This invention relates to a foul indicator for bowling alleys.

In Patent #2,664,290 there is disclosed a bowling foul indicator employing a light beam at the foul line, the interruption of which for a period in excess of that required for passage of a bowling ball results in a sound indication of short duration, and a light signal of longer duration. The apparatus there shown, particularly the light beam actuated portion thereof is rather bulky, such that it is proposed therein that the light receptor alone be located at the foul line, and the remainder located in units disposed elsewhere.

The present invention is directed to a circuit for accomplishing a similar result, but which is so compact as to be capable of mounting at the side of the bowling alley, at the foul line, without interfering with the game. The foul actuating apparatus is sufficiently compact so as to be capable of being housed in a small casing which may have a short standard cord and plug for attachment to a standard 110 volt base outlet located adjacent thereto. The unit is such as to be readily replaced with hardly a moment's loss of time if found to be inoperative, and the circuit is such that on failure for any cause, other than a blown fuse or power failure (which may be eliminated), an indication thereof is rendered.

The above and other novel features of the invention will appear more fully hereinafter from the following detailed description taken in conjunction with the accompanying drawings. It is expressly understood that the drawings are employed for purposes of illustration only and are not designed as a definition of the limits of the invention, reference being had for this purpose to the appended claims.

In the drawings, wherein like reference characters indicate like parts:

FIGURE 1 is a light beam circuit;
FIGURE 2 is a light beam sensitive signal circuit; and
FIGURE 3 is a fragmentary plan view of a bowling alley at the foul line showing the units of FIGURES 1 and 2 in position; and

FIGURE 4 is a transverse sectional view across the alley substantially at the foul line, or approximately on the line 4—4 of FIGURE 3.

Referring to the circuits, in FIGURE 1, there is shown a plug 20 for a 110 volt alternating current circuit connected through a fuse 22 to a step down transformer 24, whose secondary of which is connected to an incandescent lamp 26, whose light is concentrated by a suitable lens and reflector system 28 into a beam 30 which is directed across the bowling alley immediately above the foul line.

In FIGURE 2 there is shown the signal circuit, which is likewise energized from a 110 volt alternating current circuit from a plug 40, which is connected through a fuse 42 to normally open contacts 44 and 46 of a 10 second thermal time delay switch, through a rectifier 48, a light sensitive cell 50 upon which the beam 30 is concentrated, and a relay coil 52, having a return lead 54. The relay is provided with capacitance 56 and 58, which are closed upon energization of the coil 52 to 58 seconds. The relay contacts 44 and 46. The relay is provided with further contacts 60 and 62 which are opened upon energization of the relay coil 52. The contacts 60 and 62 are connected between the fuse 42, and the heater resistances 64 and 66, the heater 64 being associated with the bimetallic arm 50.

Across the relay coil 52, is a capacitance 82 which discharges through the relay coil, when the light cell acts to open the circuit, so that the relay coil may not be instantaneously deenergized, until after the time required to discharge the capacitance has elapsed which may be in the order of one fifth of a second.

Assuming the two units are plugged in and the light beam is directed upon the light cell 50, a circuit is initially established through relay contacts 60 and 62 to energize heaters 64 and 66, and a circuit is also initially established to energize the buzzer 76 since contacts 72 and 74 are closed, and the neon lamp is lighted. The heater 66 acts in about 2 seconds to open the buzzer circuit, so that the buzzer signal is of about 2 seconds duration. The heater 64, in about 10 seconds, closes contacts 44 and 46 completing a circuit through rectifier 48, the light beam energized cell 50, and the relay coil 52, thereby energizing the relay to close contacts 56 and 58, which are shunt with contacts 44 and 46, and thus acts as a hold in circuit. At the same time relay contacts 60 and 62 are opened, deenergizing the heaters 64 and 66, and the neon lamp 78. At the same time, capacitance 82 is charged. The operation thus described serves to indicate that the apparatus is in working order, since upon energization of the circuit as described, the buzzer and neon lamp function through a cycle to demonstrate that there is no circuit failure. Should the neon lamp remain lighted for more than 10 seconds, a failure is indicated.

The circuit is now prepared to perform its operation as a foul detector. If a bowler propels a ball through the light beam, the time of traversal of the ball through the beam is less than a fifth of a second. Thus the light cell is instantaneously cut off from the light beam, for a short interval, opening the circuit to the coil 52 from the 110 volt source. However, the capacitance 82 commences to discharge during this interval and thus maintains energization of the relay coil. The size of the capacitance is so chosen in relation to the resistance of the relay coil as to maintain energization for about one fifth of a second. Before the expiration of a fifth of a second, the ball has traversed the beam and the light cell is reenergized, and the relay coil is reenergized by the 110 volt source, and the capacitance brought back to full charge.

If the bowler should obstruct the light beam with his foot or apparel, the light beam is obstructed for a period in excess of one fifth of a second, since it is a fact that the bowler's motion or stance in obstructing the light beam is relatively slow. The capacitance 82 thus has time to discharge to a point below the level of that required to maintain relay energization, whereupon contacts 56 and 58 open, and contacts 60 and 62 close. Immediately, the buzzer signal commences, and heaters 64 and 66 are energized, and the neon light is illuminated. The thermally actuated contacts 72 and 74 are opened in about 2 seconds, and the thermally actuated contacts 44 and 46 are closed in about ten seconds. When the latter occurs the relay is reenergized, assuming the beam is no longer obstructed, and the contacts 60 and 62 opened, and the hold in contacts 56 and 58 released. The circuit is thus restored in readiness to indicate a subsequent foul.
contained in small housings 16 and 18 respectively mounted on opposite sides of the bowling alley 90 as shown in FIGURE 3. The light beam 30 is located closely and directly above the foul line 13. Each unit is independently plugged into a convenient 110 volt outlet which may be a double outlet as at 56 for accommodating the unit of an adjacent alley. Each of units 16 and 18 is readily and quickly replaceable with another unit, the instant any failure is indicated so that no delay in the game is necessary should any components of the circuits fail.

In practice the rectifier 48 may be a silicon point contact diode rectifier, the impedance of the relay coil 52 in the order of 10,000 ohms, and the capacitance 62 about 5 microfarad. The neon lamp may be protected with a resistance 80 of about 18,000 ohms. The light sensitive cell may be a cadmium sulphide cell, such as RCA #7163, having a resistance of one megohm, when dark, which is reduced to 4000 ohms in response to the light beam 30. While a neon signal lamp is referred to, other forms of signals may be provided, up to the current carrying capacity of contacts 60 and 62. The buzzer may be mounted in the casing 18, which may be a metal shell, as to resonate or amplify the audibility thereof.

It will be seen that the normal operation of the current requires only sufficient current to energize the relay, which is extremely small and the current required to illuminate the lamp 26 is likewise small.

While various specific examples are given to illustrate and facilitate the practice of the invention, such examples are merely illustrative. While a single form of the invention is disclosed, it will be understood that the invention is not limited thereto. As various changes in the construction and arrangement may be made without departing from the spirit of the invention, as will be apparent to those skilled in the art, reference will be had to the appended claims for a definition of the limits of the invention.

What is claimed is:

1. A bowling foul indicator for actuation by interruption of a light beam projected across a bowling alley adjacent the foul line for a time interval greater than that required for the passage of a ball through the beam, comprising a unitary device having a first circuit having terminals for connection to a source of alternating current comprising contacts of a normally open-when-cold thermally actuated time delay switch in a series circuit with a rectifier, a light sensitive cell conductive in response to radiant energy of a foul line light beam, and a relay coil, the latter having a capacitance in shunt therewith, relay coil actuated contacts closed only on coil energization, in a series circuit with an indicator, said second circuit being connected in parallel with said first circuit, and a heater for actuating said time delay switch connected in shunt with the indicator of said second named circuit.

2. A bowling foul indicator for actuation by interruption of a light beam projected across a bowling alley adjacent the foul line for a time interval greater than that required for the passage of a ball through the beam, comprising a unitary device having a first circuit having terminals for connection to a source of alternating current comprising contacts of a normally open-when-cold thermally actuated time delay switch in a series circuit with a rectifier, a light sensitive cell conductive in response to radiant energy of a foul line light beam, and a relay coil, the latter having a capacitance in shunt therewith, relay coil actuated contacts closed only on coil energization, in shunt with said delay switch contacts; a second circuit comprising relay actuated contacts open only on relay coil energization, in a series circuit with an indicator, said second circuit being connected in parallel with said first circuit, and a heater for actuating said time delay switch in about 10 seconds time connected in shunt with the indicator in said second named circuit; a normally closed when cold thermally actuated delay switch having an actuating period of approximately two seconds and, having its heater in parallel with the first named heater, and its contacts in a series circuit with a sound indicator connected in parallel with said first named indicator; said capacitance, and the impedance of said coil being matched so as to discharge said capacitance in a period of time less than the actuating period of said second delay switch upon said light cell being rendered non-conductive.

3. A bowling foul indicator for actuation by interruption of a light beam projected across a bowling alley adjacent the foul line for a time interval greater than that required for the passage of a ball through the beam, comprising a unitary device having a first circuit having terminals for connection to a source of alternating current comprising contacts of a normally open-when-cold thermally actuated time delay switch in a series circuit with a rectifier, a light sensitive cell conductive in response to radiant energy of a foul line light beam, and a relay coil, the latter having a capacitance in shunt therewith, relay coil actuated contacts closed only on coil energization, in a series circuit with an indicator, said second circuit being connected in parallel with said first circuit; a second circuit comprising relay actuated contacts open only on coil energization, in a series circuit with an indicator, said second circuit being connected in parallel with said first circuit; and a heater for actuating said time delay switch connected in shunt with the indicator of said second named circuit.
open only on coil energization, in a series circuit with an indicator, said second circuit being connected in parallel with said first circuit; and a heater for actuating said time delay switch connected in shunt with the indicator of said second named circuit; said capacitance and the impedance of said coil being matched so as to discharge said capacitance in a fraction of the time of actuation of said delay switch upon said light cell being rendered non-conductive.

6. A bowling foul indicator adapted to operate on the interruption of a light beam projected across a bowling alley adjacent the foul line thereof, which comprises in combination, a light sensitive cell responsive conductively to a light beam, a relay having a coil, and normally open, and normally closed contacts when the relay coil is deenergized, a capacitance connected across said coil, and said coil being connected to said cell and an alternating current terminal, two thermostatic time delay switches each having actuating heater resistances connected in parallel and with one side connected to said terminal, one of said delay switches having contacts normally closed when cold and opening after a brief interval, and the other having contacts normally open when cold, and closing after a relatively longer interval, a second alternating current terminal connected through the normally open contacts of the relay through a rectifier to said light sensitive cell, and said normally open relay contacts being connected across said other time delay switch contacts, and said normally closed relay contacts being connected between the other side of said heater resistances and said second terminal, a signal device connected to the other side of said heater resistances and to said first terminal through the contacts of said one time delay switch, and a second signal device connected between the other side of said heater resistances and said first terminal.

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