

Nov. 3, 1953

S. S. AUCHINCLOSS ET AL

2,657,929

SWEEP AND GUARD MECHANISM FOR BOWLING PIN SETTING MACHINES

Filed April 16, 1947

6 Sheets-Sheet 1

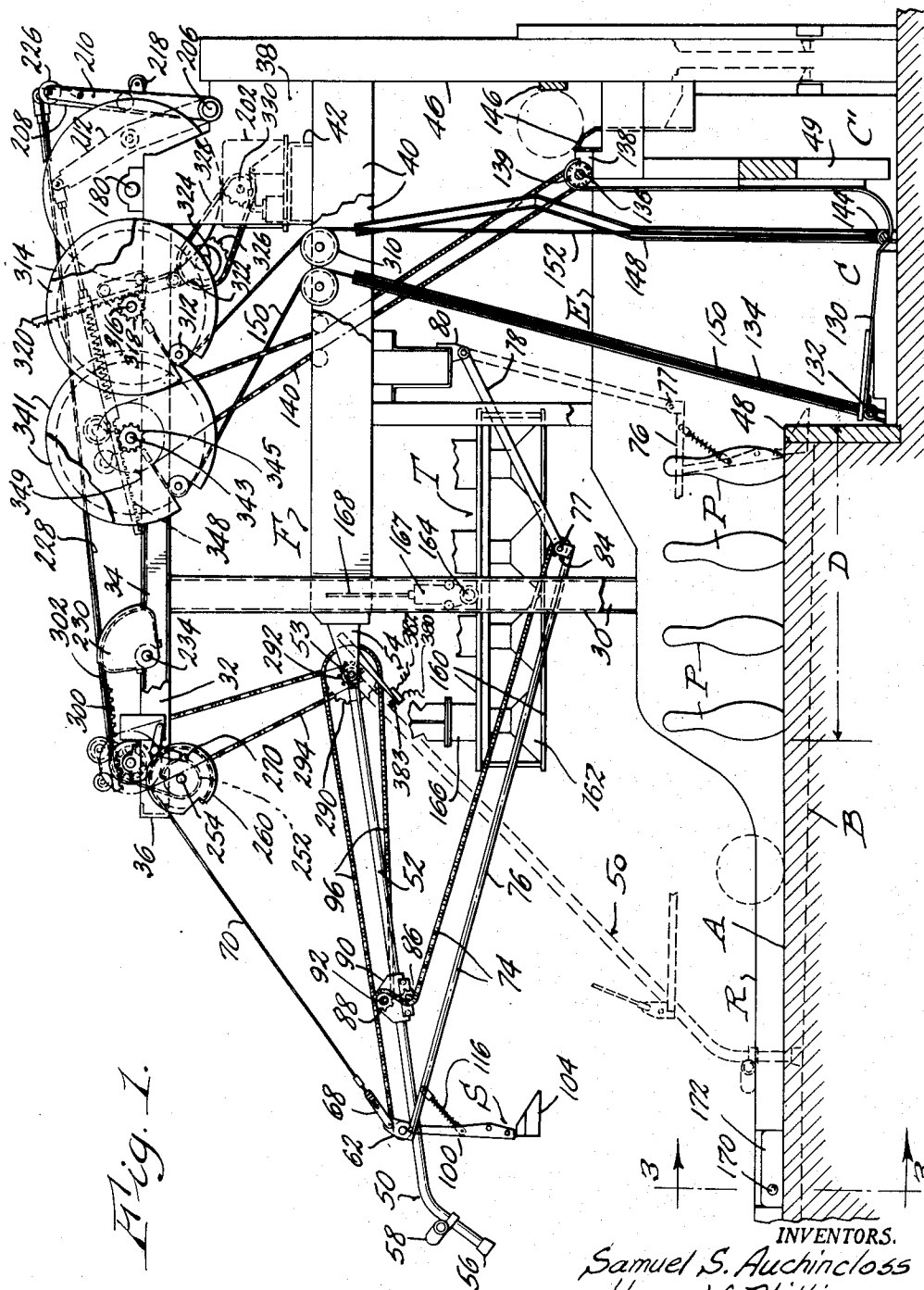


Fig. 1.

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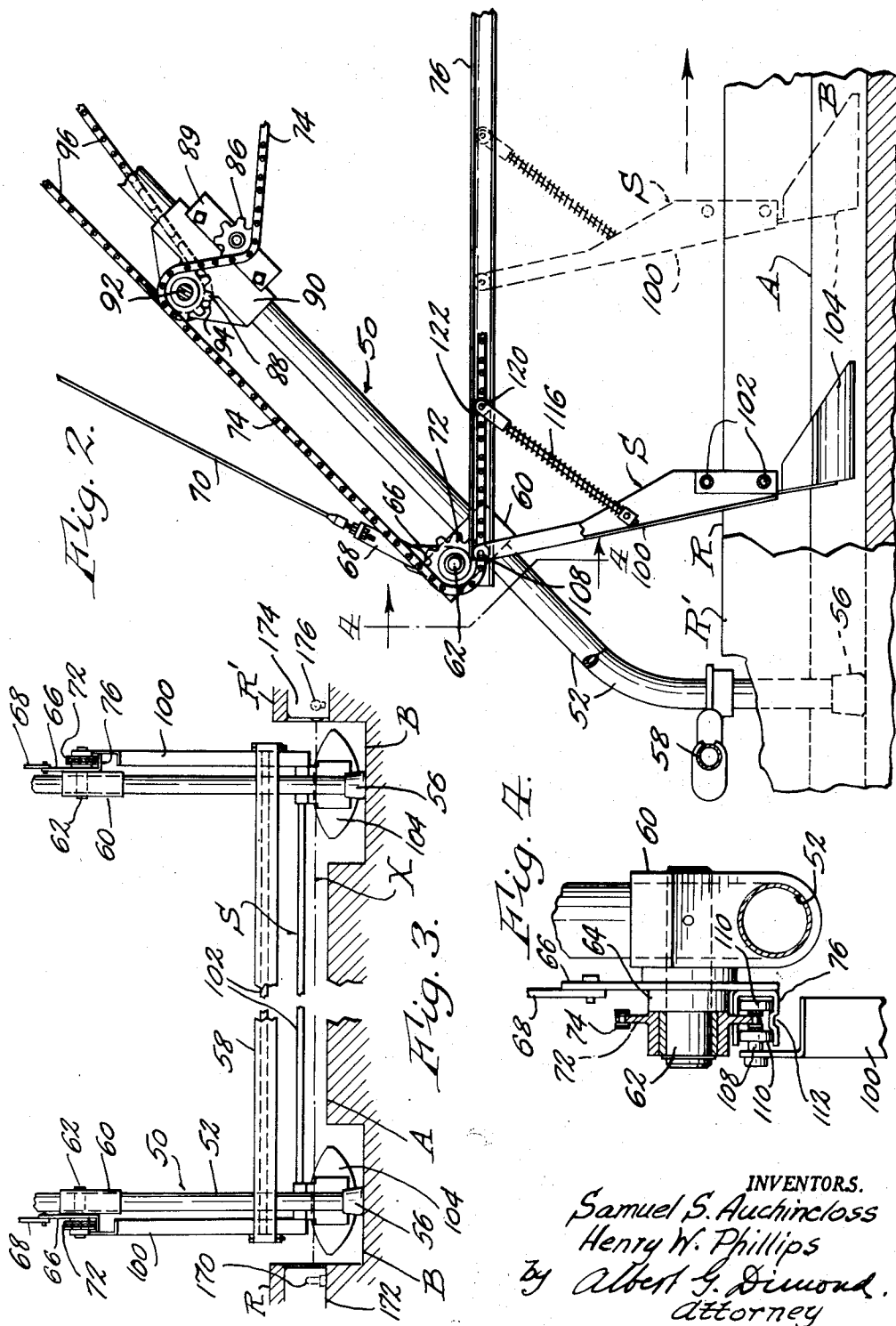
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6 Sheets-Sheet 2



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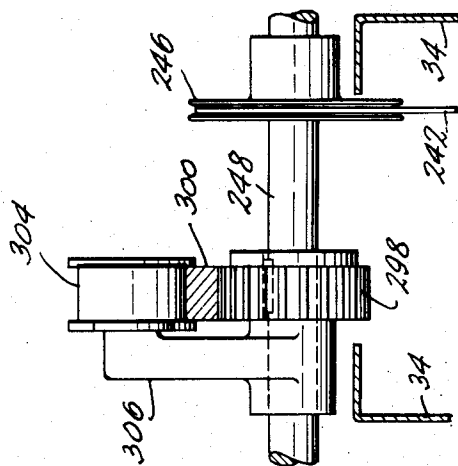
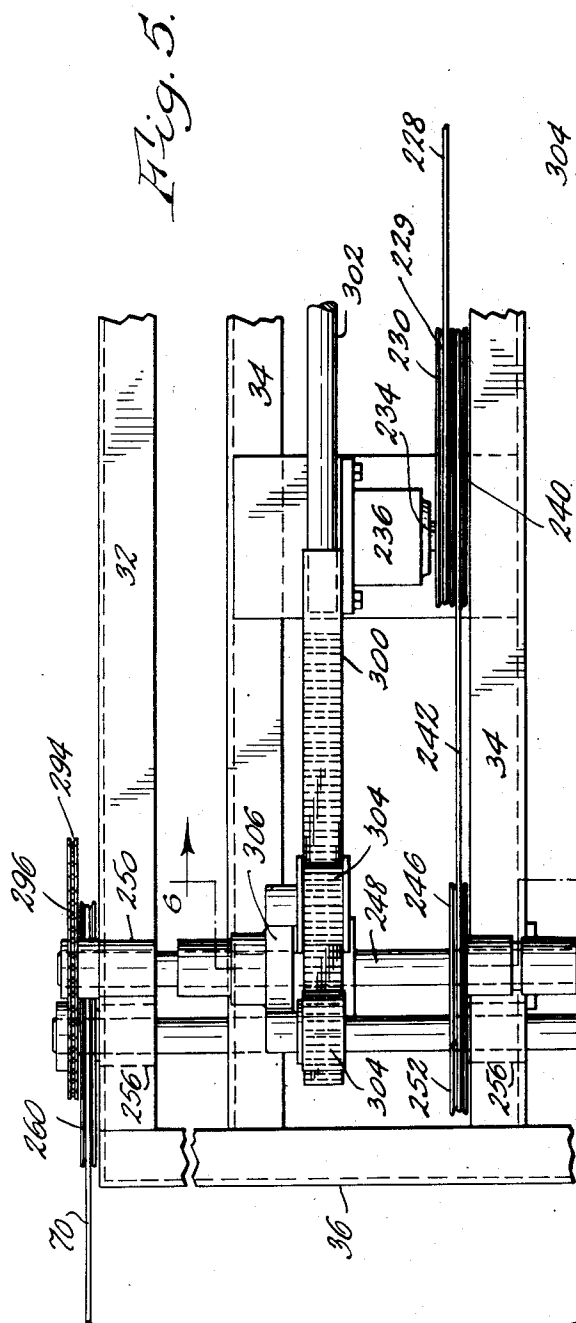
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# SWEEP AND GUARD MECHANISM FOR BOWLING PIN SETTING MACHINES

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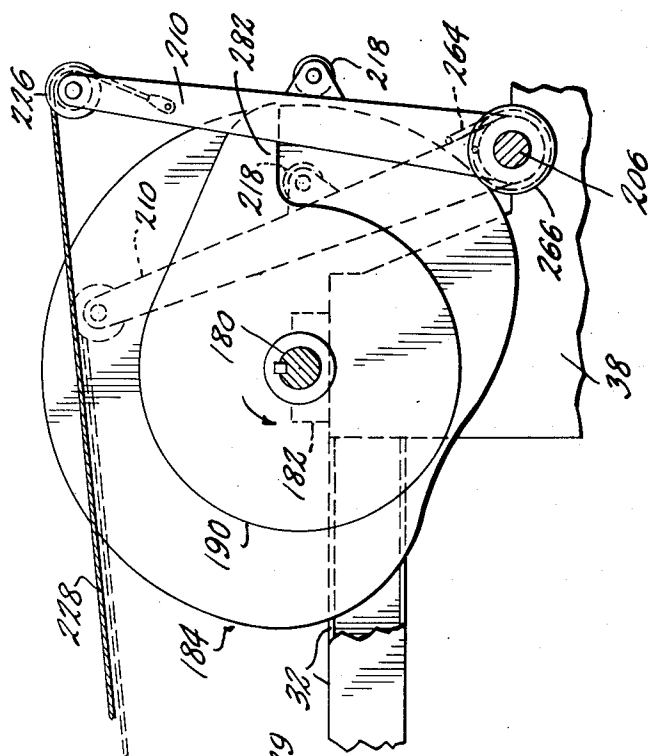


Fig. 7.

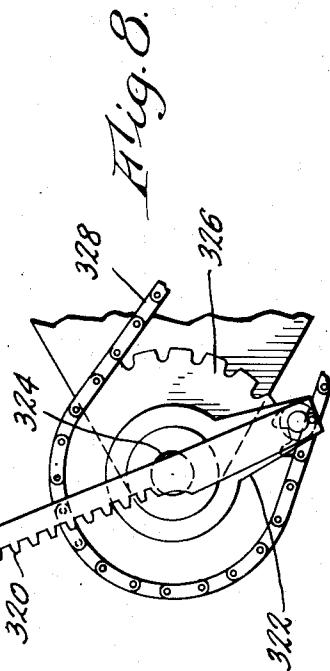


Fig. 8.

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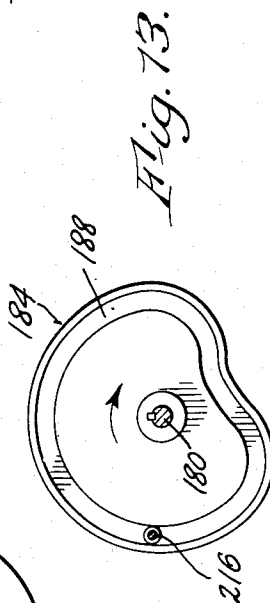
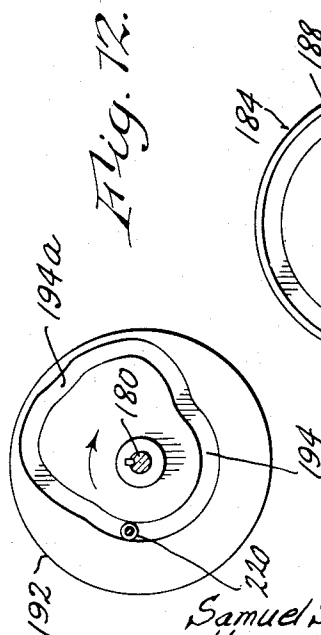
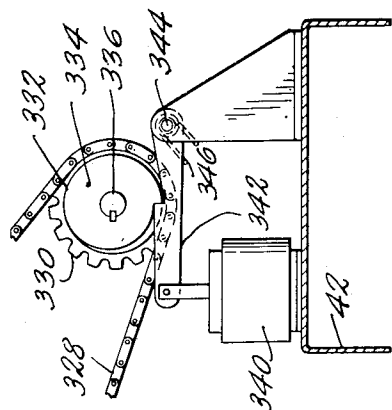
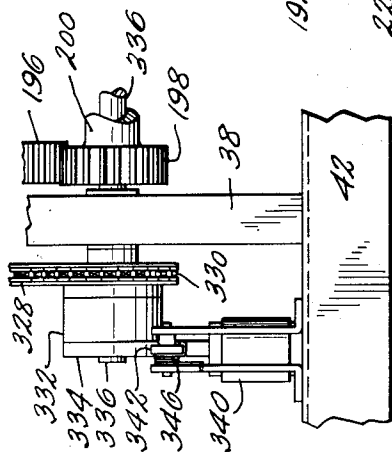
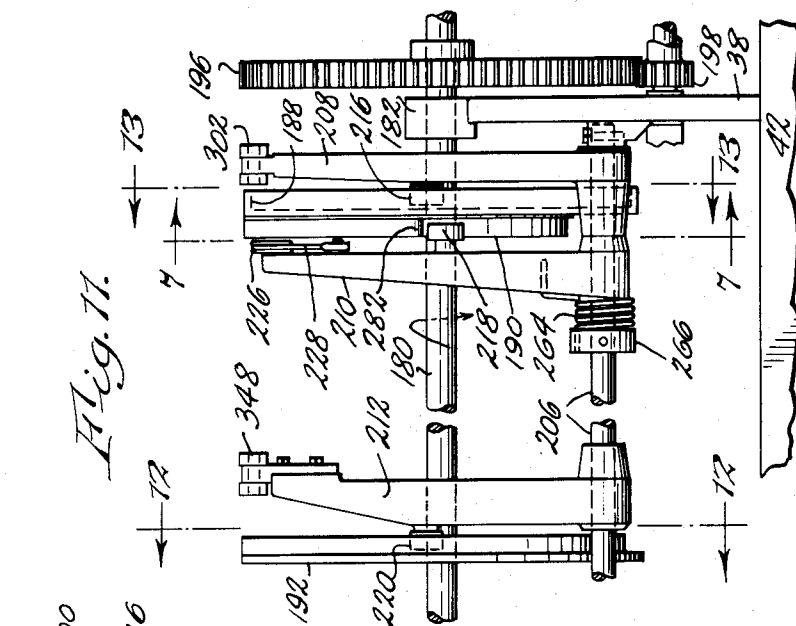
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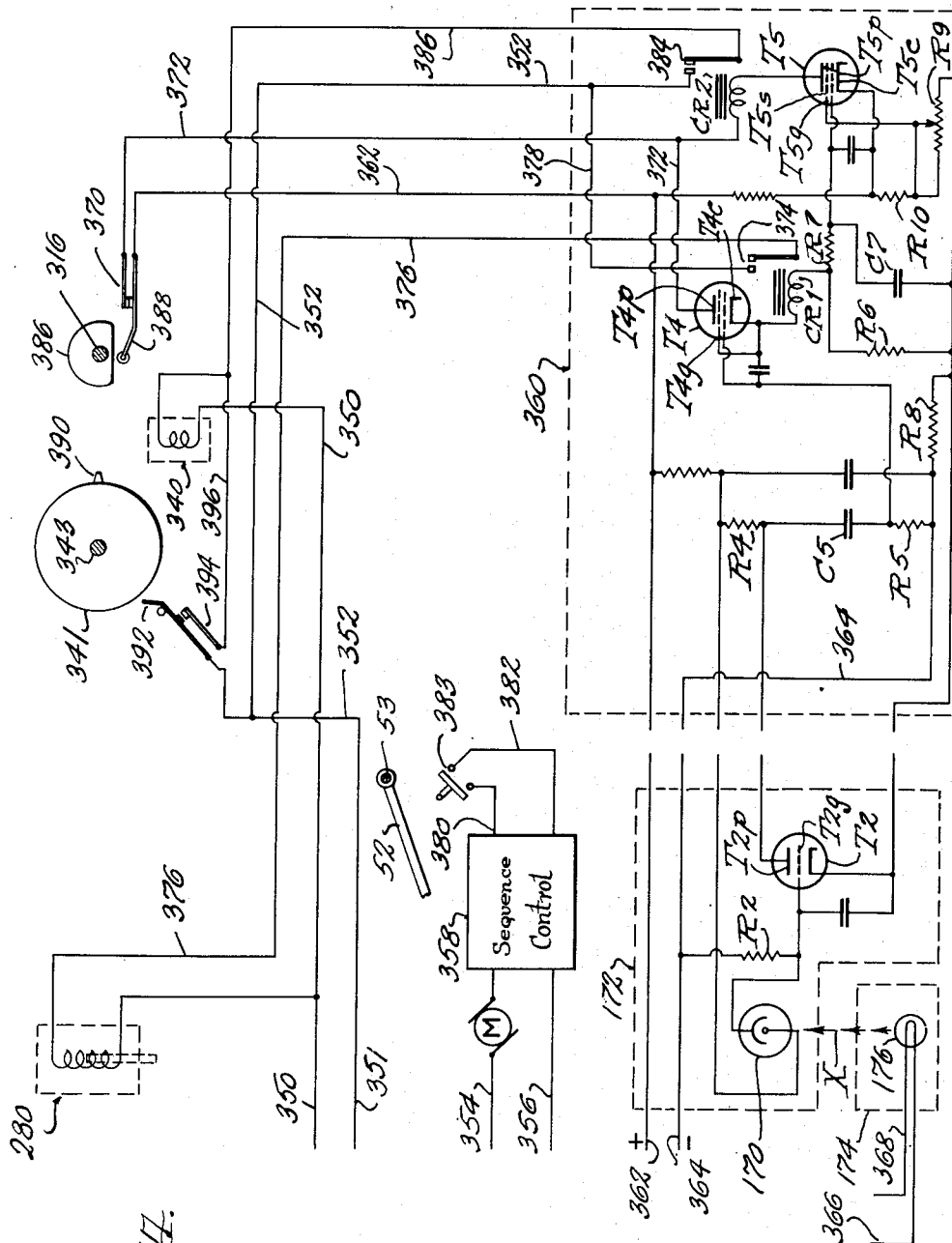


Fig. 14.

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## UNITED STATES PATENT OFFICE

2,657,929

SWEEP AND GUARD MECHANISM FOR  
BOWLING PIN SETTING MACHINES

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Application April 16, 1947, Serial No. 741,932

17 Claims. (Cl. 273-43)

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This invention relates to bowling pin setting machines and particularly to novel and improved means and mechanism for automatically controlling the operation of such machines.

Some machines of this sort are provided with a guard structure which, during a part of a playing cycle, occupies a raised position above the rear portion of an alley bed on which pins are arranged for play. At a time subsequent to the passage of a ball therebeneath into or beyond the pin occupying zone, the guard is automatically lowered to the alley in front of the pin zone to prevent passage of other balls into that zone during the subsequent operating cycle of the pin setting machine.

In some machines the operation of the guard occurs as part of a machine cycle which is automatically and sequentially operated through actuation of a switch or the like by the deposit of the ball or deadwood in the pit at the rear of the alley. The time interval between passage of a ball through the pin zone and entry of deadwood into the pit and the subsequent lowering of the guard has been of such duration that pins could, and sometimes did, "walk" or were propelled or rolled towards the front of the alley beyond the reach of the guard before the latter could be lowered. Any pins thus escaping beyond the control of the pin setting machine had to be manually retrieved, with resulting interruptions and delay.

Machines of this type may also be provided with a sweep device which is mounted on, or associated with the guard and which, after the guard is lowered, automatically moves rearwardly over the alley bed to sweep deadwood therefrom into the pit in rear of the alley. The sweep then returns to its initial position and it and the guard are elevated to clear the pin zone for subsequent play.

It is an object of the present invention to provide in a bowling pin setting machine, novel means for automatically lowering the guard, or guard and sweep, directly or quickly after a thrown ball has passed a predetermined or selected transverse zone on the alley in front of the pin zone, whereby the guard is lowered in time to prevent pins from escaping forwardly beyond the guard.

It is a further object of the invention to provide means for thus lowering the guard prior to and independently of the initiation and start of the cycle of automatic operation of other sequentially actuated machine elements.

Other objects are to effect the foregoing re-

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sults by preferably electrically controlled means. One way of effecting the desired action is by the passage of the ball through a light beam crossing the alley and activating a photo-electric cell which is included in an electrical control system or circuit for controlling the actuation of and causing the guard to be lowered within a relatively short predetermined time, preferably instantly as a result of the passage of a ball through said light beam; and also to provide in such an electric circuit, means for producing a time delay of selected duration associated with the photo-electric cell to effect actuation of the machine cycle at a selected time interval after the guard has been lowered.

With these and other objects not specifically mentioned in view, the invention consists in certain combinations which will be hereinafter fully described, and set forth in the claims hereunto appended.

In the accompanying drawings which illustrate a preferred embodiment of the invention, and form a part of this specification, and in which like characters of reference indicate the same or like parts:

Fig. 1 is a side elevation, partly in section, showing a bowling pin setting machine embodying the invention.

Fig. 2 is a fragmentary sectional elevation, on an enlarged scale, illustrating portions of the guard and sweep of the machine in lowered, operative position.

Fig. 3 is a fragmentary transverse vertical section taken approximately on line 3-3 of Fig. 1, on an enlarged scale.

Fig. 4 is an enlarged fragmentary transverse section, viewed approximately on line 4-4 of Fig. 2.

Fig. 5 is a fragmentary plan view, on an enlarged scale, illustrating a portion of the top of the machine as seen in Fig. 1.

Fig. 6 is an enlarged vertical transverse section taken approximately on the line 6-6 of Fig. 5.

Fig. 7 is a fragmentary longitudinal vertical section of an upper part of the machine, on an enlarged scale and partly broken away, as viewed in the direction of the line 7-7 of Fig. 11.

Fig. 8 is a fragmentary longitudinal vertical section, on an enlarged scale, illustrating part of the mechanism for raising balls out of the pit of the machine.

Figs. 9 and 10 are respectively longitudinal and transverse elevations of part of the mechanism shown in Fig. 8.

Fig. 11 is a fragmentary transverse vertical

section, viewed from the rear of Fig. 1, illustrating certain cams and the levers actuated thereby.

Figs. 12 and 13 are views of cams in Fig. 11 as seen on lines 12—12 and 13—13 respectively, of that figure.

Fig. 14 is a diagram illustrating an electrical system and the electronic and electric elements or controlling devices therein, their wiring connections, and certain elements of the machine with which those parts are associated.

A bowling pin setting machine in which the improvements concerned in the present invention are embodied is illustrated in the accompanying drawings in association with a bowling alley of standard form, a rear portion only of which is shown.

The bowling pin setting machine illustrated is of the general type described and illustrated in Rundell patents, Nos. 2,383,017, granted August 21, 1945, and 2,388,707, granted November 13, 1945. It is to be understood, however, that the subject matter forming the present invention can readily be used on other types of machines.

The alley, Figs. 1-3, includes the bed A, gutters B at opposite sides thereof and a pit C beyond the rear of the bed into which balls and felled or swept pins are received. On the rear of the bed A is the usual zone D within which a set of pins P are arranged for play. Laterally of this zone and outside the gutters B side walls or kick-backs E are disposed, the front ends of which descend and merge into low side rails R and R' which extend to the front (not shown) of the alley.

The pin setting mechanism is supported on a stationary frame F, Fig. 1, including opposite upright side posts or channels 30 fixed at their lower ends on top of the walls E. Secured to the tops of the posts 30 are upper longitudinal side channels or rails 32 and spaced between these are channel rails 34. The front ends of rails 32 and 34 are secured to a transverse top channel 36, while the rear ends of these channels connect with a frame section including upright brackets 38.

These brackets rest on side members 40 and a rear cross member 42, Figs. 9 and 10. The back portions of the brackets 38 connect the foregoing frame assembly to the upper portion of a transverse upright, rear frame section 46, Fig. 1, which rests upon the floor in rear of the pit C.

Spaced between this frame section 46 and the tailboard 48 at the rear of the alley there is a suitable upright cushion structure 49 forming the resilient back wall of the pit by which thrown balls and rearwardly impelled pins may be arrested and directed into the pit C.

The guard, designated as a whole by the numeral 50, includes two opposite side arms 52 each of which has its upper or rear end pivoted at 53 to a bracket 54 on the adjacent upright channel member 30 of the frame F, Fig. 1. Each arm 52 extends longitudinally of a gutter B at the corresponding side of the alley A. In the full line position shown in Fig. 1, the guard is in its upper or inoperative position wherein the guard and the sweep unit carried thereby are above the alley bed so that play may proceed.

Each arm 52 at its forward end has at its extremity a rubber foot 56, which, when the guard is lowered, rests in the gutter as indicated in broken lines in Figs. 1 and 2.

Connected to and extending between the forward portions of the guard is a rail or bumper 58

which may comprise a suitable rigid transverse tube or bar enveloped in a rubber cushion.

In the lowered position of the guard, the bumper 58 extends horizontally across and parallel with the alley bed in a plane such that balls travelling along the alley will be arrested thereby. Damage to the setting and resetting table, when lowered, or to other parts of the machine is thus prevented.

Fastened to the forward end of each guard arm 52 is a block 60 in each of which a transverse horizontal stub shaft 62 is secured, see Figs. 2 and 4. These shafts 62 are in alignment and each projects beyond the outer face of its supporting block 60.

An annular sleeve 64, Fig. 4, rotatably carried on the projecting portion of each shaft has secured about it a plate 66. The upper ends of the plates 66 are swivelled to clips 68 connected to the forward ends of cables 70 by which the guard 50 and a sweep S mounted thereon are raised and lowered, in a manner to be explained.

Each shaft 62 also rotatably supports a sprocket wheel 72 alongside the sleeve 64 and about which is engaged an endless sprocket chain 74. The sweep S is actuated to move rearwardly over the zone D of the alley A to clear the latter and return forwardly to inoperative position by operation of the two chains 74.

The lower run of each chain 74 travels in outwardly facing, longitudinal channel bars or tracks 76 the forward ends of which are fixed to the lower ends of the plates 66. The rear ends of tracks 76 are pivoted by stub shafts 77 to the lower ends of supporting links 78, Fig. 1, the upper ends of which pivot on brackets 80 fixed to a suitable part of the frame.

Each chain 74, passing to the rear through its track 76, engages about a sprocket 84 rotatably supported on the associated stub shaft 77. The chains 74 then extend forwardly to and operatively engage sprockets 86 and 88 and thence complete their path by return to sprockets 72.

The sprockets 86, see Fig. 2, may be carried on adjustable slides 89 mounted on brackets 90, one of which is fixed on each guard arm 52. The movable slides enable sprockets 86 to be adjusted to take up slack in chains 74.

The other sprockets 88 are fixed on the opposite ends of a transverse horizontal shaft 92 extending between and journaled in the two brackets 90. At the outer side of one of the brackets 90 the shaft 92 carries a sprocket 94 of the same diameter as the adjacent sprocket 88 and which is driven by a sprocket chain 96, whereby both sweep chains 74 operate in unison.

The sweep S may comprise a pair of opposed pendant side arms 100, connected by a pair of spaced horizontal rods 102, Fig. 2. The arms are positioned above and in line with the gutters B.

The sweep rods 102 are so located, that when the sweep is lowered and actuated they will engage and sweep into the pit any felled pins or any felled and standing pins, as the need arises.

Depending from and fixed to the lower ends of the arms 100 are shoes 104, which when the sweep is lowered, enter the gutters B, and as the sweep is moved rearwardly, sweep any pins P in the gutters towards or into the pit C. The form of the shoes 104 is such that an accumulation of pins in a gutter B will be readily broken up, thus avoiding jamming.

To effect operation of sweep S by the sweep chains 74, the upper end of each arm 100 is pivotally mounted on a laterally projecting pin 108,

see Fig. 4, substituted for one of the link-connecting pivots of the chain 74. Pin 108 carries a pair of rollers 110 one of which is arranged at each side of the chain and bears against the flanges of the corresponding channel or track 76. A flange of each track 76 may have an inwardly offset longitudinal rib 112 to extend between and retain the rollers on the tracks.

The sweep S may be yieldably retained in its upright operative position by spring controlled rods 116 one of which is pivoted to each arm 100 and to a pivot 120, Fig. 2, of the associated sweep chain 74. Pivot 120 carries a pair of rollers 122, similar to rollers 110, running in the adjacent track 76. The springs on rods 116 can yield to enable the sweep S to move rearwardly upon unintended engagement of the front of the sweep by a ball, or when a shoe 104 might come to rest on a felled pin, as occasionally happens.

The length of the channels or tracks 76 is such that when the sweep S is lowered with the guard 50, the chains 74 can carry the sweep along the alley A from its full-line forward position to its rear dotted line position at the end of the alley, Fig. 1, where the chain travel is arrested.

After sweeping pins, or pins and balls into the pit C the mechanism for driving the chains 74 is reversed to return the sweep S to its forward inactive position.

The mechanism for driving chain 96 for actuating the sweep to and fro will be described later.

Pins and balls deposited in the pit C come to rest upon an apron 130, Fig. 1, formed of a rectangular sheet of suitable fabric or other flexible or resilient material.

The construction and operation of apron 130 may, in general, be substantially the same as shown in the Schmidt Patent 2,389,643, issued November 27, 1945.

The front edge of the apron 130 is secured about a transverse rod or lifting member 132 which, in lower position, extends across the front of the pit with its ends projecting into the lower ends of opposed upright guideways or channels 134 arranged at the inner faces of the side walls E. The apron extends rearwardly from the lifting bar 132 across the floor of the pit C and thence upwardly along the front of the cushion structure 49. The rear edge of the apron terminates adjacent the top of the cushion structure where it is preferably attached to a winding roll 136. The ends of the roll are formed with journals rotatably supported in bearings 138. One of the ends or journals of roll 136 extends through its bearing and there carries a sprocket 139 engaged by a sprocket chain 140 by which the roll may be rotated to wind up or unwind the apron.

Extending crosswise of the rear portion of the pit C is a ball lift rod or member 144 which, in its lower position, rests on the apron 130 at such distance in front of the portion of the apron extending upwardly against the cushion that a ball may rest on rod 144 and against that apron part.

Rod 144 is spaced from the cushion 49 a distance less than the diameter of a ball, but greater than the maximum diameter of a pin. By this arrangement any pin or pins tending to be lifted by the rod 144 will drop downwardly between rod 144 and cushion 49 back into the pit, thereby preventing jams, breakage of parts, and interference with the removal of a ball from the machine.

Thus by upward movement of the rod 144 in a plane substantially parallel with the face of said cushion 49 the ball only may be elevated or rolled upwards until it is located above the wind-

ing roll 136. Continued upward movement of the rod 144 will cause the ball to be urged to the rear over the roll 136 where it is received on suitable inclined tracks 146 for transverse delivery to a side of the machine for return along a side of the alley A to the player, in a well-known manner.

The opposite ends of the rod 144 extend into upright guides or channels 148 on the side walls E.

Movement of the apron bar 132 and the ball lift rod 144 in their guides may be effected by the use of flexible cables 150 and 152 secured to slides on the opposite ends of elements 132 and 144 respectively, and operating in the respective channels. The pairs of cables 150 and 152 are actuated by mechanism under control of electrical devices in accordance with this invention, as will be described.

The type of machine selected for illustrating a preferred embodiment of this invention is provided with an automatic spotting and respotting table, an example of which is indicated at T, Fig. 1. Since the present invention does not concern itself with the construction or operation of the table T, such will be only briefly alluded to.

The pin setting and resetting table T, which is similar in construction and operation to that shown in the above referred to Rundell Patent 2,383,017, includes upper and lower horizontal plates or sections 160 between which are arranged a group of ten pick-up and respotting elements 162. At proper intervals the table and elements 162 are lowered to grip standing pins P on the alley bed. The table and gripped pins are then raised above the pin zone D to enable the zone to be cleared of deadwood by the sweep device.

The table T is again lowered and replaces the picked-up pins in their former positions on the alley and moves up again to allow further play. After removal of deadwood from the alley the table T is rotated to a relatively inverted position about pivots 164 to face spotting cups 166 thereon downwardly. Then upon lowering the table again a set of pins P in those cups may be released and placed in playing position in the zone D on the alley.

By again elevating table T and rotating it back to its former position play may proceed.

The table T may be suitably supported for the foregoing up and down movements, by mounting pivots 164 at its opposite sides in carriages 167 slidable up and down in the side channels 30 of the frame F under the action of cables 168, operated by mechanism (not shown) such as heretofore used.

It has already been stated that the actuation and control of the guard 50, sweep S, the apron lifting member 132, and the ball lift rod 144 are effected, in accordance with this invention, as a result of the passage of a thrown ball through a beam of light directed to the light-receiving element of a photo-electric cell or device.

Such a photo-electric element, represented generally at 170, Fig. 3, is disposed in a casing 172 preferably mounted in the side rail R of the alley so as to be flush with its inner wall. Directly across the alley from the element 170, and mounted in a casing 174 preferably located in the opposed side rail R<sup>1</sup>, is a source of light, such as a lamp 176, by which a beam of light X of uniform cross section may be directed across the alley to impinge on and activate the cell 170, see Figs. 3 and 14.

The light beam X must, of course, be disposed

below the horizontal plane along which the top of a ball travels in order that the ball may break the beam and interrupt its action on the photocell 170.

The photo-cell 170 and the light source 176 are incorporated in the combined electronic and electrical system or circuit shown in Fig. 14. This system also includes other electrical elements, such as switches and solenoids and also the motor M used as a source of power for the cyclic operation of several parts of the pin setting machine. Certain of these electrical elements are used to control mechanisms which operate the guard and sweep, the pit apron and the ball lift device, and such elements will be disclosed as the respective operating mechanisms are described. The electrical circuit or system will be described later in detail in connection with a cycle of operation of the machine.

To effect the desired movements of the guard 50 and the sweep S, the ball lifting rod 144 and the apron raising and lowering bar 132, a horizontal cam shaft 180, Fig. 13, is positioned transversely across the rear of the machine at the top thereof, being journaled in bearings 182 mounted on the brackets 38. This shaft has secured thereon a plurality of cams for actuating a number of the instrumentalities of the machine, but only those cams used in operating the above mentioned elements are shown in the drawings, see Figs. 1 and 11.

A combined sweep and guard cam 184 is mounted on shaft 180 and one face of which cam has formed therein a sweep cam groove 188 and the other face of which comprises a contoured guard cam 190, see Fig. 7. Another cam 192 is mounted on shaft 180, a face of which has therein an apron controlling groove or track 194, see Fig. 12.

The shaft 180 may be rotated in the direction indicated by the arrows in the several figures by a driven gear 196 secured thereon and which meshes with a drive pinion 198 having a hollow hub 200. This hub 200 may receive driving power from the motor M between which and hub 200 any suitable mechanism including a gear box or reducing mechanism 202, Fig. 1, may be arranged to drive hub 200 at a desired speed. Between gear box 202, the gears of which may rotate constantly, and the gear hub 200, a clutch (not shown) may be interposed to start and stop cam shaft 180 at the start and end of an operating cycle.

In rear of and below shaft 180 is a lever supporting shaft 206 mounted in bearings on brackets 38. Rotatably mounted on and relatively to this shaft are levers 208, 210, 212 which carry cam rollers 216, 218 and 220 respectively engaging the sweep cam, guard cam and apron cam above mentioned.

For raising and lowering the combined guard 50 and sweep S the guard actuating lever 210 has secured to its upper end a pulley 226, Figs. 7 and 11, about which passes a cable 228 the rear end of which is fastened to the lever 210. This cable 228 passes forwardly intermediate the sides of the machine into a groove 229 of a quadrant shaped member 230 to which the front end of the cable is fastened at 232. Member 230 is mounted on a transverse shaft 234 stationarily supported on the top longitudinal intermediate frame members 34. Associated with the member 230 is a suitable hydraulic braking device 236 a portion of which comprises the hollow hub of member 230 in which is arranged a suitable

vane element secured on the shaft 234 so that as relative movement between member 230 and the shaft 234 occurs, fluid within the hub or casing of member 230 can be compressed, offering resistance to slow down the movement of the member 230. The hydraulic shock absorber or brake above mentioned, is of a type well-known in commerce, and the details of construction thereof are deemed unnecessary.

The member 230 has alongside the groove 229 a similar groove 240 in which the rear portion of a cable 242 is arranged and the end of which is secured to member 230 at 244. The cables 228 and 242 thus act on member 230 in opposite directions.

Cable 242 extends forwardly from member 230 into a groove of a sheave 246 fixed on a shaft 248 mounted in bearings 250 on top of the frame. Cable 242 passes downwardly from sheave 246 and operatively engages in a groove in a sheave 252 mounted on a shaft 254 extending crosswise of the machine and supported in bearings 256 on the side members 32 and an intermediate member 34. The front end portion of cable 242 passes around sheave 252 and is connected to it at 258.

Upon reference to the plan view Fig. 5, it will be seen that shaft 254 has mounted at its opposite extremities and at the outer sides of the frame members 32, sheaves 260. Secured to these and passing around peripheral grooves therein are the upper end portions of the cables 70, before mentioned, which operatively support the guard 50 and sweep S in the manner described.

In the upper position of the guard and sweep the lever 210 extends rearwardly, its cam engaging roller 218 being out of engagement with the guard cam 190. The lever is yieldingly held in this position by a coil spring 264, Fig. 11, surrounding the shaft 206 with one of its ends connected to the hub of the lever 210 and its other end secured in a fixed collar 266 on shaft 206. The lever can be yieldingly retained thus since at this time no forward pull is exerted upon it by cable 228.

To enable the guard and sweep to be supported in said upper position with the operating parts occupying the relation shown in Fig. 7, one of the sheaves 260 has fixed to and projecting outwardly therefrom a stud 270 with which the free end 272 of one arm of a latch or bell crank lever 274 pivoted on the frame at 276 releasably engages in a manner to prevent rotation of sheaves 260 by the gravitational pull of the guard and sweep on the cables 70.

The other end of the bell crank lever 274 is pivotally connected at 278 to the core of a solenoid 280 mounted on the adjacent frame member 32.

The passage of a ball along the alley through and breaking the light beam X, causes activation of the photocell 170, effecting the instantaneous and momentary actuation of solenoid 280, the result of which swings the bell crank 274 in a direction to disengage its end 272 from the stud 270 on sheave 260. This results in the immediate gravitational descent of the guard 50 with sweep S thereon into engagement with the alley. This action is quick enough to insure that the guard is lowered at or about the time that the ball passes into the zone D occupied by the pins. It is thus impossible for any pins knocked down by that ball to have time in which to bounce or "walk" forwardly to a position beyond guard 50.

While a photoelectric cell detector, such as

described is the preferred mechanism for effecting the quick movement of the guard into operative position relative to an alley, other types of detecting devices can be used. For example, we may employ a capacity operated relay system of the same general type as shown in Bancroft patent, No. 2,305,662 for actuating solenoid 280. In this case spaced capacity controlling members can be located transversely of the alley and gutters a suitable distance in front of the pin supporting bed of the alley. This distance can be substantially the same as that used in connection with the photoelectric cell detector shown and described herein.

In lowering the guard and sweep, as explained, the cables 70 will unwind with respect to the sheaves 260 but overrunning of these sheaves will be prevented by the concomitant winding up of cable 242 about sheave 252, while at the same time the pull on cable 232 by the released guard and sweep causes brake member 230 to swing about its shaft 234 in a forward direction.

At the same time the front portion of cable 228 will be wound up on brake member 230 thereby pulling lever 210 forward to its dotted line position shown in Fig. 7 where its roller 218 will pass into operative relation with guard cam 190. The roller will then be positioned beneath a projection 282 of that cam. As the guard and sweep descend, the brake member 230 rotating as a lever in accordance with the pull thereon by the cable 242, causes the shock absorber element 236 to progressively go into action so that just prior to the engagement of the feet 56 of the guard with the gutters B, the downward travel of the guard and sweep will be slowed down to such an extent that the guard will gently engage in the gutters with a minimum of noise and shock.

Objectionable distraction caused by crashing noises of an abrupt engagement of the guard with the alley is thus avoided and the life of the guard and its actuating and controlling mechanism is thereby prolonged.

In bowling pin setting and resetting machines of the type under consideration, the guard and sweep remain in lowered position throughout a relatively long period of a cycle of operation. These parts are supported in upper position until a ball is thrown, after which the guard and sweep drop and remain in lowered position during sweeping and setting or resetting operations after which they are raised to upper position pending the throwing of the next ball.

After a ball is rolled and the guard and sweep are lowered, as just described, devices in the electrical system cause a delay approaching for example, one to four seconds, before appropriate electrical elements are actuated to couple the pinion 198 to the gear box 202 to revolve the cam shaft 180. When this occurs, guard cam 190 rotates in the direction indicated, whereby its main peripheral portion moves over the roll 218 of lever 210. The time interval during which it is required that the guard and sweep remain lowered will near its end as the projection 282 of cam 190 moves into operative relation with lever roller 218. This part 282 will then act on roller 218 to shift lever 210 to its rearmost position thereby raising the guard and sweep through the cables and connections described and release lever 210 at the appropriate time. As this action occurs, the stud 270 on sheave 260 will move past the latch or lever 274 which will snap into locking relation to the stud to thereby hold the guard and sweep in upper position. 75

Lever 210 will be retained in its rearmost position free of cam 190 under action of the coil spring 264, as previously described.

As stated earlier, the chains 74 upon which the sweep is mounted are driven by means of an endless sprocket chain 96 which passes forwardly over the drive sprocket 94 on cross-shaft 92.

Chain 96 extends rearwardly about a sprocket 290 secured on one of the stub shafts 53, the latter also carrying adjacent sprocket 290, a smaller sprocket 292, Fig. 1. This latter sprocket has engaging about it an endless sprocket chain 294 which, at its upper end, passes about a larger sprocket 296 fixed on the outer end of shaft 248 at the top of the machine.

Also secured on shaft 248 is a gear pinion 298, Fig. 6, with which meshes a rack bar 300. This bar is fixed to the forward end of a sweep rod 302 coupled at its rear end to the upper free end of the sweep lever 208 on shaft 206, as described. The rack bar 300 may be held in operative relation to pinion 298 by rollers 304 carried on a member 306 swivel-mounted on the shaft 248. Cam follower 216 carried by lever 208 enters the cam groove 188 of the sweep cam on cam shaft 180.

The action of sweep cam 188 is such that, after a ball has been thrown, and the guard and sweep have been lowered, cam 188 will cause sweep lever 208, through the described connections, to advance the rack bar 300, thereby rotating pinion 298 and sprocket 296 and through chains 294 and 96 and the associated connections will rotate sprocket 94 and shaft 92 to cause rearward travel of the lower runs of chains 74 in their tracks 76 to enable sweep S to clear the alley. After the sweep S has reached the end of its rearward travel the sweep cam 188 will have moved to a position where its continued rotation will cause rearward action of rack bar 300 and reversal of travel of chains 74 to return the sweep S to its forward position. It will stay in this position during the remaining interval in which the guard 50 rests on the alley, and during the time in which the guard moves to and remains in upper position. This at-rest position is permitted by the relatively long concentric portion of cam groove 188, see Fig. 13.

After a ball has been thrown and the ball and pins have been swept into or have otherwise entered the pit C, the ball usually rolls rearwardly across the apron 130 where it comes to rest on the ball lift rail 144 and against the upright rear portion of the apron 130. It is necessary to operate bar 144 to remove the ball from the pit prior to the raising of the apron 130 which elevates and dumps pins to the rear downwardly between tracks 146 into pin receiving chamber C' for ultimate delivery to spotters 166 by conveying mechanism (not shown), which may be similar to that shown in Rundell Patent 2,388,707. Should a ball fail to reach the described position, the rod 144 will be elevated without the ball. However the ball will subsequently be carried up by apron 130 and dumped with the pins.

The cables 152 by which the ball rod 144 is actuated pass upwardly out of the guides 148 over rollers 310 on side rails 40 and thence to rollers 312 carried on peripherally grooved cable winding and unwinding sheaves 314. One of these sheaves is mounted adjacent each side frame on a cross shaft 316 the ends of which are journaled in bearings on the top rails 34 of those side frame members.

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The ends of cables 152 are secured to the respective sheaves.

Intermediate the sheaves 314, the shaft 316 has secured to it a pinion 318 with which meshes an upwardly directed rack bar 320 mounted in a manner similar to the rack bar 300, before mentioned, and which, at its lower end, is pivoted to a crank arm 322 fixed to a shaft 324. On this shaft, see Fig. 8, is a sprocket wheel 326 about which an endless chain 328 passes and leads thence about a sprocket wheel 330. Sprockets 326 and 330 are in the ratio of 2:1. The sprocket 330 is operatively connected to one section of a one-revolution clutch 332 which, in coupled position, operatively connects the sprocket 330, by means of a toothed disc 334, to a constantly driven shaft 336 passing through the hub of the drive sprocket 330, a bearing in the adjacent bracket 38 and through the hollow hub portion 200 of the drive pinion 198.

The hub 200 of pinion 198 is driven at a desired speed under clutch control, from the gear box 202, as has been stated. The shaft 336 passing through that hub is operatively connected to and constantly driven from the gear box 202 but at a different speed such that the sheaves 314 may be timed to wind up cables 152 to cause rod 144 to elevate and dump a ball to the rear and then continue upwardly until it reaches and comes to rest at a position clear of the upper position to which the bar 132 of apron 130 is subsequently raised. By the arrangement of the parts of the mechanism operatively associated with the ball lifting rod 144, its action, through gear box 202 and the one-revolution clutch 332 is such that crank arm 322 by its engagement with pinion 318, causes sheaves 314 to rotate in a direction to raise the ball lifting rod 144. This action occurs through one-half of a revolution of crank arm 322 as a result of one operation of the one-revolution clutch 332.

Another operation of that clutch effects continued operation of the crank arm 322 whereby it continues through its other half-revolution. This effects a reverse movement of rack bar 320 and a corresponding rotation of sheaves 314 in an opposite direction whereby the ball lift rod 144 is returned to its lower position.

In operation, the timing of the mechanism just described is such that the ball lifting rod 144 is elevated to its maximum height before the rotation of the cam shaft 180 through gear 196 and its drive pinion 198 has been started. It is also desirable that the ball lift rod 144 be timed to follow the return of the apron 130 to the bottom of the pit. Thus the sheaves 314 should only operate during a portion of a time cycle of the machine, the clutch 332 being uncoupled for the rest of the cycle.

To close the clutch 332 to start the rotation of sprocket 330 at the appropriate time, a solenoid 340, see Figs. 9 and 10, is arranged in a circuit in the electrical system, being mounted on the frame member 42 adjacent clutch 332. The core of the solenoid 340 is connected to a latch 342 pivoted at 344 to a bracket on the frame.

The latch 342 is yieldingly urged by a spring 346 towards the clutch 332 to releasably retain a shoulder thereon in position to lock the driven part 334 of the clutch against rotation and whereby the clutch is held in open position.

When the solenoid 340 is actuated the latch 342 is disengaged from the clutch, allowing the clutch to close and rotate sprocket 330 to drive the sheaves 314 in the manner described.

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To raise and lower the apron bar 132 the cables 150 attached thereto are operatively connected to sheaves 341 secured on opposite ends of a transverse horizontal shaft 343 supported in bearings on the top members 34 of the frame. Intermediate the sheaves 341 the shaft 343 carries a pinion 345 which is engaged by a rack bar 348 connected at its rear end to the upper end of lever 212.

Movement of lever 212 rearwardly from the position indicated in Fig. 1, through action of its cam follower 220 in cam 192 causes, through the described connections, clockwise rotation of the sheaves 341 resulting in winding of the cables 150 about sheaves 341 and the lifting of the front portion of apron 130 through bar 132. The chain 140 operatively connected to the apron winding roll 136, as has been described, passes at its upper end around a sprocket 349 secured on an end of shaft 343. It will thus be seen that as sheaves 341 are rotated in one direction or another rotation of sprocket 349 will, through chain 140, also rotate apron winding roll 139 in corresponding directions. Thus as apron bar 132 moves upwardly, for example, with the attached apron 130, the winding roll 139 will also rotate to wind up the rear portion of the apron. These simultaneous operations are such that the winding roll 139 will wind the apron so as to draw it taut between roll 139 and bar 132, and since bar 132 is elevated to a position considerably above roll 139, the wound-up, taut apron will extend downwardly towards the rear to thereby enable pins thereon to slide downwardly behind the cushion structure 49.

As the apron bar 132 reaches its upper position cam follower 220 will move into a reversed curve portion 194a of cam groove 194, see Fig. 12, whereby bar 132 is given a slight downward and upward movement to jog any pins remaining on the apron off to the rear. Cam track portion 194a, see Fig. 12, is disposed between opposed portions of the track 194 which are formed to effect alternating up and down motions of apron lift bar 132.

It will be seen from Fig. 12 that during approximately one-half of the revolution of cam member 192 the cam follower 220 travels in a concentric portion of the cam groove 194, which connects with the opposed parts of the cam groove effecting the up and down movements of the bar 132. During this interval the sheaves 341 remain stationary. This interval is, of course, timed so that the apron 130 remains at rest at the bottom of the pit during a part of the machine cycle in which play takes place.

In addition to the gentle engagement of the guard 50 with the gutters B previously described, other advantages are obtained by the improved guard and sweep raising and lowering means which have been alluded to.

In general, former constructions have included a single central cam operated cable for raising and lowering the guard. The front end of such a cable has been connected to laterally extending or transverse cables attached to the sides of the guard. It has been found difficult to maintain equilibrium with such an arrangement, as the guard would not remain square or true with the alley bed, one side of the guard being frequently higher or lower than the other side.

In the present case, since the guard is supported at its sides by two cables 70 disposed in vertical planes which wind and unwind in unison on sheaves 260 of substantial size connected to a single shaft, the guard is always supported in

true relation to the alley. In addition, the use of the brake device 230 with which cables operate in opposite directions, affords a better control for the lowering of the guard and the sweep. Such a brake structure used in connection with the quick release of the sheaves 260 by actuation of the solenoid 280 enables rapid, and withal, easy and gentle descent of the guard and sweep.

The wiring diagram Fig. 14 will now be described in connection with the various electronic and electrical controls or elements and the wiring connections thereto.

A series of pairs of conductors for supplying current of selected or required voltage to various parts of the circuit are provided and which receive current supply from any suitable sources (not shown).

For example, lines 350 and 351 convey current to the guard release solenoid 280 and to the ball lift solenoid 340. Another pair of conductors 354 and 356 supplies current to the normally continuously running motor M and to a sequence control box 358. The sequence control may be of the same general type as shown in co-pending Broekhuysen application Ser. No. 627,605, filed November 9, 1945 for Bowling Pin Setting Machine, now Patent 2,559,274, granted July 3, 1951. It contains a rotating timing device which successively operates a series of switches and relays or other electrical devices to be set into action, in proper sequence, starting operations of a plurality of the mechanical and other units in the machine, which, since they form no specific part of the present invention, are not described or shown herein. However one of the elements contained in the control box 358 is a switch or device which, at the proper time, operates the clutch previously mentioned, disposed between the gear box 202 and the hub 200 of pinion 198 to start the rotation of the cam shaft 180. Preferably the foregoing is brought into action at the proper time by the closing of a switch 383 mounted on the bracket 54 in front of one of the frame members 30. Switch 383 is connected to the sequence control by conductors 380 and 382. The switch 383 is so positioned that it is closed when one of the guard side arms 52 reaches its lower position and engages that switch, as indicated in dotted lines in Fig. 1. The switch remains closed as long as the guard is down and automatically opens as soon as the guard arm 52 moves out of contact therewith.

In this way pinion 198 remains in running condition for rotating cam shaft 180 as long as the guard is down, the resulting time interval being of such duration as to effect one complete revolution of shaft 180 and the cams thereon before the guard is raised.

Current for the photocell unit 170 and for the various electronic and electric units contained in a box indicated at 360 is provided through supply lines 362 and 364. Filament current for the light source 176 may be provided through lines 366 and 368.

Assuming that the ball has passed through and broken the light beam X between light source 176 and photo-tube 170, or that the beam X has been otherwise interrupted, the consequent decrease in light to the photo-cell or tube 170 causes a reduction in the voltage across resistance R2 connected between current line 364 and a grid T2g of an amplifier tube T2. The reduction in voltage across resistance R2 effects a decrease in the plate current of the amplifier tube T2. Plate

T2p of tube T2 is connected to resistance R4 and to one side of a condenser C5. The other side of the condenser C5 is joined to one end of a resistance R5 which has its opposite end connected to the line 364. The decrease in plate current of tube T2 effects a decrease in voltage across resistance R4 with sufficient rapidity to develop a relatively steep wavefront.

Also located in relay unit box 360 is a thyatron tube T4. The integrating circuit of condenser C5 and resistance R5 produces a peak at the control grid T4g of the thyatron tube T4, thereby actuating it. When thyatron tube T4 is thus "triggered," current flows from the line 362 to and through a normally closed ball clutch limit switch 370 adjacent shaft 316 by way of line 372. A branch from line 372 conducts current to the plate T4p of thyatron tube T4, passing thence by way of cathode T4c of tube T4 to a relay CR1, resistance R8, and resistance R8 to the line 364.

Relay CR1 being thus energized, its contacts 374 are closed to enable current to flow from line 350 through guard release solenoid 280, then through line 376, contacts 374 and line 378 to line 352 connected into line 351, thus closing a circuit which energizes the guard release solenoid 280.

In this way the stud 270 on the sheave 280 is released, enabling the guard 50 and the sweep S to immediately descend by the unwinding of cables 70, as has been explained.

It is then that the switch 383 is closed by a guard arm 52 to initiate the sequence control 358 whereby the cam shaft 180 starts to rotate at the desired time in accordance with a selected interval between closing of switch 383 and the subsequent actuation of the elements in the sequence control that become operative to release the one-revolution ball lift clutch 332.

As stated, a time delay is required after the passage of a ball through the light beam X to enable the ball to reach the pit and the sweep S on the lowered guard to sweep the alley and return to its inoperative position. This is necessary to make sure that the ball and the desired pins have all been deposited in the pit C before the ball elevating rod 144 and then the apron bar 132 are started in their upward travel. This time delay may be selected as preferably from approximately one to four seconds.

This time delay may be effected as follows. When current flows through relay CR1 and resistance R6, as described above, voltage is impressed across a resistance R7 and a condenser C7 connected in series. The voltage across condenser C7 rises exponentially with time, effecting a time delay determined by the time required for the juncture of resistance R7 and condenser C7, which is connected to the control grid T5g of a thyatron tube T5, to equal the potential of the cathode T5c of that thyatron tube.

This time delay is adjustable within the one second to four seconds range mentioned (or any other desired time delay period within the capacity of the elements concerned) by varying the potential of screen T5s of thyatron T5. This may be effected by manipulation of a potentiometer R9 operatively connected in the circuit which includes the control grid T5g.

When thyatron T5 is "triggered," current flows from line 362 through the ball clutch switch 370, thence through line 372, relay CR2,

plate T5p, cathode T5c, a resistance R10, potentiometer R9, and resistance R8 to the line 364.

Relay CR2 has associated therewith, contacts 384 which also close to enable current from line 350 to reach the ball lift solenoid 340 and then pass through line 386, contacts 384, to the line 352 and to line 351.

When the solenoid 340 is energized, the one-revolution clutch 332 operates, as explained, to effect rotation of sheaves 314 for elevating ball rod 144 by cables 152. The ball is discharged over apron winding roll 139 to the rear of the upright cushion structure 49 by the rod 144 which continues to and remains for the desired period in its upper position.

After this has occurred, the apron 130 may be raised, in the manner heretofore disclosed, under the electrically controlled means provided.

While the shaft 316 is rotating to effect the ball lifting operation, as just explained, a cam 386 mounted on the ball lift sheave shaft 316 engages, at the proper time, an arm or extension 388 of the ball lift clutch switch 370 in a direction to open the switch contacts. This action breaks the current flowing from line 362 to 372, relay CR2, and plate T5p of tube T5 and the plate current of tube T4 and allows these tubes to deionize and then reset themselves for the next cycle.

The cam 386 is fashioned so that its concentric switch-engaging portion is of sufficient length to hold switch 370 open for a substantial period. After this period the cam runs free of the switch, allowing it to close so that the circuit in which the deionized electronic tubes are included will be operative for the next cycle.

Meanwhile the cycle of the machine has progressed so that the parts are now in a position wherein apron cam 192 will have shifted into position to swing lever 212 rearwardly, thereby pulling rack 348 with it and rotating pinion 345 on shaft 343 in a direction to rotate sheaves 341 to effect the winding up of apron cables 150. This action results in upward movement of apron rod 132 carrying with it the apron 130 and the pins thereon. Simultaneously with this action the sprocket chain 140 will be operated through the rotation of shaft 343 to cause apron roll 139 to wind up the rear portion of the apron. This operation is so timed that the apron will be drawn taut between the roller 139 and rod 132. The latter will, eventually, be elevated to a point above roller 139 so that the taut apron 130 will be tilted downwardly to the rear to enable pins thereon to be discharged.

It will be seen in Fig. 14 that one of the apron sheaves 341 on shaft 343 has a cam-like projection 390 which is positioned to actuate a normally open switch 394. Switch 394 has a resilient finger 392 engaging a stop when the switch is open.

As the shaft 343 rotates sheaves 341 in clockwise direction to wind apron cables 150, projection 390 will engage and flex finger 392 without affecting the condition of switch 394.

However in rotation of shaft 343 and sheaves 341 in counterclockwise direction for lowering the apron 130, the projection 390 will, at a selected time, engage finger 392 and move contacts of switch 394 momentarily into closed position. This action causes current formerly flowing through the circuit in which the now inactive tubes T4 and T5 are included to now flow to the ball lift solenoid 340 through a dif-

ferent circuit to effect lowering of ball rod 144 after the apron has been lowered. This circuit includes lines 351 and 352, switch 394, line 396, ball lift solenoid 340 and line 350. Thus the one revolution clutch 332 is operated a second time at the proper moment to return the ball rod 144. The return travel of rod 144 is relatively rapid. Thus, if the apron, in being lowered, is crumpled or has not descended to its proper position in the pit C, it will be engaged by the descending rod 144 and forced thereby into its intended position across the bottom of the pit.

From the above detailed description it will be apparent that means and mechanism have been provided for accomplishing the objects of the present invention. Such detailed description and the language used therein are intended to be illustrative rather than limiting in nature inasmuch as it will be understood that modification and variations in detail may be resorted to by those skilled in the art within the scope of the appended claims.

We claim:

1. In a bowling pin setting machine adapted to be positioned adjacent the pin spotting zone and the pit of a bowling alley, pin and ball handling mechanisms in said machine, a guard movable down and up to and from a position across said alley in front of said pin zone, mechanism for raising said guard, a detector mounted in front of and adjacent said pin spotting zone of said alley, mechanism operated by said detector as the result of the movement of a ball therepast and substantially simultaneously with the movement of said ball into said zone enroute to said pit for effecting the movement of said guard to guarding position adjacent said alley, and mechanism operable by said detector for actuating said pin and ball handling mechanisms of said pin setting machine subsequently to the movement of said guard to guarding position.

2. In a bowling pin setting machine operatively disposed at an end of a bowling alley whereon pins are arranged in a zone for play, a guard movable downwardly from an inoperative position to an operative position across said alley in front of said pin zone, and then back to said inoperative position, mechanism for raising said guard, a latch for releasably locking said guard in up position, and an oscillatory shock absorbing device, means for releasing said latch to allow said guard to drop to said operative position adjacent said alley, and connections between said guard and said shock absorbing device operable to rock said device in a direction in which it asserts braking action to slow down the movement of said guard as it approaches said alley to allow gentle engagement of said guard with said alley.

3. In a bowling pin setting machine operatively disposed relative to the pin supporting bed of an alley and adjacent the pit thereof, a guard mounted for movement upwardly from and downwardly into an operative guarding position across said alley in front of said pin supporting bed, guard operating mechanism including means for securing said guard in inoperative position above said alley, and means for raising said guard, said mechanism comprising an electric circuit, a solenoid in said circuit, a device controlled by said solenoid for actuating said first-named means to release said guard for movement to said operative position, a photo-electric

cell mounted at one side of said alley, a source of light mounted at the opposite side of said alley for activating said cell, said photo-electric cell being connected in said circuit, and means operative in response to the interruption of said source of light to said cell by a rolling ball for closing said circuit and operating said device to actuate said first-named means to release said guard for movement to said operative position adjacent said alley in front of said bed before pins felled by a thrown ball can move forwardly beyond said guard.

4. In a bowling pin setting machine operatively disposed for use with a bowling alley upon which pins are arranged for play in a pin spotting zone, a guard and sweep device movable downwardly from an inoperative position to an operative guarding and sweeping position relative to said alley in front of said pin zone, and then back to said inoperative position, actuating mechanism for said device including a latch operable to releasably lock said device in said inoperative position above said alley, an electric circuit including a photo-electric cell, means mounting said cell proximate one side of said alley in front of said zone, a light source for directing a light beam across said alley to said photo-electric cell, a normally inactive solenoid in said circuit operatively associated with said latch, and means operable by said photo-electric cell upon the passage of a ball through said beam into said pin zone to change the condition of said electric circuit and actuate said solenoid to release said latch thereby releasing said device for movement to said operative position across and adjacent said alley.

5. In a bowling pin setting machine for use with a bowling alley having a pin supporting bed, a guard movable downwardly from an inoperative position above said alley to an operative guarding position in front of said pin supporting bed, and then back to said inoperative position, guard actuating mechanism including a latch operable to releasably lock said guard in inoperative position above said alley, an electric circuit including a photo-electric cell, means mounting said cell proximate one side of said alley in front of said zone, a light source for directing a light beam across said alley to said photo-electric cell, a normally inactive solenoid in said circuit operatively associated with said latch, means operable by said photo-electric cell upon the passage of a ball through said beam into said pin zone to change the condition of said electric circuit and actuate said solenoid to release said latch, thereby allowing said guard to move to its operative position across and adjacent said alley while fallen and any unwanted standing pins are removed from said alley, and means for activating said guard actuating mechanism after the removal of said pins from said alley to effect the subsequent movement of said guard to said inoperative position.

6. In a bowling pin spotting machine adapted to be disposed proximate the pit end of a bowling alley for setting and resetting pins upon a pin supporting zone on the bed of said alley, a guard, means mounting said guard for movement from an inoperative position above said alley to an operative guarding position in front of said zone, guard operating mechanism, control means operated in response to the rolling of a bowling ball along said alley into said zone for actuating said mechanism to effect the movement of said

guard into said guarding position substantially simultaneously with the movement of said ball into said zone, a sweep co-acting with said guard, means mounting said sweep for movement into operative position adjacent said alley substantially simultaneously with the movement of said guard into said guarding position, means for moving said sweep rearwardly of said guard along said alley to sweep unwanted pins from said bed into said pit, and means operable after the removal of said unwanted pins by said sweep for moving said sweep and guard to said inoperative position above said alley pending the rolling of the next ball of a frame.

7. A bowling pin spotting machine operatively disposed adjacent the pit end of a bowling alley whereon pins are arranged in a pin supporting zone for play, comprising a guard and sweep mounted for movement down from an inoperative position to an operative position relative to said alley, and then back to said inoperative position, a holding device for supporting said guard and sweep in inoperative position above said alley, an electrical system, a detector connected in said system, means mounting said detector in front of said pin zone for registering the passage of an object such as a bowling ball past said detector into said pin zone enroute to said pit, mechanism in said system actuated by said detector for incapacitating said holding device, whereby said guard and sweep move into said operative position as said ball travels towards said pit, means mounting said sweep on said guard and constructed and arranged to be carried up and down therewith, sweep operating means for effecting movement of said sweep to sweep unwanted pins from said alley, a sweep operating control circuit in said system, and time delay means in said circuit operative after said guard has reached said operative position and in response to the passage of a predetermined time interval for actuating said sweep operating means to start sweeping action of said sweep.

8. In a bowling pin setting machine operatively disposed at an end of a bowling alley whereon pins are arranged in a zone for play, a guard and sweep device movable down from an inoperative position to an operative position across said alley in front of said pin zone, and then back to said inoperative position, a rotatable cam shaft, a cam thereon, actuating mechanism for said device operatively connected between said cam and said device, a latch operable to releasably lock said device in said inoperative position, an electric system including a ball actuated detector positioned in the path of travel of a ball upon said alley in front of said pin zone, a normally open relay unit in said system, a normally inactive solenoid operatively associated with said latch and operable upon closing said relay unit, means actuated by said detector in response to the movement of a ball past said detector into said zone for energizing said relay unit and said solenoid to release said latch, thereby allowing said device to move to its operative position across said alley, a switch operated by said device in response to its movement to said operative position, a circuit having said switch therein, said circuit being actuated in response to the operation of said switch, and said circuit having means therein for effecting the rotation of said cam shaft and said cam, said cam being constructed and arranged for raising said device through operation of said actuating means after a predetermined time delay, said latch being op-

erable to automatically relock said device upon its return to its inoperative position.

9. In a bowling pin setting machine operatively disposed at an end of a bowling alley whereon pins are arranged in a zone for play, a sweeping and guarding element movable down and up to and from a position across said alley in front of said pin zone, mechanism for operating said element including a latch for releasably locking said element in up position, a photo-electric cell arranged in an electric circuit, a light source for projecting a light beam across said alley in front of said pin zone for activating said photo-electric cell, and a solenoid associated with said element latch, a relay in said photo-electric cell circuit, means operated by said photo-electric cell upon decrease in the intensity of said light beam, as by the passage of a ball therethrough into said pin zone, for energizing said relay and energizing said solenoid to release said latch, whereby said element can move to its down position in front of said pin zone substantially simultaneously with the passage of said ball through said pin zone and before pins felled by the ball can move forwardly beyond reach of said element.

10. In a bowling pin setting machine for use with a bowling alley having a pin supporting zone whereon pins are arranged for play, a guard and sweep device movable down from an inoperative position to an operative position across said alley in front of said pin zone, and then back to said inoperative position, operating mechanism for operating said device including a latch for releasably locking said device in up position, a photo-electric cell arranged in an electric system, a light source for projecting a light beam across said alley in front of said pin zone for activating said photo-electric cell, a solenoid in said system associated with said device latch, means actuated by said photo-electric cell upon interruption of said light beam by passage of a ball therethrough for actuating said solenoid to release said latch, whereby said device moves substantially at once to guarding and sweeping position in front of said pin zone as said ball moves into and through said pin zone and before pins felled by the ball can move forwardly beyond reach of said device, a time delay device, and means controlled by said time delay device for operating said mechanism to raise said guard and sweep device.

11. In a bowling pin setting machine operatively disposed at an end of a bowling alley whereon pins are arranged in a zone for play, a guard and sweep device movable down and up to and from a position across said alley in front of said pin zone, mechanism for raising said device including cables, one of which is connected at one end to said device and at the other end to rotatable winding mechanism to extend in one direction therefrom, a second cable connected in an opposite direction to said winding mechanism and to an oscillatory shock absorbing device to extend in one direction therefrom, a third cable connected at one end to said shock absorbing device to extend therefrom in a direction opposite to that of said second cable, operating means connected to said other end of said third cable whereby said second and said third cables may rock said shock absorber about its oscillatory axis in opposite directions, a latch for releasably holding said winding mechanism against rotation when said first cable is wound thereon to hold said device in a position to which it has been moved by said device raising mechanism, means

for releasing said latch to allow said device to drop to the alley and thereby unwind said first cable by resultant rotation of said winding mechanism and simultaneously wind up said second cable thereon, the shock absorbing device being moved by said second cable in a direction to unwind that cable and wind up the attached end of said third cable, and said shock absorbing device being operable to assert braking action to slow down the descent of said device as it approaches said alley to allow gentle engagement of said device with said alley.

12. In a bowling pin setting machine operatively disposed at an end of a bowling alley whereon pins are arranged in a zone for play, a transversely extending guard movable down and up to and from a position across said alley in front of said pin zone, a rotatable cam shaft, means for driving said shaft, a guard cam thereon, means operatively connecting said guard cam and said guard, a latch operable to releasably lock said guard in up position, a sweep movably mounted on said guard, said sweep being operable to sweep unwanted pins from said alley when said guard is located adjacent said alley, a sweep cam on said cam shaft, actuating means between said sweep cam and said sweep, an electric system, including a photo-electric cell and a light source for directing a light beam across said alley in front of said pin zone for activating said photo-electric cell, a relay unit in said system, a normally inactive solenoid operatively associated with said latch, means operated by said photo-electric cell upon interruption of said light beam, as by passage of a ball therethrough to effect a change in condition of said system and energize said relay unit and said solenoid to release said latch, whereby said guard drops to its operative position across said alley, a control circuit, a switch operated by said guard, when lowered, to close said circuit, means controlled thereby for effecting the rotation of said cam shaft and said guard cam and said sweep cam through actuation of said shaft drive means after a predetermined time delay for raising said guard by said guard cam, said latch being operable to automatically relock said guard upon its return to its up position, and said sweep cam being positioned on said cam shaft relatively to said guard cam so as to operate said sweep, between the lowering and the raising of said guard, and effect the movement of said sweep to remove unwanted pins from said alley.

13. The invention defined in claim 2 including a sweep, means mounting said sweep for substantially simultaneous movement with said guard to said operative position, and means for moving said sweep through said zone to sweep pins from said alley.

14. In a bowling pin setting machine adapted to be positioned adjacent the pin spotting zone and the pit of a bowling alley, a sweep device movable downwardly from an inoperative position to an operative position across said alley in front of said pin zone, and then back to said inoperative position, mechanism for raising said device, a detector mounted in front of said pin spotting zone of said alley, and mechanism operated by said detector as the result of the movement of a ball therepast into said pin zone enroute to said pit for effecting the movement of said device to operative position adjacent said alley substantially simultaneously with the passage of said ball into said zone.

15. In a bowling pin setting machine adapted

to be positioned adjacent the pin spotting zone and the pit of a bowling alley, a guarding and sweeping device movable downwardly from an inoperative position to an operative position across said alley in front of said pin zone, and then back to said inoperative position, mechanism for raising said device, a detector mounted in front of said pin spotting zone of said alley, mechanism operated by said detector as the result of the movement of a ball therepast into said pin zone enroute to said pit for effecting the movement of said device to said operative position adjacent said alley substantially simultaneously with the movement of said ball into said zone, said last-named mechanism including an electric circuit, a latch holding said device above said alley, and latch releasing means connected in said circuit.

16. In a bowling pin setting machine positioned adjacent the pin spotting zone and the pit of a bowling alley, a sweep having guarding means associated therewith movable downwardly from an inoperative position to an operative position across said alley in front of said pin zone, and then back to said inoperative position, mechanism for raising said sweep, an electronic detector mounted in front of said pin spotting zone of said alley, and mechanism operated by said detector as the result of the movement of a ball therepast into said zone enroute to said pit for effecting the movement of said sweep to sweeping position adjacent said alley substantially simultaneously with the movement of said ball into said zone.

17. In a bowling pin setting machine for use with a bowling alley having a pin spotting zone on the bed thereof, a guard element movable down from an inoperative guarding position to a position across said bed in front of said pin spotting zone and which is gravity biased for said downward movement into said guarding po-

sition during the spotting and respotting of pins on the bed and the removal of unwanted pins therefrom, a latch operable to releasably hold said element in its upper, inoperative position, an electric circuit, a solenoid in said circuit, said solenoid being constructed and arranged to release said latch to enable downward movement of said gravity biased element to be effected, a rotatable shaft, a cam thereon, mechanism operatively associated with said cam for raising said element from said guarding position to said inoperative position, a second electric circuit operatively connected to said first circuit, a photo-electric cell in said second circuit, a light source for directing a light beam across said alley in front of and adjacent said pin zone to said photo-electric cell, said light beam being positioned to be intercepted by a thrown ball prior to entrance thereof into said pin zone, means including said photo-electric cell in said second circuit operated in response to the interception of said light beam as said ball moves into said pin zone to complete said circuit through said solenoid to release said latch, whereby said gravity biased element descends to guarding position, and means for subsequently rotating said shaft and said cam to actuate said mechanism for returning said element to inoperative position.

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