

July 18, 1967

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3,331,604

AUTOMATIC PINFALL DETECTING APPARATUS FOR BOWLING GAME

Filed Sept. 7, 1961

4 Sheets-Sheet 1

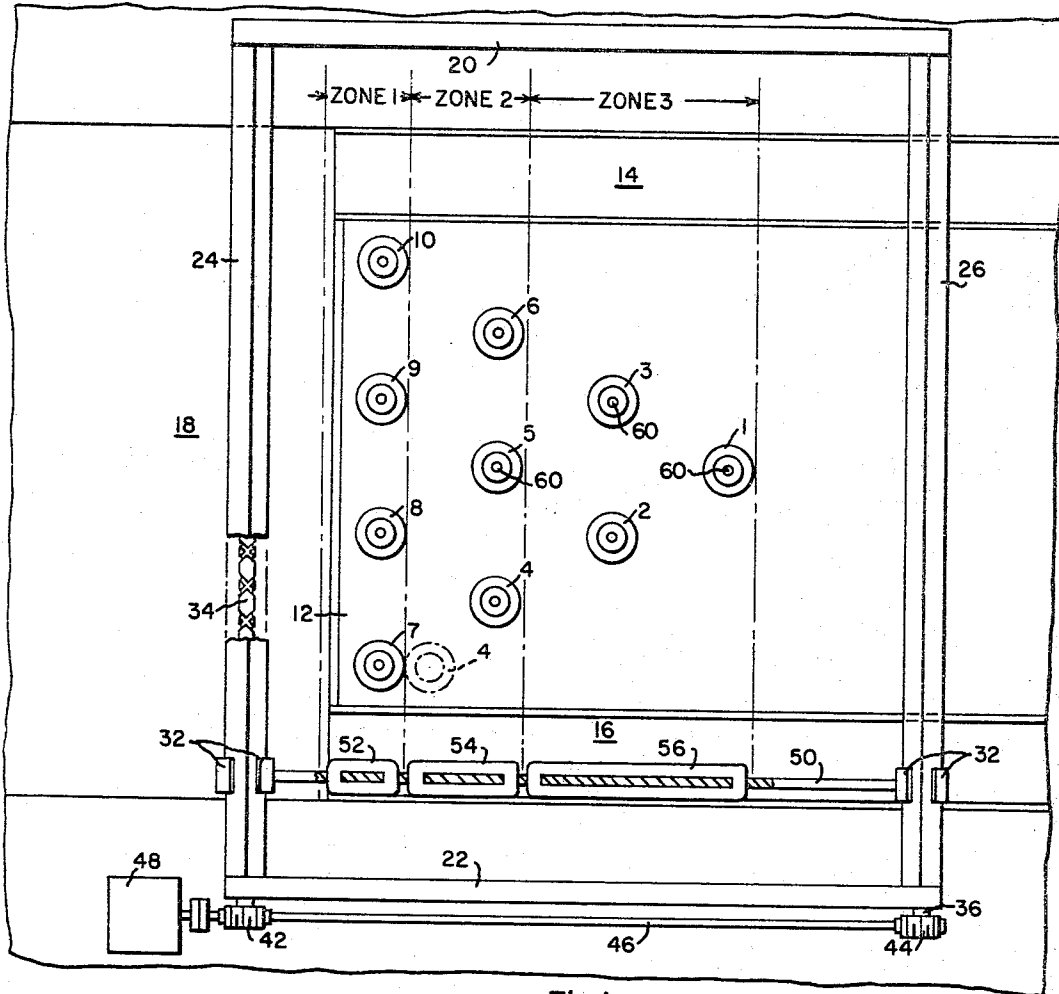


Fig. 1

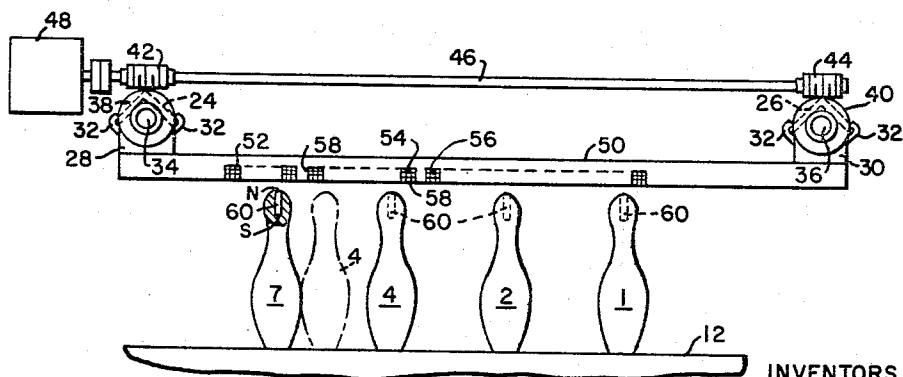


Fig. 2

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4 Sheets-Sheet 2

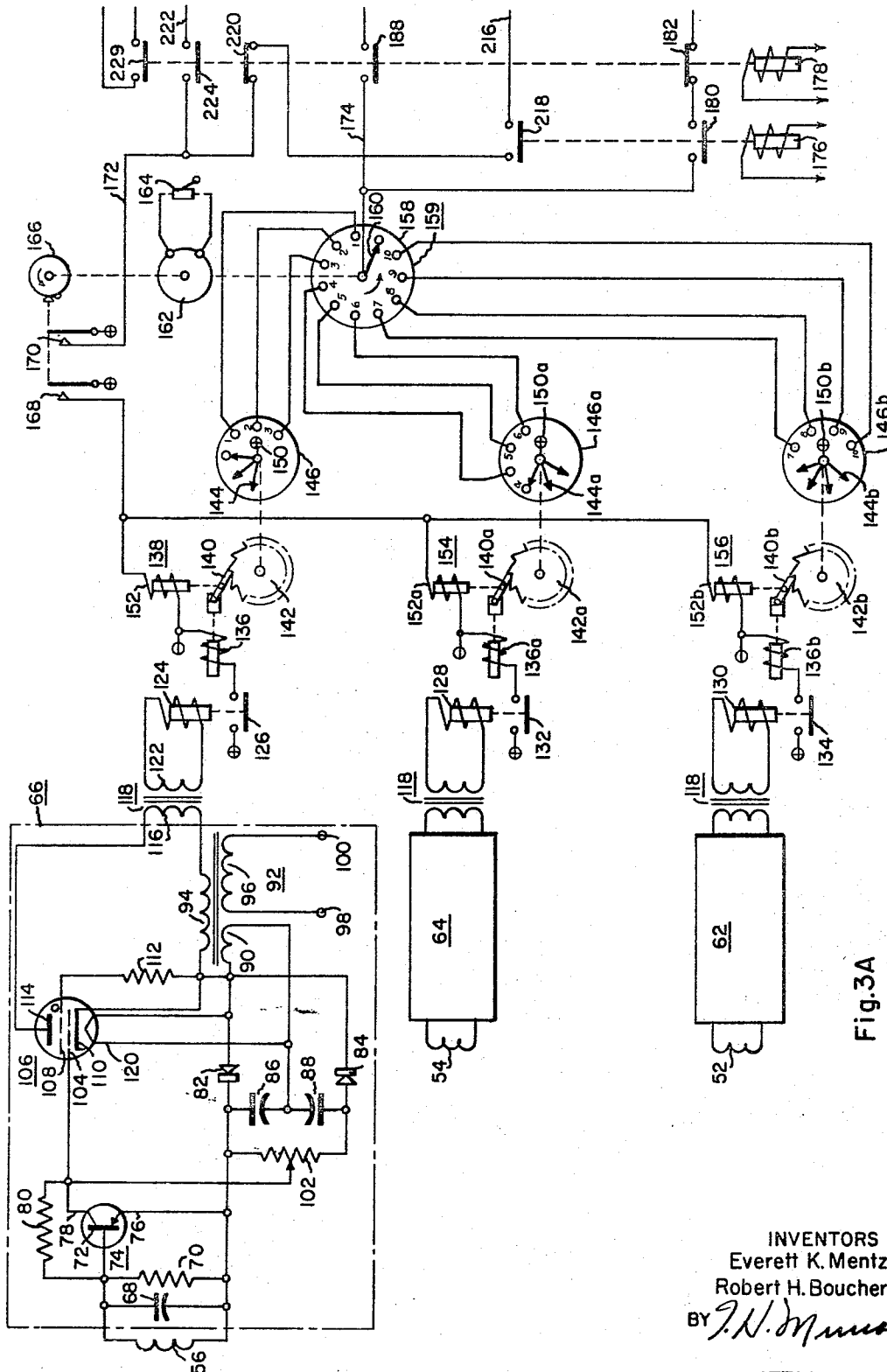


Fig. 3A

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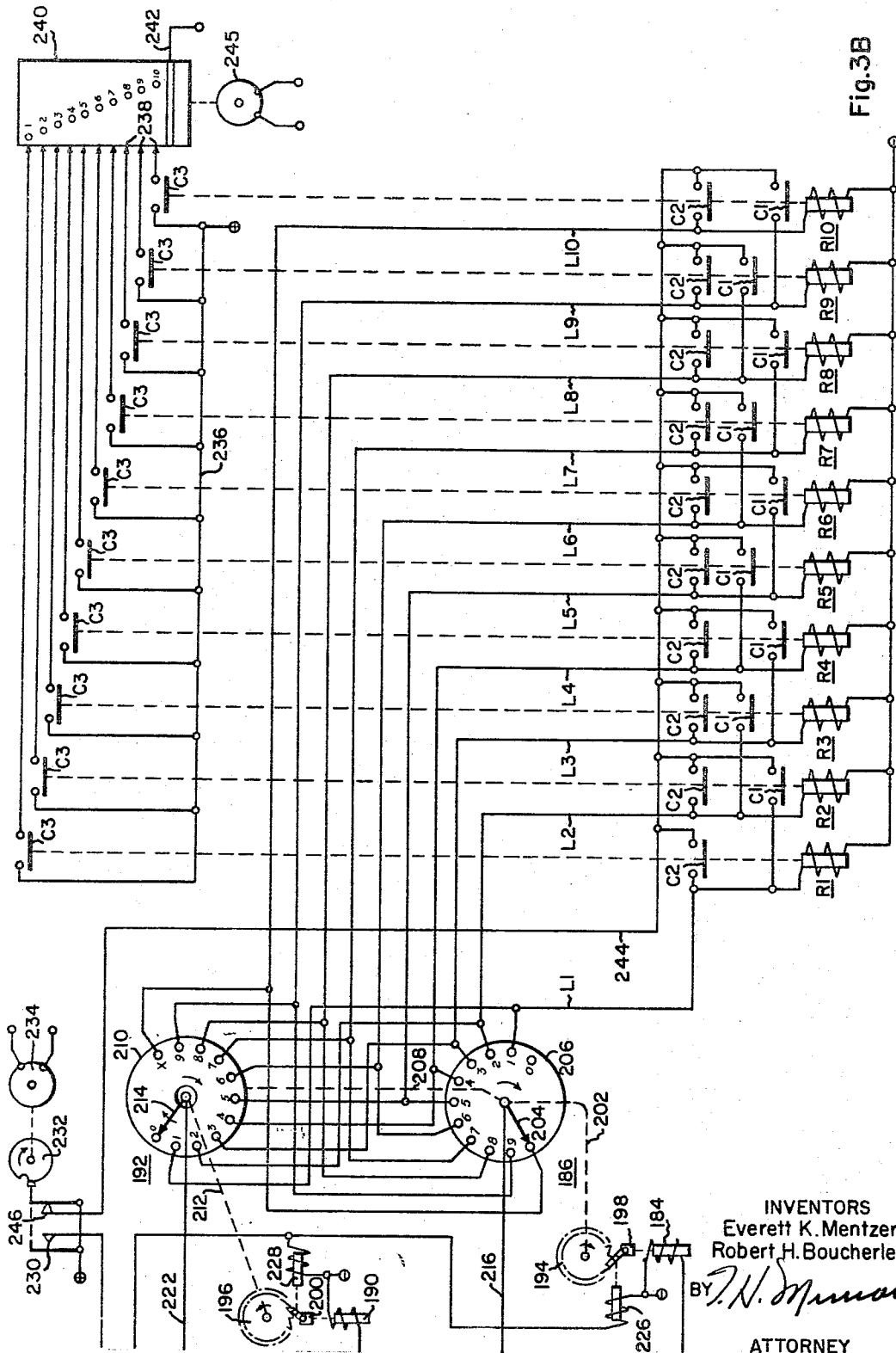
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AUTOMATIC PINFALL DETECTING APPARATUS FOR BOWLING GAME

Filed Sept. 7, 1961

4 Sheets-Sheet 3



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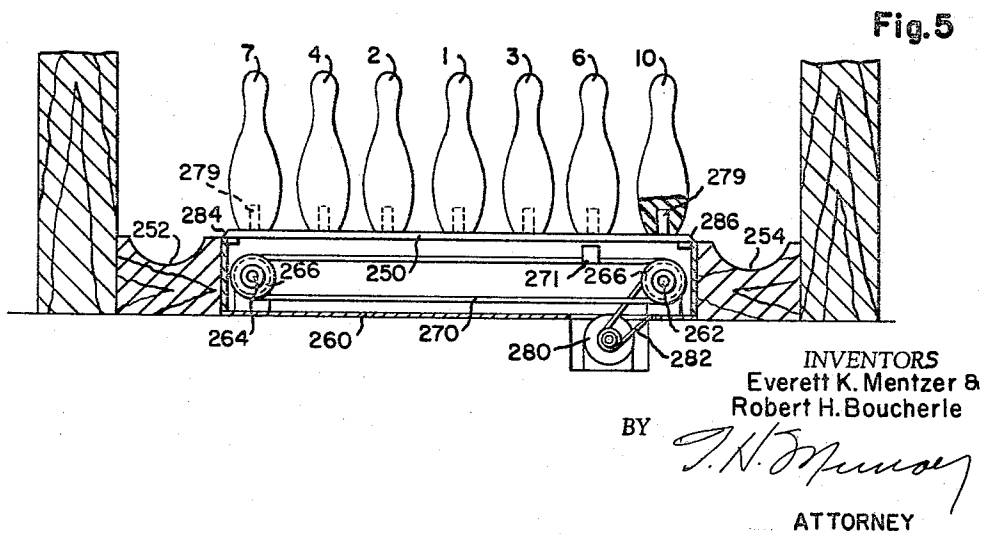
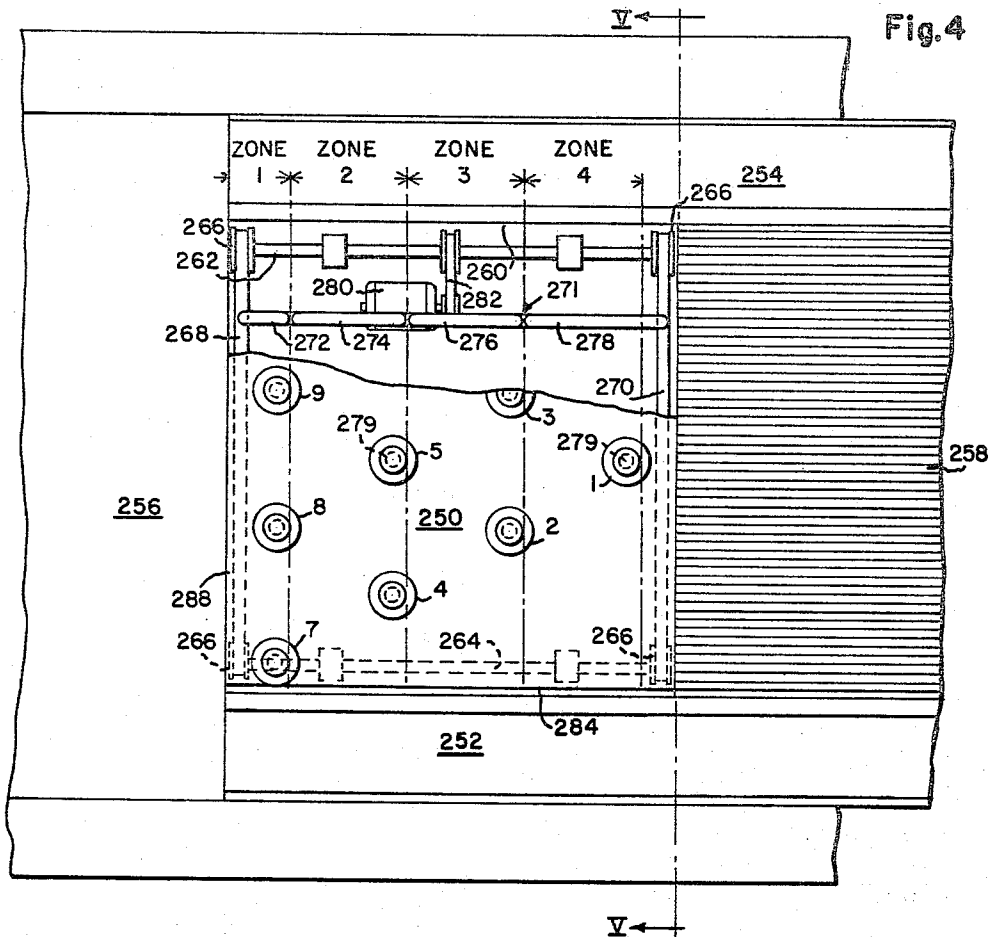
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AUTOMATIC PINFALL DETECTING APPARATUS FOR BOWLING GAME

Filed Sept. 7, 1961

4 Sheets-Sheet 4



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3,331,604

AUTOMATIC PINFALL DETECTING APPARATUS FOR BOWLING GAME

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Filed Sept. 7, 1961, Ser. No. 134,809
32 Claims. (Cl. 273-54)

This invention relates to apparatus for automatically detecting the number of pins knocked down after each ball is rolled in a bowling game. More particularly, the invention relates to apparatus of the type described adapted to produce electrical signals which may be used to automatically score, totalize, visually indicate and/or print the totalized score.

This application is a continuation-in-part of copending application Ser. No. 60,350, filed Oct. 4, 1960, now abandoned.

Although not limited thereto, the present invention is particularly adapted for use with an automatic scoring and totalizing system for a bowling game such as that shown in our copending application Ser. No. 38,091, filed July 7, 1960, or Millman et al. Patent 2,590,444, issued Mar. 25, 1952. In such systems it is first necessary, in order to score or totalize the game, to obtain an accurate indication of the pinfall after each ball in the game is rolled. Various systems have heretofore been proposed for automatically detecting pinfall; however, all are subject to malfunctioning or are unreliable for one reason or another. For example, one such system heretofore proposed calls for limit switches on the gripper arms or clamps of an automatic pin-spotting machine, the idea being that if a pin is knocked down after a ball is rolled, the gripper arms for that pin will completely close when the pin-spotter recycles, thereby closing or opening a number of limit switches corresponding to the number of fallen pins. The difficulty with this method, however, is that certain ones of the pins may slide on the alley from their correctly spotted positions and still remain standing with the result that the pin-spotter may fail to grip a standing pin; or, if two pins abut each other, the pin-spotter may pick up one pin while knocking down the second. For the foregoing reasons, the use of switches on the pin-spotter is unsatisfactory for an accurate and fail-proof method for detecting pinfall.

Another system heretofore proposed for detecting pinfall employs photocells positioned beneath the pins in their correctly spotted positions whereby the photocells will be exposed to light and conduct to produce an electrical signal whenever a pin is knocked down. This system, however, is unreliable for the same reason that limit switches on the pin-spotter are unreliable. That is, if the pins slide on the alley without being knocked down, the photocells will be exposed to light and conduct to produce a false indication of pinfall.

As a primary object, the present invention seeks to provide new and improved apparatus for automatically and accurately indicating the number of pins knocked down by each ball in a bowling game, said apparatus overcoming the disadvantages of prior-art systems enumerated above, as well as others.

More specifically, an object of the invention is to provide a system for producing a number of electrical impulses indicative of the number of pins knocked down by a bowling ball, which will function properly to give a true indication of pinfall regardless of whether any standing pins on the alley are misplaced due to sliding or other causes.

A further object of the invention is to provide apparatus for indicating the number of pins knocked down after each ball is delivered in a bowling game, in which apparatus the triangular configuration of pins is divided into zoned areas, at least some of which include a plurality of pins, and wherein each zone is provided with a single pin detecting device which detects all standing pins within its associated zoned area.

Another object of the invention is to provide pinfall detecting apparatus for a bowling game wherein an accurate indication of the number of pins knocked down by each ball is obtained before any instrumentality touches the pins and possibly alters their positioning.

Still another object of the invention is to provide pinfall detecting apparatus for a bowling game capable of producing electrical signals which may be used in an automatic scoring, totalizing, indicating and/or printing system.

In accordance with the invention, the number of pins knocked down by each ball is determined by first producing a number of electrical impulses corresponding to the number of pins left standing, and thereafter using these impulses to produce a number of signals equal to ten minus the number of aforesaid impulses. This is accomplished by means of a plurality of electrical pin detecting devices each adapted to detect pins only within a predetermined zoned area of the triangular configuration of pins. For example, one zone may cover a row of four pins in the triangular configuration; the second zone may cover the next row of three pins; and the third zone may cover the remaining three pins. Alternatively, the aforesaid third zone may be divided into two separate zones, one of which covers a row of two pins and the other of which covers the remaining single pin. In either case, a single pin detecting device is provided for each zone; and the cumulative number of electrical impulses derived from the detecting devices and representing the standing pin count is subtracted from ten in suitable circuitry to derive the number of fallen pins.

In one illustrative embodiment of the invention, means are provided in the top or bottom of each pin which can be detected electrically by a proximity device movable along a horizontal plane slightly above the tops or below the bottoms of standing pins and adapted to produce an impulse by passing over the top or under the bottom of any standing pin. For example, the means in the top or bottom of each pin may comprise a permanent magnet, and the proximity device may comprise an electrical coil assembly, the arrangement being such that the coil assembly will cut through the lines of flux produced by the permanent magnets whereby a current impulse is induced in the coil assembly each time it passes over or under a standing pin. The permanent magnets of fallen pins, however, cannot affect the coil and, hence, will not produce current impulses. By using the current impulses in circuitry including stepping switches and relays, a number of electrical signals can be obtained equal to ten minus the number of current impulses produced by the coil assembly, these signals being equal in number to the number of fallen pins.

Further, in accordance with one embodiment of the invention, the aforesaid coil assembly or other proximity device comprises a plurality of separate coils or the like which move across the tops or bottoms of the pins transversely of the bowling alley. In this manner, the usual triangular configuration of pins is zoned with each zone covering a selected number of pins in the triangular configuration. As is known, in the usual triangular configuration of bowling pins, certain ones of the pins will lie directly behind others, meaning that if a single coil were used to sweep across the tops of the pins a single elec-

trical impulse would be produced in certain cases for two pins, while it is desired to produce a single pulse for each pin. In addition, when a ball delivered down a bowling alley strikes the pins, certain ones of the pins may be knocked down, certain ones may remain standing in their correctly-spotted positions, while still others may remain standing but shifted from their correctly-spotted positions. In certain cases a pin may slide directly in front of another pin, meaning that if a single coil were used to sweep across the tops of the pins, a single electrical impulse would be produced for those two pins rather than the desired two impulses. As will be seen, the present invention provides for a novel arrangement wherein a plurality of electrical coils are arranged to sweep across the tops or bottoms of the pins such that each standing pin will produce a separate electrical impulse even though it should be shifted from its original position in the afore-said triangular configuration.

The above and other objects and features of the invention will become apparent from the following detailed description taken in connection with the accompanying drawings which form a part of this specification and, in which:

FIGURE 1 is a top view of a bowling alley incorporating the pinfall detecting means of the present invention and wherein the coils for detecting pinfall move across the tops of the pins;

FIG. 2 is a side view of the apparatus shown in FIG. 1; FIGS. 3A and 3B, when placed end-to-end, illustrate the circuit means for converting a number of current impulses proportional to the number of standing pins in a bowling game into a number of electrical signals corresponding to the number of fallen pins;

FIG. 4 is a partially broken away top view of an arrangement according to the invention wherein the coils for detecting pinfall move beneath the bottoms of the bowling pins; and

FIG. 5 is a cross sectional view taken along line V—V of FIG. 4.

Referring, now, to FIG. 1, the usual bowling alley is shown having a pin deck 12 with ten pins positioned thereon in the usual triangular configuration and numbered one through ten. On either side of the pin deck 12 are two gutters 14 and 16, while behind the pin deck 12 is a pit 18.

On either side of the pin deck 12 are a pair of horizontally-extending supporting members 20 and 22 which carry a pair of transversely-extending guideways or tracks 24 and 26. As can be seen in FIG. 2, the tracks 24 and 26 are positioned above the tops of the pins and comprise a pair of inverted angles which carry a pair of blocks 28 and 30 for sliding movement therealong. As shown, each block 28 or 30 is provided with generally L-shaped arms 32 which ride on the upper surfaces of the inverted angles 24 and 26. Extending transversely between the supporting members 20 and 22 and beneath the inverted angles 24 and 26 are a pair of driving screws 34 and 36 which threadedly engage the blocks 28 and 30, the arrangement being such that as the screws 34 and 36 turn, the blocks 28 and 30 will be moved upwardly or downwardly as shown in FIG. 1, depending upon the direction of rotation of the screws. One end of each of the screws 34 and 36 is provided with a gear 38 or 40, respectively, which meshes with a worm 42 or 44 on a common shaft 46. Shaft 46, in turn, is driven by an electric motor 48 whereby, as the motor turns, the screws 34 and 36 will be turned in synchronism. Extending between the blocks 28 and 30 is a bar 50 of soft iron or other similar material having three elongated electrical windings 52, 54 and 56 wound thereon. As is best shown in FIG. 2, the coils 52-56 are wound around notches 58 cut out of the iron bar 50 whereby portions of the iron bar between the ends of the coils will serve as magnetic cores of high permeability.

From a consideration of FIGS. 1 and 2, it can be seen that as the motor 48 turns, the bar 50 and the coils 52-56 carried thereby will be moved transversely across the

deck 12 and above the pins 1-10. Furthermore, the coil 52 will sweep across an area designated as Zone 1 and will pass over the tops of pins 7-10; coil 54 will sweep over an area designated Zone 2 and will pass over the tops of pins 4-6; while coil 56 will sweep over an area designated Zone 3 and will pass over the tops of pins 1, 2 and 3. Embedded in the top of each of the pins 1-10 is a small permanent magnet 60 having north and south poles spaced along a vertical axis and adapted to produce a magnetic field through which one of the coils 52-56 will cut in passing from one side of the alley to the other. Thus, assuming that the speed of the bar 50 is above a predetermined value as it sweeps across the alley, a momentary electrical current will be induced in each of the coils 52-56 as it passes over the top of a standing pin. These electrical current impulses are used in circuitry, hereinafter described, to produce a number of electrical pulses or signals corresponding to the number of pins knocked down after each ball in a bowling game is delivered.

As will be understood, it is necessary to produce a single and separate current impulse in one of the coils 52-56 for each standing pin on the deck 12. The necessity for three coils and three zones thus becomes apparent. That is, it can be seen from FIG. 1 that the number 1 pin is directly in front of the number 5 pin. Similarly, the number 2 pin is directly in front of the number 8 pin, and the number 3 pin is directly in front of the number 9 pin. If a single coil were swept across the tops of the pins, a single current impulse would be induced in the coil for both of the pins 2 and 8, both of the pins 1 and 5, and both of the pins 3 and 9, meaning that if all pins were standing, only seven current impulses would be produced by the single coil; whereas it is desired to produce ten impulses. With the arrangement shown in FIGS. 1 and 2, however, none of the pins in any zone are aligned with other pins in that same zone so that the cumulative number of impulses produced by the three coils will always be ten, assuming that all of the pins are left standing. Of course, if certain ones of the pins are knocked down after a ball is rolled, only the cumulative number of impulses corresponding to the number of pins left standing will be produced by the coils. Furthermore, even though certain ones of the pins may slide on the deck to positions where they are directly in front of other pins, the correct number of impulses will always be produced. To illustrate, suppose that the ball strikes the number 1 pin. Under these circumstances, the number 1 pin will always be knocked down under the impact of the ball. Certain ones of the pins, however, may slide when the ball rolls into the triangular configuration of pins shown in FIG. 1. Let us assume, for example, that the number 4 pin slides to the position shown by the dotted lines where it is directly in front of the number 7 pin. Under these circumstances, two electrical current impulses will still be produced for the number 4 and 7 pins, with the impulse for the number 4 pin being produced by coil 54 while the impulse for pin number 7 is produced by coil 52. Since all pins will slide either to the side or toward the pit 18, there is a possibility of a single current impulse for two pins in Zone 3 where pin number 1 could conceivably be aligned with pin number 2 or pin number 3. However, as was explained above, pin number 1 will be struck directly by the moving ball, meaning that it will not slide in Zone 3 in an upright position where a single current impulse can be produced for two standing pins. Thus, the apparatus shown provides a means whereby a single current impulse will be produced by one of the coils 52, 54 or 56 for each standing pin even through certain ones of the pins may slide from their correctly-spotted positions.

Referring now to FIGS. 3A and 3B, each of the coils 52, 54 and 56 is connected to a corresponding amplifying circuit 62, 64, 66, respectively. Since all of the circuits 62-66 are identical, only circuit 66, enclosed by broken lines, will be described in detail.

Across winding 56 are a capacitor 68 and a resistor 70 connected in parallel. One end of the winding 56 is connected to the base 72 of a junction transistor 74 while the other end of the same winding is connected to the emitter 76 of the transistor. Connected between the base of transistor 74 and its collector 78 is a resistor 80. Driving potential is provided for the transistor 74 by a voltage doubler rectifier including a pair of unidirectional current devices 82 and 84 and capacitors 86 and 88. The junction between capacitors 86 and 88 is connected to one side of a first secondary winding 90 on input transformer 92, while the other side of this secondary winding 90 is connected to the anode of device 82 as well as the cathode of device 84. The primary winding 96 of transformer 92 is adapted for connection to a source of alternating current voltage, not shown, at terminals 98 and 100. The direct current voltage for transistor 74 is derived, as shown, by means of a movable tap on resistor 102 connected in shunt with the capacitors 86 and 88.

The collector 78 of transistor 74 is connected to the control grid 104 of a thyratron gas discharge tube 106 having a suppressor grid 108 connected to its cathode 110 through resistor 112. The resistor 112 is also connected to the cathode of the unidirectional current device 84 in the voltage doubler rectifier whereby a bias voltage will be supplied on the suppressor grid 108. Connecting the cathode 110 and the anode 114 of thyratron 106 is a circuit including a secondary winding 94 on transformer 92 and the primary winding 116 of an output transformer 118. The circuit is completed by a heater element 120 for the thyratron 106 which is connected across two terminals of secondary winding 90 on transformer 92.

With this arrangement, whenever a current impulse is induced in winding 56 upon passage of the winding through the magnetic field of a standing pin, transistor 74 will conduct to raise the voltage on the control grid 104 of thyratron 106 to the firing level. Thus, the thyratron will conduct to produce a pulse across the primary winding 116 of output transformer 118. This pulse is applied via the secondary winding 122 of output transformer 118 to a relay 124 having a pair of normally open contacts 126. In a similar manner, the circuits 64 and 62 for windings 54 and 52, respectively, are provided with relays 128 and 130. Relay 128 is provided with a pair of normally open contacts 132, while relay 130 is provided with normally open contacts 134. Thus, if one pin is left standing in Zone 3 after a ball is rolled, the relay 124 will be energized to close contacts 126 once as the bar 50 is swept across the deck 12; if two pins remain standing in Zone 2, relay 128 will be energized twice to likewise close contacts 132 twice; and if only one pin is left standing in Zone 1, then relay 130 will be energized once to close its contacts 134 once.

Closure of contacts 126 energizes the actuating solenoid 136 of a rotary stepper switch, generally indicated at 138. The stepper switch 138, as well as the other stepper switches hereinafter described, comprises the solenoid 136 which will actuate a pawl 140 to move a spring-loaded ratchet 142 through a short arc each time the solenoid 136 is energized by closure of contacts 126, thereby advancing the three wiper brushes 144 on an index 146 from one contact point to the next. The index 146, as well as all other indexes hereinafter described, comprises a disc of insulating material having a plurality of conducting contact points spaced around its periphery, together with one or more rotatable conducting wiper brushes which are adapted to engage the contact points in succession. The wiper brushes 144 are all electrically interconnected to the positive terminal 150 of a voltage source, not shown. It will be noted that there are three contact points 1, 2 and 3 on index 146, one for each of the three pins 1, 2 and 3 shown in FIG. 1. Furthermore, there are three wiper brushes 144 such that if the solenoid 136 is energized three times, meaning that all of the 1 to 3 pins are standing, each of the contacts

1, 2 and 3 on index 146 will be covered by an associated wiper brush 144. The wiper brushes 144 are spring-biased on a common shaft whereby they will be rotated back to the position shown in FIG. 3A when the pawl 140 is moved upwardly by a solenoid 152. Thus, in order to reset the stepper switch 138, the solenoid 152 is energized to move the pawl 140 upwardly, whereupon all of the wiper brushes will be rotated in a counterclockwise direction as shown in FIG. 3A to break the circuit to each of the contacts 1, 2 and 3. As was the case with coil 56, the coil 54 is provided with a stepper switch 154 identical to the stepper switch 138 already described. Similarly, the coil 52 is provided with a stepper switch 156 identical in construction to the stepper switches 138 and 154. Since the stepper switches are all identical in construction, elements in switch 154 which correspond to those in switch 138 are identified by like reference numerals having a small "a" behind each numeral. Similarly, elements in switch 156 which correspond to those in switch 138 are identified by like reference numerals having a small "b" behind each numeral. It will be noted that the wafer 146b of switch 156 is provided with four wiper brushes 144b and four contact points numbered 7, 8, 9 and 10, one for each of the seven to ten pins shown in FIG. 1. However, the wafer 146a of switch 154, like wafer 146, is provided with three contacts 4, 5 and 6, one for each of the four to six pins in FIG. 1.

As shown in FIG. 3A, each one of the contacts on the wafers 146, 146a and 146b is connected to an associated contact point provided on a wafer 158 of a rotary wiper switch 159 having a wiper brush 160 thereon. The wiper brush 160, in turn, is rotated by a motor 162 controlled by limit switch means, schematically illustrated at 164. In the operation of the device, when a bowling ball drops into the pit 18 and strikes a backboard, not shown, a limit switch will be actuated which will cause the motor 48 shown in FIGS. 1 and 2 to traverse the bar 50 and coils 52-56 across the tops of the pins 1-10. At the end of the sweep of bar 50 across the pins, the limit switch means will stop motor 48 and energize the motor 162 to rotate through one complete revolution and stop. Various types of circuits may, of course, be employed to accomplish this function and are not described herein in detail. After the next ball is rolled, the motor 48 will be energized to rotate in the opposite direction whereby the bar 50, assuming that it is at the top of FIG. 1, will be caused to move downwardly to again sweep across the pins. At the lowermost position of bar 50, the limit switch means 164 will again be actuated to stop motor 48 and cause the motor 162 to rotate through 360°.

Connected to the shaft of motor 162 is a cam 166 adapted to close the normally open contacts 168 and 170 at the end of each complete revolution of the motor 162. When contacts 168 close, they will energize the solenoids 152, 152a and 152b to elevate the pawls 140, 140a and 140b whereby each one of the ratchets 142, 142a and 142b, being spring-biased to rotate in a counterclockwise direction, will reset each of the wiper brushes 144, 144a and 144b to their zero positions. When contacts 170 close, they will energize a lead 172 for a purpose which will hereinafter be explained.

Reviewing the operation of the system to this point, if it is assumed that the ball is rolled down the bowling alley and four pins are knocked down, there will be six pins left standing. When the ball strikes the backboard at the end of the pit 18, the motor 48 will be rotated to sweep the bar 50 and the coils 52-56 carried thereby across the tops of the standing pins. Furthermore, the bar 50 and the coils 52-56 will be swept across the tops of the pins (i.e., the standing pins) before an automatic pin-spotting machine, not shown, respins the pins. Let us assume that the number 4, 7 and 8 pins were knocked down by the ball. Thus, when bar 50 is swept

across the pins, three electrical impulses will be induced in coil 56 due to the 1, 2 and 3 pins; two current impulses will be induced in coil 54 due to the number 5 and 6 pins; while two current impulses will be induced in coil 52 due to the number 9 and 10 pins. Consequently, relay 124 will be energized three times; relay 128 will be energized twice; and relay 130 will also be energized twice. This, of course, means that all three of the contacts on index 146 will be covered by the wiper brushes 144; two of the contact points on wafer 146a will be covered by the wiper brushes 144a; and, likewise, two of the contact points on index 146b will be covered by the wiper brushes 144b. The result is that seven of the contact points on wafer 158 will be connected through the wiper brushes, 144, 144a, or 144b to a source of positive potential so that as the motor 162 is energized to rotate wiper brush 160, seven electrical impulses will appear on output lead 174. In this manner, the number of impulses appearing on lead 174 will always be equal to the number of standing pins remaining after a ball is thrown. If all of the pins are knocked down, then none of the relays 124, 128 or 130 will be energized and none of the contacts on wafer 158 will be energized to produce any output pulses on lead 174.

Referring now to the lower right-hand corner of FIG. 3A, there is shown a first ball latch relay 176 and a second ball latch relay 178. The construction and operation of these relays is fully described in our aforesaid co-pending application Ser. No. 38,091. For purposes of the present application, however, it will be sufficient to state that the relay 176 will become energized when the first ball in a normal two-ball bowling game frame is rolled, whereas relay 178 will become energized when the second ball is rolled. The relay 176, however, will remain energized until the frame is completed, meaning that both relays will be energized when the second ball is rolled. The lead 174 connected to wiper brush 160 may be connected through the normally open contacts 180 of relay 176 and the normally closed contacts 182 of relay 178 to the actuating solenoid 184 (FIG. 3B) of a rotary stepper switch 186. In a somewhat similar manner, the wiper brush 160 is adapted to be connected through lead 174 and the normally open contacts 188 of relay 178 to the actuating solenoid 190 of a second rotary stepper switch 192.

As was the case with the rotary stepper switches 138, 154 and 156, each switch 186 and 192 is provided with a ratchet 194 or 196 adapted to be actuated by a pawl 198 or 200 which is energized by the solenoid 184 or 190, respectively. The ratchet 194 of switch 186 is connected through mechanical linkage 202 to a rotary wiper brush 204 on a stationary index 206. In addition, the ratchet 194 is connected through mechanical linkages 202 and 208 to a rotatable index 210 on the switch 192. The ratchet 196 on the other hand, is connected through mechanical linkage 212 to a rotary wiper brush 214 which is mounted on the index 210 but is capable of independent rotation with respect to this index. With this arrangement, when solenoid 184 is actuated to rotate the ratchet 194, both the wiper brush 204 on stationary index 206 and the rotatable index 210 of switch 192 will be rotated in the same direction (i.e., clockwise) in synchronism. The wiper brush 214 of switch 192 will also rotate in a clockwise-direction, but it will rotate independently of the rotatable index 210. Thus, the index 210 may be rotated while the wiper brush 214 remains stationary; and, likewise, the wiper brush 214 may be rotated while the index 210 remains stationary.

Wiper brush 204 on index 206 of switch 186 is connected through lead 216, the normally open contacts 218 of relay 176 and the normally closed contacts 220 of relay 178 to the lead 172. It will be remembered that lead 172 is energized momentarily at the completion of a cycle of rotation of the motor 162 and wiper brush 160. Thus, the wiper brush 204 on index 206 of switch 186 will be ener-

gized only when relay 176 is energized upon the rolling of a first ball to close its contacts 218 and after the completion of a cycle of rotation of the wiper brush 160.

The wiper brush 214 on index 210 of switch 192 is connected through lead 222 and the normally open contacts 224 of relay 178 to lead 172. Thus, the wiper brush 214 will be energized only upon the rolling of a second ball when relay 178 is energized to close contacts 224 and the wiper brush 160 has completed a 360° cycle. When contacts 224 close, the contacts 220 of switch 178 open so that the circuit to wiper brush 204 on index 206 of switch 186 is broken. Consequently, the wiper brush 204, and only this brush, will be energized when the first ball is rolled; while the wiper brush 214, and only this brush, will be energized when the second ball is rolled.

Reverting again to the rotary wiper switches 186 and 192, they are spring-biased as were the switches 138, 154 and 156 whereby their wiper brushes will be moved back to their starting positions shown in FIG. 3B when solenoids 226 and 228 are energized to lift the pawls 198 and 200, respectively. The solenoids 226 and 228 will be energized when the second ball is rolled and relay 178 closes contacts 229 and upon closure of normally open contacts 230. Contacts 230, in turn, will be closed upon approximately 360° of travel of a cam 232 which is connected to the automatic pin-spotting machine, schematically illustrated at 234. In this manner, the cam 232 will be rotated through approximately 360° to close contacts 230 and reset switches 186 and 192 after the automatic pin-spotting machine has gone through a cycle of operation, but only after the second ball is delivered and contacts 229 are closed. When this has occurred, however, the bar 50 and coils 52-56 will have already been swept across the tops of the standing pins as was explained above.

Reverting now to the indexes 206 and 210, it will be noted that each has ten contact points thereon. Furthermore, the contacts points are numbered from 0 to X (i.e., the strike mark) in counterclockwise directions on both indexes. Furthermore, the number 1 contact of each index is connected through lead L1 to the energizing coil of a first relay R1; the number 2 contact of each index is connected through lead L2 to the energizing coil of relay R2; the number 3 contact of each index is connected through lead L3 to the energizing coil of a relay R3, and so on. Each of the relays R1-R10, with the exception of relay R1, is provided with three sets of normally open contacts C1, C2 and C3. Relay R1, however, has only the contacts C2 and C3. Whenever one of the relays R1-R10 is energized, it will close its normally open contacts. Closure of contact C3 of each relay will connect power line 236 to an associated wiper brush 238 on a pin scanner wiper drum 240. The pin scanner wiper drum 240 is provided with ten contact points, each contact point being adapted to be connected to an associated wiper brush 238 for each relay R1-R10. The contact points on pin scanner wiper drum 240 are circumferentially spaced around the drum whereby each contact point will make with its associated wiper in succession. All of the contact points on the pin scanner wiper drum 240 are electrically connected to a lead 242. Thus, if five of the relays R1-R10 are energized, five impulses appear on lead 242.

Reverting again to the relays R1-R10 let us assume that lead L5 is energized, thereby energizing the relay R5. When relay R5 is energized to close its contacts C1, a circuit is completed from lead 244 to relay R4. Lead 244, in turn, is connected through normally closed contacts 246 to a source of positive potential. Contacts 246, will be opened when, and only when, the pin-spotting machine, schematically illustrated at 234, completes its cycle. Thus, when contacts C1 of relay R5 close, they energize relay R4. Similarly, when relay R4 is energized, its contacts C1 close to energize relay R3; and when relay R3 is energized, its contacts C1 close to energize relay R2, and so on. Consequently, all of the relays are interlocked whereby when one relay in the group R1-R10

is energized, all of the preceding relays will likewise be energized. Whenever one of the relays R1-R5 is energized, a holding circuit is provided therefor through contacts C2 which connect one side of the relay coil to the lead 244.

Let us assume, for purposes of illustration, that three of the pins shown in FIG. 1 were knocked down with the first ball. Under these circumstances, seven of the contacts on index 158 will be energized since there are seven remaining standing pins. If the first ball is being rolled, relay 176 will be energized to close contacts 180 and 218. Thus, the seven electrical impulses on the wiper brush 160 will be applied through contacts 180 and 182 to the energizing solenoid 184 of rotary wiper switch 186, thereby advancing the wiper brush 204 through seven increments whereby it will be on the number 3 contact of index 206. After the wiper brush 160 has completed its revolution, the contacts 170 will be closed to energize lead 172 which is now connected through normally closed contacts 220 of relay 178, the closed contacts 218 of relay 176, and lead 216 to wiper brush 204. Thus, the wiper brush 204 will have moved to the number 3 contact; and after it does so it will be momentarily energized to energize lead L3 and the relay R3, as well as relays R1 and R2. After the relays R1-R3 are thus energized, circuitry, shown and described in our aforesaid copending application Ser. No. 38,091, will energize a scanner motor 245 to rotate the pin scanner wiper drum 240 through a complete revolution whereby three impulses will appear on lead 242, these impulses corresponding to the number of pins knocked down by the first ball.

While the wiper brush 204 on index 206 was rotating through seven increments, the rotary index 210 of switch 192 was also rotating through seven increments so that the wiper brush 214 will now be on the number 7 contact of the index 210.

After the first ball is rolled and three impulses have been produced on lead 242, the automatic pin-spotter will be actuated to pass through a cycle whereby the cam 232 will momentarily open the contacts 246, thereby de-energizing each one of the energized relays R1, R2 and R3 preparatory to the rolling of the second ball. The reset solenoids 226 and 228 of switches 186 and 192, however, will not be energized since only the first ball has been delivered, meaning that relay 178 is deenergized and contacts 229 are open. Therefore, the wiper brush 204 and index 210 will remain advanced seven increments.

When the second ball is rolled, the relay 176 will remain energized in accordance with the teachings of our aforesaid copending application Ser. No. 38,091; and, in addition, the relay 178 will be energized to open its normally closed contacts 182 and 220 while closing its normally open contacts 188, 224 and 229. With contacts 182 open, the energizing solenoid 184 of rotary stepper switch 186 is disconnected from lead 174 and rotary wiper brush 160 so that the switch 186 will not be actuated and the wiper brush 204 will not be advanced during rolling of the second ball. Since contacts 188 are now closed, the rotary wiper brush 160 on index 158 will be connected to the energizing solenoid 190 of the rotary stepper switch 192. In addition, the lead 172 will be connected through contacts 224 of relay 178 and lead 222 to the wiper brush 214 on index 210. Now, if it is assumed that the second ball knocks down three additional pins, it will mean that a total of six pins have been knocked down with the two balls, and four pins will remain standing to produce four impulses on lead 174 which actuate solenoid 190 to advance the rotary wiper 214 through four increments. However, since the wiper 214 is on the number 7 contact preparatory to the rolling of the second ball, it will be rotated through four increments in a clockwise direction to move from the 7 to the 3 contact on index 210. Thus, relay R3

will again be energized; and when the pin scanner wiper drum 240 is rotated three additional impulses will appear on lead 242. Thereafter, the pin scanner will be actuated to open contacts 246 and close contacts 230 whereby the relay R1, R2 and R3 will be deenergized and the reset solenoids 228 and 226 will be energized to position the wiper brush 204, the index 210 and the wiper brush 214 at their starting positions preparatory to the rolling of the next frame in the bowling game.

From a consideration of the circuit, it will be seen that a number of pulses corresponding to the number of pins knocked down will appear on lead 242 after each ball is rolled in a bowling game. These impulses may be used in accordance with the teachings of our copending application Ser. No. 38,091 to totalize, indicate and/or print the score of the bowling game.

Referring now to FIGS. 4 and 5, and alternative embodiment of the invention is shown wherein the permanent magnet means are imbedded in the bottoms of the pins while the detecting coils pass under the pins beneath the pin deck. As was the case in connection with FIGS. 1 and 2, ten pins, numbered 1 through 10, are positioned on a pin deck 250. On either side of the pin deck 250 are two gutters 252 and 254, while behind the pin deck 250 is a pit 256. The major length of the bowling alley ahead of the pin deck 250 comprises the usual tongue and groove flooring 258, while the pin deck itself comprises a thin board of laminated wooden sheets which has exceptionally high bending strength. As shown in FIG. 5, the pin deck 250 rests on the upper edges of an open ended rectangular housing 260 which has a width substantially equal to that of the bowling alley proper between the gutters 252 and 254. Carried within the housing 260 are a pair of parallel shafts 262 and 264 which carry pulleys 266 at their opposite ends. Movable around the pulleys 266 are a pair of rubber or the like belts 268 and 270, and between these belts is carried a bar 271 which supports four aligned coils 272, 274, 276 and 278. The shaft 262 may, for example, be selectively driven by means of an electric motor 280 connected to the shaft through a belt drive 282. Alternatively, the motor may be connected to the shaft 262 through gearing if desired. In this manner, it will be understood that by energizing the motor 280 in one direction, the bar 271 and the coils carried thereby may be traversed across the alley in one direction; while energization of the motor in the opposite direction will cause the bar and coils to be traversed in the opposite direction. The coil 272 extends from a point slightly in front of the first row of pins in the triangular configuration (i.e., pins 7-10) to the end of the bowling deck; the coil 274 extends from a point slightly in front of the pins in the second row (i.e., pins 4-6) to a point slightly in front of the first row of pins; the coil 276 extends from a point slightly in front of pins 2 and 3 to a point slightly in front of pins 4, 5 and 6; and the coil 278 extends from a point slightly in front of the number 1 pin to a point slightly in front of the number 2 and 3 pins. It will be remembered that with reference to FIG. 1, the number 1, 2 and 3 pins were covered by a single coil, namely coil 56. It was also explained that the only possibility of a single current impulse for two pins in the arrangement of FIG. 1 is where pin number 1 could conceivably be aligned with pin number 2 or pin number 3. In the embodiment of FIGS. 4 and 5, however, this possibility is entirely eliminated since, even if pin number 1 should slide into direct alignment with pin number 2 or pin number 3, it will still be detected by coil 278 while the other pins, numbered 2 and 3, will be detected by coils 276. Thus, whereas the embodiment of FIGS. 1 and 2 is divided into three zones, the embodiment of FIGS. 4 and 5 is divided into four zones, Zone 1 covering the number 7 to 10 pins, Zone 2 covering the number 4 to 6 pins, Zone 3 covering the number 2 and 3 pins, and Zone 4 covering the single pin numbered 1.

Embedded in the bottoms of the pins in FIGS. 4 and 5 are permanent magnets 279, similar to the magnets 60 of FIGS. 1 and 2. Since the pin deck 250 is formed from wood or some other non-magnetically permeable material, the lines of flux from magnets 279 will easily pass through the deck and will be cut by the coils 272-278 when they are moved transversely of the bowling alley upon energization of motor 280. In this manner, a pulse will be produced in one of the coils 272-278 for each standing pin as the bar 271 sweeps across the alley, the total number of pulses produced by the combined coils being equal to the number of standing pins.

As will be understood, due to the fact that an additional coil is added in the embodiment of FIGS. 4 and 5, it will be necessary, in the circuitry of FIGS. 3A and 3B, to add an additional amplifier similar to amplifiers 62, 64 and 66. Similarly, an additional stepper switch, like the stepper switches 138, 154 and 156 already described, will have to be added for this additional amplifier. Such an addition, however, is well within the capabilities of those skilled in the art without a specific showing herein. In the case of four coils, four wafers similar to wafers 146, 146a and 146b will have to be provided. The first of said wafers will be provided with a single contact point for the number 1 pin, the second will be provided with two contact points for the number 2 and number 3 pins, and the remaining two wafers will be identical to wafers 146a and 146b shown in FIG. 3A. The remainder of the circuitry, however, will be identical. That is, the contact points on each of the four individual wafers will lead to ten contact points on a rotary wiper switch, similar to switch 159 shown in FIG. 3A.

With reference to FIG. 5, it will be noted that the edges of the pin deck 250 are tapered as at 284 and 286. Due to space requirements, the pulleys 266 can be positioned only so close to the ends of the pin deck, meaning that as the bar 271 reaches either end of the pin deck, it will begin to travel around the pulleys and out of the range of the magnetic field produced by the permanent magnets in the bottoms of the pins at the edge of the deck. By providing the tapered edges 284 and 286, whenever any one of the pins slides far enough so that its magnetic field will not be cut by the coils on bar 271, it will be in the area of the taper 284 or 286 and will topple over into the gutter 252 or 254. In all cases, however, the distance between the top edges of the tapers 284 and 286 must be equal to or greater than the minimum permissible width of the bowling alley deck. An additional taper 288 is provided at the end of the pin deck for a similar purpose.

Although the invention has been shown in connection with a certain specific embodiment, it will be readily apparent to those skilled in the art that various changes in form and arrangement of parts may be made to suit requirements without departing from the spirit and scope of the invention. In this respect, although permanent magnets and coils have been shown herein for the purpose of producing an electrical impulse for each standing pin, various other types of proximity devices may be used for the same purpose. For example, any of the well-known metal detecting devices could be used in place of the coils and a small piece of metal embedded in the end of each pin.

We claim as our invention:

1. In a bowling game, apparatus for producing a number of electrical impulses indicative of the number of standing pins comprising permanent magnet means positioned at one end of each pin, winding means, and means for moving the winding means along a horizontal path past said ends of the pins whereby an electrical current will be induced in the winding means each time it passes the permanent magnet means at the end of a standing pin.

2. In a bowling game, apparatus for producing a number of electrical impulses corresponding to the number

of pins knocked down by a ball comprising permanent magnet means positioned at an end of each pin, winding means, means for moving the winding means along a horizontal path past said ends of the pins whereby an electrical signal will be induced in the winding means each time it passes the permanent magnet means at the end of a standing pin, and circuit means coupled to said winding means for producing a number of electrical impulses equal to ten minus the number of electrical signals induced in the winding means.

3. In a bowling game, apparatus for producing a number of electrical impulses corresponding to the number of pins knocked down by a ball comprising an electrical detecting device, means for moving the electrical detecting device along a path past the tops of said pins, means in the top of each of said pins for causing said electrical detecting device to produce an electrical signal as it passes by the pin along its path of travel, and circuit means coupled to said electrical detecting means for producing a number of electrical impulses equal to ten minus the number of electrical signals produced by said detecting device.

4. In a bowling game, apparatus for producing a number of electrical impulses corresponding to the number of pins knocked down by a ball comprising an electrical detecting device, means for moving the electrical detecting device along a path beneath the bottoms of said pins, means in the bottom of each of said pins for causing said electrical detecting device to produce an electrical signal as it passes beneath the pin along its path of travel, and circuit means coupled to said electrical detecting means for producing a number of electrical impulses equal to ten minus the number of electrical signals produced by said detecting device.

5. In a bowling game having ten pins arranged in a triangular configuration at the end of an alley with a first row of four pins extending transversely across the alley at its extreme end, a second row of three pins positioned in front of said first row and extending transversely across the alley, a third row of two pins in front of said second row and also extending transversely across the alley, and a single pin located in front of the third row midway between the two pins therein; the combination of apparatus for producing a number of electrical impulses indicative of the number of pins knocked down by a ball comprising permanent magnet means embedded in an end of each pin, a member adapted to be moved past said ends of the pins along a horizontal path, first electrical winding means carried by said member and extending from a point slightly in front of said single pin to a point slightly in front of said second row of pins, second electrical winding means carried by said member and extending from a point ahead of said second row of pins to a point slightly in front of the first row of pins, and third electrical winding means carried by said member and extending from a point in front of the first row of pins to a point behind the first row of pins, the arrangement being such that an electrical current will be induced in either the first, second or third winding means as it is moved past the permanent magnet means at the end of a standing pin.

6. In a bowling game having ten pins arranged in a triangular configuration at the end of an alley with a first row of four pins extending transversely across the alley at its extreme end, a second row of three pins positioned in front of said first row and extending transversely across the alley, a third row of two pins in front of said second row and also extending transversely across the alley, and a single pin located in front of the third row midway between the two pins therein; the combination of apparatus for producing a number of electrical impulses indicative of the number of pins knocked down by a ball comprising permanent magnet means embedded in an end of each pin, a member adapted to be moved past said ends of the pins along a horizontal path, first

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electrical winding means carried by said member and adapted to cut the lines of flux produced by the permanent magnet means in said single pin and the two pins in said third row of pins, second electrical winding means carried by said member and adapted to cut the lines of flux produced by the permanent magnet means in the pins in said second row of pins, and third electrical winding means carried by said member adapted to cut the lines of flux produced by the permanent magnet means in said first row of pins, the arrangement being such that an electrical current will be induced in either the first, second or third winding means as it is moved past the permanent magnet means in a standing pin to cut the lines of flux thereof.

7. The combination claimed in claim 6 wherein the permanent magnet means in each pin is magnetized to have north and south poles spaced along a vertical axis.

8. In a bowling game having ten pins arranged in a triangular configuration at the end of an alley, apparatus for producing a number of electrical impulses indicative of the number of standing pins comprising permanent magnet means embedded in the end of each pin, a member adapted to be moved past said ends of the pins along a horizontal path, a plurality of electrical windings carried by said member, each of said windings being adapted to cut the lines of flux of a permanent magnet and produce an electrical impulse as it passes any standing pin within said triangular configuration, and means for combining the electrical impulses produced by said windings.

9. The combination claimed in claim 8 and including circuit means coupled to said combining means for producing a number of electrical signals equal to ten minus the number of electrical impulses produced by the respective windings.

10. In a bowling game, apparatus for producing a number of electrical impulses indicative of the number of standing pins comprising permanent magnet means positioned at an end of each pin, a member adapted to be moved across said ends of the pins along a horizontal path, a plurality of aligned electrical windings carried by said member, each of said windings being adapted to produce an electrical impulse upon cutting the lines of flux produced by a magnet in the end of a pin, separate relays operatively connected to each of the windings and actuable whenever an electrical impulse is produced by their associated windings, a plurality of switching devices each responsive to actuation of an associated one of said relays for energizing a number of electrical leads corresponding to the number of times the relay is actuated, and a movable contact member adapted to contact each of said leads in succession whereby a number of electrical impulses will be produced on the movable contact corresponding to the cumulative number of impulses produced by said plurality of windings.

11. The combination claimed in claim 10 and including means incorporating a plurality of rotary stepper switches for producing a number of electrical signals equal to ten minus the cumulative number of impulses produced by said plurality of windings.

12. In a bowling game having ten pins arranged in a triangular configuration at the end of an alley with a first row of four pins extending transversely across the alley at its extreme end, a second row of three pins positioned in front of said first row and extending transversely across the alley, a third row of two pins in front of said second row and also extending transversely across the alley, and a single pin located in front of the third row midway between the two pins therein; the combination of apparatus for producing a number of electrical impulses indicative of the number of standing pins comprising permanent magnet means imbedded in an end of each pin, a member adapted to be moved past said ends of the pins along a horizontal path, first electrical winding means carried by said member and extending from a point slightly

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in front of said single pin to a point slightly in front of said third row of pins, second electrical winding means carried by said member and extending from a point slightly ahead of said third row of pins to a point slightly in front of the second row of pins, third electrical winding means carried by said member and extending from a point slightly in front of said second row of pins to a point slightly in front of the first row of pins, and fourth electrical winding means carried by said member and extending from a point in front of the first row of pins to a point behind the first row of pins, the arrangement being such that an electrical current will be induced in either the first, second, third, or fourth winding means as it is moved past the permanent magnet means at the end of a standing pin.

13. In a bowling game having ten pins arranged in a triangular configuration at the end of an alley with a first row of four pins extending transversely across the alley at its extreme end, a second row of three pins positioned in front of said first row and extending transversely across the alley, a third row of two pins in front of said second row and also extending transversely across the alley, and a single pin located in front of the third row midway between the two pins therein; the combination of apparatus for producing a number of electrical impulses indicative of the number of standing pins comprising permanent magnet means imbedded in an end of each pin, a member adapted to be moved past said ends of the pins along a horizontal path, first electrical winding means carried by said member and adapted to cut the lines of flux produced by the permanent magnet means in said single pin, second electrical winding means carried by said member and adapted to cut the lines of flux produced by the permanent magnet means in said third row of pins, third electrical winding means carried by said member and adapted to cut the lines of flux produced by the permanent magnet means in the pins in said second row of pins, and fourth electrical winding means carried by said member and adapted to cut the lines of flux produced by the permanent magnet means in said first row of pins, the arrangement being such that an electrical current will be induced in either the first, second, third or fourth winding means as it is moved past the permanent magnet means in a standing pin to cut the lines of flux thereof.

14. In a bowling game, apparatus for producing an electrical signal indicative of the number of fallen pins comprising a device at one end of each of said pins adapted to be electrically detected, apparatus electrically insulated from said devices and actuable after each ball is delivered in a bowling game for electrically detecting only those devices in the ends of standing pins to produce an electrical signal which varies as a function of the number of standing pins, and means responsive to said last-named electrical signal for producing an output electrical signal which varies as a function of the number of fallen pins.

15. In a bowling game, apparatus for producing an electrical signal indicative of the number of fallen pins comprising a device at one end of each of said pins adapted to be electrically detected, apparatus electrically insulated from said devices and actuable after each ball is delivered in a bowling game for electrically detecting only those devices in the ends of standing pins to produce a number of electrical impulses corresponding to the number of standing pins, and means responsive to said last-named electrical impulses for producing an electrical signal comprising a number of pulses corresponding to the number of fallen pins.

16. In a bowling game, apparatus for producing an electrical signal indicative of the number of standing pins on a pin deck comprising magnet means in an end of each pin, and inductive means movable relative to the pins and responsive to the lines of force produced by said magnet means for producing a number of electrical impulses corresponding to the number of standing pins.

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17. In a bowling game having ten pins arranged in a triangular configuration on a pin deck at one end of an alley, the combination of apparatus for producing a number of electrical signals indicative of the number of standing pins on the pin deck comprising a member adapted to be moved past the ends of the pins along a substantially horizontal path, a plurality of spaced pin detecting devices carried on said member, each of the detecting devices being adapted to produce an electrical signal as it passes the end of a standing pin, and each of said devices being arranged on the member to sweep across a predetermined zoned area above the pin deck such that it will detect only those pins within its zoned area.

18. In a bowling game having ten pins arranged in a triangular configuration on a pin deck at one end of an alley, the combination of apparatus for producing a number of electrical signals indicative of the number of standing pins on the pin deck comprising an elongated member having a length substantially equal to the length of one transverse dimension of the pin deck and adapted to be moved past the ends of the pins along a substantially horizontal path along the other transverse dimension of the pin deck, a plurality of pin detecting devices axially spaced along said member and carried thereon, each of the detecting devices being adapted to produce an electrical signal as it passes the end of a standing pin, and each of said devices being arranged on the member to sweep across a predetermined zoned area above the pin deck such that it will detect only those pins within its zoned area.

19. In a bowling game having ten pins arranged in a triangular configuration at the end of an alley with a first row of four pins extending transversely across the alley at its extreme end, a second row of three pins positioned in front of said first row and extending transversely second across the alley, a third row of two pins in front of said row and also extending transversely across the alley, and a single pin located in front of the third row midway between the two pins therein; the combination of apparatus for producing a number of electrical signals indicative of the number of standing pins on the alley comprising a member adapted to be moved past said ends of the pins along a horizontal path, first pin detecting means carried by said member and extending from a point slightly in front of said single pin to a point slightly in front of said second row of pins, second pin detecting means carried by said member and extending from a point ahead of said second row of pins to a point slightly in front of the first row of pins, and third detecting means carried by said member and extending from a point in front of the first row of pins to a point behind the first row of pins, each of said pin detecting means being adapted to produce an electrical signal as it passes the end of a standing pin.

20. In a bowling game having ten pins arranged in a triangular configuration at the end of an alley with a first row of four pins extending transversely across the alley at its extreme end, a second row of three pins positioned in front of said first row and extending transversely across the alley, a third row of two pins in front of said second row and also extending transversely across the alley, and a single pin located in front of the third row midway between the two pins therein; the combination of apparatus for producing a number of electrical signals indicative of the number of standing pins on the alley comprising a member adapted to be moved past said ends of the pins along a substantially horizontal path, first pin detecting means carried by said member and extending from a point slightly in front of said single pin to a point slightly in front of said third row of pins, second pin detecting means carried by said member and extending from a point slightly ahead of said third row of pins to a point slightly in front of the second row of pins, third pin detecting means carried by said member and extending from a point slightly in front of said

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second row of pins to a point slightly in front of the first row of pins, and fourth pin detecting means carried by said member and extending from a point in front of the first row of pins to a point behind the first row of pins, each of said pin detecting means being adapted to produce an electrical signal as it passes an end of a standing pin.

21. In a bowling game, means for producing a number of electrical impulses indicative of the number of standing pins comprising a metallic device at the top of each of the pins adapted to be electrically detected, apparatus for electrically detecting said devices, and means for moving said apparatus past said tops of the pins whereby the apparatus will produce an impulse whenever it passes the top of a standing pin.

22. In a bowling game having ten pins arranged in a triangular configuration on a pin deck at one end of an alley, apparatus for detecting standing pins on said pin deck including a member movable past the ends of the pins along a substantially horizontal path from one side of the pin deck to the other, pin detecting means carried on said member and adapted to produce discrete electrical signals as it passes the ends of standing pins, the number of signals produced being equal in number to the number of standing pins, and circuitry electrically coupled to said pin detecting means and actuable after each ball is delivered in a bowling game for electrically subtracting the number of discrete signals equal to the number of standing pins from ten to thereby produce a number of discrete signals equal in number to the number of fallen pins.

23. In a bowling game having pins arranged on a pin support, the combination of apparatus for producing a number of electrical signals indicative of the number of standing pins on the pin support comprising a member adapted to be moved past the ends of the pins along a substantially horizontal path, a plurality of spaced pin detecting devices carried on said member, each of the detecting devices adapted to produce an electrical signal as it passes the end of a standing pin, and each of said devices being arranged on the member to sweep across a predetermined zoned area of the pin support such that it will detect only those standing pins within its zoned area.

24. In a bowling game normally having ten pins arranged in a triangular configuration on a pin deck at one end of an alley, the combination of less than ten electrical pin sensing devices each adapted to detect pins standing on the pin deck only within a predetermined zoned area of said triangular configuration to produce a number of discrete electrical signals equal to the number of standing pins within its associated predetermined zoned area, at least some of said zoned areas having a plurality of pins therein when all ten pins are standing, at least ten electrical utilization devices, and circuit means operatively interconnecting said electrical pin sensing devices and said utilization devices for actuating a number of said utilization devices equal in number to the number of electrical signals produced by said pin sensing devices.

25. In a bowling game having ten pins arranged in a triangular configuration on a pin deck at one end of an alley, the combination of apparatus for producing an electrical quantity indicative of the number of fallen pins on the pin deck comprising a plurality of electrical pin detecting devices each adapted to detect standing pins only within a predetermined zoned area of said triangular configuration, at least some of said zoned areas having a plurality of pins therein when all ten pins are standing, and circuit means coupled to said detecting devices and operable in response to said electrical quantity for indicating the magnitude of said quantity and hence the number of fallen pins.

26. The combination of claim 25 wherein the electrical quantity indicative of the number of fallen pins is a number of electrical pulses equal to the number of standing

pins, and wherein said circuit means includes apparatus for subtracting said pulses equal in number to the number of standing pins from ten in order to obtain pulses equal in number to the number of fallen pins.

27. In a bowling game having ten pins arranged in a triangular configuration on a pin deck at one end of an alley, the combination of a plurality of electrical pin detecting devices each of which is adapted to detect standing pins only within a predetermined zoned area of said triangular configuration, said plurality of pin detecting devices being adapted to produce an electrical quantity indicative of the number of standing pins, at least some of said zoned areas having a plurality of pins therein when all ten pins are standing, circuit means coupled to said detecting devices for electrically subtracting said quantity indicative of the number of standing pins from ten in order to derive an electrical quantity proportional to the number of fallen pins, and means electrically coupled to said last-named means for indicating the number of fallen pins.

28. In apparatus for indicating the number of pins knocked down after each ball is delivered on a bowling alley having ten pins normally arranged in a triangular configuration on a pin deck at one end of the alley before balls are delivered in each frame of the game; the combination of a plurality of electrical pin detecting devices each adapted to detect standing pins only within a predetermined zoned area of said triangular configuration, at least some of said zoned areas having a plurality of pins therein when all ten pins are standing, each of said pin detecting devices being adapted to produce electrical impulses with the number of impulses produced by each pin detecting device after a ball is delivered in a bowling game being equal in number to the number of standing pins in its associated zoned area, circuit means coupled to said detecting devices for electrically subtracting the number of impulses produced by said detecting devices from ten to thereby derive a number of electrical impulses equal in number to the number of fallen pins, and means electrically coupled to said last-named means for indicating the number of fallen pins.

29. The combination of claim 28 wherein a first of said zoned areas normally has a single pin therein when all ten pins are standing, a second of said zoned areas normally has two pins therein, a third of said zoned areas normally has three pins therein, and a fourth of said zoned areas normally has four pins therein.

30. The combination of claim 28 wherein said electrical detecting devices are above the tops of standing bowling pins.

31. The combination of claim 28 wherein said electrical detecting devices are carried on a structure extending transversely across a pin deck on which the pins are positioned and above the tops of said pins.

32. In apparatus for detecting standing pins on a bowling alley pin deck, the combination of a substantially horizontal elongated member extending between opposite edges of the pin deck along one transverse dimension of the pin deck, means for moving said member across the tops of the pins along a horizontal path of travel extending parallel to the other transverse dimension of the pin deck, and electrical pin detecting means carried on said elongated member and adapted to produce a number of electrical pulses equal to the number of standing pins on the pin deck as said member moves across the tops of standing pins.

References Cited

UNITED STATES PATENTS

2,283,277	5/1942	Modine	273—186
2,585,153	2/1952	Metz	273—126
2,973,206	2/1961	Sanders	273—82
2,974,955	3/1961	Walsh	273—43
2,977,121	3/1961	Flint et al.	273—42
2,980,424	4/1961	Sanders et al.	273—43
2,988,359	6/1961	Dettman	273—82
3,011,785	12/1961	Torressen	273—52 X

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