April 20, 1943. E. F. SEAMAN ET AL 2,316,990

BOWLING ALLEY

Original Filed March 25, 1938 4 Sheets-Sheet 1

Fig. 1.

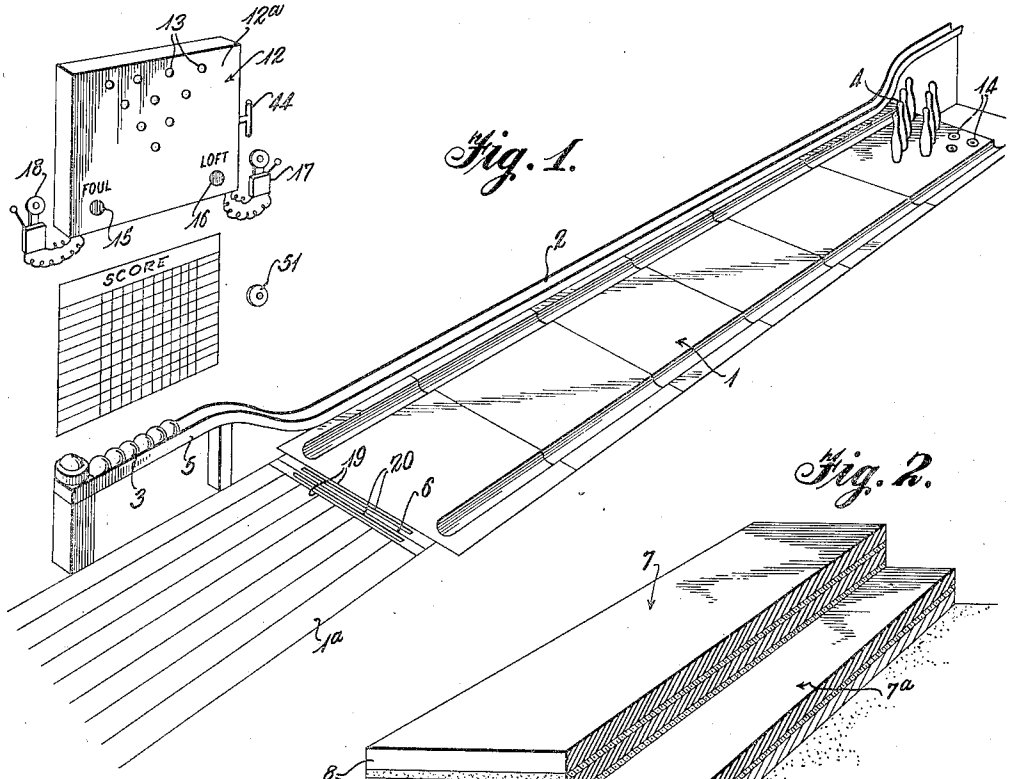
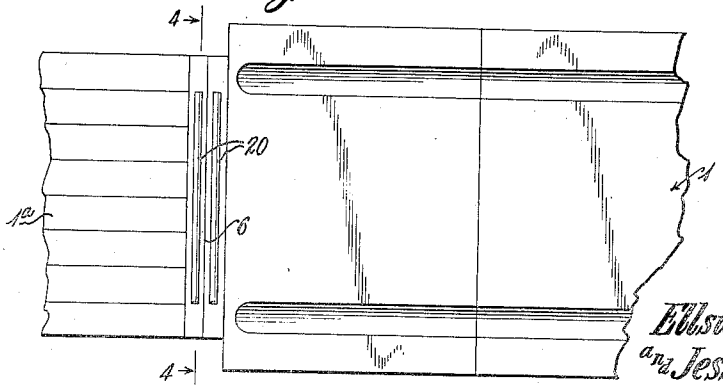


Fig. 2.

Fig. 3.



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Fig. 4.

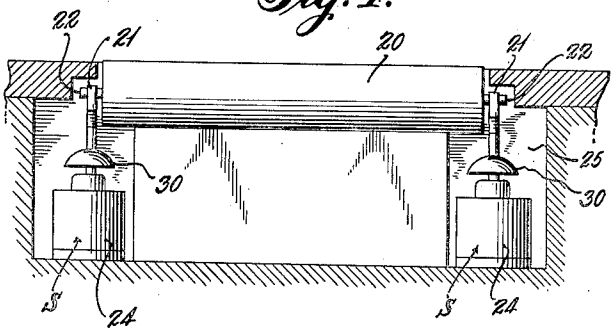


Fig. 5.

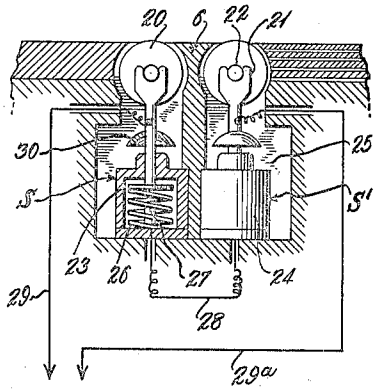


Fig. 10.

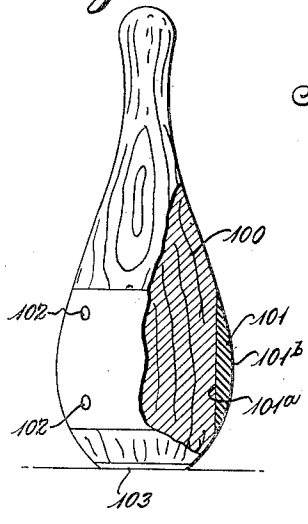


Fig. 11.

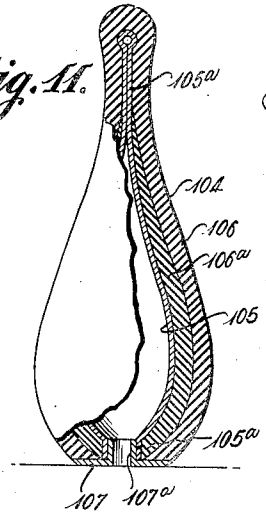
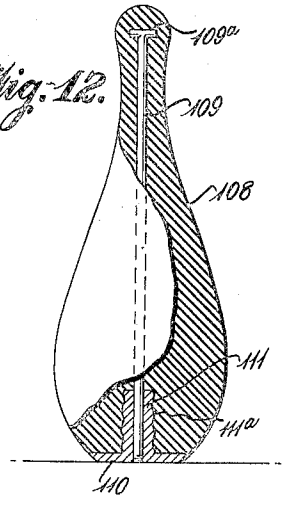


Fig. 12.



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Fig. 6.

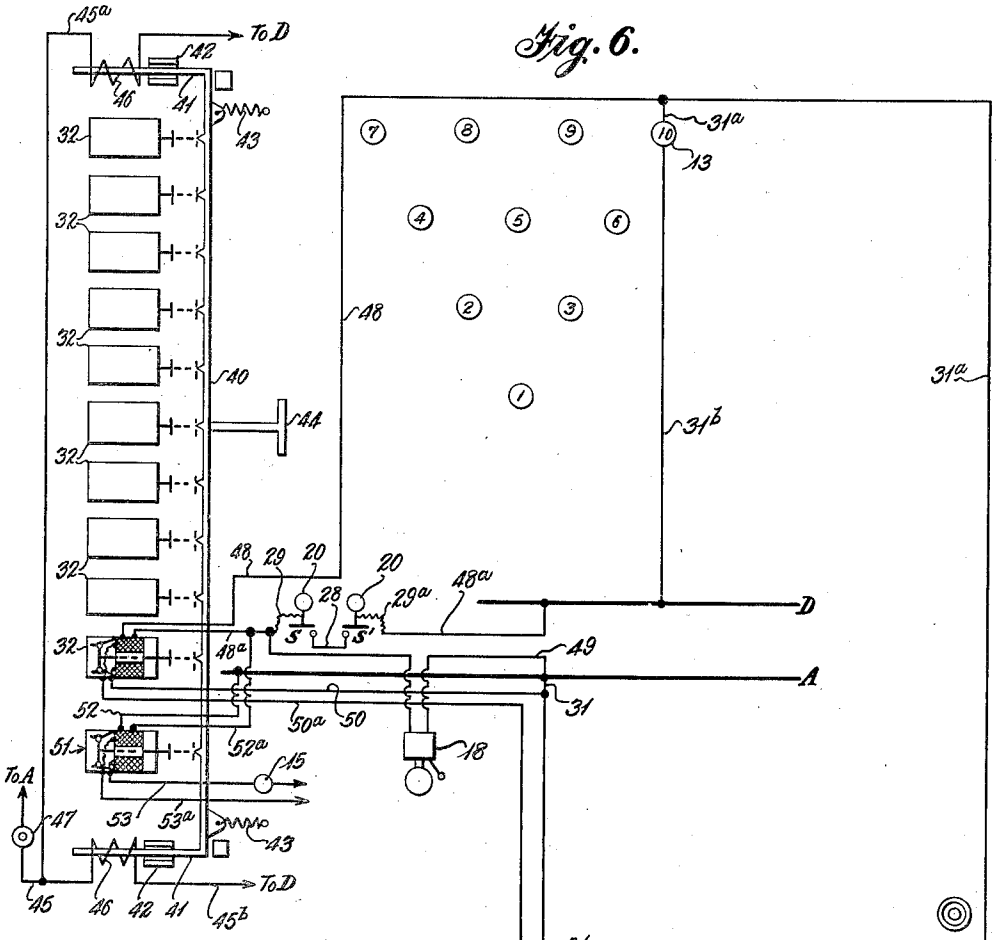
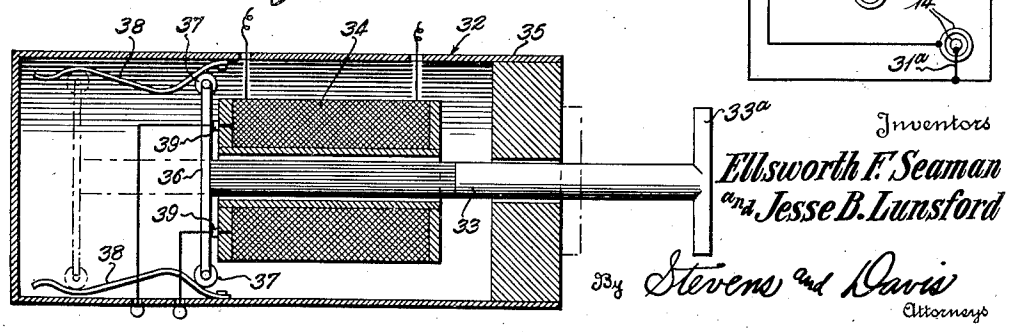


Fig. 7.



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Fig. 8.

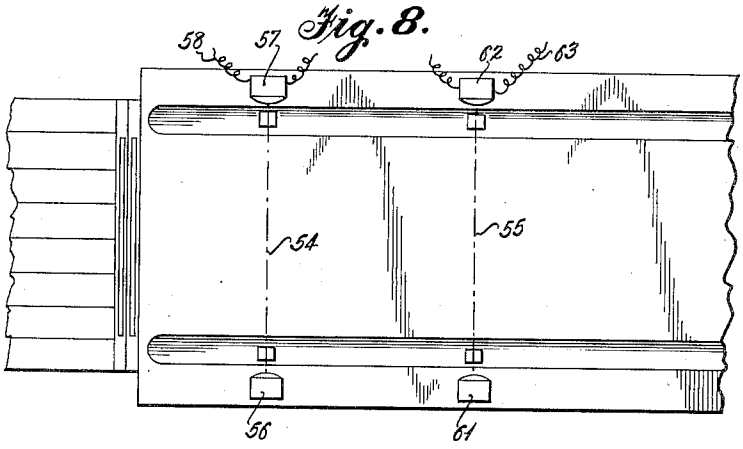
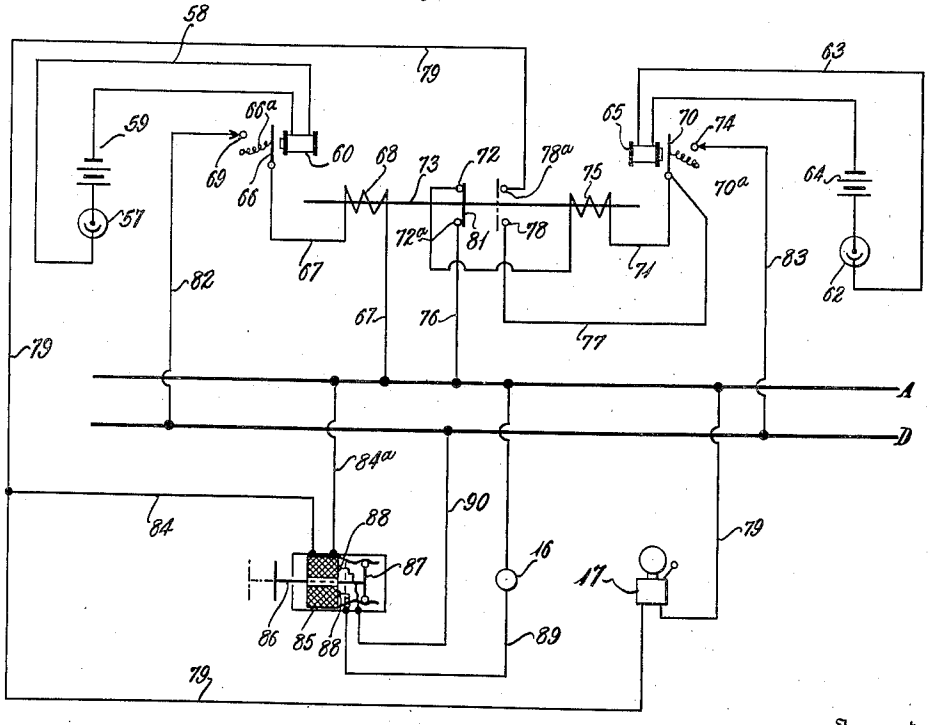


Fig. 9.



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UNITED STATES PATENT OFFICE

2,316,990

BOWLING ALLEY

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Original application March 25, 1938, Serial No. 198,116. Divided and this application May 1, 1940, Serial No. 332,798

4 Claims. (Cl. 273—50)

This invention relates to bowling alleys and the pins used in conjunction with such alleys. It is a division of our application Serial Number 198,116, filed March 25, 1938.

An important object of our invention is to provide a bowling alley of improved construction in which the factors of chance and error which heretofore have entered into the games of duck pins, ten pins and the like are largely eliminated with the result that the scores compiled by the players furnish a more reliable basis of comparison of their individual skill. In order to attain such an object the invention contemplates the provision of a bowling alley having an improved surfacing material which is free from warping and more resistant to wear than wood, the material commonly employed in the construction of alleys.

Another object of our invention is to provide a bowling alley including means such that when a player crosses the foul line of the alley this fact will be signalled either by the ringing of a bell or by the lighting of a lamp, or by both.

A further object of our invention is to provide a bowling alley having an indicator board associated therewith showing a diagram of the positions of the pins on the alley and also indicating by means of electric lights those positions occupied by pins on the alley. In the preferred form of our invention, the indicator board is connected with detector means at the forward end of the alley—that is, the end of the alley occupied by the player—so that should the player cross the foul line in delivering the ball the pins knocked down by the ball will not register on the indicator board, and the lights upon the board will remain in the same condition as before the roll was made.

Still another object of our invention is to provide signalling means to indicate either audibly or visually, or both, when a player "lofts" or throws a ball part way down the alley, instead of rolling it down the alley as required by the rules of play. It is desirable that all players in a game compete on the same basis and subject to the same conditions. To this end the loft indicator serves to show when a player has changed his method of play to the extent that a ball is thrown instead of rolled down the alley. Furthermore, the loft signal informs the management of the bowling alley of repeated lofting on the part of a player. Since continued lofting results in damage to the floor of the alley necessitating its frequent resurfacing, the practice is to be discouraged and for this reason some alleys display the sign "Do not loft ball." By the operation of the loft signal the player is automatically reminded of his weakness and ordinarily he will strive to overcome it without placing the management to the embarrassing necessity of calling the matter to his attention.

The invention has as an additional object to provide an improved form of pin which is more resistant to breakage and more capable of retaining its liveliness or ability to rebound after a prolonged period of service than the wooden pins now in common use.

Other objects and advantages will be apparent from the following detailed description of a preferred embodiment of our invention, reference being had to the annexed drawings, in which:

Figure 1 is a perspective view of a bowling alley incorporating the novel features of the invention;

Figure 2 is a fragmentary detail view of two of the superposed slabs composing the floor of the bowling alley;

Figure 3 is a plan view of the forward end of the bowling alley showing the position of the pair of rollers forming part of the foul signalling mechanism;

Figure 4 is a cross-sectional view through the floor of the bowling alley showing on an enlarged scale one of the pair of rollers of Figure 3;

Figure 5 is a view taken at right angles to that of Figure 4 showing the pair of rollers of Figure 3 with the switches associated with one of their ends;

Figure 6 is a wiring diagram showing one of the lamp circuits connected with the indicator board to designate the positions of the pins on the alley, and also showing the circuit associated with the foul signalling mechanism for controlling the lamp circuits;

Figure 7 is one of the series of relays controlling the lamp circuits and adapted to be actuated by the foul signalling circuit;

Figure 8 is a plan view of the forward end of the bowling alley schematically indicating the arrangement of the loft detecting means;

Figure 9 is a wiring diagram indicating the circuits associated with the loft signalling means;

Figure 10 is a view in side elevation of one form of pin for use with bowling alleys;

Figure 11 is a side elevational view of an alternative form of pin; and

Figure 12 is a side elevation of another form of pin.

Referring to the drawings, in Figure 1 is shown a bowling alley 1 having a trough 2 extending along one of its sides and disposed at a slight inclination for the gravitational return of balls 3 from the rear end of the alley, occupied by the pins 4 (only seven pins of the usual ten being shown) to an elevated rack 5 located adjacent a runway 1a at the forward end of the alley where the players stand when rolling the balls down the alley in playing the games of duck pins, ten pins and the like. A narrow line 6 is customarily

marked upon the floor of the alley between the alley 1 and the runway 1a which, according to the rules, no player is permitted to cross in his delivery of a ball down the alley without incurring a penalty against his score.

The floor of the alley as best indicated in Figure 2 is composed of synthetic resinous material such as a phenol-formaldehyde—for example, the material known as "Bakelite"—made up in the form of slabs 7 and 7a arranged crosswise of the alley. The upper slab 7 is composed of two sheets 8 of the resinous material united by an intermediate layer of cement 9 of any suitable nature, such as that prepared by dissolving a soluble phenol-formaldehyde resin in alcohol and mixing with the soluble condensation product prepared by heating glycerol with sebacic acid. The lower slab 7a is composed of an upper layer of resinous material 8a, such as composes the sheets 8, bonded by a layer of cement 9a to a metal backing plate 10 which rests upon the floor 11 of the building housing the alley. The slabs 7 and 7a are arranged in offset relation so that their joints are out of registry and these slabs are cemented together, as indicated as 9b, to form a firm, strong, wear-resistant flooring for the bowling alley capable of withstanding repeated pounding of the balls as they are rolled down the alley. The metal slab 10 may be fastened to the floor of the building by a suitable cement 9c, as indicated in Figure 2. The slabs 7 composing the upper surface of the alley are arranged in tight lateral abutting engagement and the minute cracks between adjacent slabs extending across the alley may be sealed by cement so that the slabs present a plane uninterrupted surface. One of the advantages of this type of flooring over wood flooring is that the effect of grain or longitudinal floor seams is eliminated by reason of the arrangement of the slabs with their lines of junction at right angles to the path of travel of the balls down the alley.

Preferably located along one side of the alley at the forward end within convenient view of the players is an indicator board 12. This indicator board is provided with a bank of electric lamps 13 arranged in wedge formation, each lamp corresponding to the position of a pin 4 in set-up position on the alley. The lamps of this pin diagram are individually connected to contacts 14 embedded in the floor of the alley and designate the spotting positions of the pins, so that when a pin is in set-up position a metal plate on its base bridges these contacts and closes a circuit, later to be described, to illuminate the lamp in the pin diagram on the indicator board corresponding to that particular pin on the alley. This indicator board facilitates keeping score and obviates error when pins left standing on the alley at the conclusion of a player's period of play are hidden behind other pins. Such a board also serves to increase the interest of spectators whose view of the alley is frequently obscured by the players. In order to protect the lamps, the diagram board may be covered by a panel 12a having glass windows over the lamps and, if desired, these windows may be numbered to designate the pin positions, as indicated in Fig. 6.

Also upon the indicator board are two additional lamps 15 and 16 designated respectively "foul" and "loft." The "foul" lamp 15 will light and a bell 18 connected in the same circuit will ring when a player crosses the foul line 6 marked upon the alley; and the "loft" lamp 16 will illuminate and bell 17 will sound when a player lofts or throws a ball part way down the alley.

The electric circuits with their associated mechanisms by which the lamps of the indicator board are controlled will now be described. As indicated in Fig. 1 the bowling alley 1 is provided with two narrow parallel slots 19 extending across the alley at opposite sides of the foul line 6. Disposed within the slots and having their circumferences approximately tangent to but projecting slightly above the floor of the alley are rollers 20. The slots and rollers are sufficiently small so as not to constitute a stumbling hazard for the players. These rollers, which may be of hard rubber composition, are supported at opposite ends in upright metal forks 21 engaging at their upper ends trunnions 22 extending axially from the ends of the rollers and at their lower ends being provided with metal plungers 23 housed within cylinders 24. The rollers, forks and cylinders are located within pits 25 provided below the level of the alley. Springs 26 maintain the plungers 24, and hence the rollers 20, in raised position, but pressure upon the rollers moves the plungers downwardly against the thrust of the springs and brings the metal plungers into engagement with contacts 27 located in the bottom of the cylinders. The contacts 27 within the cylinders at corresponding ends of the rollers are connected in series by a conductor 28 and the corresponding metal forks 21 carrying the metal plungers 23 are connected to a circuit later to be described by conductors 29 and 29a. Shields 30 fastened upon the upright forks 21 guard against the entrance of dirt into the cylinders 23 containing the plungers through the openings in the tops of these cylinders. The plungers 23 with their companion contacts 27 thus form switches S and S' arranged in series in an electrical circuit as schematically shown in Figure 6.

Each roller thus actuates the two switches S or S' respectively located at opposite ends of a roller. The separation of the two parallel rollers is such that a rolling ball will depress only one roller at a time leaving the circuit open. If, however, a player makes a foul his foot will rest in a position such as to depress both rollers and the switches S and S' connected to the forward and rear rollers are simultaneously closed to operate the foul signalling circuit. The two switches S at opposite ends of the forward roller, as well as the two switches S' at opposite ends of the rear roller, are connected in parallel to positively insure the operation of the signal even if, as might sometimes occur, only one end of the two rollers is depressed closing both switches at that end while the switches at their opposite end remain open. In other words, any pair of switches, S and S', connected in series (of the total of four switches associated with the pair of rollers) need be closed in order to actuate the foul signal.

Referring to the wiring diagram shown in Figure 6, A and D represent the two main lines of the electric lighting circuit for the building housing the bowling alley. From line A, a conductor 31 is connected to one of the contacts 14 designating the pin spotting position on the alley while a second conductor 31a extends from the other of the contacts 14 to the appropriate lamp 13 on the indicator board. From the lamp 13, a conductor 31b leads to the line D. In the same manner the contacts 14 located at each of the spotting positions of the pins are connected to

their respective lamps upon the indicator board. Therefore, when a pin is set-up on the alley its metal base will bridge the contacts **14** embedded in the alley and thus complete the electrical circuit through conductors **31**, **31***a*, lamp **13** and conductor **31***b* to main line D to light the lamp; and similarly when the pin is knocked over by a ball rolled down the alley the contacts will immediately be disconnected and the circuit broken to extinguish the lamp.

For maintaining the lamp lit when its pin is knocked down—such as is desirable when a player makes a foul—so as to preserve the indicator board in its original condition before the ball was rolled by the player making the foul, additional circuits including a solenoid type relay **32** are provided. The construction of this relay is shown in Figure 7, and it will be understood that an identical relay is provided for each lamp circuit of the pin diagram.

The relay **32** comprises a plunger **33** the outer end of which is of some non-magnetic metal and provided with a flat head **33***a*, while its opposite end is of soft iron (as indicated by shading) or other magnetic metal and reciprocable within a solenoid **34**. The solenoid is enclosed within a relay box **35**, while the headed end of the plunger projects beyond an end of the relay box. The opposite end of the plunger is provided with a metal bridging member **36** having rollers **37** at its opposite ends. A pair of bowed springs **38** is associated with the relay box, the arrangement being such that movement of the plunger within the solenoid causes the rollers to press against and flatten the springs to permit passage of the bridging member past the humps. After the rollers have passed the humps of the springs, the resiliency of the springs biases the plunger into its extreme position of travel in the direction in which it is moving. One end of the solenoid **34** is provided with a pair of contacts **39** adapted to be connected by the metal bridging member **36** when the solenoid is energized and the plunger moved outwardly, i. e., to the right in Figure 7. By pressing upon the head **33***a* the plunger may be moved inwardly to the dotted line position to break the connection between contacts **39** and when moved to its fully retracted position is impositively maintained in such position by the bowed springs **38**.

Resetting of the relays at the conclusion of a period of play by a bowler may be accomplished either manually or electrically. A metal reset frame **40** having terminal legs **41** disposed at right angles to the frame and slidable in guides **42** is maintained out of contact with the heads **33***a* of the plungers **33** by tension springs **43** located at opposite ends of the frame. By pushing upon a finger piece **44** extending out from the frame, the frame engages the heads of the plungers **33** of the various relays which have been operated and moves them rearwardly where they are retained by the bowed springs **38**. The relays **32** may be mounted upon the indicator board in which case the finger piece **44** may project beyond the side of the latter, as indicated in Figure 1, for convenient operation by the players.

Alternatively the reset frame may be operated electrically, and this will be desirable where for one reason or another it is not practicable to mount the relays **32** on the indicator board. Electrical operation may be accomplished by means of a circuit comprising a conductor **45** leading for example from the main line A and branching into two parallel lines **45***a* and **45***b* connecting with the main line D. Each of the lines **45***a* and **45***b* forms part of circuits including solenoids **46** each surrounding a leg **41** of the reset frame composed of soft iron. In the portion of the circuit formed by the conductor **45** is a push-button switch **47**. By pressing the push-button the circuit is closed and the reset frame is moved in opposition to the tension springs **43** to shift the relay plungers **33** inwardly, in the same manner as when the frame is manually operated.

The winding of the solenoid **34** is connected in circuit with conductors **48** and **48***a*. Conductor **48** extends from relay **32** and joins conductor **31***a* of the lamp circuit as shown. The conductor **48***a* extends to main line D and includes switches S and S', operable by the rollers **20** of the foul signalling device. Normally these switches will be open, but when both are closed, as by reason of a player overstepping the foul line, a circuit is completed from main line A, through conductor **31**, contacts **14**, conductor **31***a*, conductor **48**, winding of relay **32**, and conductor **48***a*, to main line D. This causes energization of the relay to move the plunger **33** in a direction so as to bridge the contacts **39** with its head **33***a* projected outwardly. At the same time the bell **18** rings by reason of a current momentarily flowing through a shunt **49**, in circuit with which the bell is connected, from conductor **48***a* to main line A.

The connection between contacts **39** of the relay **32** having been established, current is now free to flow to the lamp **13** maintaining it illuminated notwithstanding breaking of the connection between contacts **14** if the pin closing these contacts should be knocked down. This current follows the path from main line A, through conductor **31**, a conductor **50**, tapping conductor **31** and leading to one of the contacts **39** of the relay, bridging member **36** of the relay, a conductor **50***a* connected to the other contact **39** of the relay and leading to conductor **31***a*, lamp **13**, and through conductor **31***b* to main line D. The lamp **13** remains illuminated until the reset frame **40** is depressed to reposition the plungers **33** of all the relays which have been actuated.

A solenoid operated relay **51**, corresponding in all substantial respects to the relay **32** described above, is provided adjacent the latter series of relays to control the "foul" lamp **15** on the diagram board. The winding of the solenoid of relay **51** is connected through conductors **52** and **52***a* to main lines A and conductor **48***a*, respectively, as shown in the wiring diagram of Figure 6. When the switches S and S' are closed the current flows from A through the winding of relay **51**, conductor **52***a* and conductor **48***a* to the main line D. This closes a secondary circuit including conductors **53** and **53***a* in which is included the "foul" lamp **15**.

The loft detector controlling the "loft" lamp **16** comprises means for directing two beams of light, indicated by dotted lines **54** and **55** in Figure 8, horizontally across the alley short distances beyond the foul line and at an elevation above the alley such that both beams are sequentially intercepted by a ball rolling in the normal way down the alley (or, alternatively, rolling down the gutter which extends alongside the alley), but only the second light beam **55** being intercepted when the ball is lofted in such a manner as to "jump" or pass above the first light beam **54**.

The first light beam **54** is directed from a light source **56** located on one side of the alley so as to impinge upon a photoelectric relay **57** located

upon the opposite side of the alley. This photoelectric relay is interposed in a circuit 58 including a source of electrical energy 59 and a relay 60 as indicated in Figure 9. The second light beam 55 likewise is directed from a light source 61 at one side of the alley upon a photoelectric relay 62 at the other side of the alley interposed in a circuit 63 including a source of electrical energy 64 and a relay 65.

A hinged switch bar 66 is connected to one end of a conductor 67, which conductor at its other end taps the main line A of the building lighting system. A spring 66a tends to draw the switch bar 66 into engagement with a contact 69, but while the relay 60 is energized the switch bar is attracted and maintained out of engagement with said contact. The conductor 67 includes a solenoid 68 within which there slides a soft iron plunger 73, the arrangement being such that energization of the solenoid 68 draws the plunger to the left. A hinged switch bar 70 is connected to one end of a conductor 71 leading to a contact 72. A spring 70a tends to draw the switch bar 70 into engagement with a contact 74, but while energy is flowing through the relay 65 the switch bar is held away from said contact. The conductor 71 includes therein a solenoid 75 surrounding the plunger 73 and which when energized tends to draw the armature to the right. A contact 72a companion to contact 72 is connected by a conductor 76 to main line A. A conductor 77 extends between the pivoted switch bar 70 and a contact 78; while a contact 78a, companion to contact 78, is connected to main line A by a conductor 79, and interposed in this circuit is the electrically operable signal bell 17 mounted adjacent the indicator board.

The plunger 73 has fixed thereon a bridging member 81 which in its movement to the left with the plunger closes the pair of contacts 72 and 72a, and in its movement in the opposite direction closes the pair of contacts 78 and 78a. A conductor 82 leading from contact 69 and a conductor 83 leading from contact 74 connect these contacts to the main line D. A conductor 84 in parallel with conductor 79 extends between the latter conductor and the winding of a solenoid operated relay 85, identical in form with that of light relay 32, previously described, and comprising a plunger 86 carrying a bridging member 87. The other end of the winding of relay 85 is connected to main line A through a conductor 84a. One of a pair of contacts 88 on the bottom of the solenoid is connected to the main line A by a conductor 89 having interposed in circuit therewith the Loft lamp 16; while the other contact 88 on the solenoid is joined to the main line D by a conductor 90. Normally the plunger will be depressed to mantain the bridging member out of connecting relation with the pair of contacts 88 on the solenoid, but when the solenoid is energized the plunger will move to the dotted line position of Figure 9 to connect these contacts and complete a circuit to illuminate Loft lamp 16 on the indicator board.

From the description it will be seen that when the light beam 54 impinging on photoelectric relay 57 is intercepted, the circuit 58 is momentarily interrupted releasing relay 60 and allowing contact 69 to be engaged by the hinged switch bar 66 under the urge of spring 66a. The short period of time during which the switch bar engages the contact is sufficient to cause a current to flow from main line A, through conductor 67, including the solenoid 68, switch bar 66, contact 69 and conductor 82 to main line D. This current energizes the solenoid 68 which draws the plunger 73 to the left causing the bridging member 81 to move from its dotted line position to close the gap between contacts 72 and 72a. This conditions the circuit controlled by the relay 65 so that when the second light beam 55 is intercepted by the ball, the current in circuit 63 will momentarily be interrupted, causing the relay 65 to release hinged switch bar 70 and allow the latter to be pulled by the spring 70a into engagement with contact 74. Current then flows from main line A, through conductor 76, bridging member 81, conductor 71, including the solenoid 75, switch bar 70, and through conductor 83 to main line D. The solenoid 75 moves the plunger 73 to the right to break the connection between contacts 72 and 72a and restore the armature to its original dotted line position closing contacts 78 and 78a.

Now in the case of a lofted ball, only the second light beam 55 is intercepted. This causes the relay 65 in circuit 63 to be de-energized, releasing the switch bar 70 which is drawn by spring 70a into engagement with contact 74. A current is consequently caused to flow from main line A, through conductor 84a, the solenoid winding of relay 85, conductor 84, conductor 79, across bridging member 81, through conductor 77, switch bar 70, and conductor 83, thence to main line D. This current operates the relay 85 to close the circuit constituted of the conductors 89 and 90 and including the Loft lamp 16, which latter becomes lighted. The bell 17 interposed in the circuit including the conductor 79 is also sounded momentarily for the duration of the second light beam interruption.

It will be apparent from the foregoing description that the pins having been initially set up in wedge formation upon the alley ready for play, all the lamps 13 upon the indicator board will be lighted by reason of the metal bases of the pins bridging the contacts 14 embedded in the floor of the alley to close their respective lamp circuits. When a ball is rolled down the alley and a pin is knocked over, assuming no foul by the player occurs, the contacts 14 are no longer connected and the circuit of the lamp designating that particular pin position in the diagram on the indicator board is broken so that the lamp goes out. This, of course, happens in the case of all the pins knocked down by the ball so that the indicator board reveals to the player the number and position of the pins remaining standing at any time by the lighted lamps in the pin diagram.

When, however, a player oversteps the foul line in making a roll the switches S and S' are closed by reason of the player's foot simultaneously depressing the pair of rollers 20. This closes a circuit to operate the relays 32 so that current will flow to each already lighted lamp, through a secondary circuit as has been previously described and thus preserve the condition of the indicator board regardless of whether or not other pins are subsequently knocked down. Simultaneously the bell 18 will ring during the period switches S and S' are closed and the Foul lamp 15 on the indicator board will light up to signal the foul. After the pins knocked down by the player committing the foul have been restored to their proper positions on the alley, the relays 32 are reset in a manner which has been previously explained by depressing the finger piece 44 extending out from the side of the indi-

cator board and connected to the reset frame **40**. This action also extinguishes the Foul lamp **15**. Thereafter, the pins knocked over by the succeeding balls rolled down the alley until a player has finished his period of play will be registered on the pin diagram on the indicator board.

A further advantage following from the provision of individual pin circuit relays is that a referee in match play may energize relay **51** (through a control circuit, not shown) when he wishes to declare a penalty for reasons other than infraction of the rules against crossing the foul line or lofting a ball.

If a player should make a loft only one of the two light beams directed across the alley will be intercepted. Interception of the second light beam **55** without interception of the first beam **54** actuates relay **85**. This causes the bell **80** to sound and the lamp **16** marked Loft on the indicator board to illuminate in a manner which has previously been explained. The relay **85** may be reset, either manually or electrically, by means not shown but corresponding to those described above in connection with the reset frame of Figure 6. This extinguishes the "loft" light on the indicator board. It will be readily apparent that, in the same way that relay **51** operates in the case of a foul, relay **85** might be arranged to shunt out the contacts **14** on the bowling alley and preserve the indicator board in its then fixed condition when a ball is lofted, regardless of whether or not any pins are knocked down on the roll. In this event the penalty for a lofted ball would be the same as for a foul; i. e., the player loses the number of pins he knocked down with the ball when the loft was committed. Under ordinary conditions of play, however, the sounding of the bell to indicate the occurrence of a loft will probably be sufficient.

In Figures 10 through 12 are shown various forms of pins which are preferably used in conjunction with the bowling alley described above, although it will be appreciated that such pins have a broader field of application and may be employed to equally good advantages upon alleys of the type now in common use. The inability of wooden pins to withstand the repeated shocks to which they are exposed in play is attested by the fact that after one game a set of wooden pins is usually considered unfit for service in competition match play. In order to overcome the disadvantage of wooden pins we propose to construct our pins in whole or in part of synthetic resinous compositions, molded or pressed to shape, and cured under suitable conditions of temperatures, pressure and time.

One of our objects is to obtain a degree of uniformity in weight, surface contour, surface hardness and general resiliency not obtainable in any other construction, particularly wood. As is well known, all wood has a definite grain structure, and both the grain and the density of wood will vary from point to point on the periphery of even the same pin. Moreover, no two pins can possibly be exactly alike; the grain structure of wood, between the same species of trees, will vary considerably because of the unavoidable differences in the growth of trees caused by differences in soil conditions, climatic conditions, seasonal variations of rainfall, sunshine, drought, etc. Even two trees of the same species, age, soil conditions, etc., will be dissimilar if one grows on the northern slope and another grows on the southern slope of the same hill. Nor are the annular "rings" on the same tree truly concentric, one with respect to another, but these rings are usually wider on that side of the tree next to the sun.

There is no means of overcoming such variations as occur in wood, and the best which can be hoped for is a partial culling out of the worst specimens. It is obvious that, due to economic considerations (cost, lack of definite standards as to density, etc.) there must always exist a wide variation between the different pins of any one set; these wide variations in texture, hardness, etc., leading to wide variations in reaction when different pins are hit at exactly the same angle, direction, force, etc. Such variations may prove interesting, as all games of chance are, but they serve to reduce what should be and is usually intended to be a game of skill, to one of chance.

There are, of course, pins of molded or pressed composition such as hard-rubber, compressed paper, fibre, bitumen, shellac, etc., which may be held to closer tolerance as to weight, balance and hardness than wood, but that such materials are even less practicable than maple wood, of which the usual wooden pins are composed, is attested by the fact that wooden pins are still used to the exclusion of such forms of pins. This is because such composition pins tend to dent or chip rendering their life comparatively short. Likewise pins made entirely of metal have been proposed but in those cases where the metal is sufficiently light to admit of its use as a substitute for wood, such as aluminum for example, the lack of resiliency of the metal and its tendency to deform under impact makes the use of such pins unfeasible, even ignoring the factor of their increased cost. If the pins are made of sufficiently hard metal to withstand deformation, then they are either too heavy or so resistant as to cause injury to the balls.

In Figure 10 is shown a pin **100** of conventional bottle shape composed in principal part of wood but having a band **101** composed of a synthetic resinous material surrounding its barrel portion in the zone in which it is subject to impact by the balls. The inner circumference **101***a* of this band is cylindrical in form so as to tightly embrace a corresponding cylindrical portion upon the wooden pin. The band is held in assembly with the pin by means of screws suitably countersunk as indicated at **102** within the band and the countersinks filled with a polymerized Bakelite varnish flush with the outer surface of the band. The outer circumference **101***b* of the band is smoothly curved as shown in the figure so as to continue the bulged peripheral contour of the pin. Upon the base of the pin is affixed a protective metal plate **103**. Instead of being composed of a single molded ring of material, the band **101** alternatively may be composed of a plurality of layers of synthetic resinous materials adhesively bonded together. If desired, the band may be split to facilitate its assembly with the pin.

One virtue of this type of pin is that it may be economically produced by making use of wooden pins which have become unfit for further use by reason of denting or splintering of their outer surfaces. Thus, many wooden pins which have served their normal term of usefulness may be reclaimed by simply trimming off the damaged section of their periphery in a lath so as to receive the band **101**. Another advantage lies in the fact that such pins may be originally constructed of relatively cheap wood, instead of the comparatively expensive maple wood of which

wooden pins are customarily made, and thus materially reduce their manufacturing cost. The life of the pin may be prolonged almost indefinitely by renewing the bands 101 as they become unsuited for use after long periods of service.

Figure 11 shows a form of hollow pin 104. In this form of pin a metal shell 105 corresponding generally to the contour of the pin and provided with a thin metal stem 105a at its upper end is covered with outer and inner layers 106 and 106a of synthetic resinous material adhesively secured together. The outer layer 106 is molded to the contour of a conventional pin and the metal stem 105a serves to reinforce the molded neck of the pin. A metal base plate 107 is fastened to the bottom of the pin by means of an annular bushing 107a bonded to a circular surrounding flange 105a projecting from the bottom of the shell 105.

The pin 108 shown in Figure 12 comprises a thin metal rod 109, having a head 109a upon its upper end, about which the pin is molded from synthetic resinous material. This pin is provided with a base plate 110 threadedly fastened to the lower end of the rod and fixed to the base plate and extending axially upward at the bottom of the pin is a hollow sleeve 111 surrounding the lower end of the rod and having a serrated circumference 111a interlocking with the molded material of the pin.

The pins described above are not limited to any one particular synthetic resin because numerous resin compositions of a satisfactory character are already of wide commercial availability; and the selection of a particular one is largely a matter of individual choice; influenced somewhat by the facilities and normal manufacturing technique of a particular supplier; and largely by the salient features of a particular pin design.

At the present time, and based upon the molding (or press) equipment, temperatures, pressures and curing times in widest commercial use, our choice would favor a resin of the phenol-formaldehyde (50–50) type. Such resins are commonly known under brand names like "Bakelite," and we prefer to employ Bakelites XM–199, XM–200, XM–3510 and XM–1132 (in decreasing order of merit).

Although resin reinforcement is not absolutely necessary to this invention, it does offer certain advantages. The best results are obtained with, and we prefer to utilize, fabric or other fibrous reinforcing agents such as cotton or linen cloth or fragments, asbestos fibres, glass fibres, etc., in conjunction with the resin.

Where a particular construction permits or required the use of a laminated structure, for greatest strength and most economical manufacture, the raw laminating material may be prepared in exactly the same way as in preparing that used in producing laminated phenolic material of the types commonly referred to in the industry as NEMA Grade C or NEMA Grade L (National Electrical Manufacturer's Association Standards 193 covering Laminated phenolic products).

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics of the invention, and the present embodiment is therefore to be considered as illustrative and not restrictive, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

We claim:

1. In a bowling alley, an indicator board comprising a bank of lamps corresponding in arrangement to the set-up arrangement of the pins on the alley, pairs of electric contacts marking the positions of the individual pins on the alley, primary electric circuits for illuminating said lamps each including a pair of contacts and their corresponding lamp on the indicator board, said pairs of companion contacts adapted to be bridged by conductors on the bases of the pins, secondary electric circuits each also including one of said lamps upon the indicator board, relays for rendering said last-mentioned circuits effective for illuminating said lamps and switch operating means upon the bowling alley adapted to be operated by the foot of a player for closing the electric circuits to actuate said relays.

2. In a bowling alley, an indicator board comprising a bank of lamps corresponding in arrangement to the set-up arrangement of the pins on the alley, pairs of electric contacts marking the positions of the individual pins on the alley, primary electric circuits for illuminating said lamps each including a pair of contacts and their corresponding lamp on the indicator board, said pairs of companion contacts adapted to be bridged by conductors on the bases of the pins, secondary electric circuits each also including one of said lamps upon the indicator board, relays for rendering said last-mentioned circuits effective for illuminating said lamps and a pair of depressible switch operating members extending crosswise of and approximately in the plane of the alley adjacent the foul line of the alley for closing the electric circuits to actuate said relays.

3. In a bowling alley, an indicator board comprising a bank of lamps corresponding in arrangement to the set-up arrangement of the pins on the alley, pairs of electric contacts marking the positions of the individual pins on the alley, primary electric circuits for illuminating said lamps each including a pair of contacts and their corresponding lamp on the indicator board, said pairs of companion contacts adapted to be bridged by conductors on the bases of the pins, secondary electric circuits each also including one of said lamps upon the indicator board, relays for rendering said last-mentioned circuits effective for illuminating said lamps, a signal device operable by the secondary circuit and switch operating means extending crosswise of the alley adjacent the foul line of the alley for closing the electric circuits to actuate said relays.

4. In a bowling alley, a foul signaling device comprising, a pair of depressible parallel arranged rollers extending across the bowling alley in relatively closely spaced relation and projecting slightly above the level of the alley, an electric circuit, a signaling member adapted to be actuated by an electric current interposed in said electric circuit, and two pairs of normally open switches, the pairs being arranged in series in said circuits and the switches of each pair being arranged in parallel, the switches of one pair underlying opposite ends of one roller in position to be closed upon depression of either or both ends thereof and the switches of the other pair being arranged in like manner with respect to the other roller, whereby upon simultaneous depression of either or both ends of both rollers the signaling member will be actuated.

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