March 9, 1965 M. L. GOLDSTEIN 3,172,663

TIMED PINSETTER MOTOR CONTROL AND INDICATOR LIGHT THEREFOR

Filed Aug. 21, 1961 3 Sheets-Sheet 1

FIG. 1

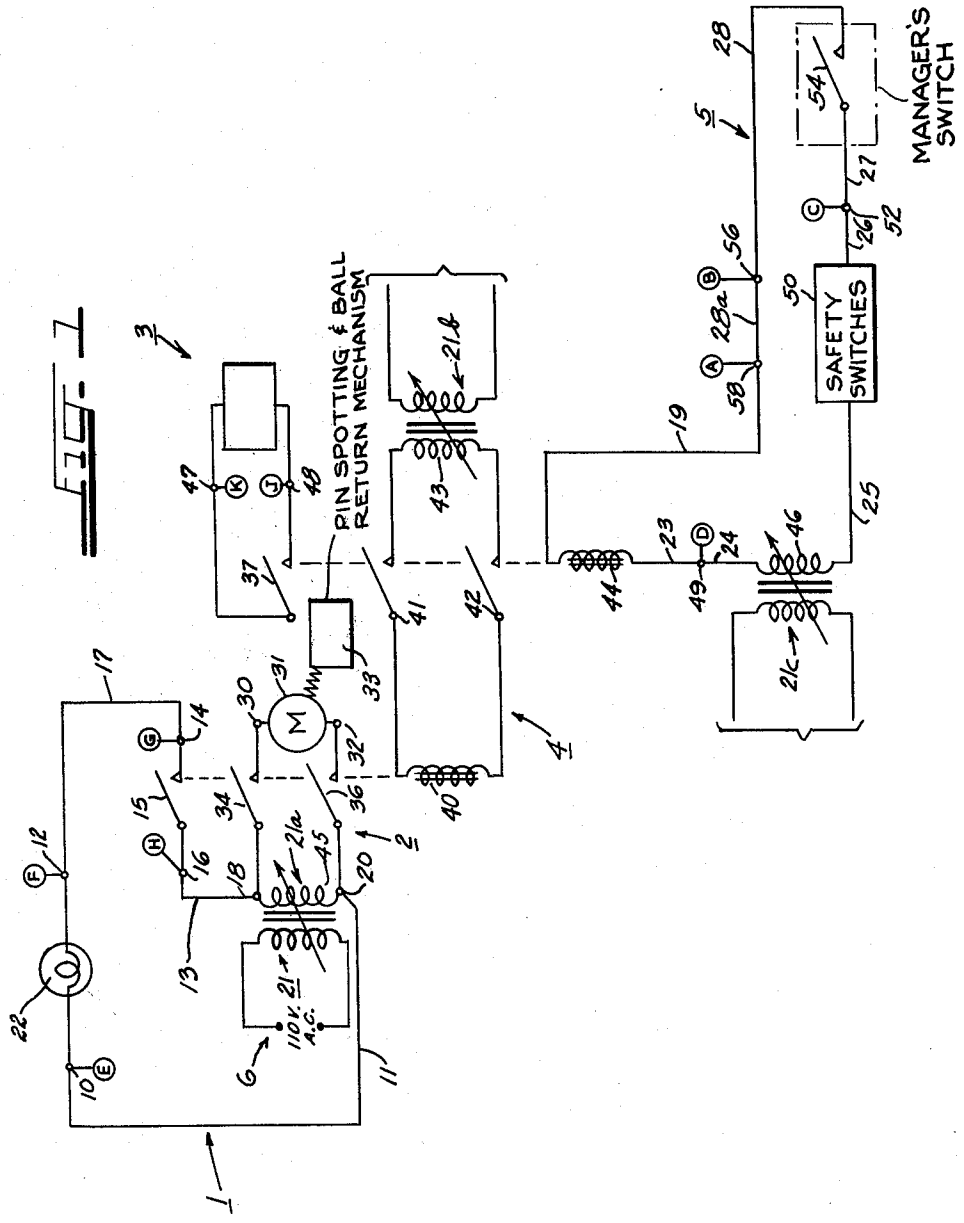

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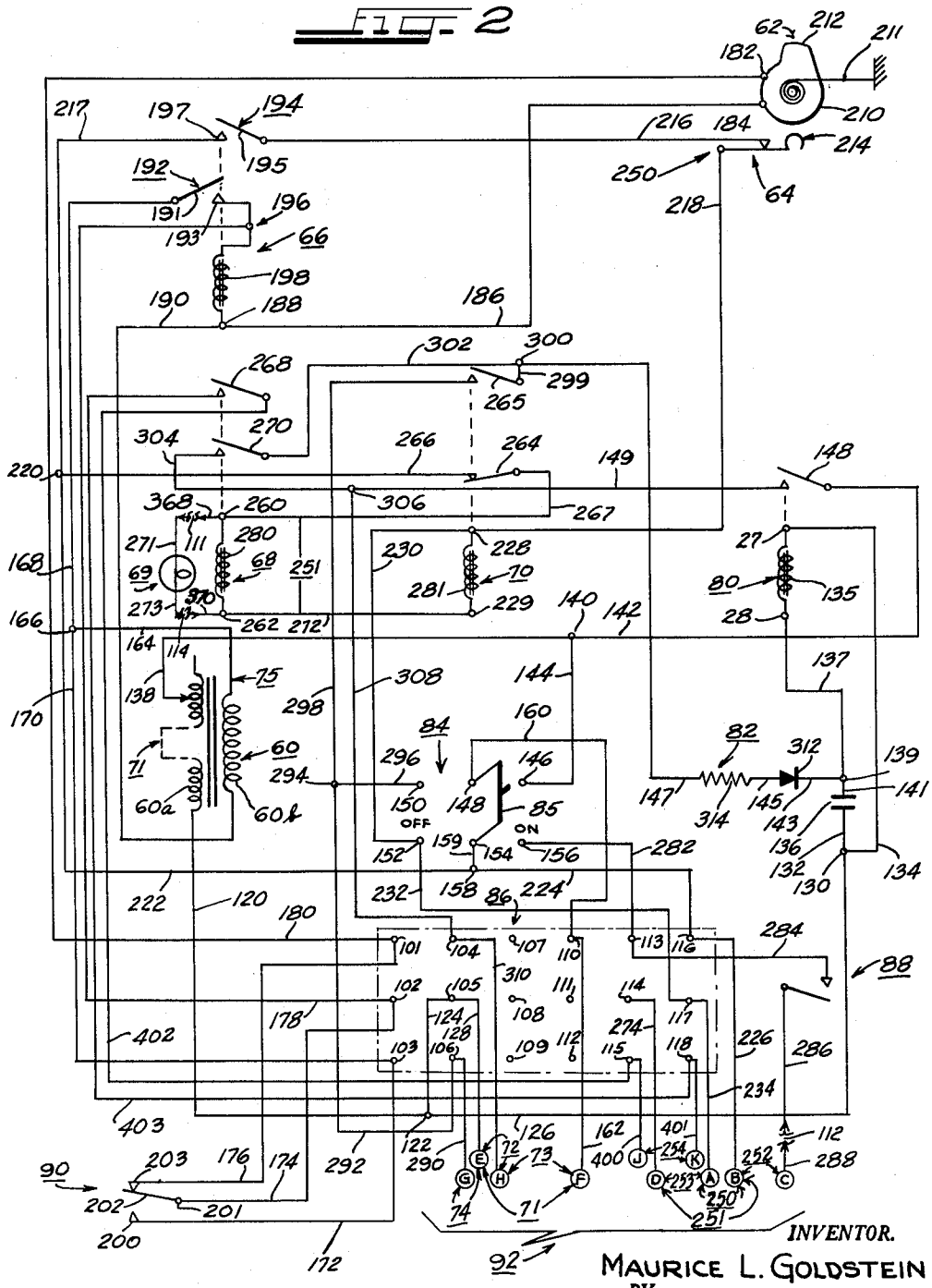
FIG. 2



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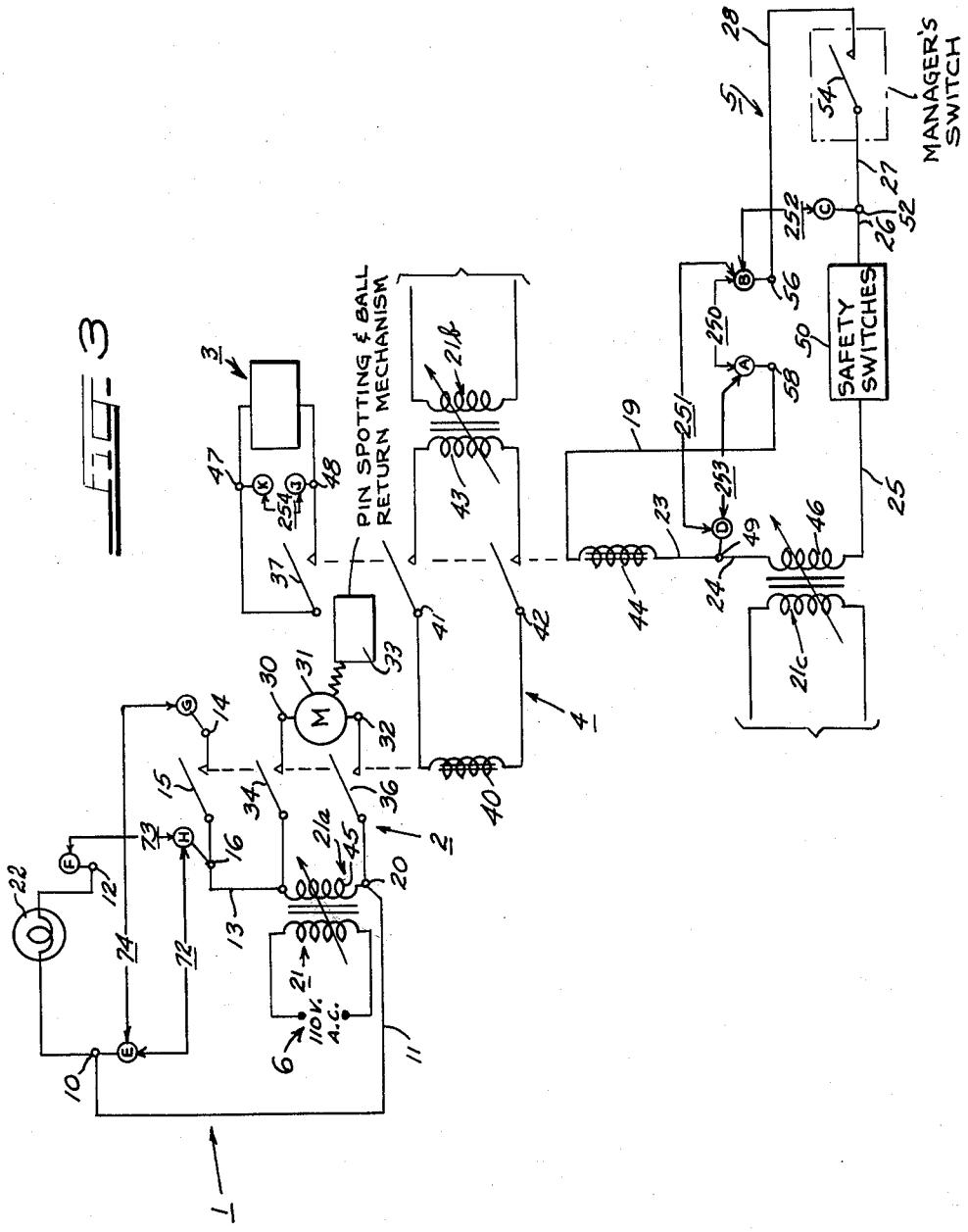

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United States Patent Office 3,172,663 Patented Mar. 9, 1965

3,172,663

TIMED PINSETTER MOTOR CONTROL AND INDICATOR LIGHT THEREFOR

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Filed Aug. 21, 1961, Ser. No. 132,924
15 Claims. (Cl. 273—54)

This invention relates to an automatic control system for a circuit, and more particularly to such a system for employment in the circuitry of an automatic bowling lane mechanism.

The invention resides in the novel provision of an automatic control system which comprises a control circuit adapted to be placed in series connection with the conventional switch and actuator for the motor of an automatically recycling bowling mechanism and a timer circuit adapted to complete the control circuit and thus to actuate the motor in response to a signal generated by a ball being bowled down the alley, and further adapted to interrupt the control circuit and thus to deactuate the motor if another ball is not bowled within a predetermined interval of time. The invention further comprises alternately energizable relay circuits, the first of which is energized when conditions are such that the motor would have been actuated if the subject invention were not utilized, and the second of which is energized when the motor is in fact actuated in the presence of the subject invention. The first relay circuit is connected in parallel with the series combination of the control circuit and the actuator but in series with the conventional switch and is adapted when energized to energize a signal light and to perform all the functions normally performed by the closing of the conventional switch including the illumination of the pin deck light but excluding the actuation of the motor. The second relay circuit is connected in parallel with the actuator but in series with the control circuit and the conventional switch and is adapted when energized to de-energize the first relay circuit and to illuminate the pin deck lights. Pin deck light control and actuating circuits corresponding to the respective relay circuits are provided to continuously illuminate the pin deck lights when the conventional switch is tripped. Additionally, an automatic recycling circuit is provided as a parallel shunt across the conventional switch so that the mechanism may complete a cycle to an inoperative position even though the conventional switch is turned off.

The past decade has seen an unheralded popularization of the sport of bowling by virtue of the innovation and commercialization of automatic bowling lane mechanisms. The primary facet in this bowling boom has been the ability of these mechanisms to greatly expedite the mechanical routine of the game by replacing the manual operations of pin spotting and ball returns. Of course, a very large capital expenditure has been required to install the automatic bowling lane in place of the old manual operation, but this investment has proved fruitful, in that the number of frames (i.e., subdivisions of the game) per unit time which can be bowled has been significantly enhanced. So long as bowling lane proprietors have been able to so vastly increase their turnover ratio of frames bowled per unit time, the installation of the complex and expensive automatic mechanisms has proved worthwhile.

In view of this situation, it is obvious that time is of the essence in the bowling lane business. In fact, the commercially available automatic mechanisms have been so far perfected that a given machine is often operating at below its peak capacity, that is, an individual bowler may not be able to keep up with the machine's operation. After a bowler throws his ball down the alley and (hopefully) knocks down some or all of the pins, the automatic mechanism can lower its pin housing to pick up any pins which remain standing, extend its rake arm to sweep the alley clear of knocked-down pins, and reset the pins, while simultaneously returning the ball to the bowler and gathering the knocked down pins for reuse. Play is ready to resume, as far as the machine is concerned, in a matter of seconds after the ball hits the pins. However, from the bowler's vantage, time is required for tabulating the score, chalking one's hands for better frictional contact, enjoying a beverage or refreshment, conversing with one's playmates, and a myriad of other personal delaying factors between each bowl of the ball. The over all operation would of course be far more efficient if the bowler had to wait for the machine instead of the present vice versa situation.

Another frequent source of delay in the bowling business resides in the initial commencement of play. After a bowler or group of bowlers is assigned to a lane from the manager's counter, the party must proceed to the lane, set up the bowling balls on the rack, arrange the score sheets, put on bowling shoes, etc., before the first ball is thrown. If the manager or attendant, who is usually equipped with an on-off control switch for the lane, turns the lane on immediately, there will be a period during which the motor of the machine is energized but the mechanism is not operating. To obviate this difficulty, the current practice is for the bowlers to call or signal the manager's counter when they are ready to commence. Obviously, when thirty-two or sixty-four or even more lanes are available, as in many of the present day commercial establishments, this places a serious burden upon the manager, who is attempting to control all the lanes simultaneously at an optimum economic efficiency.

Another problem facing the diligent management of the bowling alley is to prevent the bowling of extra frames which are not recorded. Payment for the use of the bowling lane is usually based upon the number of ten frame games played. Often a bowler will attempt to throw a few "free" balls in between games for practice or for fun. This play is not recorded on the score sheet, and, when the sheet is presented for payment, the manager must cross check it with a counter run by the automatic mechanism to see that the bowler pays for all the balls thrown. Often in a busy lane, time is not available for this piece of detection, and the "free" bowling passes unnoticed.

In addition to the various timing and policing difficulties, a flagrant source of complaint in the bowling business is evidenced by disconcerting and undesirable noises in the machinery, which, of course, detract the bowler from the concentration required to bowl effectively. Thus, in the present day commercial embodiments of automatic mechanisms, aside from the ordinary noise of the running machinery, the continuous idling of the mechanism for more than a minute or two often results in a high-pitched squeal which is ascribed to an overheating of the belts and clutches of the machinery. This undesirable overheating also results in frequent breakdowns and necessities for repairs, with concomitant expense and nonutilization of the bowling lanes.

Also, the present day bowling lane set-ups are faced with a difficulty in the turning off of the automatic mechanism. Unless the manager shuts off his control switch at the right instant, the machine may be stopped while cycling, thus leaving the pin deck or pin side of the lane in an awkward and undesirable position, with the pin rake partially extended and with knocked down pins skewed about the deck.

To obviate these difficulties and to provide other features and advantages hereinafter specified, the present in-

vention provides an automatic control system which to a marked extent relieves the manager from the necessity of policing the lanes. The invention comprises a compact and inexpensive control system which in the form of a separate unit may be readily and easily connected into the conventional circuitry of automatic bowling lane mechanisms, or alternatively, which may be incorporated in the initial design of the circuitry for the automatic bowling lane mechanism. In general, the circuitry provided by either alternative functions to retain the automatic mechanism in an inoperative position even though the manager turns his control switch on; to respond to a predetermined signal which indicates the commencement of bowling, thereby to render the automatic mechanism operative; to render the automatic mechanism inoperative if another ball is not thrown within a predetermined interval which has been preselected; to energize the pin deck lights to present a continuously illuminated bowling alley regardless of the disposition of the automatic mechanism when the manager's switch is on; to automatically signal to the manager when the mechanism is inoperative even though the pin deck light remains on; and to automatically complete an operative cycle of the mechanism and to stop the mechanism at an inoperative position after the manager's switch has been turned off.

Accordingly, it is an object of this invention to bring about any or all of the following effects: expediting and rendering more efficient the operation of the commercial automatic bowling lanes; the prevention of undue wasted time by the bowlers in between the actual bowling of balls; the avoidance of useless energization of the automatic mechanism until the bowler has actually commenced play; the prevention of undetected stealing of "free" frames in between games; the prevention of wasteful and bothersome overheating of the machinery; the absence of the disconcerting squealing of overheated machinery to promote relaxation in the game of bowling and to obviate the difficulties of operation with overheated machineries; the diminishment of overall noise level in the bowling lanes of simultaneously operating machines by activating the mechanisms only when required; and the automatic recycling of the mechanism to a clean-deck inoperative position.

It is a further object of this invention to provide the foregoing effects with a minimum of expense, with a simple and compact unit which may be readily connected into the conventional circuitry or which may constitute a portion of the initial design thereof, and with the ability to shunt the control system out of the conventional circuitry if desired.

These and other objects, advantages, and features of construction will hereafter become apparent from consideration of the following detailed description of an illustrative and exemplary embodiment of the invention, as shown in the accompanying drawings, in which:

FIG. 1 is a schematic circuit diagram of a conventional automatic bowling lane mechanism without the subject invention;

FIG. 2 is a schematic circuit diagram of the novel control system for incorporation into the circuitry of FIG. 1; and

FIG. 3 is a schematic diagram showing an example of the new bowling lane control system by the incorporation of the system of FIG. 2 into the circuitry of FIG. 1.

In FIG. 1, an exemplary conventional motor circuit for an automatic bowling lane mechanism is schematically shown. The circuit is activated by a power source 6, such as a line voltage of 110 volts, 60 cycle, which energizes a variable transformer 21, which in turn is arranged to supply various voltage levels, as by conventional winding taps, not shown. Thus, the transformers 21*a* and 21*b* can be arranged to supply 208 volts while the transformer 21*c* supplies 24 volts, all by conventional circuitry. The particular voltages and connections employed

will of course depend upon the design of the conventional unit.

In general, the motor circuit comprises a pin deck light circuit 1, a motor activating circuit 2, a reset cycle control circuit 3, a relay circuit 4, and a manager's switch circuit 5.

The pin deck light circuit comprises in series: terminals 10 and 12 with pin deck light 22 connected therebetween; wire 17; terminals 14 and 16 with relay switch 15 therebetween; wire 13; terminals 18 and 20 with the output 45 of transformer 21*a* therebetween; and wire 11 connecting into terminal 10. The pin deck light illuminates the pin side of the bowling lane when the game is in progress, in a manner to be subsequently described.

The motor activating circuit 2 comprises in series: a solenoid actuated relay switch 34; motor terminals 30 and 32 with a motor 31 connected therebetween; another solenoid actuated relay switch 36 and terminals 18 and 20 with the output 45 of transformer 21*a* therebetween. The relay switches 34 and 36 are respectively connected between motor terminal 30 and terminal 18 of the transformer 21*a* for relay switch 34 and between motor terminal 32 and terminal 20 of the transformer 21*a* for relay switch 36. The motor 31 is thus connected in parallel with the pin deck light 22, and the relay switches 15, 34, and 36 are arranged in a normally open position for closure by the relay circuit 4, to be subsequently described. Whenever the relay switches 34 and 36 are closed so as to activate the motor 31, it is apparent that the relay switch 15 will likewise be closed so as to energize the pin deck light 22.

A pin spotting and ball return mechanism 33 is shown schematically connected to the motor 31, such that activation of the motor causes the conventional mechanism to automatically set the pins and return the bowler's ball. While only a single motor 31 has been shown in the schematic representation, it is to be understood that bowling mechanisms which utilize more than one motor are likewise encompassed within the scope of this invention. The general operation of mechanisms of this kind is as follows:

A ball is thrown down the lane and it strikes some or all of the pins in an effort to knock them down. The ball passes through the standing pins, knocking them about, or, if a bad shot is involved, the ball misses the pins and passes the standing pins via one of the gutters which longitudinally extend along the length of the alley. In either event, the ball strikes a back stop which arrests its motion. The back stop is equipped with switches which are activated when the ball hits the back stop and which in turn signal the pin spotting and ball return mechanism to commence operation.

The ball is picked up and returned along a longitudinal chute to the bowler while simultaneously a pin housing is lowered over the pins to pick up those pins which remain standing. A rake arm then extends over the pin deck to sweep the knocked down and skewed about pins out of the pin deck for conveyance back into a storage facility for subsequent reloading into the pin housing. The pin housing resets the pins back onto the pin deck, as required by the game.

The reset cycle control circuit 3, being no part of the instant invention, and detailed explanation thereof being unnecessary for an understanding of the instant invention, is merely shown schematically and including the solenoid actuated relay switch 37 connected in series between the terminals 47 and 48.

Essentially, the circuit 3 accomplishes the same function as a bowled ball in terms of signalling the commencement of the pin spotting mechanism. In other words, merely pressing a button switch at the bowler's end of the alley will trip the signal switches in the back stop to activate the machinery. This function occurs when, for example, a bowler wishes to commence anew on a lane which presents a partially cycled pin set. The button is

pressed, and the pin deck is swept clean for a new series of pins to be spotted in position for subsequent play.

The relay circuit 4 comprises in series: solenoid actuated relay switch 41; solenoid 40; another solenoid actuated relay switch 42; and the ouput 43 of the transformer 21*b*. The solenoid 40 is arranged to close normally opened relay switches 15, 34 and 36 of circuits 1 and 2 when the said solenoid 40 is energized. The relay switches 41 and 42, as well as the relay switch 37 of circuit 3, are arranged in a normally opened position for closure by the manager's switch circuit 5 in a manner to be subsequently described.

The manager's switch circuit 5 comprises in series: a solenoid 44; wire 23; terminal 49; wire 24; the output 46 of transformer 21c; wire 25; conventional safety switches 50 schematically shown; wire 26; terminal 52; wire 27; the manager's switch 54; wire 28; terminal 56; wire 28*a*; terminal 58; and wire 19.

The terminals 10, 12, 14 and 16 present respectively reference points E, F, G and H; the terminals 47 and 49 present respectively reference points J and K; and the terminals 49, 52, 56 and 58 present respectively reference points D, C, B and A, all to be subsequently described.

In the operation of this exemplary conventional automatic bowling pin spotter and ball return, a manager or lane attendant desiring to activate the automatic mechanisms simply closes the manager's switch 54, thereby energizing the solenoid 44. This solenoid 44 in turn closes the relay switch 37, thereby activating the reset cycle control circuit 3, and simultaneously closes the relay switches 41 and 42, thereby energizing the solenoid 40. This solenoid 40 in turn closes the relay switches 34 and 36, thereby starting the motor 31 and operating the pin spotting and ball return mechanism shown schematically attached thereto, and simultaneously closes the relay switch 15, thereby lighting the pin deck light 22. It is apparent that the single operation of the manager's switch 54 starts and stops the motor and its attendant mechanism, the pin deck light, and the reset cycle control circuit, all in coordinated synchronism.

However, as has been indicated, prolonged operation of the automatic mechanism often results in disconcerting squealing and undesirable over-heating, and it is not feasible for the manager or attendant to constantly watch the particular alleys to arrest these conditions. Moreover, if it were possible to periodically shut off the bowling mechanism even while bowlers were still using the alley, under the conventional arrangement, it would also be necessary to shut off the pin deck light and possibly to stop the pin spotting mechanism in the middle of a cycle of operation. Thus, there would be presented the familiar and undesirable picture of an uncompleted cycle of operation of a pin spotting mechanism, such as a pin rake partially descended with pins skewed about the unlighted bowling alley.

Accordingly, to obviate these difficulties and to present other features and advantages hereinafter specified in detail, the present invention consists of the automatic control system which is schematically represented in FIG. 2 and which is designed for incorporation into the conventional circuitry of FIG. 1 to present the integrated control combination system shown in FIG. 3. For simplicity and clarity, the various components of the circuit in FIG. 2 will be referred to according to their disposition on the schematic representation of FIG. 2.

In general, the novel control system comprises: circuitry including a power source transformer 60; an automatic reset timer 62; a normally closed switch 64 adapted to be opened by the said reset timer; solenoid relays 66, 68, 70 and 80; a signal light 69; a time delay circuit 82; an on-off switch 84; a wiring connector plug 86; an automatic recycling switch 88; a switch 90; and interconnecting wires 92 which terminate at the reference points A, B, C, D, E, F, G, H, J, and K for appropriate connection into the conventional circuit of FIG. 1, in a manner to be subsequently described. These elements are all shown schematically in FIG. 2, but in practice a compact unit incorporating all the aforementioned features and elements can be readily adapted to a compact conventional mounting box (not shown) for installation in and on top of the housing of an automatic bowling lane mechanism.

In more specific detail, the transformer 60 can be chosen with appropriate windings for varying voltages, depending upon the voltage employed in the conventional circuit to be controlled, or it can be, as shown, a variable transformer. The energization of the transformer 60 is accomplished by circuit 71 which is constructed between points E and F as follows: from point E, which is at the end of wire 128; through wire 128; terminal 105 of plug 86; wire 124; terminal 122; wire 120; the input 60*a* of the transformer 60; wire 138; terminal 140; wire 144; terminal 146, handle 85, and terminal 148 of on-off switch 84; wire 160; terminal 110 of plug 86; and wire 162, which terminates at point F. The switch 84 is shown as a two-pole on-off throw switch which has an "on" position when the handle 85 is to the right in FIG. 2, and an "off" position when the handle 85 is to the left in FIG. 2. The "on" position bridges the terminals 146–148 and 154–156, whereas the "off" position bridges the terminals 148–150 and 152–154. Unless otherwise noted, the continuing description will be based upon the assumption that switch 84 is maintained in its "on" position, to the right in FIG. 2.

It should be apparent from the foregoing description that a potential impressed across the schematic points E and F will energize the input 60*a* of the transformer 60 when the switch 84 is in its "on" position. This potential will be impressed upon the output 60*b* of the transformer 60 by the well-known transformer function. The transformer 60 is preferably variable in nature so that appropriate adjustments may be made for the particular conventional circuitry in which the control system is incorporated.

The output 60*b* of the transformer 60 is connected into a timer actuating circuit 75, constructed as follows: wire 164 connects the top of the output 60*b* of the transformer 60 to terminal 166, from which branch wires 168 and 170 extend. Wire 170 connects to terminal 103 of the plug 86, from which wire 172 leads to contact point 200 of the two-pole switch 90. The switch 90 is adapted for alternate connection of contact points 200 and 203 with contact point 201 in response to actuation of the pivot arm 202. The switch has a normal position shown in FIG. 2, i.e., bridging contact points 201 and 203.

Wire 174 connects contact point 201 to terminal 102 of plug 86, from which wire 178 connects to terminal 196 in the relay 66. Wire 176 connects contact point 203 to terminal 101 of the plug 86, from which wire 180 connects to terminal 182 of the reset timer 62. Wire 186 connects terminal 184 of the reset timer 62 to terminal 188 of the relay 66. Wire 190 connects the terminal 188 to the bottom of the output 60*b* of transformer 60.

Reset timer 62, the structural details of which are not shown, may be a conventional spring loaded electrically actuated reset timer, which upon energization (as by a potential across terminals 182 and 184) rotates the cam block 210 against the action of a coil spring 211 such that the cam head 212 can strike the lug 214 of normally closed switch 64 to open the said switch and thus to break the contact between wires 216 and 218. Of course, upon deenergization of the timer 62, the spring action causes the cam block 210 to return to its normal position, and the normally closed switch 64 will thus re-establish contact between the wires 216 and 218.

The timer, by appropriate adjustments of the spring 211, may be set for any of various time intervals before it completes its rotation and opens the switch 64. However, in practice, a 60 second interval has been found

most satisfactory, for reasons to be subsequently developed.

The relay 66 comprises a solenoid 198 connected between terminals 188 and 196, and the normally opened switches 192 and 194 adapted to be closed upon energization of the solenoid 198. However, once energized, the relay is designed to remain self-closing, that is, to maintain switches 192 and 194 closed, as hereinafter appears.

As previously described, wire 190 connects the bottom of output 60*b* of transformer 60 to terminal 188 of relay 66, and thus to the bottom of solenoid 198, and also to terminal 184 of the timer 62 via wire 186. Wire 164 connects the top of the output 60*b* to terminal 166 and thus to pivot arm 191 of switch 192 via wire 168, and also to contact point 200 via wire 170, terminal 103 of the plug 86, and wire 172.

The switch 90 is positioned within the conventional automatic bowling mechanism so as to be responsive to a ball bowled down the alley or to its equivalent, namely, as signal from reset cycle control circuit 3. Thus the switch 90 may be positioned on the aforementioned back stop which arrests the movement of the bowled ball.

When the switch 90 is tripped (for example as by a ball bowled down the bowling alley), the pivot arm 202 thereof bridges contact points 200 and 201. Thereby, via wire 174, terminal 102 of the plug 86, and wire 178, the top of the output 60*b* is connected to terminal 196 of relay 66, which terminal is at the top of the solenoid 198.

Thus, upon tripping the switch 90 as indicated, the potential across the output 60*b* of the transformer 60 is impressed across the solenoid 198, which thereby closes the switches 192 and 194. However, once the switch 192 is closed so that pivot arm 191 contacts contact point 193, the top of the output 60*b* of the transformer 60 is again connected to terminal 196, or the top of the solenoid 198, via the wire 164, terminal 166, and the wire 168. Therefore, even when switch 90 returns to its normal position bridging contact points 201 and 203 and thus breaking the bridge between contact points 200 and 201, the solenoid 198 remains energized and the switches 192 and 194 remain closed. In other words, relay 66 is a starting relay which is self-locking once energized.

Furthermore, when the switch 90 returns to its normal position bridging contact points 201 and 203, the top of the output 60*b* of the transformer 60 is connected to terminal 182 of timer 62 via wire 164, terminal 166, wire 168, closed switch 192, terminal 196, wire 178, terminal 102 of the plug 86, wire 174, bridge 201–203, wire 176, terminal 101 of the plug 86, and wire 180. Since, as has been previously shown, the bottom of the output 60*b* of the transformer 60 is connected to terminal 184 of timer 62, the potential across the output 60*b* is impressed across the terminals 182 and 184 when the switch 90 is in its normal position, and thus the timer 62 is energized. When the switch 90 is again tripped by a bowled ball or its equivalent, the bridge 201–203 is broken, and the timer 62 de-energized.

To continue the description of the circuitry of FIG. 2, a circuit 250 is constructed therein between points A and B as follows: from point A, which is at the end of wire 234; through wire 234; terminal 117 of the plug 86; wire 232; terminal 152 of the switch 84; wire 230; terminal 228 of relay 70; wire 218; normally closed switch 64; wire 216; closed switch 194 (which is maintained closed by the starter relay 66, as noted, and which comprises a pivot arm 195 and a contact point 197); wire 217; terminal 220; wire 222; terminal 158; wire 224; terminal 116 of plug 86; and wire 226 which terminates at point B.

As shown in FIG. 3, circuit 250 is connected in series with manager's switch 54 of manager's switch circuit 5 of FIG. 1 and in series with solenoid 44 thereof by removing wire 28*a* from between terminals 56 and 58 and by connecting wire 234 to terminal 58 and wire 226 to terminal 56, thus correspondingly joining points A and B of FIGS. 1 and 2. Circuit 250 functions to maintain the manager's switch circuit 5 of FIG. 1 in an open position when either of the switches 194 or 64 are open.

Another circuit 251 in FIG. 2 is constructed between points B and D as follows: from point B which is at the end of wire 226; through wire 226; terminal 116 of the plug 86; wire 224; terminal 158; wire 222; terminal 220; wire 266; switch 264 of relay 70; wire 267; terminal 260 of relay 68; solenoid 280 of relay 68; terminal 262 of relay 68; wire 370; terminal 114 of plug 86; and wire 274, which terminates at point D.

Also included within circuit 251 is the signal light 69 connected in parallel with solenoid 280 of relay 68 as follows: from terminal 260 of relay 68; through wire 368; terminal 111 of plug 86; wire 271; signal light 69; wire 273; terminal 114 of plug 86; wire 370; and terminal 262 of relay 68. As previously indicated, solenoid 280 is connected between terminals 260 and 262 of relay 68.

As shown in FIG. 3, circuit 251 is also connected in series with manager's switch 54 of manager's switch circuit 5 of FIG. 1, but in parallel with the series combination of solenoid 44 and circuit 250 thereof by connecting wire 226 to terminal 56 and wire 274 to terminal 49, thus correspondingly joining points B and D of FIGS. 1 and 2. Circuit 251 functions to impress the potential across the output 46 of the transformer 21*c* onto solenoid 280 for energization of relay 68, when the manager's switch 54 of manager's switch circuit 5 of FIG. 1 is closed.

Another circuit 252 in FIG. 2 is constructed between points B and C, as follows: from point B, which is at the end of wire 226; through wire 226; terminal 116 of plug 86; wire 224; terminal 158; wire 159; terminal 154, handle 85, and terminal 156 of switch 84; wire 282; terminal 113 of plug 86; wire 284; automatic recycling switch 88; wire 286; terminal 112 of plug 86; and wire 288, which terminates at point C. Circuit 252 is connected in parallel with manager's switch 54 of manager's switch circuit 5 of FIG. 1 as a shunt thereacross by connecting wire 226 to terminal 56 and wire 288 to terminal 52, thus correspondingly joining points B and C of FIGS. 1 and 2. Switch 88 is positioned within the conventional housing of the automatic bowling mechanism. The switch is normally opened and may be positioned adjacent the operative path of the pin rake so as to be closed as long as the pin rake is extended in its operative cycle. Circuit 252 functions to permit automatic recycling of the automatic bowling mechanisms even though manager's switch 54 is opened, in a manner to be subsequently described.

Another circuit shown in FIG. 2 is circuit 253 which is constructed between points A and D, as follows: from point A which is at the end of wire 234; through wire 234; terminal 117 of plug 86; wire 232; terminal 152 of switch 84; wire 230; terminal 228, solenoid 281, and terminal 229 of relay 70; wire 272, terminal 262 of relay 68; wire 370; terminal 114 of plug 86; and wire 274, which terminates at point D. Circuit 253 is connected in series with the series connection of circuit 250 and the manager's switch 54 in manager's switch circuit 5 of FIG. 1, but in parallel with solenoid 44 thereof by connecting wire 234 to terminal 58 and wire 274 to terminal 49, thus correspondingly joining points D and B of FIGS. 1 and 2. Circuit 253 functions to impress the potential across the output 46 of the transformer 21C onto solenoid 281 for energization of relay 70 and thus to open the normally closed switch 264 thereof, thereby to de-energize relay 68 whenever both circuit 250 and manager's switch 54 are closed.

It should be apparent from the foregoing description that closing the manager's switch 54 will energize circuit 251 and thus the relay 68, but will not energize either the relay 70 or the solenoid 44 unless and until circuit 250 is closed. However, once circuit 250 is closed, circuit

253 is activated and thus relay 70 is energized. But once relay 70 is energized, the normally closed switch 264 thereof is opened, and relay 68 is de-energized. Accordingly, the relays 68 and 70 comprise a pair of "flip-flop" relays in that one can be energized only when the other is de-energized, and vice versa.

A reset cycle control shunt circuit 254 is shown in FIG. 2, between points J and K as follows: from point J, which is at the end of wire 400; through wire 400; terminal 115 of plug 86; wire 402; switch 268 of relay 68; wire 403; terminal 118 of plug 86; and wire 401, which terminates at point K.

In addition to the previously described circuitry, circuits 72, 73 and 74, in conjunction with time delay circuit 82, are utilized in the subject invention.

Circuit 72 is constructed between points H and E as follows: from point H, which is at the end of wire 310; through wire 310; terminal 104 of plug 86; wire 308; terminal 306; wire 304; switch 270 of relay 68, wire 302; terminal 300; time delay circuit 82, which includes solenoid 135 of relay 80; terminal 130; wire 126; terminal 122; wire 124; terminal 105 of plug 86; and wire 128, which terminates at point E.

As shown in FIG. 3, circuit 72 is connected across the output 45 of transformer 21*a* of pin deck light circuit 1 of FIG. 1 by connecting wire 128 to terminal 10 and wire 310 to terminal 16, thus correspondingly joining points E and H of FIGS. 1 and 2.

Circuit 73 is constructed between points F and H as follows: from point F, which is at the end of wire 162; through wire 162; terminal 110 of plug 86; wire 160; terminal 148, handle 85, and terminal 146 of switch 84; wire 144; terminal 140; wire 142; switch 148 of relay 80; wire 149; terminal 306; wire 308; terminal 104 of plug 86; and wire 310, which terminates at point H.

As shown in FIG. 3, circuit 73 is connected in pin deck light circuit 1 of FIG. 1 in series with pin deck light 22, but shunting out switch 15 and terminal 14 by connecting wire 162 to terminal 12 and wire 310 to terminal 16, thus correspondingly joining points F and H of FIGS. 1 and 2.

Circuit 74, which is analagous to circuit 72, is constructed between points G and E as follows: from point G which is at the end of wire 290; through wire 290; terminal 106 of plug 86; wire 292; terminal 294; wire 298; switch 265 of relay 70; wire 299; terminal 300; time delay circuit 82, which includes solenoid 135 of relay 80; terminal 130; wire 126; terminal 122; wire 124; terminal 105 of plug 86; and wire 128, which terminates at point E.

As shown in FIG. 3, circuit 74 is connected in pin deck light circuit 1 of FIG. 1 in series with switch 15 and terminal 16, but shunting out pin deck light 22 and terminal 12, by connecting wire 128 to terminal 10 and wire 290 to terminal 14, thus correspondingly joining points E and G of FIGS. 1 and 2.

As indicated in FIG. 3, the circuits 72, 73, and 74 of FIG. 2 are connected into the circuitry of FIG. 1 concomitantly with the removal of wire 17 between terminals 12 and 14 and thus between points F and G in pin deck light circuit 1.

Time delay circuit 82 comprises in series; wire 147; resistor 314; wire 145; rectifier 312; wire 143; terminal 139; wire 141; capacitor 136; wire 132; and terminal 130, with solenoid 135 of relay 80 connected in parallel to capacitor 136 as follows: from terminal 30; through wire 134; terminal 27; solenoid 135 and terminal 28 of relay 80; wire 137; and terminal 139. The circuit 82 serves to delay the de-energization of solenoid 135 of relay 80 since the rectified current through the series combination of resistor 314 and rectifier 312 will charge capacitor 136 at the same time that solenoid 135 is energized. If, however, that current should be interrupted, the charged capacitor 136 will maintain a temporary potential across terminals 130 and 139 and thus across solenoid 135 to prevent its immediate de-energization. This action will last only until capacitor 136 dissipates its charge; however, this is a sufficient time interval for the intended function of the time delay circuit 82, as will hereinafter appear.

Circuit 72, which connects points E and H is opened and closed by normally opened switch 270 of relay 68; circuit 74, which connects points E and G, is opened and closed by normally opened switch 265 of relay 70. Time delay circuit 82 which includes relay 80 is common to both circuits 72 and 74.

As the relays 68–70 alternately "flip-flop" in the previously described fashion, switches 270 and 265 are alternately opened and closed and circuits 72 and 74 are correspondingly activated and de-activated such that points H and G are alternately connected to point E via time delay circuit 82. The activation of either circuit 72 or 74 will of course energize relay 80 such that normally opened switch 148 thereof is closed, thereby activating circuit 73, which connects points F and H.

The time delay circuit 82 serves to insure that relay 80 will remain energized while the alternately "flip-flop" of relays 68 and 70 occurs. Whatever minute delay may occur in the transition from the one relay to the other, the delay in de-energization of solenoid 135 of relay 80 by virtue of the dissipating potiential in capacitor 136 maintains sufficient residual energization in relay 80 to keep switch 148 continuously closed during the transition.

With the aforementioned description of the aforesaid control system, the operation of the improved automatic pin spotter combination can be appreciated as follows:

The connections A, B, C, D, E, F, G, H, J, and K are made as previously described, by joining respectively wire 234 to terminal 58; wire 226 to terminal 56; wire 288 to terminal 52; wire 274 to terminal 49; wire 128 to terminal 10; wire 162 to terminal 12; wire 290 to terminal 14; wire 310 to terminal 16; wire 400 to terminal 48; and wire 401 to terminal 47; and by removing wire 17 from between terminals 12 and 14 and wire 28*a* from between terminals 56 and 58.

The first sequence in the operation is the throwing of the manager's switch 54, just as in the conventional operation without the improved control system. However, the solenoid 44 will not be actuated since the circuit 250, which has been placed in series with manager's circuit 5, will not conduct. Circuit 250 cannot conduct as long as switch 194 of relay 66 is open. Therefore, the switches 37, 41 and 42 will not be closed, and nothing will happen in the circuits 2 or 4.

However, pin deck light circuit 1 and reset cycle control circuit 3, will be affected by the closing of the manager's switch 54, as follows: The closing of the manager's switch 54 activates circuit 251 which connects points B and D. Thus, the potential across the output 46 of transformer 21*c* in circuit 5 is impressed across points B and D and therefore across both solenoid 280 of relay 68 and signal light 69 in parallel therewith. This potential will light the signal light 69 and will close the normally open switches 268 and 270 of relay 68.

When switch 268 is closed, switch 37 of reset cycle control circuit 3 is shunted out, via the reset cycle control shunt circuit 254 and circuit 3 can function as if solenoid 44 had closed switch 37.

When switch 270 is closed, the pin deck light 22 is lit, as follows: Circuit 72, which connects points E and H via time delay circuit 82 and solenoid 135 of relay 80, is activated, and solenoid 135 is energized. Solenoid 135 in turn closes switch 148 of relay 80, thereby activating circuit 73, which connects points F and H. Thus, the switch 15 and terminal 14 or point G of pin deck light circuit 1 are shunted out, and the pin deck light 22 lights.

Moreover, the activation of circuit 73 places the potential of the output 45 of transformer 21*a* in pin deck

light circuit 1 across points E and F, such that the circuit 71, which connects these points, may activate the transformer 60 in FIG. 2.

At this stage, the motor 31 and its attendant automatic bowling mechanism are quiescent, even though both pin deck light 22 and signal light 69 are lit. Also, reset cycle control circuit 3 is now capable of operation independently of switch 37. The signal light 69 indicates that the bowling mechanisms have not been started, and that a ball has not yet been thrown. Thus, the manager is enabled to throw his control switch on with the confidence that the mechanism will not operate until the first ball is thrown, as in the following manner.

When a ball is bowled or reset cycle button is pushed to energize reset cycle control circuit 3, the switch 90, as previously described, bridges contact points 200 and 201 and locks relay 66 in position. When the switch 90 now returns to its normal position, the timer 62, is actuated, and the cam block 210 begins to revolve.

The locking of relay 66 into position closes switch 194, which activates circuit 250, thereby connecting points A and B and thus energizing solenoid 44 of manager's switch circuit 5. The energization of solenoid 44 in turn starts the motor 31 through the previously described interaction of relay circuit 4 and motor activating circuit 2.

Simultaneously, solenoid 281 of relay 70 is activated by the potential A to D thereacross from the activation of circuit 253, and normally closed switch 264 is opened, and normally opened switch 265 is closed.

The opening of switch 264 breaks the potential B–D across solenoid 280 of relay 68, which is thus deactivated. Similarly, signal light 69 goes out. The de-energization of relay 68 opens switch 268 to its normally opened position, and the shunt of switch 37 in relay circuit 3 is destroyed. However, this result occurs only when the solenoid 44 is activated and at such times the switch 37 is closed by the solenoid 44 anyway.

The closing of normally opened switch 265 of relay 70 now causes the pin deck light 22 to light analogously to the previous control by the closing of switch 270 of relay 68. In this instance, circuit 74, which connects points G and E via time delay circuit 82 and solenoid 135 of relay 80, is activated, since switch 15 of pin deck light circuit 1 will have been closed and point G will be shorted to point H. Solenoid 135 will still maintain switch 148 closed, which activates circuit 73 to connect points F and H and thereby to light the pin deck light 22.

The time delay circuit 82 functions to prevent flickering of the pin deck light 22 as the control of the light is shifted from relay 68 to relay 70 in the described "flip-flop" fashion. In commercial pin spotting mechanisms, fluorescent fixtures are generally employed for the pin deck lighting. As is well known, switching in fluorescent circuits often results in an annoying flickering of the light. To obviate this difficulty, the time delay circuit 82, as previously described, provides sufficient delay in the de-energizing of solenoid 135 of relay 80 to maintain switch 148 closed even while the control thereof shifts from relay 68 to 70 or vice versa.

Should more than the time set on the timer elapse, the cam block 210 will rotate around and open the switch 64, thus breaking the circuit 250, which connects points A and B. The breaking of circuit 250 de-activates circuit 253 in series therewith, and accordingly relay 70 is de-energized. As relay 70 is de-energized, switch 264 thereof returns to its normally closed position, and relay 68 is energized by the now activated circuit 251. As this happens, the signal light 69 lights.

The breaking of circuit 250 also de-energizes solenoid 44 and stops the motor 31 and its attendant pin spotting and ball return mechanisms through the previously described interaction of circuits 2 and 4, although pin deck light 22 remains lit, the control thereof shifting from circuit 74 to circuit 72 in coordination with the shift from relay 70 to 68.

Thus, although the bowling mechanisms have stopped, the pin deck light 22 remains on and the signal light 69 gives an indication to the manager or the lane attendant that more than the prescribed time between balls thrown is being utilized. In actual practice, a bowling alley proprietor would ordinarily allow some sixty seconds between balls, and the timer can be set accordingly, but of course any other interval suitable for particular exigencies is available. The sixty second interval should be appropriate for even slow bowlers, and the deleterious overheating and squealing of the bowling mechanisms will be avoided.

If, however, a ball is bowled in less than the specified time interval set on the timer, the switch 90 is tripped in response to the presence of the ball and the timer circuit 75 is interrupted, thus allowing cam block 210 to return to its initial position under the influence of its attached coil spring 211. The return of the switch 90 to its 201–203 bridge position starts the timing cycle over again. So long as not more than the prescribed time elapses between balls thrown, the motor will operate continuously and the signal light will remain out. As soon as more than that time passes, the motor automatically shuts off, and the signal light turns on.

The manager thus prevents useless overworking and wasteful overheating of his units, with the concomitant squealing thereof, and is likewise enabled to keep tabs on unusually slow bowlers as well as on bowlers who attempt to bowl "free" frames after the necessary delay of adding up their scores for the allowed ten frames.

Unless the players can manage to tabulate their total scores in less than a one minute interval, the signal light will go on, thus notifying the manager that a given bowling game has been completed. This stolen frame detection is especially efficacious in league play, where two teams compete in adjacent alleys. When the competition is over, certain bowlers will often attempt to steal frames for practice or for extra enjoyment. However, the bowlers are required to totalize their scores for the league competition, and, since this usually requires more than sixty seconds, the signal lights for the adjacent lanes go on, and the manager can shut off these lanes to prevent the theft of "free bowling."

The automatic recycling of the pin spotter is accomplished as follows: As the pin rake extends to sweep the alley clear of the pins, the normally opened switch 88 is closed by contact therewith, thereby shunting out the manager's switch 54. If the manager switch 54 were now opened to shut off the automatic mechanism, the shunt of closed switch 88 allows the circuit to ignore the signal from switch 54. However, as soon as the pin rake retracts to a full cycled position, the switch 88 is opened, and the mechanism can turn off in accordance with the off position of manager's switch 54.

The control system represented in FIG. 2 is also designed to be electrically disconnected from the circuitry of FIG. 1 so that the operation thereof is exactly the same as if the control system were physically removed. When the switch 84 is turned to its off position by positioning the handle 85 to the left in FIG. 2, points A and B will be shorted one to the other between terminal 152, handle 85, and terminal 154 of switch 84. This is the equivalent of replacing wire 28*a* between points A and B (i.e. terminals 58 and 56) in manager's switch circuit 5. Likewise, automatic recycling circuit 252, which connects points B and C, will be open-circuited across terminals 154 and 156 of switch 84, which is the equivalent of removing circuit 252 from manager's switch circuit 5. Circuits 253 and 251 will remain in manager's switch circuit 5, but since these become common parallel connections within manager's switch circuit 5, the function thereof will not be affected by their presence.

Moreover, points F and G will be shorted one to the other between terminal 148, handle 85, and terminal 150 of switch 84. This is the equivalent of replacing wire

17 between points F and G (i.e. terminals 12 and 14) in pin deck light circuit 1. Likewise, circuit 71, which connects points E and F to energize input 60*a* of transformer 60, and circuit 73, which connects points F and H, will be open-circuited across terminals 146 and 148 of switch 84. Circuits 72 and 74 will remain in pin deck light circuit 1, but since these become parallel connections within pin deck light circuit 1, the functioning thereof will not be affected by their presence.

Thus, should there be a malfunctioning of the control system of FIG. 2, the switch 84 can be snapped, and the automatic bowling mechanism will operate in the conventional fashion. Moreover, should there be malfunctioning in the conventional circuitry, the mechanic can shut the control system off and inspect the mechanism for repair without having it stop after one minute's time. Further it is apparent from FIGS. 1 and 3 that the control system of FIG. 2 is installed on the output side of the conventional safety switches, so as not to in any way interfere with their operation.

In the preferred embodiment of this invention, the connector plug 86 is a separable male-female type prong plug such that the entire housing box for the control system can be removed and a new one installed without the necessity of disconnecting and reconnecting the wires 92 at the various points A, B, C, D, E, F, G, H, J, and K. Similarly, a dummy plug can be supplied so that if a unit is taken out for repairs (there being no new one immediately available) the dummy plug will allow the conventional circuitry to function in its conventional fashion, by shunting out the removed control connections so as to present the electrical equivalent of the original conventional circuits.

In conjunction with the foregoing description, it should be clearly understood that the descriptive nomenclature is by way of example and not of limitation. Thus, for example, reference to wires, terminals, or switches equally encompasses any equivalent types of electrical connections, such as printed circuits, splices, or photoswitches, or any other modifications which are apparent to a practitioner of ordinary skill in the art. Various changes, modifications, and rearrangements may be made in the details of construction, positioning, operation, and materials for the various elements, without departing from the spirit and the scope of the invention, especially as defined in the appended claims.

What is claimed is:

1. In an automatically cycling bowling mechanism the combination with a motor, an actuator and a switch for said motor, and pin deck lights illumined when the said motor is energized, of an electrical control system comprising:
- a control circuit in series with said actuator of said motor;
- a timer circuit adapted to complete said control circuit in response to a predetermined signal and to interrupt said control circuit unless another such predetermined signal occurs within a predetermined interval of time;
- a first relay circuit connected in parallel with the series combination of said control circuit and said actuator and in series with said switch, said first relay circuit adapted to energize a signal light and said pin deck lights, said first relay circuit being ineffective to actuate said motor;
- a second relay circuit arranged when energized to interrupt said first relay circuit and adapted to illuminate said pin deck lights;
- a first pin deck light control circuit energized in response to the energization of said first relay circuit;
- a second pin deck light control circuit energized in response to the energization of said second relay circuit.

2. A mechanism as recited in claim 1 wherein the timer circuit comprises a reset timer, a self-locking relay, means adapted to transmit an electric potential for energizing said reset timer, and a switch responsive to a predetermined signal such as the bowling of a ball for re-setting said reset timer, the said reset timer being arranged to open a normally closed switch in said control circuit when said timer is energized for a predetermined interval.

3. Mechanism as recited in claim 1 wherein the first relay circuit comprises a relay solenoid and a signal light in parallel with said relay solenoid.

4. The mechanism as recited in claim 1 and further comprising relay means connected in series with said pin deck light control circuits, a pin deck light actuating circuit and a normally open switch in said light actuating circuit, said relay means adapted to close said normally open switch in said light actuating circuit.

5. The mechanism as recited in claim 4 wherein the said relay means include time delay means to prevent flickering of the said pin deck lights.

6. The mechanism of claim 1 and further comprising automatic recycling means which comprises a normally opened shunt switch in parallel with the said actuator for said motor, and means for closing said shunt switch during an operative cycle of the said mechanism.

7. For incorporation in an automatically cycling mechanism of the type having motor means, electrical actuating means for said motor means, and pin deck light means operable upon the energization of said motor means, an electrical control system comprising:
- a control circuit adapted for series connection with the actuating means for said motor means;
- a timer circuit adapted to complete said control circuit in response to a signal;
- a first relay circuit adapted for parallel connection with the series combination of said control circuit and said actuating means;
- a second relay circuit arranged when energized to interrupt said first relay circuit;
- a first pin deck light control circuit energized in response to the energization of said first relay circuit;
- a second pin deck light control circuit energized in response to the energization of said second relay circuit; and
- a pin deck light actuating circuit energized in response to the energization of either of said pin deck light control circuits and adapted for energization of said pin deck light means.

8. In an automatically cycling bowling mechanism of the type having an on-off control switch and pin deck light means responsive to said control switch, a control system comprising.
- means for retaining the mechanism in an inoperative state even though the control switch is on;
- means responsive to a predetermined signal for rendering the mechanism operative;
- signal means responsive to indicate the operative and inoperative states of the mechanism;
- timer means for rendering the mechanism inoperative after a predetermined interval; and means for maintaining said pin deck lights illuminated through said mechanism is in an operative state.

9. The system of claim 8 further comprising:
- automatic recycling means for completing a cycle of the mechanism to an inoperative state even though the control switch is off.

10. In an automatically cycling bowling mechanism of the type having a motor, an actuator and a switch for said motor, and pin deck lights operable when said motor is energized:
- an electrical control attachment mechanism for deenergizing said bowling mechanism to render said bowling mechanism inoperative if successive bowling balls are not thrown within predetermined time intervals, said attachment mechanism comprising:

a control circuit in series with said actuator of said motor, said control circuit including:

timer circuit means adapted to complete said control circuit in response to a predetermined signal and to interrupt said control circuit unless another such predetermined signal occurs in a predetermined interval of time;

a first relay circuit connected in parallel with the series combination of said control circuit and said actuator and in series with said switch, said first relay circuit adapted to energize a signal light and said pin deck lights, said first relay circuit being ineffective to actuate said motor;

a second relay circuit arranged when energized to interrupt said first relay circuit and adapted to illuminate said pin deck lights;

a first pin deck light control circuit energized in response to the energization of said first relay circuit;

a second pin deck light control circuit energized in response to the energization of said second relay circuit; and

a pin deck light actuating circuit energized in response to the energization of either of said pin deck light control circuits.

11. The mechanism as recited in claim 1 and further comprising a reset cycle control circuit and shunt switch in said reset cycle control circuit, said shunt switch adapted to close upon energization of said first relay circuit.

12. The combination with an automatically cycling bowling mechanism of the type having motor means and electrical actuating means for said motor means, of an electrical control system for controlling the actuation of said motor means, said control system comprising:

a resettable timer circuit operable incident to actuation to initiate a predetermined time interval of energization of said timer circiut,

signal means to actuate and reset said timer circuit each time a ball is bowled, and

means responsive to said timer circuit upon completion of said predetermined time interval of energization to deactuate said motor means of said bowling mechanism.

13. The mechanism as recited in claim 12 wherein said resettable timer circuit comprises:

a reset timer, a self-locking relay for holding said timer circuit energized, and means for connection of said relay with a source of electrical potential to energize said reset timer; and wherein the said signal means comprises a switch positioned to be tripped by the bowling of a ball, the said reset timer being arranged to open a normally closed switch in said timer circuit upon completion of said predetermined time interval of energization of said reset timer.

14. In combination with an automatically cycling bowling mechanism of the type having a motor and an actuator for said motor,

an electrical control attachment for deenergizing said bowling mechanism to render said bowling mechanism inoperative if such successive bowling balls are not thrown within predetermined time intervals, said attachment comprising:

a control circuit for controlling said actuator and for controlling periods of energization of said motor, said control circuit comprising:

resettable timer means operable incident to actuation to initiate a predetermined time interval of energization of said timer means and said motor,

signal means to actuate and reset said timer means each time a ball is bowled, and

means responsive to said timer means upon completion of said predetermined time interval of energization to deactuate said motor of said bowling mechanism.

15. In combination with an automatic bowling mechanism of the character described adapted to spot bowling pins and to return bowled balls in sequential and programmed operations and including motor means for operating the mechanism, the improvement which comprises:

resettable timer means for actuating said motor means and for controlling periods of energization thereof, said timer means being operable incident to actuation to initiate a predetermined time interval of energization of said motor means, and

timer actuation means to interrupt and to reset said timer means prior to completion of said predetermined time interval in response to a predetermined signal such as the bowling of a ball.

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