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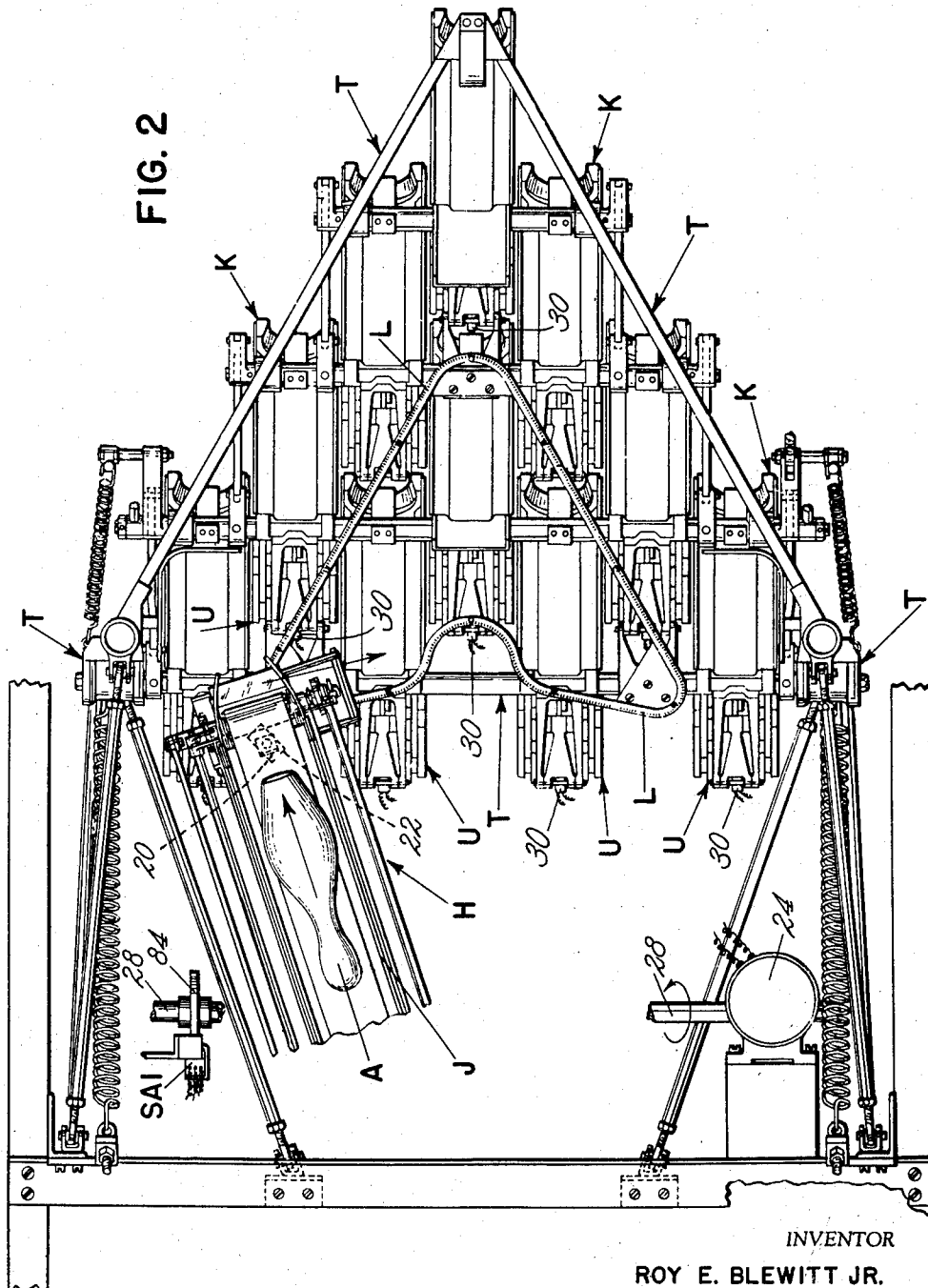
R. E. BLEWITT, JR

3,082,001

BOWLING PIN SPOTTING MACHINES

Original Filed Oct. 30, 1956

3 Sheets-Sheet 2



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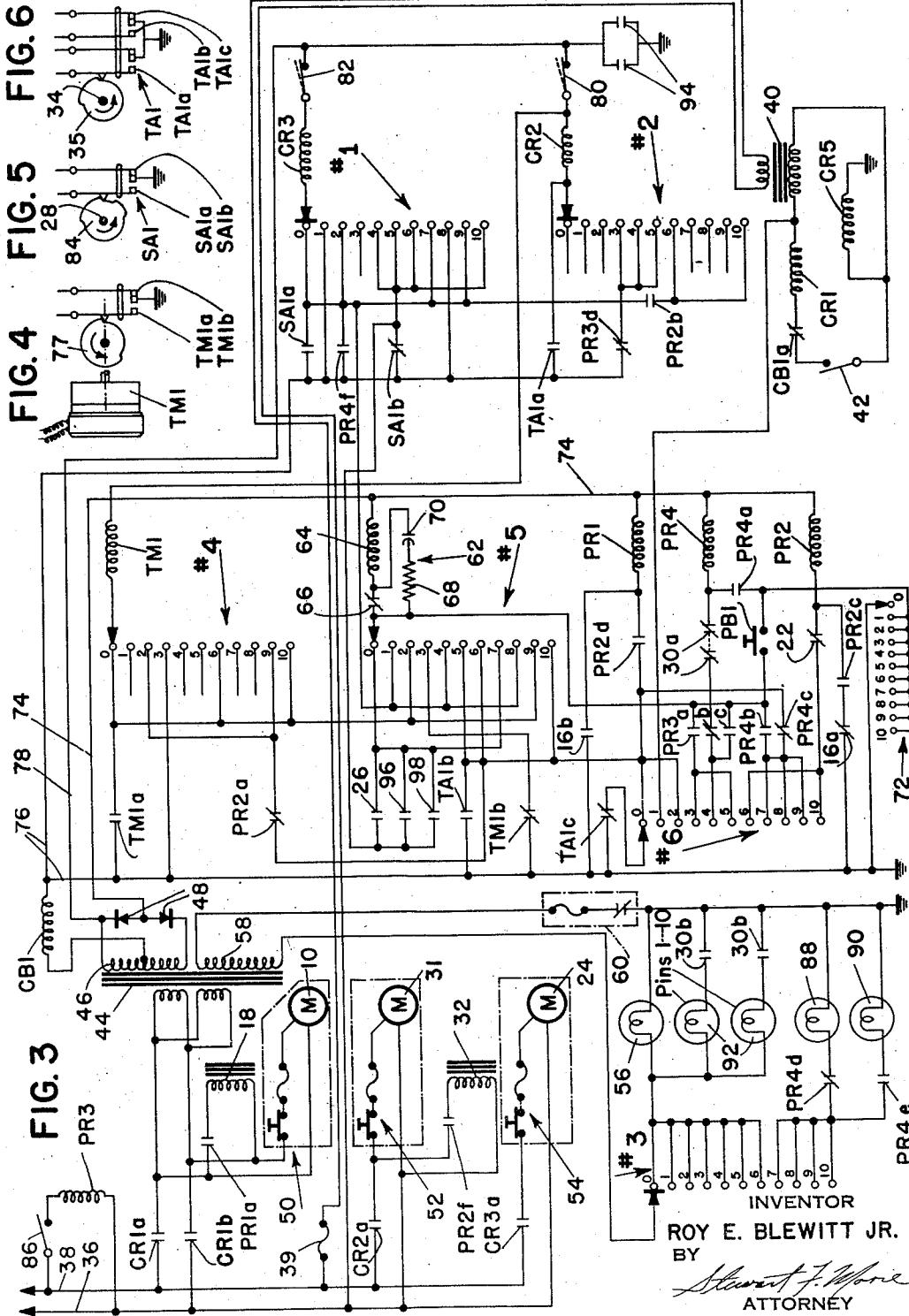
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BOWLING PIN SPOTTING MACHINES

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Original application Oct. 30, 1956, Ser. No. 619,343, now Patent No. 2,983,510, dated May 9, 1961. Divided and this application June 23, 1960, Ser. No. 38,390

1 Claim. (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 on the playing bed of a bowling alley, and to an improved and simplified control system for such a machine.

This application is a division of copending application, Serial Number 619,343, filed October 30, 1956, now Patent No. 2,983,510.

Heretofore, control systems for bowling pin spotting machines have utilized complex electrical circuitry which in some machines included interconnections between a plurality of rotatable, cam operated switches driven by several of the main movable elements to a pin spotting machine or, in the case of other machines, switches disposed in selected positions along the path of travel of the moving elements, and a multi-level stepping switch. These cam operated switches provided information as to the location of the movable elements such as the pin spotting table and sweep, and this information was programmed through the stepping relay which was selectively advanced to energize other selected circuits which, in turn, initiated functions relevant to the operation of the machine when the movable elements were in a particular position. Such control systems required many switches, cams and interlocking relays with complex associated circuits to indicate to the programming stepper switch where each movable element was disposed at a particular instant in the course of a game being played.

It is therefore an object of the invention to provide an improved and simplified control circuit for a bowling pin spotting machine which reduces to a minimum the number of positioning determining devices for the movable elements of the machine.

In accordance with the invention a switch actuating, timing device is provided which defines intervals representative of the relative time differentials required for the major moving elements to perform their various functions during the course of operation of the machine while the game is being played. By further providing a single cam operated switch on each of a minimum number of the major movable elements, the off-on character of the information provided by such switches is correlated with the selective actuation of switches associated with the timing device and jointly cooperates with a multi-position switching relay to cause it to properly program the non-repetitive sequences of the basic operating cycles required for playing a bowling game.

It is therefore another object of the invention to provide an improved and simplified control circuit for a bowling pin spotting machine which has means for effecting the non-repetitive sequences of the basic operating cycles required for playing a bowling game in response to the relative time disposition and differentials associated therewith of the functions performed by the elements of the machine.

It is yet another object of the invention to provide a bowling pin spotting machine having an improved and simplified control mechanism which enables the machine to operate under all conditions of play with a minimum amount of programming information.

With these and other objects of the invention not spe-

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cifically mentioned in view, the invention comprises certain combinations and constructions which will be described fully hereinafter and 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 constructed in accordance with the invention;

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

FIG. 3 is a schematic circuit diagram illustrating the preferred form of the novel electrical control system in accordance with the invention;

FIG. 4 is a schematic view of the timer motor and associated cam operated switch;

FIG. 5 is a schematic view of the cam which is operative in response to the rotation of the sweep operating shaft;

FIG. 6 is a schematic view of the cam and associated switch which is operated in response to the rotation of the table operating shaft.

In the embodiment of the invention illustrated herein, the improved 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.

Referring now to the drawings, and particularly to FIGS. 1 and 2, the machine illustrated therein, with the exception of the novel control mechanism of the present invention, is similar in construction and operation to that disclosed in Patent Number 2,890,886, issued June 19, 1959 to Roger E. Dumas. The mechanism illustrated for removing pins from the pit to the bowling alley is also similar in construction and operation to that disclosed in Patent Number 2,767,983, issued Oct. 23, 1956 to Robert O. Holloway and John Zuercher for Bowling Pin Elevating Mechanism. 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 Patent Number 2,767,984, issued Oct. 23, 1956 to John Zuercher for Pin Handling Mechanism for Bowling Pin Spotting Machines. 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 Patent Number 2,781,395, issued Feb. 12, 1957 to Robert L. Holloway et al. for Bowling Pin Spotting and Respotting Mechanism. 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 B 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 patents, 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 structures shown in the above referred to patents.

As shown in FIG. 1, bowling pins A when struck by a ball, fall from or are removed from alley B and gutters C by means of a sweep and guard designated generally

as S. The mechanism for actuating sweep and guard S 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 B or delivered into pit P drop onto a conveyor designated generally as E, similar in construction and operation to that disclosed in Patent Number 2,767,983 issued to R. Holloway et al., and Patent Number 2,821,395 issued to R. Dumas. This conveyor is pit wide, and continually in motion, whereby pins are moved out of pit P and delivered to pin elevating mechanism F. Bowling balls dropping upon conveyor E roll and are carried downwardly by conveyor E 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 A are delivered from conveyor E into pockets formed in the rim of a rotary disc G of pin elevating mechanism F. Disc G is mounted for rotation on a horizontal shaft and is driven by a suitable arrangement of pulleys and belts by means of a motor 10. The pins A are carried upwardly by disc G to a position which is substantially directly above pit P where each pin A is discharged into a pin distributor generally indicated as H. In the illustrated embodiment, disc G is divided with seven pin holding and conveying pockets and is constructed and operated in the same general manner as the mechanism shown and described in Patent Number 2,767,983, issued to R. Holloway and J. Zuercher. Therefore further showing and description are deemed unnecessary herein because this mechanism does not form a specific part of the invention.

Distributor H which includes an elongated telescopic, generally U-shaped chute J, is mounted for lateral movement back and forth across the machine, and also for vertical movement. This arrangement makes it possible to deliver pins A in succession from pin elevating mechanism F and selectively into spotters K on table T not only when table T is stationary, but also as it is moving to and from alley B. Pin spotters K 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 travels through channel J, it passes beneath a trip arm 12 which actuates a counting device 14. After ten pins have actuated trip arm 12, a switch 16 in counter 14 is closed which de-energizes solenoid 18. Solenoid 18 is connected to the pin releasing or delivering mechanism of pin elevator F, and when solenoid 18 is de-energized, pins are not delivered from elevator F into distributor mechanism H. On the other hand, until ten pins have actuated trip arm 12, switch 16 remains open, thus allowing pins to drop or roll into aligning device J from elevator disc G. The construction and operation of the pin releasing mechanism or elevator F are substantially the same as that shown and described in Patent Number 2,767,984 issued to J. Zuercher and Patent Number 2,821,395 issued to R. Dumas, above referred to, and a detailed description is not deemed necessary herein.

During the course of operation of distributor H, the latter moves both laterally, vertically, and longitudinally, until at #10 position (see FIG. 2), an arm 20 mounted on the distributor H engages and operates a switch 22 supported by a bracket suitably located and attached to table T. The operation of switch 22 is described more in detail hereinafter in the description of the circuit diagram in FIG. 3. The front end of distributor H is adapted to move about table T in an intermittent fashion, being guided in its movement by heart-shaped track L and stopping adjacent each spotter K to deliver a pin thereto. Distributor chute J moves in a telescopic fashion as it travels a course about track L.

When each of the spotters K contains a pin, further movement of distributor H is arrested until it is again necessary to feed pins to the spotters. Distributor H, and more particularly chute J with associated conveyor belt, is driven continuously from motor 10 by means of suitable mechanical linkage.

Table T, which is supported in a suitable frame, is moved in a controlled and selective manner to and from alley B whenever pins are to be spotted or respotted thereon. As shown, table T is generally triangular in form and supports ten triangularly arranged spotters K, and ten complementary respotter units U. It is so mounted and stabilized that it is maintained in a substantially horizontal, parallel relationship with alley B at all times. Table T is moved to and from alley B by means of motor 31 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 S 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. In the operation of the machine, sweep S, which also operates as a guard mechanism, is set in motion when a ball rolled by the player lands in pit P of the alley B and effects the closing of a pit switch 26, which is mounted adjacent a ball impact cushioning device M. The closing of pit switch 26, when cushioning device M is urged rearwardly by the impact of a ball thereon, effects the starting of sweep motor 24 (FIGS. 2 and 3), which in turn causes a shaft 28 to start rotating in the direction of the arrow shown in FIG. 2, and sweep S begins its downward movement into operative guarding and sweeping positions adjacent alley B.

Each cycle of operation of the machine requires one revolution of shaft 28. A single cam operated switch, indicated generally as SA1, is mounted upon shaft 28 and is adapted to be actuated at selected intervals during rotation of shaft 28. Cam switch SA1 forms a part of the electrical control circuit shown in FIG. 3 and described hereinafter.

Motor 31 is mounted on a cross member of the machine frame, FIG. 1, and is provided with a conventional gear reduction and associated driving mechanism connected to table T which causes the table to be lowered and raised in respect to alley B for spotting and respotting pins thereon. Each spotter K is suitably attached to a bracket on table T which, in turn, is movably attached to an operating shaft which is adapted to be rotated by motor 31 during the spotting operation. The operating shaft for the spotters is provided with suitable mechanism so that when pins are to be spotted on alley B, all of the spotters K are swung from an inclined pin receiving and supporting position shown in FIG. 2 into substantially vertical pin delivering position and pins are deposited thereby on alley B when table T is moved by motor 31 and associated driving means into a lower or pinspotting position relative to the alley. As the pin spotting units K and respotting units U and the operating means therefor form no part of the present invention, reference is made to Patent Number 2,781,395, issued to R. Holloway et al., for a full description and showing of the spotters K and respotters U and apparatus for operating them.

As shown in FIG. 1 each respotting unit U is provided with a pair of grippers designated generally as N which have mechanical linkage means associated therewith to actuate a normally closed switch 30 when a pin is gripped by grippers N. The action of the grippers is such that when table T is lowered after the rolling of the first ball of a frame, and any pins are left standing on alley B, the heads of such pins will be engaged by the grippers and continued downward movement of table T results in concurrent inward movement of the grippers N to grip on or off-spot standing pins.

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The switches 30 are connected in series so that whenever a pin is gripped by a gripper N, its associated switch is operated to break in series circuit connecting the ten switches. The construction and operation of the respotting unit U is substantially the same as that shown and described in Patent Number 2,890,886, issued to R. Dumas and since it forms no specific part of the present invention, a detailed description herein of the respotting unit and its associated switching mechanism is not deemed necessary.

When bowling pins are to be spotted on alley B, a solenoid 32 is energized. This rocks associated bell-crank lever and other mechanical linkage generally designated as Q and causes spotting units K to move from an inclined to a substantially vertical position when table T is located in Position #I as indicated in FIG. 1, thereby resulting in the delivery of ten pins in spotted arrangement on alley B.

Table drive motor 31, through the mechanical linkage mentioned hereinabove, rotates a main driving shaft 34 which, in turn, drives the spotting and respotting units. A single cam operated switch generally indicated as TA1 (FIG. 1) is mounted on shaft 34 and forms a part of the simplified and improved control circuit of the present invention and will be described in more detail hereinafter.

The control mechanism, selected for purposes of illustration, employed with collecting, pin handling, spotting and respotting mechanisms described hereinabove, may be termed a three-cycle system wherein there are provided three revolutions of table shaft 34 or three down and up trips of table T for each normal frame consisting of a first ball, or respot operation, and a second ball, or spotting operation. Each of these operations (ball cycles) requires one complete cycle of operation of sweep S which removes deadwood and unwanted pins from alley B.

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

I. First Ball Cycle:

Respot operation, two trips of table T to and from alley B—machine resets to second ball.

II. Second Ball Cycle:

Normal second ball—Spotting operation, one trip of table T to and from alley B—machine resets to first ball.

Second ball foul—Same as normal second ball operation except that a foul light indicates that a foul has been committed.

III. 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 B.

IV. First Ball Foul Cycle:

Spotting operation—trip of table T to and from alley B—machine resets to second ball and a foul signal is actuated.

Referring now to FIG. 3, power for the control circuit is furnished from a conventional, commercial source of voltage, such as 110 v.—60 cycles, which is applied to the circuit by means of main power lines 36, 38. Voltage from lines 36, 38 is applied through a safety fuse 39 to the primary of a transformer 40 which, in turn, supplies a low voltage to the main power control circuit, consisting of a series circuit which has a switch 42, normally closed contacts CB1a of a circuit breaker CB1 and the actuating coil of relay CR1. When manually operated switch 42 is closed, coil or relay CR1 is energized thereby closing contacts CR1a and CR1b which, in turn, connect the primary of a multiwinding transformer 44 to the power line mains. Although switch 42 is represented as a single-pole, single-throw switch, yet it will be understood that it may represent one or more switches which may be positioned at convenient points about a bowling alley.

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For example, one switch may be positioned near the pin spotting end of an alley, while another is connected in series therewith and conveniently located at the controlling or manager's desk for controlling a plurality of machines.

Transformer 44 is adapted to supply proper control voltages to the electro-magnetic control elements of the control mechanism, and preferably has relatively low voltage outputs in comparison with that received by lines 36, 38. Winding 46 of transformer 44 is connected to a pair of diode rectifiers 48 which, for purposes of illustration, are shown as connected in a manner such as to form a full-wave rectifier circuit in order to furnish D.C. to the control mechanisms where required. Transformer winding 46 is center tapped to provide a conventional return path for the full wave rectifier circuit and is connected to a common chassis ground line 76 through circuit breaker coil CB1. Thus it will be seen that when an overload occurs causing excessive current to be drawn into the control circuit, normally closed relay contacts CB1a will open, thereby de-energizing relay coil CR1 and opening contacts CR1a and CR1b to remove all power from the control circuit. The closing of contacts CR1a, CR1b also supplies power to pin elevating motor 19 which drives pin elevating mechanism F and distributor H.

Sweep motor 24 is connected to the main power lines 36, 38 through normally open contacts CR3a while table motor 31 is supplied power from lines 36, 38 through a normally open contact CR2a. Each of the motors 19, 24, 31 is protected by an individual thermo-overload unit 50, 52, 54 respectively, which may be of the type having a thermally expansible circuit breaking member with associated reset button. A light 56, provided for indicating that the machine is ready for a first ball, is illuminated by current from winding 58 of transformer 44 flowing through an overload circuit breaker 60, and contact zero of level 3 of stepper relay 62.

Stepper relay 62 is used to develop the program required for the several sequences necessary to the types of cycles of operation listed above and is substantially identical in construction to that described in detail in Dumas Patent Number 2,890,886. In the stepper relay illustrated in FIG. 3, six levels of contacts are used, and are accordingly designated #1-#6, inclusive. Each level is provided with a home or zero contact and ten contacts corresponding to successive positions of the conventional rotary wiper arms. Any type of stepper relay construction may be used so long as it provides means for repetitive cycling of eleven contacts. It will be noted that the wiper arms of levels 1, 2, 3 are of the bridging or short-circuiting type, whereas the wiper arms of levels 4, 5, 6 are of the non-bridging or open circuiting type. All wiper arms are physically ganged together so that like contacts of each level are wiped by their respective arms.

Each level of contacts and its associated wiper arm selectively control the operation of particular elements of the machine. For example, in the illustrated embodiment of the invention disclosed herein, the wiper arm and contacts of level #1 control the starting of motor 24 and hence the operation of the sweep mechanism driven thereby. Level #2, through associated wiper arm and contacts, controls the starting of motor 31 which lowers and raises table T. The wiper arm and associated contacts of level #3 provide means for indicating to the bowler pinfall resulting from each first ball of a frame rolled, and for showing which ball of a frame is to be rolled, and also for indicating the occurrence of a strike.

The circuit with associated indicating lights operated by level #3 is substantially similar to that operated by level #3 of the stepping switch shown and described in detail in Dumas Patent Number 2,890,886.

The contacts and associated wiper arm of level #4 control the operation of the timer motor TM1 which, acting in cooperation with cam switches SA1 and TA1,

arrange the programming of the machine. Levels #5 and #6 of stepping relay 62 control the operation of the machine corresponding to pinfall resulting from a normal two-ball frame, or a strike, and also insure the correct cycling of the machine when a foul is made. In addition, level #6 initiates the operation of the delivery of pins by the pin elevating mechanism to distributor H after table T has spotted a set of pins on alley B.

Stepper relay 62 is diagrammatically shown in FIG. 3 as having an actuating coil 64 which opens and closes a normally closed contact 66 in the conventional manner during each step of the switch so that the switch will move forward only one position for each impulse received by coil 64. A suitable resistor 68 and capacitor 70 are connected in series across normally closed contact 66 to aid in repressing any arcing of the contacts during the stepping operation. Stepping relay 62 operates in a conventional manner as will be understood by those skilled in the art.

A set of contacts, with associated wiper arm, corresponding to the main contacts of the six levels of the switch are shown in diagrammatic notation and generally indicated at 72. As all ten contacts are connected together, switch 72 may be in the form of a normally closed cam operated switch having a cam with a single lobe corresponding to the zero position of the wipers of the six levels, which is adapted to open the normally closed contacts in the zero position. The open zero contact of switch 72 insures that stepping relay 62 stops on a zero position when the self-stepping sequence is initiated. Push button PB1, connected between the wiper arm of level #5 and through the contacts 72 to ground, is provided for the purpose of starting this self-stepping sequence.

Not all of the contacts of levels #1 through #6 are used. Each contact or step may be considered as representing a certain increment in the pin spotting machine cycle during which the control elements of the machine remain in a particular operative relationship. When it is necessary to change the operative relationship of the control elements of the machine, relay 62 is energized to advance the wiper arms one or more steps. In general, circuits energized by the various wiper arms of the stepper relay initiate or start operation of elements of the machine. The sweep and table cam, SA1 and TA1 respectively, and associated switches, or switches controlled by the timing motor TM1, stop the operation of these elements. Stepper relay 62 thereby functions to coordinate, control and program the cyclical operations of the elements of the machine in accordance with prescribed rules of play.

If the contact positions are numbered 0 to 10, as shown in FIG. 3, the following contact positions are used to provide the four basic machine cycles described hereinabove:

Normal first ball—Steps 0, 1, 2, 3, 4, 5, 7

Normal second ball—Steps 7, 8, 9, 10, 0

First ball foul cycle—Steps 0, 1, 2, 6, 7

Strike cycle—Steps 0, 1, 2, 3, 4, 5, 7, 10

Step 0 is ready for the first ball and Step 7 is ready for the second ball.

On a first ball foul cycle, although normal second ball spotting functions are executed, the machine completes its sequence, ready for another second ball sequence, whereas on a strike cycle, where normal second ball spotting functions also are executed, the machine completes as ready for first ball. Both of these sequences, as well as a normal first ball cycle, start with contact or step zero. Hence, a discrimination is made by the control system as to both the type of machine functions executed and the status of the machine at the completion of the cycle.

Normal Two-Ball Cycle

First Ball: The bowler rolls the first ball of a frame which, upon arriving in pit P (FIG. 1), strikes cushioning device M and moves it rearwardly to engage an actuate starting switch 26 suitably mounted at the rear of the device M. The closing of the contacts of switch 26 establishes a circuit which energizes the solenoid 64 of stepper switch 62 (FIG. 3) causing it to advance all of the wiper arms of all banks of the switch one step, inasmuch as they are all mechanically ganged together. This circuit, beginning with the center tap of transformer winding 46, includes normally closed contacts SA1b of sweep operated cam switch SA1, pit switch 26, step zero of level #5, the interruptor contacts 66 of stepper relay 62, and the solenoid coil 64 to line 74 to the center tap of rectifiers 48 supply. As a result of energization of switch 62, the contact fingers are advanced to step 1 of their respective levels.

As soon as the wiper fingers engage step 1, the sweep contractor CR3 (level #1) is energized through contact 1 of level #1 since the energizing coil of contractor CR3 is connected between ground line 76 and line 73, which is connected to one side of the secondary of transformer 44. Energizing contractor CR3 causes contacts CR3a to close, thereby energizing sweep motor 24 which causes the sweep generally designated as S to move from its upper or dwell position and begin to descend to its lower or guard position adjacent alley B, as shown in broken lines in FIG. 1.

After approximately 30 degrees of rotation of the sweep shaft 28 driven by motor 24, the sweep cam switch SA1, affixed to shaft 28, is actuated thereby closing normally open contacts SA1a and opening normally closed contacts SA1b. The stepper relay 62 is then advanced from step 1 to step 2 through a circuit consisting of line 76, contacts SA1a (now closed), contact 1 of level #5, interruptor contact 66 and solenoid coil 64 to line 74. The stepper relay wiper arms then advance from step 1 to step 2. The sweep S continues to descend as its driving motor 24 remains actuated through the circuit established by the closing of contacts SA1a and contact 2 of level #1. The sweep continues to descend until it reaches its lowered or guarding position adjacent alley B, as shown in dotted outline in FIG. 1, which may be identified as the 76 degree point on the cam 84 of sweep switch SA1. When the 76 degree point is reached, contacts SA1a of switch SA1 open thereby breaking the circuit established through contacts SA1a and step 2 of level #1, which, in turn, stops the sweep in the guard position.

Simultaneously with the advancing of the stepper relay 62 to step 2, a timer motor TM1 is energized through a circuit including, starting with the ground line 76, normally closed contacts TA1c, contact 2 of level #6, normally closed contacts PR2a and contact 2 of level #4 to the motor coils of timer motor TM1. Timer motor TM1 is preferably a conventional synchronous clock type motor which is adapted to run at substantially the same speed as the table driving shaft 34. Timer motor TM1 has a cam 77 which is adapted to open and close contacts TM1a and TM1b at intervals according to the contour of the face of cam 77. The starting of timer motor TM1 defines the beginning of the time-delay interval required to delay the downward movement of the table T after the first ball of a frame is rolled in order to allow the time for standing pins to come to an equilibrium position. After approximately 2¼ seconds of operation, timer motor TM1, operating through cam 77, causes contacts TM1a to close and TM1b to open.

Upon the closing of contacts TM1a, the stepper relay is advanced from step 2 to step 3 through a circuit including line 76, contacts TM1a, step 2 of level #5, to the interruptor contact 66 of relay 62 and thence to

the solenoid coil 64 and return to positive line 74. When stepper relay reaches step 3, a table motor starting circuit is actuated which causes the table to descend, at the beginning of its first revolution. This starting circuit includes line 76, normally closed contacts PR3d, contact 3 of level #2, relay coil CR2 through normally closed switch 80 to line 78. Energization of the coil of relay CR2 causes normally open contacts CR2a to close and apply power to table motor 31. A switch 80 is included in the table starting control circuit which is manually operated and is usually in a normally closed position. Switch 80 allows an operator to shut off the table motor when desired. One terminal of timer motor TM1 is connected to the junction point of relay CR2 and switch 80. Thus if table motor 31 is deenergized by inactivation of relay CR2, timer motor TM1 will be deenergized simultaneously therewith. Hence the operation of the timer motor and table motor 31 are always maintained in synchronism with each other. As table T descends into pin gripping position relative to pins left standing on alley B after a ball has been rolled, grippers N 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 contacts 30a of switch 30, associated with the unit U corresponding to such pin, will be opened thereby preventing circuitry which controls the spotting operation from functioning and, conversely, allows the respotting operation to proceed. This circuitry is described in more detail hereinafter.

During the period in which the table moved downwardly, felt for and gripped standing pins, the timer motor continues to run for a period of $3\frac{3}{4}$ seconds measured from the time when the stepper advanced to step 3. The circuit for continuing the operation of timer motor on step 3 includes connections between line 76, contact 3 of level #4 and the coil of TM1 through manually operated switch 80 to line 78. At the end of the approximately $3\frac{3}{4}$ seconds interval, the timer cam 77, which requires approximately six seconds to complete one revolution, returns to its zero position and allows contacts TM1b to close which completes the circuit from line 76 through contact 3 of level #5, the interruptor contact 66 and solenoid coil 64 of relay 62 and line 78, thereby stepping stepper relay 62 from step 3 to step 4. The table driving shaft 34 continues to revolve and causes the table to continue on its respotting cycle when the stepper reaches step 4 since table actuating relay CR2 is held in an operative position through a circuit including line 76, normally closed contacts PR3d, step 4 of level #2, coil CR2 and one side of secondary winding 46 of transformer 44.

Upon reaching step 4, the motor 24 of sweep S is energized, thereby causing the sweep S to move from its guard position, "run-through," and clear the deadwood from the alley. The initiation of the sweep movement at this point of the cycle is accomplished through a circuit including line 76, contacts SA1b, step 4 of level #1, sweep control relay CR3, a manually operated, normally closed switch 82 to line 78. Switch 82 is similar to switch 80 and provides a means for manually stopping the operation of the sweep at any point in its cycle when desired. The sweep continues to run until it has completely swept the alley of fallen pins and returns to its forward position, which is at a point approximately 270 degrees from the start of the sweep revolution. When the 270 degree point is reached, the sweep cam 84, which has two switch actuating lobes, operates to open contacts SA1b, thereby stopping the sweep.

At the same time that contacts SA1b are opened, contacts SA1a are closed causing stepping relay 62 to step from step 4 to step 5 through a circuit including line 76, contacts SA1a, contact 4 of level #5, interruptor contact 66, solenoid coil 64 of stepping relay 62 and line 74.

Meanwhile, the table has continued to run on step 4 and passes through the zero or home position with re-

spect to table actuating shaft 34 and by the time the stepper relay has advanced to step 5, the table T has started its second revolution which ultimately places the standing pins back on the alley bed. The circuit for continuing the movement of table T on step 5 includes line 76, contacts PR3d, contact 5 of level #2, coil CR2, switch 80 and line 78. When the table reaches the 260 degree point of its second revolution, the stepper relay 62 is stepped from step 5 through step 6 to step 7 through the circuit including contacts TA1b, steps 5 and 6 of level #5 which are connected together, and the interruptor contact 66 to the coil 64 of stepper relay 62. At the 260 degree point, shaft 34 causes cam operated switch TA1 to actuate and close contacts TA1a and TA1b. Closing of contacts TA1b causes the stepper to advance from step 5 to step 7 as previously described. Closing of contacts TA1a causes the table shaft 34 to continue to revolve until the 350 degree-360 degree, or substantially zero position at the end of the second revolution is reached. Circuit for accomplishing this includes contacts TA1a, relay coil CR2 and switch 80. When the zero position is reached, contacts TA1a again open and the table movement is halted in the zero position. It is preferable that the table switch cam 35 open contacts TA1a at approximately the 350 degree point in order to allow for any overrun which might occur.

Upon reaching step 7, the sweep motor 24 is again actuated and the sweep rises from its forward or guard position to its zero position through a circuit comprising contacts SA1a, step 7 of level #1, coil CR3 and switch 82. It will be remembered that the sweep shaft 28 during this interval rotates from a 270 degree position to its zero position, thereby rotating cam 84 of switch SA1 during which period contacts SA1a have been held closed. When the zero position is reached, contacts SA1a open and stop movement of the sweep which is now in its home or zero position. The machine has now completed its first ball cycle and is ready for a second ball.

Second Ball: As with the first ball, the second ball rolls against the cushioning device M and operates pit switch 26 closing its contacts. This completes the circuit consisting of line 76, normally closed sweep switch contacts SA1b, pit switch contacts 26 and contact 7 of level 5, interruptor contact 66, to solenoid 64 of relay 62 to line 74. Closing of the contacts 26 causes the stepper relay to move to step 8. On this step the sweep motor 24 is started by the energization of relay CR3 through a circuit including contact 8 of step 1. After the sweep driving shaft 28 has been revolved by motor 24 to approximately the 30 degree point, the cam operated switch SA1 is actuated, thereby closing contacts SA1a which, in turn, advance stepper relay to step 9 in a circuit including contacts SA1a, contact 8 of level #5, interruptor contact 66 and solenoid coil 64 of stepper relay 62.

On step 9 the sweep continues to advance to the 76 degree position which is the end of the first switch closing lobe on cam 84 through a circuit including contacts SA1a, contact 9 of level #1 and sweep actuating relay coil CR3. At the 76 degree point contacts SA1a return to their normally open position, thereby de-energizing relay CR3 and stopping the sweep motor 24 and sweep S adjacent the alley B. Advancing of the stepper switch to step 9 energizes timer motor TM1 through a circuit consisting of line 76, normally closed contacts TA1c, contact 9 of level #6, normally closed contacts PR4c, normally closed contacts PR2a and step 9 of level #4 to the coil of timer motor TM1.

Timer motor TM1 rotates cam 77 for approximately $2\frac{1}{4}$ seconds during which time pins which may be wobbling after the ball was rolled are allowed to come to rest on the alley B. After the $2\frac{1}{4}$ second period has ended, the stepper is advanced to step 10 through a circuit comprising timer contacts TM1a, contact 9 of level #5, interruptor contact 66 and solenoid coil 64 of stepper relay 62. On step 10 the timer motor TM1 continues to rotate

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as energy is supplied thereto by contacts TM1a and contact 10 of level #4. The timer motor TM1 continues to run for another 3¾ seconds or until cam 77 has revolved one revolution whereupon the switch actuating lobe of cam 77 concludes its operation and TM1a open, thereby opening the circuit through contact 10 of level #4 and stopping the operation of timer motor TM1. When the stepper reaches step 10, the sweep motor 24 is again started through energization of sweep contactor CR3 which closed contacts CR3a. The circuit for performing this operation includes line 76, normally closed contacts SA1b, contact 10 of level #1, the coil of relay CR3, switch 82 and line 78.

The sweep now proceeds from its 76 degree point which is the guard position and performs its run-through, sweeping all pins, whether standing or fallen, into the pit and continues to a position which is approximately 270 degrees of rotation of sweep driving shaft 28 in which position the sweep is again in the guard position adjacent the alley B. At this point, the second contact actuating lobe on cam 84 is again in operation, so that contacts SA1b are opened, thereby stopping the sweep motor 24 by de-energization of relay coil CR3.

On step 10, spotting control relay PR2 is energized through a circuit comprising contacts TA1c, contact 10 of level #6, normally closed contacts 22 (provided there are 10 pins on the table) and the coil of relay PR2. Once closed, relay PR2 is held closed through a holding circuit comprising the normally closed contacts of pin counting switch 16 and contacts PR2c.

When relay PR2 is energized, contacts PR2f close, thereby preparing circuitry for the subsequent application of power through contacts CR2a to spotting solenoid 32 which, when energized, releases a spotting mechanism so that when table T descends to spotting position, the ten pins held in spotters K will be spotted on alley B.

After the sweep run-through is completed and the cam 84 of sweep cam switch SA1 has reached the 270 degree position whereby contacts SA1a are closed, table relay CR2 is then closed, thereby applying power and starting table motor 31 by closing contacts CR2a which at the same time energizes spotting solenoid 32. This is accomplished through a circuit which includes line 76, contacts SA1a, contacts PR2b, contact 10 of level #2 through the coil CR2, switch 80 to line 78.

The table then starts through its spotting operation cycle in which ten pins are placed upon the alley B. When table drive shaft 34 is revolved through approximately 260 degrees, the switch actuating lobe on the table cam 35 closes contacts TA1b. This completes a circuit from line 76 through contacts TA1b, contact 10 of level #5, interruptor contact 66, and relay coil 64 to line 78 which advances the stepper relay to step zero. When the stepper relay steps to the zero position, relay PR1, the pinfeed control relay, is energized through the circuit which includes line 76, contacts TA1b, contacts PR2d and the coil of relay PR1 to line 74. When PR1 is energized, contacts PR1a are closed thereby allowing current to flow to pin elevator solenoid 18 and the pinfeed operation is commenced.

As the switch actuating lobe on cam 35 of switch TA1 closed contacts TA1a at 260 degrees of the spotting revolution, the table contactor CR2 remains energized through these contacts until the zero position is reached, whereupon contacts TA1a are opened by the cam 35 of switch TA1 and CR2 is de-energized so that the table will stop in the zero or home position. When the zero step position of stepper relay 62 is reached, sweep motor relay CR3 is again energized through the closed contacts SA1a of cam operated switch SA1, and contact zero of level #1. The sweep motor continues to run until shaft 28 has rotated to the 360 degree position whereupon cam 84 allows contacts SA1a to open and de-energizes sweep motor relay CR3 thus stopping the sweep in the up or

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dwell position. The pin spotting machine is now ready for the first ball of a new cycle.

It will be noted that pin counting switch 16 is a mechanically operated switch and it will also be noted that the pin feed solenoid actuating relay PR1 is held closed and thus allows ten pins to be distributed by means of the mechanically operated, normally open contacts 16b of pin counting switch 16. In order to initiate the starting of a first pin so that contacts 16b will hold relay PR1 in energized condition, a by-pass or holding circuit is provided which comprises normally closed contacts 16a in series with contacts PR2c which hold relay coil of relay PR2 in an energized position once it has been energized on the previous step 10 through contact 10 of level #6. As PR2 remains energized through step 10 to step zero, contacts PR2d are held closed, thus allowing current to flow through contacts TA1b or TA1c as the table moves, the choice of contacts depending on whether the table has reached its zero position or not. After the first pin has passed into distributor H and down chute J, normally closed contacts 16a of pin counting switch 16 open, thus allowing relay PR2 to drop out while contacts 16b close and hold relay PR1 closed with the consequent actuation of pin elevator solenoid 18 until ten pins have been delivered.

When the tenth pin has been delivered to the distributor, contacts 16b then open and solenoid 18 is consequently de-energized through the de-energization of the coil of relay PR1. It will be noted that if, when the table has reached approximately 350 degrees of its spotting operation and the first pin has not been delivered to the distributor H, and contacts 16b are still open, relay PR1 will be energized through the circuit consisting of contacts TA1c, contact zero of level #6 and contacts PR2d. The coil PR1 will be de-energized on step 1 but is re-energized on step 2 of the next first ball cycle through the circuit which includes contacts TA1c, contact 2 of level #6, and contacts PR2d to coil of PR1. As long as relay PR2 is energized; that is, as long as contacts 16a are closed, indicating that a pin has not yet been delivered to the distributor H, the stepping relay will remain on step 2 of the next first ball cycle until the first pin has been delivered to the distributor since the contacts TM1a of timer motor TM1 must be closed in order to cause stepper relay to step from step 2 to step 3 through contact 2 of level #5. However, the timer motor is rendered inoperative on step 2 as long as contacts PR2a are held open by actuation of relay PR2. When PR2 is de-energized, the timer operates normally through a circuit which includes contacts TA1c, contact 2 of level #6, contacts PR2a and contact 2 of level #4 to the coil of timer motor TM1.

Strike Cycle

The strike cycle occurs when a bowler knocks down all ten pins upon the rolling of a first ball of a frame. For the first three steps programmed by the stepper relay 62, the strike cycle is substantially the same as a normal first-ball cycle; i.e., when a ball is rolled, switch 26 closes and causes stepper relay 62 to advance from step zero as heretofore and begin the programming cycle. Then the sweep moves downward into its guard position adjacent alley B on steps one and two and the normal 2¼ second time delay occurs, at the end of which time delay, table T moves down into a position adjacent the alley B where grippers N of spotting units K feel for standing pins. As no pins remain standing because a strike has been rolled, all of the contacts of series connected switches 30 remain closed. Table T then ascends as it continues its operating cycle. At the end of the normal 3¾ second timing period, timer contacts TM1b close and advance stepper relay 62 to step 4.

When the stepper relay reaches step 4, relay PR4 will be energized through a circuit which includes line 76, contacts TA1c, contact 4 of level #6, contacts PR3b,

contacts of switches 30 (now closed since no pins were left standing) to the coil of relay PR4 and line 74. Relay PR4 is held closed through a holding circuit comprising contacts PR4a and the normally closed contacts of cam operated switch 72. Upon closing of contacts of relay PR4, the stepper relay is advanced to step 5 through a circuit including line 76, contacts PR4f, contact 4 of level #5, interruptor contact 66 and the coil 64 of stepper relay 62 to line 74. When the stepper relay is positioned on step 5, the sweep continues to run through since the sweep control relay CR3 is energized through a circuit including contacts SA1b, contact 5 of level #1 to the coil of relay CR3. The table also continues to run since table motor control relay CR2 remains energized on step 5 through a circuit which includes contacts PR3d, contact 5 of level #2 to the coil of relay CR2.

When the table reaches approximately 260 degrees of rotation of shaft 34, the contacts of switch TA1 are actuated and the stepper relay is advanced from step 5 through step 6 to step 7 by the circuit which includes contacts TA1b, contacts 5 and 6 of level #5, interruptor contact 66 to the coil 64 of stepping relay 62. However, the table continues to move as table motor 31 remains energized from 260 degrees to the substantially zero position by a circuit which includes line 76, contacts TA1a and the coil of relay CR2, switch 80 to line 78. Relay CR2 is de-energized and the table motor stopped when the zero position of shaft 34 is reached as contacts TA1a open at that point. The sweep continues to run as relay CR3 remains energized on step 7 through a circuit consisting of contacts PR4f, and contact 7 of level #1 to the coil of relay CR3.

When the table reaches a position between 350 and 360 degrees, the stepper is advanced from step 7 through steps 8 and 9 to step 10 by means of a circuit which includes contacts TA1c, now closed, contacts 7, 8 and 9 of level #6, contacts PR4b, interruptor contact 66 to the coil 64 of stepper relay 62. During this period and including step 10, the sweep motor continues to operate the sweep as its energizing circuit remains operative, since relay CR3 is energized through contacts SA1b, contact 10 of level #1 to the coil of relay CR3. Contacts SA1b are opened when the sweep cam 84 reaches a position at approximately 270 degrees and the circuit just described is de-energized.

On step 10, relay PR2, the spotting control relay, is actuated by a circuit which includes contacts TA1c, contact 10 of level #6, contact 22 to the coil of relay PR2. When relay PR2 is energized, table motor contact or CR2 is also energized through a circuit consisting of contacts SA1a, or PR4f, contacts PR2b, and contact 10 of level #2. The spot solenoid 32 then closes through contacts CR2a and PR2a, and the table starts its spotting operation. When the table has reached the approximately 260 degree point of its second revolution, contacts TA1b close and complete a circuit through contact 10 of level 5 to interruptor contact 66 and coil 64 of stepper relay 62 so that the stepper relay advances to step zero. The table motor contactor CR2 remains energized during this stepping operation and is de-energized when contacts TA1a are opened at the 350 to 360 degree interval of table rotation.

When the stepper relay is advanced to its zero position, the sweep motor 24 is again started, moving the sweep to its 360 degree position through a circuit which includes contacts SA1a, closed at this point, contact zero of level #1 and the coil of relay CR3. The sweep motor remains energized until shaft 28 and associated cam 84 have reached their 360 degree or zero position at which time contacts SA1a open to de-energize sweep contactor CR3. Strike relay is also de-energized when the stepper advances to step zero by the opening of its holding circuit which occurs when the wiper arm of

switch 62 reaches a zero position. The machine is now ready for a normal first-ball cycle.

It will be noted that during the operation of a strike cycle, the pin feed relay PR1 was actuated on step #10 when spotting relay PR2 was actuated so that pin feeding and distribution occurs in the same manner as described heretofore under a normal second-ball cycle.

First-Ball Foul Cycle

When a foul is committed on the rolling of a first ball of a frame, relay PR3 will be energized by the closure of the foul switch 86. If desired, relay PR3 may be energized by the receipt of a signal from an automatic foul detecting and signalling unit (not shown), such, for example, as shown and described in U.S. Patent 2,683,602 issued to R. Dumas on July 13, 1954 for Foul Detecting and Signalling Mechanism. Although a foul has occurred, the control mechanism of the machine operates the same as for a normal first-ball cycle for the first two steps. Thus the arrival of the ball in the pit causes starting switch 26 to actuate and energize solenoid coil 64, stepper relay 62, causing it to advance one step. As soon as the wiper fingers of stepper relay 62 engage step 1, sweep contactor CR3 is energized through contact 1 of level 1 and sweep motor 24 is energized so that the sweep S moves from its dwell position and descends to its lower or guard position adjacent alley B.

After approximately 30 degrees of rotation of the sweep shaft 28, sweep cam switch SA1 is actuated and contacts SA1a are closed so that stepper relay 62 is advanced from step 1 to step 2 through a circuit comprising contacts SA1a, contact 1 of level #5 to the interruptor contact 66 of relay 62. When the sweep reaches its lower or guard position, contacts SA1a are opened which breaks the circuit established through contacts SA1a and step 2 of level #1, thereby stopping the sweep in the guard position. The timer motor TM1 is energized as on the first ball cycle when stepper relay advances to step 2 through a circuit which includes contacts TA1c, contact 2 of level #6, contacts PR2a, and contact 2 of level #4 to the motor coils of timing motor TM1. After the 2/4 second timing period has passed, contacts TM1a of timing motor TM1 are closed, thereby completing the circuit through step 2 of level #5 to the interruptor contact of relay 62, thence to solenoid coil 64, so that stepper relay 62 is advanced from step 2 to step 3.

On step 3 it is immediately advanced to step 4 through a circuit consisting of contacts TA1c, contact 3 of level #6, contacts PR3a, now closed, through the actuation of foul relay PR3, and interruptor contact 66 to the solenoid coil 64 of relay 62. Upon reaching step #4, the stepper relay is again immediately stepped to step 5 as contacts PR3c connect step 4 to the circuit just described. On step 5 the stepper relay 62 is again advanced immediately to step 6 which also is connected to the circuit just described through contact 5 of level #6 and contacts PR3a. On steps 4, 5 and 6 the sweep motor contactor CR3 is held in an energized position through a circuit which includes sweep cam switch contacts SA1b and contacts 4, 5, and 6 of level #1 to the solenoid coil CR3. The operation of the sweep at this point thus results in the sweeping of all pins, standing or fallen, into pit P. Upon completion of the sweeping operation, and when the sweep drive shaft 28 has moved to approximately 270 degrees of the sweep cycle, sweep cam switch SA1 is again actuated so that contacts SA1b are opened and the sweep motor contactor CR3 is de-energized, thus stopping sweep motor 31.

On step 6, the control relay PR2 is energized through a circuit which includes contacts TA1c, contact 6 of level #6, and normally closed contacts 22 to coil of relay PR2. Relay PR2 remains energized through the holding circuit which includes contacts 16a and PR2c. The timer motor, which was energized on steps 1, 2 and 3, continues to run on step 6 through a circuit which in-

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cludes contacts TM1a, contact 6 of level #4, to motor TM1, and stops itself when the timer contacts TM1a are opened at the end of one revolution of timer cam 77. When the sweep has completed its run-through and reached the 270 degree point, it will be recalled that cam operated switch SA1 closes contacts SA1a and opens contacts SA1b. Closing of contacts SA1a completes a circuit through contacts PR2b, contact 6 of level #2 to the coil of relay CR2 so that the table motor is energized and a spotting cycle for the table is started. The table then travels through a portion of its cycle during which spotters H deliver a new set of pins to alley B.

It will be noted that spotting occurs during this cycle of the table's operation so that spotting solenoid 32 is actuated by the closure of contacts CR2a and PR2a which are held closed due to the previous actuation of relay PR2 on step 6. When the table has reached approximately 260 degrees of its first revolution, table cam switch TA1 is actuated and the stepper relay 62 is accordingly advanced to step 7 through a circuit which includes contacts TA1b, contact 6 of level #5, and the interruptor contact 66 to the coil 64 of stepper relay 62. At the 260 degree point, the table continues to move since relay CR2 is held closed by the closing of contacts TA1a when cam switch TA1 was actuated at the 260 degree point. The table continues to move upwardly until shaft 34 has reached approximately the 350 degree position when cam 35 allows contacts TA1a to open thereby de-energizing relay CR2 and stopping the table at its zero or home position.

The sweep which, it will be recalled, was in its guard position adjacent alley B after having swept deadwood from the alley B is set in motion again on step 7 by energization of sweep motor 24 through a circuit which includes contacts SA1a, contact 7 of level #1, to the coil of relay CR3.

When the sweep reaches 360 degrees, or its dwell position, the contacts of switch SA1 are returned to their normal positions so that contacts SA1a open and relay CR3 is de-energized, thus stopping the sweep. The machine is now ready for its second ball.

When the table shaft 34 has revolved to approximately the 260 degree position and switch TA1 is actuated as previously mentioned, the closing of contacts TA1b causes the pin feed relay PR1 to close through a circuit which includes contacts TA1b and contacts PR2d. As mentioned in the description of the first-ball cycle, when the first pin is fed to the distributor H, contacts 16b are closed by the pin, thereby holding relay coil PR1 in an energized condition until the passage of the tenth pin allows the contacts 16b to open. If, however, the first pin has not entered distributor H by the time that contacts TA1b are opened due to the rotation of table shaft 34 to the 360 degree or zero position, which event would allow relay PR1 to be de-energized, PR1 remains energized through a circuit which includes contacts TA1c (now closed), contact 7 of level 6, contacts PR4c, contacts PR2d to the coil of relay PR1. In the event that a first pin has not entered distributor H by the time that the control mechanism has reached step 9 of a second-ball cycle, the machine is held on this step until a first pin is received by a circuit which includes contacts TA1c, contact 9 of level 6, contacts PR4c and contacts PR2a, contact 9 of level #4 to the timer motor TM1. Since PR2 is held in an energized condition as long as contacts 16a remain closed due to the absence of a first pin passing through chute J of distributor H, then normally closed contacts PR2a are held open preventing the timer motor TM1 from running and advancing stepper relay 62 to step 10. When a first pin is received, the holding circuit to PR2 is opened and contacts PR2a are allowed to close with the result that timer motor TM1 starts and advances stepper relay 62 to step 10 as described heretofore.

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Second-Ball Foul Cycle

For a second-ball foul there is no differentiation in machine cycles since the operations necessary for a second-ball are identical to those necessary for a normal second-ball cycle. That is, all remaining pins are swept from the alley, a complete new set of pins are spotted and the machine is returned to a "ready for first ball" condition.

Pin Indicator Circuits

The pin indicator circuit associated with level #3 is substantially the same as that shown and described in U.S. Patent 2,890,886 issued to R. Dumas, and will therefore be described only briefly. Thus, lights are mounted so that they are visible by the player and indicate whether a first ball, second ball, or strike has been rolled and which pins remain standing. Thus a light 56, indicating a first ball has been rolled, is operated through contacts zero through 6, inclusive, of level #3 of stepper relay 62 and will be lighted whenever the stepper relay is in any of these positions. A light 88, which indicates that a second ball has been rolled, is operated through contacts 7 through 10, inclusive, of level #3 of stepper relay 62 and normally closed contacts PR4d and will be lighted whenever the stepper is in any of these positions provided the strike relay PR4 is not energized. A light 90, indicating that a strike has been rolled, is actuated through a circuit which includes contacts 7 through 10, inclusive, of level #3 of stepper relay 62 and the normally open contacts of relay PR4, since relay PR4 is energized as outlined in the description of the strike cycle hereinabove. Lamps 92, associated with each one of the pins, are energized by means of contacts zero through 6, inclusive, of level #3 of the stepper relay 62 and normally open contacts 30b of respot switches 30. These switches are closed during the respotting operation and thus allow lamps 92 to light and indicate which pins remain standing after a ball has been rolled. Lamps 92 remain lighted until the pin is released by respotting devices U.

Machine Protection Circuit

If, during a first-ball cycle, the table should descend upon a standing pin which has been moved out of range of one of the respotting units U and grippers N, either by the action of the ball or engagement with other pins, either one or both of normally open contacts of switches 94 are closed. These switches 94 are pressure operated switches and are mounted at suitable positions on the table suspension mechanism and are adapted to be closed by an upward pressure against the table by a foreign object. Closure of switches 94 short circuits line 79 to ground and thereby creates an excessive current flow through the circuit breaker CB1 which causes it to actuate and open contacts CB1a in the main power control circuit which, in turn, causes CR1 to de-energize and open contacts CR1a which cuts off all power to the control mechanism. The machine cannot be re-started until the "off-limit pin" has been removed and the control circuit breaker CB1 re-set.

Manual Cycling of the Machine

In order to operate the machine, as for test purposes, without the need for rolling a ball, the control circuit is provided with a manually operable switch 96 connected in parallel with contacts of the pit switch 26. When switch 96 is operated, the starting circuit of the machine is completed, simulating the action normally effected by the arrival of a ball in the pit P as described above. If the switch 96 is actuated twice, the machine operates through a normal two-ball cycle.

Tenth Frame Spare

When a bowler makes a spare on the tenth frame of a game, he is entitled under the rules to an additional ball. As a result of rolling this ball, the machine goes through

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a normal first-ball cycle and comes to rest as ready for the second ball of a frame. In order to manually cycle the machine and place it in readiness for the first ball of a frame, i.e. the first ball of the first frame of the next game, there is provided a manually operable switch 98 having contacts connected in parallel with switches 26 and 96. When switch 98 is operated, the machine is cycled as described hereinabove without the necessity of rolling a second ball, which is not permitted under the rules. Switch 98 is preferably located adjacent the approach end of an alley where it is convenient to the bowler.

Frame Counter

An electro-magnetically operated counter CR5 is connected in the main power control circuit in order to provide a totalizing count of the number of frame cycles played during a period of operation of the machine. Counter CR5 is energized once each frame cycle by a circuit which includes contacts TA1c, contact 1 of level #6 to transformer 40. It will be seen that when one side of the secondary of transformer 40 is connected to ground, coil of counter CR5 is energized and a count is registered.

It will be noted that in operating through each cycle whether it be a first ball, second ball, strike, or foul, the control circuit of the present invention is sequenced through a fixed program common to all cycles, which is immediately followed by a variable program sequence depending upon the nature of the cycle demanded from the machine. The first program sequence includes the actuation of pit switch 26, the stepping of relay 62 at least one step, the movement of sweep S from a dwell position to a guard position adjacent alley B and the energization of timer motor TM1. The second program is initiated after timer motor TM1 has run for the 2¼ second interval, at which time it causes the stepper relay to begin to program the selected cycle.

By selectively programming information supplied by the sweep, table and timer motor cams, and, in special instances, by the foul and strike switches, stepper relay 62 during the second programming sequence thus causes

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the pin spotting machine to perform a particular cycle, as required by the rules of a bowling game, in response to the rolling of each ball.

While the present invention has been disclosed by means of specific illustrative embodiments thereof, it would be obvious to those skilled in the art that various changes and modifications in the means of operation described or in the apparatus, may be made without departing from the spirit of the invention as defined in the appended claim.

I claim:

Control apparatus for a bowling pin spotting machine of the type having a table with pin spotting and re-spotting devices, and adapted to move to and from a bowling alley and spot and respot pins thereon, and having a sweep and pin distributor, comprising, an electrical control circuit for controlling the sequential operation of said table and said sweep, a programming device having means for operating said control circuit through a first and a second program sequence, said first program sequence including the actuation of a timing device for a predetermined period, means for selecting said second program sequence in accordance with selected rules of a bowling game after a ball is rolled by a player, a timing device having means operative independently of the motion and relative position of said table and said sweep and at the termination of said predetermined period for conditioning said programming device to select said second program sequence for said control circuit, means operative in response to a selected second program sequence for actuating said pin distributor to distribute new pins to said table after pins have been spotted, and means for incapacitating said timing device during a next succeeding cycle commencing with the rolling of a first ball of a playing frame to prevent the selection of a next succeeding second program sequence until a first pin has been delivered to said table.

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UNITED STATES PATENTS

2,890,886 Dumas ----- June 16, 1959