

[54] **ELECTRONIC BOWLING GAME**

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[58] Field of Search 273/41, 126 A, 43 A, 125 A;
200/61.1, 61.11

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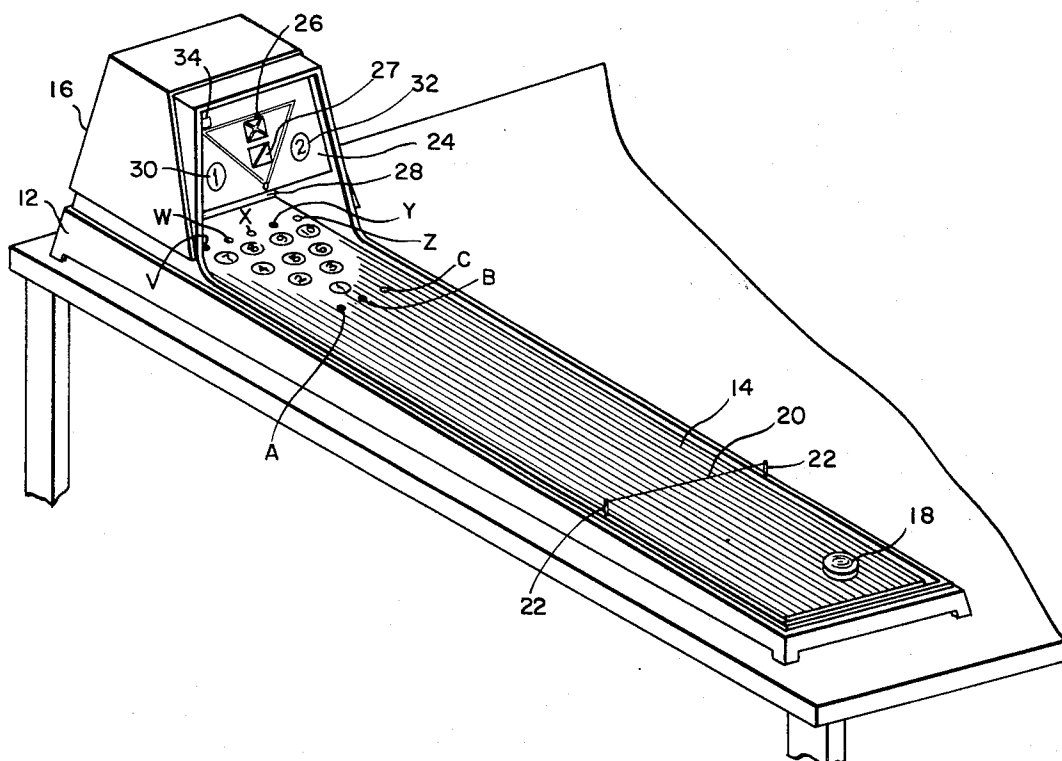
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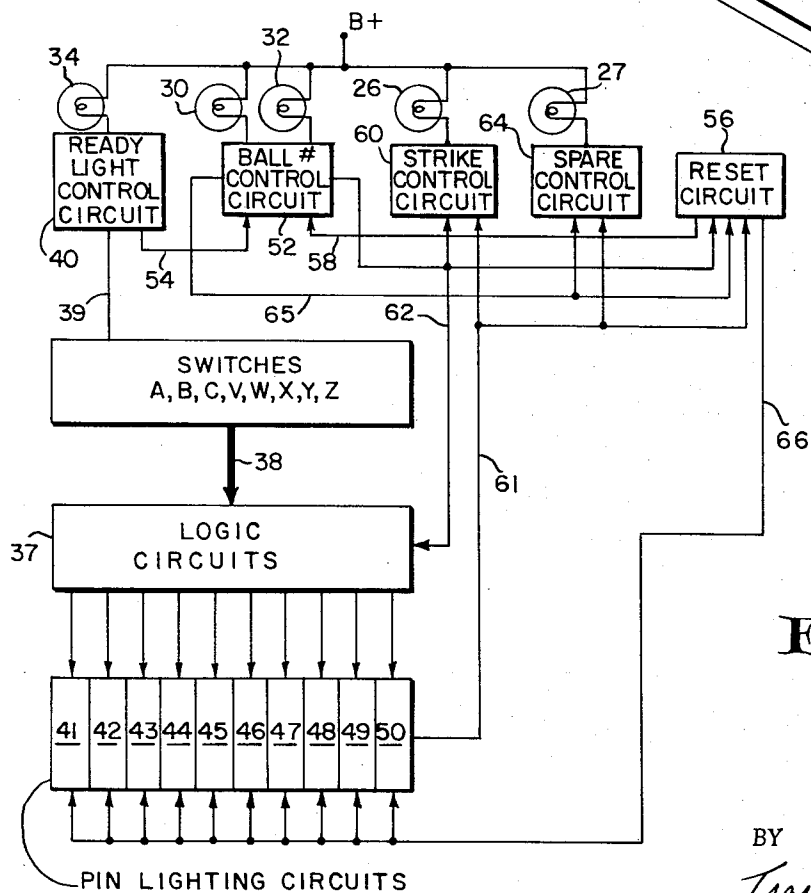
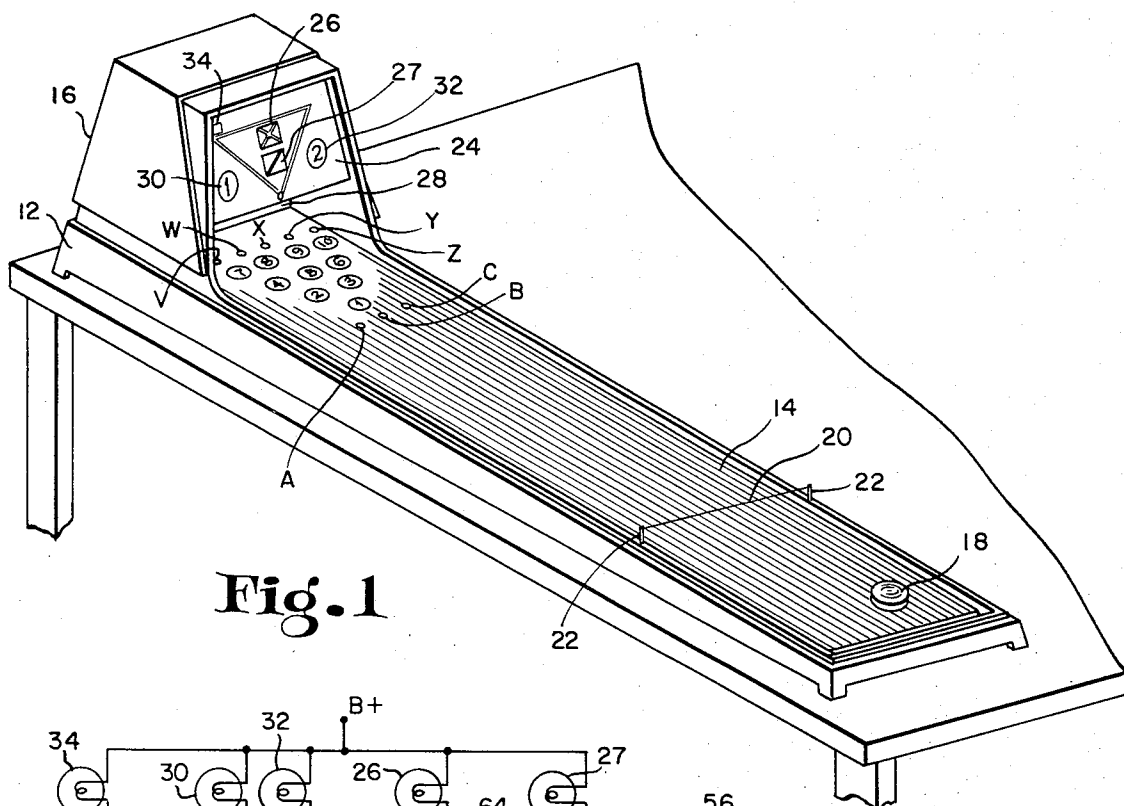
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[57] **ABSTRACT**

A bowling game formed by a platform having a plurality of switches mounted therebelow with actuators extending upwardly through the surface of the platform. Ten lights are arranged on the surface of the platform in a configuration similar to that of a conventional bowling game, and a disc is used for sliding along the platform to actuate the switches which are connected to turn off the lights. Eight switches are used and they control the ten lights by means of logic circuitry which interconnects the switches with the lights. The game also includes a second series of lights including a ready light, a "ball" light for indicating whether it is "ball one" or "ball two" which will be thrown, a strike light, and a spare light. Circuits for controlling these lights together with a reset circuit are interconnected with the switches, the logic circuitry and the pin lights so that the game is electronically controlled. Circuitry is included to prevent actuation of the logic circuitry when the platform is subject to physical shock and to prevent actuation of the switches when the disc is returned along the platform to a player.

9 Claims, 6 Drawing Figures





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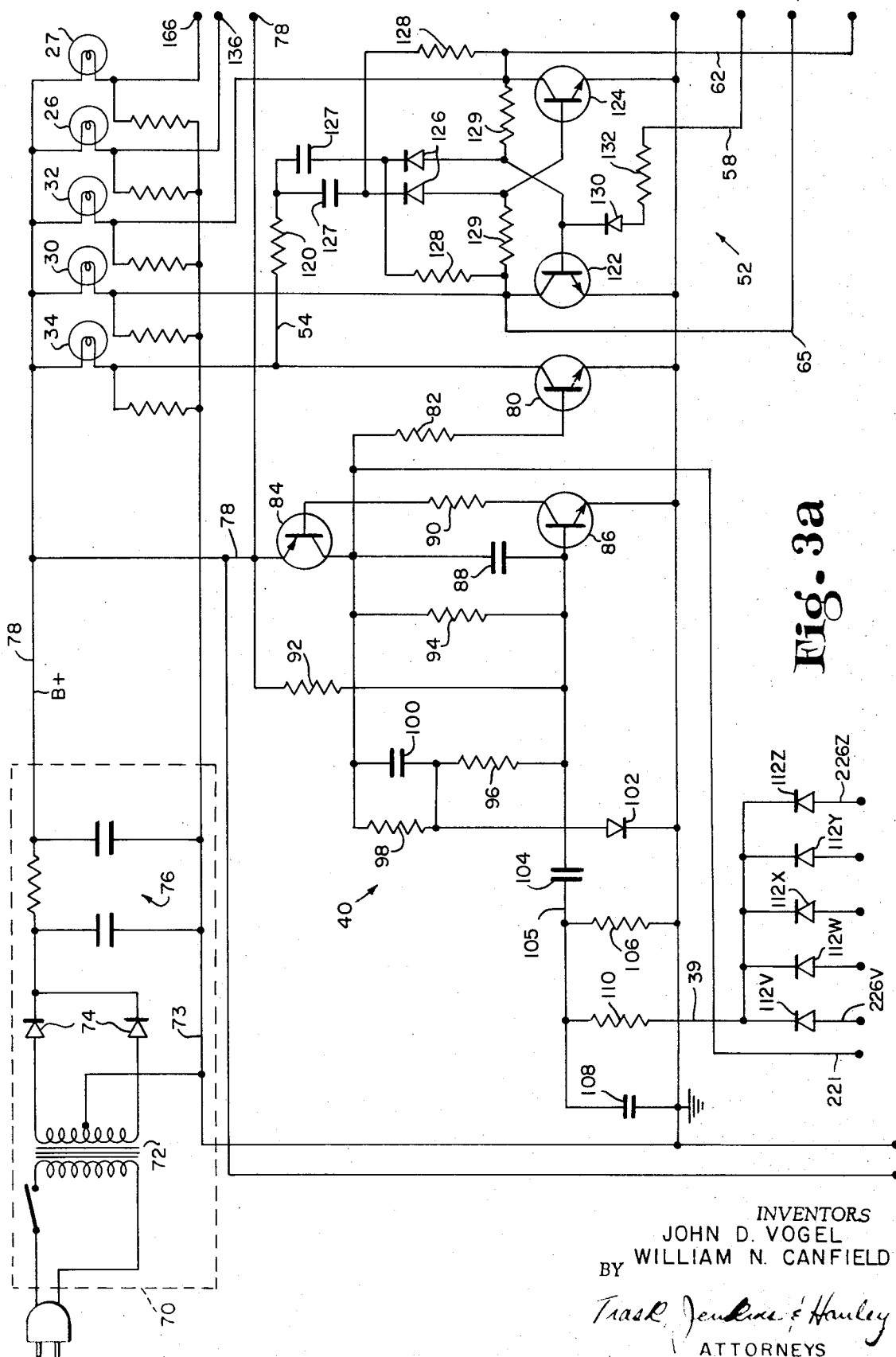
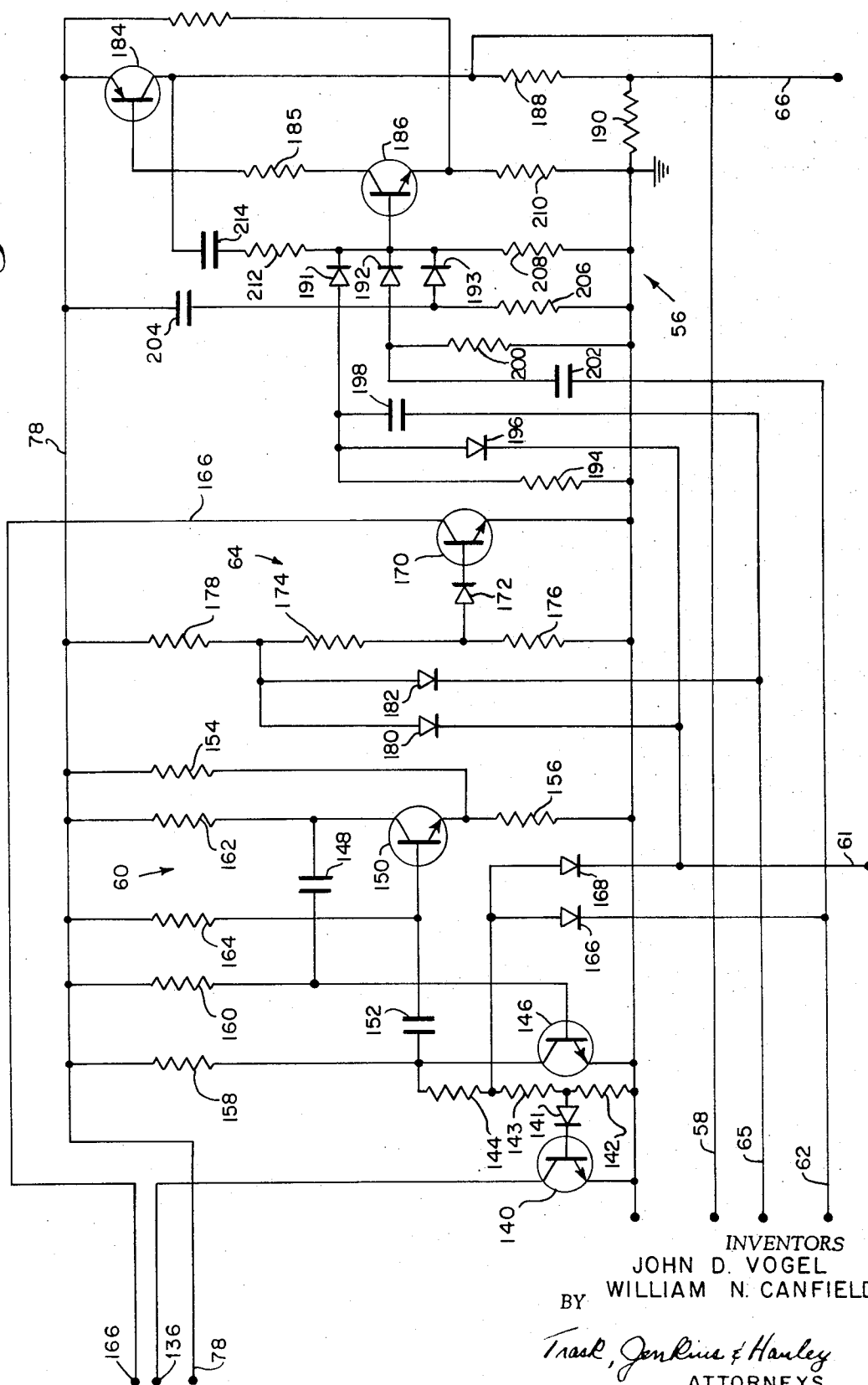


Fig. 3b



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Fig. 3c

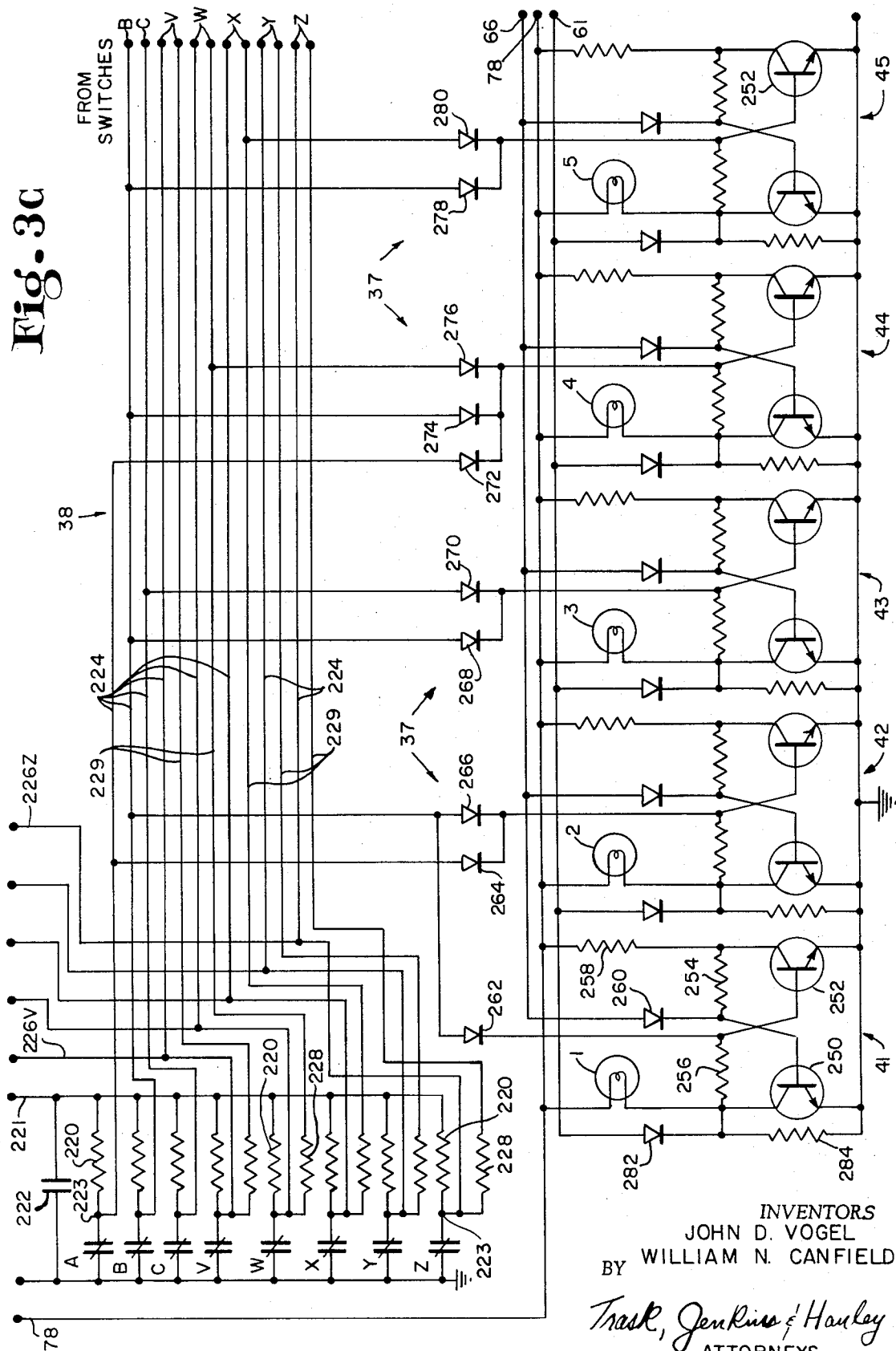
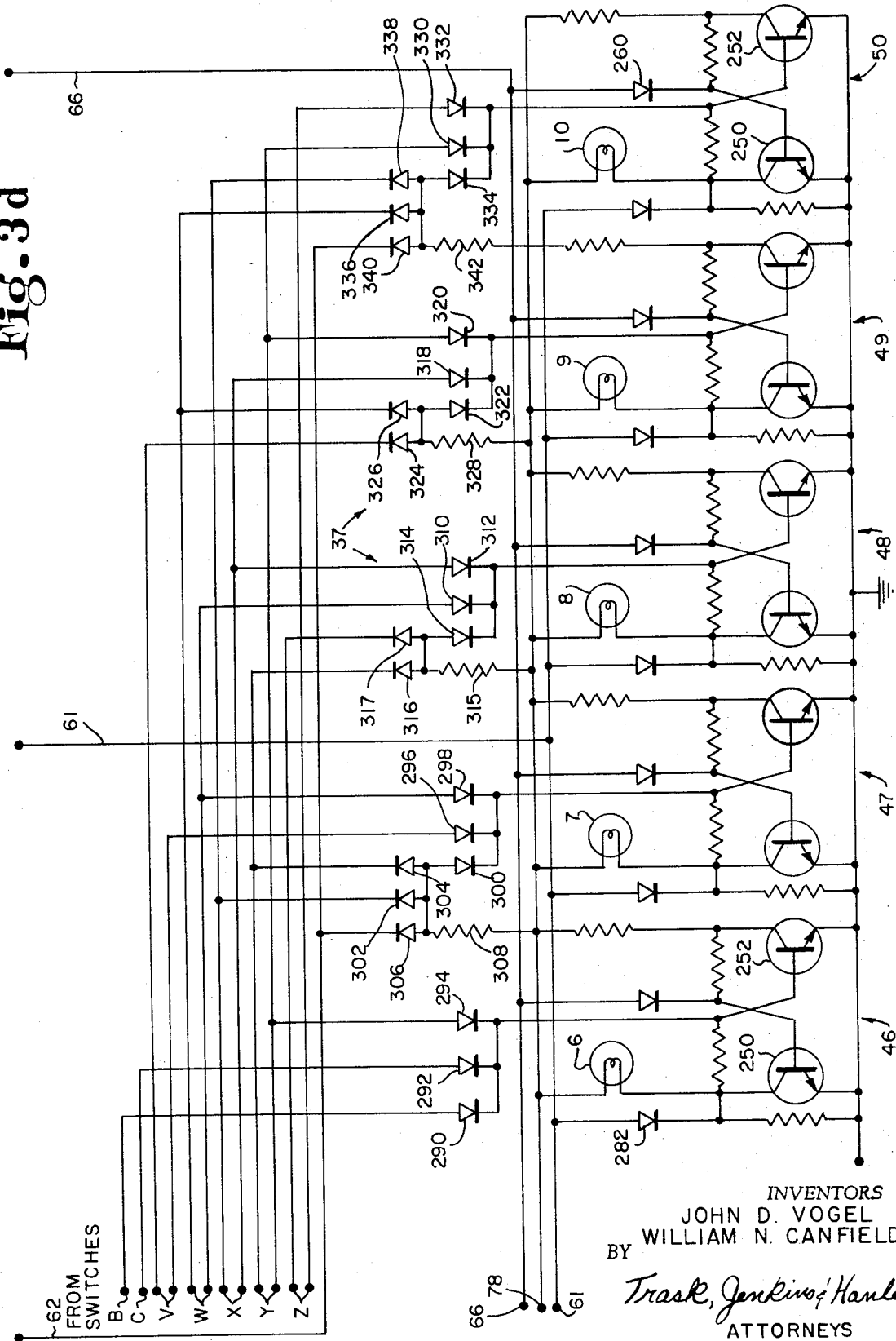


Fig. 3d



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ELECTRONIC BOWLING GAME

BACKGROUND OF THE INVENTION

It is an object of this invention to provide a compact and highly reliable electronically controlled bowling game for home entertainment purposes. Accordingly, the embodiment described herein is a solid state device having no moving parts with the exception of contact actuators on a plurality of electrical switches.

SUMMARY OF THE INVENTION

In accordance with this invention, there is provided a bowling game having a small platform which forms the alley, and having a series of lights mounted in the platform to replace the pins of a conventional game. The lights are controlled through logic circuits by a plurality of switches which have actuators mounted in the platform of the device for being depressed by a puck which is manually propelled along the surface of the platform. A series of eight switches are used, and they are spaced from each other in a manner which permits them to control all of the lights by means of the logic circuits. Furthermore, said control is effected in a manner which makes the path of the puck over the lights analogous to the path of a bowling ball through the pins.

The game is also provided with a ready light, "ball 1" and "ball 2" lights, a strike light, and a spare light, together with logic circuits for controlling each of these lights. When it is determined that all of the logic circuits are in their proper state, then the ready light is turned on by its control circuit, and all of the platform switches are rendered responsive to the sliding puck. The "ball 1" and "ball 2" lights are controlled by their logic circuits to indicate to the player whether it is his first or second turn on a particular frame. If the player is successful in hitting a proper combination of switch actuators, thereby turning off all of the pin lights on his first turn, then the strike light is energized to confirm the fact that he has thrown the puck successfully. Similarly, the spare light indicates that all of the pin lights have been turned out when the player is successful on the second turn. A reset logic circuit is included which initializes the circuit after each strike or completion of two turns, or at the start of the game, so that the control circuits are automatically operated.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings illustrate one embodiment of the invention. In such drawings:

FIG. 1 is a perspective view of an electronically operated bowling game;

FIG. 2 is a block diagram of the electrical controls of the device shown in FIG. 1, and

FIGS. 3a, 3b, 3c and 3d show schematic diagrams of the circuitry included in the block diagram of FIG. 2.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

A bowling game embodying this invention, as shown in FIG. 1, may comprise a base portion 12 having an alley or platform 14 disposed on a slight upward incline toward the rear of the base. A hood 16 extends upwardly from the base 12 to cover the rear portion of the platform. The game is played by sliding a puck 18 from

the forward end of the platform toward the rearward end thereof and over a plurality of lights 1-10 arranged on the platform in the same fashion as a set of bowling pins. A heavy elastic band 20 or other means is stretched between a pair of posts 22 near the forward end of the platform to act as a foul line. The elastic is suspended above the alley 14 to permit the puck to slide thereunder, but it is low enough to prevent the player from extending his hand past such foul line when delivering the puck toward the lights. A plurality of switches A-C and V-Z are arranged beneath the platform and in proximity to the lights such that their actuating members extend through the upper plane of the platform for engagement by the sliding puck. A rubber bumper 28 or other means is provided at the rearward end of the platform, beyond the lights and switches, to function as a puck return mechanism, by simply allowing the puck to bounce back toward the forward end of the platform at the completion of a delivery.

The switch actuators are so arranged in the platform that a player can actuate them by directing the puck over the pin lights in a manner similar to the way he would direct a ball to knock down conventional bowling pins. The switches are arranged in two rows and five columns, switches A, B, and C forming one row in front of the pins and aligned with pins 4, 1 and 6, and switches V, W, X, Y, and Z forming the second row behind the pins. Said switches in each row are spaced so that the puck can simultaneously actuate any two adjacent switches in a row, and switches W, X, and Y are positioned directly behind switches A, B, and C, while switches V and Z are placed outside of pins 7 and 10. For example, switch A will turn out lights 2 and 4; switch B, lights 1 through 6; switch C, lights 3 and 6; switch V, light 7; switch W, lights 4, 7 and 8; switch X, lights 5, 8 and 9; switch Y, lights 6, 9 and 10; and, switch Z, light 10. Additionally, the simultaneous closing of switches V and W will turn out lights 4, 7, 8, and 9, and simultaneous closing of switches Y and Z will turn out lights 6, 8, 9 and 10. Similarly, on the first turn if the player is successful in simultaneously closing switches W and X, he will turn out light 10 in addition to those normally controlled by switches W and X; and, if he simultaneously closes switches X and Y on his first turn, he will turn off light 7 in addition to those normally controlled by those switches. Thus, it can be seen that a player can get a strike by sliding the puck so as to close switches B, X and Y in a single turn, or B, W and X on a single turn. A spare is obtained by turning out all of the remaining lights on the second turn; again, by actuating the proper switches with two deliveries of the puck toward the switches. Circuitry to control the pin lights is mounted beneath the platform, and similar circuitry for controlling other indicating lights is mounted within the hood 14. Said other indicating lights, all of which are visible on the forward face 24 of the hood, includes a strike light 26, a spare light 27, "ball 1" and "ball 2" lights 30 and 32, and a ready light 34.

A block diagram of the circuitry which is embodied in this invention is shown in FIG. 2 where the switches A-C and V-Z are shown to be connected to a group of logic circuits 37 by conductors 38, and along conductor 39 to a control circuit 40 which controls the ready light 34. When the puck is thrown and causes any one of the switches to be actuated, the ready light is turned

off and all of the actuated switches are connected through the logic circuits to turn out the proper pin lights. The pin lights 1-10 are connected respectively to separate pin lighting circuits 41-50 which are controlled by the logic circuits 37. The "ball 1" and "ball 2" lights 30 and 32 are controlled by a multi-vibrator 52 having two stable states, and being triggered by the ready circuit 40 through conductor 54, each time the ready light is switched on, and by a reset control circuit 56, along conductor 58, each time the entire system is turned on. The light 26 which indicates a strike is connected to a control circuit 60 which is actuated by signals from the pin lighting circuits 41-50 along conductor 61 and from the ball indicating circuit 52 along conductor 62. That is, when all of the pin lights are out, and the "ball 2" light is out, then the strike light 26 will be energized. Similarly, the spare light 27 is connected to a control circuit 64 which is also actuated by the pin lighting circuits through conductor 61 and the ball indicating circuit 52, through conductor 65 of the circuit; and, if all of the pin lights are out, and the "ball 1" light 32 is out, then the spare light 27 will be energized. The reset control circuit 56 has input and output leads connected to both the pin lighting circuits 41-50 and to the ball indicating circuit 52. Said input and output leads are connected so that when a player obtains a strike, or when he concludes two turns with the puck, the reset circuit couples a signal along conductor 66 for resetting the pin light control circuits to re-light all the lights, and to ensure by means of a signal on lead 58 that the "ball 1" light is energized after a strike and when power is first applied to the system.

The circuitry of the invention is illustrated schematically in FIGS. 3a through 3d, which show the actual circuit components and connections for effecting the results discussed above. A power supply 70, for converting a 110 volt line voltage into a DC voltage for supplying the solid state components of the invention, is shown in FIG. 3a and comprises a transformer 72 having a center-tapped secondary lead connected to a common point or ground 73, and having its outer secondary leads connected to the anodes of a pair of diodes 74. The cathodes of the diodes are connected together and to a resistor capacitor filter 76 for providing a smooth positive DC voltage at its output conductor 78. This positive voltage (B+) is used to supply power to all of the light control circuits, the reset circuit, and all of the logic circuits.

The ready light control circuit 40, as shown in FIG. 3a, comprises a switching transistor 80 having the ready light 34 as its load. The base of the switching transistor is coupled through a resistor 82 to the output of a mono-stable multi-vibrator formed by transistors 84 and 86. Transistor 84 is a PNP type having its emitter connected to the positive voltage and its collector connected to the resistor 82. Said collector is also connected through a capacitor 88 to the base of the transistor 86, which is an NPN type having its collector connected through a resistor 90 to the base of the transistor 84 and its emitter connected to ground. The base of said transistor 86 is also connected through a high impedance resistor 92 to the positive supply potential, to another high impedance resistor 94 which is coupled in parallel with the speed up capacitor 88, and through a third high impedance resistor 96 to a se-

ries combination of a resistor 98 and capacitor 100 which have their other sides connected to the collector of transistor 84. The junction of the components 96, 98 and 100 is also connected through a diode 102 to ground. The base of transistor 86 is also connected through a differentiating capacitor 104 to a conductor 105 which is connected to the parallel combination of a resistor 106 and capacitor 108 having their other ends connected to ground. Said conductor 105 is connected through a resistor 110, and through conductor 39 to the cathodes of five diodes 112 V-Z. The anodes of the diodes are connected respectively to the switches V, W, X, Y, and Z.

In addition to controlling the ready light 34, the output of the control transistor 80 is also coupled through conductor 54 and a resistor 120 to act as the trigger for the bi-stable multi-vibrator 52 which controls the "ball 1" and "ball 2" lights 30 and 32. The "ball 1" light is connected as the load for a transistor 122, and "ball 2" light is connected as a load for a transistor 124, both of said transistors having their bases connected respectively to the anodes of a pair of diodes 126, the cathodes of which are connected through capacitors 127 to said trigger resistor 120. The collector of each transistor is connected by a resistor 128 to the cathode of the diode 126 which is connected to its base. Conventionally, the base of each transistor is connected to the collector of the opposite transistor by coupling resistors 129. The base of transistor 122 is also connected to the cathode of a diode 130, the other end of which is connected through a resistor 132 and along conductor 58 to the reset circuit 56, as shown in FIG. 3b, for initialization purposes.

The light 26 for indicating strikes is connected by conductor 136 to the switching circuit 60, as shown in FIG. 3b. Said light 26 is connected as the load for an NPN transistor 140 having its base connected through a diode 141 to the junction of a pair of resistors 142 and 143. The other end of resistor 142 is connected to ground, and the other end of resistor 143 is connected through a resistor 144 to the collector of a second NPN transistor 146. The transistor 146 has its emitter connected to ground and its base connected through a capacitor 148 to the collector of a third transistor 150 which combines with transistor 146 to form an astable multi-vibrator. The base of transistor 150 is also interconnected with the collector of transistor 146 by a capacitor 152, and it has its emitter connected to the junction point of a voltage divider formed by resistors 154 and 156. Transistor 146 receives its supply and bias currents through resistors 158 and 160 respectively, and transistor 150 receives its supply current and bias current through resistors 162 and 164 respectively. The strike light control transistor 140 is normally held in a non-conductive state by means of a pair of diodes 166 and 168 having their anodes connected together and to the junction of resistors 143 and 144, and having their cathodes connected respectively to the output of the "ball 2" transistor 124 along conductor 62, and along conductor 61 to a sensing point in each of the pin light control circuits 41-50. Thus, the paths for current through the diodes 166 and 168 hold the base bias voltage of transistor 140 at a low value until a strike occurs, thereby closing off these paths for current and allowing the astable multi-vibrator to drive said transistor 140 to cause the strike light to flash.

The spare light 27 is connected by conductor 166 as a load for a switching transistor 170 having its emitter connected to ground and its base connected through a diode 172 to a voltage divider formed by resistors 174 and 176. Resistor 176 also combines with a resistor 178 to form a voltage divider, the junction of which is connected to the anodes of a pair of diodes 180 and 182. The cathodes of the diodes 180 and 182 are connected respectively to said sensing point in each of the pin light control circuits along conductor 61, and to the output of the "ball 1" control circuit at transistor 122 along conductor 65.

Finally, the reset circuit is shown as comprising a monostable multi-vibrator having a 15 msec duration of "on" time and being formed by a pair of switching transistors 184 and 186. Transistor 184 is of the PNP type and has its emitter connected to the positive supply voltage and its collector connected along conductor 58 to control the base electrode of the "ball 1" transistor 122. The collector is also connected through a pair of resistors 188 and 190 to ground. The junction of those two resistors forms the second output of the reset circuit, and it is connected along conductor 66 to the pin light control circuits to reset said circuits after a player has completed his turn. The base of transistor 184 is connected through a resistor 185 to the collector of the second transistor 186, and the base of said second transistor is connected to be triggered by input signals coupled through three diodes 191, 192 and 193 having their cathodes connected together and to the base of said second transistor.

The anode of diode 191 is coupled through a resistor 194 to ground, and to the anode of another diode 196 having its cathode coupled to said sensing point in the pin light control circuits through conductor 61. The anode of diode 191 is also coupled through a capacitor 198 to the "ball 1" control transistor 122 along conductor 65, and the anode of diode 192 is coupled through a resistor 200 to ground and through a capacitor 202 to the "ball 2" control transistor 124 through conductor 62. Finally, the anode of diode 193 is coupled through a capacitor 204 to the B+ line 78 and through a resistor 206 to ground. The base and emitter electrodes of transistor 186 are connected through resistors 208 and 210 to ground, and said base electrode is also connected through a resistor 212 and a capacitor 214 to the collector of transistor 184.

FIG. 3c shows the pin light switches A-C and V-Z, and the logic circuitry and control circuitry which controls the pin-lights 1 through 5; and FIG. 3d shows the control circuits for pin lights 6 through 10 together with said pin light switches. The pin light switches are of the normally closed micro-switch type, and each has one side connected to ground while their other sides are connected through respective resistors 220 to the B+ line 78 as coupled through a conductor 221 and the transistor 84 in FIG. 3a. A capacitor 222 is coupled from the lead 221 to ground. Each junction 223 of resistor and switch is connected to the logic circuitry along leads 224, and each such junction 223 associated with switches V, W, X, Y and Z is also connected to the anode of the corresponding diode 112 V, 112 W, 112 X, 112 Y and 112 Z along leads 226. Such junctions 223 associated with switches V-Z are also connected through respective resistors 228 and along conductors 229 to the logic circuitry.

The control circuits for the pin lights are all identical, and the circuit for pin light 1 is representative thereof. It comprises a pair of transistors 250 and 252 connected to form a bi-stable multi-vibrator having the base electrode of each transistor coupled respectively through resistors 254 and 256 to the opposite collector. Such transistors are of the NPN type and have their emitters connected to ground, and their collectors connected respectively through the lamp 1 to B+ and through a resistor 258 to the B+ line. The output 66 of the reset circuit connected from the junction of resistors 188 and 190 is connected through respective diodes 260 to the base of the first transistor in each control circuit so that when the reset circuit sends out a signal the first transistor 250 in each control circuit conducts to turn on its corresponding pin light. The lights stay on until their corresponding multi-vibrators are switched by means of a signal applied to the base of the second transistor 252 in the multi-vibrators. Such signals are received through the logic circuitry 37 from the pin switches, and in the case of pin light 1, the signal is coupled along a path to the base of the second transistor 252 in the control circuit from the cathode of a diode 262, the anode of which is connected to the switch B along lead 224B. Therefore, whenever switch B is actuated, a signal is conducted through the diode to the base of the second transistor to switch the control circuit and turn out the lamp 1. Similarly, as can be seen from the drawing, the base of the second transistor 252 in the control circuit for lamp 2 is connected through an OR circuit formed by a pair of diodes 264 and 266 to both switches A and B; the base of the second transistor in the control circuit for lamp 3 is connected through diodes 268 and 270 to the switches B and C; the base of the second transistor in the control circuit for lamp 4 is connected through diodes 272, 274 and 276 to switches A, B, and W; and, the base of the second transistor for pin light 5 is connected through diodes 278 and 280 to switches B and X. Furthermore, the control circuits each have sensing components coupled thereto for determining whether the first transistor in the circuit is conducting, and therefore whether its light is turned on. Such sensing circuits comprise diode 282 and resistor 284 for each control circuit, each pair being connected in series with their junction connected to the collector of the first transistor in the control circuit and the opposite side of the resistor connected to ground, while the anodes of the diodes are connected in common and to the strike, spare, and reset circuits along lead 61.

Looking now to FIG. 3d wherein the pin light control circuits are identical to those shown in FIG. 3c, the base of the second transistor for pin light 6 is connected through diodes 290, 292 and 294 to the switches B, C and Y, along leads 224 B, 224C and 229Y, respectively. The logic circuits which control the pin lights 7, 8, 9 and 10 have OR circuits, as described for lights 2-6, and also AND circuits coupled to the pin switches. For pin light 7 the base of the second transistor is connected to the common cathodes of three diodes 296, 298 and 300, the anodes of which are connected respectively to switches V and W, and to the common anodes of another trio diodes 303, 304, and 306. The cathodes of that second trio of diodes are connected respectively to switches X and Y and to the output of

the "ball 2" transistor 124 along lead 62. Said anodes are also coupled through a resistor 308 to the B+ line 78. Regarding the control circuits for pin light 8, the OR circuit has three diodes 310, 312 and 314, and the AND circuit has two diodes 316 and 317; the OR circuit diodes being connected respectively to switches W and X, and to the common anodes of the AND diodes. Again, the anodes of the AND diodes are connected through a resistor 315 to B+, and the cathodes are connected to pin switches Y and Z. The logic configuration for the control circuit for pin light 9 is identical to that of pin light 8 with the anodes of two OR diodes 318 and 320 connected to switches X and Y; the anode of the third OR diode 322 connected to the anodes of the AND diodes; the cathodes of the AND diodes 324 and 326 connected to switches V and W; and, the anodes of the AND diodes connected through a resistor 328 to B+. Finally, the control circuit for pin light 10 comprises three OR diodes 330, 332 and 334, and three AND diodes 336, 338 and 340, with the OR diodes being connected respectively to switches Y and Z and to the anodes of the AND diodes, and the cathode of the AND diodes being connected to switches W and X and to the output of the "ball 2" transistor 124 along lead 62. Said AND diode anodes also being connected through a resistor 342 to the B+ line 78.

OPERATION

In the operation of the device, when power is first applied, a charge current flows in the reset circuit 56, as shown in FIG. 3b, through capacitor 204 and through diode 193 to the base of transistor 186 which begins to conduct thereby turning on transistor 184 and applying the B+ voltage along lead 58 to the resistor 132 and the diode 130 of the ball counter control circuit. The cathode of diode 130 is connected to the base of transistor 122 thereby turning it on and turning on the "ball 1" light 30. As the transistor 184 is turned on, current flows through resistors 188 and 190 causing a voltage drop across resistor 190 which applies a positive voltage along the lead 66 to the reset leads in the pin light control circuits and, for example, through the diode 260 in the control circuit for light 1 to the base of the first transistor 250 to turn on the pin light 1. Similarly, that positive voltage is connected through the diodes 260 in each of the pin light control circuits to turn on all of the pin lights when said voltage drop exists across resistor 190. Finally, when capacitor 204 continues to charge, the base current decreases in transistor 186 to the point where conduction ceases and both transistors 184 and 186 are cut off. Simultaneously with the action described above in the reset circuit, a base bias is applied to the base of transistor 86 in the ready circuit 40 causing that transistor to turn on and to turn on transistor 84. Conduction of transistor 84 applies a positive voltage to resistor 82 which feeds a base current into transistor 80 thereby turning it on and turning on the ready light 34. As transistor 84 conducts, a charging current is applied to capacitor 100 which charges up through resistor 96 and through capacitor 104 and resistor 106 to ground.

As described above, all of the pin light switches are normally closed, and therefore the anodes of the diodes 112V through 112Z are all at ground potential. The switches V-Z are so spaced that when the puck is

propelled down the alley to contact the bumper 28, at least one of the pin switches V-Z will be actuated and will open up thereby allowing current to flow from conductor 221 through the resistor 220V-220Z, which is associated with the open switch, to the anode of its associated diode 112V-112Z. Similarly, the open condition of the switch will couple a positive voltage from the lead 221 through the associated resistor 220 to one of the logic diodes and therefore to at least one of the light control circuits. When a voltage is applied to one of the diodes 112, it is coupled through the resistor 110 to charge capacitor 108. Said capacitor 108 serves as a sensitivity device and prevents the circuit from being tripped accidentally, as by a physical shock to the game board, and requires that the pin switch which generated the positive voltage be opened for at least one millisecond to allow the capacitor 108 to charge. When the switch which was opened by the puck recloses to its normally closed position, the voltage through the diode 112 is removed and the negative going wave form is differentiated by capacitor 104 and coupled to the base of transistor 86. Such a negative pulse at the base of the transistor 86 causes it to decrease its conduction thereby decreasing conduction of transistor 84 and conducting the result of the negative pulse at the collector transistor 84 through the speed-up capacitor 88 to cut off the transistor 86. B+ for all of the pin switches is supplied through the transistor 84 and conductor 221, and therefore when it is cut off, the supply voltage to the pin switch resistors is cut off, and this prevents the puck from actuating any of the pin light control circuits as said puck rebounds off the bumper 28 on its return path. The capacitor 222, connected between conductor 221 and ground, absorbs surges caused by the lights 1-10 being turned on and off. The negative voltage at the collector of transistor 84 is also coupled through the resistor 82 to the base of transistor 80 to turn it off, thereby turning off the ready light 34 and applying a positive voltage to the coupling resistor 120. This allows the capacitors 127 to charge through the resistor 128 of the conducting transistor, which in the initial case is transistor 122. Subsequently, the capacitor 100 discharges through the resistors 98, 94, and 96. At the end of the discharge time constant determined by those components, a positive base current will again be permitted to flow through the resistor 92 to again supply drive current to transistor 86. As conduction of transistor 86 begins, the transistor 84 also conducts and the positive pulse at the collector thereof is coupled to the speed-up capacitor 88 to turn the transistor 86 into a full conductive state thereby saturating transistor 84 and coupling a positive voltage through resistor 82 to the base of transistor 80. As transistor 80 is turned on, the ready light is turned on, and the negative voltage is coupled from the collector of transistor 80 through resistor 120 and through one of the charged capacitors 128 to the base of the conducting transistor, which in this case is transistor 122. At this time "ball 1" light is turned off and the multi-vibrator switches so that transistor 124 conducts, thereby turning on the "ball 2" light 32. If the player was successful in turning out all of the pin lights on his first turn, then during the timing cycle of capacitor 100 the "ball 2" light would have been off and all of the pin lights would be turned off, thereby removing the con-

ductive paths through the diodes 166 and 168 and allowing current to flow through the series combination of resistors 142, 143, and 144. Under these conditions transistor 140 will be driven by the signal present at the collector of transistor 146. The purpose of diode 141 is to increase the input impedance to transistor 140 so that it will not conduct inadvertently at high ambient temperatures. Since the transistors 150 and 146 form an astable multi-vibrator the strike light operates in a flashing manner as the transistors switch back and forth from a conductive to a non-conductive state. Furthermore, if a strike is thrown, so that all of the pin lights are turned off, the current path through diode 196 would be removed thereby causing a positive voltage to appear at the anode of diode 191 when the "ball 1" light is turned off. Such a positive voltage would be coupled to the base electrode of transistor 186 causing it to conduct and initiating the reset output voltages. Again, these reset output voltages cause all of the pin lights to be turned on again, and then also apply a positive voltage along lead 58 to ensure that the "ball 1" transistor would be turned on again. Thus, in summary, if a strike was thrown, all of the pin lights would be turned off, the strike light would flash, and subsequently the pin lights would again be turned on, the ready light would be turned on, and the "ball 1" light would be turned on. If on this first turn the player was not successful in turning out all of the pin lights, then the reset circuit would not be actuated and the "ball 2" light would remain on for the next turn.

On the second turn the pin switches again control the pin light control circuits, and at least one of the switches V-Z will be actuated as the puck approaches the bumper 28. Thus, when one of those switches is opened, a positive voltage will again be coupled through at least one of the diodes 112V-112Z to reinitiate the timing cycle of the ready light circuit. Again, if all of the pin lights were turned off by the puck on the second turn, then the spare light will come on due to the flow of current through the diode 172 since there will be no path for current through diodes 180 and 182 which are coupled respectively to the sensing circuits of the pin light control circuits through lead 61 and to the collector of the "ball 1" transistor 122 along lead 65. After the second turn, when the ready light circuit completes its timing cycle and the ready light is turned on, the voltage at the collector of transistor 80 will decrease thereby turning off the "ball 2" light and causing the voltage at the collector of transistor 124 to increase and apply a positive pulse along lead 62 and through capacitor 202 in the reset circuit thereby causing conduction of transistor 186 and starting the reset timing cycle which has a duration of 15 milliseconds.

In the operation of the pin lights, actuation of switch B by the puck allows a positive voltage to be coupled along lead 224B and through the diode 262 to the base of transistor 252 in the control circuit for lamp 1, causing that transistor to conduct and cut off transistor 250, and thereby turning off lamp 1. In a similar manner, actuation of either switch A or B turns off lamp 2; actuation of either switch B or C turns off lamp 3; actuation of either of switches A, B or W turns off lamp 4; actuation of either switch B or X turns off lamp 5; actuation of either of switches B, C or Y turns off lamp 6; actua-

tion of either switch V or W turns off lamp 7. Furthermore, the AND diodes turn off lamp 7 when X and Y are actuated simultaneously and while the "ball 2" transistor is not conducting, since under these conditions current will flow through resistor 208 and diode 300 to the base of the second transistor 252 of control circuit 47; actuation of either switch W or X turns off lamp 8, and also, the AND diodes allow the multi-vibrator for lamp 8 to be switched due to current through resistor 315 and diode 314 when there is a simultaneous actuation of switches Y and Z; actuation of either switch X or Y turns off lamp 9, and also, simultaneous actuation of switches V and W turns off lamp 9 due to current flow at that time through resistor 328 and diode 322; and, actuation of either switch Y or Z turns off lamp 10; or, the simultaneous actuation of switches X and W, and the non-conducting condition of the "ball 2" transistor will allow current to flow through resistor 342 and diode 334 to turn off lamp 10.

It is seen, therefore, that the embodiment of the invention disclosed herein, describes a device which closely simulates as actual bowling game, and which provided electronic control circuitry for scoring the game.

We claim:

1. A bowling game having electronically controlled scoring means, comprising a disc for sliding movement to actuate the scoring means, a platform forming a simulated bowling alley having a player end and a scoring end, said scoring end having means for returning discs to the player end along said platform 10 lights mounted with relation to said platform in a triangular-shaped configuration, and a corresponding plurality of solid state switching circuits connected to said lights for controlling the operation thereof; a plurality of electrical switches, each having actuating means, said actuating means being mounted with relation to said platform for actuation by movement of said disc along said platform; a plurality of solid state logic circuits coupled between said electrical switches and said solid state switching circuits, said plurality of electrical switches being fewer than 10; said logic circuits being operatively responsive to actuation of said switches by said disc to actuate said switching circuits and; solid state circuit means making said logic circuits non-responsive to actuation of said switches by said disc as said disc is returned to said player end of said platform by said disc return means.

2. The invention as set forth in claim 1 in which said triangular configuration of lights are mounted in said platform, thereby forming a target for the slidable disc.

3. The invention as set forth in claim 2 with the addition of a spare indicator light and a solid state control circuit therefor, and a strike indicator light and a solid state control circuit therefor, said solid state spare light control circuit being coupled to said solid state switching circuits for operating said spare indicator light when all of the alley lights are turned off in two consecutive actuations of said electrical switches by the disc, and said solid state strike light control circuit being coupled to said solid state switching circuits for operating said strike light when all of said alley lights are turned off by a single actuation of said electrical switches by the disc.

4. The invention as set forth in claim 3, including circuit means for preventing actuation of said solid state logic circuits when said platform is subjected to a physical shock.

5. The invention as set forth in claim 1 wherein there are eight of said electrical switches for controlling operation of said lights and including circuit means for preventing actuation of said solid state logic circuits when said platform is subjected to a physical shock.

6. The invention as set forth in claim 1 wherein said lights correspond to the 10 pins of an actual bowling alley and are mounted in said platform, thereby forming a target for said slidable disc; and, in which there are eight of said electrical switches, all having mechanical actuators mounted in said platform and projecting thereabove for actuation by said slidable disc.

7. The invention as set forth in claim 1 with the addition of circuit means for preventing actuation of said solid state logic circuits when said platform is subjected to a physical shock.

8. A bowling game having electronically controlled scoring means, comprising a disc for sliding movement to actuate the scoring means, a platform forming a simulated bowling alley having a player end and a scoring end, said scoring end having means for returning discs to the player end along said platform; 10 lights mounted with relation to said platform in a triangular-shaped configuration, and ten corresponding solid state switching circuits connected to said lights for controlling the operation thereof; a plurality of electrical switches, each having actuating means, said actuating means being mounted with relation to said platform for

actuation by movement of the disc along said platform; a plurality of solid state logic circuits coupled between said electrical switches and said solid state switching circuits, said plurality of solid state logic circuits being fewer than said 10 lights; said logic circuits being operatively responsive to actuation of said switches by said disc to actuate said switching circuits; solid state circuit means making said logic circuits non-responsive to actuation of said switches by said disc as said disc is returned to said player end of said platform by said disc return means; a spare indicator light and a solid state control circuit therefor, a strike indicator light and a solid state control circuit therefor, said solid state spare light control circuit being coupled to said solid state switching circuits for operating said spare indicator light when all of the alley lights are turned off in two consecutive actuations of said electrical switches by the disc, and said solid state strike light control circuit being coupled to said solid state switching circuits for operating said strike light when all of said alley lights are turned off by a single actuation of said electrical switches by the disc; said switching circuits being coupled to said logic circuits for operatively turning off said lights, and a solid state reset circuit coupled to said switching circuits and said logic circuits for operatively turning on said lights.

9. The invention as set forth in claim 8 with the addition of a ready light and a solid state control circuit therefor, said ready light being for indicating that all of said solid state circuits are in stable states awaiting actuation of said electrical switches.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,703,288 Dated November 21, 1972

Inventor(s) John D. Vogel; William N. Canfield

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

In the Issue Date, change "Nov. 21, 1921" to --Nov. 21, 1972--.

Column 1, line 41, change "in" to --is--.

Column 7, line 47, change "similarly" to --Similarly--.

Column 8, line 28, change "B+O" to --B+--.

Column 10, line 23, change "as" to --an--.

Column 10, line 24, change "provided" to --provides--.

Signed and sealed this 25th day of December 1973.

(SEAL)
Attest:

EDWARD M. FLETCHER, JR
Attesting Officer

RENE D. TEGTMEYER
Acting Commissioner of Patents