

June 3, 1969

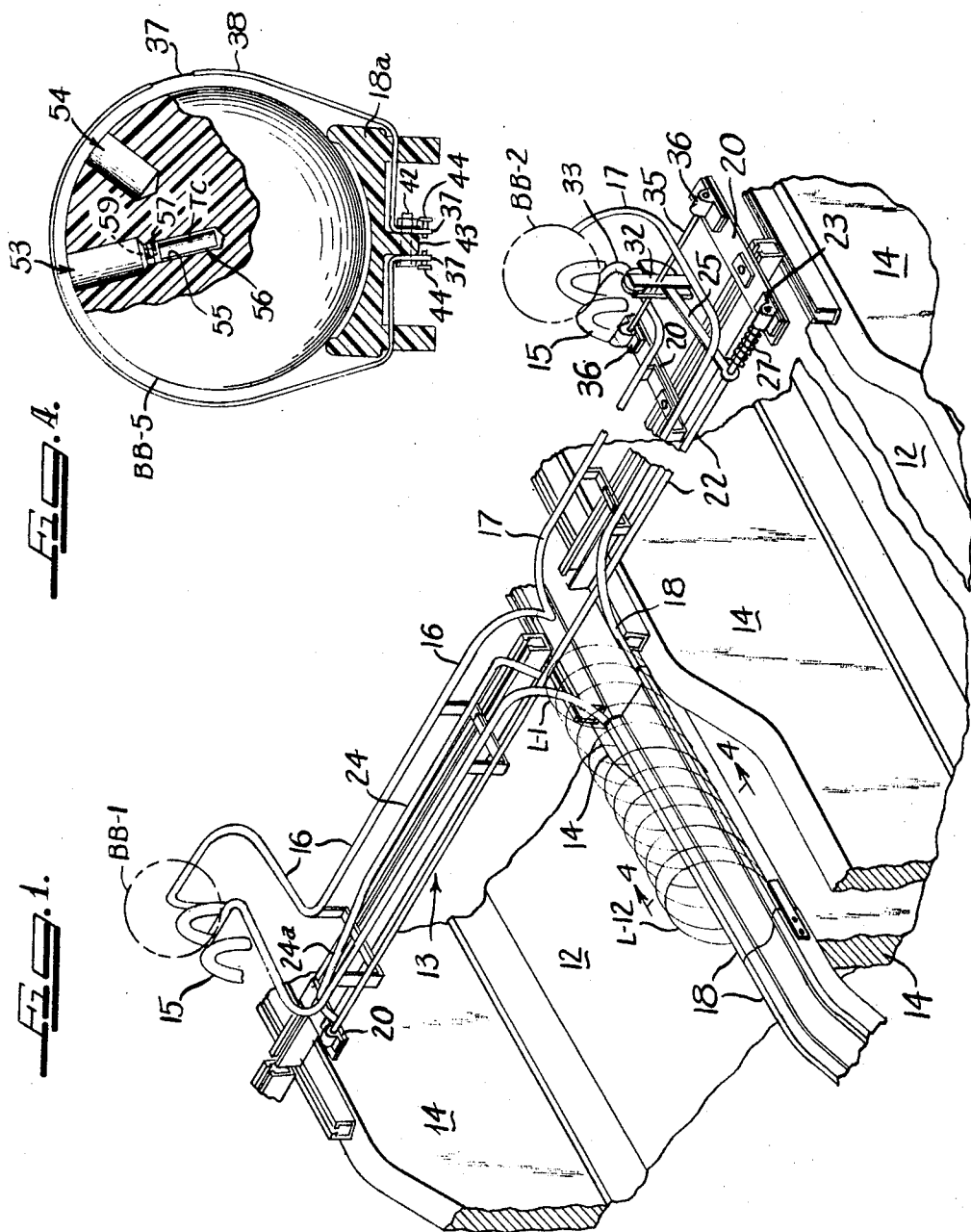
W. D. CORNELL

3,447,804

CODING OF BOWLING BALLS

Filed July 23, 1965

Sheet 1 of 4



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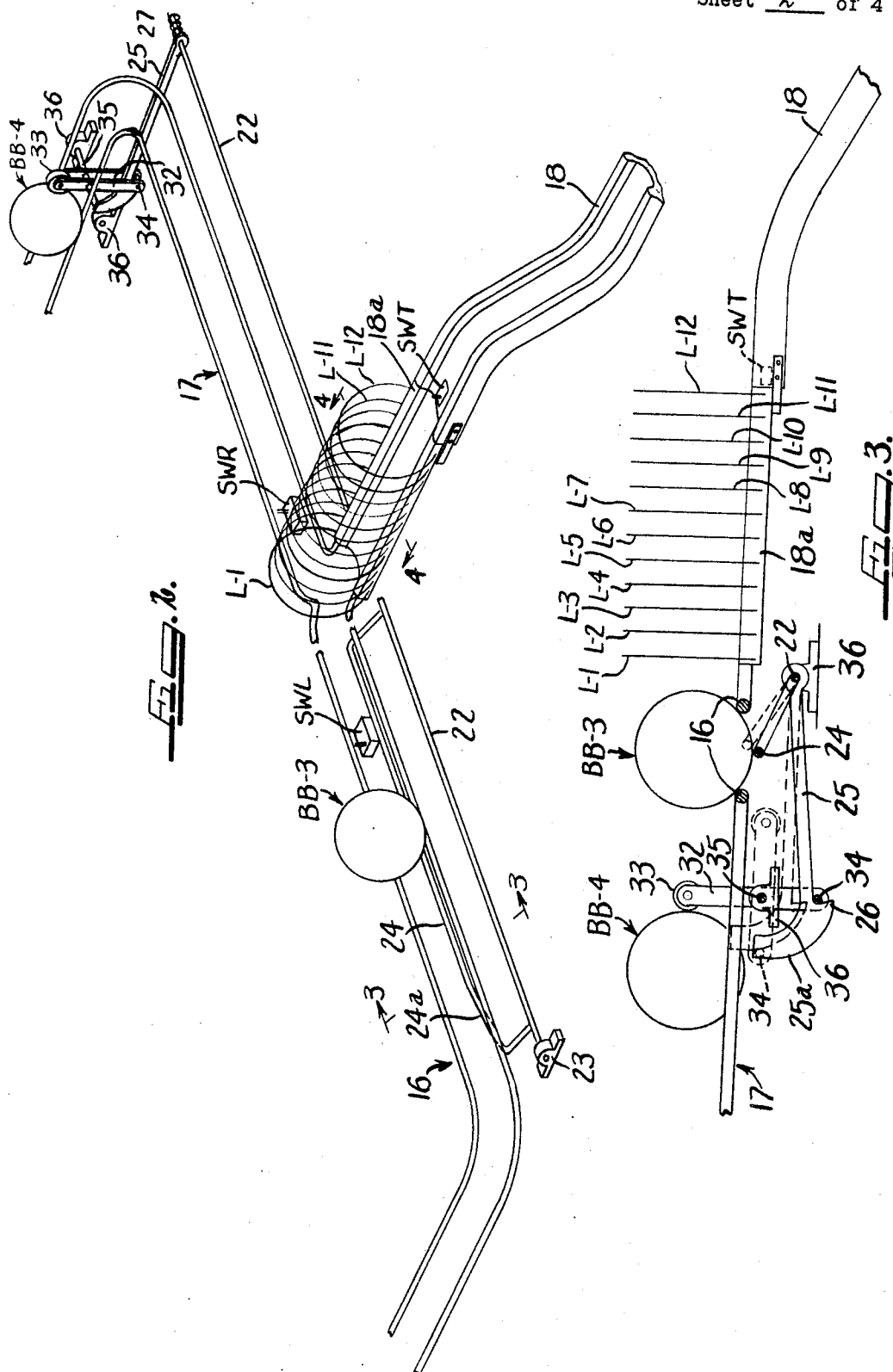
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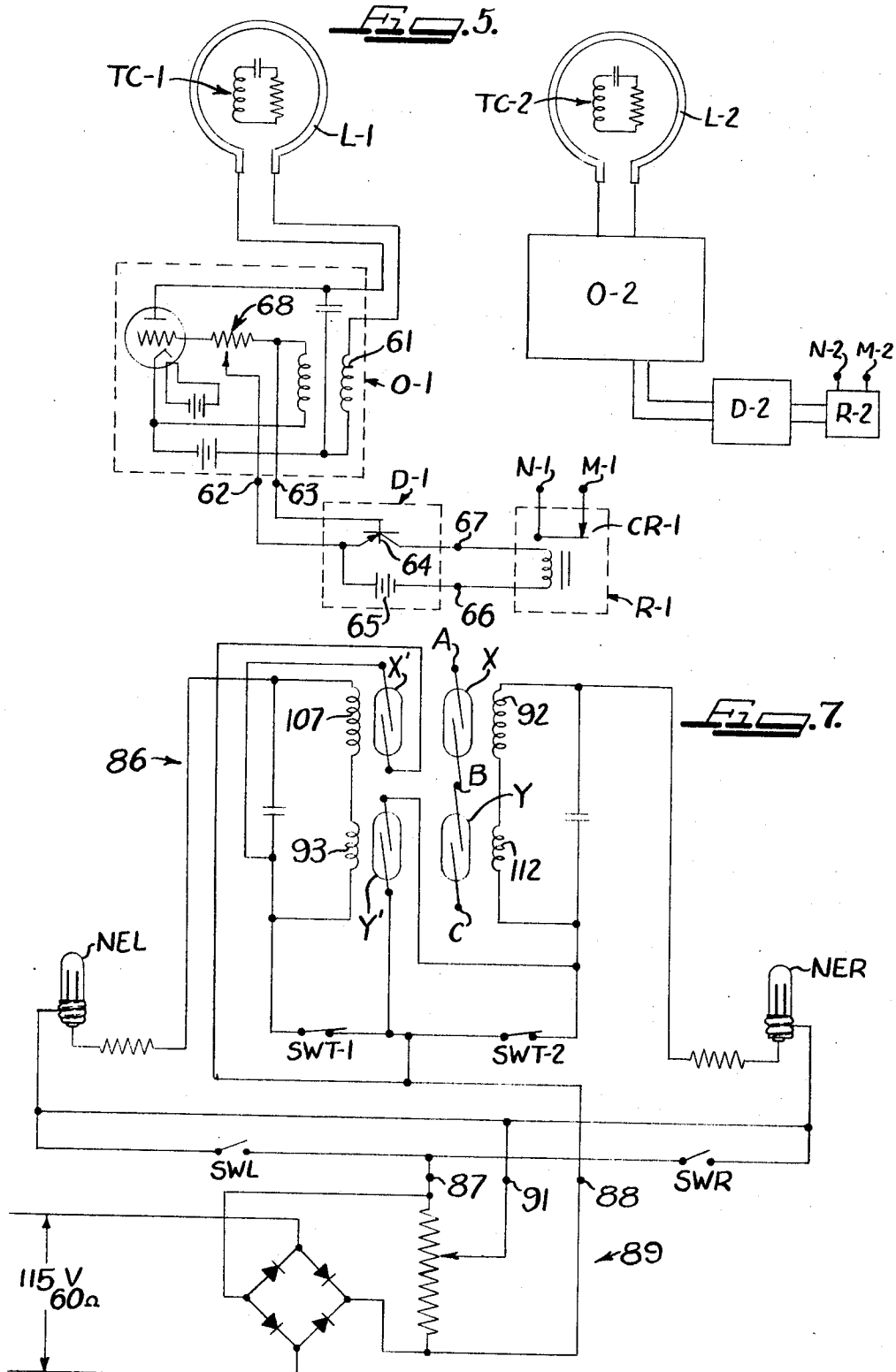
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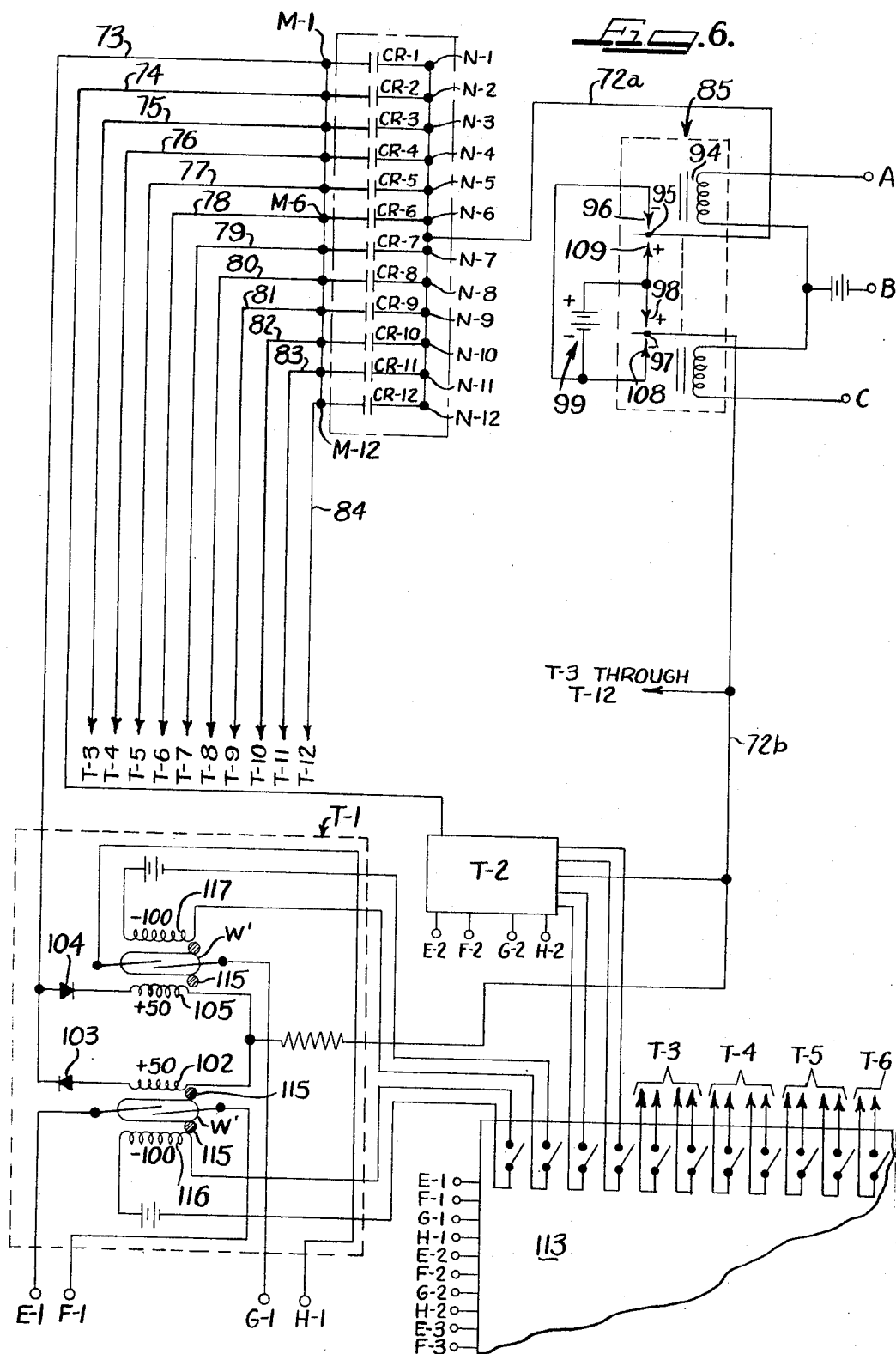
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3,447,804

CODING OF BOWLING BALLS

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Int. Cl. A63d 5/04

U.S. Cl. 273—54

23 Claims

ABSTRACT OF THE DISCLOSURE

A bowling ball detection system is provided in combination with a bowling lane. The system includes a plurality of balls, each having a distinctive signal transmitter or other detectable coding means and a detector for detecting the coding means in the ball path, e.g., on the return track. The detector can differentiate between the ball signals for identifying the balls and can comprise a plurality of oscillator loops, one tuned to the signal transmitter in each ball to be bowled on the lane.

The disclosure

This invention relates to systems for detecting bowling balls and for differentiating between bowling balls during their use on a bowling lane of a bowling establishment. The invention more particularly relates to systems for identifying and differentiating between bowling balls for controlling equipment associated with the bowling lane for purposes of scoring, ball handling, or the like, during a game of bowling.

During a game of bowling, it is often desirable to identify balls bowled on a particular lane. Assuming, as is the general practice, that each bowler of a plurality, e.g., a team, bowls with his same ball throughout a game, the identity of the bowler can be established by detecting and identifying the bowler's ball. Such ball identification, e.g. when coupled with identification of the lane on which the bowler has bowled, can be used for such purposes as directing return of a ball to a particular location or attributing the correct score to a particular bowler.

With recent trends toward development of systems for automatic scoring of bowling games, it becomes important to provide an information input for a scoring system which will identify the bowler and the lane upon which he has bowled. The information should be provided in a form useable by the scoring system and should also be provided in a manner which eliminates the possibility of error in bowler and lane identify as they correlate with bowling scores computed by the scoring system. It is highly advantageous to provide the information as a result of normal bowling during a bowling game without requiring manual input of the information to the scoring system.

It is an object of this invention to provide for the identification of bowling balls in a new and useful manner during a game of bowling.

It is a further object to provide a new and useful system for coding a plurality of bowling balls with individual code means where there are differences in the code means from ball to ball sufficient for detection and differentiation of each of the balls used during the game.

It is also an object to provide a new and useful detection system for detecting such differences between balls.

Another object is to provide separate read-out-signals resulting from identification of separate bowling balls so that the signals can be used as an information input to a scoring system or for other purposes as desired.

More particularly, it is an object to provide signal means within a bowling ball for producing a separate signal for the particular bowling ball, and to provide a

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plurality of such balls in which the separate signals are discernible.

It is also an object to provide a system of the type described wherein each signal is produced by changing an externally generated signal.

Yet another object of this invention is to provide coding means which may be removably carried by each of a plurality of balls and which are interchangeable between the balls, each coding means being distinguishable from each other.

Another object of this invention is to provide for the detection of a bowling ball in a new and useful manner while the bowling ball is traveling through a normal ball path during a game of bowling. In a particularly advantageous form of the invention, the bowling ball is detected during its travel over the ball return path from the bowling lane pit to the bowler's end of the lane.

Still another object of this invention is to provide a system in accordance with any of the foregoing objects which can be used with a pair of adjacent bowling lanes and in which there is further provided differentiation between the lanes, e.g. in the form of identification of each of the lanes.

Another object is to provide a signal memory system for use in the system of any of the foregoing objects so that the lane and ball identification signals can be received successively and transmitted concurrently for use by a scoring system or the like.

Other objects and advantageous features of the present invention will be apparent to those in the art from the following description and from the drawings, in which:

FIGURE 1 is a perspective view of a portion of pair of adjacent lanes at a bowling establishment, indicating location of components of a system in accordance with the principles of the present invention;

FIGURE 2 is a schematic showing of a system as illustrated in FIGURE 1, in more simplified form, for clarity of understanding;

FIGURE 3 is a section along line 3—3 of FIGURE 2;

FIGURE 4 is a section along line 4—4 of FIGURE 1, showing mounting of loop members illustrated in FIGURE 2 and also illustrating a bowling ball, adapted in accordance herewith, disposed within a loop and shown partially cut-away for better illustration of internal ball structure; and

FIGURES 5 through 7 are wiring diagrams of the electrical circuitry of the illustrated form of ball detection system.

While this invention is susceptible of embodiment in many different forms, there is shown in the drawings and will herein be described in detail a specific embodiment of the invention with the understanding that the present disclosure is to be considered as an exemplification of the principles of the invention and is not intended to limit the invention to the embodiment illustrated.

It is to be understood that the ball detection system of the present invention is capable of use in combination with a bowling lane or a pair of adjacent bowling lanes in a bowling establishment. Each lane may advantageously be equipped with automatic pinsetting devices of the type commercially available and well known to those in the art. In such a bowling lane, the ball is normally bowled by the bowler from the bowler's end of the lane over a lane surface, indicated by reference numeral 12, toward a pit area, indicated generally at 13. Although the bowler's end of the lane is not shown, such structure normally identified with a bowler's end may be used in accordance herewith.

As the ball progresses over surface 12 toward the pit 13, it encounters the pin setup on surface 12, normally in the area between kickbacks 14 separating each lane setup and pit from the next adjacent lane setup and pit. The

pinsetting equipment receives the ball from the pit 13 and elevates the ball above kickbacks 14, the pinsetter elevator discharge being shown at 15. Balls BB-1 and BB-2 are shown at respective ball discharges 15 in FIGURE 1. The ball then proceeds over guide or branch tracks 16 or 17, depending upon the pit from which the ball was elevated. The guide tracks join at a Y junction with a common ball return track 18 which extends to the bowler's end of the lane for return of balls to the bowlers. In the system shown, one common track 18, mounted above adjacent kickbacks 14, is provided for each of the two adjacent bowling lanes. Thus, the ball detecting system which will be described in accordance herewith will be a ball detecting system useful for two adjacent lanes. It will be apparent from the description herein that the principles of the system can be readily adapted for one lane or for a plurality of lanes greater than two.

Referring now to FIGURES 1-3, and especially FIGURES 2 and 3, a plurality of separate loops L, i.e. L-1 through L-12, are mounted to surround the ball path over a non-magnetic portion 18a of the common ball track 18. A blocking system is provided for blocking a ball from one of the branch or guide tracks in such cases where a ball from the other branch or guide track is approaching the common track 18, so that the first ball to enter the array of loops L will progress completely through the array prior to entry of a second ball from the other branch or guide track.

The blocking system is of the type providing a right-of-way on one branch track while blocking possible interfering balls on the other branch track. The system includes an elongate shaft 22 pivotally mounted by suitable means 23 supported from suitable framework 20. The shaft 22 extends along portions of both branch tracks 16 and 17. A rail member 24 is secured by a pair of arms to shaft 22 for pivoting with shaft 22. Rail member 24 is disposed between the rails of track 16 to be depressed by a ball passing over track 16, thereby pivoting shafts 22 and rail 24 from the phantom position of FIGURE 3 to the full line position in a counterclockwise direction. Rail 24 has an inclined portion 24a for camming the rail 24 downward as the ball rolls over track 16.

Mounted at the other end of shaft 22 for pivoting therewith is a latch member 25 having a latching end 26. Latch member 25 is normally biased in a clockwise direction by a torsion spring 27 around shaft 22 secured at its ends to latch member 25 and suitable framework 20. Shaft 22, secured to latch member 25, is thereby also biased in a clockwise direction as viewed in FIGURE 3, carrying rail 24 to the phantom position. The weight of a ball, e.g. ball BB-3, is sufficient to overcome spring 27 and pivot latch 25 downward.

A blocking member 32 is disposed between the rails of track 17 and comprises a pair of spaced arms, held in spaced disposition at one end by a pin 34 and at the other end by a shaft, on which a roller 33 is rotatably mounted. The arms are pivotally mounted by means of a shaft 35 impaling the arms between roller 33 and pin 34 and appropriately mounted by brackets 36, supported by framework 20. The lower end of blocking member 32 is weighted to normally hang down.

As best seen in FIGURE 3, with latch 25 biased by spring 27 to its normally raised position, shown in phantom, as a ball, e.g. BB-4, rolls over return track 17, ball BB-4 engages roller 33 and pivots the blocking member 32 in a clockwise direction, under the weight of the ball. The ball thereupon proceeds over track 17 to track 18.

However, if a ball, e.g. BB-3, has moved onto rail 24 prior to ball BB-4 reaching latching roller 33, rail 24 has been depressed against the urging of spring 27, pivoting latching member 25 downward with latching end 26 hooking over pin 34 of blocking member 32. In such instance, as ball BB-4 approaches roller 33, blocking member 32 is held by latch 25 against pivoting and ball BB-4 is stopped against roller 33. As the ball BB-3 on

rail 24 proceeds beyond rail 24 and onto common track 18, rail 24 is released and latch 25 is raised by spring 27, thereby unlatching blocking member 32. The weight of ball BB-4, with ball BB-4 resting on an inclined portion of track 17, is sufficient to pivot blocking member 32 in a clockwise direction as viewed in FIGURE 3 and ball BB-4 thereupon proceeds over branch track 17 and onto common track 18.

Whenever a ball on track 17 passes and pivots blocking member 32 down while latch 25 is released, pin 34 on blocking member 32 is carried beneath an extension 25a of latch 25 to block latch 25 from being depressed. This holds rail 24 raised and blocks any ball on track 16 entering rail 24 so that the ball from track 17 proceeds completely through loops L-1 through L-12 prior to arrival of the ball from track 16 to the first of loops of L-1 through L-12. Thus, in the ball blocking system illustrated, the first ball to arrive at a particular point has the right-of-way over a ball on the other track and delays the other ball enough to pass completely through loops L-1 through L-12 prior to entry of the other ball into the loops.

It will be noted in FIGURES 2 and 3 that, as the balls on tracks 16 and 17 approach track 18, they pass over switches SWL and SWR respectively. Switches SWL and SWR are normally open switches which are momentarily closed by passage of a ball thereover, the ball engaging an upstanding actuator arm for closing the switch. Each of switches SWL and SWR is spring-loaded so that after passage of the ball the switch reopens. The ball then proceeds onto track 18 and rolls over non-magnetic portion 18a while rolling through the loops L-1 through L-12.

The loops L-1 through L-12 comprise a portion of the ball detection system provided in accordance herewith. Each of the loops L is individually mounted as illustrated in FIGURE 4. Each loop includes a central, electrically conductive stiff wire 37 encased in an electrically insulating sheath 38, of phenolic resin coating or the like. The loops are mounted by electrically non-conductive or insulating bolts 42 to a rib 43 on the bottom of the non-conducting and non-magnetic track section 18a. Each loop L is disposed to surround the ball path so that the ball passes through the loop during its return over track section 18a. Each loop also includes a pair of lead terminals in the form of electrically conductive screws 44 which are threadedly connected with the wire portion 37. The sheath 38 is scraped away to provide a conductive surface of wire portion 37 opposite the head of screw 44. The wire portion 37 of each loop may be generally flat to provide good rigidity and better bearing surface for attaching lead wires between wire 37 and screw 44.

As the ball leaves the last of loops L, i.e. L-12, the ball trips switch SWT, a normally closed double pole switch which is spring-loaded toward closed position and is momentarily opened by engagement of an upstanding actuator arm with a ball passing thereover.

In general, the switches SWL and SWR function as lane identification switches for identifying the left and right lanes respectively. Signals from momentary closure of the switches are fed to a holding system where the lane identification is memorized, as will be seen. As the ball passes through the loops L-1 through L-12, its identification is established and a signal can then be given for identifying both the lane and ball. Tripping of switch SWT cancels the lane identification signal from the lane identification holding system.

As one feature of the present invention, there is provided a coding means for a ball or a plurality of separate coding means for a plurality of separate balls. Each coding means is comprised of a signal system for giving a signal detectable by one of the loops L-1 through L-12. In the system shown, the signal is detected as a change in a signal generated by an oscillator O-1 through O-12

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(only O-1 and O-2 being shown in FIGURE 5), the change resulting from the presence of the coding means in the form of a tuned loading circuit TC carried within the bowling ball.

Referring now to FIGURE 4 and the ball BB-5 illustrated therein, it is seen that the ball includes a pair of finger holes 53 and 54 and a cavity 55 continuing from one hole for receiving a loading circuit device 56. A loading circuit portion of the device, diagrammatically shown in FIGURES 4 and 5 at TC, e.g. TC-1 or TC-2, includes a resistor, an inductance coil and a capacitor in a complete series circuit. The circuit components may be molded in a body of plastic material for convenient insertion. The loading circuit device 56 includes a male threaded base portion 57 supporting and carrying the loading circuit portion TC. The male threaded base portion 57 is removably received in a female threaded portion at the entry of cavity 55 below finger hole 53. A screw driver slot or Allen head socket 59 is provided in base portion 57 to facilitate threading so that the loading circuit device can be removably secured in cavity 55.

It is to be understood that a plurality of balls such as ball BB-5 described above, can be provided as a set of balls in accordance herewith. Preferably, twelve balls are provided with loading circuits T-1 through T-12, the loading circuit of each of which is detectable by a respective one of the loops L-1 through L-12 and attentive equipment. The twelve balls permit bowling by two teams of five bowlers each plus a pace bowler for each team, with the teams alternating between two lanes in the illustrated system. For example, the balls BB-1 through BB-5, referred to hereinabove, and seven additional balls may each be provided with a loading circuit tuned to a different frequency.

Turning now to the wiring diagrams of FIGURES 5-7, it is to be understood that although less than twelve each of the tuned loading circuits TC, loops L, oscillators O, amplifiers D, relays R, relay contacts CR and signal differentiating system sections T are illustrated, the total particular system described includes twelve of each which may be referred to herein and differentiated from each other by number suffixes 1 through 12 on the respective letter designations. Further, in the system, there are twelve each of terminals E, F, G and H in the signal differentiating system T and the same number of corresponding terminals in the scoring system. It is intended that each terminal having the identical designation, including identical suffix of 1-12, is interconnected. Also, in the signal differentiating system T, it is to be understood that contacts V-1 through V-12 and V'-1 through V'-12, in the scoring system are operated by relays or the like (not shown) in a computation or control section of a scoring system, and are connected by suitable wiring to the respective sections T-1 through T-12, i.e. having the same numerical suffix, as is shown for contacts for V-1 and V'-1 in section T-1. Contacts A, B and C in FIGURE 6 are connected to contacts A, B and C respectively in FIGURE 7.

Referring to FIGURE 5, each loading circuit TC is tuned to a frequency for cooperation with one of the oscillator circuits, including a loop L and an oscillator O in the detection system, to increase the oscillator induction coil current. The frequencies of the tuning circuits differ from each other an amount discernible by the oscillator system. Since frequency is dependent on the product of inductance and capacitance, either the inductance or capacitance or both will vary between the loading circuits TC-1 through TC-12. Such variance in frequency by changing inductance and capacitance is in accord with the formula

$$F=1/2\pi\sqrt{LC}$$

where F is frequency in cycles per second, L is inductance in henries and C is capacitance in Farads. Also, the in-

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ductance coils of each of the various oscillators are tuned to frequencies at which a maximum power transfer is achieved to the proper and corresponding loading circuit so that the induction coil 61 (of which the corresponding loop L forms a portion) of only one oscillator O is loaded by each loading circuit TC.

As the ball BB-1 to BB-12 having the proper tuned loading circuit of TC-1 through TC-12 passes through the proper coil loop of L-1 to L-12, the presence of the ball loading circuit causes a power transfer from the loop L to the loading circuit. Each loop L is connected into the induction system of the proper oscillator O of a series of oscillators O-1 to O-12 to comprise a portion of the inductance coil 61. Each oscillator is of a structure resembling a grid dip meter with the exception that a portion of coil 61 is provided in the form of external loop L and a micro-ammeter from across terminals 62 and 63 has been eliminated. Terminals 62 and 63 are instead connected to the input of the proper amplifier D of the series of amplifiers D-1 through D-12.

Each of the amplifiers D-1 through D-12 includes a normally conductive transistor 64 which becomes non-conductive upon application thereto of a voltage above a known level. Transistor 64 is used for completing a circuit from a direct current source 65 to the amplifier output terminals 66 and 67, which circuit is broken by transistor 64 whenever the voltage applied thereto is above the conductive voltage level of the transistor. The corresponding relay of relays R-1 through R-12 is connected across terminals 66 and 67 for energization by source 65 while transistor 64 is conductive.

Each oscillator O is set to proper frequency by placing the proper loading circuit TC in the loop L of the oscillator and adjusting the variable resistance 68 in the grid circuit to a value providing a voltage across terminals 62 and 63 above the level at which transistor 64 becomes non-conductive, so that transistor 64 is non-conductive while the proper loading circuit is present. The adjustment of resistance 68 should be such that, with the loading circuit TC removed, the voltage across terminals 62 and 63 is below the level at which transistor 64 becomes non-conductive, so that transistor 64 is conductive in the absence of loading circuit TC in loop L and non-conductive when loading circuit TC passes near or through loop L.

During ball detection, the oscillators O-1 through O-12 in the detection system are constantly operating with a low current in the inductance coil 61, including loop L. When the proper loading circuit TC is near or passes through the proper loop L, the loading circuit has been so tuned as to provide maximum power transfer thereto from the proper loop L. A high current flow results in the loading circuit, and the resulting load on the oscillator increases the current in the inductance coil to a high level. As a result, the voltage across resistor 68 and terminals 62 and 63 increases, rendering transistor 64 non-conductive, thereby deenergizing the relay R, resulting in making the CR contacts of the proper one of relays R-1 through R-12, thereby giving a signal identifying the ball, e.g., for ultimate use by a scoring system or a ball return control system.

The contacts CR-1 through CR-12 for the respective relays are identified in FIGURE 6. In the system illustrated, one contact terminal of each relay contact is connected to a common line 72a as at N-1 through N-12, and the other contact terminal is connected as at M to a separate one of input leads 73 through 84 to one of a plurality of signal differentiating systems T-1 through T-12, each of which functions to change the incoming signal to an output signal which identifies not only the ball bowled but also the lane it was bowled on. The common line 72a is connected through a signal modifier system 85 which completes a circuit between any closed relay contact and the appropriate signal differentiating system section T-1 through T-12 via line 72b in such a manner as to indicate to the appropriate signal differen-

tiating system the identity of the lane on which the ball was bowled. Input information used by the signal modifier system 85 is received at contacts A, B and C from a lane memory system 86 (FIGURE 7) which functions to remember the lane from which the ball is being returned until the ball is detected by one of detector loops L. The lane memory system receives an input lane identity signal from either of switches SWL or SWR, depending on the lane on which the ball has been bowled.

Turning to FIGURE 7 and the lane memory system 86 illustrated therein, assuming a ball has been bowled on the right lane, the ball, during return from the pit, progresses over branch track 17 and momentarily closes switch SWR (FIGURES 2 and 7). The momentary closing of switch SWR results in a DC voltage higher than the firing voltage being applied to neon tube NER by connecting tube NER across the higher voltage output terminals 87 and 88 of power source or supply 89. Although this circuit immediately breaks with opening of switch SWR, tube NER remains lit due to the normally applied DC voltage from the lower voltage terminals 91 and 88 of power supply 89.

The contacts X, X', Y and Y' are contacts of a magnetic reed switch of a type commercially available. The contacts are normally open. In the switch illustrated, it requires a flux of at least +100 ampere turns to close contacts Y and Y' and a negative flux of at least -50 ampere turns to open the Y and Y' contacts. Also, it requires a negative flux of at least -100 ampere turns to close contacts X and X' and a positive of at least +50 ampere turns to open contacts X and X'.

With tube NER lit, about -125 ampere turns of flux are applied through coil 92 on magnetic reed switches X and X', thereby closing reed switches X and X' while magnetic reed switches Y and Y' remain open because +100 ampere turns of flux are required to pull in Y and Y' by their coil 93. Closing of contacts X and X' completes the circuit between contacts A and B in FIGURE 6 energizing the coil of relay 94 to thereby close contacts 95 and 96 and contacts 97 and 98 to place the positive side of DC power source 99 on common line 72b and the negative side of source 99 in circuitry with line 72a.

As the ball proceeds over the common return track 18 and through the loops L-1 through L-12 (FIGURES 2 and 5), the appropriate loop and oscillator system detects the ball with the corresponding tuned circuit in the manner described above and closes the appropriate relay contact CR (FIGURE 6). Thus, because common line 72b is positive and the appropriate one of lines 73 to 84 is negative, the magnet 102 of the appropriate differentiating system T is energized through blocking diode 103 to close magnetic reed switch contacts W to give a read-out signal at terminals E and F, giving the identity of the ball, depending upon which of signal differentiating system sections T-1 through T-12 was actuated by the corresponding circuitry through lines 73 to 84 and relay contact CR, and further giving indication that the ball is being returned from the right lane in that right lane reed switch W is closed rather than left lane magnetic reed switch W'. Blocking diode 104 blocks energization of coil 105 so reed switch W' does not close.

Considering FIGURES 2 and 7, if a ball has also been bowled on the left lane and is being returned from the left lane immediately after the right lane ball, as close as permitted by the ball blocking system, switch SWL is closed, lighting tube NEL, which is held in due to the holding voltage of the normal circuit across terminals 88 and 91 after SWL opens. If normally open switch SWT-2 has not been tripped yet by the ball from the right lane, none of the contacts X, X', Y or Y' is altered and the signal modifier system 85 (FIGURE 6) remains actuated in its position indicating right lane ball return to the signal differentiating system side of the DC source. Assuming that the ball from the left lane is detected by its

appropriate loop L, when the ball from the right lane opens normally closed switch SWT-1 and SWT-2 momentarily, tube NER is extinguished since switch contact Y' is still open. However, contact X' is still closed and tube NEL is not extinguished. With tube NEL lit, a flux of about +125 ampere turns is applied through coil 93 on reed switch Y and Y' closing Y and Y'. The positive flux of about +125 ampere turns applied through coil 107 is sufficient to open switches X and X'. Tube NEL holds in through normally closed switch SWT-1. Closing of contacts Y and Y' reverses signal modifier system 85, since B and C are now closed and A and B are open, resulting in closing contacts 97 and 108 and contacts 95 and 109 (FIGURE 6) to apply the negative side of power source 99 on common line 72b and the positive side of power source 99 through line 72a and any closed relay contact CR to the appropriate section T-1 through T-12 of the signal differentiating system T. This results in closing magnetic reed switch contact W' through blocking diode 104 and coil 105 in the signal differentiating system section corresponding to the ball detected to signal left lane identification for the detected bowled ball at terminals G and H. Diode 103 blocks coil 102.

If the right lane ball had already tripped and opened SWT-2, tube NER would have been extinguished prior to lighting NEL and the system would function in a similar manner as previously described for the right lane ball.

Also in similar manner, subsequent balls are detected and signals, indicating the identity of the ball and the identity of the lane from which the ball is being returned, are created. Negative flux of -125 ampere turns is applied to reed switch contacts Y and Y' via coil 112 to open these contacts, if closed, each time contacts X and X' are closed by negative flux from coil 92.

The system described above is capable of providing signals for indicating to a computer the identity of both bowler and lane. Accordingly, the switch contacts W and W' (FIGURE 6) in the signal differentiating system sections T-1 through T-12 are intended to be wired as bowler identity switches through terminals E-1 through E-12, F-1 through F-12, G-1 through G-12 and H-1 through H-12 into the circuit of a scoring system, as indicated by the respective terminals on scoring system 113, to cause the scoring system to receive pinfall information from the proper bowling lane pit and to award the pinfall information which has been received to the proper bowler, e.g. after score values have been computed from the pinfall information.

In each of sections T-1 through T-12 of the signal differentiating system, the contacts W and W' are contacts of magnetic reed switches. Each reed switch is normally open and is closed responsive to a magnetic flux of 100 ampere turns or higher. A magnetic flux of at least 50 ampere turns is necessary to maintain the switch contacts closed after they have been moved to closed position. A ring-like permanent magnet 115 is provided for each switch W and W' biasing the switch to 75 ampere turns, sufficient to hold the switch closed after it has been closed. The coils 102 and 105 are in phase with the respective biasing permanent magnets 115. For initially closing contacts W and W', coil 102 or 105, upon energization, supplies an additional 50 ampere turns, giving a total above the 100 ampere turns needed for closing. After coil 102 or 105 is deenergized, magnet 115 holds the contact closed so that the ball and lane information are thereby stored for use by the scoring system whenever the scoring system is ready to use the information. In order to reopen the switch contact, i.e. after coil 102 or 105 is deenergized, it is necessary to overcome the effect of the permanent magnet and, for this purpose, a negative flux of -100 ampere turns can be applied by a reset coil 116 or 117 by closing the respective contacts or switches V or V', illustrated as in scoring system 113. The contacts V and V' may be closed, for example, by a computer

portion of the scoring system after all necessary data has been assimilated, to cancel the computer input signal at contacts E and F or G and H.

The system described herein may additionally or alternatively be used for directing return of bowling balls to bowling ball storage positions in a ball rack and for releasing balls in sequence from the rack during return of a prior ball, such as that described in copending application, Ser. No. 358,759, entitled Bowling Ball Return Apparatus, filed by D. F. Uecker on Apr. 10, 1964, and assigned to the assignee of this application.

I claim:

1. A ball detection system for a pair of adjacent bowling lanes wherein a plurality of balls are bowled respectively by a plurality of bowlers on both lanes from a bowler's end toward a pit end of the lane with each bowler rebowling the same ball throughout the bowling game, and in combination with which is provided a ball return system including means defining separate ball return paths from each of said lane pit ends and a common path for returning balls from each of the separate paths to the bowler's end of the lanes, the improvement which comprises means at each of said separate ball return paths for providing a lane identity signal responsive to passage of a ball through the paths; means at said common path for cancelling said lane identity signal; means for holding the lane identity signal until cancelled by said cancelling means; detector means between said lane identity signal means and said cancelling means comprising a plurality of oscillator means including oscillator coils tuned to different frequencies, each of said oscillator coils including a coil loop mounted for surrounding the ball path between said identity signal means and cancelling means; means defining a loading circuit in each of said bowling balls tuned to a different frequency relative to each of the other balls, each of said loading circuits being complementary with respect to maximum power transfer from a separate one of said oscillator coils to create an increased oscillatory load responsive to positioning of said loading circuit axially within the loop of its respective oscillator coil; separate means for providing a ball identification signal responsive to the increased load of each respective one of said oscillator means; means for concurrently receiving the lane identity signal from said holding means and ball identification signal from said ball identification signal providing means, translating the signals to a single signal designating both ball and lane identity, and storing the separate single signal for use by a scoring system, and means operable by the scoring system for cancelling the stored signal after use by the scoring system.

2. A ball detection system for a pair of adjacent bowling lanes wherein a plurality of balls are bowled by a plurality of bowlers on both lanes from a bowler's end toward a pit end of the lane with each bowler rebowling the same ball throughout the bowling game, and in combination with which is provided a ball return system for returning balls from each of the pits to the bowler's end of the lanes, the improvement which comprises means for providing a lane identity signal, means for cancelling said lane identity signal upon bowling of a ball on either lane, means for holding the lane identity signal until cancelled by said cancelling means, ball signal means in each of said bowling balls tuned to a different signal frequency relative to each of the other balls, detecting means including signal generating and differentiating means between said lane identity means and said cancelling means, for detecting and identifying each of said signal means by its frequency for providing a ball identification signal identifying each ball as it passes between said lane identity means and cancelling means, and means for concurrently receiving the lane identity signal and ball identification signal, translating the signals to a single signal designating both ball and lane identity, and storing the separate signal for use by a scoring system.

3. A system for identifying each of a plurality of bowling balls bowled on a bowling lane in which a ball path is defined by the bowling lane and by a ball return system, through which path balls are bowled from the bowler's end of the lane to the pit end of the lane and are returned to the bowler's end of the lane, which system comprises separate code means carried by each of the plurality of balls for distinguishing each ball from each other and detector means along said ball path for detecting and distinguishing between each of said code means whereby each ball is identified by the detector means in accordance with the code means carried by the ball.

4. The system of claim 3 including means interchangeably securing each of said code means to the respective ones of said bowling balls.

5. A system for identifying each of a plurality of bowling balls bowled on a bowling lane in which a ball path is defined by the bowling lane and by a ball return system, through which path balls are bowled from the bowler's end of the lane to the pit end of the lane and are returned therefrom to the bowler's end of the lane, which system comprises tuned loading circuit means carried within each of the plurality of balls with each tuned loading circuit means tuned to a different frequency, separate oscillator means for each of the loading circuits including an oscillator coil having an electrically conductive loop portion, each of said oscillator means being tuned to a separate and distinct frequency for loading by one of said tuned loading circuit means, and means separately mounting each of the loops along said ball path in power transmitting association with the tuned loading circuit of each ball passing through said ball path.

6. A system for identifying each of a plurality of bowling balls bowled on each of a plurality of bowling lanes, in which ball paths are defined by the bowling lanes and by a ball return system for each lane through which paths balls are bowled from the bowler's end of a lane to the pit end of the lane and are returned therefrom to the bowler's end of the lane, said ball paths including a common portion of said ball return system used for return of balls from each of said plurality of lanes and a separate portion for each lane joined to said common position, which system comprises separate code means carried by each of the plurality of balls for distinguishing each ball from each other, a plurality of separate detector means along said ball path for detecting and distinguishing between each of said coding means whereby each ball is identified by the detector means in accordance with the code means carried by the ball, and lane detection means for detecting balls passing over portions of each lane's ball path portion separate from the ball path of each other lane.

7. The system of claim 6 wherein said detector means is disposed for detecting balls on the common portion of the ball return system.

8. The system of claim 6 in which said lane identification means and said detector means are spaced from each other along the ball path and including means responsive to said lane identification means and detector means for providing concurrent lane and ball identification.

9. The system of claim 6 wherein said common ball path comprises a common ball return track for receiving balls from each lane pit for return of balls to the bowler's end and said separate detector means are mounted spaced along said return track with sufficient spacing therebetween to eliminate interference from one detector means to the next.

10. A system for identifying each of a plurality of bowling balls bowled on a plurality of bowling lanes where a common ball return system is provided for returning bowled balls to bowlers from the plurality of lanes, the lane and ball return system comprising the ball path for each lane for each ball bowled and returned, which system comprises separate code means carried by each of the plurality of balls for distinguishing each ball

from each other and detector means associated with said common ball return system for detecting and distinguishing between each code means carried by each ball being returned for each lane, whereby each ball is identified by the detector means in accordance with the code means carried by the ball.

11. A system for identifying bowlers for awarding bowling scores earned by each of a plurality of bowlers bowling separate bowling balls on a bowling lane, which system comprises a scoring system, detector means for detecting and distinguishing each of said balls during travel of each ball over a ball path during bowling, and means for transmitting the ball identification from said detecting means to said scoring system.

12. The system claim 11 wherein said transmitting means includes means for storing ball identity information and including means for erasing information from said storing means after the scoring system has used the information.

13. A system for identifying each of a plurality of bowling balls bowled on a bowling lane in which a ball path is defined by the bowling lane and by a ball return system through which path balls are bowled from the bowler's end of the lane to the pit end of the lane and are returned therefrom to the bowler's end of the lane, which system comprises separate code means carried by each of the plurality of balls for distinguishing each ball from each other, a plurality of separate detector means along said ball path for detecting and distinguishing between each of said code means whereby each ball is identified by the detector means in accordance with the code means carried by the ball and storage means separate from said detector means for receiving and storing ball identification information from each of said detector means.

14. A scoring system for use in a game of bowling using a plurality of bowling balls bowled on a bowling lane in which a ball path is defined by the bowling lane and by a ball return system, through which path balls are bowled from the bowler's end of the lane to the pit end of the lane and are returned therefrom to the bowler's end of the lane, which system comprises separate code means carried by each of the plurality of balls for distinguishing each ball from each other, detector means along said ball path for detecting and distinguishing between each of said coding means whereby each ball is identified by the detector means in accordance with the code means carried by the ball, and scoring means for attributing bowling scores to individual bowlers responsive to ball identity information from said detector means.

15. A system for identifying each of a plurality of bowling balls bowled on each of a pair of bowling lanes in which a ball path is defined by the bowling lane surface and by a ball return system, through which path balls are bowled from the bowler's end of the lane to the pit end of the lane and are returned therefrom to the bowler's end of the lane, which system comprises a plurality of separate oscillator means, one for each ball, including an oscillator coil having an external loop portion disposed in signal transmitting proximity with the ball path, each of said oscillators being tuned to a separate and distinct frequency, separate loading circuit means, one for each separate oscillator means, for loading the induction coil of the respective oscillator means, means for mounting each loading circuit means in a separate bowling ball, means associated with each lane for indicating the lane on which each ball is bowled and means responsive to said indicating means and to loading of said oscillator means for providing a combined lane and ball identification readout.

16. A system for identifying each of a plurality of bowling balls bowled on a pair of adjacent bowling lanes toward pit ends thereof in which a ball path is defined by the bowling lane and by a ball return system including a common ball track for returning balls to the bowler's end

of both lanes and a pair of branch tracks for receiving and guiding balls from the two separate lane pit ends and onto the common track, which system comprises a plurality of separate oscillator means, one for each ball, including an oscillator coil having an external loop portion disposed in signal transmitting proximity with the common track, each of said oscillators being tuned to a separate and distinct frequency; separate loading circuit means, one for each separate oscillator means, for loading the induction coil of the respective oscillator means; means for mounting each loading circuit means in a separate bowling ball; and means for delaying a ball on one of said branch tracks responsive to passage of a ball over the other of said branch tracks, said delaying means delaying the ball a period of time sufficient to permit passage of the other ball beyond all of said external loops prior to passage of the delayed ball into signal receiving proximity to any of said loops.

17. A system for use in identifying each of a plurality of bowling balls in bowling games and for awarding bowling scores earned by a plurality of bowlers comprising a plurality of discernible separate code means, means for securing said code means in different ones of the plurality of bowling balls, detector means disposed for momentary association with each of the balls during the bowling game for identifying each of said code means and means for attributing bowling scores to individual bowlers according to ball identity information from said detector means.

18. A system for detecting the presence of a bowling ball at a station, which system comprises non-magnetic means defining the station, a tuned circuit providing inductance and capacitance, means for mounting said tuned circuit in the bowling ball, an oscillator having a coil tuned for maximum transfer of power from said tuned circuit to said coil, means for mounting said coil at said station in power receiving association with said tuned circuit while the tuned circuit is at the station, and means associated with the oscillator output for converting maximum output to an indicating signal.

19. A coded bowling system comprising means defining a bowling ball path including a bowling lane and a ball return system, a bowling ball having an outer rolling surface and a finger-hole in said ball for gripping said ball and bowling the ball on said lane, said finger-hole extending inward from said outer surface and terminating at a finger-hole bottom within said ball, a receiver within said ball and accessible from said finger-hole code means removably secured within said receiver, and means removed from said ball and mounted at said lane for detecting said code means to identify the ball rolled.

20. A coded bowling ball system for separately identifying individual ones of a plurality of bowling balls comprising signal means in each ball for creating a signal different from the signal of each other signal means, means defining a path of travel for the balls, and means adjacent the ball travel path for detecting the signal created by each ball signal means and for differentiating between the different signals.

21. The coded bowling ball system of claim 20, including similar means for removably mounting each of said signal means in respective ones of said balls and wherein each of said signal means is interchangeable with respect to each other for mounting by each of said mounting means in each ball.

22. A detection system for detecting and differentiating between bowling balls during a game of bowling in which each of a plurality of bowlers bowls with a separate ball on a bowling lane equipped to return the ball to the bowler's end of the lane over a ball return track, an array of separate electrically conductive loops mounted at spaced positions along said track transverse to said track and surrounding the ball path along said track and an oscillator for each of said loops and having an oscillator coil including the respective loop as a portion thereof whereby

balls having different loading circuits passing along said track are separately detected by separate ones of said oscillator means.

23. In a bowling establishment, a separate ball for each of a plurality of bowlers, a pair of adjacent bowling lanes, each including a lane surface for bowling from a bowler's end of the lane toward a pin setup and lane pit at the other end of the lane, a ball return system including a common track defining a ball return path for returning balls to the bowler's end of the lanes and separate guide track means for returning balls from the pit end of each lane to said common ball return track, means on said guide tracks for delaying the return of a ball over the other of said guide tracks, switch means on each of said guide tracks, means for providing a lane identity signal responsive to passage of a ball over the guide track, and a cancel switch on said common track for cancelling said lane identity signal, the improvement which comprises magnetic reed switch means for holding the lane identification signal until cancelled by said cancel switch means, detector means between said lane identification switch means and said cancel switch means comprising a plurality of oscillator means including oscillator coils tuned to different frequencies; means defining a loading circuit in each of said bowling balls tuned to a frequency complementary with the frequency of one of the oscillator means for maximum power transfer thereto and different from the loading circuit in each of the other balls, said oscillator coil means including a loop mounted on said common track for surrounding the ball path between said identity switch means and cancel switch means; separate electrically operable relay means for each oscillator means; separate amplifier means for amplifying the output signal from each oscillator means and for feeding the amplified signal to the respective relay means of sufficient strength to operate the relay means; separate ball identification switch means associated with each of said electrically operable relay means for providing a ball identification signal responsive to operation of the relay means; means for concurrently feeding the lane identification

signal and ball identification signal to a scoring system including means defining a separate circuit energized by each of said ball identification switch means, means defining a direct current power source for all of said separate circuit means, means for changing the polarity of said last mentioned means for establishing a different polarity in any of said circuit means energized by one of said ball identification switch means, and magnetic reed switch means in each of said circuits for generating distinct output signals for each polarity of the respective circuit responsive to energization of the circuit by the corresponding ball identification switch means, whereby distinct output signals are provided for use by a scoring system in identifying each ball or its bowler and the lane on which the ball was bowled; and means operable by the scoring system for controlling said last mentioned magnetic reed switch means to cancel the distinct output signal after use of the output signal by the scoring system.

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