March 7, 1967 F. S. BRACKETT ETAL 3,307,848

BOWLING PIN DETECTING APPARATUS

Filed Oct. 9, 1963 5 Sheets-Sheet 1

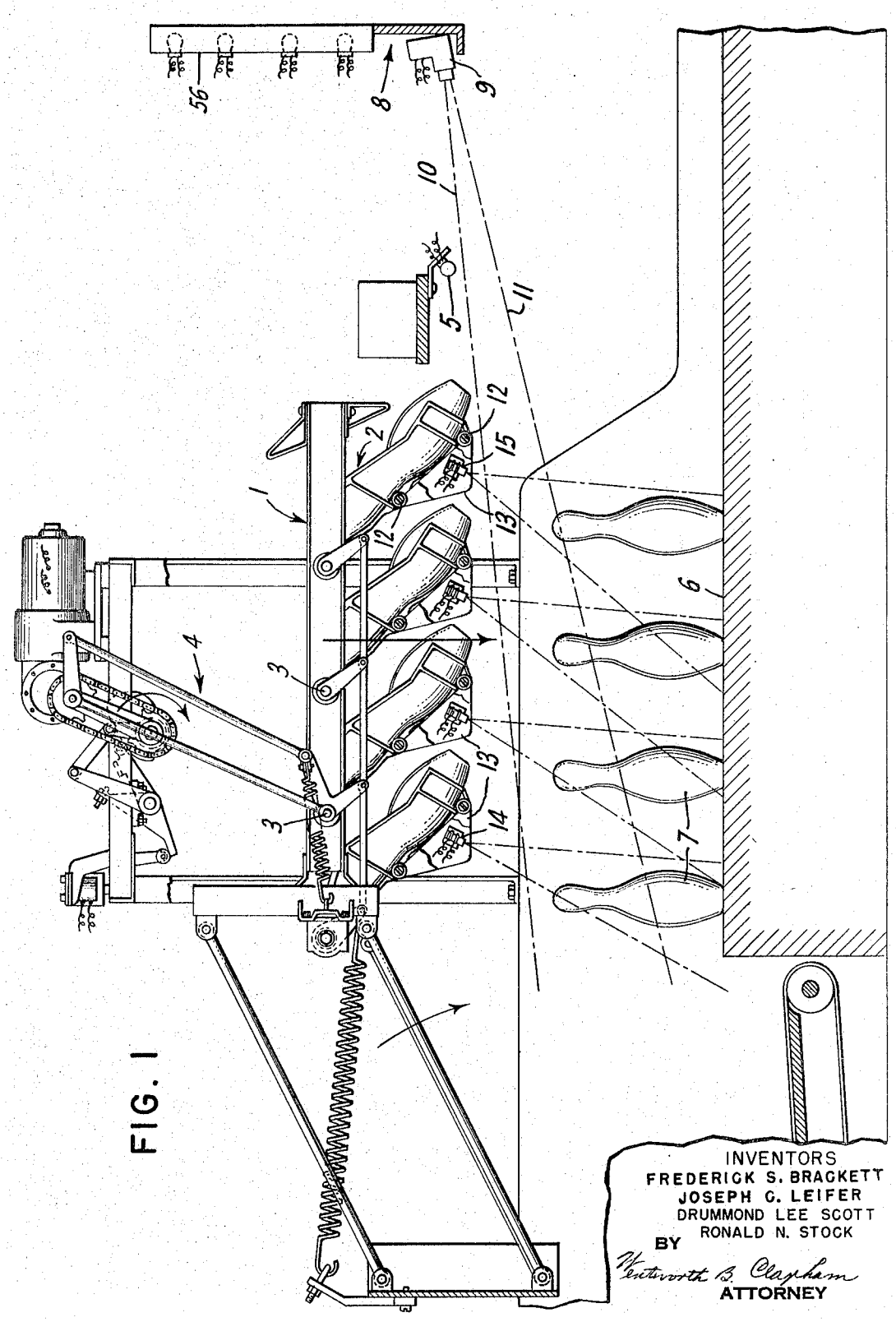


FIG. 1

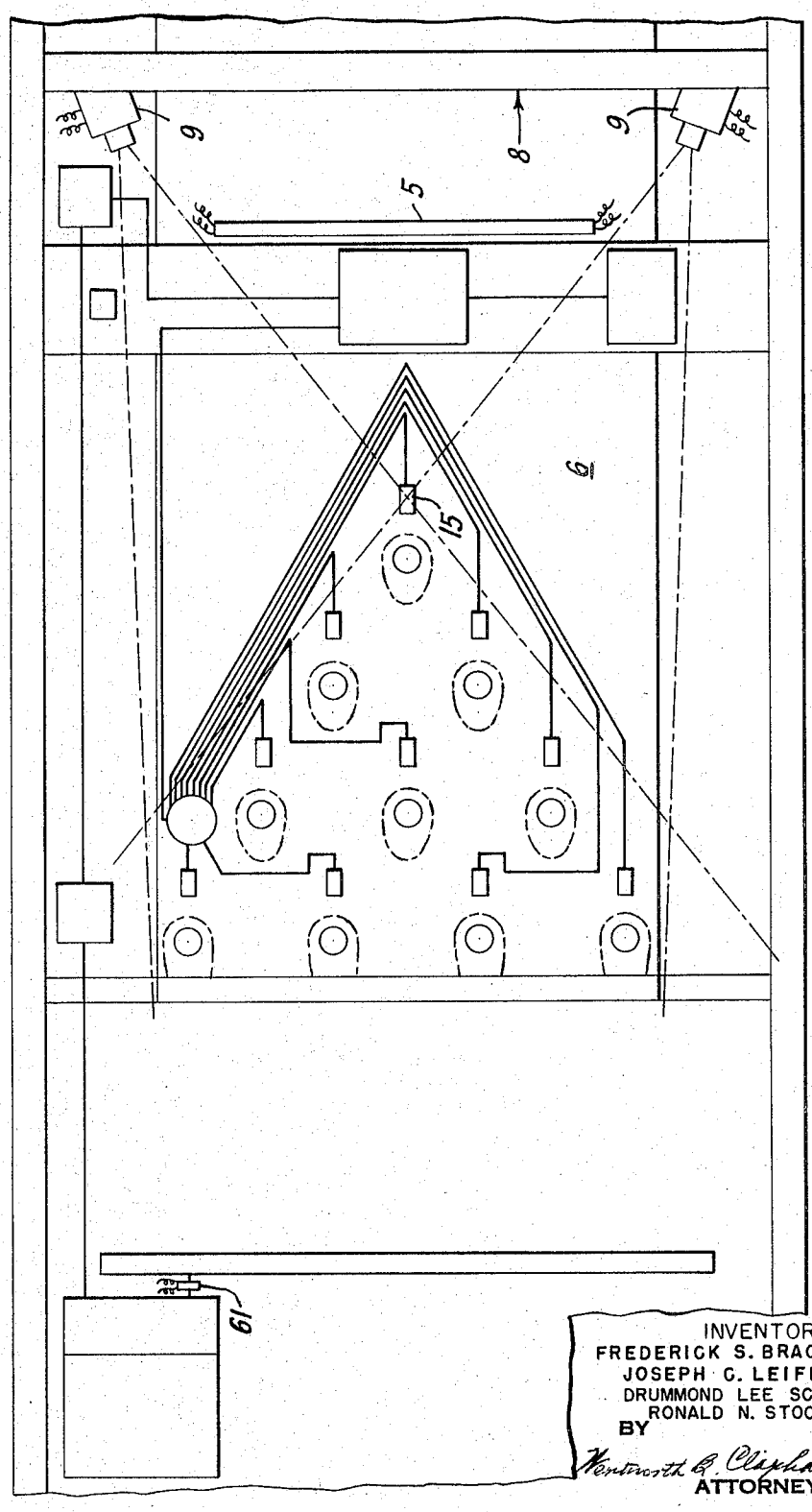
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BOWLING PIN DETECTING APPARATUS

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FIG. 2



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FIG. 3

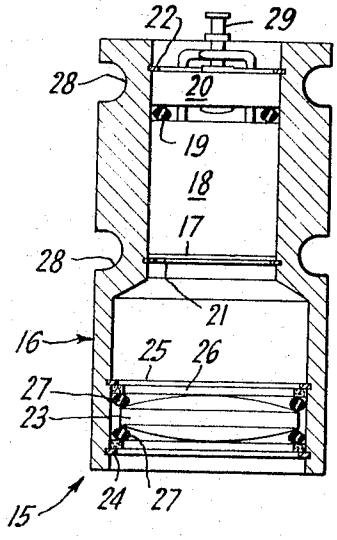
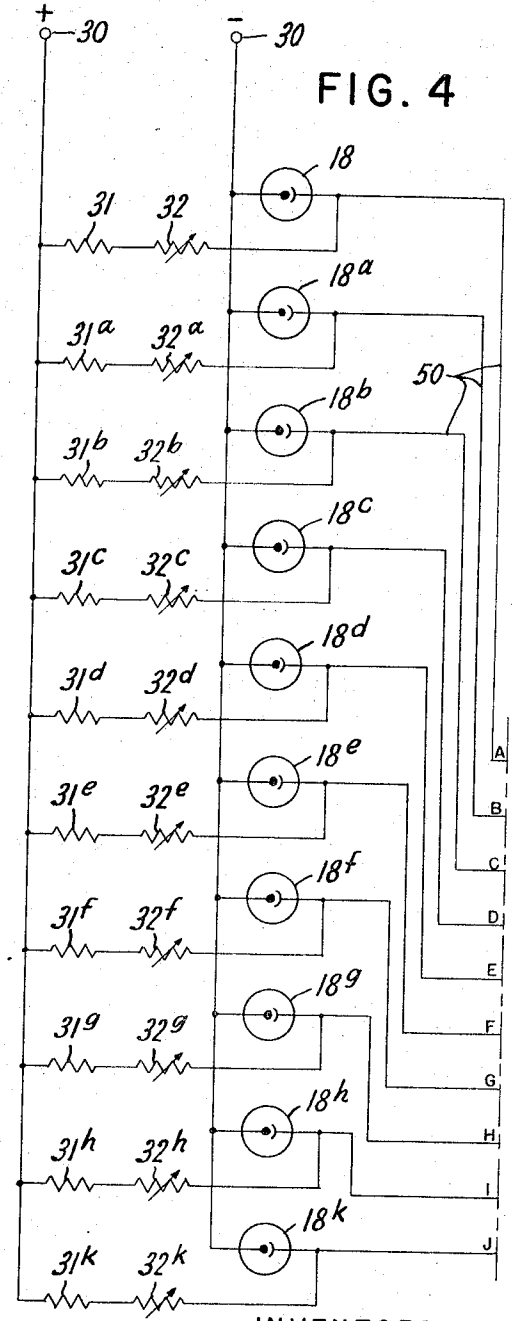


FIG. 4



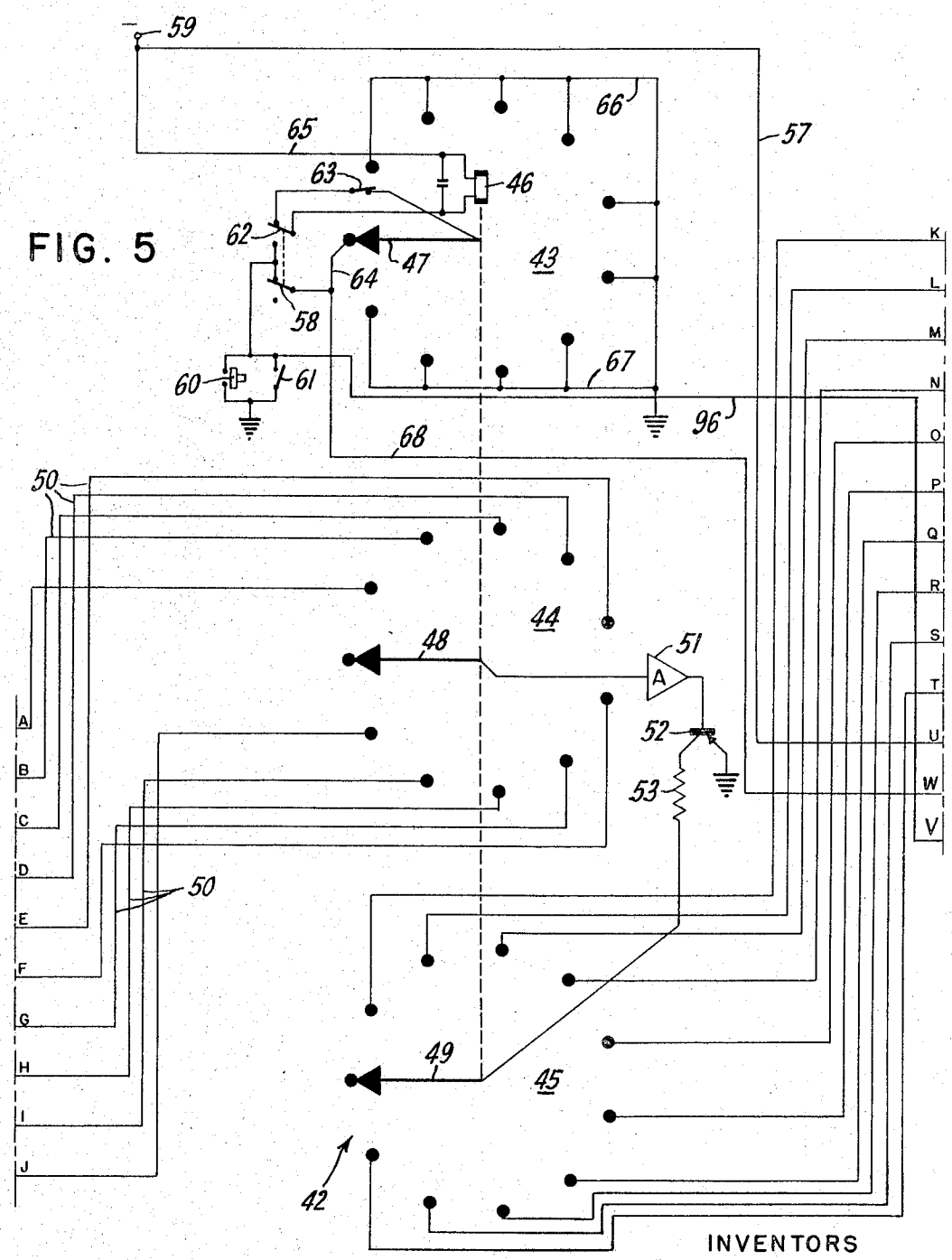
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BOWLING PIN DETECTING APPARATUS

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FIG. 5



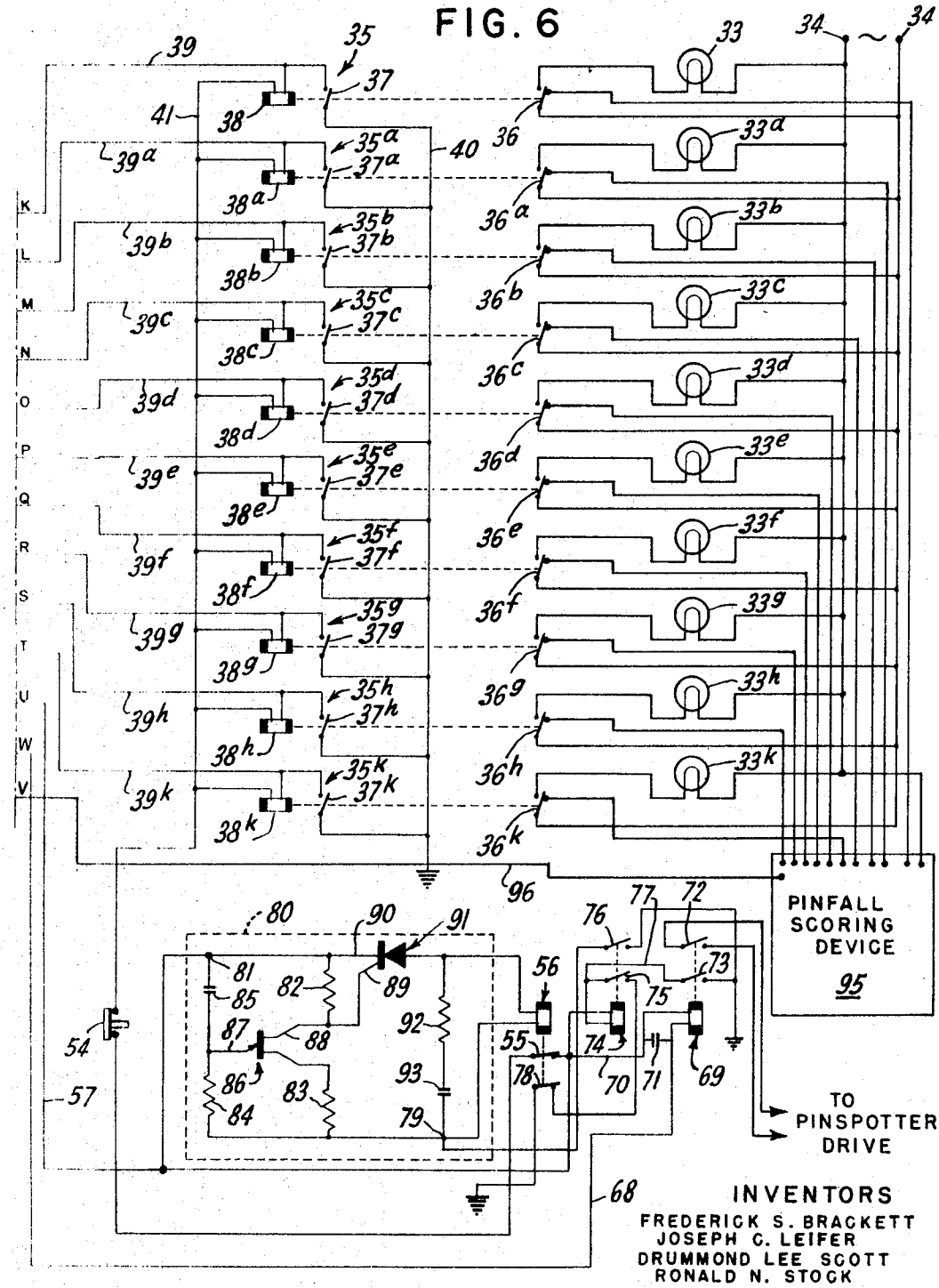
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BOWLING PIN DETECTING APPARATUS

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FIG. 6



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3,307,848

BOWLING PIN DETECTING APPARATUS

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Filed Oct. 9, 1963, Ser. No. 315,015
8 Claims. (Cl. 273—54)

This invention relates to bowling alley equipment and particularly to bowling alley installations incorporating improved means for providing information as to which pins are standing on the pin deck.

A number of systems have heretofore been proposed for providing information, usually in the form of electrical signals, as to the pins standing on the pin deck of a bowling alley at various stages of play. Some such systems have employed sensing switches associated with the pin-handling devices of the spotting table of an automatic pin spotter. Other systems have been proposed which require sensing devices each embedded in the pin deck at one of the pin spots. Still other systems proposed in the past have depended upon photoelectric devices for detecting the presence or absence of standing pins.

While photoelectric systems for providing information about standing pins have some distinct advantages, including speed of operation, freedom from dependence on mechanical devices, and avoidance of devices embedded in the pin deck, attempts to provide successful photoelectric pin sensing systems have met with considerable difficulty because of the fact that the entire area of the pin deck must be well illuminated with visible light for the benefit of the players, the visible illumination falling as well on fallen pins as on standing pins, so that ordinary photoelectric systems fail to distinguish adequately between standing and fallen pins.

It is accordingly a general object of this invention to provide an improved photoelectric system capable of responding only to standing pins even though the entire pin deck, and all fallen pins thereon, are subjected to visible light.

Another object is to provide improved means for photoelectrically scanning or otherwise observing only the standing pins on the pin deck and providing electrical signals, or other meaningful information, as the locations and/or number of the standing pins.

Another object is to provide a dependable photoelectric device which can be employed to provide information as to the locations and/or number of either standing pins or fallen pins. Thus, for example, the invention can be employed simply as a standing pin indicator, or both for indicating standing pins and providing a score dependent on the pinfall, or simply for responding to the pinfall.

A further object is to devise a simple and particularly dependable means for providing information as to which pins remain standing on the pin deck, such information being useful, for example, for operating visible display or indicating means, automatic scoring means, or electrical computing equipment of various types which can be employed in bowling alley installations.

Stated generally, the invention employs means for projecting across the space above the pin deck a beam or beams of light at least predominantly in a portion (e.g., red, infrared or ultraviolet) of the electromagnetic spectrum which is distinguishable from that portion of the spectrum occupied by the visible light employed to illuminate pins for view by the players, the projected light being confined to an area which includes the top portions of all standing pins but is spaced above the pin deck by

a distance greater than the major diameter of a bowling pin so that the projected light does not strike fallen pins, and employing a plurality of photoelectric transducers each focused on the area occupied by the upper portion of a pin standing on a different one of the pin spots or positions on the deck. For simplicity, the term "infrared" will be employed hereinafter to refere to the generally invisible light employed for detection of the standing pins, but it is to be understood that the invention is not limited to the use of infrared light. Since the projection infrared light is confined to an area above the fallen pins, and since the photoelectric transducers employed are insensitive to light in the visible portion of the spectrum, the system indicates only standing pins despite the presence of full visible illumination of the pin deck.

In order that the manner in which the foregoing and other objects are achieved in accordance with the invention can be undestood in detail, reference is had to the accompanying drawings, which form a part of this specification, and wherein:

FIGURE 1 is a partial side elevational view of a bowling alley installation constructed in accordance with one embodiment of the invention;

FIGURE 2 is a diagrammatic plan view of the bowling alley installation of FIGURE 1;

FIGURE 3 is a vertical sectional view of one of the photoelectric transducer units employed in the bowling alley installation of FIGURE 1; and

FIGURES 4–6 combine to illustrate the electrical circuit of the bowling alley installation of FIGURE 1.

Referring now to the drawings in detail, and first to FIGURES 1 and 2, the invention is here illustrated as applied to a bowling pin spotting machine having a spoting mechanism of the type disclosed in U.S. Patent 2,755,089, issued July 17, 1956, to John Zuercher, and including a horizontal frame **1** on which are mounted ten spotting cups **2**. The spotting cups are arranged in the usual triangular plan and each cup is mounted to swing about the horizontal axis of one of the shafts **3**. Vertical movement of frame **1** upwardly and downwardly is accomplished by the drive means indicated generally at **4** and the same mechanism causes oscillation of shafts **3** in such fashion that, as the frame descends, the cups swing downwardly to pin-depositing position but, during upward travel of the frame, are always swung back to their initial positions, seen in FIGURE 1.

At the end of the pin spotter which is directed toward the players' end of the alley, a fluorescent lamp **5**, or other suitable source of visible light, is mounted in such fashion as to direct light downwardly and rearwardly to illuminate the entire pin deck **6** and the bowling pins **7** standing thereon.

The installation also includes a frontal mask unit indicated generally at **8**, the lower edge of mask unit **8** being spaced above the alley bed by about the same distance as are the pin cups **2** when the latter are in their raised positions, as seen in FIGURE 2. Mask unit **8** carries two light projectors **9** of conventional construction, each projector **9** being disposed adjacent a different end of the mask and at the bottom edge thereof. The projectors **9** are each so positioned that the light projected thereby will be directed rearwardly and across the alley, as will be clear from FIGURE 2, and at such a small downward angle, as will be clear from FIGURE 1, that the projected light will traverse the locations of the tops of all standing pins but will not approach close enough to the pin deck to impinge upon any fallen pins, regardless of their positions. Thus, the upper and lower limits of the projected beams of light emanating from projectors **9** are indicated at **10** and **11** in FIGURE 1 and it will be noted that the beams pass into the pit of the alley, the lower limits **11** of the beams being spaced

bove the pin deck by a distance greater than the major liameter of a pin even at the edge of the pit. Each pro-ector 9 is equipped with a red filter capable of passing ight having wavelengths greater than 0.75 micron, so hat the light directed onto the standing pins by the pro-ectors is both invisible to the players and of markedly lifferent spectral characteristics than the visible light pro-ided by lamp 5.

As fully described in the aforementioned Patent 2,755,-89, each cup 2 comprises two half sections secured to-ether by bolts 12. In accordance with this invention, the olts 12 secure to each cup 2 two vertically disposed nounting plates 13. To each plate 13 there is secured, as y U-bolts 14, a photoelectric transducer unit 15. The ransducer is mounted between the plates for protection rom flying pins. As will be clear from FIGURE 1, each ransducer unit 15 is focused downwardly and slight rear-tanding pin 7, so as to receive that light, originating from vardly toward the position occupied by the corresponding tanding pin 7, so as to receive that light, originating from rojectors 9, which is reflected from the upwardly directed urfaces of the standing pin. The angle of acceptance of ach photodetector is such that it detects reflected infra-ed light from the corresponding pin over the entire re-pot area without detecting reflected light from a pin in n adjacent respot area.

As seen in FIGURE 3, each transducer unit 15 com-rises a tubular housing 16 having at its top a bore por-on of smaller diameter accommodating a red filter 17, photoelectric transducer 18, advantageously of the cad-ium selenide, low impedance photosensitive resistance ype, an O-ring spacer 19, and the header cell 20, the ombination of elements 17–20 being retained between pair of snap rings 21 and 22 disposed in suitable grooves n the wall of the bore of housing 16. At its opposite nd, the housing 16 supports a suitable lens 23, the lens eing retained by snap rings 24 and 25, fiber washers 6 and O-ring spacer 27. It will be apparent that the ens 23 serves to focus the transducer unit on the desired elatively small area and that the filter 17 renders the ransducer unit responsive only to light in the desired nvisible, infrared portion of the spectrum. Housing 16 provided with two spaced transverse annular grooves 28 o accommodate the U-bolts 14 for mounting the trans-ucer units on plates 13. Connections to the photoelectric ransducer are made via the conventional terminals 29.

Turning now to FIGURE 4, it will be seen that all of he photoelectric transducers 18–18*k* are connected to he same D.C. supply terminals 30. Connected in series ith transducer 18 are a fixed resistance 31 and a variable esistance 32, the series combination of transducer 18, xed resistance 31 and variable resistance 32 being con-ected across the supply terminals. In identical fashion, ransducer 18*a* is connected in series with a fixed resist-nce 31*a* and a variable resistance 32*a*, and the series com-ination of transducer 18*a*, fixed resistance 31*a* and ariable resistance 32*a* is connected across supply erminals 30 in parallel with the series combination f transducer 18, fixed resistance 31 and variable re-stance 32. As shown, each of transducers 18*b*–18*k* are milarly connected in series with a fixed resistance and variable resistance and the series combination of the ransducer, fixed resistance and variable resistance is in ach case connected to the supply terminals as just de-cribed.

As electrical indicating devices, this embodiment of the nvention employs ten incandescent lamps 33–33*k*, FIG-RE 6, all of the lamps 33–33*k* being connected in par-allel across A.C. supply terminals 34. For each lamp 3, there is employed an electromagnetic relay having a et of single pole double throw contacts and a set of single ole single throw normally open contacts. Thus, lamp 33 controlled by the relay indicated generally at 35 which as single pole double throw contacts 36, single pole single row contacts 37 and an actuating winding 38. The series combination of lamp 33 and the normally open fixed contact and the movable contact of contact set 36 is connected across supply terminals 34 so that the lamp can be energized only when relay 35 operates to shift the movable contact of contact set 36 into engagement with the normally open fixed contact. One terminal of winding 38 is connected both to conductor 39 and, via contact set 37, to grounded conductor 40. The remaining terminal of winding 38 is connected to conductor 41. As will be later described, winding 38 is initially energized by current via conductors 39 and 41, so that contact sets 36 and 37 are closed. Closing of contact set 47 completes a holding circuit which maintains the winding energized, as hereinafter described. Lamp 33*a* is similarly associated with relay 35*a*, the normally open fixed contact and the movable contact of contact set 36*a* of this relay being connected in series with the lamp and the second contact set 37*a* thereof being connected between one terminal of actuating winding 38*a* and conductor 40, this terminal also being connected to conductor 39*a*. The remaining terminal of winding 38*a* is connected to conductor 41. All of relays 35*b*–35*k* are identically arranged, each being associated with the respective ones of lamps 33*b*–33*k*.

The relays 35–35*k* are controlled in accordance with the operative conditions of the respective ones of photoelectric transducers 18–18*k* via means including the stepping switch indicated generally at 42, FIGURE 5. Stepping switch 42 includes a first contact bank 43, a second contact bank 44, a third contact bank 45, and an actuating winding 46. Contact bank 43 comprises eleven fixed contacts and a movable contact 47, the movable contact being advanced sequentially through the series of fixed contacts as the winding 46 is sequentially energized. Contact bank 44 includes eleven fixed contacts and a movable contact 48, the latter advancing sequentially along the series of fixed contacts during operation of the switch. Contact bank 45 also includes eleven fixed contacts and a movable contact 49. The stepping switch 42 is of conventional construction and it will be understood that the three movable contacts 47–49 move in unison from initial positions, as shown in FIGURE 5, through the complete series of fixed contacts, returning to the initial position at the end of each cycle of operation of the stepping switch.

Save for one fixed contact, hereinafter termed the "initial contact" and with which the movable contact 48 is shown to be engaged in FIGURE 5, each of the fixed contacts of bank 44 is connected to one terminal of a different one of the photoelectric transducers 18–18*k*, by the respective ones of the conductors 50. Movable contact 48 is connected, via conventional D.C. amplifier 51, to the base terminal of a grounded emitter-connected, PNP-type transistor 52. The collector of transistor 52 is connected, via fixed resistance 53, to movable contact 49 of contact bank 45.

Save for the "initial contact" with which movable contact 49 is engaged automatically at the completion of any cycle of operation of the stepping switch 42, each fixed contact of contact bank 45 is connected, via the corresponding one of conductors 39–39*k*, to one terminal of a different one of the relay actuating windings 38–38*k*, as shown.

Assuming that movable contacts 48 and 49 are advanced one position beyond their "initial position," it will be seen that one terminal of photoelectric transducer 18 is connected via its conductor 50 through a fixed contact of the contact bank 44 and movable contact 48 to the D.C. amplifier 51, transistor 52, movable contact 49 and conductor 39 to one side of relay 38. The other terminal of relay 38 is connected to conductor 41 which is connected via reset contactor 54, normally closed contacts 55 of electromagnetic relay 56, and conductor 57 to D.C. supply terminal 59. If at this time transducer 18 is receiving infrared light reflected from the upper portion of a standing pin, a signal will be provided through the path described to cause a sufficient difference of potential across

actuating winding 38 to energize relay 35, thereby closing contacts 37 and the normally open contact of contacts 36. In its closed position, contact 37 provides a ground for one side of winding 38. The other side of winding 38 remains connected to a D.C. supply via conductor 41, as described, and the relay is maintained in held-in position until such time as either reset contactor 54 or electromagnetic relay 56 is actuated to disconnect this D.C. supply. With the relay energized, contacts 36 complete the circuit from A.C. terminal 34 to incandescent lamp 33 and back to the other A.C. terminal 34. It is therefore obvious that, as long as relay 38 is energized, lamp 33 will also be energized. Actuation of movable contacts 48 and 49 to their next successive position similarly causes energization of actuating winding 38*a* of relay 35*a*, with attendant actuation of contact set 36*a* to energize lamp 33*a*, assuming that photoelectric transducer 18*a* is receiving reflected infrared light from the top portion of a standing pin. It will be evident that, as the movable contacts 48 and 49 advance through the fixed contact series of banks 44 and 45, those of lamps 33*b*–33*k* corresponding to the ones of photoelectric transducers 18*b*–18*k* which are receiving infrared light from the top portions of standing pins will be energized.

Referring now to FIGURE 1, it will be seen that the lamps 33–33*k* are supported and forwardly displayed by a suitable mounting box 56 which forms part of the mask unit 8. In box 56, the indicating lamps are arranged in triangular fashion corresponding to the triangular arrangement of the pin positions or spots on the pin deck 6. Accordingly, one complete cycle of operation of the stepping switch 42 will be effective to accomplish energization of appropriate ones of the lamps 33–33*k* and display to the players just which ones of the ten pins are in standing position.

Turning again to FIGURE 5, it will be seen that the "initial position" fixed contact of bank 43 of stepping switch 42 is connected via conductor 64 to the movable contact of a manually operated selector switch 58, the fixed contact of switch 58 being connected to the parallel combination of a normally open push-button switch 60 and a normally open switch 61, and thence to ground. Switch 58 is ganged for simultaneous operation with a single pole double throw switch 62. One fixed contact of switch 62 is connected via the interrupter contacts 63 of the stepper switch 42 to movable contact 47 of bank 43. The movable contact of switch 62 is connected to one terminal of the actuating winding 46 of the stepping switch, the other terminal of winding 46 being connected to D.C. supply terminal 59 via conductor 65. The remaining fixed contact of switch 62 is connected to the fixed contact of switch 58 and, therefore, to switches 50 and 61, as shown.

Switch 61 is operatively associated with the pit cushion (not shown) in such fashion that the switch is closed whenever a bowling ball, having been rolled down the alley, strikes the cushion. Assuming that switch 58 has been actuated manually to the position shown in FIG. 5, such closing of switch 61 will complete a circuit to energize winding 46 from supply terminal 59 via conductor 65, winding 46, the switch 62, interrupter contacts 63, movable contact 47, conductor 64, switch 58, and switch 61 to ground. Thus energized, winding 46 will cause all of movable contacts 47–49 to advance, this action being limited to the amount of movement necessary to bring the movable contacts into engagement with the second fixed contact of each of the respective series of fixed contacts.

All of the fixed contacts of bank 43 of the stepper switch are connected, via conductors 66 and 67, to ground, save for the "initial contact." Accordingly, as soon as the movable contacts 47–49 have been advanced from their "initial position" to the next fixed contact, as a result of momentary closing of cushion switch 61, actuating winding 46 is energized from supply terminal 59 via conductor 65, the winding, switch 62, interrupter contact 63, movable contact 47, and conductor 66.

For manual operation of the stepping switch, switches 58 and 62 are moved to the opposite positions from those illustrated in FIGURE 5, so that the movable contact of switch 62 connects winding 46 to the parallel combination of switches 60 and 61, and thus to ground when either switch 60 or 61 is closed. Stepwise operation of the stepping switch can be accomplished by periodically closing manual push-button switch 60.

Referring now to FIG. 6, it will be seen that one side of the actuating winding of electromagnetic relay 69 is connected via conductor 68 to the movable contact of switch 58, the other side of that winding being connected via conductors 70 and 57 to D.C. supply terminal 59. When either of switches 60 and 61 is closed as explained above, with switch 58 in the position shown, a circuit is completed from terminal 59 via conductor 57, conductor 70, the winding of relay 69, conductor 68, switch 58 and one of switches 60 or 61 to ground, thus energizing relay 69. Contacts 72 of relay 69 are provided to complete a starting circuit (not shown) in the bowling pin spotting machine referred to previously. It is necessary to maintain contacts 72 closed for a longer period of time than cushion switch 61 is normally closed, due to the relatively slow response of the pin spotting machine starting circuit. Similarly, contacts 73 must be held closed for a time long enough to assure energization of relay 74. A capacitor 71 is therefore connected across the winding of relay 69, in a manner which will be familiar to one skilled in the art, to allow that relay to remain energized longer than switch 61 is closed.

It will now be evident that closing switch 61 starts operation of the sensing circuitry by energizing the stepping switch winding 46, and simultaneously starts operation of the pin spotting mechanism by energization of relay 69. At the same time, normally open contacts 73 of relay 69 close to complete a circuit via conductor 77 from ground to one side of the actuating winding of electromagnetic relay 74, the other side of that winding being connected via conductor 57 to D.C. supply terminal 59, thereby energizing relay 74 and closing the normally open contacts 75 and 76. One side of contacts 75 is connected to conductor 77 and one terminal of relay winding 74. The other side of contacts 75 is connected to ground via normally closed contacts 78 of relay 56. If relay 56 is deenergized, contacts 75 will maintain a ground connection to hold relay 74 energized until such time as relay 56 is energized.

Contact 76 of relay 74 is connected between ground and terminal 79 of time delay circuit 80. Terminal 81 of circuit 80 is connected via conductor 57 to D.C. supply terminal 59. It is therefore evident that circuit 80 begins operatiton when its ground connection is supplied through contacts 76 by energization of relay 74.

Circuit 80 is a conventional unijunction transistor time delay circuit. Initially, when a D.C. voltage is provided between terminals 79 and 81, current flows through the resistance 84 to charge capacitance 85, and a small current flows through the voltage divider formed by resistances 82 and 83 and the base contacts of unijunction transistor 86. When the voltage across capacitance 85 reaches the peak point voltage of the unijunction transistor, current will flow from emitter 87 to base 88 and through resistance 82, thereby increasing the voltage across resistance 82 and thus the voltage across the gate 89 and cathode 90 of silicon controlled rectifier 91. This high gate-to-cathode voltage is sufficient to place SCR91 in a conductive state, allowing high current flow through SCR91 and thence through the actuating winding of relay 56, energizing that winding. The voltage which must appear across capacitance 85 to cause the unijunction emitter current to flow is reached in a time determined by the values of resistance 84 and capacitor 85. The

ime lapse between circuit energization and energization of relay 56 is therefore a function of these values which can be adjusted to provide a range of time delays from as short as, for example, one second, to periods of one minute. The time selected in the present embodiment would be logically as long as is desirable or necessary to maintain the display for a time adequate for reading by the players or for actuating a scoring device, without undue delay. Resistance 92 and capacitance 93 are connected to delay the deenergization of relay 56, insuring its proper action in deenergizing relays 38–38*k*.

The circuit elements used to cause reset and to begin the detecting cycle could easily be arranged to cause both of these operations to occur on actuation of the cushion switch 61.

Since circuit 80 commences operation when relay 74 is energized, it is evident that energization of relay 56 will follow energization of relay 74 by the chosen delay. Energization of relay 56 opens contacts 78, removing the ground from relay 74 and so causing relay 74 to be deenergized. When relay 74 is deenergized, the ground circuit of circuit 80, provided via contacts 76, is removed, again deenergizing relay 56.

The operation of the entire system is as follows: A ball is rolled down the alley and strikes the cushion, momentarily closing switch 61. Assuming switches 58 and 62 to be in the position shown, a ground connection is provided by switch 61 for the actuating winding 46 of the stepping switch 42 and, via conductor 68, for one terminal of relay 69, so that both relay stepping switch 42 and relay 69 are energized.

The movable contact of stepping switch 42 then advances to its second position where a ground is again provided via conductor 66, allowing the switch to proceed through the remainder of the eleven steps.

Simultaneously, the contacts 72 and 73 of relay 69 are closed, completing the start circuit of the pin spotting machine and energizing relay 74. The contacts 75 and 76 of relay 74 are then closed, contact 75 locking in relay 74 through normally closed contacts 78 of relay 56 to ground, and contacts 76 providing a ground connection to initiate operation of the time delay circuit 80.

During the delay afforded by circuit 80, the stepping switch 42 connects each of the photoelectric transducers 18–18*k* to its associated relay 35–35*k* through the fixed contacts of contact bank 44, movable contact 48, amplifier 51, transistor 52, movable contact 49, the fixed contacts of contact bank 45, and conductors 39–39*k*. Each of the photoelectric transducers 18–18*k* which receives infrared light reflected from the top portion of a standing pin provides a signal via the path described which, when amplified by amplifier 51, is sufficient to energize the corresponding one of relays 35–35*k*, which then locks itself in by the appropriate one of contacts 37–37*k* and energizes the corresponding lamp 33–33*k* via contacts 36–36*k*.

The relays 35–35*k* and the lamps remain energized until the end of the delay period, at which time the silicon controlled rectifier 91 passes sufficient current to energize relay 56, opening contacts 55 and 78. Opening of contacts 55 removes the D.C. supply from relays 35–35*k*, deenergizing those relays and their associated lamps. Opening of contacts 78 removes the ground from the winding of relay 74, deenergizing that relay and opening its contacts 75 and 76. Opening of contacts 76 removes the ground from time delay circuit 80, stopping the operation of that circuit and allowing relay 56 to be deenergized. The system is completely reset, prepared to start again on actuation of the cushion switch 61.

The apparatus can also be employed to provide for a pinfall count and scoring operation generally in accordance with U.S. Patents 2,590,444, issued March 25, 1952, to Millman, and 2,974,955, issued March 14, 1961, to Walsh. Thus, a pinfall counting and totalizing device, indicated generally at 95, FIGURE 6 has a plurality of input circuits each connected to supply terminals 34 through the normally closed fixed contact and the movable contact of a different one of the contact sets 36–36*k*, so that each of the input circuits is completed only so long as the corresponding one of relays 35–35*k* is deenergized. Considering relay 35, for example, the corresponding input circuit will supply a signal to pinfall counting and scoring device 95 only so long as the relay is in its unenergized state, which state occurs, during operation of the apparatus, only when the corresponding pin has been knocked down so that photoelectric transducer 18 does not receive infrared light.

In order that the pinfall counting and totalizing device 95 shall not receive input signals via the contact sets 36–36*k* until the apparatus is activated to scan the pin deck photoelectrically, device 95 is provided with an activating control relay (not shown) connected between ground and one of the supply terminals 34 via conductor 96 and cushion switch 61. Thus, momentary closing of cushion switch 61 completes a circuit to energize the activating control relay and allow device 95 to receive pinfall signals via the contact sets 36–36*k* of all of relays 35–35*k* which remain unenergized. So long as switch 61 has not been actuated, however, signals are not supplied to the pinfall counting and totalizing device even though the relays 35–35*k* are unenergized.

It will thus be apparent that, once operation of the apparatus has commenced, energization of relays 35–35*k* provides standing pin signals while lack of energization of the relays provides pinfall signals, so that standing pin response, pinfall response, or both standing pin and pinfall response can be achieved.

While one particularly advantageous embodiment has been chosen to illustrate the invention, it will be understood that various changes and modifications can be made therein without departing from the scope of the invention as defined in the appended claims.

We claim:

1. In a bowling alley installation, the combination of a bowling pin spotting machine comprising a plurality of pin spotting units, support means for said spotting units, and means for moving said support means in a path including a predetermined position in which said spotting units are spaced above the pin deck of the alley by a distance greater than the height of the pins; a light source mounted above the alley bed and arranged to direct light predominantly in the visible portion of the spectrum generally rearwardly across the pin deck and toward the pit to illuminate the bowling pins for view by the players; at least one light source operative to project light predominantly in a portion of the spectrum distinguishable from that portion occupied by the visible light from said first-mentioned source, said source being constructed to project a controlled beam of such light and being mounted above the alley bed to direct said beam at a small angle downwardly from the horizontal and across the pin deck, the location of said at least one light source and the size of said angle being such that the light projected thereby passes the locations of the top portions of all standing pins on the pin deck and does not approach close enough to the pin deck beneath said spotting units to impinge on fallen pins; a plurality of photoelectric transducers equal in number to said spotting units and each selectively responsive to the light from said at least one source, each of said transducers being mounted on a different one of said spotting units and so disposed as to be directed toward the top portion of a pin standing on the playing position above which such spotting unit is located; and electrically operated signalling means connected to said transducers for selective operation in accordance with the state of said transducers for indicating pinfall results after the rolling of a ball.

2. A bowling alley installation in accordance with claim 1 and wherein said electrically operated means comprises a plurality of electrically operated signalling devices equal in number to said spotting units, and circuit means for

selectively operating said electrically operated signalling devices each in accordance with the operative condition of a different one of said transducers.

3. A bowling alley installation in accordance with claim 2 and wherein said circuit means comprises a supply circuit connectable to said electrically operated signalling devices; a plurality of switching devices equal in number to said spotting units and each arranged to connect a different one of said electrically operated signalling devices to said supply circuit; and sequence switching means operative to connect said switching devices sequentially each to a different one of said transducers.

4. A bowling alley installation in accordance with claim 3 and wherein each of said switching devices is provided with holding means operative to hold the same in operative condition to maintain continued operation of the respective one of said electrically operated signalling devices once such switching device has been operated, the installation further comprising reset switching means connected to simultaneously de-energize said electrically operated signalling devices.

5. A bowling alley installation in accordance with claim 4 and wherein said reset switching means is an electrically operated switching device, the installation further comprising a time delay device connected to control said electrically operated switching device to cause such simultaneous de-energiaztion of said electrically operated signalling devices to occur at a predetermined time after operation of said sequence switching means.

6. A bowling alley installation in accordance with claim 3 and further comprising starting circuit means connected to initiate operation of said sequence switching means; and means responsive to occurrence of a predetermined playing event for controlling said starting circuit means.

7. A bowling alley installation in accordance with claim 6 and further comprising electrically operated switching means connected to simultaneously de-energize said electrically operated signalling devices; and a time delay device connected to control said electrically operated switching means, said means responsive to occurrence of a predetermined playing event being connected to initiate operation of said time delay device.

8. In a bowling alley installation having a pin deck provided with a plurality of predetermined pin positions, the combination of:

a plurality of transducers spaced from said pin positions each operatively arranged to provide an electrical output in response to presence of a pin at a different one of said pin positions;

a plurality of electrically operated signalling devices equal in number to said transducers for indicating pinfall results after the rolling of a ball;

a supply circuit;

a plurality of electrically operated switching devices each arranged to connect a different one of said electrically operated signalling devices to said supply circuit and each comprising holding means for maintaining such connection once the same has been made;

sequence switching means arranged to sequentially connect said switching devices each to receive the output of a different one of said transducers;

a starting circuit connected to said sequence switching means to initiate operation thereof;

control means connected to control said starting circuit;

said control means being responsive to occurrence of a predetermined playing event; and

means for simultaneously deactivating said electrically operated devices, said deactivating means including an electrically operated deactivating switch and a time delay device, said time delay device being connected to be placed in operation in response to completion of said starting circuit and to operate said deactivating switch when a predetermined time has elapsed after the placing of said time delay device in operation.

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