

Dec. 11, 1956

M. PATTERSON ET AL

2,773,689

AUTOMATIC PIN SPOTTER CONTROL MECHANISM

Filed June 2, 1950

5 Sheets-Sheet 1

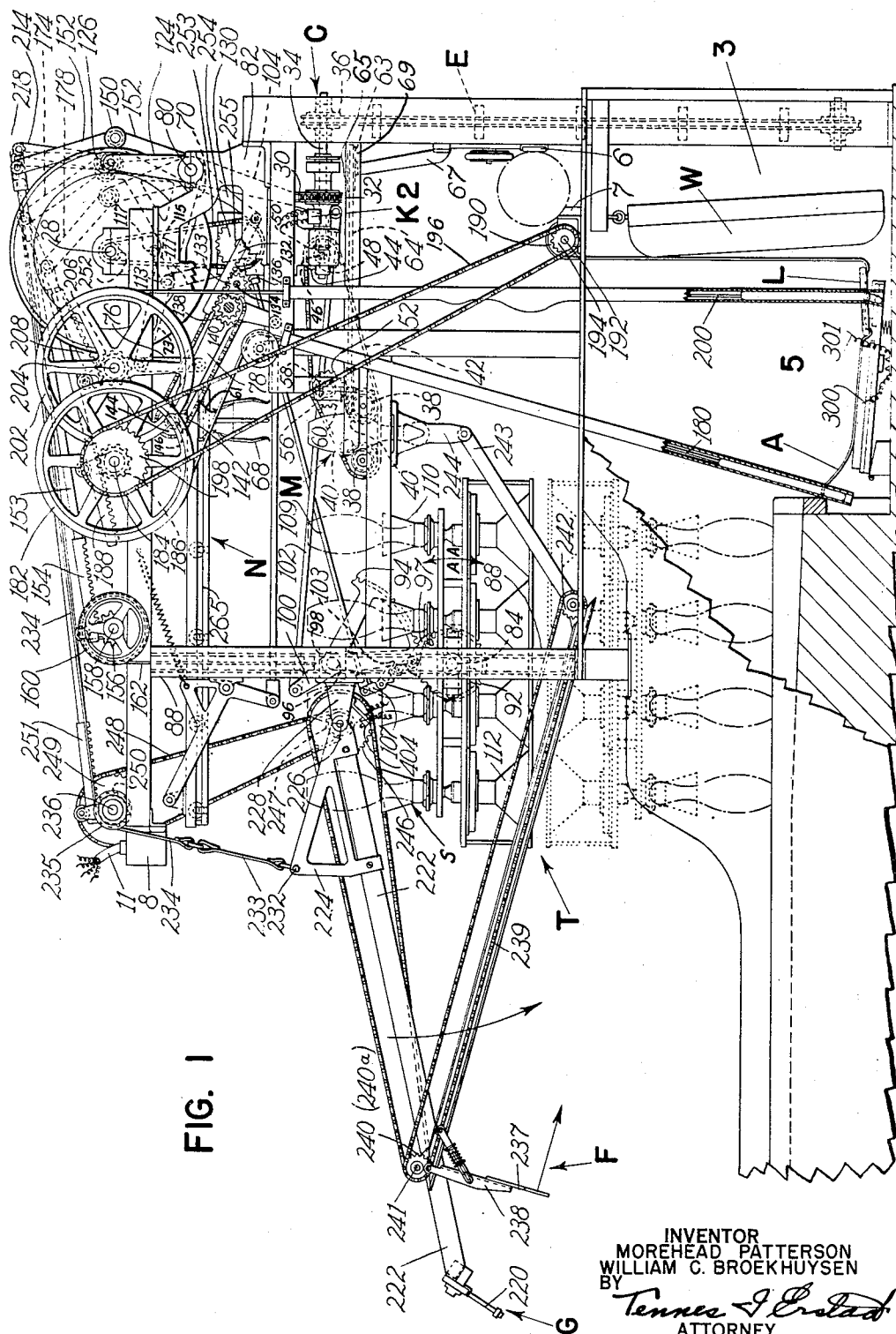


FIG. 1

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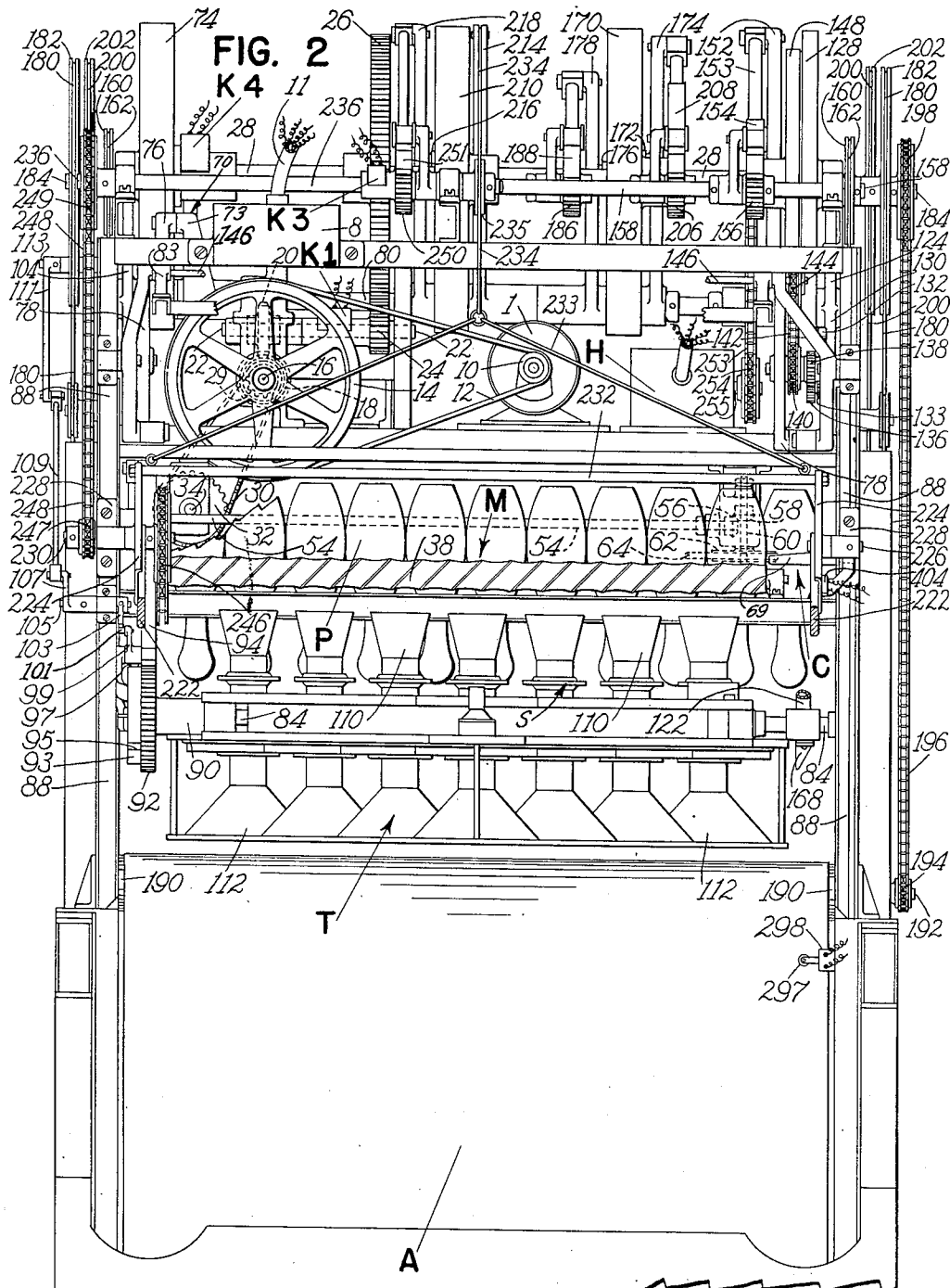
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5 Sheets-Sheet 2



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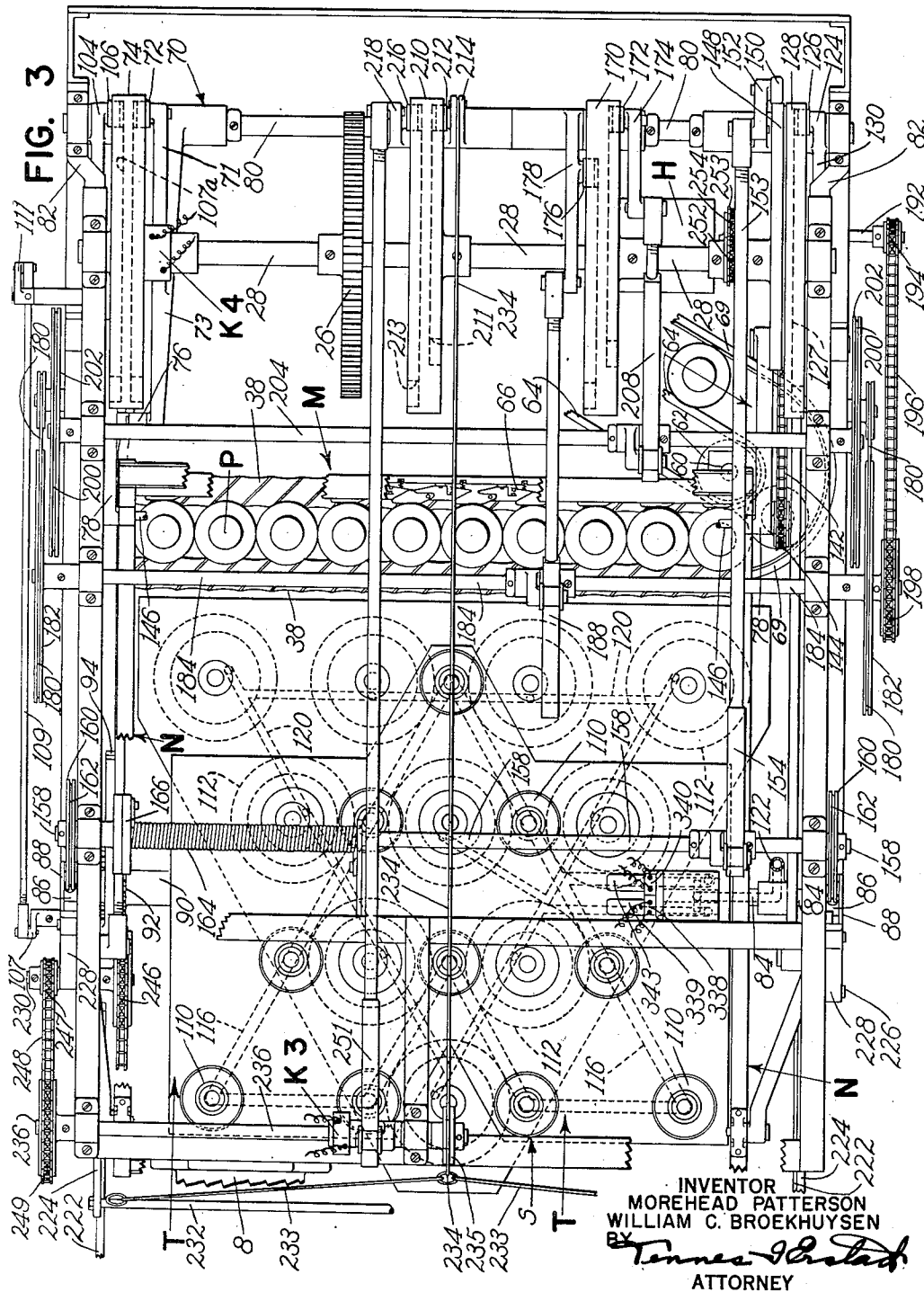
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5 Sheets-Sheet 4

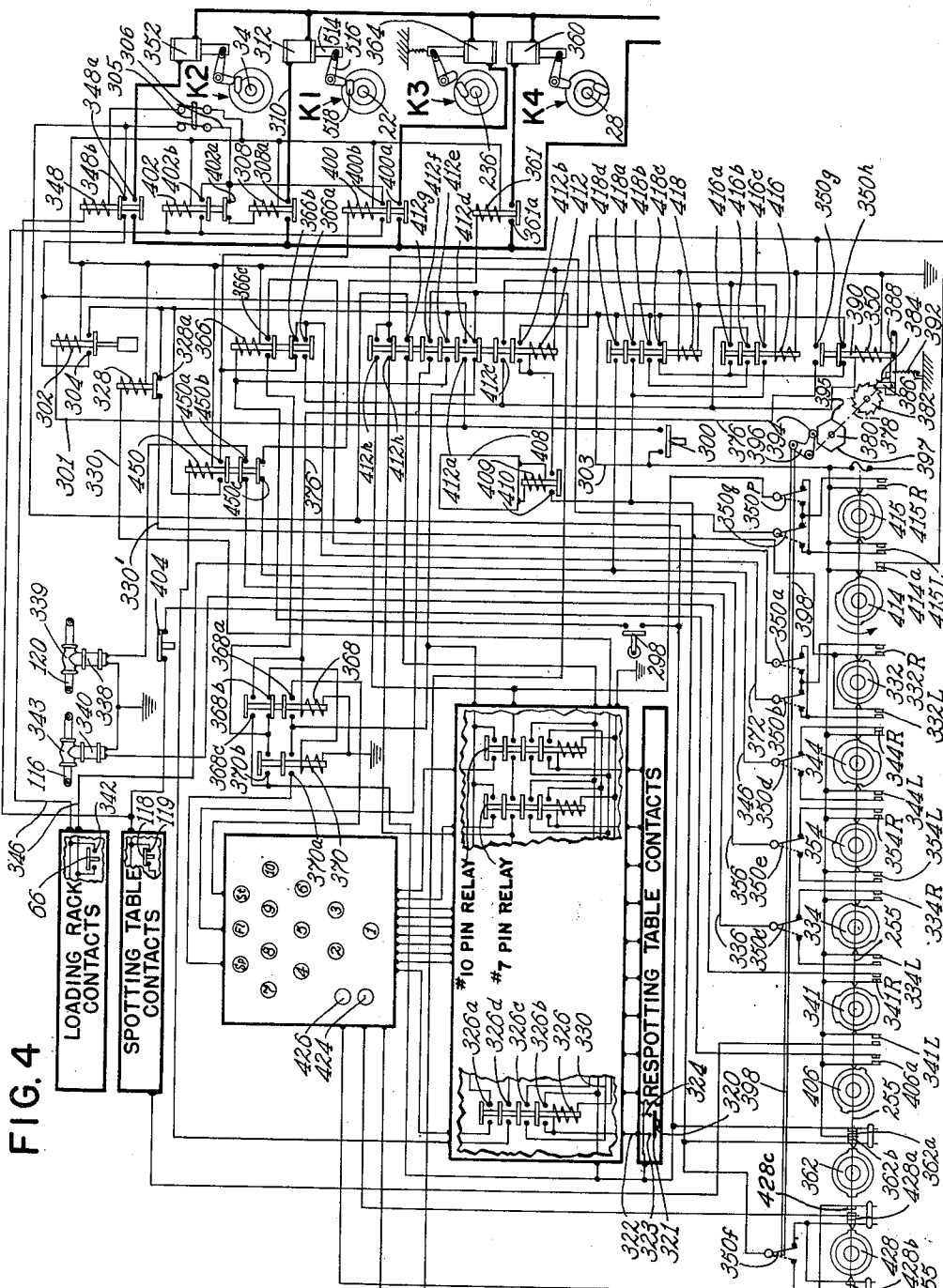


FIG. 4

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AUTOMATIC PIN SPOTTER CONTROL MECHANISM

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FIG. 5

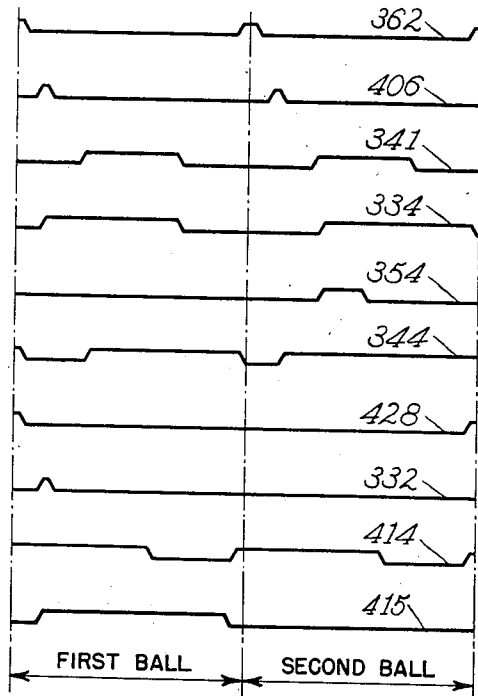


FIG. 6

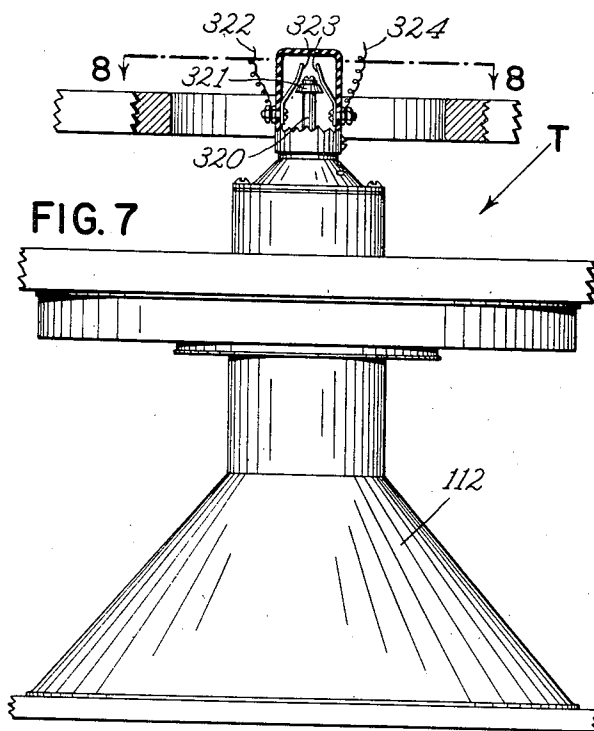
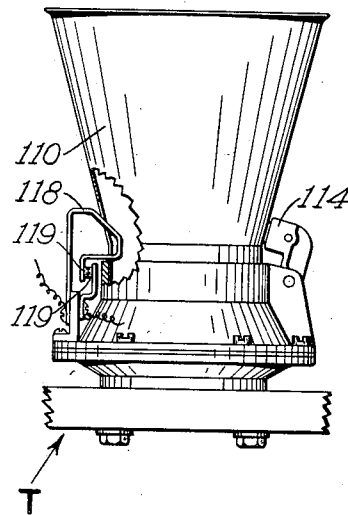
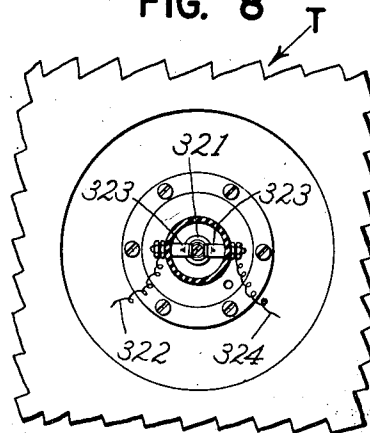


FIG. 8



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2,773,689

AUTOMATIC PIN SPOTTER CONTROL MECHANISM

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Application June 2, 1950, Serial No. 165,794

10 Claims. (Cl. 273—43)

This invention relates to a machine for performing the functions of a pin boy on a bowling alley and more particularly to an improved machine of this type wherein the motions of the machine have been simplified in such a way as to effect an elimination of unnecessary wear and tear on the machine and on the bowling pins.

In automatic pin setting machines developed heretofore the machine was designed to go through a predetermined cycle after the first ball has been thrown to detect standing pins and sweep fallen pins from the alley, even though the first ball was a gutter ball or foul ball which did not knock down any of the pins. The machine would also go through a sweeping operation after a second ball was thrown even though the second ball was also a gutter ball or foul ball which did not knock down any of the bowling pins. These routines in the machine, while they make for accuracy and reliability, also cause undesirable wear and tear on the machine and pins.

It is the purpose of our invention to overcome these disadvantages of the prior art by simplifying the operation of such a machine by designing the machine so that when a gutter ball is thrown on the first ball, or where only the No. 7 or No. 10 pin is knocked down, the only action by the machine will be to return the bowling ball to the player.

A further object of the invention is to design an automatic pin spotting and respotting machine so that if the first and second balls are both gutter balls, the pin setting machine will return the ball to the front of the alley and set itself directly into readiness for the throwing of a first ball without placing a new set of pins on the alley.

Another advantage of our invention is that if only the seventh or tenth pin in a ten pin game of bowling is knocked down by a first ball which is not a foul, the machine will, after its detecting operation omit the sweeping operations and go into readiness for the throwing of the second ball.

It is an object of this invention to provide an automatic pin setting and resetting machine which will have a minimum of motion when all pins remain standing after the second ball is thrown as might occur where the first ball is either a gutter ball or foul.

It is a further object of this invention to put an automatic pin setting machine into second ball cycle without a sweeping operation where all pins remain standing after a first ball foul.

In the accompanying drawings which form a part of this specification, like characters of reference have been applied to corresponding parts throughout the views which make up the drawings.

Fig. 1 is a side elevation of a bowling pin setting machine embodying the invention;

Fig. 2 is a front elevation of the same;

Fig. 3 is a partial plan view of the machine;

Fig. 4 is an electrical wiring diagram of the electrical control of the pin setting machine embodying the present invention;

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Fig. 5 is a diagrammatic development of the electrical relay control cams;

Fig. 6 is a side elevation of one of the spotting cups on the pin setting table, with parts broken away to illustrate a suitable electrical contact provided in each cup;

Fig. 7 is a side elevation of one of the respotting cups carried by the pin setting table with parts broken away to show the electrical contact provided in each cup; and

Fig. 8 is a sectional plan view of the same taken on line 8—8 of Figure 7.

As mentioned heretofore, the present invention constitutes an improvement over automatic pin spotting and respotting machines developed heretofore such for example as that disclosed in U. S. Patent 2,559,274 granted July 3, 1951 to William C. Broekhuysen.

To illustrate the invention applicants will now describe how the present invention may be readily incorporated in a machine of the type referred to wherein the machine is driven by a motor 1 (Figure 2) provided with a pulley 10 on which runs a belt 12 continuously driving a pulley 14 mounted on a shaft 16. A worm 18 secured to the shaft 16 meshes with a worm gear 20 keyed to a shaft 22 to which is attached the solenoid controlled main clutch K1 of the machine. Clutch K1 which may be of the well known Bliss type, is connected with the hub of a gear 24 loosely mounted on shaft 22. Gear 24 meshes with gear 26 (Figures 2 and 3) secured to the main cam shaft 28 of the machine. Cam shaft 28 is supported by suitable bearings mounted on the frame of the machine.

The constantly rotating shaft 16 carries a sprocket 29 (Fig. 2) on which runs a chain 30 driving a sprocket 32 loosely mounted on shaft 34. The hub of sprocket 32 (Figure 1) is provided with a solenoid controlled one-revolution clutch K2 which may be of the Bliss type which engages or disengages sprocket 32 from shaft 34, thereby controlling the drive of the pin distributing mechanism of the machine.

The mechanism for handling and distributing pins is of the same general construction as, and similar in operation to, that shown in Rundell Patent 2,388,707 issued November 13, 1945, for Bowling Pin Setter. This mechanism consists of a transverse, ascending conveyor E which carries upwardly pins which are removed by apron A from the pit and discharged into chamber 3 at the rear of bumper W and discharges pins one by one into a rectifying and aligning conveyor extending from a point adjacent the top or discharge end of conveyor E to a delivery point adjacent magazine M. Conveyor E is actuated at the proper time in the cycle of operations by a sprocket 36 mounted on shaft 34 to deliver pins from chamber 3 to conveyor C which in turn delivers them to magazine or storage M. Magazine of the loading station of the machine includes a pair of spaced rotatable spirals 38. Conveyor C consists of a positively driven belt 64 having its active lap spaced from and extending substantially parallel to a stationary guide member 69. Each spiral carries a sprocket 40 driven by a chain 42 from a sprocket 44 fixed to shaft 46.

Shaft 46 carries bevel gear 48 (Figure 1) meshing with bevel gear 50 mounted on loading mechanism control shaft 34. Chain 42 also drives sprocket 52 mounted on one end of a horizontal shaft 54. The other end of the latter has secured thereto a bevel gear 56 (Figure 2) meshing with bevel gear 58 mounted on a vertical shaft 60. A belt 64 running on a pulley 62 secured to the lower end of shaft 60 and pulley 63 on shaft 65 supported by bracket 67 is the driven part of conveyor C.

Adjacent one of the spirals 38 are located eleven loading rack contacts or switches 66 (Figure 3) which are normally open when a predetermined number of pins P, eleven in the illustration shown, is in the loading station (see also Figure 4).

Pins P are lifted out of the magazine or loading station M by means of ten individual grippers 68 suspended from a supporting frame N similar in construction to that described in the above referred to Rundell Patent No. 2,388,707.

The pin setter table locking mechanism is provided for the purpose of locking the table in the spotting as well as respotting position. For this purpose integral with the gear 92 is a disk 93 provided with two slots 95 spaced 180° apart with which in either spotting or respotting position engages the nose of a spring mounted lock arm 97 which is pivoted on one of the pin setter table guide shoes 86. Lock arm 97 is provided with a control arm 99 which carries on its free end a roller 101, which when contacted and depressed by a control finger 103 causes the nose of lock arm 97 to disengage from the slot 95 of disk 93. Upon release the spring mounted lock arm rides on the periphery of the control disk 93 until a slot 95 contacts the nose of said lock arm and a spring effects an engagement of the latter with said disk. The control finger 103 is mounted on a short shaft 105 supported by a suitable bearing bracket attached to the frame of the machine. Shaft 105 is actuated by a lever 107 which by means of an adjustable link 109 is connected to an arm 111 mounted on a short shaft 113 to which is also secured a cam lever 115 which by means of a cam roller 117 engages with a suitable cam track on cam 74.

The up and down motion of frame N and grippers 68 carried thereby is effected by the motions of a bell crank type cam lever 70 carrying an arm 71. A cam follower 72 on arm 71 runs in a suitable track in cam 74 loosely mounted on main cam shaft 28. The hub of cam 74 is provided with a suitable solenoid controlled one-revolution clutch K4, such as a well known Bliss clutch, which effects an engagement or disengagement of cam 74 from rotating main cam shaft 28. Arm 73 of lever 70 is connected by link 76 to arm 78 which imparts the vertical up and down motion to frame N and pin grippers 68. Cam lever 70 is loosely mounted on cam lever supporting shaft 80 supported at each end by suitable bearing brackets 82 secured to the frame of the machine.

Cam 74 is also provided with two additional cam tracks. One of these tracks is designed to effect the turning operation of the pin setter table T at the proper time in the sequence of operations of the machine. The other cam track controls the above mentioned locking mechanism of pin setter table T. These cam tracks are shown in detail in copending application, Serial No. 636,737, filed December 22, 1945 by G. J. Schmidt for Bowling Pin Setting Machine which issued as U. S. Patent 2,578,319 on December 11, 1951. Since they form no specific part of the present invention, detailed description thereof is omitted. It will be evident from the foregoing that the clutching and unclutching of cam 74 to shaft 28 due to the operation of solenoid controlled clutch K4, controls the up and down movement of frame N, also the turning of table T and the locking mechanism therefor.

The pin setter-resetter table T illustrated may be of the same general construction as that shown in Nejedly patent, No. 2,298,718 granted October 13, 1942. This table is provided with support members 90 which are mounted loosely for turning movement on hollow shaft 84. The ends of shaft 84 are secured to shoes 86 which are slidably supported in vertical guide channels 88 forming a part of the framework of the machine.

A gear 92 formed integrally on one of the support members 90 (Figure 2) meshes with a gear segment 94 pivotally mounted on a stud 96 secured to a bearing plate 98 attached to one of the vertical guide channels 88. Gear segment 94 is provided with an actuating arm 100 (Figure 1) connected by rod 102 with one arm of lever 104. The other arm of lever 104 carries a cam follower 106 which engages a cam track 107a in cam

74. The rocking motion imparted by lever 104 to gear segment 94 effects a turning of the pin setter table T 180° back and forth in the direction indicated by arrow AA (Figure 1). Table T carries on one side ten pin spotting cups 110 and on the opposite side ten individually laterally movable respotting cups 112.

The construction of the setter cups 110 and resetting cups 112 is generally the same as that disclosed in Rundell patent, No. 2,310,996 and Schmidt patent, No. 2,283,613 with certain changes in detail. Pin grippers 114 of setter cups 110 are all identical in construction and only one is described. As shown in Figure 6, the grippers 114 are actuated by fluid means, such as suction, which is supplied thereto by ducts 116 connecting the several pin setter cups 110 with a source of supply conduit in which is mounted a magnet-operated suction control valve 343 of conventional design supported on the table T. Each setter cup 110 is provided with a normally closed pin actuated contact 119 (Figure 6) so that when a pin is delivered by a transfer gripper 68, the contact 119 of switch 118 is forced open. Obviously, if desired, normally open contacts could be used. In the illustrated embodiment, all contacts 119 of switches 118 (as shown in Fig. 4) are in multiple and all contacts 119 of switches 118 must be opened by pins in order to operate the machine.

The respotting cups 112 on the opposite side of table T are also supplied with suction through an interconnected series of conduits 120 (Figure 3) from a source of supply conduit in which is mounted a magnet operated suction control valve 339 of conventional design secured to table T. Suction valves 339 and 343 are connected to a conduit 122 (Figure 3) leading to a suitable source of suction such as a suction pump of known design (not shown).

Each respotting cup 112 is provided with a switch operating member 320. When the setter-resetter table T is lowered into pin lifting position adjacent the alley after the throwing of a ball, any standing pins on the alley will cause a closing of contacts 321, 323 (Figure 7) in the same general manner as disclosed in Nejedly Patent No. 2,298,718, issued October 13, 1942.

All other mechanisms of the machine, such as the sweep F and associated guard G, the pin lifting pit apron A, ball cradle L, the table T, and the pin grippers 68 on frame N are actuated by means of suitable cams secured to the main cam shaft 28, as described hereinafter.

The operations of frame N and transfer grippers 68 carried thereby are resolved into two distinct motions: the back and forth movement of the grippers 68 between magazine M and pin delivery position above setter table T, and the up and down movement of the frame N and the grippers 68 for removing pins from the magazine M and for delivering the same into the spotter cups 110 on the table T.

The back and forth motion of the pin grippers 68 on transfer frame N is effected by means of cam lever 124 provided with cam follower 126 engaging a suitable cam track 127 in cam 128 mounted on cam shaft 28. Cam lever 124 is provided with an arm 130 to which is pivotally connected a gear rack 132 engaging with a gear 133 loosely mounted on stud 134 supported in a suitable bracket secured to bracket 82 on the side frame.

Gear 133 is formed integral with a gear 136 meshing with gear 138 integral with sprocket 140 driving a chain 142 running on a sprocket 144 on shaft 146. It will be seen that the rotation of cam 128 and its coaction with cam follower 126 on cam lever 124 effects the oscillation of shaft 146 rotatably mounted in arms 78 pivotally attached to the side frames of the machine. Shaft 146 is provided with several driving gears of different diameters (not shown) which mesh with driven gears (not shown) fixed to shafts (not shown) carried by frame N, each mounting a pulley (not shown). When shaft 146 is rotated, these driving gears cause the pulleys to revolve and

cause differential movement of pin gripper carriages 61 along rails 265 from aligned into triangular arrangement above, and ready for delivery to, spotter cups 110. After frame N has been moved downwardly to effect the delivery of pins held by grippers 68 into cups 110, grippers 68 are returned to aligned arrangement adjacent magazine M where a dwell in the cam 128 positions them until in the cycle of operation of the machine a new set of pins is to be removed from the magazine and transferred to the setter table T.

A detailed description of the structure and operation of the grippers 68 on frame N is not deemed necessary in the present case since it is described and claimed in co-pending application Serial No. 636,737 filed by Gottfried J. Schmidt now U. S. Patent No. 2,578,319, granted December 11, 1951.

The movements of table T to and from the pin supporting bed of the alley for setting and/or resetting pins are effected by means of a cam 148 which as shown is formed integrally with cam 128. Cam 148 is tracked by a follower 150 on lever 152, which lever is fulcrumed on shaft 80. One arm of lever 152 is pivotally connected to a rod 153 which supports a gear rack 154 meshing with a gear 156 mounted on a horizontal shaft 158 supported by suitable bearings attached to the main frame of the machine. On each end of shaft 158 is secured a pulley 160 to each of which is attached one end of a cable 162, the other end of each cable being secured to one of the pin setter table guide shoes 86, mentioned heretofore.

A balance spring 164 encircling shaft 158 (Figure 3) is provided to counterbalance the weight of the pin setter table T. One end of spring 164 is anchored to the frame of the machine; the other end is attached to a flange 166 secured to shaft 158. Pin setter table T carries a cam wedge 168 (Figure 2) employed for the purpose of closing the pin setter table limit switch 298 when the table reaches its lowermost or pin engaging and lifting position.

Main cam shaft 28 mounts a cam 170 provided with cam tracks on both faces. The cam track on one side is tracked by a cam follower 172 on cam lever 174 which operates the ball lift or cradle L. The cam track on the other side is tracked by a cam follower 176 on cam lever 178 which operates the pit or pin lifting apron A. Apron A and ball lift L are of the same general construction and operation as disclosed in co-pending application Serial No. 425,318, filed January 1, 1942, by Gottfried J. Schmidt, now Patent 2,389,643, issued November 27, 1945. The front end of the pit apron A is elevated by means of a pair of cables 180 the ends of which are secured to pulleys 182 mounted adjacent the ends of horizontal shaft 184 which is oscillated by means of a gear 186 (Figure 1) actuated by a reciprocating gear rack 188, the free end of which is pivoted on cam lever 178. The rear end of the pit apron A is wound upon a cylindrical roller 190 mounted on a shaft 192. The latter is oscillated by means of a sprocket 194 and a chain 196 driven by a sprocket 198 mounted on the oscillating shaft 184. The ball cradle L is also raised and lowered by a pair of cables 200, each of which is secured to a pulley 202, both of which are mounted on a horizontal shaft 204 oscillated by means of a gear 206 which is actuated by a reciprocating gear rack 208 connected to the free end of a cam lever 174.

Secured to main cam shaft 28 is a cam 210 having cam tracks 211, 213 provided on its opposite faces. The cam track 211 on one side is tracked by a cam follower 212 pivotally mounted on cam lever 214 which is responsible for the movement of guard G at the proper time during the operation of the machine to and from the alley. The cam track 213 on the other side of cam 210 is engaged by a cam follower 216 on cam lever 218 which actuates the sweep mechanism of the machine. The guard as well as the sweep is of the same general construction as disclosed in Rundell Patent No. 2,250,503, issued July 29,

1941. The guard G consists chiefly of a guard plate 220 (Figure 1) attached at each end to an arm 222, each of which is mounted on a bracket 224 one of which is pivoted to a stud 226 held by a bearing bracket 228 (Figure 2), while the other is pivoted to a short shaft 230 also held by a bearing bracket 228. Both brackets 224 are connected to each other by a tie bar 232 to which are fastened two cables 233, which in turn are connected to a third cable 234 which runs over an idler or guide pulley 235 and is anchored to the free end of cam lever 214. Guide pulley 235 is loosely mounted on a horizontal shaft 236 supported by suitable bearings secured to the frame of the machine.

Sweep F (Figure 1) is interconnected with the guard G and consists of a sweep board 237 which at each end is supported by a bracket 238 each of which is pivoted to a stud projecting from one of a pair of endless chains 239, the chains being reciprocated by sprockets 240, 240a mounted on horizontal shaft 241 supported by a pair of suitable bearing brackets attached to arms 222. Both chains 239 run over idler sprockets 242 each pivotally mounted on a stud held by one end of a link 243 while the other end of each link is pivoted to a suitable supporting bracket 244 secured to the frame of the machine. Shaft 241 is oscillated by means of a sprocket 246 (Figures 1, 2 and 3) mounted on shaft 226 to which one of the sweep arm brackets 224 is pivoted (Figure 2). A sprocket 247 is secured to shaft 230 and through a chain 248 is driven by a sprocket 249 mounted on the horizontal shaft 236. The latter carries a gear 250 the hub of which is provided with a solenoid actuated sweep control clutch K3 by means of which the gear 250 is engaged with or disengaged from the shaft 236, thereby providing means of making the sweep inoperative when a pin or pins walk or move out of the range of the descending respotting cups 112 of the pin setter table T. Gear 250 is oscillated by a gear rack 251 the free end of which is pivoted to the heretofore mentioned cam lever 218.

All cam levers 124, 152, 174, 178, 214 and 218 are loosely mounted on the cam lever supporting shaft 80. To the main cam shaft 28 is also secured a sprocket 252 which by means of a chain 253 drives a sprocket 254 secured to the electrical control cam shaft 255 on which all electrical control cams 428, 362, 406, 341, 334, 354, 344, 332, 414, and 415 are mounted. These cams, as well as their electrical contact fingers are enclosed in a housing H (Figs. 2 and 3). Sprockets 252 and 254 driving the control cam shaft 255 are on a 1:2 ratio, i. e., for every two revolutions of the main cam shaft 28, the control cam shaft 255 makes only one revolution. Or in other words, for every two balls, the control cam shaft 255 makes one revolution.

While the operation of the machine will be hereinafter described in more detail, the functions of the timing cams which are shown in Figs. 4 and 5 can be summarized as follows: The cams operate two groups of contacts which are located 180° apart.

Cam 362 serves to bring the machine to a stop at the end of each ball cycle.

Cam 406 operates a circuit for the protection of the guard and the monorail distributing frame N against abnormal positions of pins. The monorail distributing frame N descends and picks up 10 pins from the magazine M and delivers them into the spotting cups 110 mounted on the spotting table, a complete description of which will be found in U. S. Patent 2,578,319, granted to G. J. Schmidt on December 11, 1951.

Cam 341 operates an air valve which controls the suction in the spotting mechanism for new pins.

Cam 334 operates an air valve which controls the suction in the respotting mechanism for standing pins after the first ball is rolled.

Cam 354 operates a clutch for engaging the cams which cause the monorail distributing frame N to move

down and up for picking up ten new pins from the magazine and for turning the spotting table.

Cam 344 operates the clutch which controls the loading of ten new pins into the magazine.

Cam 428 controls the lights which indicate to the players whether the machine is waiting for first or for second ball.

Cam 332 controls the operation of a relay which energizes the strike circuit when the descending table finds no pins standing in the first ball cycle.

Cam 414 controls the operation of the foul indicator.

Cam 415 controls the operation of the circuit responsive to the throwing of a gutter ball.

The electrical equipment which we embody in the machine and which makes up the control is formed of commercial relays, switches, parts and accessories readily available to the trade. For ease and simplicity in design and manufacture, the relays are contained in a relay box 8 mounted on a cross frame member (Fig. 2). The wires which connect the relays and switches in the wiring diagram are enclosed in suitable conduits such as conduit 11 projecting from box 8.

Operation.—The operation of the machine can best be appreciated by a reference to the wiring diagram shown in Fig. 4. The description covers the several possibilities resulting from throwing the allotted number of balls per frame.

At the start of playing all relays and solenoids are in released position; only the driving motor and vacuum pump are running and control power is applied between wire 303 and ground. The lamps and clutch solenoids are supplied with power from separate sources.

First ball, one or more pins remain standing.—The ball dropping into pit 5 effects a closing of switch 300 connected by wire 301 to a delayed closing relay 302. This type of relay preferably is provided in order to allow a few seconds, say three or four, before the ball and pin handling mechanisms begin operating. In this way any pin movement on the alley or gutters has ceased; and all pins standing are at rest before the machine operation starts and table T moves down.

At the end of the delay period contact 304 closes, completing a circuit from line 303, through normally closed contact 348b, manually closed switch 305, wire 306 and normally closed contact 402a, energizing relay 308, thereby closing contact 308a which through wire 310 energizes solenoid 312 controlling the operation of clutch K1. Clutch K1 may be of the well known Bliss type. The energization of solenoid 312 causes armature 514 to swing lever 516 out of engagement with clutch actuating arm 518 whereupon gear 24 is coupled to shaft 22 and the machine operation is started.

Following the actuating of clutch K1, rotating of cam shaft 255 of the control mechanism causes normally open contact 362a on cam 362 to close which shunts contacts 304 and 348b and holds in clutch K1 until the end of the cycle. Guard G is moved to operative position adjacent the alley. Ball cradle L removes the ball from the pit and delivers it to runways 6, 7 for return to the player. Pin transfer device N is operated by cams 74, 128 to deliver ten pins from magazine M to setters 110.

Rotation of main cam shaft 28 causes table T to be lowered into pin lifting position for lifting and resetting standing pins in "on" or "off" spot positions. Movement of the table to this position causes first of all the closing of table limit switch 298, through the engagement of cam 168 (Fig. 2) with cam follower 297. This energizes relay 366, closing contacts 366a and 366c and opening contact 366b as long as the table is in lowered position. Continued downward movement of the table causes the heads of the standing pins to engage switch actuating members 320 (see Fig. 7) which are raised in respotting cups 112 so that contacts 321 engage switch members 323 and close one or more circuits 322—324 in which are connected ten multi-contact locking-in relays 326.

Each of the relays 326 which is energized as a result of the presence of a standing pin closes a relay hold-in circuit through contact 326b on relay 326 and contact 362a on cam 362 and thereby maintains contacts 326a and 326c closed. Whenever a contact 326a is closed because of a standing pin it lights a signal lamp corresponding to the position of the particular pin remaining standing. These relays 326 remain locked in for the remainder of the cycle, after which the light circuits are broken by deenergization of relays 326 through the opening of cam contact 362a, and the light or lights as the case may be, are extinguished.

In order to insure that neither the strike nor spare signal lamp shall be lighted inadvertently or at the wrong time when pins remain standing after the first or second ball of a frame is thrown, there is provided a circuit-controlling relay 328 which is connected by wire 330 in a circuit controlled by ten contacts 326c and a normally closed contact 412g so that whenever any of the relays 326 are energized, closing of a contact 326c energizes relay 328 breaking normally closed contact 328a and interrupting circuit 330' to strike and spare cam contacts 332L and 332R operated by cam 332.

When table T is located in pin engaging and lifting position adjacent the alley, cam 334 on shaft 255 closes contact 334R, which closes circuit 336, thereby energizing solenoid 338 through a normally closed contact 450b which opens valve 339 and creates suction in conduits 120 which are connected to the several respotter units 112 which grip any standing pins with which they come in contact. In the meantime continued rotation of shaft 255 causes strike-spare cam 332 to close contact 332R, but since contact 328a is open, a strike control impulse is prevented. The table T starts its upward movement lifting the pins gripped by units 112 and continued rotation of cam 332 opens contact 332R.

While table T dwells above the alley, fallen pins or deadwood are swept therefrom by sweep 237. The pin transfer device N is operated to deliver ten pins from magazine M to the spotter cups 110, and substantially simultaneously therewith solenoid 340 is energized as the result of the rotation of cam 341 on shaft 255 which closes contact 341R.

As described hereinabove, pin carrying grippers 68 of the transfer device N are moved by cam 128 back and forth once each cycle of the machine. The up and down movement which locates grippers 68 in position to grip and remove pins from magazine M, and after horizontal movement to delivery position above table T, lower and deliver the pins to spotters 110, is controlled by cam 74 loose on shaft 28 and clutch K4, which is similar in construction and operation to clutch K1.

Clutch K4 is "in engagement" at the time the machine operation starts shortly after the arrival of the first ball of a frame in pit 5 and the desired up and down movement of grippers 68 takes place to remove pins from magazine M and to place them in setter cups 110. In this regard it will be noted the cycle preceding a first ball is always either a second ball or a strike cycle. In either case solenoid 360 was energized during this preceding cycle by the closing of cam contact 354 (R or L) in Fig. 4 as shown by the cam diagram in Fig. 5. This allowed clutch K4 to engage and connect cam 74 to main cam shaft 28. This clutch is of the Bliss type and cannot be disengaged until it passes through the same position at which it was engaged. It will therefore still be in engagement at the start of the first ball cycle. As soon as the grippers 68 have delivered pins to the spotter and have moved upwardly and clear thereof, clutch K4 is thrown out, as solenoid 360 is not energized, and further up and down movement of frame N and grippers 68 carried thereby ceases until another set of pins is to be transferred from magazine M to setter cups 110. Table T is not turned in this cycle, as cam 74 remains stationary for the remainder of this cycle. This is because during

this cycle cam 354 does not close contact 354R, thus preventing energization of relay 361 and maintaining the disengagement of clutch K4.

As described hereinabove, sweep F is actuated cyclically to clear the alley of fallen pins. Apron A removes any pins in the pit and delivers them into chamber 3 for distribution by pin elevator E and conveyor mechanism C, which in turn conveys the pins one by one, and in succession, between spirals 38 of magazine M where they are aligned awaiting delivery by transfer N to spotters 110.

As a result of the removal of pins and balls from the pit 5, pit switch 300 opens, and starting delay relay 302 is deenergized and reset for the next ball. The adjustment of switch 300 is such that preferably if there are less than three pins in the pit, the removal of the ball causes pit switch 300 to open thus causing the starting relay 302 to be deenergized and reset for the next ball.

Removal of a set of pins from magazine M by transfer N allows pin switch arms 66 to close contacts 342. Rotation of shaft 255 causes cam 344 mounted thereon to close contact 344R and through contact 350d and a circuit 346 including contacts 342 connected in multiple, relay 348 is energized to close contact 348a, thereby energizing solenoid 352 which controls the actuation of clutch K2, which may be of the Bliss type, to start the conveying mechanism for transferring pins from chamber 3 and delivering them into magazine M between spirals 38. As each pin is located in proper position in the magazine, it moves a switch arm 66 which opens one of the contacts 342 in a multiple circuit. When a predetermined number of pins, eleven in the embodiment illustrated, has been fed into the magazine, all contacts 342 are opened, the circuit is broken, clutch K2 is thrown out, and the conveying or magazine loading mechanism, including conveyors C and E and means for rotating spirals 38, is incapacitated. The magazine is then filled with pins awaiting the next removal of a set of pins by transfer N.

As the machine operations continue, the table T moves downwardly to pin resetting position and resets pins in the same position they occupied before being gripped and elevated. The table T carries a full set of pins in spotters 110. As soon as the table T reaches pin resetting position, further rotation of cam 334 on shaft 255 opens contact 334R which deenergizes solenoid 338, of suction valve 339 thereby closing suction conduits 120 and effecting the release of pins from respotter cups 112 and their delivery in proper on or off spot position on the alley.

At substantially the same time, one of the high portions on cam 341 on rotating shaft 255 moves out of engagement with contact 341R thereby breaking the circuit through solenoid 340 which closes valve 343 and cuts off suction in spotters 110. The operation of the machine continues until table T moves back to its normal rest position where it dwells above the alley awaiting the throwing of the next ball of the frame. As cam 362 completes half a revolution (Figure 4), normally open contact 362a returns to open position, thereby breaking the circuit through solenoid 312 which effects a disengagement of clutch K1, the several signal lamp relays 326 and relay 328 are de-energized and accordingly all signal lamps are extinguished. Cam 344 opens contact 344R, de-energizing relay 348 which breaks the circuit formed by contact 348a to solenoid 352. With the deenergization of solenoid 352, clutch K2 is thrown out and further movement of the pin distributing conveyor mechanism is interrupted.

Second ball—no spare.—The initial operation of the machine caused by the second ball dropping into the pit is the same as described above. The table is moved down to test for standing pins. In the condition of play assumed since a pin or pins remain standing, selected

signal lamps are lighted by the energization of corresponding signal lamp relays 326, as described above.

One or more of pin position lights 1-10 is lighted at this time. The spare light cannot be lighted because, although rotation of cam 332 causes contact 332L to close, relay 328 is energized and since contact 328a is open an impulse to spare lamp relay 370 is prevented.

Since in the two-ball game discussed herein the second ball is the last allotted for a frame, resetter cups 112 remain inoperative. Due to the fact that control cam shaft 255 makes one-half revolution for each complete revolution of main cam shaft 28, contact 334R is open when table T moves down and locates resetter cups 112 in pin gripping position adjacent the alley. Therefore, at this time circuit 336 including solenoid 338 is not closed, and valve 339 remains closed; suction is not cut into respotter units 112, table T travels upwardly, after which any pins standing and any fallen pins are swept from the alley into the pit 5 by sweep F. Contact 332L which had been closed momentarily by the high portion of cam 332 on rotating shaft 255 opens.

While the table was being lowered to the alley and raised again, pin transfer grippers 68 moved horizontally thereabove under the action of cam 128, as described hereinabove. Grippers 68 are not operative to deliver a set of pins to the spotters 110 because clutch K4 disengaged cam 74 from cam shaft 28 during the previous cycle, and also spotters 110 are already filled with pins. The ball has been returned to the player as described above, and the pins in pit 5 have been removed therefrom by apron A and discharged into chamber 3 for return to magazine M by conveyors E and C. Pit switch 300 returns to open position, as described above, awaiting the next ball of the game which is the first ball of the next frame.

Continued rotation of control cam shaft 255 results in closing contact 341R which energizes solenoid 340 and opens suction valve 343 creating suction in conduits 116 connecting spotter cups 110. In this manner pins are firmly held in spotters 110 during subsequent rotation of table T.

Continued rotation of cam 334 results in closing contact 334R, and the energization of solenoid 338 which opens suction valve 339. This operation creates suction in conduits 120 and causes respotter cups 112 to be locked against movement or shifting on table T while the latter is turned through 180° in placing the set of pins held in spotter cups 110 on the alley, and while the table T is swung back to pin receiving position. Following the opening of valve 339, cam 354 closes contact 354R, which through contact 350e, wire 356, and normally closed contact 450c energizes relay 361 and closes contact 361a thereby actuating solenoid 360 allowing clutch K4 to reengage cam 74 with cam shaft 28 and turn table T through 180° prior to its second downward movement. The mechanism for holding respotter cups 112 by suction against lateral movement on table T when the latter is turning, can be similar in construction and operation to that shown and described in Rundell Patent 2,383,017. Since this specific mechanism forms no part of the invention, further showing and description are omitted in the interest of brevity.

When table T reaches pin delivery position relative to the alley, contact 341R opens, and the pins held in spotters 110 are released and placed in playing arrangement on the alley. This is effected by a deenergization of solenoid 340 and the resulting closing of suction valve 343.

After ten pins have been placed in playing arrangement on the alley, the machine operation continues until the end of the cycle. After the table reaches its upper position, it turns 180° in reverse direction. Cam contact 362a, as shown in Figure 4, opens, releasing clutch K1 the signal lamp relays 326 and relay 328. At the end of the cycle the position of cam 334 allows contact 334R to open, thereby deenergizing solenoid 338 which closes

valve 339 and releases the respotter units 112. Cam contact 344R, however, remains closed permitting the pin elevating conveyor to reload magazine M. When the required number of pins has been delivered, all switches 342 are opened, releasing relay 348 and solenoid 352 thereby causing the disengagement of clutch K2 and stopping conveyors E and C and rotation of spirals 38.

Second ball—spare.—The operation is generally the same as in the case of the second ball when pins remain standing with certain exceptions. In this case table T moves downwardly after the second ball is thrown, but since all pins have been knocked down, all signal lamps 1-10 remain extinguished. All contacts 326c remain open and relay 328 is not energized so that contact 328a remains closed.

Movement of table T to its down position results in the closing of contact 366c, as described above. Contact 332L is closed by cam 332 and through contact 350a, contact 366c of relay 366, and contact 368b of relay 368, relay 370 is energized and contacts 370a and 370b are closed. When contact 370a is closed, spare light SP is lit and the player is apprised visibly of the results obtained by the second ball of a particular frame. Contact 370b is a lock-in contact for relay 370 so that light SP remains lit until the end of the cycle.

Other operations of the machine are the same. A new set of pins is placed on the alley and further play is in order as for the first ball of the next frame.

Strike.—In this case all pins are knocked down by the first ball of a frame, and a new set of ten pins is placed on the alley awaiting delivery of the first ball of the next succeeding frame. The initial operations resulting from the first or strike ball falling into pit 5 are the same as described above.

In the sequence of operations table T moves downwardly cam 168 carried thereby closing limit switch 298 and energizing relay 366, and momentarily closing contact 366a. Since no pins are standing, lamp relays 326 are not energized. So also relay 328 is not operated.

Rotation of timing cam 332 causes contact 332R to close. Contact 328a being closed, current flows through wire 330', and relay 350 is energized through contacts 332R and 350b, wire 372, and contact 366a. Relay 350 is an alternating relay such as a ratchet relay or equivalent so that each time it is energized it causes a shifting of contacts 350a-f, inclusive and p and q back and forth between full line positions indicated diagrammatically in Figure 4 and dotted line positions.

Relay 350 may be of any suitable conventional type, such as series S-125, manufactured by Guardian Electric Manufacturing Company, Chicago, Illinois. The relay selected for illustration is shown diagrammatically in Fig. 4. It consists of a suitably mounted shaft 378 having fixed thereto a six-sided cam 380 and a twelve tooth ratchet 382. A pawl 386 is pivotally mounted on a lever 388 connected to armature 390 of relay 350. A spring 384 urges pawl 386 into engagement with the teeth of the ratchet 382. Spring 392 returns lever 388 and armature 390 to the position shown in Figure 4 after each operation of relay 350.

Running on cam 380 is a cam follower 394 on one arm of bell crank lever 396; the other arm of which is pivoted to a link 398 pivotally connected to shiftable contacts 350a-f, p and q. It will be evident that for each movement of ratchet 382, cam 380 is turned to engage follower 394 with either a high portion 395 or a low portion 397 of cam 380. Therefore, this operation results in a shifting and holding of contacts 350a-f, p and q, in shifted positions.

The shifting of contact 350b to dotted position (Figure 4) interrupts the current through the coil of relay 350 thereby releasing armature 390 almost as soon as it was pulled up. The momentary closing of contact 350g by this movement of armature 390 energizes relay 368, from the live side of the power supply through contacts

414a, contact 350g, and wire 376, the other side of coil 368 being connected to ground. Relay 368 locks in through its holding contact 368c and cam contact 362a till the end of the cycle, lighting strike lamp ST through contact 368a. The opening of contact 368b prevents energizing of spare lamp relay 370 which would otherwise result from the shifting of contact 350a to dotted position.

The shifting of contact 350c to dotted position prevents the opening of respotting suction valve 339 at this time.

The remainder of this cycle is the same as for any second ball. Contacts 350a to f, p and q, having shifted to dotted position all functions controlled by them are now also controlled by the closing of the left contacts 332L, 334L and 344L by the second ball halves of their respective cams. Clutch K4 remains engaged as relay 361 is energized through cam contact 354L and relay contact 350e. The table turns and ten new pins are set on the alley. At the end of this cycle the relay contacts 350a-f, p and q remain in dotted line position and the operation of the next cycle will be as described above for a first ball, substituting 332L, 334L, 344L and 354L for 332R, etc.

The next time a strike is made, relay 350 is again energized, returning contacts 350a-f, p and q to full line position.

At the start of any first ball cycle (also strike), the loading rack must be full as the pin transfer mechanism N will remove ten pins immediately after the start. Therefore, as long as relay 348 is energized, indicating that the loading is not completed, contact 348b is open and prevents the energizing of relay 308 even after the delayed closing relay 302 has closed contact 304.

At the start of the second ball cycle, there are already ten pins in the spotting cups. Cam contact 344 (R or L) being open, relay 348 is released, contact 348b is closed and the machine can start as soon as the delay period is up.

Off center pins (full downward movement of the table T prevented) (first ball of a frame).—It is well known that pins have a tendency to "walk" or move as the result of being hit or moved by the ball or other pins when or after the ball travels over the alley. On quite infrequent occasions a pin may move so far with reference to its spotted position that it cannot be picked up and reset. When this condition occurs, table T in moving towards the alley comes into engagement with the handle end of such abnormally located pin or pins and its downward travel is arrested. In such case, switch 298 cannot close. Also relay 366 is not energized and hence contact 366a remains open and contact 366b remains closed.

If this condition occurs on the first ball of a frame, the closing of cam contact 332R or 332L by cam 332, results in energization of relay 400 which closes contact 400a and energizes solenoid 364 thereby throwing out clutch K3, normally continuously operating while the machine is in motion. Clutch K3 is of the same type as clutches K1, K2 and K4. In this manner sweep F is rendered inoperative and cannot sweep standing pins from beneath table T.

Energization of relay 400 also closes contact 400b and pulls in relay 402, which locks in through its holding contact 402b, and normally open cam contact 362a. Energization of relay 402 opens normally closed contact 402a which results in the deenergization of solenoid 308 and disengagement of clutch K1, and a stopping of the machine. Even if the machine should overrun enough to cause cam 332 to rotate an amount sufficient to open contact 332R, relay 402 remains locked in.

Relay 350 cannot be energized because contact 366a is open. Hence, strike lamp relay 368 does not operate either. No score is shown.

While the machine is stopped, all fallen pins can be removed manually and thrown in the pit.

Momentarily opening and reclosing manual control

switch 305 releases relay 402 and energizes relay 308 controlling the main or starting clutch K1 which restarts the machine. As sweep F is disengaged, it is evident that standing pins are not swept from the alley, and the machine completes its normal first-ball cycle. The sweep clutch throws in automatically at the end of the cycle.

Off center pins (second ball of frame).—On the second ball, cam contact 332L or R closes under the actuation of cam 332, the circuits being energized depending on the position of cam portions 395 and 397 with respect to cam follower 394. Relay 366 is not pulled in and contact 366c in the spare light relay (370) circuit is open so that light SP is not lighted. The remainder of the cycle is the same as for a normal second ball when standing pins remain on the alley. Since on a second ball, as previously described, the circuit through cam contacts 332L and R, and relay contacts 350a and 350b, is such that power is applied through contact 350a to contact 366c, and not through contact 350b to contacts 366a and 366b, there is no possibility of relay 400 being energized, even though contact 366b is closed. That is, sweep F operates, and removes both standing and fallen pins. The table T sets a new set of pins, the ball is returned to the playing position, and eleven pins are conveyed to magazine M for delivery to the setters 110.

Switch 298 is preferably located so that for a normal cycle of operation, relay 366 is energized during the entire time that cam contact 332R or 332L is closed.

Spotter safety mechanism.—It may happen that because of long use the handle ends of pins become worn, cracked or split so that such pins can be handled only with some difficulty. This may result in pins being improperly transferred to or held in the spotters 110. Under such conditions insufficient pins may be transferred to setters 110 or possibly such pins might be moved by transfer grippers 68 towards magazine M, or even drop from spotters 110 when the table is delivering a set of pins to the alley. Damage or jamming of the machine might result. The present spotter safety mechanism is designed to prevent any of the above possibilities from happening and to insure that the required number of pins, usually ten, will always be set on the alley.

Each of the spotters 110 is provided with a normally closed switch 118, the contacts 119 of these switches being connected in multiple between contact 341L and relay 402. Therefore, if each spotter 110 is filled with a pin, the multiple circuit is broken and relay 402 is not energized. If on the other hand a single switch remains closed, as where insufficient pins are transferred to spotters 110 or where a pin drops during turning of table T, relay 402 is energized and locked in through contact 402b, contact 402a is broken and relay 308 throws out thereby effecting a disengagement of clutch K1 and the machine stops. After correcting the cause of the failure, the machine is restarted by momentarily opening and then closing manual control switch 305.

It should be noted that both contacts 341L and 341R are closed at the same time by symmetrical cam 341. This means that contact 341L is closed when spotting suction valve 343 is open which for proper operation requires ten pins in the spotters 110.

Guard safety.—It may happen that a fallen pin may lie in such a position on the alley as to prevent guard G and sweep F from moving downward their full stroke adjacent the alley after a ball is thrown. In such case, limit switch 404 which is normally open when the guard and sweep are down, remains closed. Cam contact 406a is closed by cam 406 and a circuit is made through switch 404 which pulls in relay 402 which is locked in by its own contact 402b, relay 308 is thrown out, clutch K1 is disengaged because of the deenergization of solenoid 312 and the machine stops. The pin or pins which prevented full movement of the guard and sweep to down position is or are removed by hand. The machine is restarted by opening and closing switch 305 as described above.

Inching or jogging mechanism.—Manually controlled switch 305 mounted at any convenient position on the machine or at any other suitable position may be used to inch or jog the machine. Opening and closing switch 305 controls the operation of relay 308, solenoid 312 and clutch K1 for stopping or starting the machine. As mentioned hereinabove, opening of two pole switch 305 also interrupts the holding circuit of relay 402 and therefore acts as a reset switch if the machine stops for any of the reasons stated above. This two pole switch also is connected in series with the control for clutch K2. As a consequence whenever switch 305 is opened the pin loading mechanism is stopped.

Foul control.—According to the American Bowling Congress, certain rules of play govern when and if a foul is rolled. If a foul is made on the first ball, a new set of pins must be placed on the alley, and no score is counted. If a foul occurs on the second ball of a two ball frame, the machine runs through its normal cycle, but no score for that ball is counted.

A foul is indicated in any suitable manner, either automatically by an automatic foul detector which controls the further operation of the machine, or by a manually operated indicator and control. In Figure 4 there is illustrated a suitable electrically controlled fully automatic foul indicator and machine control mechanism. This mechanism includes a suitable automatic foul indicator control 408, such as a photoelectric cell operated device located adjacent the head of an alley so that any unauthorized movement of a player beyond the foul line results in the operation of the control. When a foul, therefore, is made a relay 409 is pulled in, momentarily closing a contact 410 which makes a circuit through normally closed cam contact 362b to relay 412 which is locked in by contact 412b and cam contact 414a. Contact 412a on being closed by-passes delayed-closing contact 304 as soon as pit switch 300 closes because the number of pins standing is of no consequence as ten pins must be reset before the next ball, in this case the second ball, is played. Normally closed contact 412d opens the light power circuit to all pin lamps as well as the strike and spare lamps on the score board, so that none of these lamps can light. The foul lamp circuit is closed by contact 412f, and this lamp F1 is lighted by a wire connecting the contact 412f with the lamp F1. The opening of contact 412g prevents relay 328 from being energized.

Since a first ball foul is being described, the fact that contact 328a remains closed results in an impulse to relay 350, so that in effect the control operates as a strike cycle minus the lighting of strike lamp ST. As previously described, in a strike cycle, when all ten relay contacts 326c remain open, relay 328 is not energized, contact 328a remains closed, and relay 350 is energized when cam contact 332R (or 332L as the case may be) closes. In this case, the same result is accomplished by the fact that relay contact 412g being open prevents the operation of relay 328.

The respotting suction valve 339 operates as in any strike cycle, that is, it does not open until later and any standing or fallen pins are left on the alley, and swept therefrom by sweep F in usual manner. Contact 412c connects relay 416 across the coil of relay 350 and hence relay 416 is energized along with relay 350 and locks in through its own contact 416a and normally closed contact 418c. Continued rotation of cam 414 opens contact 414a releasing relay 412 which in turn releases step relay 350, relay 416 remains locked in at the end of the cycle and relay 418 is pulled in through normally closed cam contact 362b and contact 416c and locks in through its own contact 418a.

Closing of contact 418b energizes relay 350 through contact 416b. Relay 416 is released when both contacts 418c and 350h are opened. The opening of contact 416b releases relay 350, which has been operated twice during

this cycle thereby bringing the machine control to second ball position.

In the second ball position, the only difference from normal operation is that the clutch K4 controlling the operation of cam 74 is engaged because the preceding cycle operated as a strike cycle. Since a set of pins was removed from the magazine, it must be reloaded before this second ball cycle is allowed to start. Relay 418 remains locked in and contact 418d holds in the loading clutch K2 until the loading of magazine M is completed.

At the beginning of the second cycle, cam 362 opens contact 362b thereby releasing relay 418.

In case a first ball foul should coincide with a pin far off-center, it is necessary to by-pass the off-center protection in order to insure the removal of the pins. This is done by shunting contact 412e across the table limit switch 298 causing relay 366 to be energized in spite of the off-center pin.

Foul (second ball).—It will be noted that foul lamp FL is lighted so long as relay 412 is energized and contact 412f is closed. In case of a foul on the second ball, relay 412 is energized which effects a lighting of lamp FL. The delay relay 302 is energized and none of the other signal lamps are turned on. Relays 416 and 418 are inoperative because step relay 350 is inactive. The cycle in this case continues as for any normal second ball.

Played balls signal.—In order to apprise a player of the number of balls to be played, there are provided signal lights 424 (first ball), and 426 (second ball), respectively, which are lighted in proper sequence. When the machine is at rest before the first ball of a frame is rolled, first ball light 424 is lighted through closed contact 428a, contact 350f, and closed contact 362b. As soon as the machine starts, cam 362 opens contact 362b thereby breaking the circuit and the lamp 424 is extinguished.

Between the first and second ball cycles, second ball light 426 goes on through contact 428b which has been closed by the 180° turn of cam 428. After a strike, the first ball light is lighted again through contact 428c which is now closed, closed contact 362b, and contact 350f which due to the operation of step relay 350 has shifted to the other side.

In some cases no pins are knocked down by the first or second ball. In such a case there is no need to pick up the standing pins or to put the machine through a sweeping operation since there are not any fallen pins and all pins can be left standing on the alley. Similarly if on a first ball the 7th or 10th pin is knocked down it usually falls into the pit or falls where it is not likely to interfere with the throwing of a second ball and there is no need for lifting the remaining pins to sweep the 7th or 10th pin into the pit prior to the throwing of a second ball.

Gutter balls.—If pins 1 to 6 and pins 8 and 9 are left standing after the first ball is rolled a relay 450 will be energized from 40° to 340° of the first ball cycle through the eight series connected normally open contacts 326d on the corresponding relays 326, and through normally closed contact 412h, and through contact 350q on ratchet relay 350 and the right hand contact 415R on cam 415.

If all pins including #7 and #10 are left standing after the second ball of a frame, gutter ball relay 450 will be energized through the normally open contacts 326d on all ten pin lamp relays 326 through contact 350p on ratchet relay 350 and the left hand contact 415L on cam 415.

In case of a strike, contacts 350p and 350q switch to the left position and the functions of contacts 415R and 415L are interchanged in the same manner as described for contacts 350a, 350b, 332R and 332L.

Whenever gutter ball relay 450 is energized sweep clutch relay 400 will be energized through the closing of normally open contact 450a which connects the coil

of sweep clutch relay 400 directly across the control power lines. This declutches the sweep both on first and on second ball in the same way as for an off-center pin on the first ball.

When gutter ball relay 450 is energized, the opening of normally closed contact 450b in series with the respotting suction valve solenoid 338 prevents the pins from being picked up on first ball. On second ball they are never picked up because cam operated switch 334L does not close until later in the second ball cycle. Also the opening of normally closed contact 450c, which is in series with the table turning relay 361, prevents the re-engagement of the solenoid actuated table control clutch on second ball, thereby preventing the table from turning and also preventing the grippers 68 from picking up pins from the spirals 38 during the first part of the next cycle.

At 340° in either the first or second ball cycle, cam contact 415R (or 415L) opens, releasing gutter ball relay 450. Thus the respotting suction is held off during the second down-up movement of the table, thereby preventing "locking-down" of the cones, which might otherwise interfere with the second descent. In a normal second ball cycle the respotting suction must be on during the time the table is turned, to lock the cones and keep them from shifting and rattling around.

In the case of a pin too far off-center on first ball, the pins are left standing and the sweep is cut-out automatically whether it was a gutter ball or not. In the same case on second ball they will be swept off and ten new pins set-up (as should be) irrespective of a gutter ball or normal ball.

In order to accomplish the same objectives, that is the elimination of the lifting of pins and the sweep-action on first ball, or the sweep action and the setting of ten new pins on second ball, in case a foul is committed at the same time that a gutter ball is rolled, the following modifications were made in the control circuit as compared with that shown in U. S. Patent 2,559,274. Instead of preventing the operation of all pin lamp relays by inserting a normally closed contact 412d in series with their common lead, we now prevent only the lighting of the lamps by inserting this contact in series with the common lamp lead (except for the foul lamp). The circuit to the coil of relay 328 is broken by the normally closed contact 412g. This must be done in order to keep contact 328a closed and cause a strike cycle on a regular first ball foul which is not a gutter ball. The sequence of operations in case of a combined gutter ball and foul will now be described.

Gutter ball-foul combinations.—In the case where the first ball is both a gutter ball and a foul the sequence of operations is the same as for a normal first ball foul, except that the gutter ball relay 450 is energized through all ten pin lamp relay contacts 326d through normally open relay contact 412k, through ratchet relay contact 350q and cam contact 415R. Consequently the sweep is disengaged as well as the table control clutch.

In case the second ball in a frame follows a first ball which was either a gutter ball or a first ball foul, or both, and the second ball is both a gutter ball and a foul, the sequence of operations is the same as for a normal second ball foul, except that gutter ball relay 450 is energized through all 10 pin lamp relay contacts 326d. Consequently the sweep is disengaged and the table prevented from turning.

It should be noted that due to the contacts 412h and 412k, all 10 normally open pin lamp relay contacts 326d are in series with gutter ball relay 450 on both first and second ball in case of a foul. Thus, if pin 7 or 10 is knocked down in either case, gutter ball relay 450 cannot pull in and 10 new pins are set on the bowling alley.

The invention above described may be varied in construction within the scope of the claims, for the par-

ticular device selected to illustrate the invention is but one of many possible embodiments of the same. The invention, therefore, is not to be restricted to the precise details of the structure shown and described.

What is claimed is:

1. A machine for performing the duties of a pin boy on a bowling alley comprising means for placing a new set of pins on a bowling alley, apparatus for removing fallen pins from the bowling alley, a detector having a control circuit comprising ten normally open switches connected in series and each adapted to be actuated by a separate standing pin, and a second control circuit adapted to bypass the switches actuated by pins 7 and 10 on 1st ball only, an electrical sequence control circuit for moving said means, apparatus and detector through one sequence of operations after a first ball is thrown and through another sequence of operations after a second ball is thrown, a device for interrupting that portion of the circuit which operates said apparatus, and connections between the control circuits of said detector and said electrical sequence control circuit for automatically actuating said device each time the switches in said first and second control circuits permit current to flow therethrough.

2. In a bowling pin setting machine having components comprising a movable table, pin gripper units and pin setting units mounted on said table, a drive for moving said table towards and away from a bowling alley, actuating mechanism for operating said pin gripper units to grip and release pins and said pin setting units to position new sets of pins on the bowling alley, a pin remover for removing bowling pins from the bowling alley in proper timed sequence with the movement of said table, a control circuit comprising ten switches connected in series and each adapted to be actuated by a separate standing pin, and a second control circuit adapted to bypass the switches actuated by pins 7 and 10 on 1st ball only, a machine control for moving the components of said bowling pin setting machine through a predetermined sequence of operations after the first ball of a frame is thrown and through another predetermined sequence of operations after the second ball of a frame is thrown, and a device actuated by said control circuits to incapacitate the pin remover after either a first or a second ball of a frame has been thrown, and to incapacitate the pin grippers after a first ball of a frame has been thrown, each time the switches in said control circuits are actuated.

3. A bowling pin handling machine comprising a table, a pin setter connected to said table for spotting a new set of bowling pins in playing arrangement on a bowling alley, a respotter for gripping, elevating, and replacing standing pins on the bowling alley, a detector having a first control circuit comprising ten switches connected in series and each adapted to be operated individually due to actuation by standing pins, and a second control circuit adapted to bypass the switches actuated by pins 7 and 10 on first ball only, a pin remover for removing bowling pins from the bowling alley, a drive for moving said detector, pin setter, pin respotter and pin remover into and out of operating position, and a device operated through the control circuits of said detector to incapacitate said pin remover after the first and second ball and said respotter after the first ball whenever the switches in said first control circuit are actuated by standing bowling pins.

4. In a bowling pin handling machine a table movable towards and away from a bowling alley, pin gripping units and pin setting units mounted on said table, a drive for moving said table towards and away from the bowling alley, actuating mechanism for operating said pin grippers and pin setting units in proper timed relationship with the movement of said table, a sweep for removing bowling pins from the bowling alley when the table is in elevated position, a pin sensing device comprising a control circuit having ten switches connected

in series and each adapted to be actuated by a standing pin, means adapted to bypass some of said switches on first ball only, a foul detector, disabling means actuated by said foul detector for rendering said bypass means inoperative whenever a foul is made, a control for moving the components of said bowling pin handling machine through a sequence of operations after a first ball of a frame is thrown and through another sequence of operations after the second ball of a frame is thrown, means for incapacitating said sweep and pin gripping and pin setting units, and connections between said pin sensing device, said foul detector, and said control for automatically actuating said incapacitating means whenever the switches in said control circuit are actuated indicating the pins do not have to be replaced after a first or second ball and each time said by-passing means and the switches in said first control circuit are actuated after a first ball indicating fallen pins do not have to be swept from the bowling alley.

5. A machine for positioning bowling pins on and removing bowling pins from a bowling alley comprising a device for positioning a new set of bowling pins in playing arrangement on a bowling alley, sweep apparatus for removing fallen pins and standing pins from a bowling alley, a detector device having a control circuit comprising ten switches connected in series and each adapted to be actuated by a separate standing pin for detecting whether all pins remain standing on the bowling alley after a bowling ball has been thrown, a second control circuit adapted to bypass the switches actuated by the 7 and 10 pins, a drive responsive to activation by a bowling ball for moving said detector and sweep apparatus through their respective cycles after a first bowling ball has been thrown and after a second bowling ball has been thrown, means for interrupting the operation of said sweep apparatus, means for connecting said first and second control circuits to said sweep interrupting means after a bowling ball has been thrown to incapacitate said sweep whenever one or the other of said first or second control circuits is operative after a bowling ball has been thrown, and means for rendering said second control circuit inoperative each time a second ball is thrown.

6. In a bowling pin handling machine a table movable towards and away from a bowling alley, pin gripping and pin setting units mounted on said table, a sweep for removing bowling pins from a bowling alley, a pin sensing device having ten normally open switches connected in series each being adapted to be actuated by a standing bowling pin, a source of electrical energy for energizing said pin sensing device, a cam controlled mechanism for moving said sweep and said pin gripping and pin setting units through one cycle of operations after a first ball is thrown and through another cycle of operations after a second ball has been thrown, incapacitating mechanism for incapacitating said sweep and said pin gripping and pin setting units, a cam operated switch for connecting said incapacitating mechanism in series with eight of said normally open switches of said pin sensing device to incapacitate said sweep and pin gripping and pin setting units when electrical energy flows from said source indicating that all of said eight pins remain standing after a first ball has been thrown, and a second cam operated switch for connecting said incapacitating device with said ten normally open switches of said pin sensing device after a second bowling ball has been thrown to actuate said incapacitating mechanism to incapacitate said sweep and said pin gripping and pin setting units when electrical energy flows from said source indicating that all ten pins remain standing.

7. In a bowling pin handling machine a table movable towards and away from a bowling alley, pin gripping units and pin setting units mounted on said table, a drive for moving said table towards and away from the bowling alley, actuating mechanism for operating said pin grippers and pin setting units in proper timed rela-

tionship with the movement of said table, a sweep for removing bowling pins from the bowling alley when the table is in elevated position, a pin sensing device comprising a control circuit having ten normally open switches connected in series and each adapted to be actuated by a standing pin, a second control circuit adapted to bypass the switches actuated by pins 7 and 10 on first ball only, a foul detector, a circuit breaker in said second control circuit adapted to be opened by said foul detector whenever a foul is made, a control for moving the components of said bowling pin handling machine through a sequence of operations after the first ball of a frame is thrown and through another sequence of operations after the second ball of a frame is thrown, means for incapacitating said sweep and pin gripping and pin setting units, and connections between said pin sensing device, said foul detector, and said control for automatically actuating said means each time current flows through the pin sensing device indicating the pins do not have to be replaced after a first or second ball and each time after a first ball when current can flow through said first and second control circuits.

8. In a bowling pin handling machine a table movable towards and away from a bowling alley, pin gripping and pin setting units mounted on said table, a sweep for removing bowling pins from a bowling alley, a pin sensing device having ten normally open switches connected in series each being adapted to be actuated by a standing bowling pin, a source of electrical energy for energizing said pin sensing device, a cam controlled mechanism for moving said sweep and said pin gripping and pin setting units through one cycle of operations after a first ball is thrown and through another cycle of operations after a second ball is thrown, incapacitating mechanism for incapacitating said sweep and said pin gripping and pin setting units, a cam operated switch for connecting said incapacitating mechanism in series with either of said normally open switches of said pin sensing device to activate said incapacitating mechanism to incapacitate said sweep and pin gripping and pin setting units when electrical energy flows from said source indicating that all of said eight pins remain standing after a first ball has been thrown, a foul detector, and means actuated by said foul detector for connecting said cam operated switch in series with said ten normally open switches of said pin sensing device to actuate said incapacitating mechanism to incapacitate said sweep and said pin gripping and pin setting units when electrical energy flows from said source indicating that all of said ten pins remain standing after a foul is made following the throwing of a bowling ball.

9. In a pin handling machine constructed and arranged to position a new set of ten pins in triangular playing arrangement on a bowling alley in such a way that the seventh and tenth pins occupy the corner positions of the triangular arrangement which are most distant from the player, a movable carrier, pin setting and resetting mechanism connected to said carrier for positioning a new set of bowling pins on a bowling alley and for gripping, lifting and resetting standing bowling pins on the bowling alley after the first ball in a frame has been thrown, a pin remover for removing bowling pins from

the bowling alley, pin detecting mechanism having a control circuit comprising ten switches connected in series and each adapted to be actuated by a separate standing pin, a second control circuit adapted to bypass the switches actuated by pins 7 and 10, a foul detector, and means in said second control circuit adapted to be actuated by said foul detector for rendering said second control circuit inoperative, whenever a foul is made, a control for causing the components of said bowling pin handling machine to move through one sequence of operations when the first ball of a frame is thrown and through another sequence of operations when the second ball of a frame is thrown, and incapacitating mechanism responsive to said pin detecting means to incapacitate said pin setting and resetting mechanism and said pin remover in the sequence of operations whenever the first and second control circuits of said pin detecting mechanism are actuated indicating that all pins other than the 7th and 10th pins remain standing after the first ball of a frame is thrown, which ball is not a foul, or whenever all pins including 7 and 10 remain standing after a first ball foul when the switches in said first control circuit are actuated.

10. In an automatic bowling pin setting machine for use with a bowling alley provided with a pin supporting playing bed, mechanism for removing pins from said alley after a ball of a frame is thrown, means for returning the ball to the player, means for placing a complete set of pins on said bed, a detector having a control circuit comprising ten switches connected in series and each adapted to be actuated by a separate standing pin, a second control circuit adapted to bypass the switches actuated by pins 7 and 10, a foul detector, and one or more switches in said second control circuit adapted to be actuated by said foul detector whenever a foul is made, electromagnetically operated mechanism responsive to said detector for controlling the operation of said pin removing mechanism, said ball return means and said pin placing means after a bowling ball has been rolled, said electromagnetic control mechanism including a timing cam shaft, a plurality of timing cams mounted on said shaft, means for rotating said shaft after each ball is thrown, an electric circuit operatively associated with said control mechanism, cam operated contacts in said circuit for effecting the operation of said pin removing mechanism, said ball return means and said pin placing means, and incapacitating mechanism responsive to the actuation of said detector control circuit for incapacitating said pin removing mechanism and said pin placing means each time said detector detects that a full set of pins or a set consisting of pins 1-6, 8, and 9 after the first ball remain standing after a bowling ball has been thrown.

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