from the finisher assembly **12** to a position wherein the pointer end **504** is aligned with the indicia marks of a scale **506.** The scale **506** is supported on one end of a scale support **508,** the opposite end of the scale support **508** being removably secured to the transverse frame assembly **14.**

Thus, the position of the pointer end **504** relative to the indicia marks on the scale **506** indicates the position of the surface finishers **24** and **26** relative to the transverse frame assembly **14,** thereby providing an assembly for establishing an alignment of the surface finishers **24** and **26** relative to the transverse frame assembly **14.** Once a particular alignment indication between the marks on the scale **506** and the pointer end **504** has been established for a particular application, the surface finishers **24** and **26** can be easily and quickly reset to the established alignment position utilizing the alignment assembly **500.**

EMBODIMENT OF FIG. 17

The surface finishers **24** and **26** are each angularly oriented with respect to a vertical plane extending generally perpendicular to the transverse width of the surface to be finished **32** in a surface engaging position thereof to move a portion of the grout-like surface material in a generally forward direction **354** to be subsequently finished via the finisher assembly **12,** in a manner described before. In one preferred embodiment, as shown in FIG. **17,** each surface finisher **24***a* and **26***a* is also angularly oriented in a vertical plane at an angle **512** with respect to the rotational axis **513** of the surface finishers **24***a* or **26***a* and the surface to be finished **32,** the formed end of each surface finisher **24***a* and **26***a* being disposed in a horizontal plane a distance **514** generally below the surface to be finished **32** and the rearward end of each surface finisher **24***a* and **26***a* being disposed in a horizontal plane a distance **516** generally above the surface to be finished **32.**

In practice, it has been found that the angular orientation of the surface finishers **24***a* and **26***a* in a vertical plane such that the rearward end of the surface finishers **24***a* and **26***a* is disposed the distance **516** above and the rearward end of the surface finishers **24***a* and **26***a* further enhances the quality of the surface finish effected via the finishing apparatus of the present invention. The angular orientation of the surface finishers **24***a* and **26***a* in a vertical plane and in a plane perpendicular to the transverse width of the surface to be finished **32** cooperate to move the grout-like surface material in a forward direction **354** to be subsequently, finishingly engaged via the finisher assembly, thereby substantially reducing the possibility of leaving an area of grout-like material on the finished surface generally rearward of the finishing apparatus.

EMBODIMENT OF FIG. 18

Shown schematically and diagrammatically in FIG. **18** is a modified remote controller **375***a* which is, more particularly, constructed to operate with the finishing apparatus **10***a*, shown in FIGS. **10** and **11,** described before, although the basic rationale and objects can easily be incorporated in a remote controller for controlling the various finishing apparatus, described herein. The various actuating components for controlling the various aspects of the finishing apparatus from a remote position are supported within a remote controller box **520,** the remote controller box **520** being supported in controller support **377,** shown in FIG. **1.**

The remote controller **375***a* includes an automatic-manual selector **522,** having an "automatic" switch position and a "manual" switch position, the finishing apparatus being operated via the various automatic and semi-automatic controls controlled from the operator control unit **90** in the automatic switch position of the automatic-manual selector **522,** and the first finisher hydraulic motor **426,** the first auger hydraulic motor **430,** the second auger hydraulic motor **432,** the second finisher hydraulic motor **428,** a finisher drive assembly **524,** and a track drive assembly **526** each being controlled via the remote controller **375**a in the manual switch position of the automatic-manual selector **522.** The automatic manual selector **522** is, in a preferred form, a toggle-type switch having a center-off construction, and movable to the automatic and to the manual switch position, as diagrammatically shown in FIG. **18.**

The finisher drive assembly **524** is constructed to provide the driving impetus for moving the finisher assembly **12***a* in the first and the second transverse directions **20** and **22** back and forth across the surface to be finished **32,** in a manner similar to that described before with respect to the finisher assembly **12** of the finishing apparatus **10,** in the automatic switch position of the automatic-manual selector **522.** In the automatic switch position of the automatic-manual selector **522,** the finisher drive assembly **524** is, more particularly, connected to an automatic finisher drive control assembly **528,** the automatic finisher drive control assembly **528** being connected to the finisher drive assembly **524** via the automatic-manual selector **522** to automatically actuate the finisher drive assembly **524** automatically moving the finisher assembly **12***a* in the first and the second transverse directions **20** and **22,** in a manner similar to that described before with respect to the finishing apparatus **10** and the finisher assembly **12.** In the manual switch position of the automatic-manual selector **522,** the finisher drive assembly **524** is, more particularly, connected to a manual finisher drive control assembly **530,** the manual finisher drive control assembly **530,** the manual finisher drive control assembly **530** being connected to the finisher drive assembly **524** via the automatic-manual selector **522** and a finisher drive selector control **532** to actuate the finisher drive assembly **524** moving the finisher assembly **12***a* in the first transverse direction **20** in a first position of the finisher drive selector control **532** and to actuate the finisher drive assembly **524** moving the finisher assembly **12***a* in the second transverse direction **22** in a second position of the finisher drive selector control **532.** The finisher drive selector control **532** is, in a preferred form, a toggle-type switch having a center-off position and movable to the first and the second positions, as diagrammatically shown in FIG. **18.**

The first and the second auger hydraulic motors **430** and **432** are connected to the first and the second auger members **400** and **402,** as shown in FIG. **11,** for rotatingly driving the augers in a driven position thereof. In the automatic switch position of the automatic-manual selector **522,** the first and the second auger hydraulic motors **430** and **432** are each, more particularly, connected to an automatic auger drive control assembly **534,** the automatic auger drive control assembly **534** being connected to the first and the second hydraulic motors **430** and **432** via the automatic-manual selector **522** to automatically actuate the first and the second

auger hydraulic motors **430** and **432** automatically and rotatingly driving the first and the second auger members **400** and **402.** In the manual switch position of the automatic-manual selector **522,** the first and the second auger hydraulic motors **430** and **432** are, more particularly, connected to a manual auger drive control assembly **536,** the manual auger drive control assembly **536** being connected to the first and the second auger hydraulic motors **430** and **432** via the automatic-manual selector **522** and an auger drive selector control **538** to actuate the first auger hydraulic motor **430** rotatingly driving the first auger hydraulic motor **430** in a first position of the auger drive selector control **538** and to actuate the second auger hydraulic motor **432** rotatingly driving the second auger hydraulic motor **432** in a second position of the auger drive selector control **538.** The auger drive selector control **538** is, in a preferred form, a toggle-type switch having a center-off position and movable to the first and the second positions, as diagrammatically shown in FIG. **18.**

The track drive assembly **526** is constructed to actuate and drive the finishing apparatus in a forward and a rearward direction. A track stop selector assembly **540,** having an actuated position, is connected to the track drive assembly **526,** the track stop selector assembly **540** stopping the forward and the rearward movement of the finishing apparatus in the actuated position of the track stop selector assembly **540.** In a preferred form, the track stop selector assembly **540** is a push-button type of switch actuator, as diagrammatically shown in FIG. **18.**

A finisher hydraulic motor control **542** is connected to the first and the second finisher hydraulic motors **426** and **428** and, more particularly, the finisher hydraulic motor control **542** is interposed between the drive assembly providing the driving impetus for the first and the second finisher hydraulic motors **426** and **428.** The first and the second finisher hydraulic motors **426** and **428** are each rotatingly driven in a position wherein the drive assembly is connected thereto via the finisher hydraulic motor control **542.**

A control release assembly **544** and an emergency stop assembly **546** are each interposed between each of the first and the second hydraulic motors **426** and **428,** the first and the second auger hydraulic motors **430** and **432,** the finisher drive assembly **524** and the track drive assembly **526,** and the various components and assemblies providing the driving impetus therefor; that is, the automatic-manual selector **522,** the automatic finisher drive control assembly **528,** the manual finisher drive control assembly **530,** the finisher drive selector control **532,** the automatic auger drive control assembly **534,** the manual auger drive control assembly **536,** the auger drive selector control **538,** the track stop selector assembly **540,** the finisher hydraulic motor control **542** and the control release assembly **544.** The emergency stop assembly **546** and the control release assembly **544** are each, more particularly, push-button type of switch actuators, as diagrammatically shown in FIG. **18.**

The emergency stop assembly **546** provides an apparatus for stopping the various driven components and assemblies connected thereto in an actuated or depressed position of the emergency stop assembly **546.** The control release assembly **544** is a total override switch releasing all of the various components and assemblies, and disengages the emergency stop assembly **546.** Should the operator utilizing the remote controller **375***a* observe some hazardous condition or for some other reason desire to disconnect and stop all of the driven apparatus of the finishing apparatus, the operator merely depresses the emergency stop assembly **546,** the finishing apparatus being subsequently started via depressing or actuating the control release assembly **544.** In a preferred form, the emergency stop assembly **546** effects a bypassing of the hydraulic fluid so the various pumps are not decamed, thereby stopping the finishing apparatus in a position wherein the finishing apparatus is quickly, easily and conveniently restarted.

As mentioned before with respect to the remote controller **375,** the remote controller **375***a* is constructed and supported on the finishing apparatus so the operator is optimumly positioned to observe the operation of the finisher assembly and to control the various driven components to effect a predetermined surface finish at any particular given instant depending upon the immediate, observable conditions and circumstances. More particularly, the operator positions the automatic-manual selector **522** in the manual position and, in this position, the operator controls the transverse movement of the finisher assembly **12***a* via the finisher drive selector control **532.** The operator also controls the first and the second auger hydraulic motors **430** and **432,** in the manual position of the automatic-manual selector **522,** via the auger drive selector control **532,** thereby allowing the operator to directly control the metering of the surface material effected via the auger members **400** and **402** between the surface finishers **24** and **26.**

It should also be noted that the utilization of the remote controller **375***a* tends to reduce the total manpower required during the surface finishing operation, since the finishing apparatus is controlled by the operator positioned forward from the finishing apparatus and thus the operator not only observes the operation of the finisher assembly; but, the operator can also operate the chute disposing the concrete or surface material on predetermined portions of the roadway. The operator is thus able to perform a dual function.

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 the scope of the invention as defined in the following claims.

What is claimed is:

1. Apparatus for moving hydraulically operated apparatus between predetermined positions and providing operating power fluid therefore, comprising:

a frame assembly extending generally between the predetermined positions;

a support frame for supporting the hydraulically operated apparatus, the support frame moveably supported on the frame assembly;

chain means, having opposite ends, drivingly supported on the frame assembly generally between the predetermined positions, the chain means being rotatable in a first rotating direction and in a second rotating direction, in a driven position of the chain means, one end of the chain means connected to one portion of the support frame and the opposite end of the chain means connected to one other portion of the support frame to move the support frame in one direction along the frame assembly in the first rotating direction of the chain means

and to move the support frame in one other direction in the second rotating direction of the chain means;

chain drive means drivingly connected to a portion of the chain means to drive the chain means in the first rotating direction and in the second rotating direction;

hydraulic pump means responsive to the chain means and supported on a portion of the support frame to provide power fluid to the hydraulically operated apparatus supported thereon, in a driven position of the hydraulic pump means; and

gear means in gearing engagement with the chain means and having a portion thereof drivingly connected to the hydraulic pump means to drive the hydraulic pump means in a driven position of the chain means in the first rotating direction and the second rotating direction thereof.

2. The apparatus of claim **1** wherein the gear means is defined further to include:

an idler drive gear rotatingly supported on a portion of the support frame and in gearing engagement with the chain means, the chain means drivingly rotating the idler drive gear in a driven position of the chain means in the first rotating direction and the second rotating direction; and

means connecting the idler drive gear to the hydraulic pump means, the rotation of the idler drive gear driving the hydraulic pump means; and

idler gear means rotatingly supported on a portion of the support frame, the idler gear means in gearing engagement with the chain means and being positioned on the support frame with respect to the idler drive gear to maintain the gearing engagement between the chain means and idler drive gear during the operation of the finishing apparatus.

3. A finishing apparatus for finishing concrete surfaces or the like, comprising:

a transverse frame assembly, having opposite ends;

support means connected to a portion of the transverse frame assembly to support the transverse frame assembly a distance above the surface to be finished;

a finisher assembly supported on a portion of the transverse frame assembly, comprising:

a support frame movably supported on the transverse frame assembly;

a surface finisher means rotatingly supported on a portion of the support frame, the surface finisher means finishingly engaging the surface to be finished, in one position thereof; and

a finisher drive means connected to the surface finisher means to rotatingly drive the surface finisher means;

chain means, having opposite ends, drivingly supported on the transverse frame assembly generally between the opposite ends thereof, the chain means being rotatable in a first rotating direction and in a second rotating direction, in a driven position of the chain means, one end of the chain means connected to one portion of the support frame and the opposite end of the chain means connected to one other portion of the support frame to move the support frame in one direction along the transverse frame assembly in the first rotating direction of the chain means and to move the support frame in one other direction in the second rotating direction of the chain means;

chain drive means drivingly connected to a portion of the chain means to drive the chain means in the first rotating direction and in the second rotating direction; and

means connecting the chain means to the finisher drive means to drive the finisher drive means in a driven position of the chain means in the first rotating direction and the second rotating direction thereof.

4. The finishing apparatus of claim **3** wherein the means connecting the chain means to the finisher drive means is supported on a portion of the support frame and is further defined to include:

an idler drive gear rotatingly supported on a portion of the support frame and in gearing engagement with the chain means, the chain means drivingly rotating the idler drive gear in a driven position of the chain means in the first rotating direction and the second rotating direction; and

means connecting the idler drive gear to the finisher drive means, the rotation of the idler drive gear driving the finisher drive means; and

idler gear means rotatingly supported on a portion of the support frame, the idler gear means in gearing engagement with the chain means and being positioned on the support frame with respect to the idler drive gear to maintain the gearing engagement between the chain means and idler drive gear during the operation of the finishing apparatus.

5. The finishing apparatus of claim **3** wherein the finisher assembly is defined further to include:

a rocker support arm pivotally secured to a portion of the support frame, the rocker support arm being pivotable to a first pivot position and a second pivot position; and

wherein the surface finisher means is defined further to include:

a first surface finisher rotatingly supported on one portion of the rocker support arm, the first surface finisher finishingly engaging the surface to be finished in the first pivot position of the rocker support arm; and

a second surface finisher rotatingly supported on one other portion of the rocker support arm, the second surface finisher finishingly engaging the surface to be finished in the second pivot position of the rocker support arm; and

means to sequentially pivot the rocker support arm to the first pivot position and to the second pivot position, so that the first surface finisher and the second surface finisher cooperate to finishingly engage the surface to be finished across substantially an entire transverse width thereof.

6. A finishing apparatus for finishing concrete surfaces or the like, comprising:

a transverse frame assembly, having opposite ends;

support means connected to a portion of the transverse frame assembly supporting the transverse frame assembly generally above the surface to be finished;

a finisher assembly movably supported on a portion of the transverse frame, having a portion thereof pivotable to a first pivot position and to a second pivot position, comprising:

a first surface finisher rotatingly supported on a portion of the finisher assembly, the first surface finisher being positioned on the finisher assembly to finishingly engage the surface to be finished in the first pivot position of the finisher assembly;

a second surface finisher rotatingly supported on a portion of the finisher assembly, the second surface finisher being positioned on the finisher assembly to finishingly engage the surface to be finished in the second pivot position of the finisher assembly; and

means to pivot the finisher assembly to the first pivot position and to the second pivot position, the first finisher assembly and the second finisher assembly cooperating to finishingly engage the surface to be finished across substantially the entire transverse width thereof;

chain means drivingly supported on the transverse frame generally between the opposite ends thereof, the chain means being connected to the finisher assembly and rotatable in a first rotating direction to move the finisher assembly in a first transverse direction and being rotatable in a second rotating direction to move the finisher assembly in a second transverse direction, the finisher assembly being moved in the first and the second transverse directions generally transversely over the surface to be finished;

chain drive means drivingly connected to the chain means to drive the chain means in the first rotating direction in one position thereof and in the second rotating direction in one other position thereof, comprising:

a hydraulic motor connected to the chain means to drive the chain means in the first rotating direction and the second rotating direction;

pump means connected to the hydraulic motor to provide power fluid therefor;

solenoid valve means interposed between the hydraulic motor and the pump means having a de-energized position, a first energized position, and a second energized position, the pump means providing power fluid via the solenoid valve means to the hydraulic motor to drive the chain means in the second rotating direction in the first energized position of the solenoid valve means, and the pump means providing power fluid via the solenoid valve means to the hydraulic motor to drive the chain means in the first rotating direction in the second energized position of the solenoid valve means; and

a power source connected to the solenoid valve means;

first sensor means having a portion sensing the position of the finisher assembly moving in the first transverse direction in a reverse actuating position of the first surface finisher, comprising:

a first trip switch interposed between the power source and the solenoid valve means, the first trip switch being closed in the reverse actuating position of the first surface finisher energizing the solenoid valve means to the first energized position thereof; and

second sensor means having a portion sensing the position of the finisher assembly moving in the second transverse direction in a reverse actuating position of the second surface finisher, comprising:

a second trip switch interposed between the power source and the solenoid valve means, the second trip switch being closed in the reverse actuating position of the second surface finisher energizing the solenoid valve means to the second energized position thereof, the chain drive means driving the chain means in the second transverse direction when the first sensor means senses the finisher assembly in a reverse actuating position of the first surface finisher and driving the chain means in the first transverse direction when the second sensor means senses the finisher assembly in a reverse actuating position of the second surface finisher.

7. The finishing apparatus of claim **6** wherein the first sensor means is defined further to sense the position of the finisher assembly moving in the first transverse direction in a transition actuating position of the first surface finisher prior to the finisher assembly being moved to the reverse actuating position of the first surface finisher; and wherein the second sensor means is defined further to sense the position of the finisher assembly moving in the second transverse direction in a transition actuating position of the second surface finisher prior to the finisher assembly being moved to the reverse actuating position of the second surface finisher; and wherein the chain drive means is defined further to decrease the rate of travel of the finisher assembly in the transition actuating position of the first surface finisher, and to decrease the rate of travel of the finisher assembly in the transition actuating position of the second surface finisher.

8. The finishing apparatus of claim **7** wherein the chain drive means is defined further to include:

variable resistance valve means interposed between the solenoid valve means and the pump means, the variable resistance valve means providing a virtually unrestricted flow path therethrough in one position thereof and an increasingly restricted flow path therethrough in one other position thereof, thereby linearly increasing the pressure drop thereacross;

relief valve means interposed between the solenoid valve means and the pump means, the relief valve means connected to the variable resistance valve means to increasingly relieve power fluid therethrough as the pressure drop across the variable resistance valve means linearly increases, the relief valve means and the variable resistance valve means thereby cooperating to linearly decrease the flow of power fluid from the pump means to the hydraulic motor; and

means connected to the variable resistance valve means to position the variable resistance valve means to increasingly restrict the flow path therethrough.

9. The finishing apparatus of claim **8** wherein the variable resistance valve means is defined further to include:

a valve member having an opening formed therethrough defining the flow path through the variable resistance valve means; and

bias spring means disposed in the variable resistance valve means in biasing engagement with the valve member to bias the valve member to a spring biased position wherein the flow path through the

variable resistance valve means provides a virtually unrestricted flow path therethrough; and

wherein the means to increasingly restrict the flow path through the variable resistance valve means is defined further to include:

charge pump means connected to the variable resistance valve means to provide power fluid to a portion thereof, to biasingly move the valve member therein generally against the biasing force of the bias spring, the flow path through the variable resistance valve means becoming increasingly restricted as the valve member moves against the biasing force of the bias spring, in a position wherein the charge pump means fluidically communicates with the variable resistance valve means; and

means connected to the first sensor means and the second sensor means interposed between the charge pump means and the variable resistance valve means to establish fluidic communication therebetween in the transition actuating position of the first surface finisher and the second surface finisher.

10. The finishing apparatus of claim **9** wherein the means to increasingly restrict the flow path through the variable resistance valve means is defined further to include:

orifice means interposed between the means to establish fluidic communication between the charge pump means and the variable resistance valve means, to control the rate at which the charge pump means provides power fluid to the variable resistance valve means, thereby controllingly decreasing the rate of travel of the finisher assembly.

11. The finishing apparatus of claim **10** wherein the means to establish fluidic communication between the charge pump means and the variable resistance valve means is defined further to include:

a fluid reservoir;

solenoid valve means having an energized position and a de-energized position, the solenoid valve means establishing fluidic communication between the charge pump means and the variable resistance valve means in the energized position thereof, and establishing fluidic communication between the variable resistance valve means and the fluid reservoir to drain the power fluid from the variable resistance valve means in the de-energized position of the solenoid valve means, thereby returning the variable resistance valve means to the spring biased position; and

a power source connected to the solenoid valve means.

12. The finishing apparatus of claim **11** wherein the orifice means is defined further as being interposed between the variable resistance valve means and the solenoid valve means to control the rate at which the power fluid in the variable resistance valve means drains to the reservoir thereby controlling the increasing of the rate of travel of the finisher assembly.

13. The finishing apparatus of claim **12** wherein the first sensor means is defined further to include:

a first trip switch interposed between the power source and the solenoid valve means, the first trip switch being closed in the transition actuating position of the first surface finisher to energize the solenoid valve means; and

wherein the second sensor means is defined further to include:

a first trip switch interposed between the power source and the solenoid valve means, the first trip switch being closed in the transition actuating position of the second surface finisher to energize the solenoid valve means.

14. The finishing apparatus of claim **6** wherein the chain drive means is further defined to include:

a latching relay network connected in electrical parallel with the second trip switch of the first sensor means and in electrical parallel with the second trip switch of the second sensor means, to maintain electrical continuity between the power source and the solenoid valve means in an open position of the second trip switch of the first sensor means subsequent to the second trip switch of the second sensor means being closed, and to maintain electrical continuity between the power source and the solenoid valve means in an open position of the second trip switch of the second sensor means subsequent to the second trip switch of the first sensor means being closed.

15. A finishing apparatus for finishing concrete surfaces or the like, comprising:

a transverse frame assembly, having opposite ends;

support means connected to a portion of the transverse frame assembly to support the transverse frame assembly generally above the surface to be finished; and

a finisher assembly movably supported on a portion of the transverse frame assembly, having a portion thereof pivotable to a first pivot position and to a second pivot position, comprising:

a support frame movably supported on a portion of the transverse frame assembly;

a rocker support arm pivotally secured to a portion of the support frame and pivotally movable to a first pivot position and to a second pivot position;

a first surface finisher rotatingly supported on a portion of the rocker support arm, the first surface finisher being positioned via the rocker support arm to finishingly engage the surface to be finished in the first pivot position of the rocker suport arm;

a second surface finisher rotatingly supported on a portion of the rocker support arm, the second surface finisher being positioned via the rocker support arm to finishingly engage the surface to be finished in the second pivot position of the rocker support arm;

means to rotatingly drive the first surface finisher and the second surface finisher; and

means to pivot the rocker support arm to the first pivot position in a reverse actuating position of the second surface finisher and to pivot the rocker support arm to the second pivot position in a reverse actuating position of the first surface finisher, the first surface finisher and the second surface finisher cooperating to finishingly engage the surface to be finished across substantially the entire width thereof.

16. The finishing apparatus of claim **15** wherein the chain means is defined further as having opposite ends; and wherein the first pivot linkage and the second pivot linkage are each defined further to include:

a jaw means having a portion thereof pivotally secured to a portion of the support frame, a portion of the jaw means removably secured to one end portion of the chain means; and

an adjustable connector having opposite ends, one end thereof being pivotally secured to a portion of the jaw means and the other end thereof being pivotally secured to a portion of the rocker support arm.

17. A finishing apparatus for finishing concrete surfaces or the like, comprising:

a transverse frame assembly, having opposite ends;

support means connected to a portion of the transverse frame assembly to support the transverse frame assembly generally above the surface to be finished;

a finisher assembly movably supported on a portion of the transverse frame assembly, having a portion thereof pivotable to a first pivot position and to a second pivot position, comprising:

a first surface finisher rotatingly supported on a portion of the finisher assembly, the first surface finisher being positioned on the finisher assembly to finishingly engage the surface to be finished in the first pivot position of the finisher assembly;

a second surface finisher rotatingly supported on a portion of the finisher assembly, the second surface finisher being positioned on the finisher assembly to finishingly engage the surface to be finished in the second pivot position of the finisher assembly; and

means to rotatingly drive the first surface finisher and the second surface finisher; and

means to pivot the finisher assembly to the first pivot position and to the second pivot position, the first surface finisher and the second surface finisher cooperating to finishingly engage the surface to be finished across substantially the entire width thereof;

vibrator means connected to a portion of the finisher assembly to vibratingly engage the surface to be finished in the first pivot position and in the second pivot position of the finisher assembly;

means connected to the vibrator means to vibratingly drive the vibrator means, comprising:

a power source disposed on a portion of the transverse frame;

reel means rotatingly supported on a portion of the transverse frame assembly, the reel means being rotatable in one direction and in one other direction; and

cable means connected to the power source and to the vibrator means, the power source providing operating power to the vibrator means via the cable means, a portion of the cable means being reeled about a portion of the reel means, a predetermined length of the cable means being released from the reel means in one rotating position of the reel means and a predetermined length of the cable means being retrieved about the reel means in the other rotating position of the reel means; and

means to move the finisher assembly in a first transverse direction and in a second transverse direction generally transversely over the surface to be finished, having a portion connected to the means to rotate the reel means to maintain a predetermined length of the cable means between the reel means and the finisher assembly in the driven position of the finisher assembly in the first transverse direction and in the second transverse direction.

18. A finishing apparatus for finishing concrete surfaces or the like, comprising:

a transverse frame assembly, having opposite ends;

support means connected to a portion of the transverse frame assembly to support the transverse frame assembly generally above the surface to be finished;

a finisher assembly movably supported on a portion of the transverse frame assembly, having a portion thereof pivotable to a first pivot position and to a second pivot position, comprising:

a first surface finisher rotatingly supported on a portion of the finisher assembly, the first surface finisher being positioned on the finisher assembly to finishingly engage the surface to be finished in the first pivot position of the finisher assembly;

a second surface finisher rotatingly supported on a portion of the finisher assembly, the second surface finisher being positioned on the finisher assembly to finishingly engage the surface to be finished in the second pivot position of the finisher assembly; and

means to rotatingly drive the first surface finisher and the second surface finisher;

means to pivot the finisher assembly to the first pivot position and to the second pivot position, the first surface finisher and the second surface finisher cooperating to finishingly engage the surface to be finished across substantially the entire transverse width thereof;

first auger means, having a left-hand auger flight, rotatingly supported via a portion of the finisher assembly, a portion of the auger flight engaging the surface to be finished;

second auger means, having a right-hand auger flight, rotatingly supported via a portion of the finisher assembly, a portion of the auger flight engaging the surface to be finished;

a bearing support connected to the finisher assembly and to the first auger means bearingly supporting the first auger means, the bearing connection between the bearing support and the first auger means interposed within the auger flight of the first auger means; and

a bearing support connected to the finisher assembly and to a portion of the second auger means bearingly supporting the second auger means, the bearing connection between the bearing support and the second auger means interposed within the auger flight of the second auger means and offset with respect to the bearing connection between the bearing support and the first auger means, the outer periphery formed by the second auger means disposed in close proximity with the outer periphery formed by the auger flight of the second auger means.

19. The finishing apparatus of claim **18** wherein the first and the second auger means are each disposed generally between the first and the second surface finishers, the first auger means extending generally parallel to the second auger means.

20. The finishing apparatus of claim **19** wherein a portion of the auger flight of each of the first and the

second means extends a distance generally between the first and the second surface finishers, and another portion of the auger flight of each of the first and the second auger means extends a distance generally beyond one end of the first and the second surface finishers.

21. The finishing apparatus of claim **20** defined further to include:

means moving the first and the second surface finishers to finishing engaging positions;

means rotating the first auger means in one position thereof;

means rotating the second auger means in one position thereof;

means rotating the first and the second surface finishers in one position thereof; and

remote controller means, having a portion connected to the means rotating the first auger means for selectively positioning the means to rotate the first auger means, one portion connected to the means rotating the second auger means for selectively positioning the means to rotate the second auger means, one portion connected to the means rotating the first and the second surface finishers for selectively positioning the means to rotate the first and the second surface finishers, and one portion connected to the means moving the first and the second surface finishers to finishing engaging positions for selectively positioning the first and the second surface finishers in finishing engaging positions, the remote controller means providing an operator control controllable from a position wherein the operator observes the finishing of the surface via the finishing apparatus.

22. A finishing apparatus for finishing concrete surfaces or the like, comprising:

a transverse frame assembly, having opposite ends;

support means connected to a portion of the transverse frame assembly to support the transverse frame assembly generally above the surface to be finished;

a finisher assembly movably supported on a portion of the transverse frame assembly, having a portion thereof pivotable to a first pivot position and to a second pivot position, comprising:

a first surface finisher rotatingly supported on a portion of the finisher assembly, the first surface finisher being positioned on the finisher assembly to finishingly engage the surface to be finished in the first pivot position of the finisher assembly;

a second surface finisher rotatingly supported on a portion of the finisher assembly, the second surface finisher being positioned on the finisher assembly to finishingly engage the surface to be finished in the second pivot position of the finisher asembly; and

means to rotatingly drive the first surface finisher and the second surface finisher;

means to pivot the finisher assembly to the first pivot position and to the second pivot position, the first surface finisher and the second surface finisher cooperating to finishingly engage the surface to be finished across substantially the entire transverse width thereof;

first auger means, having a left-hand auger flight, rotatingly supported by a portion of the finisher assembly, a portion of the auger flight engaging the surface to be finished;

second auger means, having a right-hand auger flight, rotatingly supported via a portion of the finisher assembly, a portion of the auger flight engaging the surface to be finished;

a pair of vibrators, each vibrator supported from a portion of the finisher assembly disposed within a portion of the surface material vibratingly engaging the surface material, one of the vibrators having a portion disposed generally below the first auger means and the other vibrator having a portion disposed generally below the second auger means;

a pair of rods, each rod having one end pivotally connected to the finisher assembly and the opposite end connected to one of the vibrator means, each rod pivotable in one pivot direction moving the vibrator connected thereto in a direction generally into vibrating engagment with the surface material and pivotable in one other direction moving the vibrator connected thereto in a direction generally from vibrating engagment with the surface material; and

a pair of chains, one end of each chain connected to the finisher assembly and the opposite end of the chain connected to one of the rods limiting the pivotal movement of the rods in a pivot direction moving the vibrators into vibrating engagement with the surface material.

23. The finishing apparatus of claim **22** defined further to include:

pair of spring means, each spring means interposed between one of the vibrators and the rod connected thereto, providing limited movement of each rod and vibrator connected thereto generally in the one pivot direction and in the one other pivot direction.

24. A finishing apparatus for finishing concrete surfaces or the like, comprising:

a transverse frame assembly, having opposite ends;

support means connected to a portion of the transverse frame assembly to support the transverse frame assembly generally above the surface to be finished;

a finisher assembly movably supported on a portion of the transverse frame assembly, having a portion thereof pivotable to a first pivot position and to a second pivot position, comprising:

a first surface finisher rotatingly supported on a portion of the finisher assembly, the first surface finisher being positioned on the finisher assembly to finishingly engage the surface to be finished in the first pivot position of the finisher assembly;

a second surface finisher rotatingly supported on a portion of the finisher assembly, the second surface finisher being positioned on the finisher assembly to finishingly engage the surface to be finished in the second pivot position of the finisher assembly; and

means to rotatingly drive the first surface finisher and the second surface finisher;

means to pivot the finisher assembly to the first pivot position and to the second pivot position, the first surface finisher and the second surface finisher cooperating to finishingly engage the surface to be finished across substantially the entire transverse width thereof;

a pointer rod having one end connected to the finisher assembly and extending a distance therefrom terminating with a pointer end; and

a scale, having indicia marks, connectd to the transvere frame assembly and supported in close proximity to the pointer end of the pointer rod, the position of the pointer end of the pointer rod relative to the scale indicating the position of the first and the second surface finishers relative to the transverse frame assembly.

25. A finishing apparatus for finishing concrete surfaces or the like, comprising:

a transverse frame assembly, having opposite ends;

support means connected to a portion of the transverse frame assembly to support the transverse frame assembly generally above the surface to be finished;

a finisher assembly supported on a portion of the transverse frame assembly movable in transverse direction across the surface to be finished generally between the opposite ends of the transverse frame assembly;

surface finisher means rotatingly supported via a portion of the finisher assembly finishngly engaging the surface to be finished;

first auger means, having a left-hand auger flight, rotatingly supported via a portion of the finisher assembly, a portion of the auger flight engaging the surface to be finished;

second auger means, having a right-hand auger flight, rotatingly supported via a portion of the finisher assembly, a portion of the auger flight engaging the surface to be finished;

a bearing support connected to the finisher assembly and to a portion of the first auger means bearingly supporting the first auger means, the bearing connection between the bearing support and the first auger means interposed within the auger flight of the first auger means; and

a bearing support connected to the finisher assembly and to a portion of the second auger means bearingly supporting the second auger means, the bearing connection between the bearing support and the second auger means interposed within the auger flight of the second auger means and offset with respect to the bearing connection between the bearing support and the first auger means, the outer periphery formed by the second auger means disposed in close proximity with the outer periphery formed by the auger flight of the second auger means.

26. A finishing apparatus for finishing concrete surfaces or the like, comprising:

a transverse frame assembly, having opposite ends;

support means connected to a portion of the transverse frame assembly to support the transverse frame assembly generally above the surface to be finished;

a finisher assembly supported on a portion of the transverse frame assembly movable in transverse directions across the surface to be finished generally between the opposite ends of the transverse frame assembly;

surface finisher means rotatingly supported via a portion of the finisher assembly finishingly engaging the surface to be finished, the surface finisher means comprising:

a first surface finisher rotatingly supported via a portion of the finisher assembly finishingly engaging the surface to be finished in one position;

a second surface finisher rotatingly supported via a portion of the finisher assembly finishingly engaging the surface to be finished in one other position; and

means moving the first and the second surface finishers to finishing engaging positions;

first auger means, having a left-hand auger flight, rotatingly supported via a portion of the finisher assembly, a portion of the auger flight engaging the surface to be finished, the first auger means disposed generally between the first and the second surface finishers; and

second auger means, having a right-hand auger flight, rotatingly supported via a portion of the finisher assembly, a portion of the auger flight engaging the surface to be finished, the second auger means being disposed generally between the first and the second surface finishers and the second auger means extending generally parallel to the first auger means.

27. The finishing apparatus of claim **26** wherein a portion of the auger flight of each of the first and the second auger means extends a distance generally between the first and the second surface finishers, and another portion of the auger flight of each of the first and the second auger means extends a distance generally beyond one end of the first and the second surface finishers.

28. A finishing apparatus for finishing concrete surfaces or the like, comprising:

a transverse frame assembly, having opposite ends;

support means connected to a portion of the transverse frame assembly to support the transverse frame assembly generally above the surface to be finished;

a finisher assembly supported on a portion of the transverse frame assembly movable in transvere directions across the surface to be finished generally between the opposite ends of the transverse frame assembly;

surface finisher means rotatingly supported via a portion of the surface finisher assembly finishingly engaging the surface to be finished, comprising:

a first surface rotatingly supported via a portion of the finisher assembly finishingly engaging the surface to be finished in one position;

a second surface finisher rotatingly supported via a portion of the finisher assembly finishingly engaging the surface to be finished in one other position; and

means moving the first and the second surface finishers to finishing engaging positions;

first auger means, having a left-hand auger flight, rotatingly supportd via a portion of the finisher assembly, a portion of the auger flight engaging the surface to be finished;

second auger means, having a right-hand auger flight, rotatingly supported via a portion of the finisher assembly, a portion of the auger flight engaging the surface to be finished;

means rotating the first auger means in one position thereof;

means rotating the second auger means in one position thereof;

means rotating the first and second surface finishers in one position thereof; and

remote controller means, having a portion connected to the means rotating the first auger means for selectively positioning the means to rotate the first auger means, one portion connected to the means rotating the second auger means for selectively positioning the means to rotate the second auger means, one portion connected to the means rotating the first and the second finishers for selectively positioning the means to rotate the first and the second surface finishers, and one portion connected to the means moving the first and the second surface finishers to finishing engaging positions for selectively positioning the first and the second surface finishers in finishing engaging positions, the remote controller means providing an operator control controllable from a position wherein the operator observes the finishing of the surface via the finishing apparatus.

* * * * *

PO-1050
(5/69)

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,870,427 Dated March 11, 1975

Inventor(s) Thomas E. Allen

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

After the name of the inventor, the city of "Mustank" should be --Mustang--.

Column 16, line 16, "450" should be --40--.

Column 16, line 22,"movemnt" should be --movement--.

Column 16, line 36, "interpsoed" should be --interposed--.

Column 17, line 55, "284" should be --284--.

Column 17, line 60, "rellay" should be --relay--.

Column 19, line 32, after the word "second" and before the word "assembly" insert the word --sensor--.

Column 19, line 36, after the word "and", the word "the" should be --to--.

Column 19, line 39, after the word "and", the word "the" should be --to--.

Column 20, line 57, "finished" should be --finisher--.

Column 24, line 26, "the" should be --The--.

Column 24, line 34, after the word "trip" and before the word "76" insert the word --switch--.

Column 25, line 66,"nected" should be --necting--.

Column 28, line 43, "dchain" should be --chain--.

Column 33, line 31, "augermember" should be --auger member--.

Column 36, line 30, "420" should be --402--.

Column 37, line 35, "and" should be --or--.

Signed and sealed this 13th day of May 1975.

(SEAL)
Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents
and Trademarks