April 7, 1964 H. D. KELLEY 3,127,974

GREEN BOARD INVERTER AND TRANSFER MACHINE

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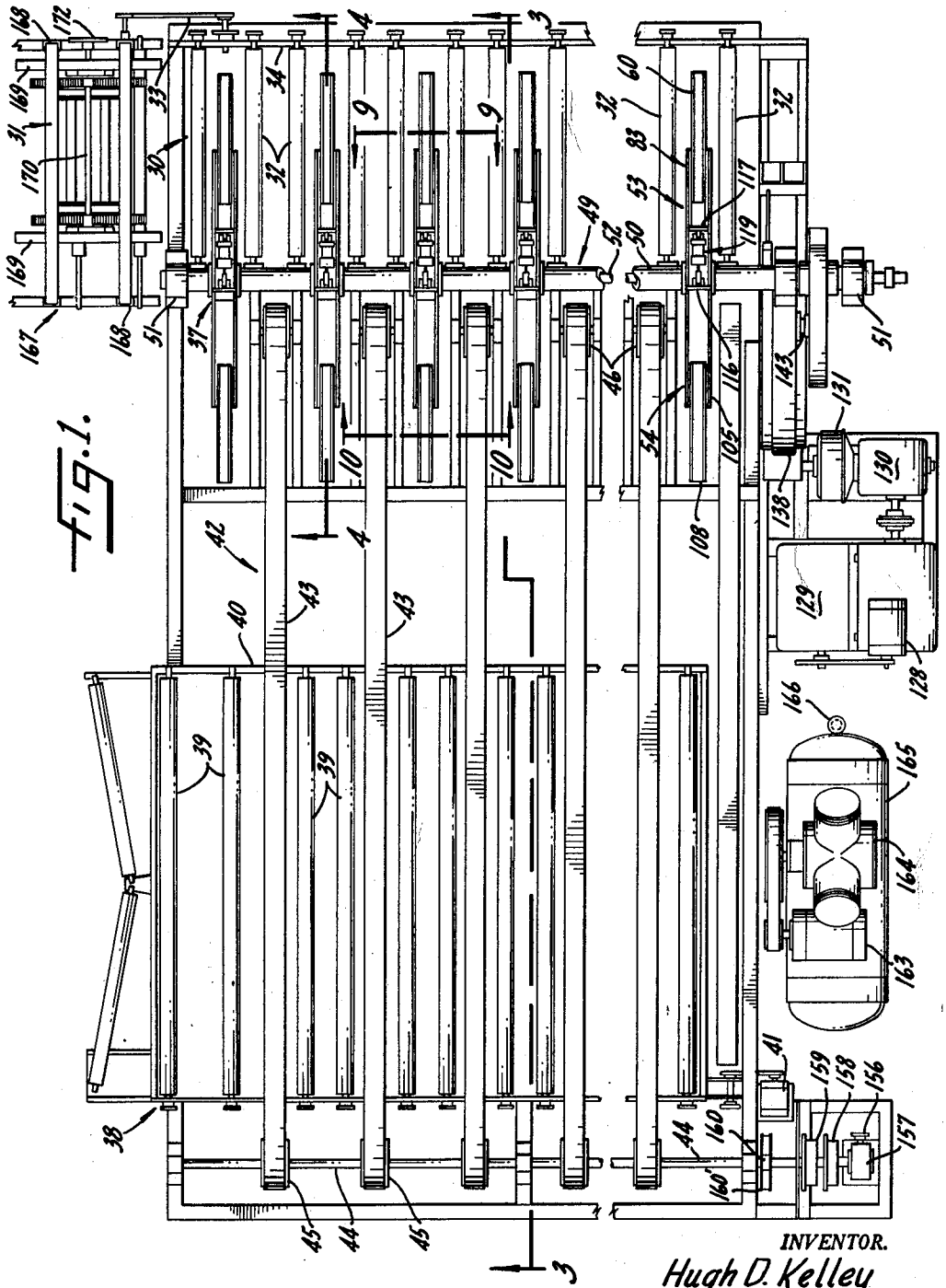


Fig. 1.

INVENTOR.
Hugh D. Kelley
BY Harold B. Hood
Attorney.

April 7, 1964 H. D. KELLEY 3,127,974

GREEN BOARD INVERTER AND TRANSFER MACHINE

Filed Sept. 28, 1961 11 Sheets-Sheet 2

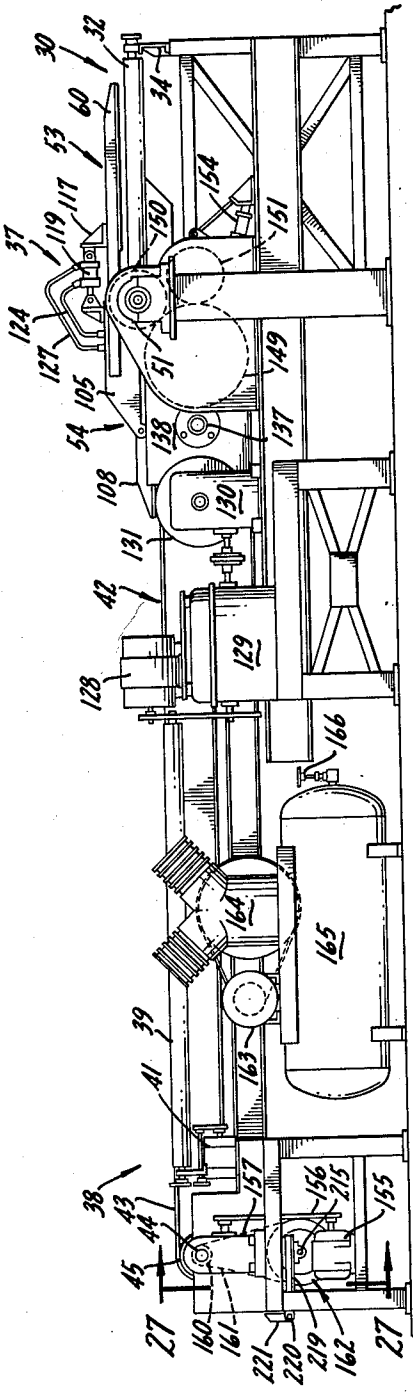


Fig. 2.

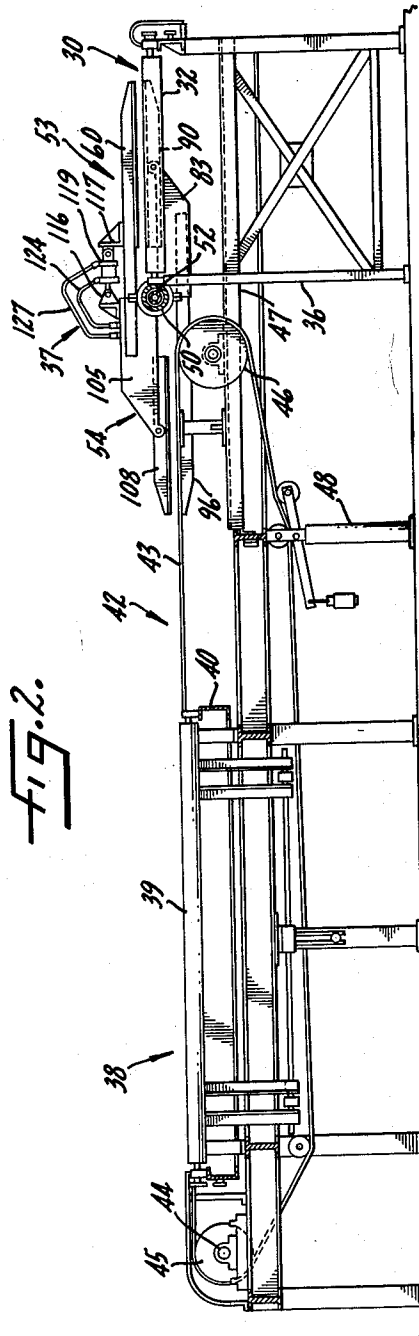


Fig. 3.

INVENTOR.
Hugh D. Kelley
BY Harold B. Hood
Attorney.

April 7, 1964 H. D. KELLEY 3,127,974

GREEN BOARD INVERTER AND TRANSFER MACHINE

Filed Sept. 28, 1961 11 Sheets-Sheet 3

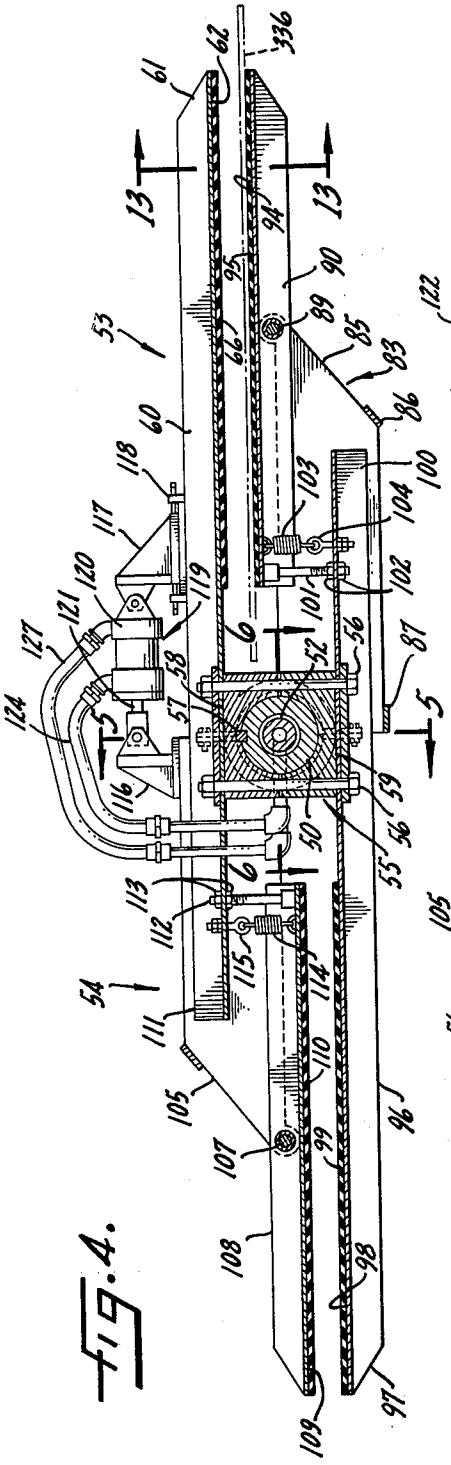


FIG. 4.

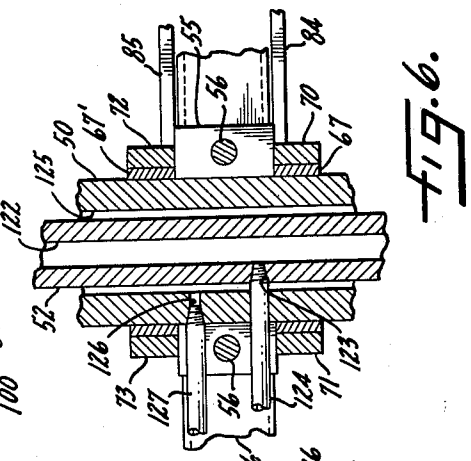


FIG. 6.

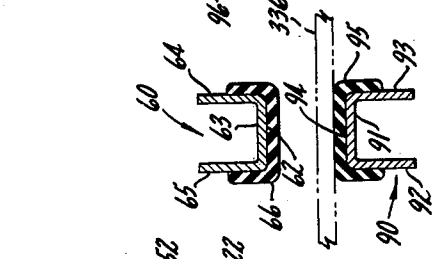


FIG. 13.

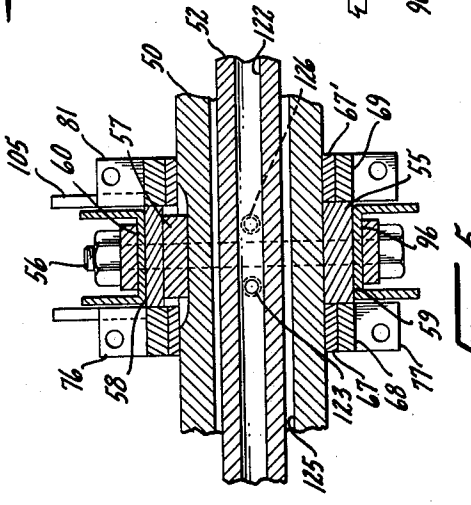


FIG. 5.

INVENTOR.
Hugh D. Kelley
BY
Harold B. Hood
Attorney.

April 7, 1964 H. D. KELLEY 3,127,974

GREEN BOARD INVERTER AND TRANSFER MACHINE

Filed Sept. 28, 1961 11 Sheets-Sheet 4

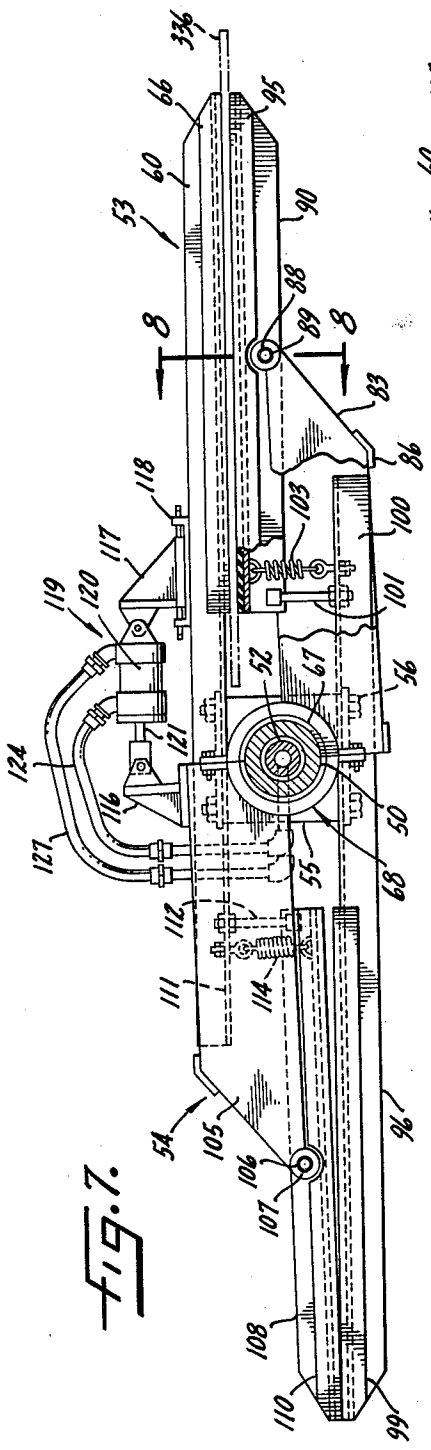


FIG. 7.

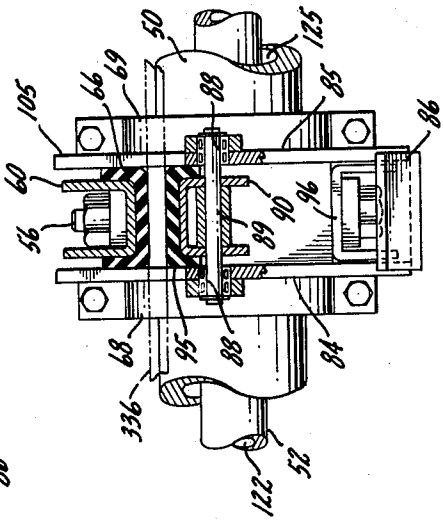


FIG. 8.

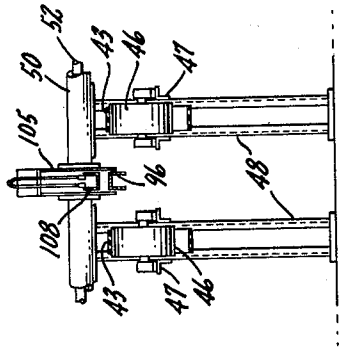


FIG. 10.

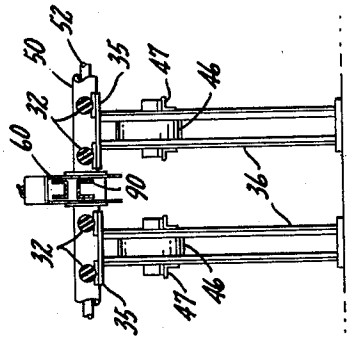


FIG. 9.

INVENTOR.
Hugh D. Kelley
BY Harold B. Hood
Attorney.

April 7, 1964 H. D. KELLEY 3,127,974

GREEN BOARD INVERTER AND TRANSFER MACHINE

Filed Sept. 28, 1961 11 Sheets-Sheet 5

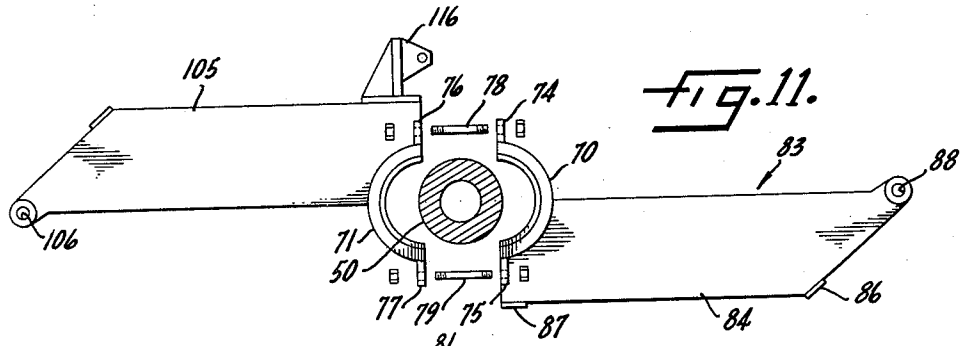


Fig. 11.

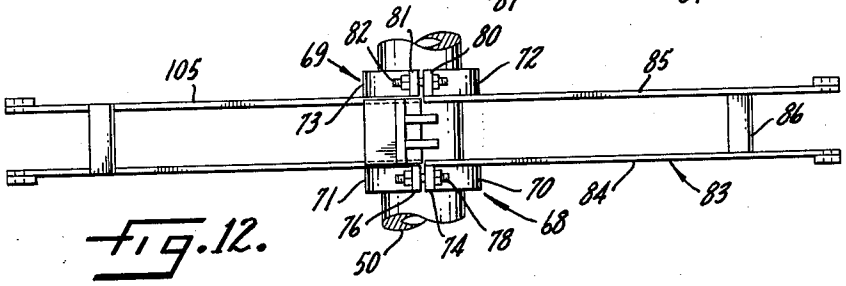


Fig. 12.

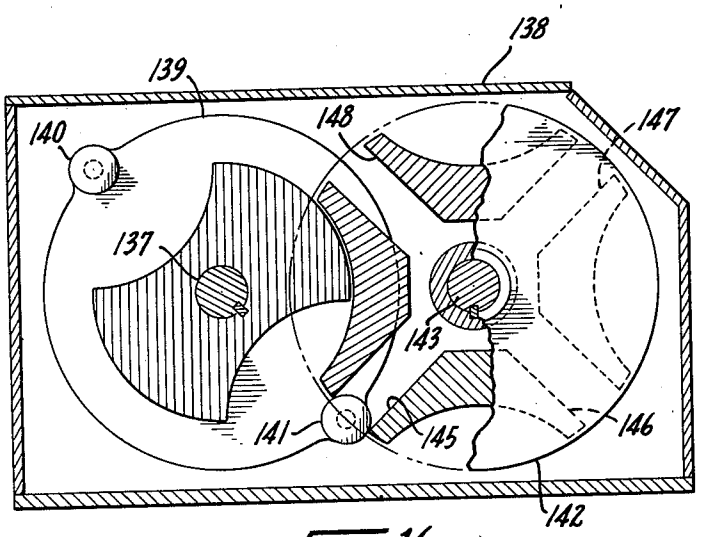


Fig. 16.

INVENTOR.
Hugh D. Kelley
BY
Harold B. Hood
Attorney.

April 7, 1964 H. D. KELLEY 3,127,974

GREEN BOARD INVERTER AND TRANSFER MACHINE

Filed Sept. 28, 1961 11 Sheets-Sheet 6

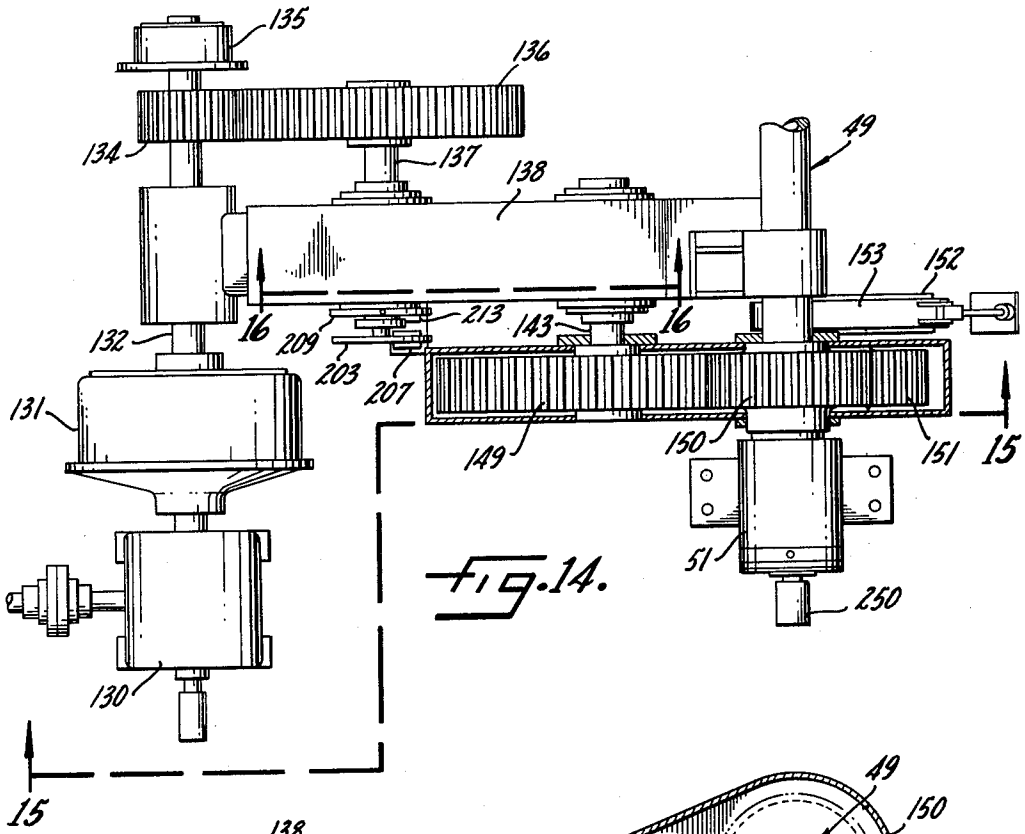


Fig. 14.

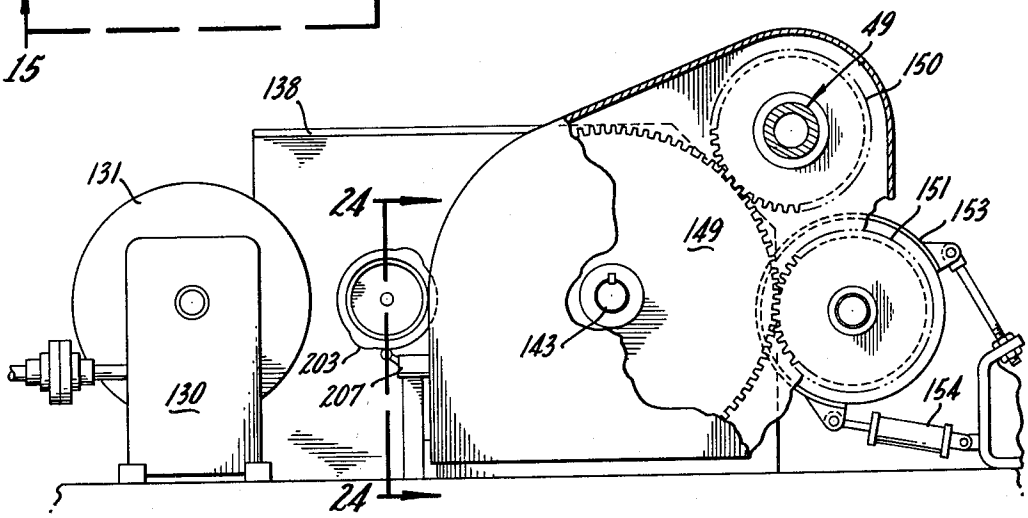


Fig. 15.

INVENTOR.
Hugh D. Kelley
BY
Harold B. Hood
Attorney.

April 7, 1964 H. D. KELLEY 3,127,974

GREEN BOARD INVERTER AND TRANSFER MACHINE

Filed Sept. 28, 1961 11 Sheets-Sheet 7

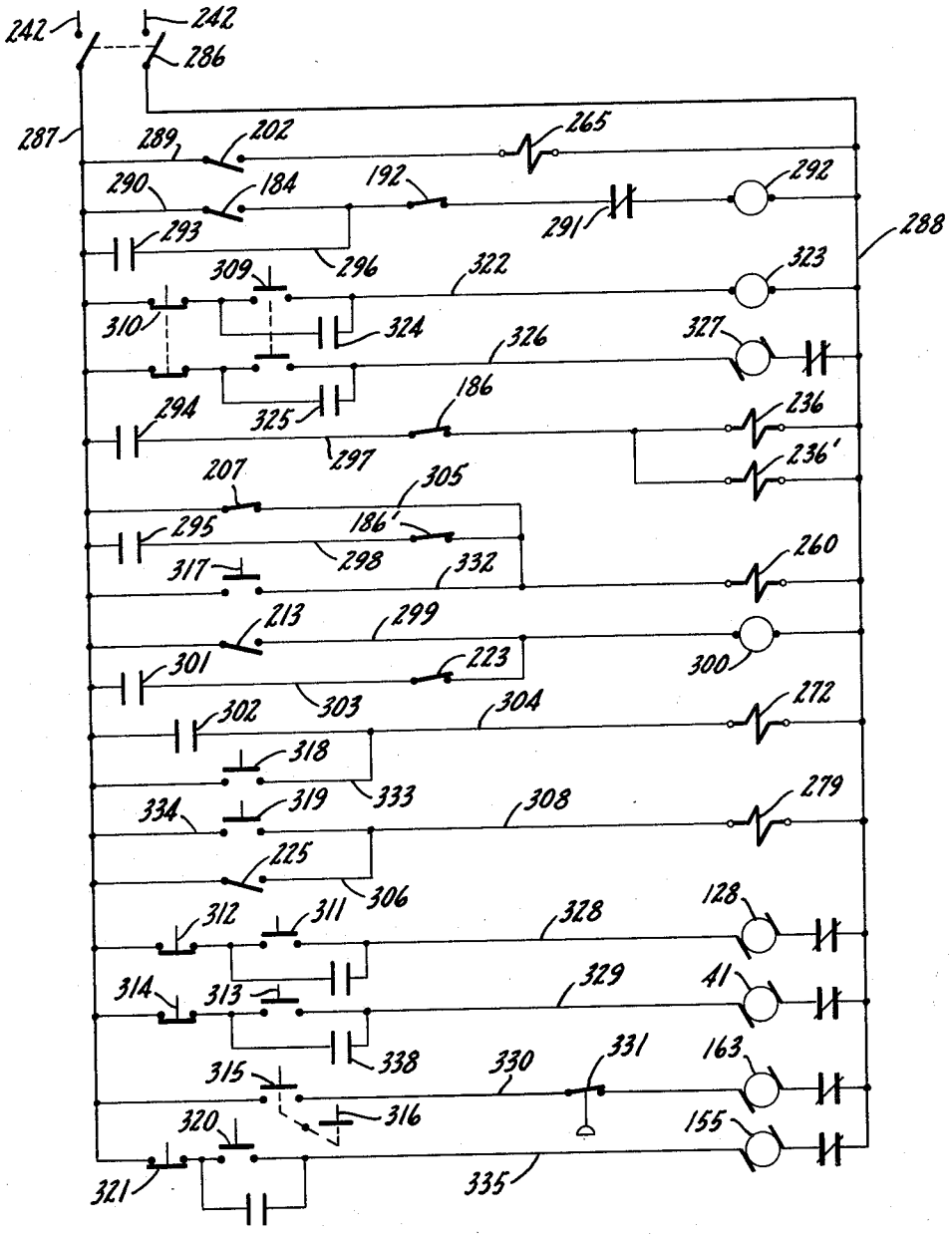


Fig. 17.

INVENTOR.
Hugh D. Kelley
BY Harold B. Hood
Attorney.

April 7, 1964 H. D. KELLEY 3,127,974

GREEN BOARD INVERTER AND TRANSFER MACHINE

Filed Sept. 28, 1961 11 Sheets-Sheet 8

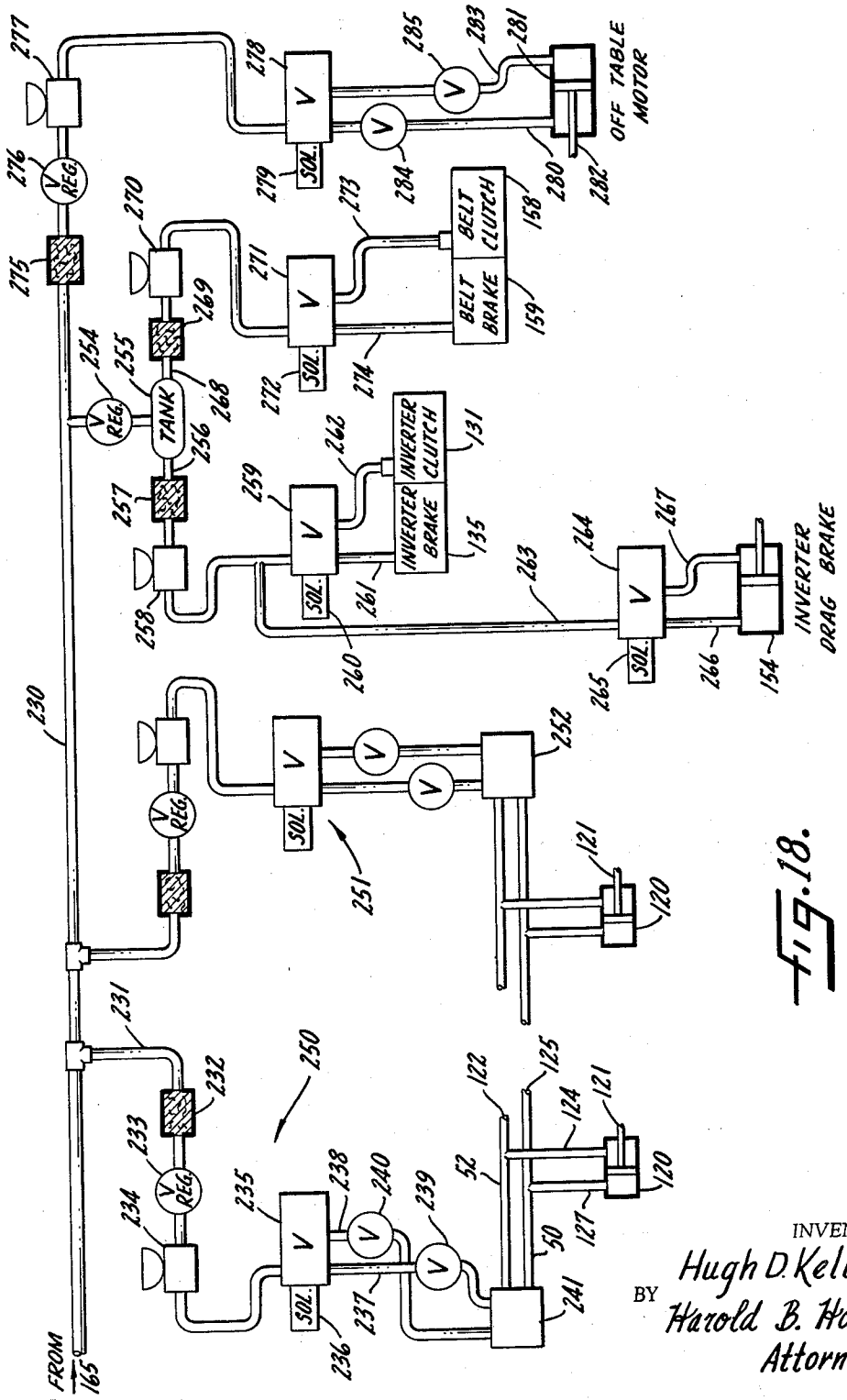


Fig. 18.

INVENTOR.
Hugh D. Kelley
BY Harold B. Hood
Attorney.

April 7, 1964 H. D. KELLEY 3,127,974

GREEN BOARD INVERTER AND TRANSFER MACHINE

Filed Sept. 28, 1961 11 Sheets-Sheet 9

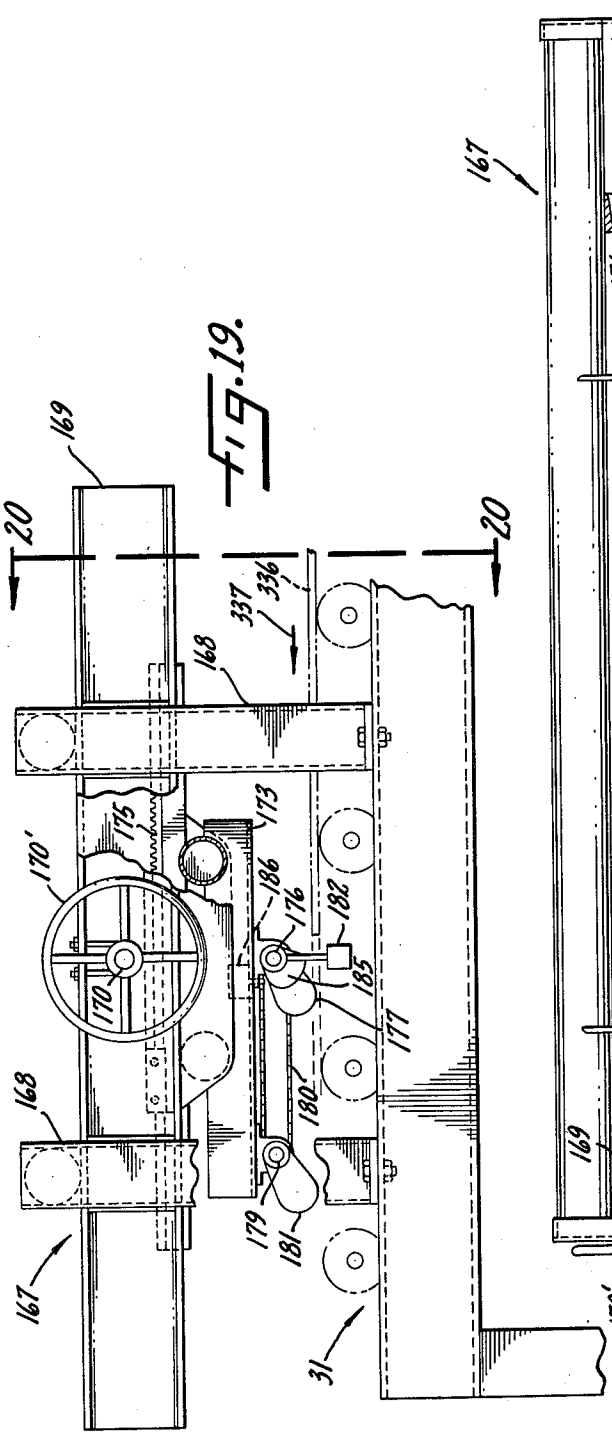


Fig. 19.

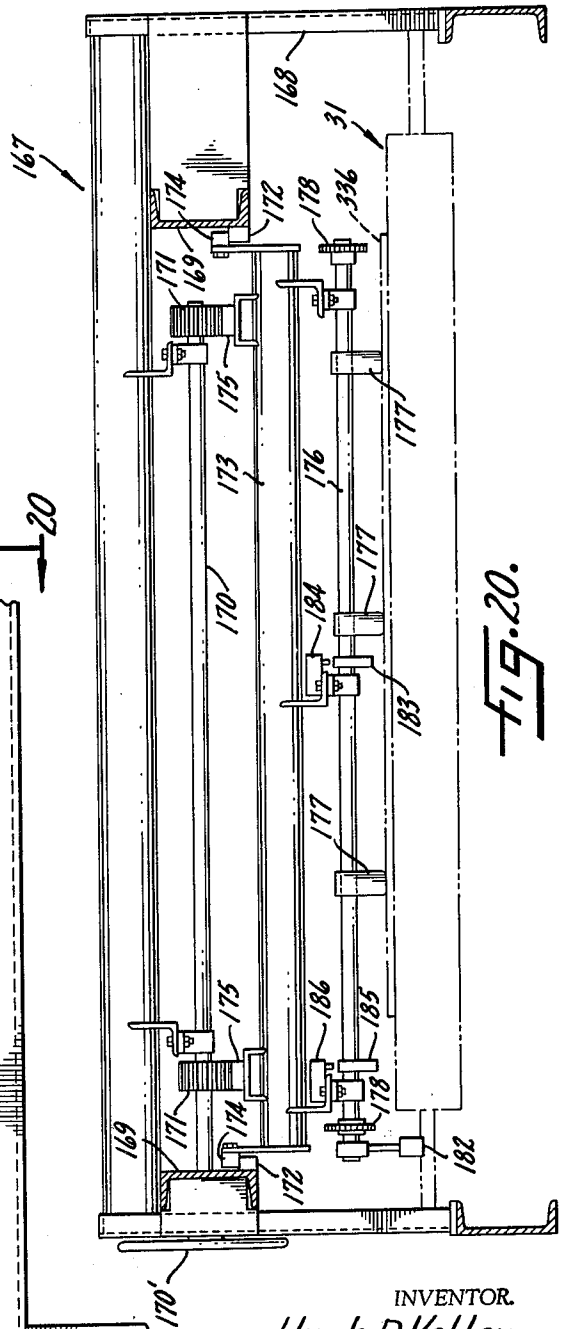


Fig. 20.

INVENTOR.
Hugh D. Kelley
BY
Harold B. Hood
Attorney.

April 7, 1964 H. D. KELLEY 3,127,974

GREEN BOARD INVERTER AND TRANSFER MACHINE

Filed Sept. 28, 1961 11 Sheets-Sheet 10

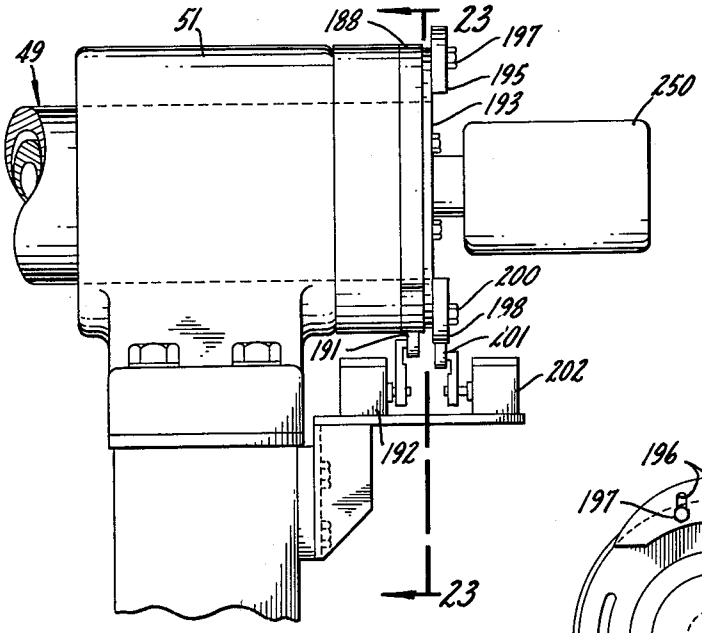


Fig. 21.

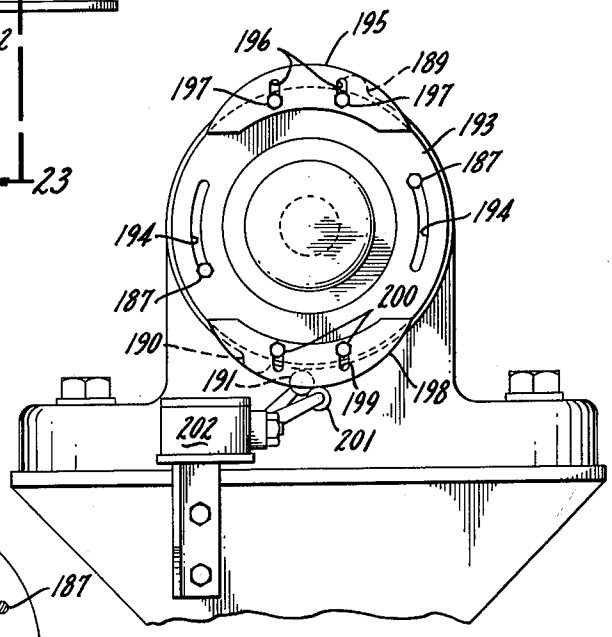


Fig. 22.

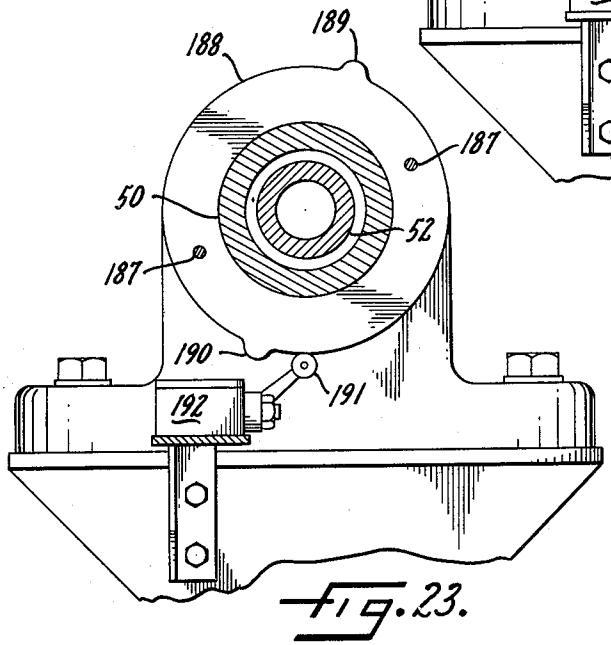


Fig. 23.

INVENTOR.
Hugh D. Kelley
BY Harold B. Hood
Attorney.

April 7, 1964 H. D. KELLEY 3,127,974

GREEN BOARD INVERTER AND TRANSFER MACHINE

Filed Sept. 28, 1961 11 Sheets-Sheet 11

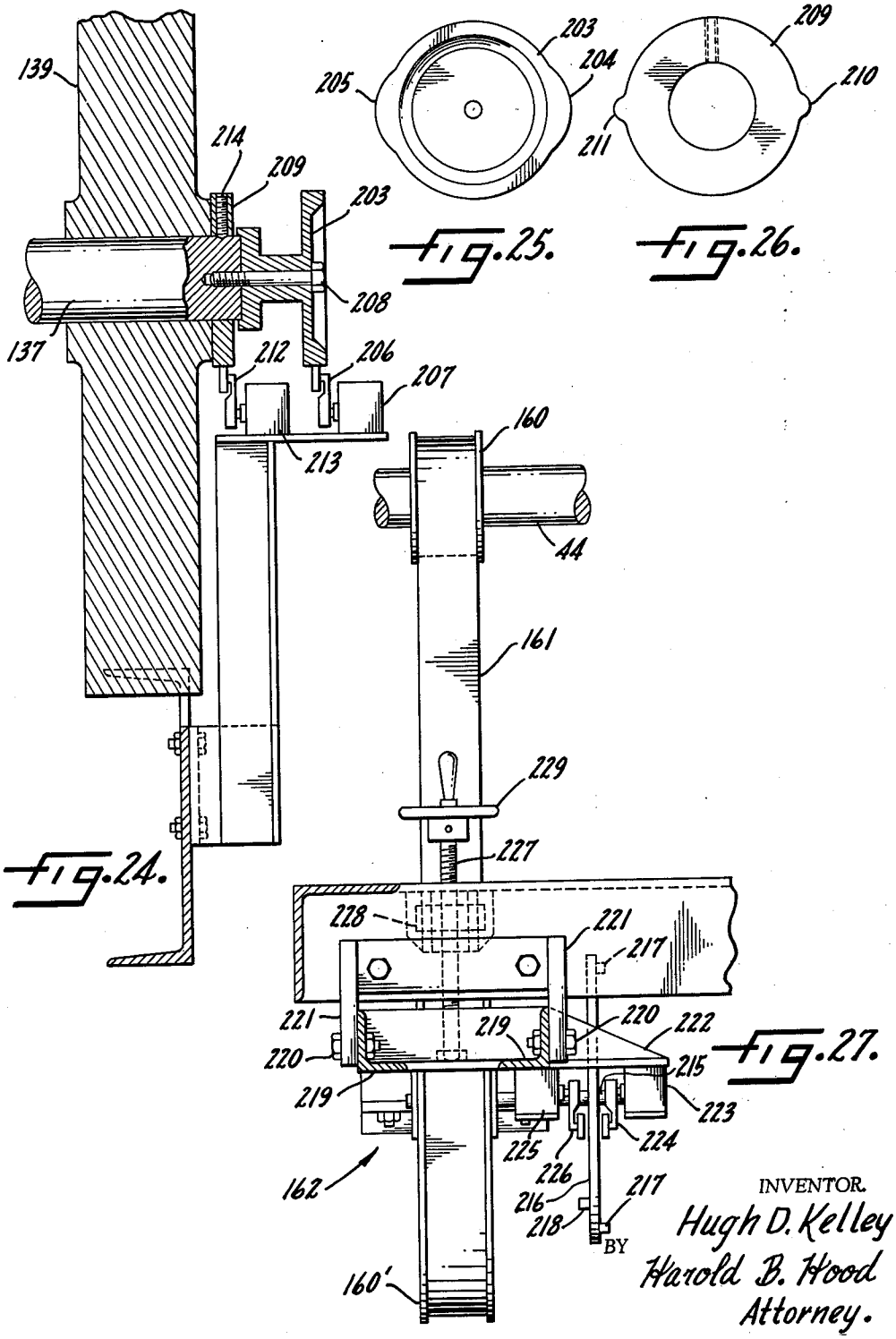


Fig. 24.

Fig. 25.

Fig. 26.

Fig. 27.

INVENTOR.
Hugh D. Kelley
Harold B. Hood
Attorney.

United States Patent Office 3,127,974 Patented Apr. 7, 1964

3,127,974

GREEN BOARD INVERTER AND TRANSFER MACHINE

Hugh D. Kelley, Enterprise, Kans., assignor to The J. B. Ehrsam & Sons Manufacturing Company, Enterprise, Kans., a corporation of Kansas

Filed Sept. 28, 1961, Ser. No. 141,528
6 Claims. (Cl. 198—31)

The present invention relates to an inverter and transfer machine primarily intended for use in a plaster board manufacturing and booking line. While the invention may be applicable in numerous other environments, it is primarily designed, and has been illustrated and will be described herein, for handling green plaster board.

Such plaster board is conventionally made in widths of 48", 32" or 24", and the machine is designed to handle without substantial modification, any one of those widths or to handle, as well, plaster lath in the conventional 16" width. By sutable adjustment, one size of machine will handle, also, all of the various conventional lengths of plaster board and lath, being so constructed that the following groupings of pieces can be inverted and transferred for each cycle of the machine:

Four 6' broads totaling	24'
Three 7' boards totaling	21'
Three 8' boards totaling	24'
Two 9' boards totaling	18'
Two 10' boards totaling	20'
Two 11' boards totaling	22'
Two 12' boards totaling	24'
Two 13' boards totaling	26'
One 14' board totaling	14'
One 15' board totaling	15'
One 16' board totaling	16'
Six 4' laths totaling	24'

Obviously, the machine may alternatviely be dimensioned to handle other length combinations.

When board 32" or 48" wide is being handled, one stream of pieces will move through the machine. When 24" board is being handled, two streams of board will move, side-by-side, through the machine; and when 16" lath is being handled, three streams of pieces will move through the machine, side-by-side.

The primary object of the invention is to provide a novel assembly comprising a receiving conveyor, an inverter which lifts the work from the receiving conveyor, inverts it and deposits it on a transverse conveyor means, and an "off" conveyor which receives the work from the transverse conveyor and carries it to a point at which a further operation is performed on the work. An important feature of the invention resides in the provision of novel inverter means which performs its function more effectively than previously known devices intended to accomplish analogous functions.

A further object of the invention is to provide, in an assembly of the character indicated, inverter means which affirmatively grips the work fed to it and holds the work firmly while moving through a rotary path of approximately 180°, releasing the work as the inverting movement is completed.

A further object of the invention is to provide wholly automatic operating means for such an inverter, including not only means for actuating the gripping mechanism but also means for turning the inverter mechanism unidirectionally in steps of 180° for as long, but only for as long, as work is fed to the inverter.

Still another object of the invention is to provide control means for the transverse conveyor means of such character as to transfer work from the inverter, either singly or in groups of two or more pieces, and to deposit

the work in proper alignment on the "off" conveyor, without causing the edges of the work pieces to bump against any barrier means or against each other.

A further object of the invention is to provide automatic control means for the entire assembly.

Still further objects will appear as the description proceeds.

To the accomplishment of the above and related objects, my invention may be embodied in the form illustrated in the accompanying drawings, attention being called to the fact, however, that the drawings are illustrative only, and that change may be made in the specific construction illustrated and described, so long as the scope of the appended claims is not violated.

FIG. 1 is a plan view of an assembly constructed in accordance with the present invention, parts being omitted and other parts being broken away for clarity of illustration;

FIG. 2 is an end view of the assembly, taken from the bottom of FIG. 1, with parts omitted for clarity of illustration;

FIG. 3 is a transverse sectional view taken substantially on the line 3—3 of FIG. 1;

FIG. 4 is an enlarged sectional view through the inverter assembly taken substantially on the line 4—4 of FIG. 1;

FIG. 5 is a further enlarged, fragmental, longitudinal section taken substantially on the line 5—5 of FIG. 4;

FIG. 6 is a fragmental horizontal section taken substantially on the line 6—6 of FIG. 4 and drawn to the scale of FIG. 5;

FIG. 7 is a view similar to FIG. 4 but showing the parts in a different position of adjustment;

FIG. 8 is an enlarged, fragmental section taken substantially on the line 8—8 of FIG. 7;

FIG. 9 is a fragmental section taken substantially on the line 9—9 of FIG. 1;

FIG. 10 is a similar section taken approximately on the line 10—10 of FIG. 1;

FIG. 11 is an exploded view, approximately on the scale of FIG. 4, showing the mode of construction and assembly of the shiftable gripper arms;

FIG. 12 is a plan view of the parts shown in FIG. 11, after assembly thereof;

FIG. 13 is an enlarged section taken substantially on the line 13—13 of FIG. 4;

FIG. 14 is an enlarged plan view of the drive train for the inverter rotor;

FIG. 15 is an end elevation of the structure illustrated in FIG. 14, parts being broken away for clarity of illustration;

FIG. 16 is a sectional view taken substantially on the line 16—16 of FIG. 14;

FIG. 17 is an elemental wiring diagram illustrating the electrical controls of the machine;

FIG. 18 is an elemental fluid flow diagram showing the manner in which the several fluid motors of the machine are controlled;

FIG. 19 is a side elevation, drawn to an enlarged scale, of a control assembly constituting an element of the machine;

FIG. 20 is a transverse section taken substantially on the line 20—20 of FIG. 19;

FIG. 21 is an enlarged elevation, looking from the left in FIG. 1, and illustrating the cam mechanisms carried near one end of the inverter rotor for controlling certain switches;

FIG. 22 is an end elevation, looking from the right of FIG. 21;

FIG. 23 is a section taken substantially on the line 23—23 of FIG. 21;

FIG. 24 is a fragmentary section, drawn to an enlarged

scale, looking toward the right in FIG. 14 and showing the cam mechanism carried on the Geneva input shaft for controlling certain switches;

FIG. 25 is an elevation of one of the cams shown in FIG. 24;

FIG. 26 is an elevation of the other cam shown in FIG. 24; and

FIG. 27 is an enlarged section taken substantially on the line 27—27 of FIG. 2.

THE GENERAL ASSEMBLY

Referring more particularly to FIGS. 1 and 2, it will be seen that I have illustrated a live roll receiving conveyor generally indicated by the reference numeral **30**. Said conveyor may be aligned with the accelerating section **31** of conveyor means leading from a board-making machine, and it comprises a series of live rolls **32** which may be commonly driven by means of a chain **33** or the like from said accelerating section. The rolls **32** are arranged in spaced, parallel relation with one end of each roll journalled in a suitable bearing carried by a frame member **34** of the machine and the other end of each roll journalled in a suitable bearing carried upon a pad **35** (FIG. 9) supported upon a post **36**. As is clearly to be seen in FIG. 9, the posts **36** are separated and the pad **35** of each post is spaced from the pads of adjacent posts for a reason which will become apparent.

An inverter assembly is indicated generally by the reference numeral **37** and an off conveyor, to which the work is to be delivered after inversion by the assembly **37**, is indicated generally by the reference numeral **38**.

The off conveyor comprises a spaced series of live rolls **39** journalled in a bed or frame **40** mounted for vertical reciprocation in a conventional manner. The rolls **39** are driven from a motor **41** in a manner which is well known in the art.

Intervening between the inverter assembly **37** and the off conveyor **38** is a transfer conveyor means or belt section indicated generally by the reference numeral **42** and comprising a spaced series of belts **43** trained over a corresponding series of pulleys **45** on a common shaft **44** and a similar series of pulleys **46**. As is most clearly to be seen in FIGS. 1, 3 and 9, each pulley **46** is journalled in bearings supported upon rails **47** which, in turn, are supported from the posts **36** and from other posts **48**. Thus, the pulleys **46** and their supporting axles are spaced apart, as is most clearly to be seen in FIG. 9, for a reason which will appear hereinafter.

THE INVERTER

The inverter unit **37** comprises a rotor **49** which, as is most clearly to be seen in FIGS. 1, 4, 5 and 6, comprises a tubular shaft **50** journalled in bearings **51**, **51** stationarily mounted on the machine frame, and a smaller tubular shaft **52** received within the shaft **50** and mounted to rotate therewith. Gripper assemblies indicated generally by the reference numerals **53** and **54** extend transaxially in opposite directions from the rotor **49** at spaced intervals along the length of said rotor. Because of the particular mounting of the bearings for the inner ends of the rolls **32** as shown in FIG. 9 and the particular mounting for the pulleys **46** as shown in FIG. 10, said gripper assemblies may move freely into and through interdigitated relationships with the rolls of the conveyor **31** and the belts of the conveyor **42** as the rotor **49** turns.

Gripper Assemblies

Referring particularly to FIGS. 2, 3, 4 and 7, it will be seen that each gripper assembly **53** and **54** comprises a split block **55** mounted on the tubular shaft **50** and secured thereto by bolts **56** passing through the block sections, and by a key **57**, said block being formed to provide oppositely-facing flat surfaces **58** and **59**. The gripper assembly **53** includes an arm **60** fixed to the block surface **58** by means of the bolts **56**, the distal end portion **61** of said arm presenting a downwardly facing surface **62** which, when the rotor **49** is in one position of rest, traverses the conveyor **30** at a level slightly above the common plane tangent to the uppermost surfaces of the rolls **32**. As shown, the arm **60** is of U-cross section, comprising a web **63** and upstanding flanges **64** and **65** as most clearly shown in FIG. 13; and preferably, a soft, rubberoid shoe **66** embraces and covers the web **63** and portions of the flanges **64** and **65**.

Split bronze bushings **67** and **67'** (FIGS. 5 and 6) are suitably carried respectively by split rings indicated generally by the reference numerals **68** and **69** (FIGS. 5, 6, 11 and 12); and the bushed rings are journal mounted on the shaft **50** closely adjacent the opposite sides of each block **55**.

The ring **68** is made up of separate half rings **70** and **71** while the ring **69** is made up of similar half rings **72** and **73**. The half ring **70** is formed with oppositely-projecting ears **74** and **75** adapted to mate with similar ears **76** and **77** on the half ring **71**; a bolt **78** is adapted to penetrate the ears **74** and **76** to receive suitable nuts for securing said ears in mating relation while a bolt **79** similarly penetrates the ears **75** and **77** to receive similar nuts to retain the ears **75** and **77** in mating relation, whereby the bushed ring sections **70** and **71** are mounted for oscillation on the shaft **50**. The ring sections **72** and **73** are similarly provided with similar ears **80** and **81** adapted to be similarly secured together by bolts **82**, whereby the bushed ring **69** is similarly mounted for oscillation on the shaft **50**.

An arm indicated generally by the reference numeral **83** comprises plates **84** and **85** carried, respectively, by the ring sections **70** and **72** and joined by welded straps **86** and **87**. At the distal end of said arm, eyes **88** are provided for the reception of a pivot pin **89** (FIG. 4) upon which is oscillably mounted a rocker **90**. The rocker **90** is preferably of U-cross section, comprising a web **91** and downwardly projecting flanges **92** and **93**, said web **91** presenting a gripper surface **94** arranged in spaced, facing registry with the surface **62** of the arm **60**. Preferably, a rubberoid shoe **95** embraces and covers the web **91** and portions of the flanges **92** and **93**.

When the rotor is in said one position of rest, the rocker **90** traverses the conveyor **30** with its surface **94** disposed just below the common plane tangent to the uppermost surfaces of the rolls **32** (see FIG. 3).

An arm **96** identical with the arm **60** is secured by the bolts **56** to the surface **59** of the block **55**, and is allochirally arranged with respect to the arm **60** so that its distal end extends transaxially of the rotor **49** in a direction opposite the direction of extension of the arm **60**. The distal end portion **97** of the arm **96** is formed to provide a surface **98** analogous to the surface **62** of the arm **60**, and said arm **96** preferably carries a rubberoid shoe **99** similar to the shoe **66**.

The opposite end **100** of the arm **96** extends a short distance beyond the rotor **49** in the direction of extension of the arm **60**, and carries a post **101** which is adjustable relative to said arm end **100** by means of nuts **102** positioned on opposite sides of the web of the arm **96**. A coiled spring **103** is anchored at one end near the distal end of the rocker **90** and is anchored at its opposite end to an eye bolt **104** secured to the end **100** of the arm **96**. Obviously, the spring **103** resists rocking movement of the rocker **90** in a clockwise direction about the axis of the pin **89** and the post **101** limits counter-clockwise rocking movement of said rocker.

An arm **105** identical with the arm **83**, but allochirally arranged relative thereto, is carried by the ring sections **71** and **73** and, at its distal end, is formed with eyes **106** in which is received a pin **107** constituting a pivotal mounting for a rocker **108** identical with the rocker **90**. Said rocker **108** presents a surface **109** in mating registry with the surface **98** of the arm **96** and preferably carries a rubberoid shoe **110** similar to the shoe **95**. The proximal end **111** of the arm **60** extends transaxially beyond the rotor

49 in the direction of extension of the arm 96 and carries a post 112 similar to the post 101 and similarly adjustable relative to the arm end 111 by means of nuts 113. A coiled spring 114 similar to the spring 103 is anchored to the proximal end of the rocker 108 and to an eye bolt 115 carried by the arm 111. The spring 114 and post 112 are functionally equivalent to the spring 103 and post 101.

The arm 105 carries a fixed bracket 116 and the arm 60 carries a bracket 117 mounted for adjustment, longitudinally of said arm, in a frame 118. A fluid motor, indicated generally by the reference numeral 119, comprises a cylinder 120 pivotally anchored to the bracket 117 and a piston rod 121 pivotally anchored to the bracket 116. It will be apparent that, when the piston rod 121 is forced outwardly with respect to the cylinder 120, the bracket 116 will be moved away from the bracket 117 and that, since the bracket 117 is carried on the arm 60 which is fixed with respect to the rotor 49 while the bracket 116 is carried on the arm 105 which, in turn, is carried by the rings 68 and 69, such movement will turn the rings 68 and 69 in a counter-clockwise direction relation to the rotor 49, thereby moving the rockers 90 and 108 toward the arms 60 and 96, respectively. Thus, a piece of work 336 which may currently be disposed between the surfaces 62 and 94 of the arms 60 and 90, will be gripped between said arms.

At a point registering with each block 55, the tubular shaft 52 is formed with a radial port 123 (FIG. 6) opening to the interior 122 thereof; and a conduit 124 provides a connection between said passage 122 and one end of the motor cylinder 120. Likewise in registry with each block 55, the tubular shaft 50 is formed with a radial port 126 opening from its interior 125, and a conduit 127 provides a connection between the port 126 and the other end of the motor cylinder 120. The passages 122 and 125 are connected, through control valves later to be described, to a source of fluid under pressure; and it will be obvious that, when the valve controlling flow to the passage 125 is opened, the piston rods of all of the motors 119 will be projected, and when the valve controlling flow to the passage 122 is opened, the piston rods of all of the motors 119 will be retracted.

INVERTER DRIVE

Referring to FIGS. 1 and 2, it will be seen that an electric motor 128 is connected to drive, through a speed varying transmission 129, a reducer 130. The output shaft of the reducer 130 is connected, through a fluid-actuated clutch 131, to a shaft 132 (FIG. 14) which carries a pinion 134 and the drum of a fluid actuated brake 135. The pinion 134 meshes with a gear 136 carried on the input shaft 137 of a Geneva drive unit 138. As is most clearly illustrated in FIG. 16, the shaft 137 carries a drive disc 139 mounting diametrically-opposed rollers 140 and 141. A driven element 142 is mounted on a shaft 143 and is formed with slots 145, 146, 147 and 148, opening through the periphery of the element 142 at 90° intervals for engagement by said rollers.

The shaft 143 carries a gear 149 (FIGS. 14 and 15) with which mesh a pinion 150 fixed to the rotor 49 and a pinion 151 connected to the drum of a deceleration brake 152 which includes a band or shoe 153 dominated by a fluid motor 154.

BELT SECTION DRIVE AND OFF CONVEYOR CONTROL

An electric motor 155 (FIG. 2) is connected by a belt or chain 156 to drive a reducer 157 whose output shaft is connected, through a fluid actuated clutch 158 and a fluid actuated brake 159 (FIG. 1), to drive the shaft 44. A pulley 160 on the shaft 44 is connected by a belt 161 (FIGS. 2 and 27) to drive a timer mechanism indicated generally by the reference numeral 162 for controlling the bed 40 of the off conveyor. This timer mechanism will be described in further detail hereinafter.

AIR SUPPLY

A further electric motor 163 (FIGS. 1 and 2) is connected to drive a compressor 164 for maintaining a predetermined pressure in an accumulator tank 165 from which air (or other suitable fluid under pressure) may be supplied to the several fluid motors of the machine through a control valve 166.

WORK-RESPONSIVE CONTROL

A work-responsive control assembly 167 is illustrated in FIGS. 1, 19 and 20. Corner posts 168 carry beams 169 and are adapted to be suitably mounted near the entrance to the receiving conveyor as, for instance, upon the accelerating section 31. FIG. 19 is taken from the right hand side of FIG. 1, and the work is adapted to flow in the direction indicated by the arrow 337.

A shaft 170 is journalled on a stationary axis in suitable bearings supported from the corner posts 168 and carries one or more pinions 171. Support means such as rollers 172 are carried by the beams 169 and a carriage 173 having rails 174 is supported from the means 172 for adjustment in the line of movement of the work 336. One or more racks 175, fixed with respect to the carriage 173, mesh with a corresponding number of the pinions 171, and a hand wheel 170' is secured to the shaft 170. It will be apparent that, by manipulation of the hand wheel 170', the carriage 173 may be adjustably positioned relative to the inverter means 37.

Supported in suitable bearings from the carriage 173 is a rock shaft 176 which carries three actuator arms 177 spaced across the width of the conveyor means 31. One or more sprockets 178 are fixed to the rock shaft 176 in line with a corresponding number of sprockets (not shown) upon a further rock shaft 179 supported from the carriage 173 in parallelism with the shaft 176. A chain 180 is trained over each sprocket 178 and over a corresponding sprocket on the shaft 179 to provide a driving connection between the shafts; and three arms 181, aligned, respectively, with the arms 177, are fixed to the shaft 179. A weight 182 is rotationally fixed to the shaft 176 to provide a yielding resistance against upward or clockwise movement of the arms 177 and 181. As work advances toward the left as viewed in FIG. 19, it engages the arms 177 to turn the shafts 176 and 179 in a clockwise direction as viewed in FIG. 19. A plurality of arms 177 and 181 is provided so that, in case the machine is operated with a plurality of streams of board moving side-by-side through the machine, as mentioned above, any one of such streams will actuate this control mechanism. The shaft 179 with its arms 181 is provided in order to prevent the machine from starting a cycle at the wrong time in case a perforation break occurs, causing a small gap between two successive boards entering the machine.

A cam 183 carried on the shaft 176 is arranged and designed to actuate a limit switch 184 when the arms 177 are lifted, and a further cam 185 carried on said shaft 176 actuates a limit switch 186 when the arms 177 are lifted.

PROGRAMMING CAMS AND SWITCHES

Machine screws 187 secure a cam ring 188 (FIGS. 21, 22 and 23) to the rotor 49 adjacent one end thereof. Said cam ring 188 is formed with two diametrically opposed lobes 189 and 190 arranged to actuate the arm 191 of a switch 192.

Said screws 187 further secure to the rotor 49 a second cam ring 193 formed with opposite, arcuate slots 194 whereby said cam ring 193 may be rotationally adjusted, through a limited arc, relative to the rotor 49. An arcuate lobe plate 195 is mounted for radial adjustment relative to the ring 193 by means of screws 197 passing through slots 196 in said plate; and a similar lobe plate 198 is similarly mounted on said ring 193 diametrically opposite the plate 195 by means of screws 200 passing

through slots 199 in said plate. The lobes 195 and 198 are arranged to actuate the arm 201 of a switch 202.

A cam disc 203 (FIGS. 14, 15, 24 and 25) having diametrically opposed lobes 204 and 205 for cooperation with the arm 206 of a switch 207, is secured to the exposed end of the Geneva input shaft 137 by means of a screw 208. A further cam ring 209 having opposed lobes 210 and 211 is likewise secured to the shaft 137 for cooperation with the arm 212 of a further switch 213. As shown, the cam ring 209 may be secured to the shaft 137 by means of a set screw 214.

The timer mechanism 162 (FIGS. 2 and 27) comprises a shaft 215 carrying a cam disc 216. Said disc is provided with a plurality of lugs 217 projecting from one face thereof and with a single lug 218 projecting from the other face thereof. The shaft 215 is journalled in suitable bearings supported from an arm 219 which is pivotally mounted at 220 upon brackets 221 secured to the machine frame. A bracket 222 is also supported from the arm 219 and carries a switch 223 whose actuator arm 224 is disposed in the path of the lugs 217; and the arm 219 further carries a switch 225 whose actuating arm 226 is disposed in the path of the lug 218. A screw shaft 227, threaded through a rocker 228 supported in the machine frame is operatively connected to the arm 219 and is provided with a manipulating hand wheel 229. The pulley 160' over which the belt 161 is trained is likewise mounted on the shaft 215, and the screw 227 coacts with the arm 219 to provide means for adjusting the tension of the belt 161.

THE FLUID FLOW SYSTEM

Gripper Actuation

Referring to FIG. 18, it will be seen that I have suggested a header 230 leading from the tank 165. A pipe 231 is connected to the header and leads through a filter 232, a regulator valve 233 and a lubricator 234, all of conventional construction, to a valve 235 controlled by a solenoid 236. A pipe 237 leads from valve 235 through an adjustable valve 239 to one port of a rotating syphon type union 241 which is connected to the passage 122 through the tubular shaft 52, and another pipe 238 leads through an adjustable valve 240 to the other port of the union 241 which communicates with the passage 125 through the tubular shaft 50.

This system just described, and indicated generally by the reference numeral 250, provides for a controlled flow of fluid under pressure through the passages 122 and 125 to the several fluid motors 119 which actuate the gripper assemblies 53 and 54, and in some installations, such a system would be sufficient for actuation of such assemblies. However, in many installations the length of the inverter assembly is such, and the number of the motors 119 is such, that I deem it advisable to duplicate the system 250, as indicated generally at 251, to supply another union 252 at the opposite end of the rotor 49.

The header 230 is further connected, through a regulator valve 254, with a small accumulator tank 255; and a pipe 256 leads therefrom through a filter 257 and lubricator 258 to a valve 259 dominated by a solnoid 260. A pipe 261 leads from the valve 259 to the inverter brake 135 and another pipe 262 leads from the valve 259 to the inverter clutch 131. A branch pipe 263 leads from the pipe 256 to a valve 264 dominated by a solenoid 265; and pipes 266 and 267 lead from the valve 264 to the opposite ends of the fluid motor 154 controlling the inverter drag brake 151 (FIG. 15).

A further pipe 268 leads from the tank 255 through a filter 269 and lubricator 270 to a valve 271 dominated by a solenoid 272. A pipe 273 leads from the valve 271 to the belt drive clutch 158 (FIG. 1) and a further pipe 274 leads from said valve 271 to the belt drive brake 159.

Through a filter 275, a regulator valve 276 and a lubricator 277, the header 230 is connected to a valve 278 which is dominated by a solenoid 279. A pipe 280 leads from the valve 278 through an adjustable valve 284 to one end of a fluid motor 281 whose piston rod 282 is connected to reciprocate the off conveyor bed 40, and a second pipe 283 leads through an adjustable valve 285 to the other end of said motor 281.

OPERATION

FIG. 17 is an elemental wiring diagram indicating a source of current at 242. A manually manipulable switch 286, when closed, connects the opposite sides of the line with wires 287 and 288, respectively.

The leading end of a board entering the unit 167 (FIGS. 1, 19 and 20) engages the arms 177 to turn the shaft 176 against the tendency of the weight 182, whereby the cam 185 actuates the switch 186. The switch 186 comprises two sets of normally closed contacts (FIG. 17) 186 and 186'. The action of the cam 185 opens both these sets of contacts. Momentarily thereafter, the cam 183 actuates the switch 184. 184 is a normally open switch connected in series in a line 290 extending from the wire 287 through normally closed switch 192 (FIGS. 17 and 21), normally closed relay switch 291 and relay 292, to wire 288. Thus, when switch 184 is so closed, relay 292 will be energized.

Relay 292 dominates normally open relay switches 293, 294 and 295. Relay switch 293 is connected in wire 296 which bridges switch 184 to hold the energizing circuit for the relay 292. Relay switch 294 is connected in series in a wire 297 extending through contacts 186 to energize solenoids 236 and 236' which dominate the solenoid valves of the systems 250 and 251, respectively (FIG. 18). However, since contacts 186 are held open by cam 185 (FIG. 20) closure of relay switch 294 does not immediately energize solenoids 236 and 236'. Relay switch 295 is connected in series in a wire 298 which extends from wire 287 through contacts 186' and solenoid 260 (FIGS. 17 and 18) to wire 288. Since contacts 186' are held open by cam 185, solenoid 260 is not immediately energized. (Switch 207 in wire 305 bridging relay switch 295 and contacts 186' is at this time held open by one of the lobes 204 or 205 of cam 203, as will be explained.)

As the trailing end of the board leaves the arms 131, the weight 182 will return the shaft 176 to its normal position and the cam 185 will permit the contacts 186 and 186' to close. Thus, the solenoid 260 is energized to actuate the valve 259 (FIG. 18) to release the inverter brake 135 and to engage the inverter clutch 131; and at the same time the solenoids 236 and 236' are energized to actuate the valves of the systems 250 and 251 (FIG. 18) to supply fluid under pressure to the passage 125, whereby the motors 119 (FIGS. 1, 4 and 7) will be actuated to swing the arms 83 and 105 in a counter-clockwise direction relative ot the rotor 49.

The board has been fed into a position between the rockers 90 and the arms 60 of the several gripper assemblies 53. This actuation of the motors 119 will, therefore, lift the board 336 off the rolls 32 and grip it between the shoes 95 and 66. By manipulation of the hand wheel 172, the carriage 173 can be so positioned that this will occur when the trailing end of the board is substantially in registry with the last roll 39 on the off conveyor 38.

Engagement of the inverter clutch 131 and release of the inverter brake 135 starts rotation of the shaft 132 to drive the shaft 137 (FIG. 14) and the drive element 139 of the Geneva motion (FIG. 16). The cam 203 turns with the shaft 137 to allow switch 207 to close. The roller 140 enters the slot 145 to turn the shaft 143 through 90°. Because of the ratio between the gear 149 and the pinion 150, this results in a 180° rotation of the rotor 49. Thus, the gripper assemblies 53 are moved from their position illustrated in FIG. 4, in which they are cooperatively associated with the receiving conveyor 30, to the position

in which they are cooperatively associated with the transfer conveyor 42.

After approximately 100° of rotation of the rotor 49, switch 202, which is normally open and which is connected in series in a wire 289 leading from wire 287 through solenoid 265 (FIGS. 17 and 18) to the wire 288, is closed by cam 193 (FIGS. 21 and 22), and solenoid 265 (FIGS. 17 and 18) is thereby energized to actuate the motor 154 to apply the drag or deceleration brake 152 to retard the rate of movement of the rotor 49. The interval during which switch 202 is thus held closed is variable by adjustment of the cam lobe plate 195 or 198 radially of the ring 193, and the point in the cycle of the rotor at which the switch 202 will be closed is variable by adjustment of the ring 193 rotationally relative to the screws 187 (FIG. 22). In most cases, it is found desirable to close the switch 202 at about 100° of the 180° cycle of the rotor 49 and to reopen it at about 170° of its travel.

At approximately 175° of the rotor travel, one of the lobes of the cam 188 momentarily opens switch 192 to break the energizing circuit for relay 292. Relay switch 293 is thus reopened, relay switch 294 is reopened to deenergize solenoids 236, 236' whereby the motors 119 are reversed and relay switch 295 is reopened. Normally closed switch 207 in wire 305 bridging relay switch 295, however, maintains an energizing circuit for solenoid 260, so that the inverter clutch 131 and the inverter brake 135 are unaffected. The rotor 49 thus continues to move and the gripper assemblies are reopened just before the arms 61 reach a level immediately beneath that occupied by the upper runs of the belts 43, and the board 336 is thus laid upon those belts.

The Geneva input shaft 137 continues to rotate, through approximately 90° after the roller 140 has left the slot 145 leaving the rotor 49 in its new stationary position. The cam 209 (FIG. 25), which is carried on said input shaft 137, actuates switch 213 just as the roller so emerges from said slot. Normally open switch 213 is connected in series in a wire 299 which leads from tthe wire 287 through relay 300 to wire 288. Cam 209 momentarily closes switch 213 thus energizing relay 300 which dominates normally open relay switches 301 and 302. Relay switch 301 is connected in series with normally closed switch 223 in a wire 303 which bridges normally open switch 213. Relay switch 302 is connected in series in a wire 304 which leads from wire 287 through solenoid 272 to wire 288. Thus, energization of relay 300 establishes a holding circuit for said relay and energizes solenoid 272 to actuate valve 271 (FIG. 18) to release belt brake 159 and engage belt clutch 158. The shaft 44 is thus driven to move the belts 43 to remove the board from the inverter and carry it toward the off conveyor 38, to a position such that it will just clear the next board or group of boards to be laid on the belts 43 by the next turning operation of the inverter.

Cam 216 (FIG. 27) is driven with the shaft 44. It is so adjusted that, after cam 209 has released the arm 212 of switch 213, and as the work piece on the belts 43 attains the above-described position, a lug 217 will engage the arm 224 of the switch 223 to actuate said switch. As has been stated, switch 223 is a normally closed switch in bridging line 303 for the energizing circuit of relay 300, and when the cam lug 217 actuates switch arm 224, switch 223 is opened to deenergize relay 300, thereby opening relay switch 302 to deenergize solenoid 272. Thereby, valve 271 is returned to a position in which belt brake 159 will be applied and belt clutch 158 will be disengaged, thus stopping the belts 43. Thus, shaft 44, and therefore shaft 215, will be stopped in this position to hold switch 223 open until rotation of shaft 44 is reinitiated as above described.

Thereafter, as shaft 137 continues to rotate, the other lobe 205 or 204 of cam 203 engages the actuating arm 206 of switch 207 (FIG. 24). When switch 207 is opened by cam 203, solenoid 260 is deenergized and valve 259 (FIG. 18) moves to a position in which the inverter clutch 131 is disengaged and the inverter brake 135 is applied to stop the shaft 137, with switch 207 held open. Cam 203 is so adjusted on shaft 137 as to stop that shaft when roller 141 has reached the position occupied by roller 140 in FIG. 16.

It will be noted that I have shown two lugs 217 on the cam disc 216. The width of the off conveyor (FIG. 1) is approximately twice the width of the receiving conveyor 30. When 48" board (or any plurality of widths totaling 48") is being handled by the machine, the parts are so proportioned and arranged that the cam disc 216 will turn through one revolution for each full revolution of the rotor 49. Thus, when the rotor 49 turns through 180° to lay one batch of work on the belts 43, the switch 213 will be actuated by the cam 209 to cause the belts 43 to be driven until the work reaches the above-described clearing position, at which time one lug 217 will actuate the switch 223 to stop the belts. Upon the next 180° movement of the rotor 49, the gripper assemblies 54 lay another batch of work on the belts 43 immediately to the right (FIG. 1) of, but not touching, the first work batch. Now, the switch 213 will again be actuated by the cam 209 as above described, and the belts 43 will again be driven to transport the two batches of work toward the off conveyor 38. At this time, the common plane tangent to the uppermost surfaces of the rolls 39 is below the plane common to the upper runs of the belts 43. The second lug 217 on the cam plate 216 is so positioned that, as the leading edge of the first work batch attains substantial registry with the left-hand edge (FIG. 1) of the off conveyor and the trailing edge of the second work batch attains substantial registry with the right-hand edge of that conveyor, said second lug 217 will again actuate the switch 223 to stop the belts 43. Concurrently, the lug 218 on said plate 216 engages the arm 226 of switch 225 to close that switch.

Switch 225 is connected in series in a wire 306 leading from wire 287, through wire 308 and solenoid 279, to wire 288. Thus, closure of switch 225 energizes solenoid 279 to actuate valve 278 whereby motor 281 is actuated to lift the off conveyor bed 40 to a position in which the common plane tangent to the uppermost surfaces of the rolls 39 is above the plane common to the upper runs of the belts 43. The work which has been moved by the belts into registry with the off conveyor will thus be lifted from the belts and the live rolls 39 will discharge the work from the off conveyor. Motor 41 may operate continuously or, as suggested in FIG. 17, it may be controlled by a relay switch 338 dominated by a relay (not shown) which is energized by elevation of the bed 40 and is deenergized when the work has been discharged from the off conveyor.

When 32" board is being handled, three lugs 217 are mounted on the disc 216 and the ratio of the drive between the pulleys 160 and 160' will be so changed that the shaft 215 will make one complete revolution for each 540° movement of the rotor 49 so that three batches of work will be arranged side-by-side on the belts 43, and then will be moved into registry with the conveyor means 38, before the switch 225 is actuated to lift the bed 40. The above-mentioned ratio change may be effected by substituting other pulleys for the pulleys 160 and/or 160'; or the drive means connecting the shaft 44 to the shaft 215 may be a variable speed or selective speed transmission.

Thus it will be seen that, because operation of the transfer conveyor 42 is controlled in the manner above described, rather than by work-actuated means, I have avoided the necessity, common to all previous machines of this general character known to me, for causing or permitting the work pieces to bump against control means or stop means or against other work pieces, with the resulting hazard of damage to the work piece edges.

The regulator valve 233 and its analogue in the sys-

tem 251 control the pressure exerted between the mating arms of the gripper assemblies 53 and 54. The valve 240 and its analogue are manipulable to control the rate at which the gripper mechanisms are closed and the valve 239 and its analogue are manipulable to control the rate at which the gripper assemblies are opened.

The regulator valve 254, of course, controls the amount of pressure exerted upon the fluid actuated clutch and brake 131 and 135 for the inverter, the drag brake 152 for the inverter and the clutch and brake 158 and 159 for the belt conveyor. The regulator valve 276 controls the pressure of fluid supply to the motor 281 for elevating the conveyor bed 40, and the valves 284 and 285 are manually manipulable to control the speed of movement of the conveyor bed 40.

PUSH BUTTON CONTROLS

While the machine will ordinarily be operated automatically in the manner above described, I have indicated, in FIG. 17, a series of push buttons whereby the various functions of the machine will be manually controlled.

Thus, a "board reject" button 309 carries normally open contacts in a wire 322 for energizing a relay 323 when said button is depressed. Relay 323 acts to close a relay switch 324 bridging the push button contact in the wire 322, and to open normally closed relay switch 291 which is connected in series in the energizing circuit for the relay 292. Deenergization of the relay 292 disables the normal circuits for controlling the gripper mechanisms 53 and 54 and the rotor 49, so that work will pass through the machine, once the button 309 has been pressed, without being inverted and transferred to the belts 43, until push button 310, dominating normally closed contacts in the wire 322, is depressed. Push button 309 also carries normally open contacts in wire 326 connected in series with motor 327 which will continue the rolls 32 in operation to carry away boards which have been fed to the inverter mechanism 37. Normally open relay switch 325 is also dominated by relay 323 to bridge the contacts of push button 309 in wire 326 until button 310 is depressed.

Push button 311 controls contacts in a wire 328 representing the energizing circuit for the motor 128; and the arrangement is such that, when button 311 is momentarily depressed, the motor 128 will be started and will be continued in operation until the stop button 312 is pressed.

Push button 313 is connected in wire 329 representing the energizing circuit for the motor 41, and the arrangement is such that, after momentary depression of the button 313, the motor 41 will continue in operation until the button 314 is depressed.

Push buttons 315 and 316 are mechanically connected together and the button 315 carries normally open contacts in a wire 330 which extends from wire 287, through a pressure-responsive switch 331 dominated by pressure conditions in the tank 165, and represents the energizing circuit for the motor 163.

Push button 317 is connected in a wire 332 leading from the wire 287 through the solenoid 260 for manual engagement of the inverter clutch 131 and release of the inverter brake 135.

Push button 318 is connected in a wire 333 bridging relay switch 302, to energize solenoid 272 for manual control of the belt clutch 158 and belt brake 159.

Push button 319 is connected in wire 334 bridging switch 225 in the enegizing circuit for the solenoid 279, for manual control of the motor 281 for lifting the off conveyor table 40.

Push button 320 carries normally open contacts in a line 335 which represents the energizing circuit for the motor 155, and the arrangement is such that, when the button 320 is momentarily pressed, the motor 155 will be continued in operation until the button 321 is pressed.

I claim as my invention:

1. In an inverter for sheet material, a rotor, a plurality of pairs of arms arranged in axially-spaced relation along said rotor to project in a common transaxial direction therefrom, each arm pair comprising a first arm fixed with respect to said rotor and a second arm mounted for limited peripheral movement relative to said rotor toward and away from said first arm, a rocker pivotally mounted intermediate its ends adjacent the distal end of said second arm of each pair, spring means biasing the distal end of each rocker toward the first arm of the same pair, adjustable means for limiting the movement of each rocker under the influence of its spring, each rocker providing a material supporting surface and all of said surfaces being disposed normally in a common plane, the first arm of each pair presenting a mating surface toward the material supporting surface of its associated rocker, means for moving a sheet of material into supported position on said material supporting surfaces, means for simultaneously shifting said second arms relative to said rotor toward said first arms to grip said sheet between said supporting surfaces and said mating surfaces, means for turning said rotor through 180°, and means for returning said second arms to their original positions relative to said rotor to release said sheet as said turning movement of said rotor is completed.

2. In an inverter for sheet material, a rotor, a plurality of blocks fixed to said rotor at spaced intervals therealong, each block providing two opposite, transaxially-extending surfaces, a first arm fixed to one of said surfaces of each block and extending in one direction away from said rotor, a second arm fixed to the other surface of each block and extending in the opposite direction away from said rotor, a ring journalled on said rotor adjacent each block, a third arm fixed to said ring and extending in said one direction away from said rotor in cooperative registry with said first arm, a fourth arm fixed to said ring and extending in said opposite direction away from said rotor in cooperative registry with said second arm, said third and fourth arms being provided with surfaces normally spaced from, but facing, surfaces provided by said first and second arms, respectively, means for turning said rings in a direction to shift said third and fourth arm surfaces into clamping association with said first and second arm faces, respectively, and for returning said rings, and means for intermittently rotating said rotor unidirectionally in 180° steps.

3. In an inverter for sheet material, a rotor, a plurality of blocks fixed to said rotor at spaced intervals therealong, each block providing two opposite, transaxially-extending surfaces, a first arm fixed to one of said surfaces of each block and extending in one direction away from said rotor, a second arm fixed to the other surface of each block and extending in the opposite direction away from said rotor, a ring journalled on said rotor adjacent each block, a third arm fixed to said ring and extending in said one direction away from said rotor in cooperative registry with said first arm, a fourth arm fixed to said ring and extending in said opposite direction away from said rotor in cooperative registry with said second arm, said third and fourth arms being provided with surfaces normally spaced from, but facing, surfaces provided by said first and second arms, respectively, a fluid motor for each block and ring group, each such motor comprising a cylinder element and a piston element, means operatively connecting one element of each motor to its associated block, means operatively connecting the other element of each motor to its associated ring, and means for intermittently rotating said rotor unidirectionally in 180° steps.

4. In an inverter for sheet material, a rotor, a plurality of blocks fixed to said rotor at spaced intervals therealong, each block providing two opposite, transaxially-extending surfaces, a first arm fixed to one of said surfaces of each block and extending in one direction away from said rotor, a second arm fixed to the other surface

of each block and extending in the opposite direction away from said rotor, a ring journalled on said rotor adjacent each block, a third arm fixed to said ring and extending in said one direction away from said rotor in cooperative registry with said first arm, a fourth arm fixed to said ring and extending in said opposite direction away from said rotor in cooperative registry with said second arm, said third and fourth arms being provided with surfaces normally spaced from, but facing, surfaces provided by said first and second arms, respectively, a fluid motor for each block and ring group, each such motor comprising a cylinder element and a piston element, means operatively connecting one element of each motor to the first arm of its group, means operatively connecting the other element of each motor to the third arm of its group, and means for intermittently rotating said rotor unidirectionally in 180° steps.

5. In a machine of the class described, a receiving conveyor, an inverter operatively associated with said receiving conveyor to accept work pieces successively therefrom, an off conveyor spaced from said inverter, a transfer conveyor interposed between said inverter and said off conveyor to receive work pieces from said inverter and deliver the same to said off conveyor, means for intermittently driving said inverter through successive 180° cycles to invert work pieces and transfer the same from said receiving conveyor to said transfer conveyor, drive means for said transfer conveyor, means independent of such work pieces and moving with said inverter to activate said transfer conveyor drive means each time said inverter deposits a work piece on said transfer conveyor, means independent of said work pieces and moving with said transfer conveyor to deactivate said transfer conveyor drive means after a first such deposit, with the deposited work piece positioned between said inverter and said off conveyor, and means independent of said work pieces and moving with said transfer conveyor means to deactivate said transfer conveyor drive means, after a subsequent such deposit, with all of the work pieces so deposited on said transfer conveyor in operative registry with said off conveyor.

6. The machine of claim 5 including means independent of said work pieces and moving with said transfer conveyor to transfer such work pieces from said transfer conveyor to said off conveyor upon attainment of such registry.

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