Jan. 28, 1958 R. E. DUMAS 2,821,395

CONTROL MECHANISM FOR BOWLING PIN SPOTTING MACHINE

Filed May 15, 1951 6 Sheets-Sheet 1

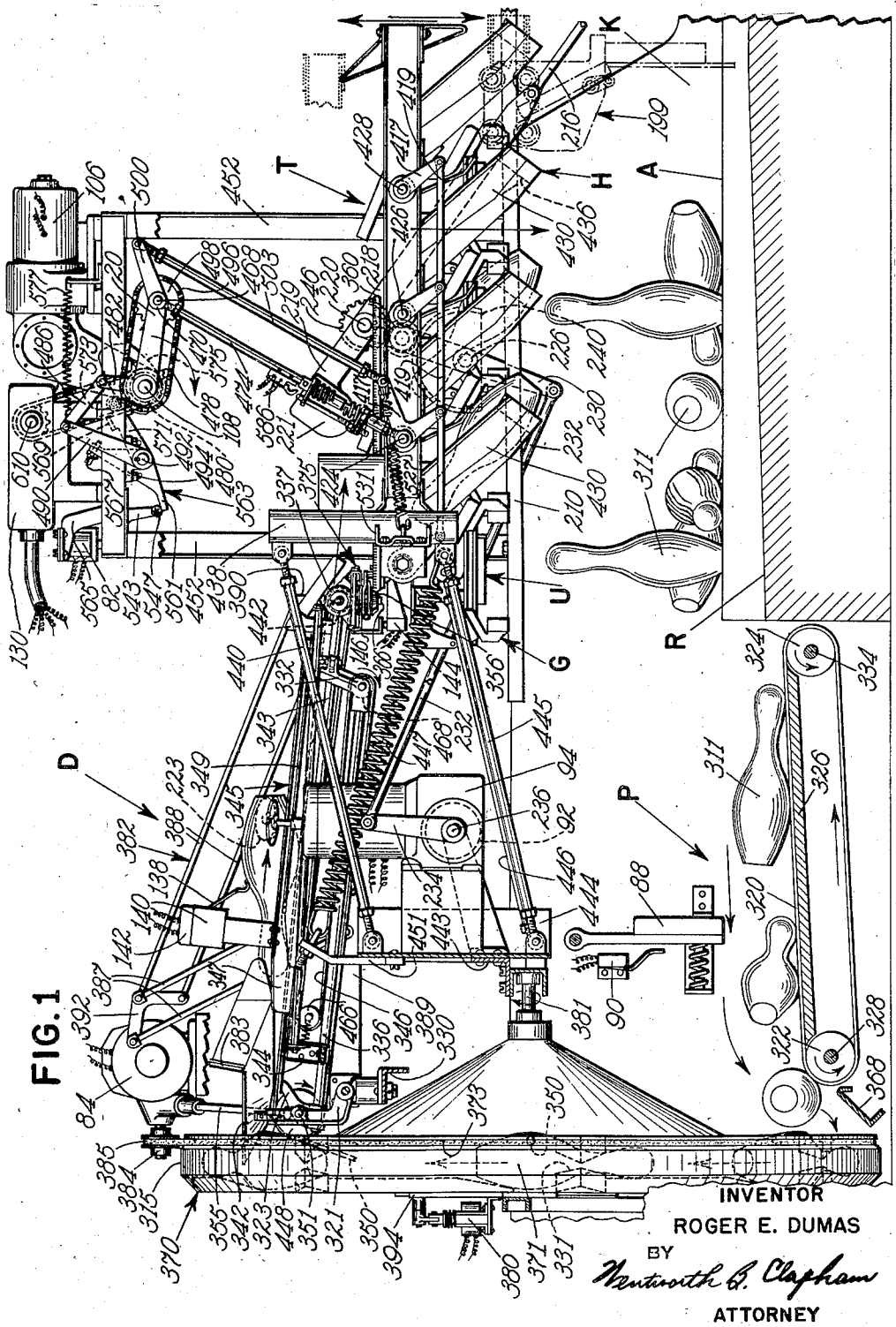


FIG. 1

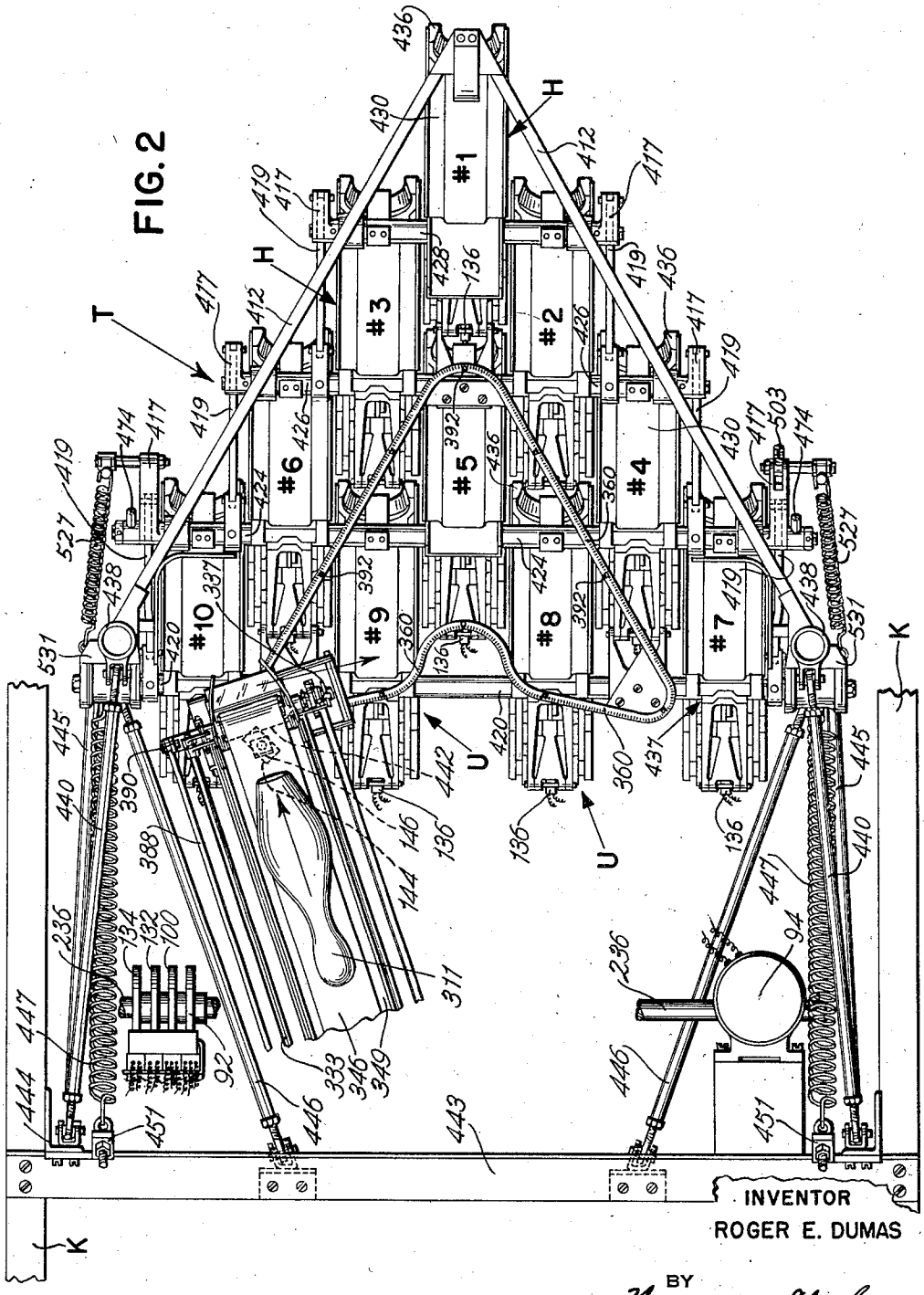
INVENTOR
ROGER E. DUMAS
BY
Wentworth B. Clapham
ATTORNEY

Jan. 28, 1958 R. E. DUMAS 2,821,395

CONTROL MECHANISM FOR BOWLING PIN SPOTTING MACHINE

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FIG. 2



INVENTOR
ROGER E. DUMAS

BY
Wentworth B. Clapham
ATTORNEY

Jan. 28, 1958 R. E. DUMAS 2,821,395

CONTROL MECHANISM FOR BOWLING PIN SPOTTING MACHINE

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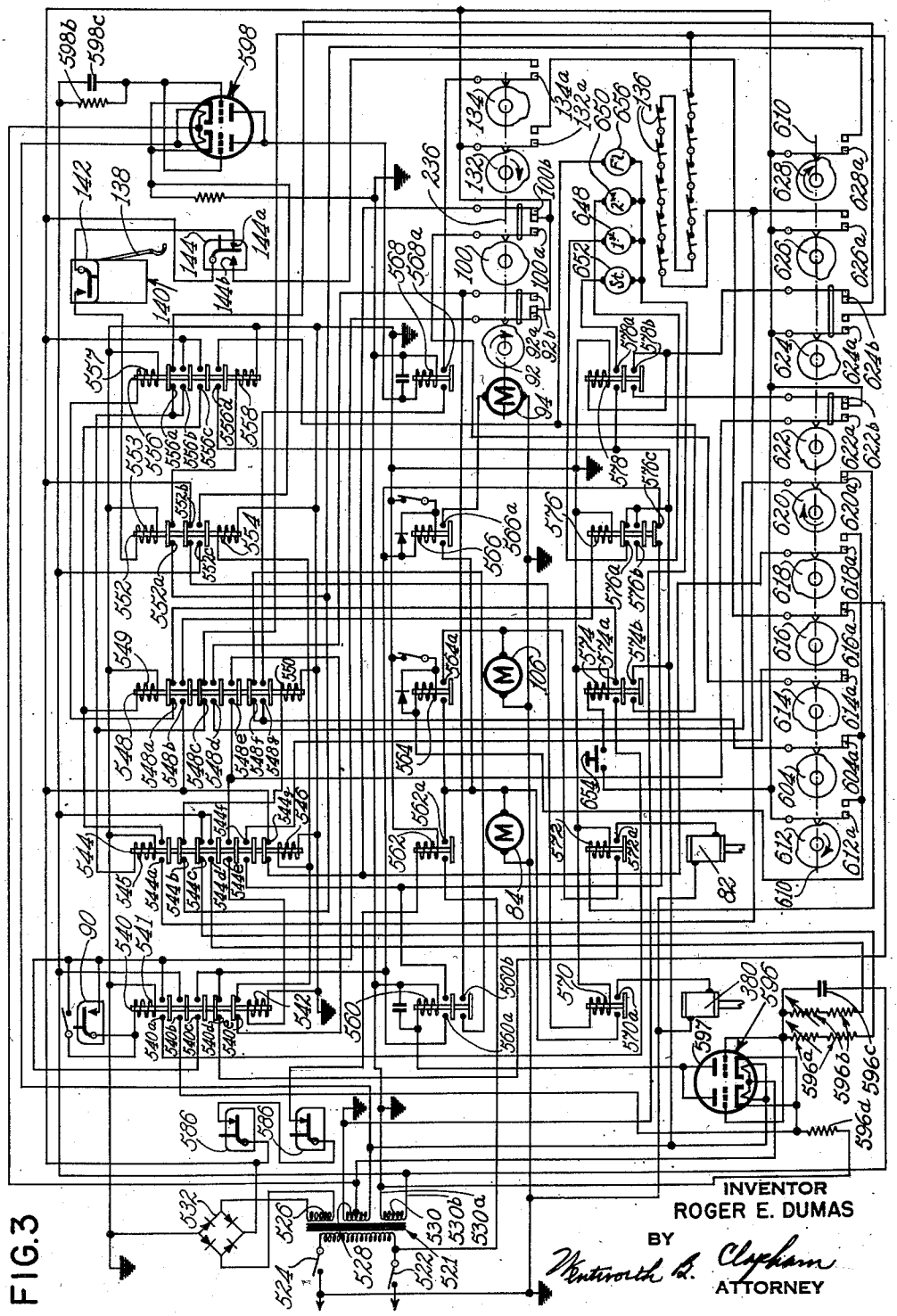


FIG.3

INVENTOR
ROGER E. DUMAS
BY
Wentworth E. Clapham
ATTORNEY

Jan. 28, 1958 R. E. DUMAS 2,821,395

CONTROL MECHANISM FOR BOWLING PIN SPOTTING MACHINE

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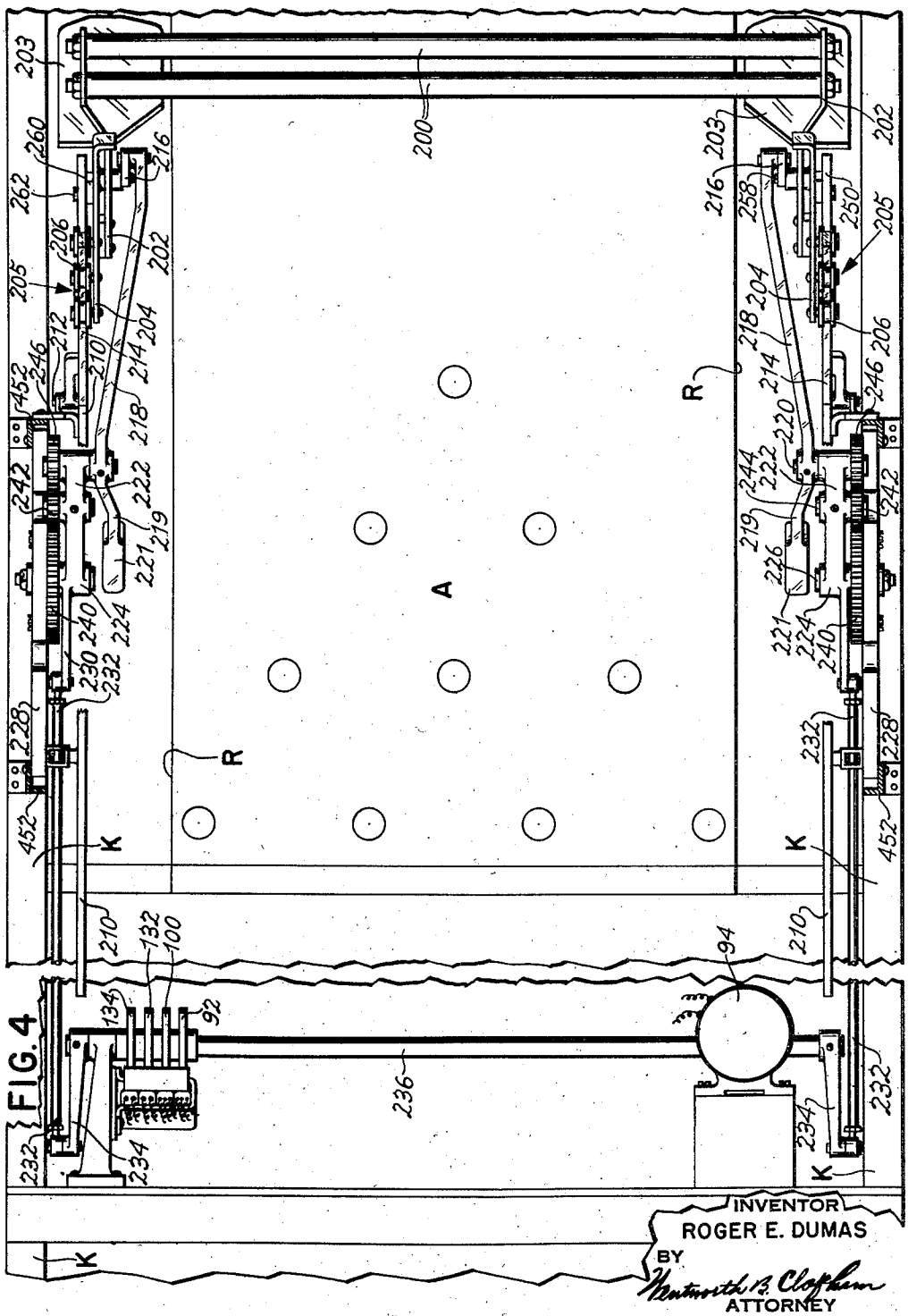


FIG. 4

INVENTOR
ROGER E. DUMAS
BY
Wentworth B. Clapham
ATTORNEY

Jan. 28, 1958 R. E. DUMAS 2,821,395

CONTROL MECHANISM FOR BOWLING PIN SPOTTING MACHINE

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FIG. 6

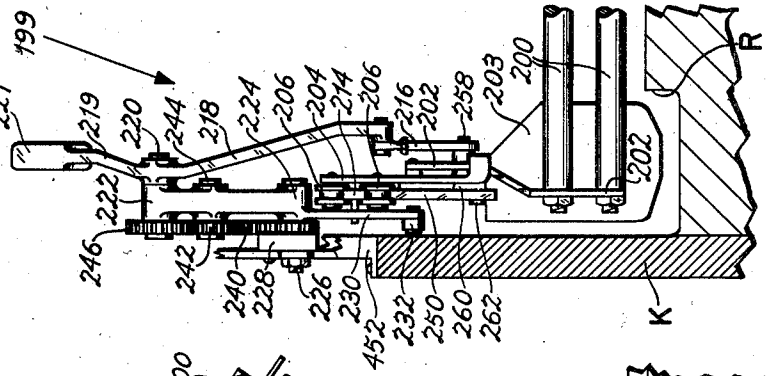
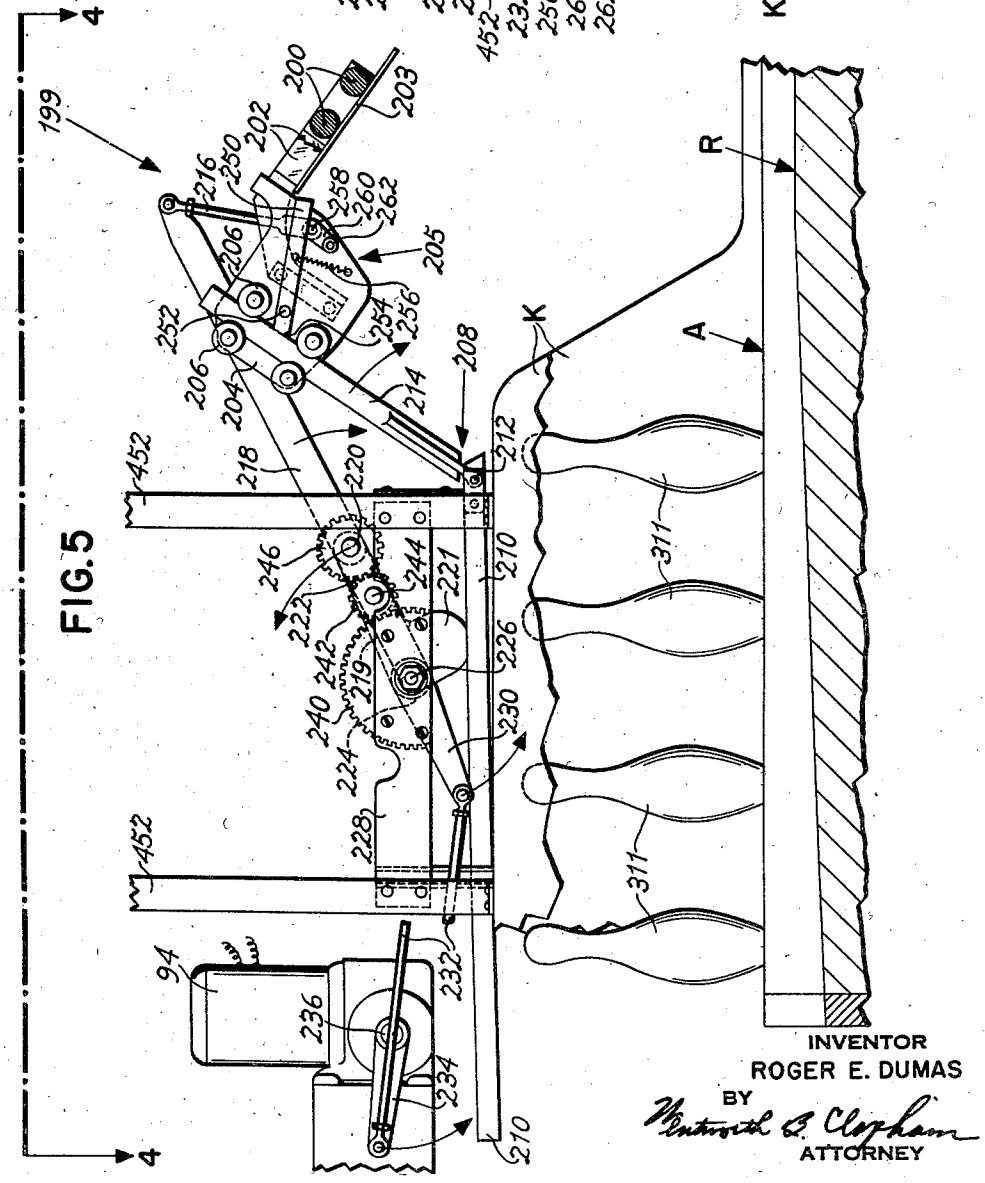


FIG. 5

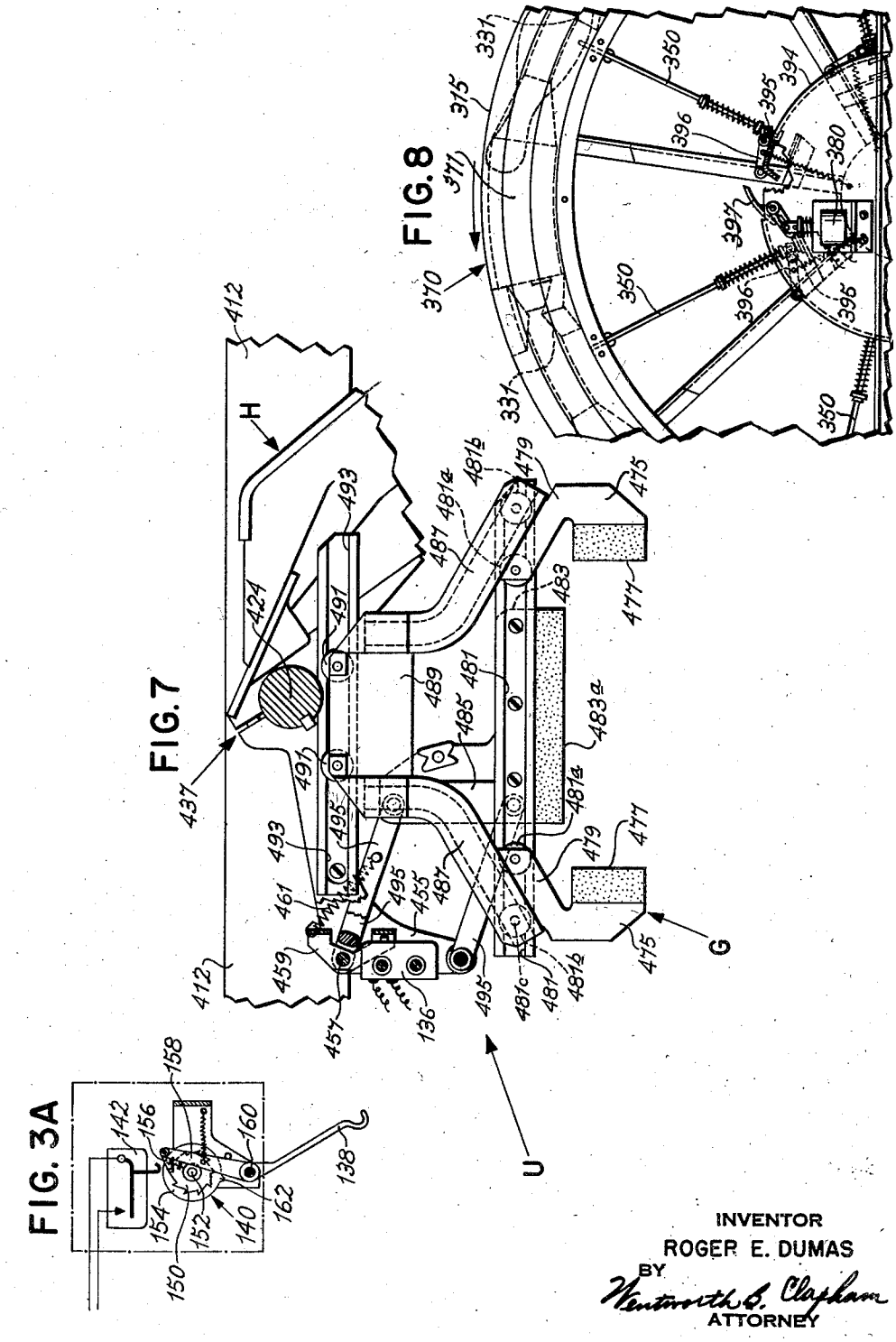


INVENTOR
ROGER E. DUMAS
BY
Wentworth B. Clapham
ATTORNEY

Jan. 28, 1958 R. E. DUMAS 2,821,395

CONTROL MECHANISM FOR BOWLING PIN SPOTTING MACHINE

Filed May 15, 1951 6 Sheets-Sheet 6



United States Patent Office 2,821,395
Patented Jan. 28, 1958

2,821,395

CONTROL MECHANISM FOR BOWLING PIN SPOTTING MACHINE

Roger E. Dumas, Snyder, N. Y., assignor to American Machine & Foundry Company, a corporation of New Jersey

Application May 15, 1951, Serial No. 226,359

6 Claims. (Cl. 273—43)

This invention relates to bowling pin spotting machines, and more particularly to bowling pin spotting machines for automatically spotting and respotting bowling pins upon the playing bed of a bowling alley, and to an improved control system for controlling the automatic and sequential operation of the coacting mechanisms of an automatic bowling pin spotting machine under all conditions of play.

In accordance with the invention, my improved apparatus consists in a bowling pin spotting machine having apparatus for removing pins from the pit of a bowling alley and delivering them to a distributor which in turn conveys them in succession to a pin spotting device wherein pins are held in substantially triangular arrangement for placement on the playing bed of an alley. The machine also includes a sweep device having its operation controlled in such manner that it is actuated at proper times during the play of the game to sweep deadwood and unwanted pins from the alley into the pit for delivery to the apparatus mentioned above. The machine also includes devices for lifting and respotting pins standing upon an alley in the position each occupied before being lifted after the rolling of the first ball of a frame, in order that the sweep device may remove deadwood or fallen pins, after which the lifted pins are respotted in the position each occupied prior to being lifted above the alley pending further play.

In accordance with the invention, there is provided an automatic control apparatus for operating the bowling pin spotting machine of which it forms a part under all conditions of play such that pins are spotted and respotted for frame to frame play as the game proceeds. The invention includes an electrical control apparatus having mechanisms associated therewith which selectively operate the several interconnected units of the machine in order to feed pins from the elevating mechanism to the distributor and the pin spotting units. The invention also includes selectively actuated control mechanism for effecting the proper spotting and respotting of pins in a normal two ball frame, or after a spare is made, and after a strike is made, thereby causing the pin setting device to place a new set of pins on the alley bed pending the throwing of the first ball of the next frame, and also to cause the spotting mechanism to place a new set of pins on the alley if a foul is made on the first ball.

It is an object of the invention to provide an improved electrical control mechanism for controlling the operations of an automatic bowling pin spotting machine such that the associated parts of the machine are automatically active or inactive in proper sequential order in carrying out their respective functions.

It is a further object of the invention to provide an electrically operated control mechanism for a bowling pin spotting machine having means for selectively actuating and timing the sequential operations of the several interconnected and cooperating units of a bowling pin spotting machine.

It is a further object to provide an improved control

mechanism for a bowling pin spotting machine in which the operations of a bowling pin spotting machine are automatically controlled and modified when a player makes a strike, or fouls.

It is a further object to provide a novel control mechanism for an automatic bowling pin spotting machine having devices continuously maintaining intelligence of the condition of all controlled coacting units of the machine depending upon the particular cycle of the machine operations from ball to ball and frame to frame as the game proceeds, such that interruption of the electric power supply merely stops the motions of the machine and upon resumption of the electric power the controlled units will automatically resume their normal sequential operations, and complete the cycle in which the machine was operating prior to power interruption.

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

In the accompanying drawings, which 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 of a bowling pin spotting machine provided with a preferred embodiment of the invention;

Fig. 2 is a plan view illustrating the spotting and respotting mechanisms of the machine;

Fig. 3 is a wiring diagram illustrating the preferred form of the electrical control system in accordance with the invention;

Fig. 3A is a view showing a detail of the control mechanism;

Fig. 4 is a plan view of the sweep mechanism of the machine taken on line 4—4 of Fig. 5;

Fig. 5 is a side elevation of the mechanism shown in Fig. 4;

Fig. 6 is an end elevation of one side of the sweep mechanism in operative position relative to a bowling alley;

Fig. 7 is a side elevation of an improved form of a respotting unit used in the machine, showing an electrical control element associated therewith; and

Fig. 8 is a fragmentary rear view of the pin elevating mechanism control.

In the embodiment of the invention illustrated herein, the control mechanism is associated with and forms an operative part of a bowling pin spotting machine provided with mechanisms for removing or elevating pins from the pit of a bowling alley, and delivering them in succession to a distributor associated therewith from which pins are delivered in succession and conveyed one by one to a pin spotting device having means for supporting and spotting pins and also for respotting pins during the course of play, when such is desired.

The mechanism illustrated for removing pins from the pit of a bowling alley is similar in construction and operation to that disclosed in copending application, Serial Number 150,232, filed March 17, 1950 by Robert L. Holloway and John Zuercher for Bowling Pin Elevating Mechanism, now Patent 2,767,983, granted October 23, 1956. Pins delivered by the device which removes or elevates them from the pit of the alley are discharged therefrom into a distributing device operatively associated therewith, and which may be similar in construction and operation to that disclosed and described in copending application, Serial Number 178,777, filed August 11, 1950 by John Zuercher for Pin Handling Mechanism for Bowling Pin Spotting Machines, now Patent 2,767,984, granted October 23, 1956. Operatively associated with the distributing mechanism is a bowling pin spotting and

respotting device, which may be similar in construction and operation to that illustrated and described in copending application, Serial Number 180,174, filed August 18, 1950 by Robert L. Holloway et al. for Bowling Pin Spotting and Respotting Mechanism, now Patent No. 2,781,195, granted Feb. 12, 1957. These mechanisms which form coacting and selectively actuated parts of the bowling pin spotting machine with which the control mechanism of the invention is operatively connected, are controlled thereby in such manner that all sequential and cyclical operations of the machine take place in proper timed order in spotting and respotting pins upon the playing bed of alley A during the entire course of play of a game after each normal two ball frame, or after a strike, or when a foul is rolled. While reference is made to the above referred to copending applications, the present invention may be used with other types of bowling pin spotting machines with which it is adaptable, and therefore it is not to be considered as limited in use with the structure shown in the above referred to applications.

As shown in Figure 1, bowling pins **311** struck by a ball, fall from or are removed from alley A and gutters R by means of a sweep and guard designated generally **199**. The mechanism for actuating sweep and guard **199** is operated after each ball is rolled by a bowler. After the last ball of a frame is rolled, all pins either standing or fallen, are swept into pit P.

In the illustrated embodiment, pins falling from alley A or delivered into pit P, drop onto a conveyor or travelling apron, designated generally **320**, similar in construction and operation to that disclosed in said Holloway et al. Patent, 2,767,983. This conveyor is pit wide, and is continually in motion, whereby pins are moved out of pit P beneath cushion **88** and delivered to pin elevating mechanism **370** described more in detail hereinafter.

Conveyor **320** runs upon driving and driven pulleys **322** and **324** respectively, mounted at the front and rear of pit P, as shown in Fig. 1. Pulley **322** is mounted on shaft **328** provided at one end with a sprocket (not shown), tracked by a sprocket chain (not shown), which runs on a sprocket (not shown) secured to a continuously driven drive shaft (not shown) operated by motor **84**.

As indicated in Fig. 1, shaft **334** which supports pulley **324**, preferably is mounted at a higher level than shaft **328** so that the upper lap **326** of conveyor **320** is inclined downwardly and rearwardly and preferably towards one side of pit P. Bowling balls dropping downwardly, because of this arrangement, both roll and are carried downwardly by conveyor **320** to one corner of pit P for delivery therefrom by suitable ball lifting mechanism (not shown) onto a return runway of conventional design (not shown) for return to a bowler. Since the ball return mechanism forms no part of this invention, further description and showing thereof are omitted in the interest of brevity.

Pins **311** are delivered from conveyor **320** by guide chute **368** and side guides (not shown) into pockets **331** formed in and spaced equidistantly along a flange or channel **315** forming the rim of rotary disc **371** of mechanism **370**. Disc **371** is mounted for rotation on a horizontal shaft **381**, and in the illustrated embodiment is continuously driven by belt **385** running on pulley **384** fixed to the shaft of motor **84**. Belt **385** tracks a pulley **373** formed integrally in the rim of disc **371**. The speed of rotation of disc **371** is such that pins **311** are not hurled or thrown about in channel **315** while being seated in pockets **331** for delivery from pit P upwardly to a position substantially directly thereabove where each pin is discharged into pin receiving and aligning device **342** of distributor D.

The axis of rotary disc **371** is disposed midway between the inner faces of kickbacks K of the alley, the periphery of disc **371** being of such a diameter that it may rotate close to but not touch kickbacks K or the bottom of pit P, shaft **381** being at a suitable elevation for this purpose. In the illustrated embodiment, disc **371** is provided with 7 pin holding and conveying pockets, the same as shown and described in Holloway et al. Patent 2,767,983.

Each pin after being seated in a pocket **331**, is held therein by a gripper rod **350** mounted for radial movement into and out of engagement therewith. A stationary cam **394** of suitable shape mounted on the frame of the machine is tracked by a cam follower **395** on a lever **396** suitably resiliently connected at one end by a pin to each rod **350** (Fig. 8). Hence, as disc **371** rotates, rods **350** are moved into engagement with pins in pockets **331** and are held in engagement with pins seated therein until the latter are to be disengaged therefrom to effect their discharge into device **342**. In this manner, all pins received in pit P are elevated by mechanism **370** and delivered thereby in succession to distributor D. The specific details of construction and operation of pin elevating mechanism **370** do not form a part of this invention, and the description herein has therefore been limited to only as much as is considered necessary to an understanding of its operation. Reference is made to Halloway et al. Patent 2,767,983 for a complete disclosure.

Distributor D, which includes an elongated telescopic generally U-shaped chute or channel **345**, is mounted for lateral movement back and forth across the machine, and also for vertical movement. This arrangement makes it possible to deliver pins **311** in succession from pin elevating mechanism **370** selectively into spotters H on table T not only when table T is stationary, but also as it is moving to and from alley A.

Channel **345** consists of two relatively longitudinally movable parts: a fixed pivoted rear U-shaped guide chute **347**, which receives pins **311** oriented and delivered from device **342**, and a longitudinally movable pin delivering guide chute **349**.

Chute **347** is secured at its rear end to spaced swivel lugs **323** pivotally mounted on a horizontal shaft **351** supported at each end in a bearing by bracket **321** pivotally attached to a cross frame member **330** by a suitable vertical stud shaft. Swivel lugs **323** and horizontal shaft **351** form the pivot which permits distributor D to swing vertically as table T moves to and from alley A in spotting and respotting pins thereon. The vertical stud shaft to which bracket **321** is pivoted allows distributor D to swing laterally during the movement of the front end of the same on track **360**.

Each pin **311** discharged from a pocket **331** in disc **371** rolls or drops into receiving and aligning device **342**, which extends partly into channel **315**. Each pin aligned by engagement with one of two spaced upstanding pins **383** located at opposite sides of device **342**, is conveyed by continuously driven conveyor belt **346** through chute **345** and discharged from part **349** thereof into a spotter H in table T for subsequent placement on alley A. Pinspotters H are mounted in substantially triangular arrangement on table T, a pattern conforming with the conventional arrangement of pins on a bowling alley.

As each pin is fed by belt **346** through channel member **345**, it passes beneath a trip arm **138** which actuates a counting device **140**. After ten pins have actuated trip arm **138**, a switch **142** in counter **140** is closed which de-energizes solenoid **380**. Solenoid **380** is connected to a movable gate portion **397** of cam **394**, and when solenoid **380** is de-energized, this gate portion of cam **394** is closed and clamping rods **350** remain in engagement with pins in pockets **331**, and pins are not delivered therefrom into receiving and aligning device **342**. On the other hand, until ten pins have actuated trip arm **138**, switch **142** remains open (see Fig. 3). The movable gate portion **397** of cam **394** also is open and clamping rods are disengaged from pins in pockets **331** which, at the point of discharge relative to device **342**, drop or roll into receiving and aligning device **342** and are delivered thereby onto belt **346**. The construction and operation of cam **394** and its movable gate portion **397** are substantially the same as that shown and described in Zuercher Patent

2,767,984, above referred to, and a detailed description is not deemed necessary herein.

During the course of operation of distributor D, the latter moves laterally, and vertically and longitudinally as described hereinbefore, until at #10 position, see Figure 2. an arm **146** mounted on the distributor engages and operates a switch **144** supported by a bracket attached to track **360** on table T. The operation of switch **144** is described more in detail hereinafter in the description of Figure 3.

The front end of guide chute **347** is attached to a U-shaped bracket **332** secured to two parallel rods **336** mounted in and extending outwardly from swivel lugs **323** pivotally mounted on shaft **351** (Figure 1). The longitudinally movable front part **349** of chute **345** is attached at its rear end to a cross member (not shown) connected to spaced elongated rods **343**. The free ends of these rods are secured to a roller bracket **344** mounted to roll along rods **336**.

The front end of distributor D, which includes telescopically movable chute **349**, is supported and guided by means of an intermittently operated driving mechanism designated generally **375**, which is similar in construction and operation to that shown and described in Zuercher Patent 2,767,984, referred to above. This mechanism includes a bevelled disc **356**, and a guide roller (not shown) which engage opposite sides of track **360**, suitably attached to table T. As shown in Figure 2, track **360** is generally heart shaped and is provided with ten stop pins **392**, one of which is located adjacent each spotter H. These stop pins interrupt the movement of distributor D for delivery of a pin into each empty spotter H, and also insure that the discharge end of distributor D is positioned properly for delivery of a pin therefrom. Track **360** is provided with teeth with which engage complementary teeth on disc **356** such that when the latter is rotated, the front end of distributor D is moved laterally and extended longitudinally as disc **356** moves stepwise along track **360**.

As shown and described in the above referred to Zuercher Patent 2,767,984, bevelled disc **356** is driven intermittently as the result of the engagement of a bowling pin **311** on belt **346** with a trip **223** secured to the shaft **333** (Fig. 2). When shaft **333** is rocked, a clutch **337** operatively connected to the shaft of pulley **442**, is thrown in, and bevelled disc **356** is rotated. This movement of disc **356** travels the discharge end of distributor D to the next empty spotter H for delivery of a pin thereto, when the stop pin adjacent this spotter causes the clutch to be thrown out, and further movement of distributor D stops until trip **223** is again actuated.

When each of the spotters H contains a pin, further movement of distributor D is arrested until it is again necessary to feed pins to spotters H. Conveyor belt **346**, the upper lap of which travels in guide chutes **347** and **349**, runs on driving and driven pulleys **448**, **466**, **442** and **468**, respectively. These pulleys are suitably supported in such manner that the pin carrying lap in chutes **347** and **349** is lengthened or shortened in accordance with the longitudinal movement of chute **349** relative to chute **347**. Conveyor belt **346** is driven continuously from motor **84** by shaft **355** through suitable conventional driving connections to shaft **351**. Since the specific details of the mechanism for operating distributor D do not form a part of the present invention, and are fully shown and described in the above referred to Zuercher Patent 2,767,984, there has been described hereinabove only so much as is deemed necessary for an understanding of its coaction with pin elevating mechanism **370** and its delivery of pins to spotters H.

Since the distributor is designed to deliver pins to spotters H not only when table T is stationary, but also when it is moving, there is provided a parallelogram system designated **382** which maintains the discharge end of the distributor, which supports bevelled disc or driving member **356**, in a substantially horizontal position at all times although chutes **347** and **349** comprising channel **345** may be in upwardly or downwardly inclined position. Channel **345** is inclined upwardly when the table T is in its topmost position, i. e. when crank arms **20** and connecting rods **474** are in the top dead center position. Fig. 1 shows the table T approximately one-half of the way from the top to the bottom positions assumed by table T during one revolution of the table crank arm shaft **108**. This system includes a pair of rods **387** pivoted to a horizontal bracket **389**. The other pair of rods **388** are pivoted to a vertical member **390** which forms a part of the bearing bracket of mechanism **375** which supports stud **366**, to which bevelled disc **356** is attached. Both pairs of rods are pivotally connected to a bell crank lever **392**.

In accordance with the invention, table T, which is supported in a suitable frame mounted on alley kickbacks K, is moved in a controlled and selective manner to and from alley A whenever pins are to be spotted or respotted thereon. As shown, table T is generally triangular in form and supports ten triangularly arranged spotters H, and ten complementary respotter units U. It is so mounted and stabilized that it is maintained in a substantially horizontal substantially parallel relationship with alley A at all times. For this purpose, the table frame T which is triangular in nature as shown in Fig. 2, is provided with upstanding brackets **438**, at the ends of the table side frame members **412**. Pivotally connected to brackets 438 are upper and lower radius rods **440** and **445** (Figs. 1 and 2) respectively, which are also pivotally connected to members **444** on a cross frame member **443** of the machine. Also connected to the frame of table T and to member **443** are stabilizing arms **446**. Springs **447**, attached to brackets **438** and to brackets **451** on member **443**, balance the weight of table T and assist in insuring its smooth movement to and from alley A.

Table T is moved to and from alley A by means of motor **106** which is selectively operated in order to spot and respot pins on the alley as the play of the game proceeds from frame to frame. After each ball is rolled, sweep **199** is operated in proper timed relation with the movements of table T to sweep deadwood or fallen pins from the alley, or to sweep deadwood and unwanted pins from the alley depending upon which ball of a frame is rolled.

A preferred form of sweep and guard mechanism is shown in Figures 4, 5 and 6 in which this mechanism is designated generally **199**. This mechanism consists of a pair of horizontal transverse bars **200** having their ends attached to supporting brackets **202**. Each bracket **202** is secured to a plate **204** provided with two pairs of rollers **206** which, with plate **204**, form a trolley **205** by means of which bars **200** are moved back and forth over the alley.

Bars **200** not only are operative to sweep pins **311** from alley A and gutters R, but also when located in operative sweeping position adjacent alley A, form an effective guard for preventing carelessly thrown balls from damaging parts of the machine, such as the pin spotting and respotting table when the latter is lifting and respotting pins on alley A. Rollers **206** of each trolley **205** engage with and run on track **208** (Fig. 5) consisting of a fixed horizontal portion **210** and a movable portion **214**. Each track portion **210** is secured adjacent to the top edge of kickback K to a pair of uprights **452** which form a frame for the support of spotting and respotting table T and its operating mechanism shown in Figure 1. These uprights are fastened to the top edge of kickbacks K.

Since the mechanism supporting and operating each end of sweep and guard bars **200** is identical in construction and operation, except for being located at opposite sides of alley A to obtain a perfect parallel movement, it is considered only necessary to describe one, like parts bearing

the same reference characters. Movable track portion **214** is pivotally attached to the forward end of fixed track portion **210** by means of a stud **212**. This allows track portion **214** to be swung to and from alley A for the purpose of permitting trolleys **205** and sweep and guard bars **200** supported thereby to be moved upwardly into inoperative position above alley A when a ball is rolled by a player, and downwardly into operative position adjacent alley A after a ball is rolled. For this purpose, plate **204** of trolley **205** is connected by an adjustable rod or link **216** to one end of an arm **218**, the other end of which is secured to a stud shaft **220** rotatably supported at the free end of an arm **222** of a double lever **224** pivoted to a stud **226** held by a suitable cross member **228** attached to uprights **452**. The other arm **230** of double lever **224** is connected by an adjustable rod or link **232** to crank arm **234** mounted on shaft **236** projecting from a suitable gear reduction motor **94**. Shaft **236** extends almost all the way across the rear end of the alley and carries a crank arm **234** at each end, each crank arm actuating the sweep and guard supporting and operating mechanism on its respective side of alley A.

Also secured to each cross member **228** is a stationary gear sector **240** which engages with a gear **242** loosely mounted on a stud **244** mounted in arm **222** of double lever **224**. Gear **242** also engages with gear **246** which is mounted on stud shaft **220** to which arm **218** is secured and thereby controls the movement thereof. To somewhat counterbalance the weight of trolley **205** and sweep and guard bars **200** connected to the free end of each arm **218**, the latter on its free end is provided with an extension **219** which carries a counterweight **221**. In order to insure the removal of fallen pins lying in the two gutters R, each bracket **202** carries a plate **203**, the lower end of which, when the plate **203** is in operative position, projects partly into its respective gutter, as shown in Fig. 6.

In the operation of the machine, the sweep and guard mechanism is set in motion when a ball rolled by the player lands in pit P of the alley and effects the closing of the pit switch **90**, the function and connections of which are disclosed in detail in the description of the control circuit described herein. The closing of pit switch **90** effects the starting of sweep motor **94**, which in turn causes shaft **236** and cranks **234** to start rotating in the direction of the arrow shown in Fig. 5. Since cranks **234** are connected by rods **232** to arms **230** of double levers **224**, the latter also start to rotate about their pivot studs **226**, causing gears **242** to rotate due to their meshing with fixed gear sectors **240**. Since gears **242** are in mesh with gears **246**, the latter are rotated also, and through shafts **220**, effect a downward motion of the free ends of arms **218** which are connected by rods **216** to trolleys **205** and sweep and guard bars **200**. A downward motion of the free ends of arms **218** thus effects a lowering of trolleys **205** and sweep and guard bars **200** towards and into operative position adjacent alley A. Since trolleys **205** when in lifted position are locked against the free end of swingable track portions **214** by means of lock levers **250**, these track portions will swing about their pivots **212** downwardly until they reach a substantially horizontal position and form an extension of stationary track portions **210**. Each lock lever **250** is pivotally mounted on a stud **252** held by a trolley plate **204**. One end of each lock lever is provided with a cam-like edge **254** which at the proper time is urged into wedge-like engagement with the lower edge of track portion **214** by means of a tension spring **256**. However, the lower end of each connecting rod **216** is secured to a stud shaft **258** which is pivotally supported in plate **204** and to which shaft is also secured a short arm **260** which at its free end carries a roller **262**. By means of this arrangement during the downward motion of arm **218**, arm **260** is caused to swing upwardly, and shortly before trolleys **205** reach their horizontal positions, effects a sufficient engagement of roller **262** with its respective lock lever **250** to disengage the cam shaped edge of lock lever **250** from the lower edge of track portion **214**.

When track portion **214** reaches its substantially horizontal or operative position, sweep motor **94** stops and the bars **200**—one above the other—form a guard across the alley (Fig. 6) as stated above, and prevent interference and/or damage to the table T which descends shortly thereafter to pick up any pins **311** which remained standing after the first ball was rolled. After pin grippers G, carried by table T, have engaged and gripped such pins, table T ascends again, after which sweep motor **94** is started again, and crank arms **234** continue their rotation, and through the connections described, swing arms **218** through a forward arc which causes trolleys **205** to move from the track portions **214** onto fixed portions **210** and towards the rear of the alley while the sweep bars **200** in combination with the gutter plates **203** sweep all fallen pins from said alley A into the pit P. This movement constitutes the forward arc of arm **218**.

After bars **200** have reached the rear end of alley A, the arcuate movement of arms **218**, due to their described connections, is reversed and through rods **216**, the arms pull trolleys **205** and bars **200** back to the front of the alley, after which sweep motor **94** is stopped again. Bars **200** then remain in their operative or "down" position in front of the pin supporting bed of alley A and act as a guard until the now descending table and respotting units have placed previously lifted pins on the alley in their respective on and off-spot positions and have moved upwardly again, at which time sweep motor **94** is started again and crank arms **234** continue their rotation, causing arms **218** to be lifted upwardly, thereby effecting a lifting of trolleys **205**, bars **200** attached thereto and track portions **214**. Since this lifting action also effects a disengagement of roller **262** from the lock lever **250**, each tension spring **256** urges the cam shaped end of lever **250** into frictional engagement with the under edge of track portion **214**, thereby locking the trolley **205** against sliding downwardly or backwardly on the now inclined track portion **214**.

After trolleys **205** and bars **200** reach their uppermost positions, sweep motor **94** stops again, at which time shaft **236** has completed one full revolution. The above described sequence of intermittent operation of the sweep mechanism applies to a first ball cycle and changes somewhat during the second ball cycle. After the second ball, rolled by the player, lands in the pit, sweep motor **94** starts again and effects the lowering of the sweep bars **200**. However, since the table and pin gripper mechanism does not descend in this cycle to pick up standing pins, bars **200**, after a brief stop, immediately are moved towards the rear of the alley to sweep all pins, standing or fallen, into pit P. They then return to their positions in front of the alley where they act as guards until the table has placed a new set of pins on the alley and has returned to its uppermost position. Bars **200** are then raised again, as described heretofore, and come to rest in their lifted position, marking the end of the second ball cycle.

Each cycle requires one revolution of shaft **236**, and in order to properly control the position at which the sweep mechanism must be arrested at the different intervals, shaft **236** carries four electrical control cams **92**, **100**, **132** and **134** which operate suitable switches and contacts, and form part of the electrical control circuit shown in Fig. 3 and described hereinafter.

Motor **106** is mounted in any suitable manner on a cross member of the machine frame, Fig. 1, and is provided with a conventional type of gear reduction for driving shaft **108** having a crank arm **20** attached to each end. Each crank arm **20** supports in its free end a stud shaft **468** to which is pivotally attached an eye **470** to which is connected one end of a table supporting rod **474**, the other end of which is pivotally connected to shaft

424. When, therefore, motor **106** is set into motion, as described hereinafter, and arms **20** are rotated by shaft **108**, arms **20** will cause table T to be lowered and raised with respect to alley A for spotting and respotting pins thereon. This mechanism allows the spotting and respotting operations to be effected at substantially the same height above alley A, because of the use of the simple harmonic drive described.

In table T, the positions occupied by spotters H and respotting units U are indicated generally at #1–#10 inclusive, as shown in Fig. 2. Spotters #7–#10 inclusive and their complementary respotting units U are mounted on shaft **420** supported in brackets **531** attached to side frame members **412**. Spotters #4–#6 inclusive, and #2 and #3, and #1 are mounted on shafts **424**, **426** and **428**, respectively, supported in side frame members **412** of table T. Each spotter H is suitably attached to a bracket designated generally **437** fixed to its respective support and operating shaft. Shafts **420**, **424**, **426** and **428** are each provided with crank arms **417**, to the free ends of which are secured links **419** such that when shaft **424** is rocked when pins are to be spotted on alley A, all of the spotters H are swung from the inclined pin receiving and supporting position shown in Fig. 1 into substantially vertical pin delivering position and pins will be deposited thereby on alley A when table T is moved by crank arms **20** into lowered or pin spotting position relative to the alley. As shown in Figure 1, loosely mounted adjacent one end of shaft **108** is a sprocket **478** having a hub **480** provided with an upstanding lug **482** to which is pivotally connected one end of a link **486**, the other end of which is pivotally connected to lever **490** keyed to stud shaft **492** mounted in bearing bracket **494** attached to the machine frame. Sprocket **478** is tracked by a sprocket chain **496** running on sprocket **498** fixed to shaft **468**.

Attached to shaft **468** is a crank arm **500** pivotally connected to one end of connecting rod **503**. The other end of rod **503** is connected to one arm of bell crank lever **417** on shaft **424**. Springs **527** perform the function of balancing the weight of the several pin spotters H, and assist in returning them to their pin receiving and holding positions, shown in Figure 1, after they have spotted a set of pins on alley A. The ends of springs **527** are attached to brackets **531** on the frame of table T and to arms of bell crank levers **417** on shaft **424**, respectively.

The several spotters H are essentially the same in construction, and it is deemed necessary to describe only one. As shown in Figures 1 and 2, a typical spotter H includes an elongated, generally U-shaped trough-like member **430** somewhat greater in length than the length of a pin. Adjacent and attached to the lower or free end of member **430** is a half-ring support **436**, which coacts with the walls and bottom of member **430** in guiding and supporting a pin for proper placement on alley A, as spotters H are swung to spotting position adjacent alley A, and then rearwardly therefrom to clear spotted pins due to the movement of crank arms **500** during the movement of table T to and from alley A. Reference is made to copending Holloway et al. application, Serial Number 180,174, for a full description and showing of spotters H, and apparatus for operating them.

Each bracket **437** also supports a respotting unit U. There are ten respotting units employed in the mechanism illustrated. Since each is identical in construction and operation, only one is described briefly herein, reference being made to the above referred to Holloway et al. copending application, Serial Number 180,174 for a full and complete disclosure. Since the details of construction of respotters U do not constitute a part of the present invention, a complete description herein is deemed unnecessary.

As shown in Figures 1, 2 and 7, each unit U is provided with a pair of grippers designated generally G. Each gripper G includes an elongated gripping member **475** preferably faced with a resilient pin gripping surface **477**. Each member **475** is provided at its ends with an upstanding arm **479** on each of which are mounted horizontally spaced rollers **481***a* and **481***b*. Rollers **481***a* are adapted to run in substantially horizontal tracks **481** attached to the ends of a substantially vertically movable clamping plate **483** having a resilient pin head clamping surface **483***a*. Two rollers **481***b* are mounted on each end of a shaft **481***c* supported in a rearwardly extending projection in arms **479**. One roller **481***b* rolls in track **481**; the other rolls in cam track **487** fastened to carriage **489**. Carriage **489** at its ends is provided with rollers **491** running in horizontal tracks **493** attached to bracket **437**. Pivotally attached to an upwardly extending flange **485** formed integrally with plate **483** and to bracket **455** forming a part of bracket **437** are a pair of parallel links **495**. The action is such that when table T is lowered after the rolling of the first ball of a frame, and any pins are standing on alley A, the heads of such pins will be engaged by surfaces **483***a*. Continued downward movement of table T results in a relative upward movement of plate **483**, and a concurrent inward movement of grippers G to grip on or off-spot standing pins.

As indicated in Figures 3 and 7, when any plate **483** is raised, switch **136**, mounted on bracket **455**, is operated to break a series circuit connecting the ten switches, one of which is provided for each unit U. For this purpose, one end of each upper link **495** is attached to a shaft **457** to which is pivoted an operating lever **459**, which, as plate **483** is moved upwardly relative to grippers G, opens normally closed switch **136**. Grippers G are automatically latched in closed gripping relationship by latch mechanism (not shown) and hold pins for lifting and respotting. When each lifted pin is respotted in its respective on or off-spot position on alley A, the latch mechanism is automatically released, and upon upward movement of table T, such pins are left standing on alley A, pending rolling of the next ball of the frame. A spring **461** attached to lever **459** and to link **495** then swings switch lever **459** in a clockwise direction as viewed in Figure 7 to its normal position resulting in the operation of switch **136** and closing its part of the series circuit of these switches.

When bowling pins are to be spotted on alley A, solenoid **82** is energized. This rocks bell-crank lever **543** connected to the armature of solenoid **82** and disengages cam follower **547** from latching engagement with a cam surface formed on lock arm **561** of lock lever **563** keyed to shaft **492**. An adjustable set screw (not shown) mounted in bracket **565**, which supports bell-crank lever **543**, is provided in order to properly position cam follower **547** on arm **561**. Lock lever **563** is provided with an adjustable screw **567** adapted to engage a lateral projection **569** on cam lever **571** loosely mounted on shaft **492**. Cam lever **571** is provided with a cam follower **573** tracking a cam **575** attached to shaft **108**.

A spring **577** having one end attached to lever **490** and its other end attached to a bracket mounted on the frame of the machine, tends to pull lever **490** to the right, as viewed in Fig. 1, whereby whenever solenoid **82** is energized, screw **567** is held pressed against projection **569**, and cam follower **573** of lever **571** is held resiliently against the surface of cam **575**. The movement of cam **575** with respect to cam follower **573**, and the linkage and leverage described hereinbefore, result in sprocket **478** being rotated in the direction of the arrow shown in Fig. 1. That is, the movement of cam **575** on shaft **108** with respect to cam follower **573**, produces a rocking motion in levers **571** and **490**. The rocking (limited arc of travel of lever **490**) is transmitted by link **486** to lug **482** attached to sprocket **478**, sprocket **478** being free to turn relative to shaft **108**. Movement of sprocket **478** is transmitted by chain **496** to sprocket **498** which is keyed to shaft **468**. Shaft **468** is free to turn in the end of crank arm **20**. Attached to shaft **468** is crank arm

500 pivotally connected at one end of connecting rod 503. The other end of connecting rod 503 is pivotally connected to one arm of bell crank lever 417 on shaft 424. This linkage permits the motion generated by the action of cam follower 573 with respect to cam 575, to be transmitted to the table shafts 420, 424, 426, and 428. Thus the rotation of shaft 492 is transmitted to a corresponding but not equal rotation in shafts 420, 424, 426, and 428. The rotation of shaft 492 results in the rocking of crank arm 500, thereby effecting a turning of shafts 420, 424, 426 and 428, which, when table T is located as indicated in Figure 1, results in the delivery of ten pins in spotted arrangement on alley A.

The control mechanism selected for purposes of illustration employed with the coacting pin handling and spotting and respotting mechanisms described hereinabove, may be termed a three cycle system, wherein there are provided three revolutions of table crank arms 20 or three down and up trips of table T for each normal frame consisting of a first ball or re-spot operation, and a second ball or spotting operation. Each of these operations (ball cycles) requires one complete cycle of operation of sweep 199 which removes deadwood and unwanted pins from alley A.

There are four basic types of machine cycle generated by the electrical control constructed and operated in accordance with the invention. These are:

I. *Normal Two Ball Cycle.*—
   First Ball: Respot operation, two trips of table T to and from alley A—machine resets to second ball.
   Second Ball: Spotting operation, one trip of table T to and from alley A—machine resets to first ball.

II. *Strike Cycle.*—Mechanical and electrical intelligence notifies machine to spot a new set of pins and reset to first ball—two trips of table T to and from alley A.

III. *First Ball Foul Cycle.*—Spotting operation—one trip of table T to and from alley A—machine resets to second ball and a foul signal is actuated.

IV. *Second Ball Foul Cycle.*—Same as a normal second ball operation except that a foul light indicates that a foul has been committed.

Referring to Figure 3, when switches 522 and 524 are closed, power is supplied to secondary windings 526, 528 and 530 of transformer 521. Current from winding 526 is rectified by rectifier 532 and through contact 552*b*, energizes relay 570 which closes contacts 570*a* and through contacts 562*a* which are closed substantially simultaneously as explained hereinafter, energizes solenoid 380 so that cam gate 397 opens and pins are discharged from pin elevating mechanism 370 and forwarded by distributor D to table T.

Driving power is supplied to both pin elevating mechanism 370 and distributor D by gear reduction motor 84, which is energized at the same time as solenoid 380, when the rectified current passes through two normally closed "too far off-spot" pin or safety switches 586 and energizes main contactor 562, closing contacts 562*a* and starting motor 84 from the main power line. A light 648, provided for indicating that the machine is ready for a first ball, is illuminated by current from winding 528 through contacts 576*a* of relay 576.

NORMAL TWO BALL FRAME

First Ball

FIRST REVOLUTION OF CONTROL CAM SHAFT 610

The following occurs during the first revolution of a normal first ball cycle. As the bowler rolls his first ball, it strikes or rolls against backstop 88 (Fig. 1), moves it rearwardly and closes pit switch 90. At this moment, contacts 92*a* of sweep cam 92 are closed and current passes from rectifier 532 through these contacts and switch 90 and energizes the latch coil 541 of relay 540, which latches itself in and maintains that position until latch coil 541 is de-energized thereby unlatching relay 540. All latch relays mentioned hereinafter are of this type. At the beginning of a first ball cycle all latch relays are unlatched.

As relay 540 latches in, contacts 540*c* close, and current passing therethrough and through contacts 92*a*, energizes sweep contactor 566, closing its contacts 566*a*, and supplying power from the main line, and through contacts 562*a* to sweep motor 94 which lowers sweep 199, in a manner previously described, into operative position relative to alley A. When sweep 199 reaches this position, sweep cam 92, which is rotated by shaft 236 of sweep motor 94, opens its contacts 92*a*, de-energizing sweep contactor 566 and stopping sweep motor 94. When contacts 92*a* opened, contacts 92*b* closed. Just prior to the sweep reaching its down-most position, a second sweep cam 100, also secured to shaft 236, closes its contacts 100*a* and opens contacts 100*b*. Sweep 199, as mentioned hereinabove, in this down position acts as a guard for the table T which is now about to descend.

Two timers, generally designated as 596 and 598, are provided. Timer 596 relays the start of the downward movement of table T after the first ball is rolled in order to allow time for standing pins to come to equilibrium. Timer 596 also delays the start of the sweep run-through on the second ball for the same reason. Timer 598 allows time for the last pin delivered to the last empty spotter H to become properly seated therein before the table can descend in a spotting operation. Both of these timers employ a resistance-capacity network operating on the grid of a triode or three element electron tube. When the contact controlling the timer is open, the grid is charged negatively during the time that the A. C. voltage supplied the circuit is of such a phase that the cathode is negative with respect to the grid. This charge is stored on the condenser. When the contact is closed, the cathode is connected to the opposite side of the A. C. line. Since the grid of the tube is at a negative potential with respect to the cathode, no plate current can flow. The charge on the condenser is dissipated by the resistance connected across the condenser. Depending on the value of this resistance, a finite time is required to reduce the value of negative grid voltage to the point where the tube will conduct. When this point is reached, plate current flows between the cathode and plate of the tube during the time that the A. C. voltage makes the plate positive with respect to the cathode. This results in pulses of plate current through the timer relay energizing this relay. The capacitor, or condenser, shunted or paralleled across the relay, stores a charge during the period of these pulses of current and tends to smooth out the current through the relay, preventing it from chattering. When the contact controlling the timer (between the cathode and one side of the A. C. supply) is opened, the plate and cathode are then connected to the same side of the A. C. line. Since these two elements of the tube are at the same voltage, no current flows between them. The relay then de-energizes and the charging operation starts in preparation for the next timing cycle.

More specifically, timer 596 consists of a triode or three element vacuum tube 597. In addition to the tube, timer 596 consists of an adjustable resistor 596*a* and a fixed resistor 596*b*. Adjustable resistor 596*a* allows setting of the operating point to desired time values by compensating for tolerances of the particular tube, relays, and capacitor used.

In the plate circuit of tube 597 is the coil of relay 560 shunted by a capacitor which smoothes the pulsating plate current flowing in the plate circuit of tube 597 when it is conducting and prevents the relay from chattering. Heater power for tube 597 is supplied by one winding, 528, of transformer 521. A. C. plate power for tube 597 is supplied by winding 530 of transformer

521. Lead 530*a* of winding 530 is connected to one end of the coil of relay 560; the other end of this coil is connected to the plate of tube 597. Lead 530*a* is also connected to the cathode of tube 597 through a resistance 569*d*. The cathode of tube 597 is connected to one side of contacts 540*b* of relay 540. The other side of contacts 540*b* is connected to lead 530*b* of winding 530 of transformer 521. The grid of tube 597 is connected to one side of resistances 596*a*, 596*b*, and to timing capacitor 596*c*. The other sides of resistances 596*a* and 596*b* are connected to contacts 544*c* and 544*d* of relay 544. The other sides of contacts 544*c* and 544*d* are connected together and to lead 530*b* of winding 530 of transformer 521. The other side of timing capacitor 596*c* is also connected to lead 530*b* of winding 530 of transformer 521. Relay 544 operation serves to connect one or the other of resistances 596*a* or 596*b* to lead 530*b* of transformer winding 530, thus placing either one or the other of the resistances in parallel with timing capacitor 596*c*. The values of these two resistances are such as to give two different values of timing in the operating of timer 596. Two values are required since the table delay period used for first ball cycles is essentially one-half of the sweep delay period used on second ball cycles.

Referring to Figure 3, it will be seen that the cathode of tube 597 is connected to lead 530*a* of winding 530 through resistance 596*d*. When, however, contacts 540*b* are closed, the cathode of tube 597 is also connected to lead 530*b* of winding 530. In this condition tube 597 has the grid connected to lead 530*b* of the transformer and the cathode and plate, through the resistor 596*d* and the coil of relay 560, respectively, are connected to lead 530*a*. In this condition no current flows between the cathode and plate, but the grid and cathode are connected as a diode or rectifier circuit and electrons flow from the cathode to the anode (grid) making the grid negative with respect to the cathode. This voltage between the grid and cathode charges timing capacitor 596*c* to a D. C. potential approaching the peak value of the A. C. voltage across winding 530. Resistors 596*a* and 596*b* act as a small load on this rectifier circuit. When contacts 540*b* of relay 540 close to start the timing period, the cathode of tube 597 is connected through these contacts to lead 530*b* of winding 530. Resistor 596*d* is then connected across this winding and acts as a small paralleled load across the winding in addition to the plate-cathode circuit of tube 597. Under these conditions, current would normally flow between the plate and cathode of tube 597. However, the charge stored on timing capacitor 596*c* biases the grid negatively with respect to the cathode and prevents the tube from conducting from plate to cathode. The grid and cathode no longer act as a diode rectifier, and the charge stored on the timing capacitor dissipates itself exponentially with time through either resistance 596*a* or 596*b*, depending on the position of relay 544. When the potential applied to the grid, equal to the voltage across the timing capacitor, falls below the cutoff value for the triode, current flows between the cathode and plate and energizes relay 560. Relay 560 will remain energized until contacts 540*b* are opened by the operation of relay 540, at which time the charging circuit previously explained is set up and relay 560 is deenerized since no current flows in the plate circuit of triode tube 597 when the cathode and plate are both connected to the same side of winding 530. When the tube of timer 596 conducts, relay 560 will be energized and its contacts 560*b* close and current then flows from rectifier 532 through contacts 92*b* 560*b*, 548*f*, 604*a* and energizes table contactor 564, closing contacts 564*a*.

Table motor 106 then receives power from the main line through contacts 562*a* and 564*a*. Crank arms 20, secured to motor shaft 108 (Fig. 1), rotate and table T descends. Contacts 604*a* are actuated by cam 604 secured to a shaft 610 (Fig. 1) which is driven from shaft 108 by suitable sprockets and a chain in a one to one ratio.

Also secured to the shaft 610 are cams 612, 614, 616, 618, 620, 622, 624, 626, and 628, the operations of which will be described later. These cams are enclosed with other components of the control mechanism in a control box designated generally 130 suitably detachably mounted on the machine, and preferably on top of the frame (Fig. 1), where it is readily accessible for replacement or repair.

As table T descends, contacts 618*a* of cam 618 close, so that when contacts 604*a* open, table T will continue its descent. The current to keep table contactor 564 energized is provided by rectifier 532 through contacts 544*g* and 618*a*. Continued rotation of shaft 610 causes contacts 612*a* operated by cam 612 to close and keep table contactor 564 energized from rectifier 532 when contacts 618*a* open. As table T moves into pin gripping position relative to pins standing on alley A, grippers G of respotting units U are moved automatically to gripping position to grip any pins left standing for lifting and respotting. If there is at least one standing pin, then one of the switches 136, associated with unit U corresponding to such pin, will be opened. Therefore, when contacts 626*a* of cam 626 are closed because of the continued rotation of shaft 610, the machine will not be put on a second ball cycle. Table T ascends without stopping, with grippers G holding pins gripped thereby for respotting and, while so doing, cam 624 closes its contacts 624*a* and current from rectifier 532 through contacts 624*a* and 548*c*, energizes the latch coil 545 of relay 544 which is then automatically latched in.

Continued rotation of shaft 610 causes cam 614 to close its contacts 614*a* and current from rectifier 532 flows through contacts 100*a*, 614*a*, 544*f*, 576*c* and energizes sweep contactor 566, closing contacts 566*a* which energizes sweep motor 94 and sweep 199 is moved rearwardly towards pit P on its sweeping operation. Just prior to the completion of one revolution of shaft 610, cam 604 closes its contacts 604*a* which keeps table contactor or relay 564 energized by current from rectifier 532 through contacts 92*b*, 560*b*, 548*f*, and 604*a*. Therefore power to table motor 106 continues to be supplied from the main line through contacts 562*a* and 564*a*. Thus the table starts its second descent during the first ball cycle.

SECOND REVOLUTION OF CONTROL CAM SHAFT 610

Continued rotation of shaft 610 causes cam 618 to close its contacts 618*a* to supply current to table contactor 564 when the contacts 604*a* are opened by cam 604. However, at this time contact 544*g* is open and until the sweep has completed its sweeping action and is out from underneath table T, cam 100 will not have closed its contacts 100*b*, and the circuit to table contactor 564 will be open. When the sweep completes its sweeping operation, cam 100 opens its contacts 100*a*, deenergizing sweep contactor 566 so that sweep motor 94 stops the sweep at the front of the machine where it remains in its "down" position adjacent the alley. A sweep cam 132 secured to shaft 236 at this time has closed its contacts 132*a*. Contacts 100*b* are also closed and the table contactor 564 is energized by current from rectifier 532 through contacts 100*b* and 618*a*, thus supplying power to table motor 106 and permitting the table to descend to respot pins which were lifted, in their respective on or off-spot positions on the alley.

Due to continued rotation of shaft 610, cam 612 closes its contacts 612*a* so that when cam 618 opens its contacts 618*a*, table contactor 564 will be maintained in an energized position, thereby supplying power to table motor 106 so the table may complete its second trip. As shaft 610 continues to rotate, cam 622 closes its contacts 622*a*, and current from rectifier 532 through contacts 622*a* and 544*e* energizes unlatch coil 542 and unlatches relay 540. Contact 540*b* opens and relay 560 is deenergized. Cam 626 then closes its contacts 626*a*, and

current from rectifier 532, passing through contacts 626*a* and 544*a*, energizes the latch coil 549 of relay 548 which is then automatically latched in. This results in closing contacts 548*b* and relay 576 is energized by current from rectifier 532. Then contacts 576*a* open and the first ball light 648 is extinguished, contacts 576*b* close and the second ball light 650 is illuminated. Now that both relays 544 and 548 are latched, the electrical control is set up for a second ball. Table T then ascends, and as this takes place, cam 616 closes its contacts 616*a*. Therefore, current from rectifier 532, through now closed contacts 132*a*, 616*a*, and 540*d*, energizes sweep contactor 566, providing power to motor 94. The sweep is therefore raised to its "up" position and when cam 132 opens its contacts 132*a*, the upward movement of the sweep is arrested and it remains in its inoperative position above alley A. Just prior to the completion of the second revolution of shaft 610, cam 612 opens its contacts 612*a*, and the table motor 106 overrides and brings the table to rest at the completion of two complete revolutions of the main crank shaft 108.

Both motors 94 and 106 are provided with a conventional type of electrically released, spring operated brake which limits the amount of override of the table and the sweep when power to each motor is interrupted, such that table T and sweep 199 always come to rest in a closely controlled proper position.

Second Ball

The following occurs during a normal second ball cycle: As with the first ball, the second ball strikes or rolls against backstop 88 and closes pit switch 90. Relay 540 will be latched in and the sweep descends, as before. When the sweep reaches its lowermost or "down" position relative to alley A, contacts 92*b* are closed, as are also contacts 620*a* of cam 620. Therefore current from rectifier 532, through contacts 92*b*, 548*d* and 620*a*, energizes relay 572, closing contacts 572*a*. No power is supplied to solenoid 82 at this time because table contactor 564 is not energized, and since its contacts 564*a* are not closed, motor 106 is not operated and table T remains in its "up" position. The cathode of the tube of timer 596 is again connected to the opposite side 530*b* of transformer winding 530. This time, however, the timer condenser discharges through contacts 544*d* and a different timer resistance 596*b*, which, being greater, provides a longer delay before the tube conducts and energizes relay 560. As the sweep is lowered, cam 100 closes its contacts 100*a*. When the tube conducts, relay 560 is energized and contacts 560*a* will close. The sweep contactor 566 is then energized by current from rectifier 532 through contacts 100*a*, 614*a*, 544*f*, and 560*a*. Contacts 566*a* of sweep contactor 566 close and power is supplied to sweep motor 94, which then operates the sweep through its sweeping operation as before. Just prior to the stopping of sweep motor 94, sweep cam 134, secured to shaft 236, closes its contacts 134*a*.

As soon as ten pins fed by distributor D from elevating mechanism 370 to spotters H of table T have tripped lever arm 138 of counter 140, counter switch 142 is closed and latch coil 553 of latch relay 552 is energized by current from rectifier 532 through the closed contacts 144*a* of distributor switch 144 and counter switch 142. This relay automatically latches itself in, opening contacts 552*b*, which de-energizes relay 570 opening its contacts 570*a* which de-energizes solenoid 380. De-energization of solenoid 380 moves gate 397 into coincidence with cam 394 whereupon grip rods 350 are held in clamping engagement with pins in pockets 331. This prevents additional pins from being delivered by elevating mechanism 370 to distributor D until such time as spotters H have spotted their ten pins and are in receiving position. When distributor D after delivering a pin to each of the spotters H again, as shown in Figure 2, reaches #10 position, the contacts 144*b* of the distributor switch 144 are closed by a contact arm 146 (Figs. 1 and 2).

Counter 140 is provided with a ten tooth ratchet 150, Fig. 3A, mounted on shaft 152 having secured thereto a one tooth trip cam 154. Ratchet 150 is actuated by a spring mounted pawl 156 pivoted to ratchet arm 158 supported on stud shaft 160 to which is also secured pin actuated trip finger 138. Each pin passing trip finger 138 results in the advancing of one tooth of ratchet 150. A nose 162 on trip cam 154 turning intermittently with ratchet 150 is so arranged that it will close switch 142 when the tenth pin passes trip finger 138. The zero position of ratchet 150 and the position assumed by the distributor after delivery of ten pins to the spotters H of table T correspond.

When relay 552 is latched in, contacts 552*c* close and start timer 598, the purpose of which is to provide a time delay to prevent the descent of table T during a spotting cycle until proper seating of the last pin of a set of ten pins in its spotter H. When the tube of timer 598 conducts, the relay 568 is energized and its contacts 568*a* close, whereupon a circuit is now completed and table contactor 564 is energized by current from rectifier 532 through contacts 144*b*, 134*a*, 568*a*, 548*g* and 604*a*. Contacts 564*a* close, motor 106 is actuated, and table T moves downwardly. At the same time, the closing of contacts 564*a* completes a circuit from the main line through contacts 562*a*, 564*a*, and 572*a* which energizes solenoid 82 and releases the spotting mechanism so that when table T descends to spotting position, the ten pins in spotters H will be spotted on the alley. Table T descends and ascends through the same series of circuits used during the first revolution of shaft 610 after the first ball. During the rotation of shaft 610, cam 622 closes its contacts 622*a* and unlatches relay 540 as before. Switch 144 is operated only when the distributor is in the #10 position. When operated by the distributor, contacts 144*b* are closed and contacts 144*a* are opened. The distributor stays in the #10 pin position during a spotting operation of the table. As the table approaches the end of a spotting operation, relay 552 unlatch coil 554 is energized to unlatch relay 552 and restore pin feeding operation from the pin wheel to the distributor. In order for relay 552 to be unlatched, electrical power must be removed from the latch coil 553. Since switch 142 is closed when the ratchet counter is in the zero position, corresponding to the delivery of ten pins, the circuit to the latch coil of relay 552 must be interrupted at this time since latch relays of the type used when energized on both coils simultaneously from the same power supply will not change position but will remain in the position existing prior to the application of power to both coils. To provide the necessary circuit interruption in the latch coil circuit, switch 144 is used. This switch is operated by the distributor when proceeding from the #6 to the #10 pin position; this movement of the distributor is the last movement made in the delivery of a set of ten pins to the table.

Both switches 144 and 142 have to be operated for table T to be lowered for a spotting operation. Switch 142 provides information to the control system that ten pins have passed down the distributor belt; switch 144 provides information that one complete trip around the distributor track has been made by the distributor. When both of these switches are operated, the control system has assurance that the ten pins have been delivered from the wheel to the distributor and have been placed in the table by the distributor. This double check system prevents operating of the table for a spotting operation with pins not in the correct position, which should result in an incorrect setup of pins for the bowler or possible damage to table T.

The opening of contacts 540*b* de-energizes relay 560. The closing of contacts 540*e* completes a circuit from rectifier 532 through contacts 622*a*, 548*e*, and 540*e* which

energizes unlatch coils 546 and 554, thereby unlatching relays 544 and 552 respectively. Unlatching of relay 552 closes contacts 552*b* which energizes relay 570 closing contacts 570*a* and energizing solenoid 380. This results in opening gate 397 in cam 394 which is holding grip rods 350 in engagement with pins in pockets 331, and as disc 371 rotates, pins drop from pockets 331 into device 342 of the distributor, which in turn delivers them by belt 346 to spotters H of table T. Further rotation of shaft 610 causes cam 628 to close its contacts 628*a*, which completes a circuit through contacts 544*b*, energizing unlatch coil 550 which unlatches relay 548 opening contacts 548*b*. This de-energizes relay 576 closing contacts 576*a* and opening contacts 576*b* which lights the first ball light 648 of the next frame and extinguishes the second ball light 650 of the completed frame, respectively. As the table ascends, contacts 616*a* close, and as before, the sweep goes up and stops. Table T stops at the end of one revolution of shaft 108 and dwells above alley A, the same as on the second revolution of the first ball cycle.

Latch relays 552, 540, 544, 556 and 548 used in the control circuit remain in their last energized positions in case of a power failure so the information that the latched or unlatched positions of these relays represent is not lost due to a power failure. When power is resumed, the machine resumes operation at the same point in a particular type of cycle and with the same information storage as was present in the control system when the power failure occurred.

Strike

If a strike occurs, i. e. when all pins are knocked down by the first ball of a frame, the following happens: The initial operations are the same as for the first ball, but as there will be no pins standing, when table T is moved downwardly no gripper G will operate its respective strike switch 136. Therefore the series circuit through all ten strike switches 136 remains closed when cam 626 closes its contacts 626*a*. This latches in relays 544 and 548, which puts the electrical control on a second ball cycle. The relay 578 is also energized and the strike light 652 goes on. When contacts 626*a* close, relay 578 is energized by current from rectifier 532 through strike switches 136 and contacts 548*c*, 556*a*, and 624*b*. When relay 578 is energized, its contacts 578*b* close and lock the relay in, current being supplied from rectifier 532 through contacts 622*b*, and 578*b*. Contacts 578*a* are now closed and the strike light 652 glows, power being directly supplied from winding 528. This light stays on until cam 622 opens its contacts 622*b*, which occurs during the next revolution of shaft 610. This de-energizes relay 578. When contacts 626*a* close, relay 544 is latched in by current from rectifier 532 through switches 136 and contacts 548*c*. When relay 544 is latched in, its contacts 544*a* close and current from rectifier 532, through contacts 626*a* and 544*a*, energizes latch coil 549 which latches in relay 548.

The table ascends, and as soon as cam 614 closes contacts 614*a*, a circuit is completed from rectifier 532 through contacts 100*a*, 614*a*, 544*f* and 560*a*, whereupon sweep contactor 566 is energized closing contacts 566*a*. Thus motor 94 is actuated and sweep 199 operates, using the same circuit as for a second ball cycle. When the sweep completes its operation, and providing there are ten pins in spotters H, and providing the tube of timer 598 is conducting and energizes relay 568, table T descends, spots ten pins and returns to its up position, the same as during a second ball cycle. The sweep returns to its up position also.

Foul—First Ball

The following occurs during the first ball foul: When the foul is committed, the manual foul button 654 is depressed and held. This energizes relay 574 and closes its contacts 574*a*. When the ball reaches the pit and actuates pit switch 90, relay 540 is latched in, as described above, and contacts 540*a* close and complete a circuit from rectifier 532 through contacts 92*a*, 540*a*, 574*a* and 548*a*. This energizes the latch coil 557 of relay 556 which is then latched in. When a current passes through coil 557, relay 556 is pulled in, closing contacts 556*b* and 556*c* and energizing relays 544 and 548. When relay 574 is energized, contacts 574*b* close and a foul light 656 is illuminated by current from winding 528. After relay 556 latches in, contacts 556*d* close and keep the foul light 656 lit until the time that relay 556 is unlatched.

When relay 556 latches in, contacts 556*b* and 556*c* close and energize the latch coils 545 and 549 directly from rectifier 532. The relays 544 and 548 of these coils are then latched in, which puts the electrical control on a second ball or spotting cycle. The machine sweeps and spots ten new pins. Ordinarily, relays 544 and 548 would be unlatched during this one revolution of a second ball cycle. However, the next ball rolled by the bowler will be a normal second ball. Therefore it is necessary to maintain electrical control on a second ball cycle by keeping relays 544 and 548 latched in. This is accomplished in the following manner: The latch relays 544 and 548 have the property that if a maintained voltage is applied to one coil, then application of an equal voltage to the opposite coil will have no effect on the position of the relay. Therefore, relay 556 is held latched in until after the period that relays 544 and 548 would be unlatched. Consequently, the contacts 556*b* and 556*c* of relay 556 remain closed and apply voltage to the latch coils 545 and 549 of relays 544 and 548 at a time when the regular unlatching of these relays would be effected by cams 622 and 628. Therefore, the unlatching operation is ineffective and at the end of the cycle, both these relays will still be latched and the electrical control will be set up for a second ball or pin spotting cycle. However, when cam 622 closes contacts 622*a*, a circuit is established from rectifier 532, through contacts 622*a* and 544*e* which energizes coil 542 unlatching relay 540. Cam 628 unlatches relay 556 by energizing unlatch coil 558 through contacts 552*a*. Opening of contacts 556*d* extinguishes the foul light 656.

Foul—Second Ball

On a second ball foul when the manual foul button 654 is depressed relay 556 is not energized because contacts 548*a* are open. Therefore the machine will go through a normal second ball cycle. When foul button 654 is depressed it energizes relay 574 and contacts 574*b* close. This supplies the foul light with current from winding 528 and the light is illuminated, indicating a foul has been committed.

The invention above described may be varied in construction within the scope of the claims, for the particular device, selected to illustrate the invention, is but one of the many possible concrete embodiments of the same. It is not, therefore, to be restricted to the precise details of the structure shown and described.

What I claim is:

1. In a bowling pin spotting machine of the type comprising a pin elevating mechanism to be mounted in the pit of a bowling alley for elevating pins to a discharge point, a travelling pin distributor mounted adjacent said discharge point and including a conveyor disposed to receive pins from the pin elevating mechanism, and a pin spotting table provided with a plurality of spotters mounted in spotting arrangement, said table being movable toward and away from the alley bed and including means actuatable to release pins carried by said spotters, said distributor being constructed and arranged for movement to distribute a pin to each spotter in succession, the combination of control mechanism for said elevating

mechanism, said distributor and said pin spotting table comprising counting means operatively associated with said distributor to count pins as they are advanced toward said table by said distributor, position responsive circuit controlling means disposed for actuation by said distributor as said distributor is moved to a position to deliver a pin to a given one of said spotters, circuit means controlled by said counting means and operatively associated with said elevating mechanism to terminate discharge of pins by said elevating mechanism to said distributor when said counting means has detected a predetermined number of pins, and second circuit means for effecting actuation of said pin releasing means, said second circuit means being controlled jointly by said counting means and said position responsive means to condition the same for actuation only when said counting means has detected a predetermined number of pins and said position responsive means has been actuated by movement of said distributor to said position.

2. In a bowling pin spotting machine, the combination of a pin elevating mechanism to be mounted in the pit of a bowling alley for elevating pins to a discharge point, a travelling pin distributor mounted adjacent said discharge point and including a conveyor disposed to receive pins from the pin elevating mechanism, a pin spotting table provided with a plurality of spotters mounted in spotting arrangement, said table being movable toward and away from the alley bed and said spotters being actuatable to release pins for spotting thereof, said distributor being constructed and arranged for movement to distribute a pin to each spotter in succession, actuating means connected to said spotters to actuate the same for the release of pins, a solenoid operated latch operatively associated with said actuating means, drive means for actuating said pin spotting table, counting means operatively associated with said distributor to count pins as they are advanced by said distributor toward said table, position responsive circuit controlling means disposed for actuation by said distributor as said distributor is moved to a position to deliver a pin to a given one of said spotters, first control means for effecting operation of said drive means, second control means for actuating said latch to cause said spotters to release pins, and circuit means for activating said first and second control means, said circuit means being controlled jointly by said counting means and said position responsive means to condition the same for actuation only after said counting means has detected a predetermined number of pins and said position responsive means has been actuated by movement of said distributor to said position.

3. In a bowling pin spotting machine, the combination of a pin elevating mechanism to be mounted in the pit of a bowling alley for elevating pins to a discharge point, a travelling pin distributor mounted adjacent said discharge point and including a conveyor disposed to receive pins from the pin elevating mechanism, a pin spotting table provided with a plurality of spotters mounted in spotting arrangement, said table being movable toward and away from the alley bed and said spotters being actuatable to release pins for spotting thereof, said distributor being constructed and arranged for movement to distribute a pin to each spotter in succession, actuating means connected to said spotters to actuate the same for the release of pins, drive means for actuating said pin spotting table, counting means operatively associated with said distributor to count pins as they are advanced by said distributor toward said table, position responsive circuit controlling means disposed for actuation by said distributor as said distributor is moved to a position to deliver a pin to a given one of said spotters, an electrical circuit connected to actuate said drive means and said spotter actuating means, said circuit including a time delay device, and means connecting said counting means and said position responsive means to said circuit to condition said circuit for actuation of said drive means and spotter actuating means only when said counting means has detected a predetermined number of pins and said position responsive means has been actuated by movement of said distributor to said position.

4. In a bowling pin spotting machine, the combination of a pin elevating mechanism to be mounted in the pit of a bowling alley for elevating pins to a discharge point, a travelling pin distributor mounted adjacent said discharge point and including a conveyor disposed to receive pins from the pin elevating mechanism, a pin spotting table provided with a plurality of spotters mounted in spotting arrangement, said table being movable toward and away from the alley bed and said spotters being actuatable to release pins for spotting thereof, said distributor being constructed and arranged for movement to distribute a pin to each spotter in succession, actuating means connected to said spotters to actuate the same for the release of pins, an electrical motor arranged to drive said pin spotting table, electrical means arranged to control said spotter actuating means, counting means operatively associated with said distributor to count pins as they are advanced by said distributor toward said table, position responsive circuit controlling means disposed for actuation by said distributor as said distributor is moved to a postion to deliver a pin to a given one of said spotters, a time delay device, circuit means controlled jointly by said counting means and said position responsive means to activate said time delay device only when said counting means has detected a predetermined number of pins and said position responsive means has been actuated by movement of said distributor to said position, and means operated by said time delay device for actuating said motor and said electrical means.

5. In a bowling pin spotting machine of the type having a movable pin spotting mechanism having a plurality of spotters, and a travelling pin distributor constructed and arranged for movement to distribute a pin to each spotter in succession, the combination of counting means for counting pins as they are advanced toward said spotting mechanism by said distributor, a position responsive switch disposed for actuation by said distributor as said distributor is moved to a position to deliver a pin to a given one of said spotters, and electrical means for actuating said pin spotting mechanism, said electrical means being controlled jointly by said counting means and said switch to condition the same for actuation only when said counting means has detected a predetermined number of pins and said position responsive means has been actuated by movement of said distributor to said position.

6. In a bowling pin spotting machine of the type having a movable pin spotting mechanism having a plurality of spotters, and a travelling pin distributor constructed and arranged for movement to distribute a pin to each spotter in succession, the combination of counting means for counting pins as they are advanced toward said spotting mechanism by said distributor and including a counter switch, a position responsive switch disposed for actuation by said distributor as the distributor is moved to a position to deliver a pin to a given one of said spotters, means arranged to control said pin spotting mechanism and including an actuating relay, and circuit means connecting said counter switch and position responsive switch in series to actuate said relay to control said pin spotting mechanism only when said counting means has detected a predetermined number of pins and said position responsive means has been actuated by movement of said distributor to said position.

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