March 15, 1966 A. J. COHEN 3,240,493

APPARATUS FOR SELECTIVELY DEENERGIZING THE REAR END MOTOR OF A PIN SPOTTING MECHANISM

Filed March 27, 1963 3 Sheets-Sheet 1

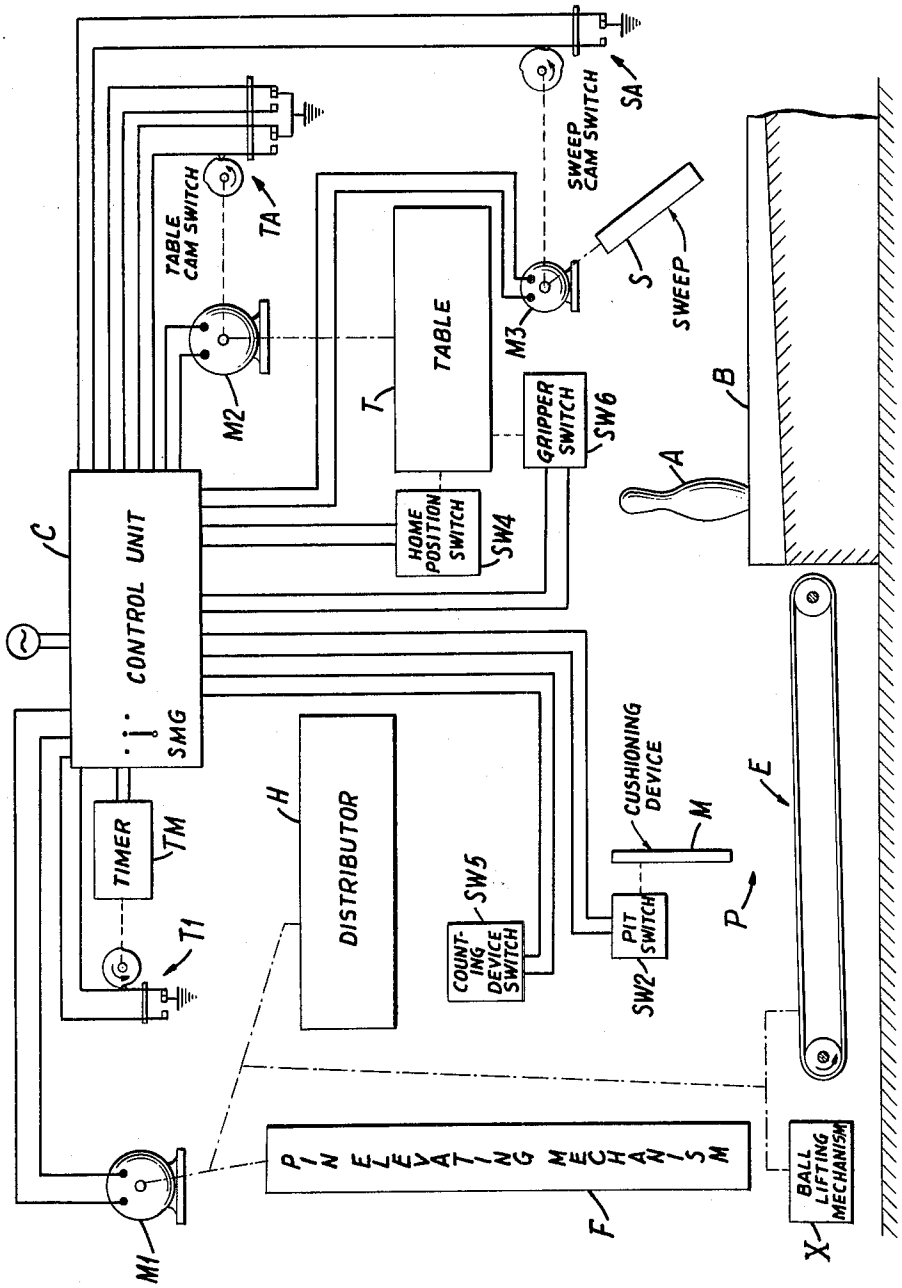


FIG. 1

INVENTOR.
ABRAHAM J. COHEN

BY Philip B. Hilbert

ATTORNEY.

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Filed March 27, 1963 3 Sheets-Sheet 2

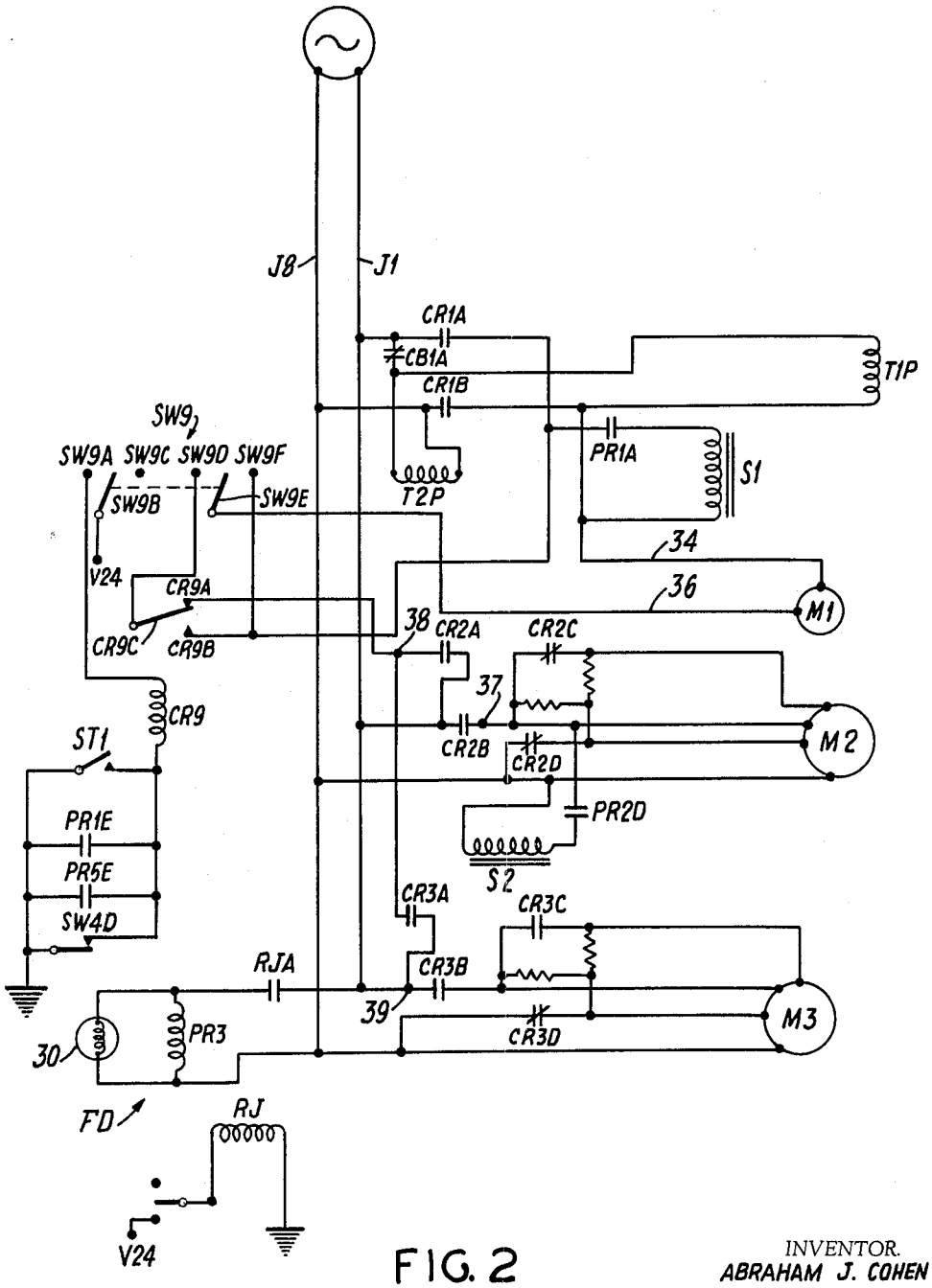


FIG. 2

INVENTOR.
ABRAHAM J. COHEN

BY Philip S. Hilbert

ATTORNEY.

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Filed March 27, 1963 3 Sheets-Sheet 3

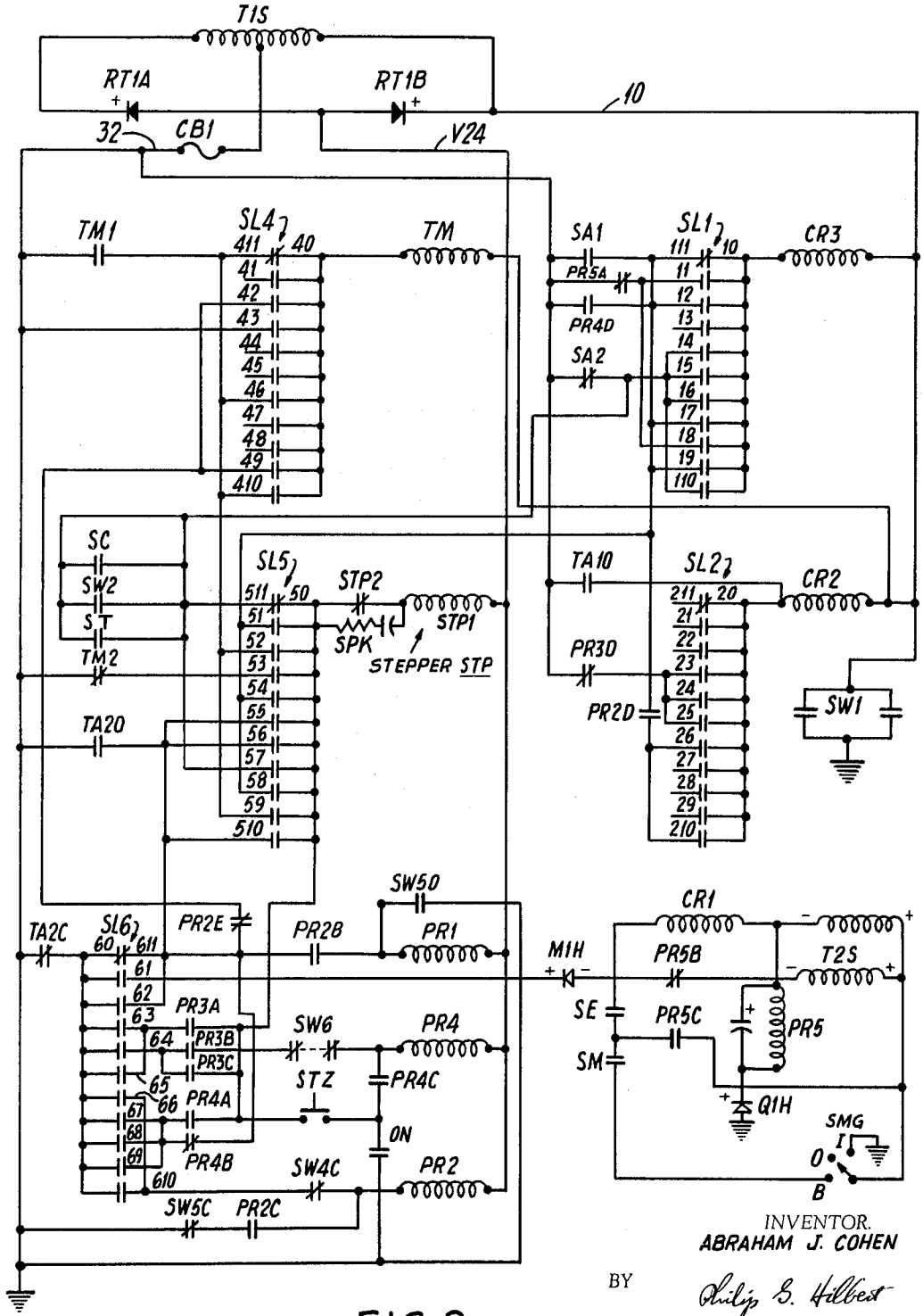


FIG. 3

INVENTOR.
ABRAHAM J. COHEN

BY Philip S. Hilbert

ATTORNEY.

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APPARATUS FOR SELECTIVELY DEENERGIZING THE REAR END MOTOR OF A PIN SPOTTING MECHANISM

Abraham J. Cohen, Yonkers, N.Y., assignor to Sports Arenas, Inc., Yonkers, N.Y., a corporation of Delaware

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2 Claims. (Cl. 273—54)

This invention pertains to bowling pin spotting machines and more particularly to electrically operated bowling pin spotting machines for automatically spotting and respotting bowling pins on the playing bed of a bowling alley, and to improve control apparatus therefor.

At the present time there is in existence a particular type of bowling pin spotting machine which has been in use for many years. At this time, upwards of eighty thousand of these machines are either in operation or are in the process of being manufactured and delivered. Such machines include a complexity of conveyor belts, mechanical linkages, gear boxes, pin elevator wheels and other units which are driven by an electric motor. From the instant that the pin spotting mechanism is activated from a central control desk, the motor is energized and continues to operate until the mechanism is deactivated at the end of the use of the associated alley. Accordingly, such motor continues to run, driving the conveyor belts and the aforementioned elements regardless of whether the alley is in actual use or not. Even when the alley is in use, there is an appreciable lapse of time when such elements do not require actual operation. It has been found, for example, that when the alley and its associated pin spotting machine is being utilized by a rapid bowler, the motor need only operate sixty percent of the bowling interval. The remaining 40% of the bowling interval does not require motor operation and its driven members can be inactivated. Of course this inactive portion of the bowling interval time is considerably increased when slow bowlers and children use the alley. In particularly, there can be considerable periods of elapsed time between the throwing of each ball, for one reason or another.

Not only is such a system extremely wasteful of the current, but also adds to the wear and tear on the continuously running conveyor belts, drive belts, gear boxes, bearings, shafts. Furthermore, the constant movement of certain of these elements causes a continuous jostling of the bowling pins themselves which splinter the pins and greatly shortens their useful life.

It is accordingly a general object of the invention to provide means for minimizing the actual time of operation of particular mechanisms in presently available bowling pin spotting machines.

It is another object of the invenion to provide a bowling pin spotting machine which is more economical to operate.

It is a further object of the invention to include in a bowling pin spotting machine simple and inexpensive control means which insure that a particular motor and its associated driven elements are only in use when they are actually required.

It is yet a further object of the invention to provide a simple control means which insures that the back end mechanism and its associated motor in a bowling pin spotting machine is energized automatically only after a ball is rolled and will remain in the running position until the ball is returned to the bowler and the pins are appropriately distributed in the spotting mechanism.

It is a specific object of the invention to provide improved control means for bowling pin spotting machines of the type shown in Patent No. 2,983,510, October 30, 1956.

Briefly, in accordance with the invention, there is provided an improvement for a bowling pin spotting machine of the type which has a pit conveyor means that moves pins to a pin elevator means and further includes a pin distributor means for delivering the pins from the pin elevator means to a table means for spotting pins on the alley. Associated with such a machine is a ball return delivery means which includes an elevator that carries balls from the alley pit to a return track. Such elements, including the pit conveyor means, the pin elevator means, the pin distributor means and the ball return delivery means are driven by a single first motor via mechanical linkages. Included in the machine is a sweep means for sweeping fallen pins from the alley into the pit, driven by a second motor. The table means which accepts pins from the distributor means and the spotting means are driven by a third motor. Disposed in the pit is a pit switch which is activated by a thrown bowling ball to energize a control means which controls the operating cycles for the machine and in particular determines the times of energization for the second and third motors that respectively drive the sweep means and the table means. The improvement includes a control element which is responsive to the control means for energizing the first motor only when the second motor has been energized so that the first motor drives the pit conveyor means, the pin elevator means, the pin distributor means and the ball return delivery means, only when actually required.

It should be noted that in the presently existing machines the first motor is continuously operating.

Other objects, features and advantages of the invention will be apparent from the following detailed description when read with the accompanying figures, wherein:

FIGURE 1 is a block diagram of a bowling pin spotting machine and a portion of the alley it services;

FIGURE 2 shows the schematic diagram of the motors employed by the pin spotting machine of FIGURE 1 as well as some of the control circuitry; and

FIGURE 3 is a schematic diagram of the remainder of the control circuitry employed by the bowling pin spotting machine of FIGURE 1.

Referring to FIGURE 1, bowling pins A, when struck by a ball, either fall from or are removed from alley B by means of a sweep S. The mechanism for actuating sweep S is operated after each ball is rolled by a bowler. After the last ball of the frame is rolled, all pins either standing or fallen are swept into pit P.

In the embodiment as shown, pins falling from alley B or delivered into pit P, drop onto a conveyor E which is pit wide and which is driven by motor M1 (the rear end motor). Bowling balls dropping upon conveyor E roll and are carried backward to one corner of pit P to a ball lifting mechanism X, also driven by motor M1, for return on a return runway not shown, conventional design. Pins A are delivered from conveyor E into pin elevator mechanism F which comprises a disc mounted for rotation on a horizontal shaft and is driven by a suitable arrangement of mechanical linkages such as pulleys and belts connected to motor M1. The pins A are carried upward to a position which is substantially directed above pit P, where each pin is discharged into a distributor H. Distributor H includes an elongated telescopic, generally U-shaped chute and is mounted for lateral movement back and forth across the machine so that pins may be transferred to table T. As each pin travels across distributor H, it passes over an actuating counting device and switch arrangement SW5. During the course of operation of distributor H, the latter moves both vertically and longitudinally until a home position is reached. When the home position is reached, the distributor H engages and operates the home position switch

SW4 indicating that a complete delivery cycle has been performed, that is, the distributor H has deliverd one pin to each of the pin receptacles in the table T. It should also be noted that the counting device switch SW5 is stepped off a home position when the first pin passes across distributor H and returns to its home position after the tenth pin has passed across distributor H. Distributor H and more particularly, its chute including a conveyor belt, is driven by motor M1 by means of a suitable interconnecting mechanical linkage.

Table T, which is supported on 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. Table T is moved to and from alley B by means of motor M2 (the table motor) 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 by motor M3 (the sweep motor) in proper timed relationship with the movements of table T, to sweep dead wood and fallen pins from the alley or to sweep dead wood and unwanted pins from the alley, depending upon which ball of the frame is rolled. In the operation of the machine, sweep S which also operates as a guard mechanism, is started in motion when a ball rolled by the player lands in pit P of the alley B and effects the closing of pit switch SW2, which is mounted adjacent a ball impact cushion M. The closing of pit switch SW2 when cushion M is urged rearward by the impact of a ball thereon, effects the starting of the sweep motor M3, and under certain conditions the rear drive motor M1. Coupled to motor M3 is sweep cam switch SA which is adapted to be actuated at selected periods during the rotation of the motor M1. Switch SA will be more fully described with respect to FIGURES 2 and 3.

Motor M2 is suitably mounted and coupled via a conventional gear reduction and associated driving mechnism, to table T for causing the table to be lowered and raised with respect to alley B for spotting and respotting pins. The table T includes gripping mechanisms, not shown, for engaging pins A on alley B. Associated with each of the individual gripping mechanisms is a gripper switch SW6. The action of the gripping mechanisms is such that when the table T is lowered after the rolling of the first ball of the frame and any pins are left standing on alley B, the heads of such pins will be engaged by the gripping mechanisms and continued downward movement of table T results in the mechanisms grasping the pins. The switches SW6 are connected in series so that whenever a pin is gripped its associated switch is operated to break a series circuit connecting 10 such switches. When bowling pins are to be spotted on the alley B a spot solenoid in the table is actuated so that the ten pins may be delivered in spotted arrangement on alley B. Table motor M2 is connected to a table cam switch TA whose operation is more fully described with respect to the control circuitry of FIGURE 3. The control mechanism in control unit C is employed with collecting, handling, spotting and respotting mechanisms described above and goes through a three phase cycle system wherein there are provided three revolutions of the shaft connecting motor M2 to the table T. In other words, there are three down and up trips of the 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 dead wood and unwanted pins from alley B.

Although the mechanism has four basic cycles, that is, first ball cycle, second ball cycle, strike cycle and first ball foul cycle, it will be only necessary to describe the first ball cycle and the second ball cycle to indicate the operation of applicant's invention.

Before proceeding with the operation of the control unit C a brief mention will be made of several of the components therein. The stepper STP is used to develop the program required to sequence the mechanism through its operating cycle. The stepper STP is shown schematically in FIGURE 3 and comprises five levels designated SL1, SL2, SL4, SL5 and SL6 respectively. Each level is provided with a home or zero contact and ten contacts corresponding to successive positions of conventional rotary wiper arms. Any type of stepper relay construction may be used which provides means for repetitively cycling of eleven contacts. It will be noted that the wiper arms of levels SL1 and SL2 are of the bridging or short-circuiting type, whereas the wiper arms of levels SL4, SL5 and SL6 are of the nonbridging or open circuiting type. All wiper arms are mechanically ganged together so that like contatcs of each level are wiped by their respective arms. The stepper mechanism of stepper STP includes the usual interrupting contact with a spark suppressor SPK, a coil STP1 and interrupter contacts STP2.

The timer TM is a conventional motor driving cam which actuates contacts T1 (FIG. 1). The contacts are shown schematically in FIGURE 3 as contacts TM1 (normally open) and contacts TM2 (normally closed). The motor of timer TM makes one revolution in 6 seconds. For the first 2.25 seconds, contacts TM1 are closed and contacts TM2 are open. For the last 3.75 seconds, contacts TM1 are open and contacts TM2 are closed.

The sweep cam switch SA includes a cam driven by motor M3 (FIG. 1) and contacts SA1 and SA2 shown in FIGURE 3. The contacts SA1 are closed only during the 30°–76° and 270°–360° portions of each rotation cycle of motor M3. The contacts SA2 are closed only during the 0°–30° and 76° to 270° portions of the rotation cycle.

The table cam switch TA includes a cam driven by motor M2 (FIG. 1) and contacts TA10, TA2C and TA20 shown in FIGURE 3. Contacts TA10 and TA20 are closed only during the 260°–350° portion of rotation cycle of motor M2. The contacts TA2C are closed only during the 350°–260° portion of the rotation cycle of motor M2.

There are two transformers in the system, i.e., T1 and T2. For the sake of clarity the primary T1P of transformer T1 is shown on FIGURE 2 and the secondary T1S of transformer T1 is shown on FIGURE 3. Similarly the primary T2P of transformer T2 is on FIGURE 2 and the secondary T2S of transformer T2 is shown on FIGURE 3.

There are a plurality of control relays CR1 to CR3 and PR1 to PR5 included in the circuitry. For convenience the coils of the relays carry the same reference character as the relay, i.e., the coil of relay CR1 is designated and shown as coil CR1. The contacts of the relays carry the same reference character as the relay or coil but with a letter subscript. For example, the relay CR1 has contacts CR1A and CR1B.

A conventional first and second ball cycle will be described as it normally occurs in the heretofore available bowling pin spotting mechanisms. In this case, the override switch SW9 which is of the double pole, double throw type, FIGURE 2, is in the right hand position. Initially, generator GEN supplies alternating current to the busses J1 and J8. The alternating current passes from the line J1 via the contacts CB1A of safety circuit breaker CB1 through the primary T2P of transformer T2 and back to the bus J8. When the machine is to be operated, the control switch SMG at the manager's desk is moved from the off (O) to the bowl (B) position, FIGURE 3. Accordingly, a circuit is closed which includes the secondary T2S of the transformer T2, the coil CR1 of a first control relay CR1 and the contacts SE and SM of normally closed interlocked mechanisms. When the alternating current passes through the coil CR1 of the rear end motor control relay CR1 its normally opened contacts CR1A and CR1B (FIG. 2) close. Alternating current now passes in a circuit from bus J1 via contact CR1A to

the contact SW9F, the contact SW9E, through the motor M1, back through the contacts CR1B to the line J8. Accordingly, the whole rear end mechanism as heretofore described starts operating. At the same time, alternating current is supplied to the transformer primary winding T1P, and secondary winding T1S (FIG. 3) generates direct current for the control unit. The full wave rectification performed by the diodes RT1A and RT1B causes line V24 to carry a 24 volt D.C. potential. The transformer action also causes the line 32 to carry a 32 volt alternating current signal.

A current path is set up from the line V24 through the coil STP1 and interrupter mechanism STP2 of the stepper STP through the closed contact 511 of level SL5 via the now closed contacts of switch SW2 and the now closed contacts of sweep cam switch SA2 to the line 32. Since the contacts SW2 of sweep cam switch SA are closed during the zero to 30 degree cycle of revolution and also the 76° to 270° portion of the cycle of revolution of the sweep mechanism, at this time, that is, the start of the cycle (0°) these contacts are closed.

The stepper STP steps to its first position. Accordingly, a circuit is now closed from line 32 via the closed contacts PR5A of relay PR5 through the contact 11 of deck of level SL1 and the coil CR3 of relay CR3 to the line 10. The current passing through the coil CR3 energizes the sweep control relay CR3 which closes its contacts CR3A and CR3B (FIGURE 2) energizing the motor M3 which drives the sweep S. After the sweep motor M3 has rotated 30 degrees the sweep cam switch SA (FIGURE 1) is operated and the contacts SA2 open while the contacts SA1 (FIGURE 3) close. It should be noted that the contacts SA1 operate inversely with respect to the contacts SA2. Therefore the contacts SA1 will be closed during the 30° to 76° portion of the cycle as well as the 270° to 360° degree portion of the cycle of the sweep motor M3. During this time, the sweep S is dropping to its guard position. With the contacts SA1 closed, the stepper STP is stepped from step 1 to step 2 by virtue of the path established between lines V24 and 32 through the stepper coil STP1, stepper interrupter STP2, the contact 51 of level SL5, and the now closed contacts SA1. When stepper STP has advanced from step 1 to step 2, coil CR3 remains energized by virtue of the path which includes the contacts SA1 and the contacts 12 of level SL1. Accordingly, the sweep motor M3 proceeds to the 76 degree position of rotation. When the sweep S reaches the 76 degree position of rotation the contacts SA1 open and the coil CR3 is deenergized and contacts CR3A and CR3B drop. Accordingly, sweep motor M3 stops with the sweep S in the guard position. Simultaneously with this action, as the stepper STP reaches step 2 the timer TM starts to run through a circuit which includes the line 32, the closed contacts TA2C of the table cam switch TA, the contact 62 of the level SL6, the closed contacts PR2E and the contacts 42 of level SL4. The timer TM starts operating and a time delay is introduced to insure that all pins stop wobbling before the table T moves. After the motor of timer TM completes two and a quater seconds of operation, the timer contacts TM1 close and the timer contacts TM2 open. The closing of timer contacts TM1 advance the stepper from step 2 to step 3 by virtue of a circuit passing via the contacts TM1 and the contacts 52 of level SL5. When the stepper STP reaches step 3, the coil CR2 is energized by virtue of a path from line 32 via the now closed contacts PR3D, the contacts 23 of the level SL2, the coil CR2 and the line 10. With the relay CR2 energized, its contacts CR2B (FIGURE 2) close, causing the alternating current from generator GEN to be fed via lines J1 and J8 to motor M2. The motor M2 starts moving the table T (FIGURE 1) down towards the alley B. While the stepper STP is still on step 3 (FIGURE 3), the timer TM is running by virtue of a path from line 32 through the contacts 43 of level SL4 to the line 10. The timer TM runs an additional three and three-quarter seconds at which time the timer cam switch is tripped, causing timer contacts TM1 to open and timer contacts TM2 to close. The stepper STP now advances to step 4 through the circuit including line 32, the now closed timer contacts TM2, the contacts 53 of level SL5 through the interrupter STP2 and the coil STP1 to line V24 (FIGURE 3).

The table motor M2 continues to run since the relay CR2 remains energized by the current passing through the coil CR2 via the path established between lines 32 and 10 by the closed contacts PR3D and the contact 24 of the level SL2. During step 4 the sweep motor M3 still runs as the control relay CR3 is energized by way of the path established between lines 32 and 10 by the now closed contacts SA2 of the sweep cam switch SA and the contacts 14 of level SL1. When the sweep cam switch SA reaches the 270° position, the contacts SA2 open, breaking the current flow through coil CR3. Accordingly, contacts CR3B (FIGURE 2) open and the sweep motor M3 stops. The sweep S of FIGURE 1 is now in the guard position. When the contacts SA2 are opened, the contacts SA1 of the sweep cam switch SA close, establishing a path from line 32 through the now closed contacts SA1 and the contacts 54 of level SL5 to the stepper coil STP1. Accordingly, the stepper STP steps from step 4 to step 5. Table motor M2 continues running by virtue of the path established between lines 32 and 10 by the contacts PR3D and the contacts 25 of level SL2. Stepper STP now steps from step 5 through step 6 to step 7 by virtue of the path established by the now closed contacts TA20 which connect line 32 via the sequentially closed contacts 55 and 56 of level SL5 to the stepper coil STP1 which is connected to the line V24. Table motor M2 continues to run by virtue of the path established between the lines 32 and 10 by the now closed contacts TA10 of the table cam switch TA and the coil CR2.

The motor M2 runs until the table cam reaches the 350° position, causing the opening of the contacts TA10 which deenergizes the coil of relay CR2, its contacts CR2B breaking the current feeding the motor M2. The table T now coasts to the electrical zero position. On step 7 the sweep motor M3 runs by virtue of the relay CR3 being energized. Thus, current flows through the path established between lines 10 and 32 by the now closed contacts SA1 of the sweep cam switch SA and the contact 17 of the level SL1. However, when the sweep motor M3 reaches the 360° position, the sweep cam switch SA (FIGURE 1) opens the contacts SA1 (FIGURE 3) breaking the circuit to the relay coil CR3. The sweep S, accordingly, stops at electrical zero, terminating the first ball cycle.

The apparatus is now ready to accept the second ball. The table motor M2 and the sweep motor M3 are at the electrical zero position. The stepper STP is at step 7. There are ten pins in the table T and the distributor H (FIGURE 1) is in its home position. When the ball is delivered and hits the cushioning device M, the switch SW2 is momentarily closed. The momentary closing of the switch SW2 (FIGURE 3) establishes a path from line 32 via the closed contacts SA2 of the sweep cam switch SA through the now closed contacts SW2 to and through the contacts 57 of level SL5 to energize the stepper coil STP 1 and the stepper STP steps from step 7 to step 8. On step 8 the sweep motor M3 is activated by virtue of the energization of the control relay CR3, a path being established via the normally closed contacts PR5A and the contacts 18 of the level SL1. The sweep motor M3 is accordingly energized and the sweep cam starts rotating. After 30° of rotation the contacts SA1 of sweep cam switch SA close and a path is established between the line 32 via the contacts SA1 and the contacts 58 of the level SL5 to the stepper coil STP1. The stepper accordingly steps from step 8 to step 9. The sweep motor M3 continues to run by virtue of the coil CR3 remaining energized through the contacts SA1 and the contacts 19

of level SL1. When the sweep motor M3 reaches the 76° position, the contacts SA1 open, causing the deenergization of the relay CR3 and the sweep motor M3 stops with the sweep S in the guard position. Simultaneous with this action, as the stepper STP advances to step 9 the timer TM is energized by virtue of a path starting from line 32 passing through the now closed contacts TA2C, the contacts 69 of level SL6, the contacts PR4B, the contacts PR2E, the contacts 49 of level SL4 and the coil of the timer TM to the line 10. After the timer TM completes two and a quarter seconds of operation the timer contacts TM1 close and the timer contacts TM2 open. The closing of the timer contacts TM1 causes the stepper STP to advance from step 9 to step 10 by virtue of the path through the timer contacts TM1 and the contacts 59 of level SL5. On step 10 the timer TM continues to run by virtue of the path established through the timer contacts TM1 and the contact 410 of level SL4, an additional three and three-quarter seconds, at which time the contacts of the timer TM are again operated, that is, the timer contacts TM1 open and the timer contacts TM2 close. On step 10, the sweep control relay CR3 is again energized by virtue of a path established between the lines 32 and 30 by the contacts SA2 and the contacts 110 of the level SL1. When the sweep motor M3 reaches the 270° position, the contacts SA2 open, deenergizing the coil CR3 and the sweep S stops at the 270° guard position. At this time, i.e. on step 10, relay PR2 is energized via a path including the now closed contacts TA2C, the contacts 610 of level SL6 and the contacts of SW4C if the distributor is in the home position, which is the usual case. Relay PR2 will be held by the path including the counting device switch contacts SW5C and its own holding contacts PR2C. The contacts SW5C of the counting device switch SW5 will be closed if ten pins have been delivered by the distributor H to the table T (FIGURE 1). At the same time, the PR2D contacts of relay PR2 close, energizing the solenoid S2 which places the receptacles of the table T in the spotting position. Simultaneously, table T starts moving down since its relay CR2 is energized by a path including contacts SA1, contacts PR2D and contacts 210 of the level SL2. When the table motor M2 reaches the 260° position, the contacts TA20 of the table cam switch TA close and current is supplied via these contacts and the contacts 510 of level SL5 to the coil STP1 and the stepper STP advances from step 10 to step 0. At the same time the relay PR1 is energized through a circuit consisting of the contacts TA2C, the contacts 611 and the contacts PR2B. Contact PR1A of the relay PR1 close a path to solenoid S1 (FIGURE 2). Solenoid S1 is in pin elevator mechanism F and permits the release of pins from the pin elevator to the distributor H (FIGURE 1). When the table T reaches the 360° point of travel the contacts TA10 close (FIGURE 3), applying power to the coil of relay CR2 so that the table motor M2 continues operating until the 350° point is reached. At that time the contacts TA10 open and the table T coasts to the electrical zero point. The sweep motor M3 is energized by a path including the contacts SA1 of the sweep cam switch SA and the contacts 10 of the level SL1. The sweep motor M3 continues until the 360° position is reached, causing the contacts SA1 to open and the sweep motor M3 stops at the zero position.

If the first pin had been delivered from the pin elevator mechanism F to the distributor H, then, at this time, the relay PR1 will be energized through the contacts SW50 of the switch SW5, that is, the counting device switch, and will remain energized until the tenth pin is delivered to the distributor H at which time the contacts SW50 would open. Operation of the switch SW5 by the first pin will also deenergize the relay PR2, interrupting the circuit which includes the switch SW2, the contacts SW5C and the contacts PR2C.

If at the time the table T reaches the 350° position of its spotting operation, the first pin has not been delivered to the distributor H and the contacts SW50 are open, but the coil PR1 will be energized through the circuit including the contacts TA2C, the contacts 60 of level SL6 and the contacts PR2B. The coil of relay PR1 will remain energized on step 2 of the next first ball cycle through the circuit including the contacts TA2C, the contacts 62 of the level SL6 and the contacts PR2B. Stepper STP will accordingly remain on step 2 of this next first ball cycle until the first pin has been delivered to the distributor H and the relay PR2 is deenergized, letting the operation of the timer TM through the circuit, including the contacts TA2C, the contacts 62 of level SL6, the contacts PR2E and the contacts 42 of level SL4. These two procedures insure that ten pins are delivered to the table T.

There has thus been described the operation of the controls for a normal two ball frame. It should be noted that during the entire two ball frame, the control relay CR1 is energized and consequently the motor M1, that is, the rear end motor is continuously operating and driving the distributor H, the pin elevating mechanism F, the ball lifting mechanism X and the conveyer E. However, from the foregoing it should be apparent that it is necessary for the rear end motor M1 to operate only a portion of the cycle, and particularly that portion of the cycle from when a ball strikes the pit switch SW2 until the table has returned to its electrical zero position, preparatory to another ball being delivered on the alley.

Accordingly, there will now be described in accordance with the invention the mechanisms and apparatus required to insure that the rear end drive motor M1 operates only at the appropriate useful time intervals. In order to minimize the operation of the rear end motor M1, the override switch SW9 (FIGURE 2) is positioned to the left. Therefore, when the central control switch SMG (FIGURE 3) is placed in the B position, the rear end motor control relay CR1 is energized as before. However, in spite of the fact that the contacts CR1A and CR1B (FIGURE 2) close, it is seen that the power circuit from the lines J1 to J8 to motor M1 is open. In particular, the line J8 is connected via the now closed contacts CR1B to the line 34 which feeds one input terminal of rear end motor M1. The line 36 feeding the other terminal of rear end motor M1 is connected to the common contact SW9E of the override switch SW9. Since the common contact SW9E, in this case, is connected to the fixed contact SW9D, a path is established to the common contact CR9C of relay CR9. When the relay CR9 is in the deenergized state, which is the usual case, the path continues via the fixed contacts CR9A to the junction 38. It will be noted that the junction 38 is connected to the contacts CR2A and to contacts CR3A. It will be recalled that the control relay CR2 is associated with controlling the operation of the table motor M2 and the control relay CR3 is associated with the control of the sweep motor M3. Therefore, when either the table motor M2 or the sweep motor M3 is energized by virtue of the actuation of its associated control relays CR2 and CR3, in particular, when relay CR2 is energized, power will be fed from the line J1 via the contacts CR2A to the other terminal of motor M1. Similarly, when the control relay CR3 is energized, power will be fed from the line J1 through the CR3A contact to junction 38 and via the above described circuit to the other terminal of motor M1. Therefore, motor M1 will only be energized when either the motor M2 or the motor M3 is operating. In most cases, the contacts CR3A and the connections between the junction 38 and the junction 39 can be eliminated so that the rear end motor M1 operates only when the table motor M2 is operating. However, it will be recalled that the ball lifting mechanism X (FIGURE 1) is one of the elements driven by the rear end motor M1. Sometimes, a rapid howler would want a

quicker return of his ball. Under such circumstances it would be desirable to include the circuit now shown between the junctions **38** and **39**.

It will be recalled that the operating cycle first included the activation of the sweep mechanism S, followed by the activation of the table mechanism T and again followed by the activation of the sweep mechanism S. Therefore. since the sweep mechanism S starts before the table mechanism T, it is possible to speed up or minimize the time for the ball return by making the activation of the rear end motor **M1** dependent upon both the activation of the table motor **M2** and the sweep motor **M3**. However, when this specific circumstance is not required, it is merely necessary to make the activation of the rear end motor **M1** dependent on the energization of the table motor **M2** which occurs when the contacts **CR2A** are closed as above described. In fact, in such a case, contacts **CR2A** can be eliminated and junction **38** is connected to junction **37**.

Since the rear end motor **M1** also drives the elements which move the pins from the pit P to the table T via the conveyor E, the pin elevator mechanism F and the distributor H (FIGURE 1) there are time intervals when the table T is not completely loaded at the time during which the table motor **M2** is operating. Therefore, to handle such situations, the relay **CR9** and it associated circuitry is included. These situations are sensed when the distributor H is off its home position and is distributing pins to the table T, or when less than ten pins have been transferred from the pin elevator mechanism F via the distributor H to the table T. Accordingly, the following circuitry is provided. The relay **CR9** has its coil connected to the fixed contact **SW9A** of the second bank of the override switch **SW9**. The common contact **SW9B** of this bank is returned to a 24 volt D.C. potential. The other end of the coil of the relay **CR9** is returned particularly to the contacts **PR1E** and to the contacts of the switch **SW4O** which are returned to ground. Accordingly, whenever the contacts **PR1E** or the contacts **SW4O** are closed, relay **CR9** is energized. Accordingly, power is applied to rear end motor **M1** via that path from bus **J1**, contacts **CR1A**, contact **CR9B**, contact **CR9C**, contact **SW9D** and contact **SW9E**.

The switch **SW4O** is the normally open contacts of the home position switch **SW4**. That is, when the distributor H is in its home position, that is, having completed a delivery cycle, contacts **SW4O** will be open. However, if it is anywhere during the delivery cycle, these contacts will be closed, indicating that the table T is not completely loaded. Therefore, the relay **CR9** is energized to complete the delivery cycle. Generally, when the relay **PR1** is energized, it will be apparent from the above description for a normal cycle that less than ten pins have been delivered by the distributor H. When the ten pins have been delivered, the relay **PR1** will be deenergized and the contacts **PR1E** will open. Therefore, as long as the relay **PR1** is energized, pins are being delivered by the distributor H to the table T and the relay **PR1** will only deenergize after the tenth pin has been delivered in response to the switch **SW4O** as previously described.

The contacts **PR5E** which also control the relay **CR9** are provided to permit immediate ball return during what is known in the art as the instruction or practice periods. That is, the period of time when a bowler merely throws a ball down the alley and no pins are set. Accordingly, at such a time, the switch SMG is placed in the I position (FIGURE 3) causing the energization of the relay **PR5**. When the relay **PR5** is energized, the contacts **PR5E** close and the relay **CR9** is energized, causing the rear end motor **M1** to operate to drive the ball lifting mechanism X.

In order to permit the throwing of practice balls, provision is made to only permit motor **M1** to operate for ball returns and prevent operation of the table motor **M2** and sweep motor **M3**. This is accomplished by moving switch SMG to the I position. In such case, the coil of relay **PR5** is energized via a circuit including the secondary **T2S**, the I contact of switch SMG to ground the diode **Q1H**. Contacts **PR5A** and **PR5B** open, and contacts **PR5C** close. It should be recalled that once initial power is applied, busses **J18** and **J1** from the prime A.C. source directly feed the primary **T2P** of transformer **T2**.

Current is now applied to the coil of relay **CR1** by a circuit including secondary **T2S**, now closed contacts **PR5C**, and normally closed interlock switch SE. The contacts **CR1A** and **CR1B** of relay **CR1** close, applying power to transformer **T1** (FIG. 2). Current also flows in a circuit from bus **J1** via contact **CR1A** to contact **SW9F**, the contact **SW9E**, through motor **M1**, back through the contacts **CR1B** to the line **J8**. Accordingly, motor **M1** which drives the rear end mechanism and the ball lifting mechanism X is energized.

The secondary **T1S** of transformer **T1** energizes line **10** and the stepper STP steps to the first position as previously described, for normal bowling. Normally the relay **CR3** is energized via a path including line **10**, the coil of relay **CR3**, contact set **SL1–11**, contacts **PR5A** and line **32**. However, contacts **PR5A** are open so that relay **CR3** can not be energized. Since operation of motors **M2** and **M3** depend on energization of relay **CR3**, said motors are ineffective and normal bowling cycles cannot be performed. Therefore, motor **M1** alone is energized and the system under such condition will only return balls thrown down the alley.

Although only a normal two ball cycle and the modified two ball cycle in accordance with the invention have been described, the pin spotting machine can also pass through a strike cycle or a foul cycle. However, since either of these cycles are variations of the normal two ball cycle and are not required for the teaching of the invention, they will not be described. Similarly, some of the circuits shown in FIGURES 2 and 3 have not been described. However, a brief mention will be made of these circuits for completeness.

In particular, the circuits centered around the foul detector FD are concerned with detecting fouls during the course of bowling, and are generally only employed in league play. A foul detector is brought into operation when the relay RJ is energized by positioning the foul switch **SF1** to the down position, closing the contacts RJA which energize the relay **PR3**. When the relay **PR3** is energized, then a foul ball cycle will be initiated during bowling whenever the light to the foul light detector **30** is interrupted. Similarly, in FIGURE 3 the switch **SW1** is an off-limit switch which prevents the jamming of the spotting mechanism whenever a pin has been disturbed beyond a position wherein the spotting mechanisms on the table T can grasp it.

Although many elements of the system such as the distributor H, the pin spotting mechanism F, the ball lifting mechanism X, the conveyor E, the table T, the counting device switch **SW5**, the home positions switch **SW4** and the gripper switches **SW6** have been shown in block diagrams, these elements are more completely described and shown in Patent 2,983,510 noted above.

Although one embodiment of the invention has been disclosed and shown in detail, there will be now obvious to those skilled in the art many modifications and variations which satisfy many or all of the objects but which do not depart from the spirit of the invention as defined in the claims which follow.

What is claimed is:

1. In a bowling pin spotting machine including pit conveyor means, pin elevator means, pin distributor means and ball delivery means all driven by a first motor, pin sweep means driven by a second motor, table means for at least accepting pins from said pin distributor means and spotting said pins driven by a third motor, said pin distributor means cyclically moving from a home position to place pins received from said pin elevator means into receptacles in said table means, first switch means for

indicating when said pin distributor means is off said home position, pin counter means for counting the number of pins transferred from said pin elevator means to said table means by said pin distributor means, second switch means responsive to said pin counter means for indicating that less than ten pins have been transferred during a delivery cycle, master control means for controlling the cycles of said pin spotting machine, pit switch means operable by a bowling ball for activating said master control means to step through an operating cycle and a source of electrical energy, in combination, a relay including a normally open contact, a normally closed contact, a moving contact and a coil, a control element in said master control means activatable during a given portion of a cycle of said master control means and having an input connected to said source of electrical energy and an output means connected to said normally closed contact and to said second motor, means for connecting said source of electrical energy to said normally open contact, means for connecting said moving contact to said first motor, means for connecting said first switch means to said coil for energizing said coil when said first switch means indicates said pin distributor means is off the home position, means for connecting said second switch means to said coil for energizing said coil when said second switch means indicates that less than ten pins have been transferred during a delivery cycle, and overriding switch means for selectively connecting said first motor directly to said source of electrical energy.

2. The apparatus of claim 1 wherein said overriding switch means includes: a first switch having a first fixed contact connected to said source of electrical energy, a second fixed contact connected to the moving contact of said relay and a moving contact connected to said first motor; and a second switch having a fixed contact connected to the coil of said relay and a moving contact connected to a source of relay energizing voltage, said moving contacts being mechanically coupled so that when the moving contact of said first switch is connected to the second fixed contact of said first switch the moving contact of said second switch is connected to the fixed contact of said second switch.

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DELBERT B. LOWE, *Primary Examiner.*