May 28, 1940. E. F. SEAMAN ET AL 2,202,674

BOWLING PIN

Filed March 25, 1938 4 Sheets-Sheet 1

Fig. 1.

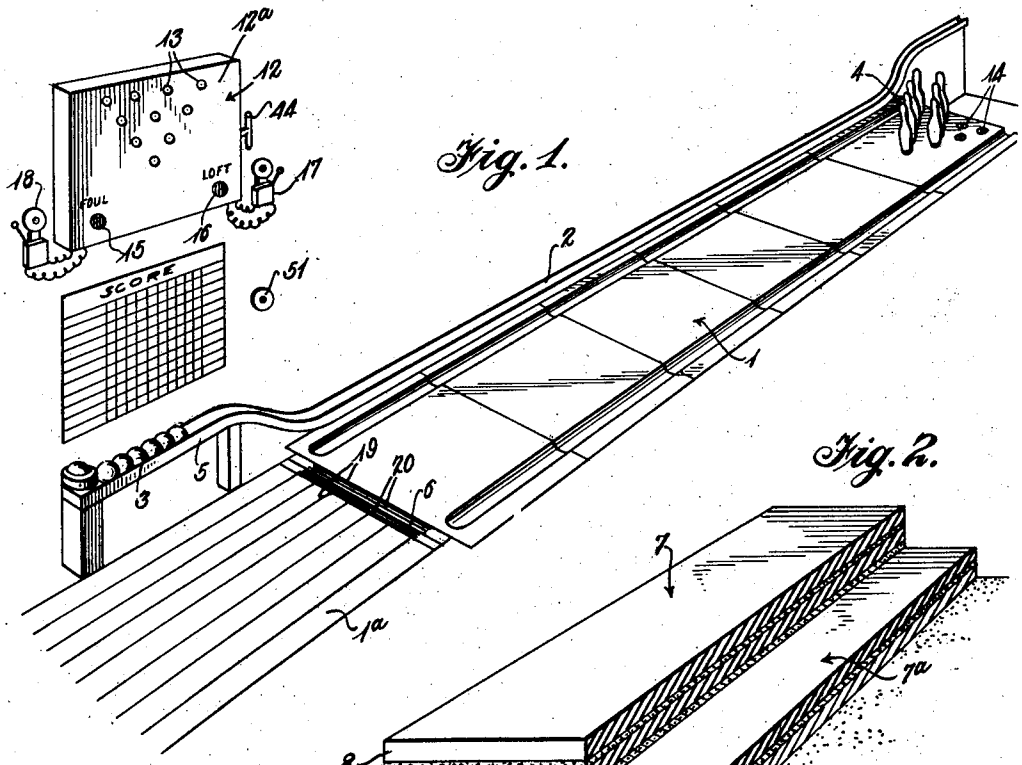
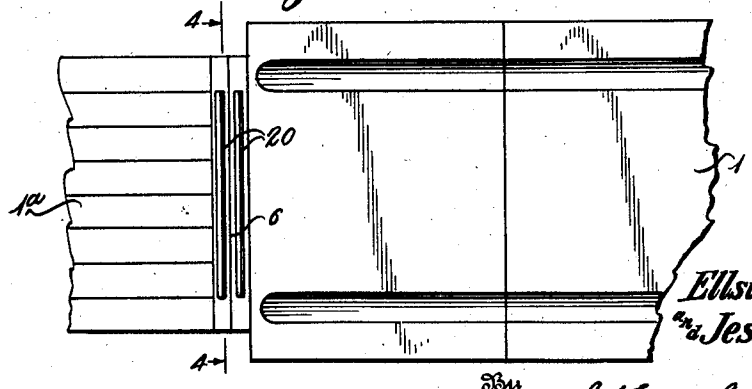



Fig. 2.




Fig. 3.




Inventors
Ellsworth F. Seaman
and Jesse B. Lunsford
By Stevens & Davis
Attorneys

May 28, 1940. E. F. SEAMAN ET AL 2,202,674

BOWLING PIN

Filed March 25, 1938 4 Sheets-Sheet 2

Fig. 4.

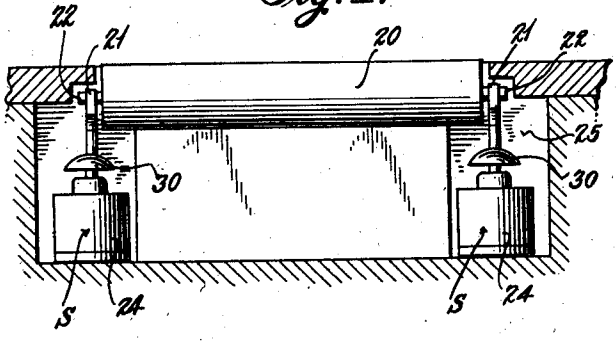



Fig. 5.

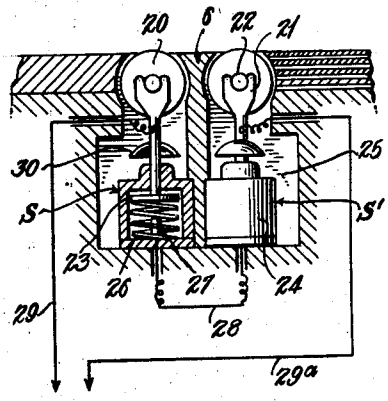



Fig. 10.

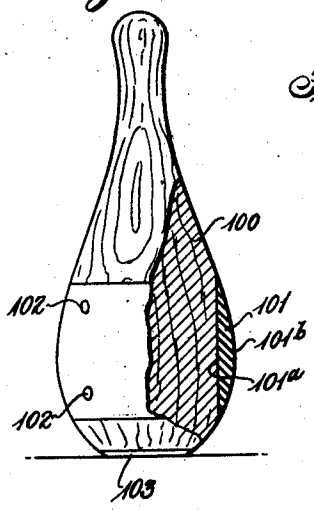



Fig. 11.

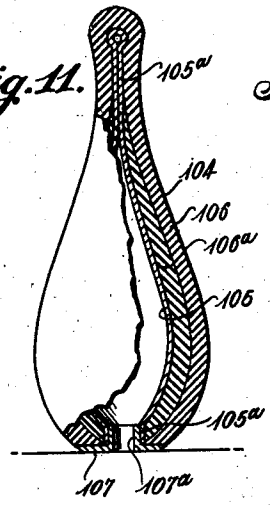



Fig. 12.

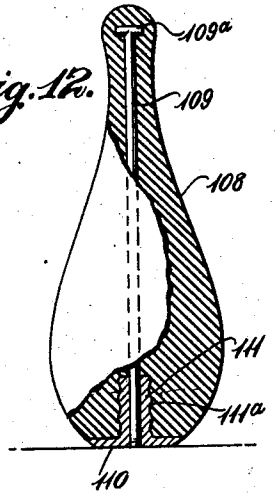



Fig. 13.

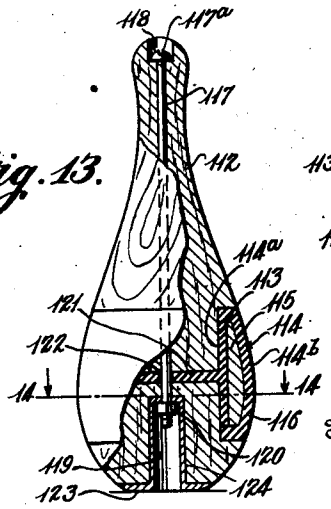
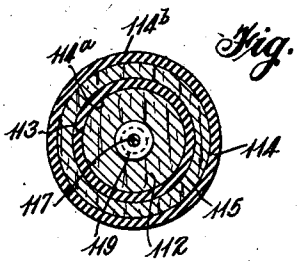



Fig. 14.




Inventors

Ellsworth F. Seaman

and Jesse B. Lunsford

By Stevens & Davis

Attorneys

May 28, 1940. E. F. SEAMAN ET AL 2,202,674

BOWLING PIN

Filed March 25, 1938 4 Sheets-Sheet 3

Fig. 6.

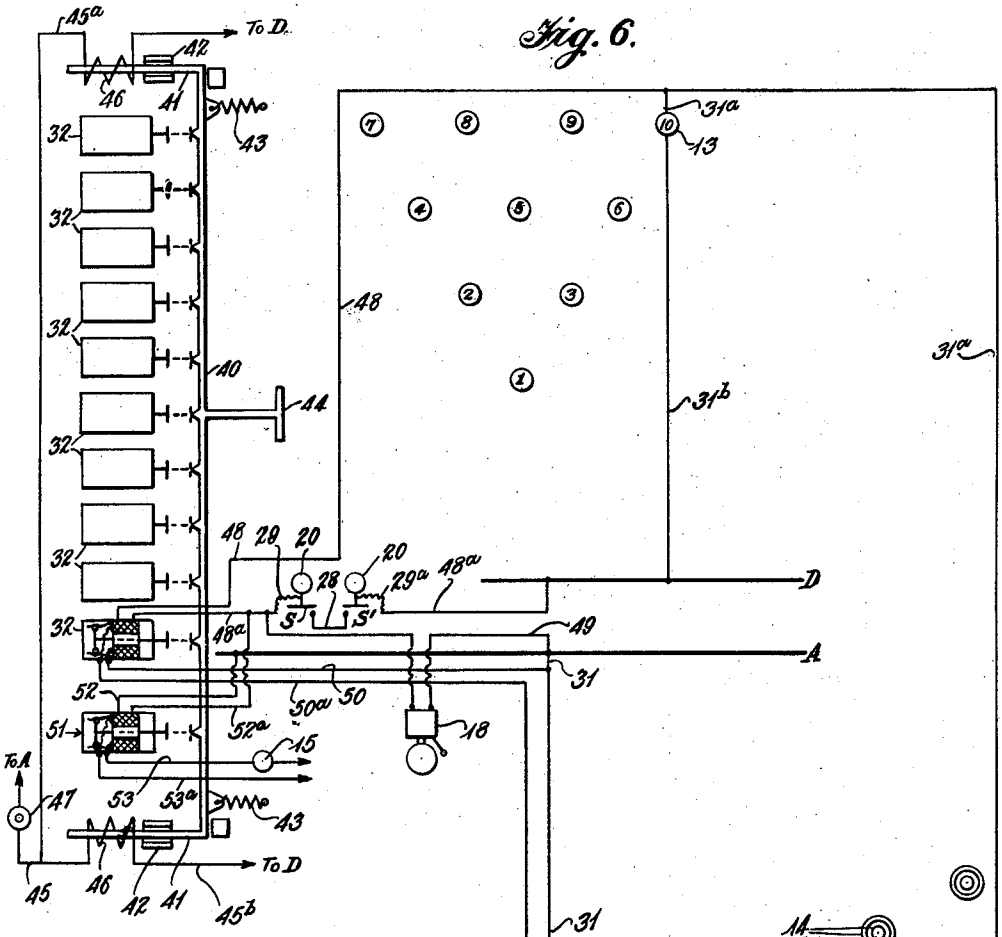
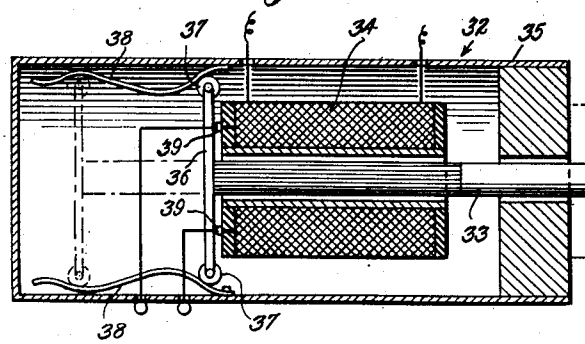



Fig. 7.




Inventors
Ellsworth F. Seaman
and Jesse B. Lunsford
By Stevens and Davis
Attorneys

May 28, 1940. E. F. SEAMAN ET AL 2,202,674

BOWLING PIN

Filed March 25, 1938 4 Sheets-Sheet 4

Fig. 8.

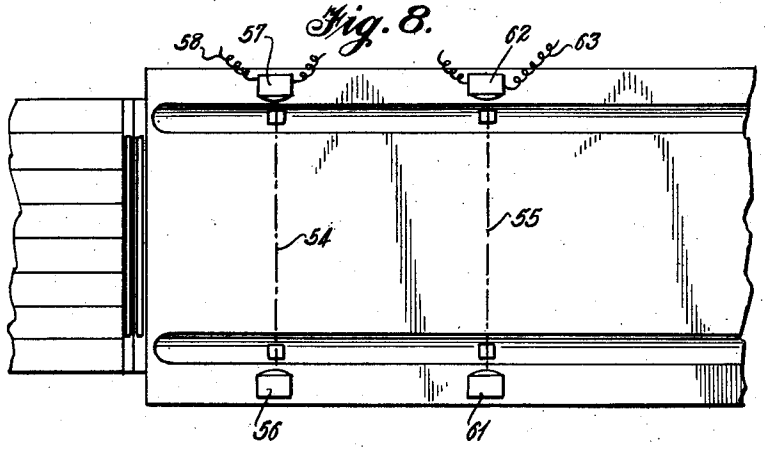
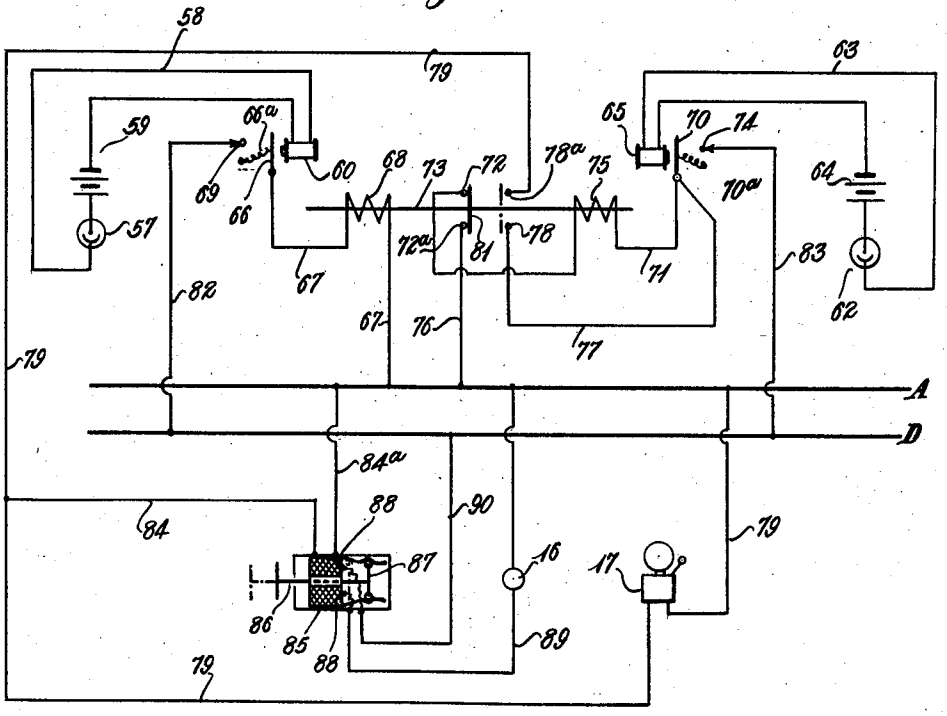



Fig. 9.




Inventors

Ellsworth F. Seaman

and Jesse B. Lunsford

By Stevens and Davis

Attorneys

Patented May 28, 1940 2,202,674

# UNITED STATES PATENT OFFICE

2,202,674

## BOWLING PIN

Ellsworth F. Seaman, Washington, D. C., and
Jesse B. Lunsford, East Falls Church, Va.,

Application March 25, 1938, Serial No. 198,116

3 Claims. (Cl. 273—82)

This invention relates to bowling alleys and the pins used in conjunction with such alleys.

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 Fig. 3;

Figure 5 is a view taken at right angles to that of Fig. 4 showing the pair of rollers of Fig. 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;

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

Figure 13 is a view in side elevation of still another form of pin; and

Figure 14 is a cross-sectional view of the pin of Fig. 13, taken on the line 14—14 of the latter figure.

Referring to the drawings, in Fig. 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 Fig. 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 at 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 Fig. 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 its 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 Fig. 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 Fig. 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, 31a, lamp 13 and conductor 31b 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 Fig. 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 33a, 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 Fig. 7. By pressing upon the head 33a 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 33a 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 Fig. 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 45a and 45b connecting with the main line D. Each of the lines 45a and 45b 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 in 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 48a. Conductor 48 extends from relay 32 and joins conductor 31a of the lamp circuit as shown. The conductor 48a 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 31a, conductor 48, winding of relay 32, and conductor 48a, 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 33a 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 48a 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 50a connected to the other contact 39 of the relay and leading to conductor 31a, lamp 13, and through conductor 31b 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 52a to main lines A and conductor 48a, respectively, as shown in the wiring diagram of Fig. 6. When the switches S and S' are closed the current flows from A through the winding of relay 51, conductor 52a and conductor 48a to the main line D. This closes a secondary circuit including the conductors 53 and 53a 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 Fig. 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 Fig. 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 66*a* 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 70*a* 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 72*a* 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 78*a*, 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 72*a*, and in its movement in the opposite direction closes the pair of contacts 78 and 78*a*. 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 84*a*. 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 maintain 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 Fig. 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 66*a*. 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 72*a*. 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 70*a* 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 72*a* and restore the armature to its original dotted line position closing contacts 78 and 78*a*.

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 70*a* into engagement with contact 74. A current is consequently caused to flow from main line A, through conductor 84*a*, 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 indicator 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 Fig. 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 Figs. 10 through 14 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 advantage 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 disadvantages 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 tolerances 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 Fig. 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 lathe 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.

Fig. 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 circular surrounding flange 105a projecting from the bottom of the shell 105.

The pin 108 shown in Fig. 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.

In Figs. 13 and 14 is shown a pin 112 incorporating certain of the features of the pins illustrated in Figs. 10 and 12. This pin is composed in major part of wood but is circumferentially provided with a relatively wide annular recess 113 coextensive with the zone subject to impact of the ball with the pin. In this recess is tightly confined a band 114, having a cylindrical inner circumference 114a adapted to engage the bottom of the recess and a curved outer circumference 114b continuing the bulged peripheral contour of the pin. This band comprises a metal reinforcing ring 115 of segmental cross-section entirely covered by a layer 116 of synthetic resinous material. A rod 117 extends axially through the pin, this rod having a head 117a seating within a countersink 118 in the pin and being provided at its lower end, which terminates within an enlarged axial bore 119 of the pin, with a nut 120.

The band may be molded onto the pin during manufacture. A cross arm 121 extends diametrically through the pin and connecting opposite points upon the inner circumference of the band. The cross arm which is made of synthetic resinous material is provided with an opening 122 to pass the rod 117. The ends of the arm are bonded to the inner circumference of the band, at the time the latter is molded onto the pin whereby the band is retained in rigid assembly with the pin. Upon the bottom of the pin is a metal base plate 123. This base plate forms in effect a flange or ring surrounding the end of an inverted cup 124, telescoping into the axial bore 119 in the bottom of the pin. The nut 120 on the lower end of rod 117 clamps against the bottom of the cup to hold the cup, together with the base plate, in tight association with the pin.

This form of pin like the pin of Fig. 13 admits of the manufacture of the pin from a cheaper grade of wood than the usual maple wood, and further suggests how pins of the conventional all-wood construction which have become too battered for further service may be easily and cheaply reclaimed by fitting them with the form of band described above.

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 requires the use of a laminated structure, for greater 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 N. E. M. A. Grade C or N. E. M. A. 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. A pin for bowling alleys comprising a wooden central portion having an annular recess coextensive with the area of the pin normally contacted by the ball, a band of synthetic resinous material adapted to engage in said annular recess to complete the normal outline of the pin, and a cross-arm composed of a synthetic resinous material extending diametrically through the pin connecting opposite points of the inner circumference of the said band to effect rigidity of construction.

2. A pin for bowling alleys comprising a wooden central portion having an annular recess coextensive with the area of the pin normally contacted by the ball, a band of synthetic resinous

material adapted to rigidly engage in said annular recess to complete the normal outline of the pin, a cross-arm composed of synthetic material extending diametrically through the pin connecting opposite points of the inner circumference of the said band to effect transverse rigidity of construction of the pin, a rod extending axially through the pin adapted to effect vertical rigidity of construction of the pin.

3. A pin for bowling alleys comprising a wooden central portion having an annular recess coextensive with the area of the pin normally contacted by the ball, a band of synthetic resinous material adapted to engage in said annular recess to complete the normal outline of the pin, a cross arm composed of a synthetic resinous material extending diametrically through the pin connecting opposite points of the inner circumference of the said band to effect rigidity of construction, and a metal plate attached to the bottom of said pin.

ELLSWORTH F. SEAMAN.
JESSE B. LUNSFORD.