

April 14, 1936.

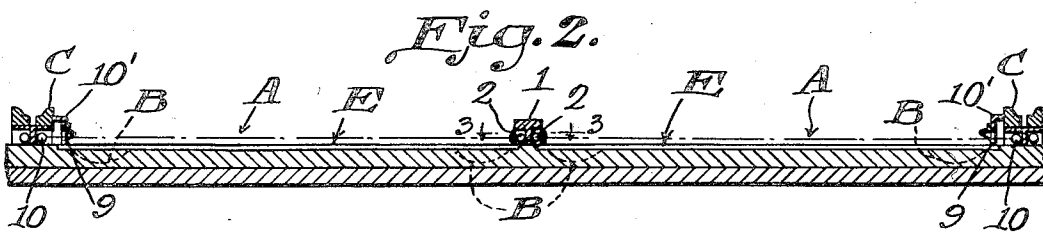
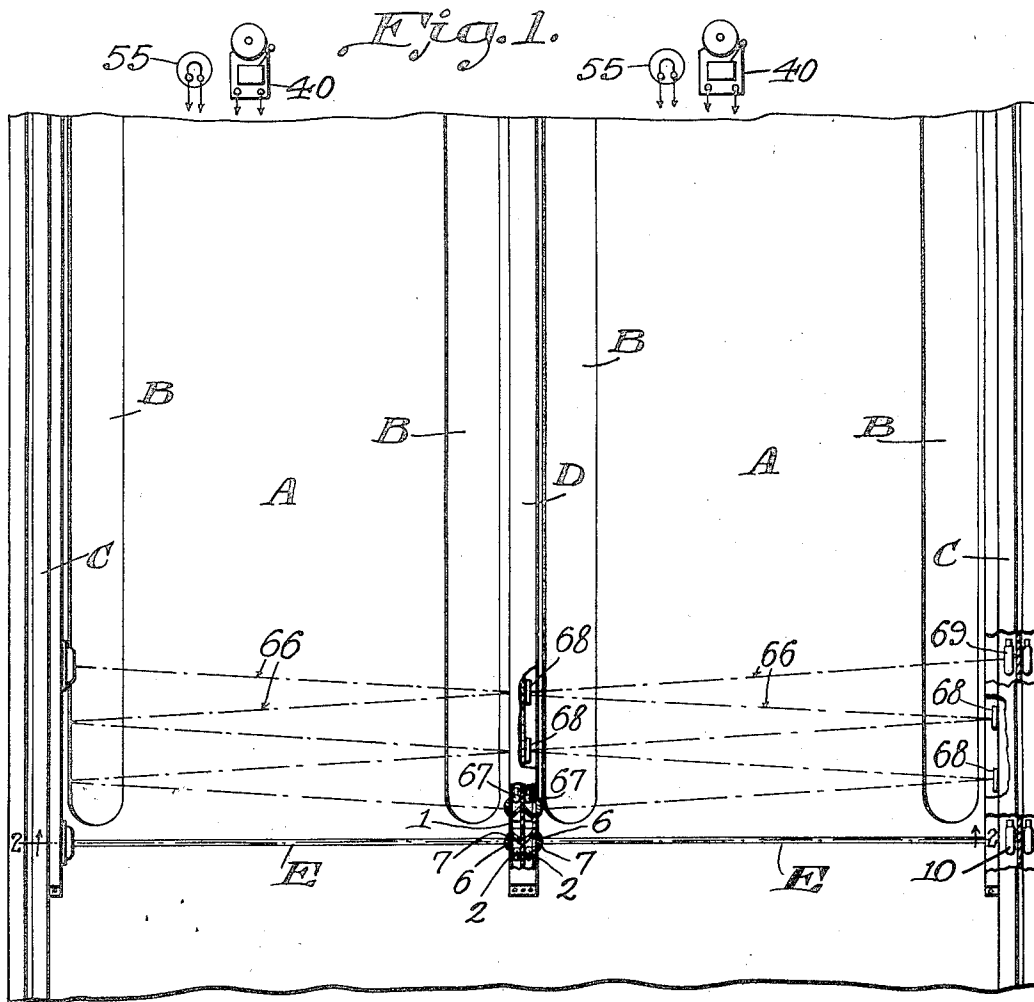
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2,037,671

FOUL LINE SIGNAL

Filed Feb. 2, 1933

5 Sheets-Sheet 1



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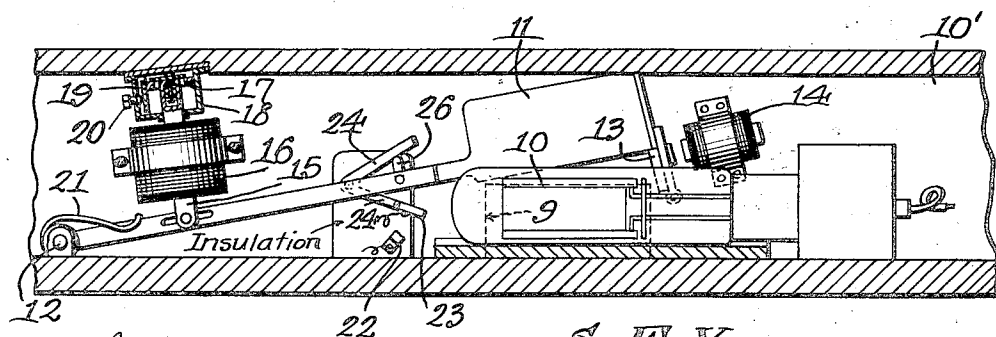
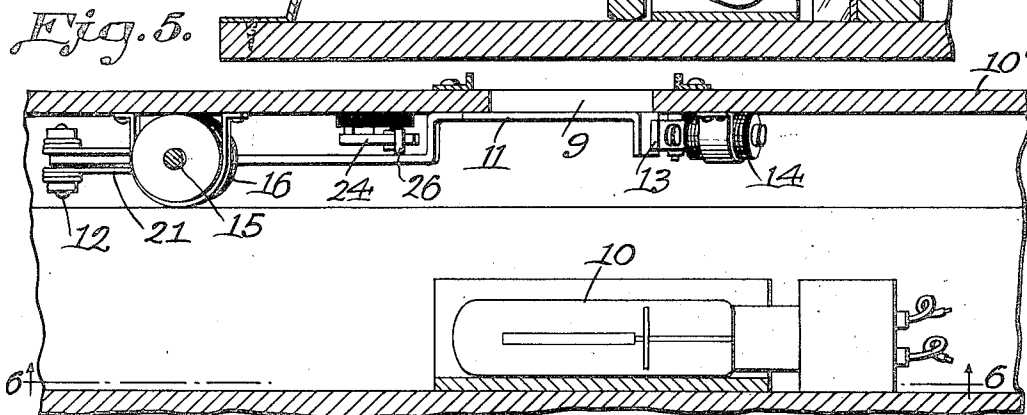
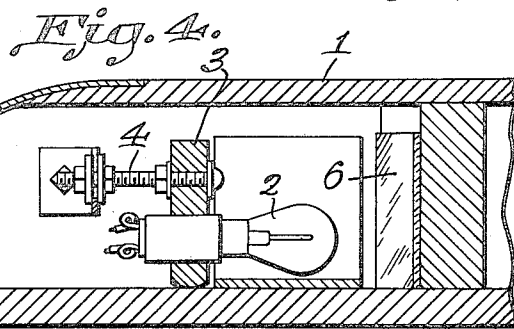
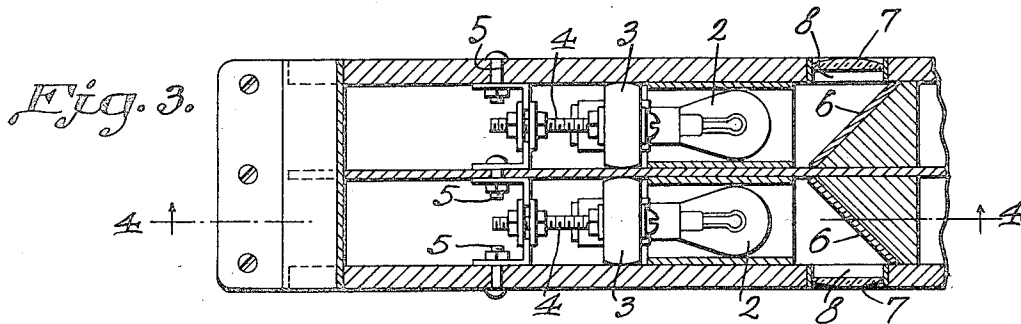
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FOUL LINE SIGNAL

Filed Feb. 2, 1933

5 Sheets-Sheet 2



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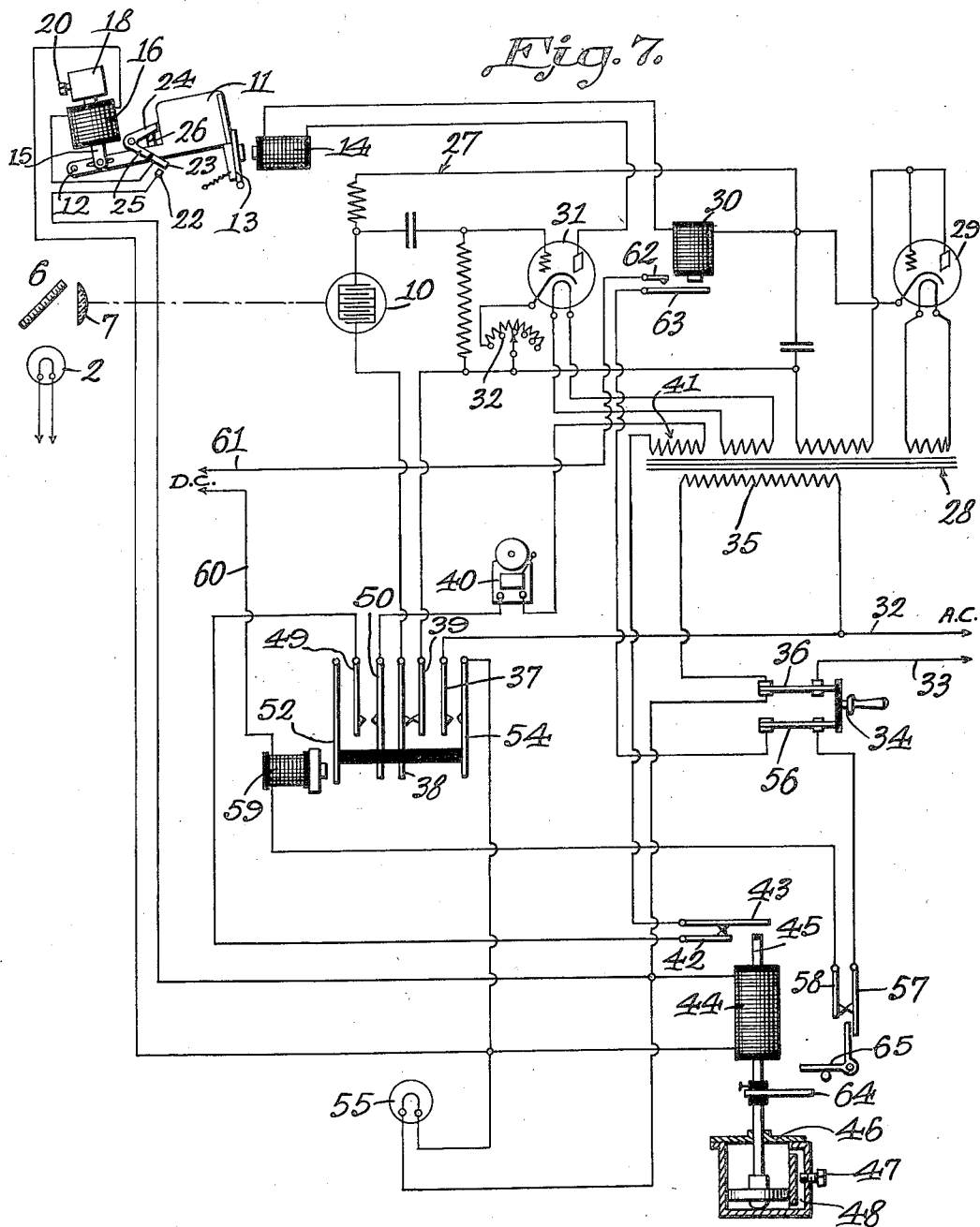
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2,037,671

FOUL LINE SIGNAL

Filed Feb. 2, 1933

5 Sheets-Sheet 3



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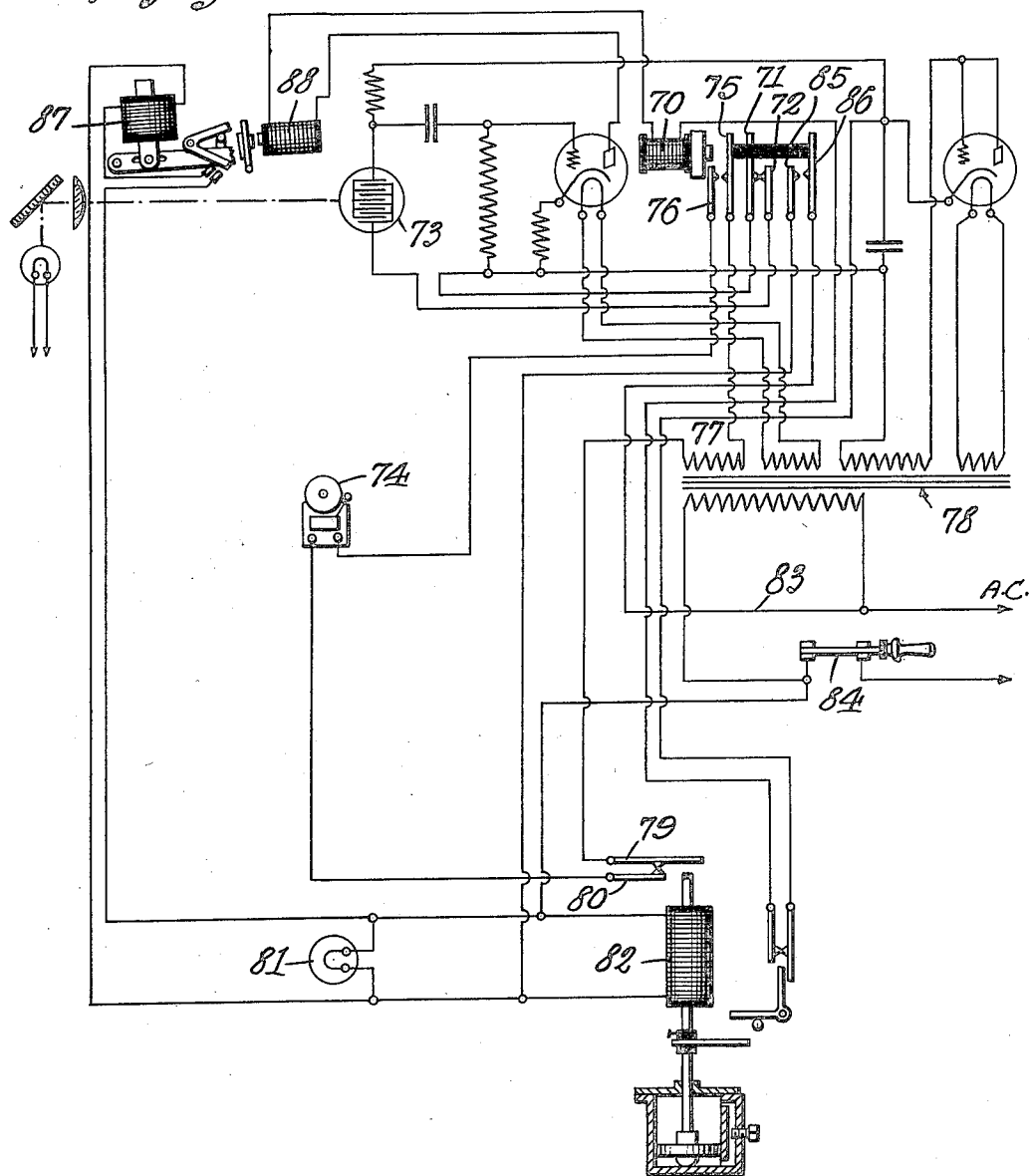
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FOUL LINE SIGNAL

Filed Feb. 2, 1933

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Fig. 8.



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2,037,671

FOUL LINE SIGNAL

Filed Feb. 2, 1933

5 Sheets-Sheet 5

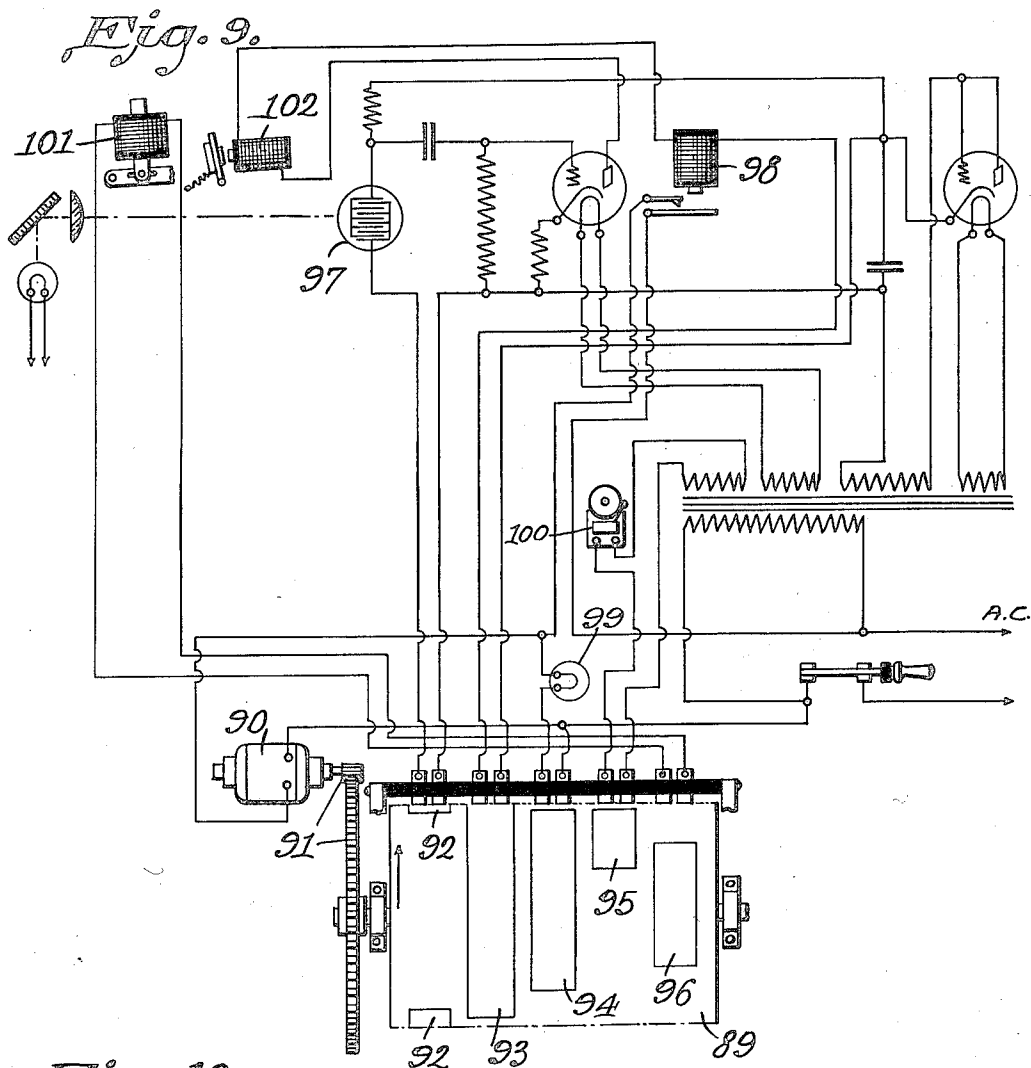
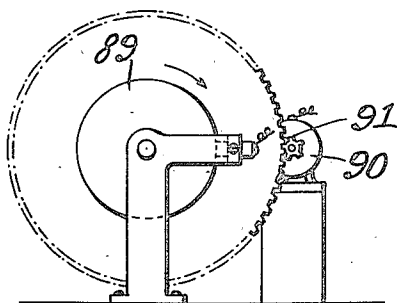


Fig. 10.



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UNITED STATES PATENT OFFICE

2,037,671

FOUL LINE SIGNAL

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Application February 2, 1933, Serial No. 654,945

7 Claims. (Cl. 273—54)

This invention relates to a foul line signal for use in connection with bowling alleys.

Whether or not a player has crossed the foul line is a matter which causes frequent arguments during bowling contests and thus far no satisfactory means has been provided for indicating automatically and positively whether or not a foul has occurred.

It is an object of the present invention to provide an automatic means whereby, when the player steps onto or past the foul line a suitable signal will be operated calling attention to that fact.

A still further object is to provide a signal apparatus utilizing a light-sensitive cell which is maintained normally at a low resistance by light rays directed thereupon transversely of the alley close to the floor level whereby interception of the light to the cell for more than a predetermined period will result in actuation of the signal.

A further object is to provide timing means for preventing the closing of the signal circuit unless the light rays are intercepted for predetermined selected periods, it being thus possible to intercept the light rays momentarily, as by the passage of a ball, without operating the signal.

Another object is to provide apparatus of this character utilizing audible and visual signals, both being operated by interception of light rays for more than a predetermined interval, suitable means being employed whereby the audible signal will first be actuated for a short period, the visual signal being also operated and maintained in circuit for a longer period or until ample time has been provided in which to locate the alley where the foul line has been crossed.

A still further object is to so distribute the light rays over the alley's surface that should a foul be committed without stepping across the foul line but by leaning thereover and touching the alley with a hand, interception of light rays will result and the required operation of the signals will be effected.

Another object is to provide a novel form of shutter mechanism controlled by the light-sensitive cell whereby, after the light has been obscured by the fouling action of the player it will be automatically cut off for a sufficiently long period to insure operation of the signals in spite of any quick action by the player.

Another object is to provide signal apparatus which will automatically reset after a predetermined time interval so as to be ready for the next play.

With the foregoing and other objects in view which will appear as the description proceeds, the invention consists of certain novel details of construction and combinations of parts herein-after more fully described and pointed out in the claims, it being understood that changes may

be made in the construction and arrangement of parts without departing from the spirit of the invention as claimed.

In the accompanying drawings the preferred forms of the invention have been shown.

In said drawings:

Figure 1 is a view partly in plan view and partly in section of portions of alleys equipped with the present improvements, the signals being shown more or less in diagram.

Figure 2 is a transverse section along the foul line and taken on the line 2—2, Figure 1.

Figure 3 is an enlarged horizontal section through a double lamp housing for serving two alleys, said section being taken substantially on the line 3—3, Figure 2.

Figure 4 is a section on line 4—4, Figure 3.

Figure 5 is a plan view of one of the light-sensitive cells and the adjacent parts, the housing provided therefor being in horizontal section.

Figure 6 is a section on line 6—6, Figure 5.

Figure 7 is a view showing, in diagram, the complete signal apparatus.

Figure 8 is a similar view showing a modified signal system.

Figure 9 is a diagram of another modified system.

Figure 10 is a side elevation of the commutator and motor shown in Figure 9.

Referring to the figures by characters of reference A designates a bowling alley of the usual construction with side gutters B and ball-racks C. Where the alleys are arranged in series they are of course grouped in pairs with a partition D between the alleys of each pair. A foul line E is extended across each alley.

Each alley is to be equipped with the same signal apparatus which includes a lamp housing 1 located at one side of the alley, either in the partition D or the rack C. In the present instance the housing is shown in partition D and contains an incandescent lamp 2 adjustably supported. For example this lamp can be mounted in block 3 adjustably mounted on a screw-threaded stem 4 which, in turn, is tiltably mounted on pivot bolts 5. Thus the block 3 and the lamp 2 carried thereby can be adjusted longitudinally of the housing by means of stem 4 and angularly within the housing about bolts 5. This adjustment is desirable in order to bring the lamps into proper relation with a reflector 6 within the housing and adjacent to a lens 7 extending across an opening 8 in the housing. This opening is located at one end of the foul line and the parts are so arranged and proportioned that light rays emanating from the lamp 2 will be deflected by mirror or reflector 6 through the lens 7. This lens is of such a type as to direct the light rays along the foul line E close to the floor of the alley so that they will enter an open-

ing 9 provided in a housing 10' at the opposite side of the alley. This opening 9 is of course located at the end of the foul line and directly back of it is situated a light-sensitive cell 10.

5 A shutter 11 is pivotally mounted in the housing as shown at 12 and is held normally elevated above the window by a pivoted latch 13, constituting the armature of an electro-magnet 14.

10 Connected to the shutter 11 is the armature 15 of a solenoid 16 and this armature, as shown particularly in Figure 6 is connected to a valved piston 17 mounted for reciprocation in a cylinder 18. The cylinder is provided with a by-pass 19 regulated by a screw-valve 20. Thus the piston 15 and cylinder cooperate to form a dashpot whereby downward movement of the armature and piston will be unrestrained whereas upward movement will be retarded by the closing action of the piston valve and the controlled flow of fluid 20 through the by-pass 19. Thus when the shutter 11 is released by latch 13 it will drop by gravity into position to close the opening 9 and this movement can be accelerated by any suitable means such as a spring 21 or the like.

25 Adjacent to the shutter is a stationary contact 22 and a pivoted contact 23. The pivoted contact has diverging arms 24 and 25 each of which is adapted to project into the path of a finger 26 or the like carried by the shutter. When the shutter is raised the contact 23 is pulled away from contact 22. When the shutter approaches the lower limit of its movement while closing opening 9 the finger 26 will come against the lower arm 25 and press contact 23 against contact 22. 30 The two contacts will thus remain engaged with each other until the shutter approaches the upper limit of its movement following the uncovering of opening 9 at which time finger 26 will press against arm 24 and shift contact 23 away from contact 22. The shutter is normally raised and, therefore, the connection between the contacts 22 and 23 is normally broken.

35 The light-sensitive cell is included in an impulse circuit for A. C. operation, this circuit being indicated generally at 27 and including a transformer 28, a rectifier 29, a main relay 30, a valve 31, electro-magnet 14, and a variable resistance 32.

40 The two leads of the A. C. circuit have been indicated at 32 and 33. One side of a switch 34 is utilized for coupling one of these leads, 33, to the primary 35 of the transformer, as shown at 36, this primary, in turn, being connected to the lead 32. Lead 32 is also connected to a fixed contact 37. The impulse circuit including the light-sensitive cell includes a movable contact 38 and a fixed contact 39 which are normally in engagement with each other.

45 An audible signal in the form of a bell 40 or the like is connected to one of the secondaries 41 of the transformer and is also connected to a fixed contact 42. This fixed contact is normally engaged by a movable contact 43 likewise joined to the secondary 41. A solenoid 44 is located adjacent to the contacts 42 and 43 and has an armature 45 normally spaced from but adapted to move against the contact 43. A dashpot 46 is connected to the solenoid and is provided for the purpose of retarding the movement of the armature 45 toward the contact 43. The movement of the solenoid can of course be controlled by a screw valve 47 or the like extending into the by-pass 48 of the dashpot.

50 The solenoid 44 is electrically connected in parallel to the solenoid 16 and solenoid 16 is in

turn electrically connected to contact 23. The other contact 22 is electrically connected to solenoid 44 and switch 36. The audible signal circuit also includes a fixed contact 49 and a movable contact 50 which are normally spaced apart.

5 Cooperating with the contact 37 but normally spaced therefrom is a movable contact 54 electrically connected to a lamp 55 constituting a visual signal and this lamp in turn is electrically connected to the side 36 of switch 34.

10 The other side 56 of switch 34 is electrically connected to a movable contact 57 which normally engages a fixed contact 58 electrically connected to a timing means in the form of a retarded relay 59 to which is connected one lead 60 of a D. C. circuit. The other lead 61 of this circuit extends to the fixed contact 62 of the relay 30 and the movable contact 63 of this relay is electrically connected to the side 56 of the switch 34.

15 The movable contacts 52, 50, 38, and 54 are all connected, the contact 52 serving as the armature of the retarded relay 59. As before explained the contacts 39 and 38 normally engage so as to close the circuit which includes the light-sensitive cell 10. The other movable contacts 25 which are connected to form the group above mentioned are normally out of engagement with the fixed contacts.

20 The solenoid 44 constitutes a timing device and its armature has an arm 64 which is adapted to engage one arm of a lever 65 so as to force the other arm of the lever against contact 57 and break the connection between the two contacts 58 and 57. Normally, however, these two contacts are in engagement as shown in Figure 7. 35 Arm 64 is so located that it will not engage lever 65 and operate it until after contact 43 has been shifted by armature 45. The time interval between the actuation of the two contacts 43 and 57 can be varied by adjusting the arm 64 along the armature 45.

40 When the apparatus is set for use the shutter 11 is supported in raised position and the various parts are arranged as shown in Figure 7. Under these conditions light rays from the lamp 2 are spread over the light-sensitive cell at the opposite end of the foul line so that resistance through said cell is thus cut down and the relay 30 is not energized. By means of the variable resistance 32 it is possible to control the time 50 required to set up sufficient resistance in the light-sensitive cell to cause the relay 30 to be energized. Thus adjustment can be effected which will prevent the relay from being energized when the light is momentarily intercepted by a ball being propelled across the foul line but should the light be intercepted by the foot of the player or any other portion of the body the light to the cell 10 would be cut off for a sufficiently long period to insure the energizing of 60 the relay.

65 When the light is intercepted as the result of a foul the resistance set up in the light-sensitive cell will result in the energizing of magnet 14 and relay 30 and the movement of contact 63 against contact 62. Instantly a D. C. circuit is closed through contacts 57 and 58 and the retarded relay 59. When this relay is energized it shifts the movable contacts controlled thereby, thus breaking the circuit between the contacts 70 38 and 39 and simultaneously closing the circuits between contacts 50 and 49, and 54 and 37. This results in the following operations:

75 When magnet 14 is energized, the latch 13 is withdrawn from engagement with shutter 11, 75

Thus the shutter snaps closed and in so doing shifts contact 23, the magnet 88 is in circuit with relay 70. Instantly the shutter, which has closed the opening 9, will begin to move toward its raised position, this movement being retarded by the dashpot 18. At the same time the armature 45 of the solenoid 44 will begin to move slowly in one direction, this movement being retarded by the dashpot 46.

When contact 50 engages contact 49 the circuit to the audible alarm 40 is closed, this circuit including the secondary 41 and the contacts 42 and 43.

When contact 54 engages contact 37 the A. C. circuit to the lamp or visual signal 55 is closed.

As the result of the foregoing operation the audible signal 40 will be sounded simultaneously with the dropping of the shutter and the visual signal 55 will also be operated. As the solenoid armature 45 is gradually ascending it will first shift the contact 43 and thereby break the circuit to signal 40. Thereafter the arm 64 will come against lever 65 and break the circuit to the relay 59 which in turn breaks the circuit to solenoid 44. Thus the movable contacts controlled by the relay will be released and the parts restored to the positions shown in Figure 7. The circuit to the lamp will also be cut off and the shutter, which had previously reached its raised position will be locked against downward movement by latch 13 because as soon as the circuit to magnet 14 is broken the latch will spring into engagement with the shutter.

As soon as the solenoid 44 and the lamp have been de-energized by the breaking of the circuit thereto due to the de-energizing of retard relay 59, the armature 45 will drop to its initial position so that the contacts 43 and 57 can return into engagement with their respective contacts 42 and 58.

By providing apparatus such as described the operation of the signals will only occur when the light rays are cut off for more than a predetermined time. When that occurs the shutter will be dropped to insure obliteration of rays from the cell 10. The audible signal will be sounded for a short period and then cut off but the visual signal will remain energized until all of the parts are reset automatically after a predetermined time interval controlled by the timing means consisting of solenoid 44 and dashpot 46.

While it is intended to have light rays projected close to and along the foul line it is to be understood that additional light rays may be reflected obliquely back and forth over an area beyond the foul line as indicated by broken lines at 66 in Figure 1. A separate line projecting apparatus indicated generally at 67 can be used for this purpose and a series of reflectors 68 can be associated therewith. Ultimately the light rays will be directed against the light-sensitive cell 69 corresponding with cell 10 and included in the same circuit therewith or provided with an independent circuit similar to the one already described. Thus should a player lean over the foul line and touch the alley with his hand the light rays would be intercepted and the action would take place as explained heretofore.

In Figure 8 a modified apparatus has been illustrated. This differs from that previously described in that a retard relay 70 corresponding with the relay 59, is substituted for the relay 30. In this modified apparatus a movable contact 71 and a stationary contact 72 are included in the circuit of the light-sensitive cell 73. The audible

alarm 74 includes in its circuit a movable contact 75, a fixed contact 76 normally spaced therefrom, a secondary 77 of the transformer 78, and movable and fixed contacts 79 and 80. The visual signal 81 is included in the circuit with the timing solenoid 82 and the two are joined to the A. C. circuit 83 through switch 84 and fixed and movable contacts 85 and 86. The solenoid 87 of the shutter is in parallel with the lamp and solenoid 82 while the magnet 88 is in circuit with relay 70.

In the apparatus illustrated in Figure 8 the obliteration of light rays from the light-sensitive cell 73 results in energizing the retard relay 70 with the result that contacts 71 and 72 are moved apart, breaking the circuit, while the other circuits are closed and the timed operations will be carried out in an obvious way.

Instead of utilizing a timing means in the form of a retarding relay and/or a retarded timing solenoid, a timing means in the form of a motor-driven commutator 89 can be employed as in Figures 9 and 10. The motor 90 is on a power circuit and is adapted to drive the commutator through a separate reduction mechanism 91. The several circuits have contacts adapted to cooperate with circuit closers 92, 93, 94, 95, and 96 carried by the commutator and so proportioned and arranged as to close the several circuits in properly timed sequence and subsequently to restore the parts to their initial positions all during one complete rotation of the commutator. For example the circuit closers 92 open the circuit to the light-sensitive cell 97. Before that circuit is broken the circuit closer 93 closes the circuit to the relay 98 leading to the motor. Following the starting of the motor and prior to the breaking of the motor circuit, the circuit closer 94 establishes a circuit across the motor leads to the visual signal of lamp 99. During the initial period while the lamp circuit is closed the closure 95 closes the circuit to the audible signal 100 and while the circuit to the signal 100 is still closed and before the signal to the lamp 99 has been broken the closure 96 operates to maintain a circuit to the solenoid 101 controlling the resetting of the shutter. The latch releasing magnet 102 is arranged in parallel with the audible signal 100.

Obviously by means of the mechanism described and shown in Figure 9 when the resistance is set up in cell 97 by obliteration of light rays the motor will be started and commutator 89 rotated. Immediately thereafter the relay 98 will be energized and while it is energized the bell and signal lamp will be operated, the bell or audible signal being cut out before the circuit to the lamp is broken. During the operation of the bell the shutter is released to cut off the light and thereafter while the lamp is still lighted the circuit to the shutter solenoid 101 is maintained for a predetermined period to elevate the shutter and permit its engagement by the latch which has been released by the de-energized magnet 102.

Obviously various other modifications of this apparatus can be employed within the scope of the present invention. I do not restrict myself to any particular location of the light-projecting means nor of the light-sensitive cell. Any number of these can be used on one alley. The signal device can be located wherever desired.

What is claimed is:

1. A foul indicating signal for bowling alleys having foul lines, including means for projecting

a light beam across the alley in a vertical plane including the foul line, a main relay circuit including a main relay, a valve, and a light-sensitive cell positioned to receive said light beam, a connection bridging said relay and valve, a resistance parallel with the cell and valve, said bridging connection constituting means for shunting current around the relay and resistance when the cell is exposed to the action of the light beam, a signal circuit, a switch, means operated by the main relay when energized for actuating the switch to close said signal circuit, a timing circuit including a magnet, means controlled by the closing of the signal circuit for energizing said magnet, means operated by the magnet for breaking the circuit to the switch, and means for retarding the action of the magnet.

2. A foul indicating signal for bowling alleys having foul lines, including means for projecting a light beam across the alley in a vertical plane including the foul line, a circuit including a light sensitive cell normally exposed to said light beam, and a resistance, a normally deenergized main relay in parallel with the resistance and cell, a shutter movable into the light beam, means for holding the shutter out of the beam, means responsive to the current energizing the main relay for actuating the holding means to release the shutter, a normally open signal circuit, a switch, a retarded relay for operating the switch, means controlled by the switch for closing the signal circuit, a circuit leading to the retarded relay and including a circuit closer, said main relay constituting means for actuating the said circuit closer.

3. A foul indicating signal for bowling alleys having foul lines, including means for projecting a light beam across the alley in a vertical plane including the foul line, a circuit including a light sensitive cell normally exposed to said light beam and a resistance, a normally deenergized main relay in parallel with the resistance and cell, a shutter movable into the light beam, means for holding the shutter out of the beam, means responsive to the current energizing the main relay for actuating the holding means to release the shutter, a switch, a retarded relay for operating the switch, a signal circuit controlled by said switch, a circuit leading to the retarded relay and including a circuit closer, said main relay constituting means for actuating the said circuit closer, a switch for breaking the circuit to the retarded relay, an electro-magnet, means operated by the first named switch for closing the circuit to said electro-magnet, separate means operated by the electro-magnet for breaking the signal circuit and the retarded relay circuit respectively, and means for retarding the action of said electro-magnet.

4. A foul indicating signal for bowling alleys having foul lines, including means for projecting a light beam across the alley in a vertical plane including the foul line, a circuit including a light sensitive cell normally exposed to said light beam and a resistance, a normally deenergized main relay in parallel with the resistance and cell, a shutter movable into the light beam, means for holding the shutter out of the beam, means responsive to the current energizing the main relay for actuating the holding means to release the shutter, a normally open signal circuit, a switch therefor, and means controlled by

the energizing of the main relay for actuating the switch to close the signal circuit.

5. A foul indicating signal for a bowling alley having a foul line, including means for projecting a light beam across the alley adjacent to the foul line, a main relay circuit including a main relay, a valve, and a light-sensitive cell positioned to receive said light beam, a connection bridging said relay and valve, a resistance parallel with the cell and valve, said bridging connection constituting means for shunting current around the relay and resistance when the cell is exposed to the action of the light beam, a normally open signal circuit, a retarded relay controlled by the operation of the main relay when energized through the obliteration of light from the cell, means operated by the retarded relay for closing the signal circuit, a shutter movable into the path of the light beam, means for holding the shutter in position away from the light beam, and electrically operated means responsive to current energizing the main relay for releasing the shutter holding means from the shutter.

6. A foul indicating signal for a bowling alley having a foul line, including means for projecting a light beam across the alley adjacent to the foul line, a main relay circuit including a main relay, a valve, and a light-sensitive cell positioned to receive said light beam, a connection bridging said relay and valve, a resistance parallel with the cell and valve, said bridging connection constituting means for shunting current around the relay and resistance when the cell is exposed to the action of the light beam, a signal device, a retarded relay controlled by the operation of the main relay when energized through the obliteration of the light beam from the cell for effecting a delayed actuation of the signal device, a shutter, means for holding the shutter out of said light beam, means responsive to current supplied to the main relay for actuating the shutter holding means to release the shutter, a switch operated by the retarded relay, a normally open circuit including a magnet, said switch constituting means for closing the circuit when actuated by the retarded relay, and means controlled by said magnet when energized for returning the released shutter into engagement by its holding means.

7. A foul indicating signal for a bowling alley having a foul line, including means for projecting a light beam across the alley adjacent to said foul line, a main relay circuit including a main relay, a valve, and a light-sensitive cell positioned to receive said light beam, a connection bridging said relay and valve, a resistance parallel with the cell and valve, said bridging connection constituting means for shunting current around the relay and resistance when the cell is exposed to the action of the light beam, a signal circuit, a shutter movable into and out of the light beam, means for holding the shutter normally in one position, a switch for controlling the signal circuit, a circuit adapted to be closed by the main relay when energized, means in said last named circuit for effecting a retarded actuation of said switch when the main relay is energized, and means responsive to current energizing the main relay for actuating the shutter holding means to release the shutter.

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