Feb. 10, 1953 C. H. BAUERSCHMIDT 2,628,098

AUTOMATIC PIN-SETTING MACHINE

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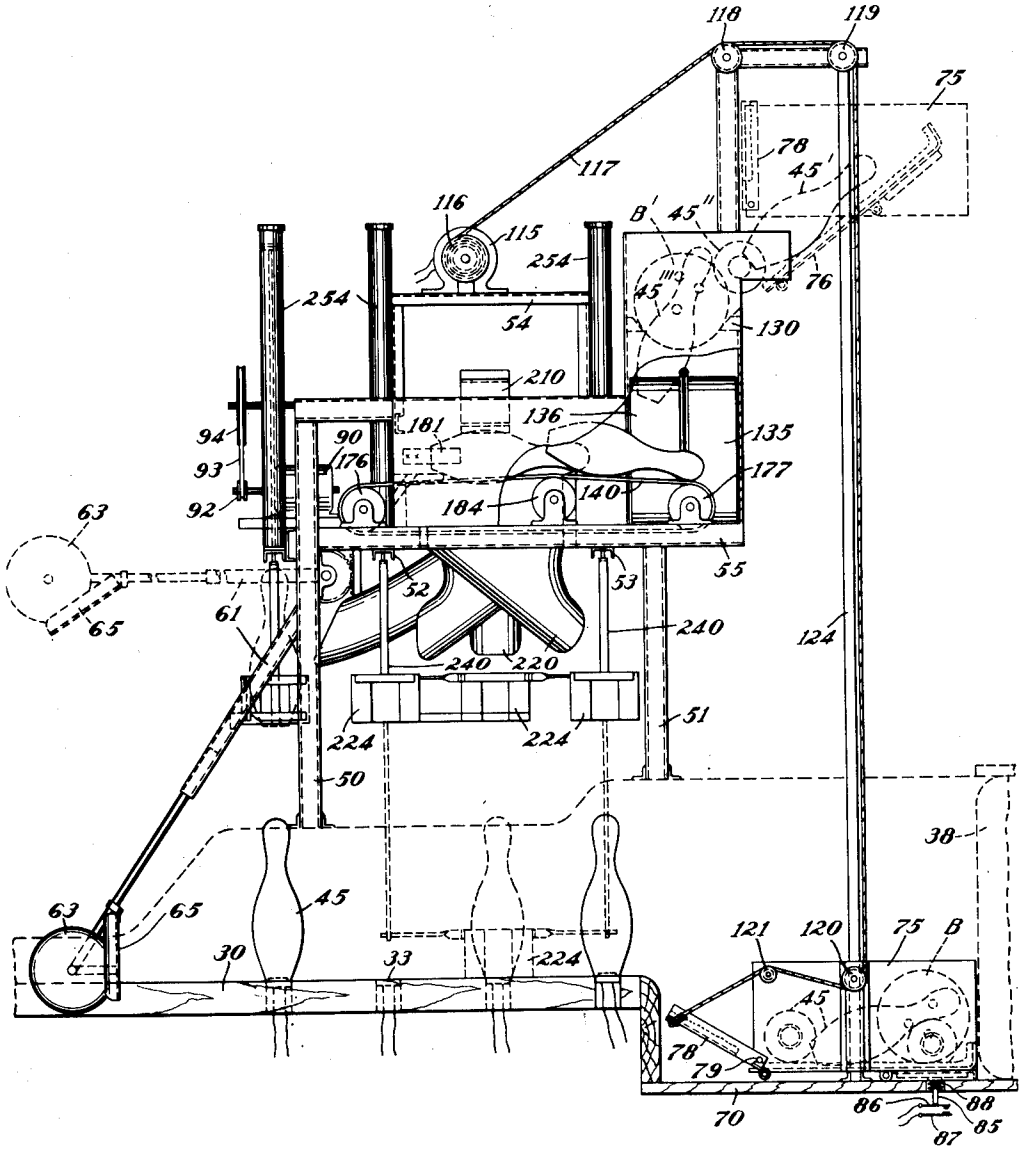

Fig. 1

INVENTOR.
CHARLES H. BAUERSCHMIDT
BY B. H. Schlesinger
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Feb. 10, 1953 C. H. BAUERSCHMIDT 2,628,098

AUTOMATIC PIN-SETTING MACHINE

Filed May 3, 1946 10 Sheets-Sheet 2

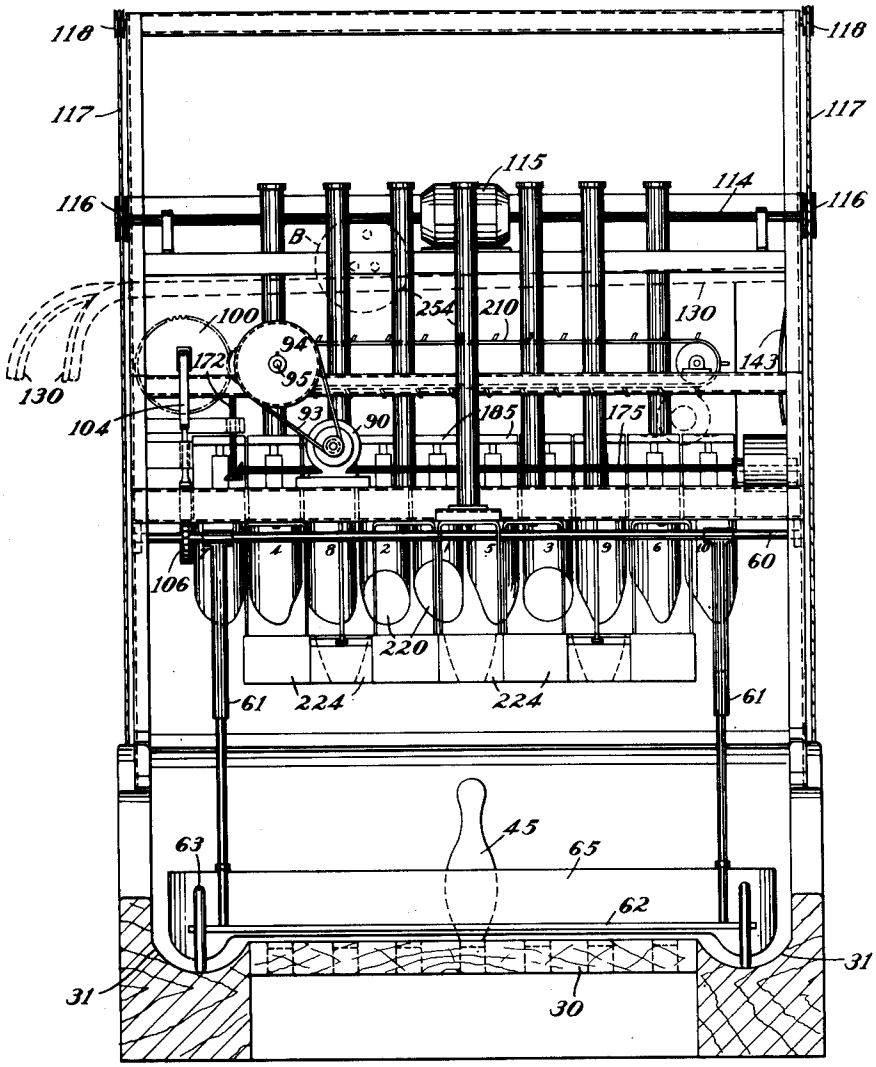

Fig. 2

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AUTOMATIC PIN-SETTING MACHINE

Filed May 3, 1946 10 Sheets-Sheet 3

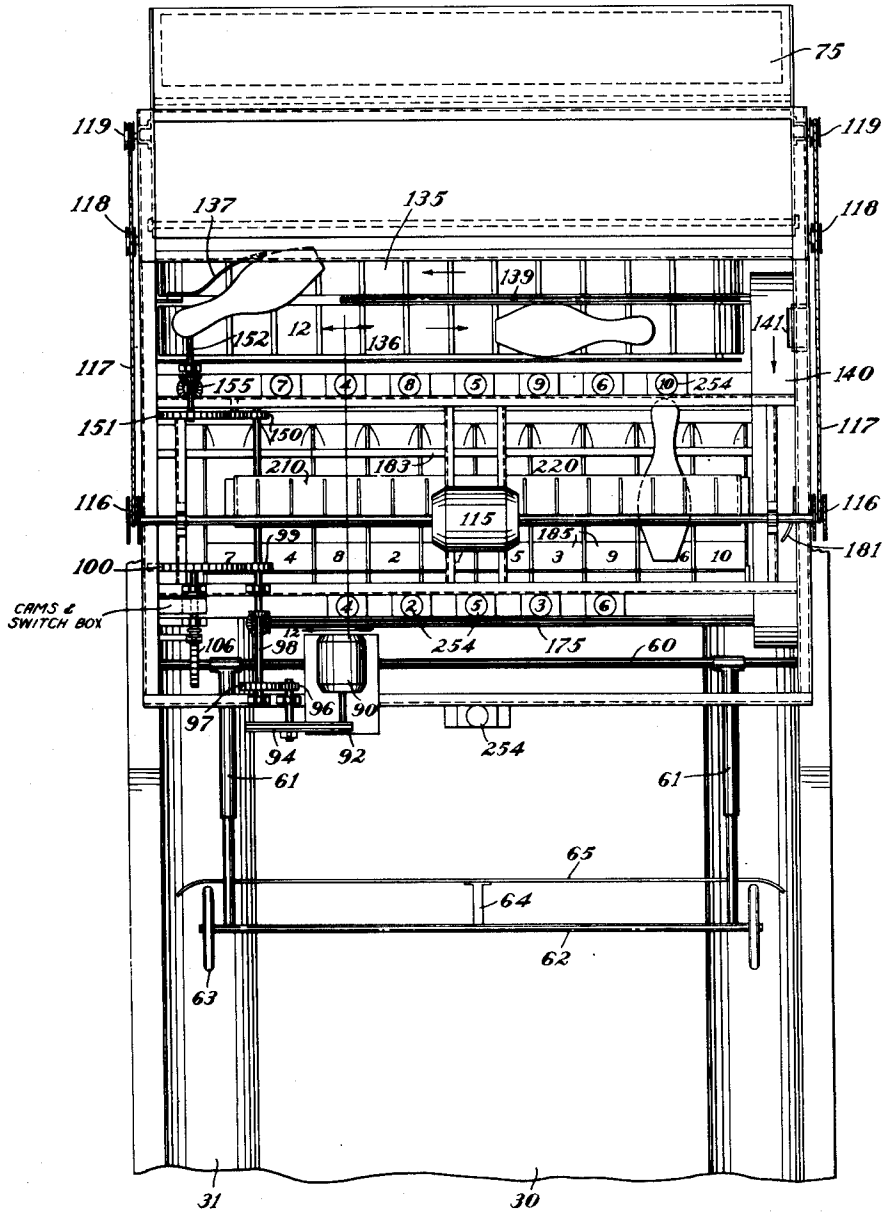

Fig. 3

INVENTOR.
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Feb. 10, 1953 C. H. BAUERSCHMIDT 2,628,098

AUTOMATIC PIN-SETTING MACHINE

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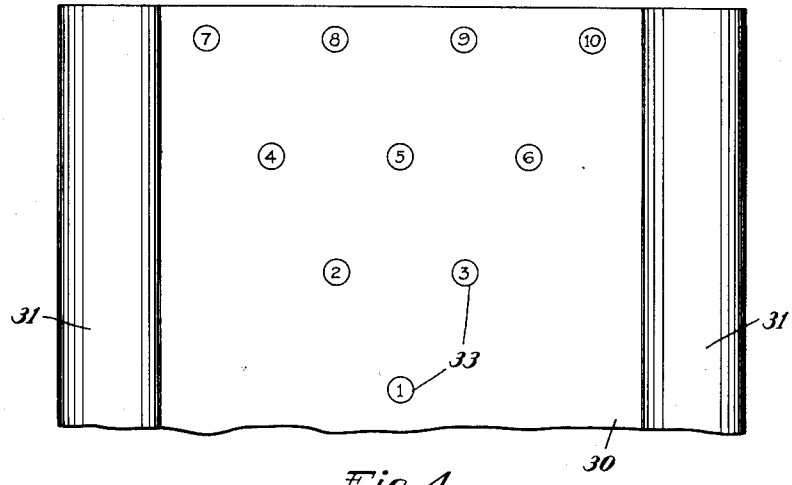

Fig. 4

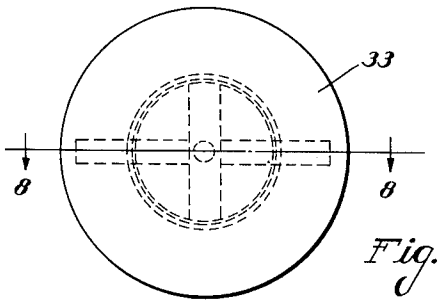

Fig. 7

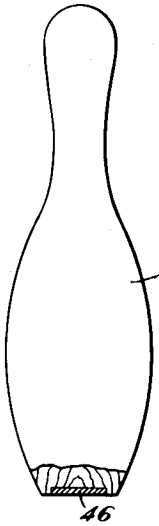

Fig. 5

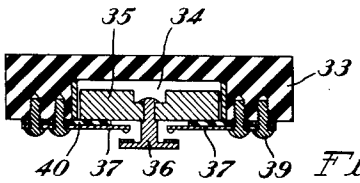

Fig. 8

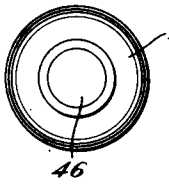

Fig. 6

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AUTOMATIC PIN-SETTING MACHINE

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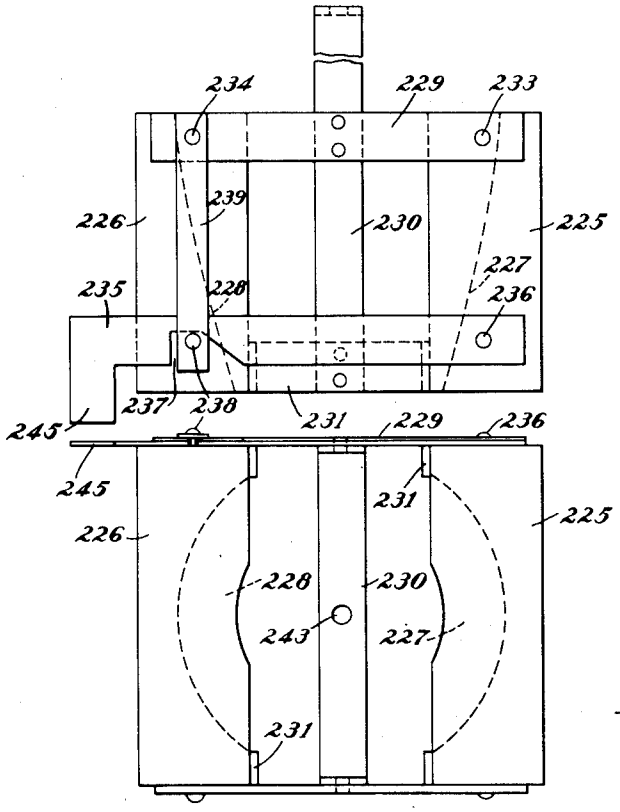

Fig. 9

Fig. 10

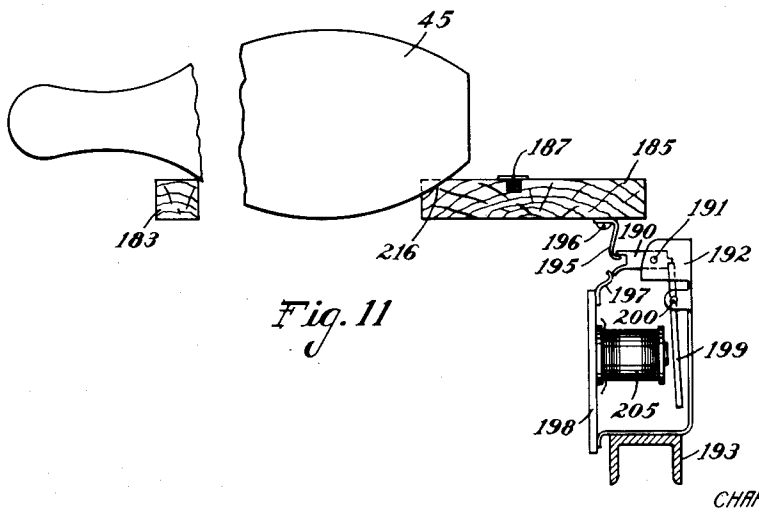

Fig. 11

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AUTOMATIC PIN-SETTING MACHINE

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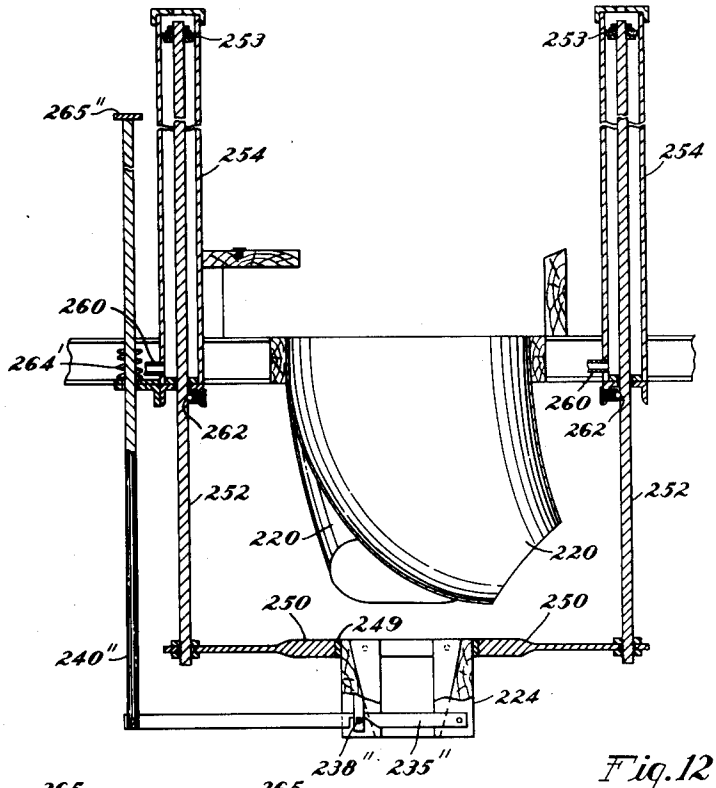

Fig. 12

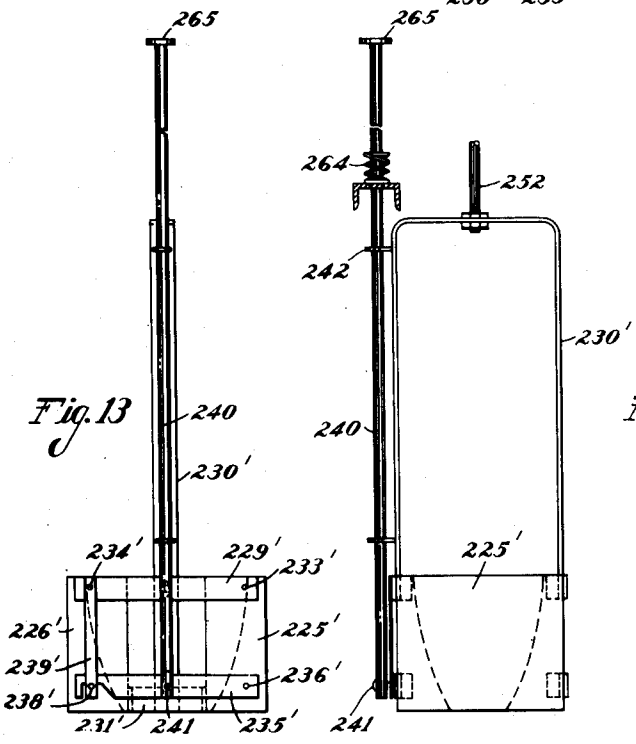

Fig. 13

Fig. 14

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Feb. 10, 1953 C. H. BAUERSCHMIDT 2,628,098

AUTOMATIC PIN-SETTING MACHINE

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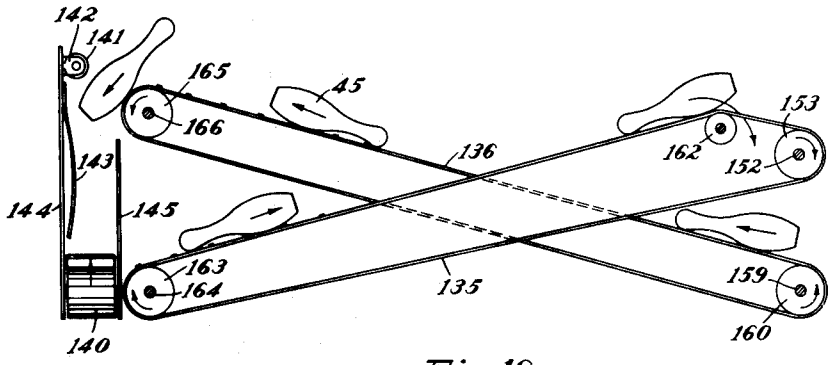

Fig. 16

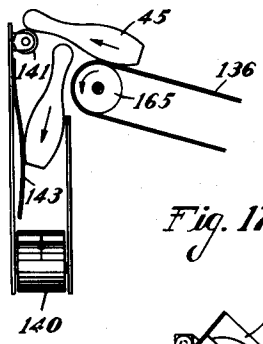

Fig. 17

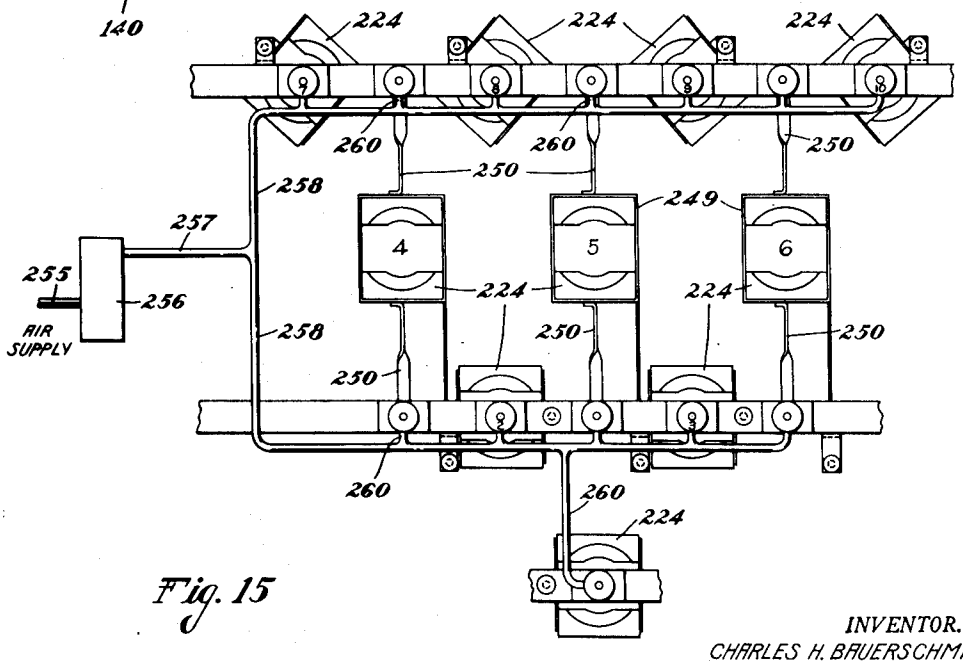

Fig. 15

INVENTOR.
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Feb. 10, 1953 C. H. BAUERSCHMIDT 2,628,098

AUTOMATIC PIN-SETTING MACHINE

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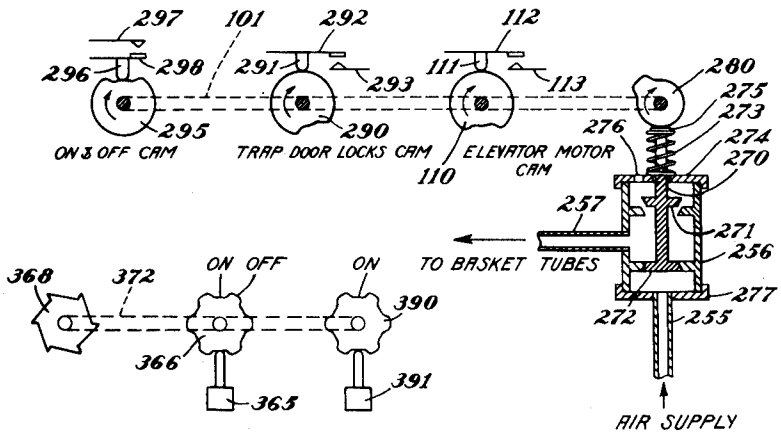

Fig. 18

Fig. 26

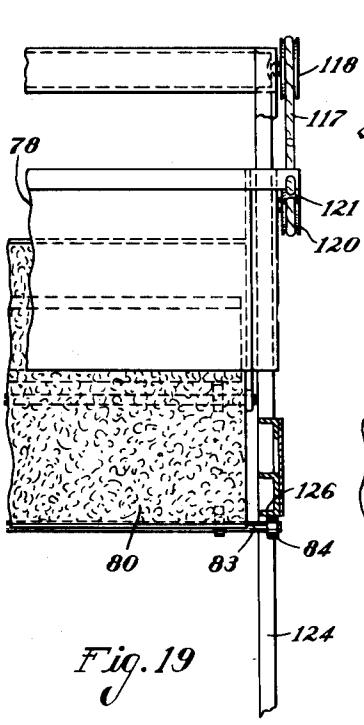

Fig. 19

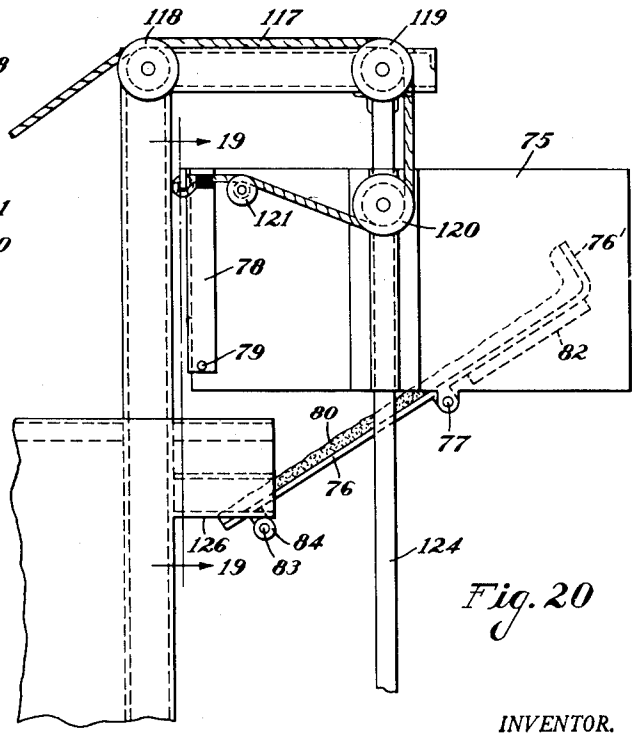

Fig. 20

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Feb. 10, 1953 C. H. BAUERSCHMIDT 2,628,098

AUTOMATIC PIN-SETTING MACHINE

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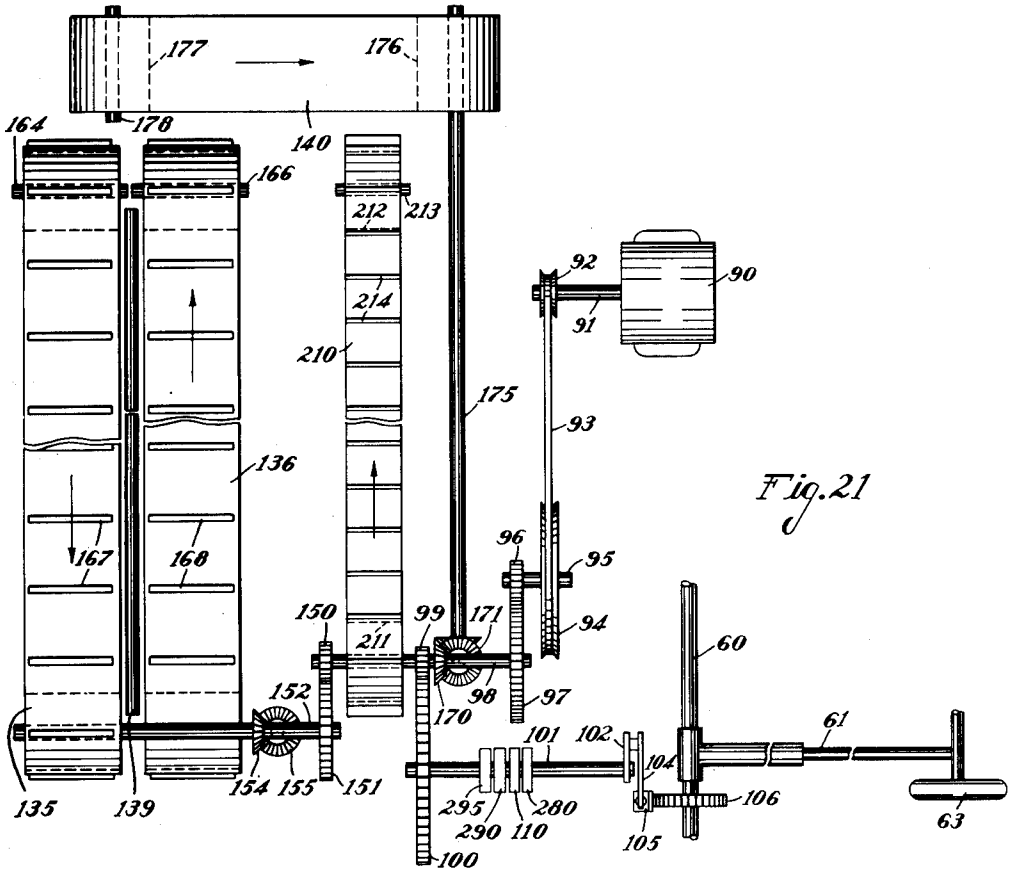

Fig. 21

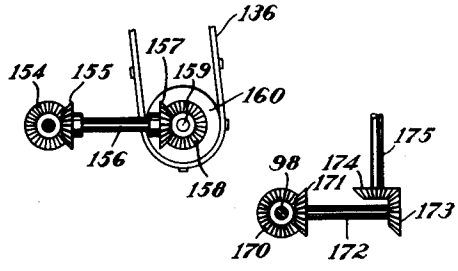

Fig. 22

Fig. 23

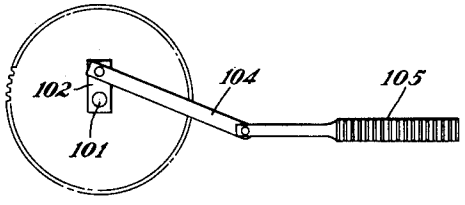

Fig. 24

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AUTOMATIC PIN-SETTING MACHINE

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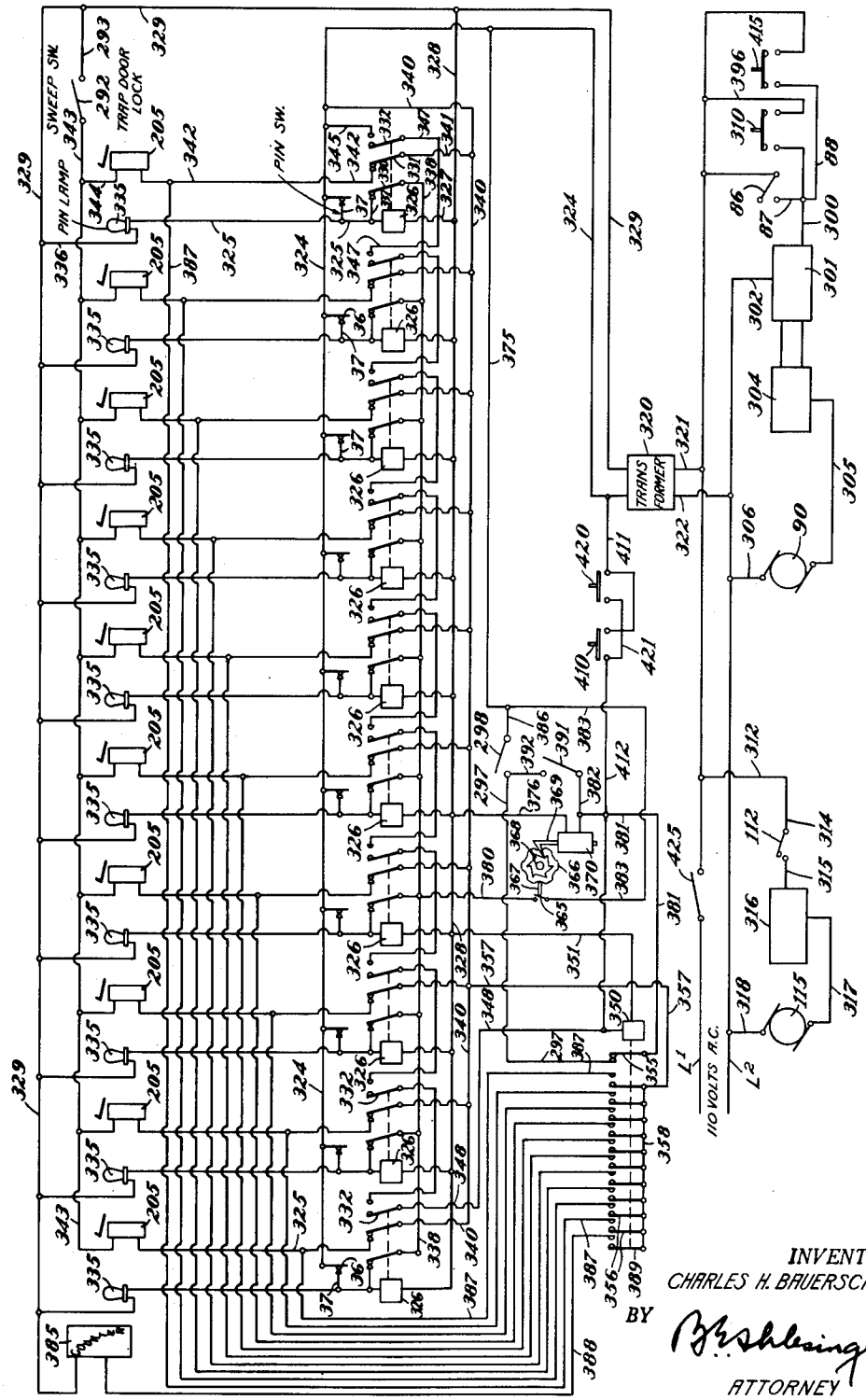

Fig. 25

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Patented Feb. 10, 1953 2,628,098

UNITED STATES PATENT OFFICE

2,628,098

AUTOMATIC PIN-SETTING MACHINE

Charles H. Bauerschmidt, Rochester, N. Y.

Application May 3, 1946, Serial No. 667,149

5 Claims. (Cl. 273—43)

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The present invention relates to apparatus for automatically setting pins on a bowling alley.

Such work as has heretofore been done on automatic pin-setting machines has been generally along the line of providing an apparatus through which two different set-ups may take place, depending upon whether all of the pins are knocked down with the first ball of a frame or upon whether some of the pins are left standing after the rolling of the first ball.

With the previously proposed apparatus, if all of the pins are knocked down by the first ball of the frame, the alley is swept clear of the downed pins, or "deadwood" as it is termed, and a new set of pins is placed on the alley ready for the next frame. With the previously proposed apparatus, on the other hand, if some pins are left standing, after the first ball has been rolled, these pins are lifted from the alley, the alley is swept clear of all pins that have been knocked down, and then the pins, that were left standing, are lowered onto the alley again, ready for the rolling of the second ball of the frame. After the second ball is thrown, a whole new set of pins is reset on the alley, regardless of whether all of the pins have been knocked down or not.

With prior proposed designs for automatic pin-setting machines, therefore, two pin-setting devices have had to be provided, namely, one, which lifts the pins that are left standing after the first ball of the frame is rolled and resets these pins after the deadwood is swept from the alley, and the other, to set a whole new group of pins after the second ball of a frame is rolled, or in the event that the first ball of a frame knocks down all of the pins. Since both of these pin-setting devices have to set pins on the same spots on the alley, difficulties have been encountered in these prior designs in getting the required pin-setting devices and their actuating mechanisms into position where each can perform its function without interfering with the other. Moreover, with the prior proposed designs, mechanism had to be provided which would operate both pin-setting devices at the proper time and, further, which would insure that each of the two pin-setting devices would operate only at the time when that pin-setting device should operate. Provision of two different pin-setting devices and the actuating mechanism therefor naturally increases the cost of the apparatus. Moreover, because the standing pins have to be lifted off the alley after the first ball is rolled to permit sweeping away of the deadwood, considerable loss of time is entailed in the pin-setting operation unless all pins are knocked down with the first ball of a frame.

2

Furthermore, prior proposed types of automatic pin-setting mechanism have required hoppers or magazines in which to store extra pins so that pins could be supplied to the setting device when a whole new set of pins had to be positioned. With prior proposed types of automatic pin-setting mechanisms, moreover, involved and complicated types of conveyor mechanism have had to be employed for conveying the pins, which are knocked down and swept off the alley, from the pit at the end of the alley, to the pin-magazine or hopper.

A primary object of the present invention is to provide an automatic pin-setting mechanism which will be much less complicated, and therefore much less costly, than automatic pin-setting apparatus heretofore proposed.

A further object of the invention is to provide an automatic pin-setting mechanism which can function in a minimum of time and which does not require that the pins, which are left standing after the rolling of the first ball of a frame, be lifted off of the alley and reset.

Another object of the invention is to provide a pin-setting mechanism which will always function in the same minimum length of time, and which will require no longer for operation when some of the pins only are knocked down by the first ball of a frame than when all of the pins are knocked down by that ball.

Another object of the invention is to provide an automatic pin-setting mechanism in which a single pin-setting device only is employed regardless of how many pins are knocked down by a ball.

A further object of the invention is to provide a pin-setting mechanism which will operate without a pin-magazine and without conveyors for conveying pins to a magazine.

Still another object of the invention is to provide an automatic pin-setting mechanism having simple controls to insure that it functions in proper sequence regardless of how many pins may be knocked down by each ball of a frame.

Another object of the invention is to provide an automatic pin-setting mechanism of the type described which can be put in use on a standard bowling alley.

Other objects of the invention will be apparent hereinafter from the specification and from the recital of the appended claims.

In the pin-setting apparatus of the present invention standard bowling pins are used, but each has a piece of iron or steel set into its base. The pins are placed in the usual manner on ten spots provided in the alley floor and arranged in

a pattern conforming to the relative arrangement of the pins required for the bowling game being played. Beneath the pin spots, however, are discs made of some permanently magnetized material, and to each disc there is connected an electric switch. When a pin is on a spot, the piece of iron or steel in the base of the pin attracts the disc and closes the switch beneath that particular spot, but when the pin is knocked down, the switch opens by gravity. At the start of a frame, when all ten pins are on their spots, all ten of the switches beneath the spots are closed.

In the pin-setting mechanism of the present invention, all of the pins are swept off of the alley each time that a ball is rolled down the alley. If the ball is the first ball of a frame and only part of the pins have been knocked down, then, after all of the pins have been swept from the alley, pins corresponding to those that were left standing are reset on the proper spots.

The pin-setting mechanism of the present invention is preferably put into operation by the rolling of the ball down the alley. At the rear end of the alley is an elevator and beneath the floor of this elevator is a normally open switch. When a bowler rolls a ball down the alley, it drops onto the elevator floor and the weight of the ball closes this normally open switch. This starts the motor that drives the sweep. Of course, the switches under the bowling pins, that have been knocked down by the ball, are open, but the switches under the pins, that have been left standing, are closed. As the sweep moves downwardly and rearwardly, and before it strikes any of the standing pins, a switch is closed that establishes, with the aid of the switches under the standing pins, hold-in circuits to electromagnets corresponding to the pins that have been left standing. These circuits therefore remain closed when the standing pins are subsequently knocked down by the sweep in its continued rearward movement. The sweep continues rearward until it has swept all of the pins off of the alley into the elevator. Then a switch is closed which starts the motor that drives the elevator, and the ball and pins are carried upward. At the end of its upward movement, the elevator is tilted to dump the pins and ball. The ball rolls down on rails and is returned to the head of the alley, ready for the bowler to use again. The pins drop between the rails onto a series of conveyor belts which carry them forward onto a series of trap-doors.

There are ten of these trap-doors, one for each pin of a set. These trap-doors are normally locked, but each has an electromagentically operated mechanism for opening its lock. As the sweep swings back on its return movement, after having swept the pins from the alley, and when it has reached a position forward of the foremost pin-spot, a switch is tripped that completes, in cooperation with the hold-in circuits described above, circuits to the electromagnetically operated releasing mechanisms corresponding to the pins that were left standing on the alley after the rolling of the ball. The trap doors corresponding to the pins, which were left standing, are therefore opened. The pins on these trap-doors drop into chutes which convey them to baskets that are aligned with the spots on the alley on which the pins corresponding to those that were left standing are to be reset. There are ten baskets, one for each pin. The weight of a pin dropped into a basket causes the basket to be lowered by gravity, and when the pin reaches the floor, the basket is opened, allowing the pin to be reset on the floor. The sweep motor is controlled by a time relay. It is stopped long enough to allow the pins to be reset. Then the sweep motor starts up again, and the sweep arm is swung upwardly to inoperative position. At the end of its upward swing, the circuit to the sweep motor is opened and the machine stops. At the end of the upward movement of the elevator, the elevator motor is stopped, and the elevator returns to its lowermost position by gravity.

The machine is so wired that if all of the pins are knocked down by the first ball, then all of the trap doors are opened on the subsequent movement of the sweep, to allow setting of a whole new set of pins. It is also wired so that after the second ball of a frame has been thrown, all of the trap doors are also opened to allow setting of a new set of pins.

The machine can operate with a single set of ten pins, but if it is desired to reduce operating time to a minimum, twenty or more pins can be employed. In this latter event, ten pins can at all times be positioned on the trap-doors so that the pins required can be released to be reset at the proper time in the cycle of operation of the mechanism. Thus, the sweep can be operated faster since it is not necessary to delay the opening of the trap-doors until the elevator has been raised and the original set of pins has been delivered by the belts onto the trap-doors. The extra ten or more pins simply remain on the conveyor belts until there is room for them to be positioned on the trap doors.

In the drawings:

Fig. 1 is a side elevation at the pin end of a bowling alley provided with an automatic pin setting machine built according to one embodiment of this invention, parts being broken away for clearness in illustration;

Fig. 2 is a view showing the pin setting mechanism in front elevation and the bowling alley in transverse section;

Fig. 3 is a plan view of the pin setting mechanism and alley;

Fig. 4 is a fragmentary plan view of the alley showing particularly the spots for the pins;

Fig. 5 is an elevational view of a bowling pin such as is used with the mechanism of the present invention, the base of the pin being broken away;

Fig. 6 is a bottom plan view of the pin;

Fig. 7 is a plan view and Fig. 8 a vertical sectional view, on an enlarged scale, through one of the spots;

Fig. 9 is a side elevation and Fig. 10 a bottom plan view of a pin basket, built according to one embodiment of this invention;

Fig. 11 is a fragmentary sectional view showing one of the trap doors and the mechanism for operating same and showing a pin in position on the trap door;

Fig. 12 is a fragmentary view, on an enlarged scale, showing in section one of the pin chutes, one of the pin-baskets, the mechanism for raising the basket, and a modified form of mechanism for opening the basket to permit it to position a pin on the floor;

Figs. 13 and 14 are views taken at right angles to one another showing another of the baskets and the trip mechanism therefor;

Fig. 15 is a more or less diagrammatic plan view showing the relative positions of the several

baskets and showing the fluid pressure operated system for raising the baskets;

Figs. 16 and 17 are more or less diagrammatic views showing three of the conveyor belts for the pins and the mechanism for assuring that all pins travel in the same direction to the trap doors;

Fig. 18 is a diagrammatic view showing the several control cams and the parts which they actuate;

Figs. 19 and 20 are a fragmentary front elevation and a fragmentary side elevation, respectively, illustrating the elevator structure and the means for dumping the elevator floor;

Fig. 21 is a diagrammatic view showing the means for driving the various parts of the machine;

Figs. 22, 23 and 24 are fragmentary views on a somewhat enlarged scale illustrating details of this drive;

Fig. 25 is a diagrammatic view showing the electric circuit of the machine; and

Fig. 26 is a detail view of the mechanism for insuring proper setting of the pins in each frame and at the end of each frame.

Referring now particularly to Figs. 1 to 8 inclusive, 30 denotes the floor of the bowling alley and 31 the gutters at each side of the alley. Set into the floor of the alley, adjacent the pit or rear end thereof, are ten spots 33 (Fig. 4) which may be made of Bakelite or similar material. These spots are preferably cylindrical in shape with plain top surfaces that are flush with the floor of the alley. They are arranged and spaced, as shown in Fig. 4, at the proper distances apart corresponding to the arrangement of the pins in a bowling game. The numerals on the spots in Fig. 4 correspond to the conventional designations of the pins which are to be placed on the several spots.

Each of the spots 33 is recessed on its under face, as denoted at 34 in Fig. 8, and mounted for reciprocatory movement in each recess is a disc 35 that is made of some permanently magnetized material. Riveted or otherwise secured in each disc 35 is a stud 36, that, when raised, is adapted to bridge two terminal strips 37 to close an electric circuit across those strips. The strips are secured to the under face of the spots 33 by screws 39. An insulating ring 40 is interposed between each set of terminal strips 37 and the corresponding disc 35. These insulating rings 40 have sufficient rigidity to act as stops limiting the downward movement of the discs 35.

The bowling pins are denoted at 45. These are of standard construction except that each has a recess in its base, as shown in Figs. 5 and 6, in which is fixedly secured a disc 46 of steel or iron. When a pin 45 is on a spot 33, the steel or iron piece 46 in the base of the pin attracts the permanently magnetized disc 35 of the spot and causes the disc 35 to be pulled upwardly so that the head of the plunger 36 bridges the terminals 37. When a pin is on a spot, then, it closes an electric circuit across a pair of terminals 37. As will be described more particularly hereinafter, if a pin is left standing on the alley after the rolling of the first ball of a frame, hold-in circuits will be completed through all of the plungers 36 and terminals 37 under the standing pins, so that at a proper time in the cycle of operation of the mechanism, pins can be reset, corresponding to the pins that were left standing, ready for the rolling of the second ball of the frame.

The pin-setting mechanism of this invention is mounted upon a steel framework which comprises a plurality of uprights, such as the uprights 50 and 51 of Fig. 1, cross-pieces like the cross-pieces 52 and 53 of that figure, and other cross-pieces like the cross-pieces 54 and 55, all bolted or welded together to make a strong, rigid support for the operating parts of the mechanism.

The sweep apparatus will now be described. Pivotally mounted on the uprights 50 of the frame is a shaft 60 (Figs. 1, 2 and 3) to which is secured a pair of arms 61. These arms are of telescoping construction and they carry at their outer or free ends the bar or rod 62 on which are mounted the wheels 63. The bar or rod 62 has a bracket 64 secured to it which extends rearwardly and to which is fastened the sweep plate 65. The rod 62 and plate 65 are of sufficient width to span the width of the alley 30 and extend over the gutters 31, as clearly shown in Figs. 2 and 3, so that, as the sweep swings about the axis of shaft 60, the wheels or rollers 63 will travel in the gutters 31 and the sweep plate 65 will sweep off of the alley and out of the gutters and into the pit, which is just beyond the rear end of the alley, any pins left on the alley or in the gutters after a ball is rolled.

The floor of the pit is denoted at 70 in Fig. 1 and is below the level of the floor 30 of the alley. Mounted in the pit is an elevator or carriage 75. This is adapted to receive the balls, which are rolled down the alley and the pins which are knocked down by the balls, as well as those that are swept off of the alley by the sweep plate 65. In its lower position, this elevator or carriage rests on the pit floor 70. This elevator is provided with rigid side walls, with a bottom or floor 76 (Figs. 1, 19 and 20) which is pivotally connected to the side walls at their lower ends by means of a pin or rod 77, and with a front wall 78 which is pivotally connected to the side walls by means of a pin or rod 79. The elevator floor 76 is padded as denoted at 80 to prevent marring of the ball and minimize scuffing of the pins. It has its rear turned upwardly, as denoted at 76' in Fig. 20, to provide a back wall or stop, and it has a block 82 secured to its under-face adjacent the rear thereof, and a rod 83 near the front thereof. The rod 83 carries rollers 84 which project laterally beyond the sides of the elevator.

When the elevator is in its lowermost position, as shown in Fig. 1, the front wall 78 pivots by gravity about its hinge pin 79 so that it forms an incline or chute down which the bowling ball and the pins can drop into the elevator.

Mounted in the pit floor 70 is a plunger 85 (Fig. 1). This plunger is normally spring-pressed upwardly by a spring 88 to project slightly above the top of the pit floor. Beneath the floor 70 is a switch arm 86 and a terminal 87. The switch arm 86 is normally held open by a spring or other suitable means (not shown). When the plunger 85 is depressed, however, the switch arm 86 is forced downwardly into contact with terminal 87.

When the elevator 75 is in its lowermost position the block 82 (Fig. 20) carried on the under-face of the elevator floor engages the plunger 85. Spring 88 is selected, however, so that its tension will not be overcome by the weight of the elevator 75 alone. Hence, even though the elevator be resting on plunger 85, if the elevator is empty, switch arm 86 will still be open. When a bowling ball B or a pin 45 (Fig. 1) drops or is swept onto the floor of the elevator, however, the extra weight of the ball or pin is sufficient to

depress the pin 85 and the switch arm 86 is closed. This serves to start the motor 90 which operates the sweep, as will be described more particularly hereinafter.

The motor 90 (Figs. 1, 2, 3 and 21) is mounted upon one of the crossbars of the frame. Its armature shaft 91 drives the sweep arm shaft 60 through a pulley 92, (Figs. 1, 2, 3, and 21) the belt 93, the pulley 94, the shaft 95, the spur gear 96 which is secured to that shaft, the spur gear 97, the shaft 98 to which this latter gear is secured, a spur pinion 99, which is secured to shaft 98, spur gear 100, the shaft 101, the crank member 102 (Fig. 24), which is fastened to this last named shaft, the connecting rod 104, the rack 105 which is pivotally connected to connecting rod 104, and the spur gear 106 which is keyed or otherwise secured to the shaft 60 and which meshes with rack 105.

The sweep arms 61 are normally held in the upper or dotted line position shown in Fig. 1. When the sweep motor is started, the crank 102 causes the sweep arms to be moved down to the full line position shown in Fig. 1 and rearwardly to the end of the alley, sweeping all of the pins off the alley, those left standing as well as those knocked down. As the plate 65 moves above the surface of the floor of the alley, the wheels or rollers 63 roll in the gutters 31 and they continue to roll in the gutters to the full end of the swing of the sweep arm. The telescoping construction of the sweep arms 61 permits this, for the arms shorten or lengthen properly at all times for the wheels to roll in the gutters. Collars or stops (not shown) are provided on the two telescoping parts of each arm 61 so as to limit the outward movement of the male part of the arm and prevent the parts from becoming disconnected.

Secured to the shaft 101 is a cam 295 (Figs. 18 and 21). A follower 296, which is secured to a switch arm 298, engages and rides on the periphery of this cam. This cam is so constructed that just before the sweep plate 65 can strike the foremost pin on the alley, it will, through rotation of shaft 101, close switch 298 to make contact with terminal 297. As will be described more particularly hereinafter, this causes a solenoid to be energized which functions, if any pins have been left standing on the alley after the rolling of the first ball of a frame, to establish a series of hold-in circuits corresponding to the pin or pins left standing. These hold-in circuits subsequently operate, as will also be described more particularly hereinafter, to insure that, after the sweep has performed its function, pins are reset on the alley corresponding to those that were left standing.

Secured to the shaft 101 is a cam 110 (Figs. 18 and 21). 111 denotes a follower which engages and rides on the periphery of this cam. This follower is secured to a switch arm 112 that is adapted to make contact with a terminal 113. When the follower 111 is riding on the high part of the cam, the switch arm 112 is held open, but when the follower rides on the low part of the cam, the switch arm is allowed to close. The sweep arms 61 move, of course, first in one direction and then in the other under actuation of crank 102, but the shaft 101 rotates always in the same direction which is clockwise as viewed in Fig. 18. When the shaft 101 has rotated far enough for the sweep 65 to have completed its operating stroke, and for the bowling pins 45 and ball B to have been swept into elevator 75, the follower 111 rides onto the low portion of the cam and allows the switch arm 112 to close, making contact with the terminal 113.

This makes a circuit to the elevator motor 115 (Figs. 1, 2, 3 and 25). The armature shaft 114 of this motor projects from both ends of the motor, as clearly shown in Fig. 2, and carries at its opposite ends two winches 116, each of which is connected by a cable or rope 117 with the elevator 75. Each cable 117 runs over two spools 118 and 119 (Fig. 1), which are journaled in the frame of the machine, under a roll or spool 120 and over a roll or spool 121, which are mounted on the side walls of the elevator, and each is connected at its outer end by a loop with the front wall or door 73 of the elevator. When the elevator motor 115 is started, therefore, to wind up the cables 117, the door 73 of the elevator is closed first. As soon as this is tight, the tension on the cables pulls up the elevator itself.

In its movement, the elevator slides on the upright rails 124 (Figs. 1 and 20) which are secured at their lower ends to the pit floor 70 and at their upper ends to the frame work of the machine. Projecting rearwardly from the frame work of the machine are rails 126 (Figs. 19 and 20). As the elevator approaches the upper limit of its travel, the rollers 84 carried by rod 83 engage the rails 126 and as the elevator continues upwardly, the floor 76 of the elevator is rocked about its pivot pin 77 to discharge the ball and the bowling pins 45 from the elevator. The elevator is shown in dotted lines in Fig. 1 in the act of discharging the ball and pins and also in this same position in Fig. 20. The pins roll out in any fashion, one of them being shown rolling out sidewise at 45'' in Fig. 1 and one dropping out longitudinally at 45'.

There are two spaced rails 130 (Figs. 1 and 2) mounted on the frame work of the machine. These rails are mounted far enough apart to allow the pins, which are dumped out of elevator 75, to drop between them, as shown in the case of the pin 45''', but they are close enough together to prevent the ball from dropping between them. The rails are inclined toward one side of the alley. Hence the ball, which is shown in dotted lines as B', rolls along these rails to one side of the alley and is returned in the conventional manner to the front of the alley to the bowler.

The bowling pins dropping between the rails 130 drop off on to one or the other of two endless belts 135 and 136 (Figs. 3, 16, 17, and 21) that extend transversely of the frame. These belts are positioned one in front of the other; they are inclined to one another; and they travel in opposite directions. Those pins which drop on to the belt 135 are carried upwardly, as shown in Fig. 16, which is a view looking from the rear, until they strike a deflector 137 (Fig. 3) which causes them to roll forward to drop onto the belt 136. This belt carries these pins and any pins, which drop onto it, upwardly to a point where they drop off onto a belt 140 (Figs. 1, 3, 16, 17 and 21) which is mounted in the frame to run in a front to rear direction.

Mounted on a plate 144, which is secured at the side of the frame of the machine adjacent the point where the bowling pins drop off of the belt 136, is a roller or deflector 141 (Figs. 16 and 17). If the pins are carried up by the belt 136 with their butt ends upward, they do not contact the roller 141 but drop with these ends in position onto the belt 140, as shown in Fig. 16, but if the pins travel with their top ends upward along

the belt 136, the tops engage the roller or deflector 141 and the pins are caused to pivot about this roller or deflector, as shown in Fig. 17, so that the butt ends will drop foremost onto the belt 140. This deflector 141, thus, insures that all pins drop onto the belt 140 with their butt ends traveling forward along the belt as shown in Fig. 1. A leaf spring 143 which is secured to the plate 144 and which projects out above the belt 140 serves to hold the pins in correct position as they start to travel on belt 140.

The belts 135 and 136 are driven from the shaft 98 (Fig. 21) through the spur gears 150 and 151, the shaft 152, and the pulley 153 (Fig. 16) which is secured to that shaft. The belt 136 is driven from the shaft 152 through the bevel gearing 154 and 155 (Figs. 21 and 22), the vertical shaft 156, the bevel gearing 157 and 158, the shaft 159, and the pulley 160 (Figs. 22 and 16) which is secured to the shaft 159. The shafts 152 and 159 are suitably journaled in the frame in parallelism to one another.

The belt 135 rides on the pulley 153 and a pulley 163 which is mounted on a stub shaft 164 that is suitably journaled in the frame. An idler 162 serves to take up slack in the belt. The belt 136 rides over the pulley 160 and a pulley 165 which is mounted on a stub shaft 166. The belts 135 and 136 are provided with leather cleats 167 and 168, respectively (Fig. 21), to help grip and carry the pins along.

The belt 140 is driven from the shaft 98 through the bevel gearing 170 and 171 (Figs. 21 and 23), the vertical shaft 172, the bevel gearing 173 and 174, the shaft 175, and the pulley 176 which is secured to this shaft. This belt travels over the pulley 176 and a pulley 177 which is journaled on a stub shaft 178.

The pins are carried forward by the belt 140 with their butt ends foremost as already described. There is a deflector 181 (Fig. 3) secured to the side plate of the frame and projecting over the belt 140. This serves to force the pins off of the belt 140 onto a trackway which comprises a rail 183 (Figs. 11 and 3) at one side and at the opposite side a series of trap doors 185. The belt itself may also be biased somewhat, so as to permit the pins more easily to roll off the belt, by use of a conical idler, such as shown in Fig. 1 at 184. The smaller end of this idler is toward the inside of the machine so that the pins tend to roll off of the belt 140 toward the rail 183 and trap doors 185.

There are ten trap doors 185, one for each bowling pin of a set. These trap doors are pivoted on a rod 187 which is secured at opposite ends in the side walls of the frame. The trap doors are normally held locked so that they form an approximately horizontal surface along which the pins can roll from one side of the frame to the other. Since the trap doors and their operating mechanisms are all identical in construction, the structure and operating mechanism of only one trap door will be explained. The trap door is locked by a catch 190 (Fig. 11) which is pivoted by means of a pin 191 in a bracket 192. This bracket is secured to one of the crossbars 193 of the frame. The catch 190 is bifurcated at its outer end, and, when the catch is in operative position, one of its bifurcations engages the hook 195 which is secured by a screw 196 to the under side of the trap door. The other bifurcation is engaged by a leaf spring 197 that is secured to a plate 198 which is fastened to the bracket piece 192. The catch 190 is normally held in locking position by a lever 199 which is pivoted by means of the pin 200 in the bracket 192. The upper end of this lever, which is the shorter end, engages under a lug or teat formed on the short end of catch 190. Each catch 190 is adapted to be released when an electromagnet 205 associated with that catch is energized. The electromagnet is mounted upon the plate 198 and is adapted, when energized, to rock the lever 199 about its pivot 200. The spring 197 acts as a stop, engaging the shorter, upper bifurcation of catch 190, when the catch is released, to limit the downward swing of the catch about its pivot 191.

The pins are carried along the trackway comprising the rail 183 and the trap doors 185 by an endless belt 210 (Figs. 2, 3 and 21). This belt is driven from the shaft 98 through the pulley 211 which is keyed to that shaft. It runs over the pulley 211 and a pulley 212 which is keyed to a stubshaft 213 which is suitably journaled in the frame. The belt 210 is provided with flexible leather cleats 214 to help move the pins along.

Because the large or butt end of a pin will roll further per revolution of a pin than the small or head end of the pin, I have provided the trap doors 185 with scallops or recesses, such as indicated at 216 in Fig. 11. These scallops provide a hill-and-dale contour to the trap-doors 185 and make the butt ends of the pins travel over a greater length of surface than the head ends of the pins, thereby, compensating for and offsetting the difference in diameters between the head and butt ends of the pins.

The ten trap-doors are designated, respectively, in Fig. 3 with numerals corresponding to the conventional designations of the ten bowling pins, respectively, which are adapted to rest thereon. Each trap-door 185 is of approximately the width of a bowling pin at its maximum diameter. The belt 210 therefore carries the pins along the trap doors until one bowling pin registers with each trap-door. Then the leather fingers 214 (Fig. 21), which are secured to belt 210 and which are flexible, simply deflect as they pass over the ten pins in the continued running of belt 210. The ten pins butting against one another at their points of maximum diameter hold the pins properly spaced in place on the trap-doors and the scallops 216 in the individual trap-doors aid, also, in so holding them.

There are ten electromagnets 205 (Fig. 25), one for each trap-door. These electromagnets are adapted to be energized when the switch 292 (Figs. 18 and 25) is closed. This occurs when the shaft 101 has rotated far enough for the follower 291, which is secured to switch 292, to ride down onto the flat part of cam 290 that is secured to shaft 101. Then switch 292 makes contact with terminal 293. This happens when sweep plate 65 has moved far enough on its return stroke to be forward of the foremost (the No. 1) pin-spot 33. If only the first ball of a frame has been rolled and some of the pins have been left standing, closing of switch 292 completes, through the hold-in circuits already mentioned, circuits only to those electromagnets 205 associated with the trap-doors corresponding to the pins left standing. If all of the pins have been knocked down by the first ball of a frame, or if it is the second ball of a frame, which has been rolled, then all of the electromagnets 205 are energized and all of the trap-doors 185 are opened.

Beneath each of the trap-doors 185 is a chute 220 (Figs. 1, 2 and 12) and when a trap-door is opened, the pin, that has been lying on that trap-door, drops into the chute associated with that trap-door. These chutes are shown in Fig. 2 designated by numerals corresponding to the conventional designations of the pin spots 33 (Fig. 4) on which the bowling pins that drop through the respective chutes are to be set.

Beneath each chute is a pin receiving basket 224. These baskets, of which there are ten, one for each pin, may be made in various ways. One embodiment of basket is shown in Figs. 9 and 10. It comprises two blocks of wood 225 and 226 which are spaced apart and whose adjacent faces are formed with opposed concave recesses 227 and 228, respectively, that are shaped to receive between them the butt end of one of the bowling pins. The blocks 225 and 226 are pivotally connected at their upper ends by pins 233 and 234, respectively, to two parallel metal straps 229. These straps are in turn riveted to a U-shaped carrier-bar 230. This bar has riveted to the lower ends of its legs two U-shaped spacing plates 231 whose legs are interposed between the adjacent faces of the blocks 225 and 226. The pivot points 233 and 234 of the blocks are so disposed that the blocks tend to swing toward one another, the better to grip a bowling pin between them. The spacing plates 231 limit the distance which the two blocks can swing toward one another about their pivots 233 and 234.

The blocks are held in pin receiving position by a latch member 235. This member is pivoted at 236 on the block 225 and is provided with a kerf 237 that is adapted to engage a pin 238 that is carried by a strap 239 which is secured to one of the side straps 229 of the basket. When the latch member 235 is in the position shown in Fig. 9, the two blocks 225 and 226 are prevented from moving apart, and they can securely hold a bowling pin between them. When the latch member is lifted, however, to disengage its kerf 237 from the pin 238, the two blocks swing about their respective pivots 233 and 234 to release the bowling pin. In the embodiment of the invention shown in Figs. 9 and 10, the latch member 235 is provided with a downwardly projecting portion 245 which extends beneath the basket a sufficient distance to engage the floor of the alley 30, when the basket is lowered, before the basket itself does, so that the keeper 235 is unlatched by engagement of portion 245 with the floor, and the bowling pin in the basket is released.

In another embodiment of the invention, each basket comprises blocks 225' and 226' (Figs. 13 and 14) which are made like the blocks 225 and 226 and which are pivoted at their upper ends by pins 233' and 234', respectively, to plates 229' that are carried by a U-shaped carrier-bar 230'. The swinging movement of the blocks toward one another is limited by U-shaped spacing straps 231', similar to the straps 231, and the blocks are adapted to be held together by a keeper 235' similar to the keeper 235. The difference between the embodiment shown in Figs. 9 and 10 and that shown in Figs. 13 and 14 is in the means for releasing the keeper. In Figs. 13 and 14, this comprises a rod 240 which is connected to the keeper, intermediate the ends of the keeper, by means of a pin 241. This rod slides in guides 242 that are secured to or formed integral with the U-bar 230'. Near the end of the downward movement of the basket, the head 265 of the rod 240 engages a coil spring 264, which is mounted on the frame. Thus,

the rod 240 is moved relative to the U-strap 230', disengaging the keeper 235' from the pin 238' and releasing the bowling pin from the basket.

The baskets are adapted to be lowered by gravity and to be returned to their normal upper position by air pressure. For this purpose, piston rods are secured to the bars 230 (Figs. 9 and 10) or the bars 230' (Fig. 14). The hole through which the piston rod may be connected to strap 230 is designated 243 in Fig. 10. One of the piston rods is shown fragmentarily at 252 in Fig. 14.

Because of the confined space and the necessity for lowering each bowling pin accurately on its proper spot 33, it is not practical to provide piston rods directly above and centrally disposed with reference to each pin-basket. Some of the piston rods 252 would then interfere with the chutes 220. The means for raising the baskets must be clear of the area in which the chutes are mounted. For this reason, some of the baskets, namely those baskets which are adapted to carry the bowling pins that are to be place on Nos. 4, 5 and 6 spots 33, have to be carried, as shown in Figs. 12 and 15, by pairs of piston rods 252 spaced from one another and positioned so as to clear the chutes. These baskets have their blocks 225 and 226 or 225' and 226', as the case may be, pivotally mounted in a rectangular frame 249. Bars 250 are welded or otherwise secured to opposite ends of these frames and piston rods 252 are secured to the ends of these bars 250.

This structure is employed for carrying pins Nos. 4, 5 and 6, whether the basket trip mechanism of Figs. 9 and 10 be employed or a basket trip mechanism more like that of Figs. 13 and 14 be used. The latter type trip mechanism is illustrated in Fig. 12. Here, the keeper, as shown at 235'', has an elongated projecting portion connected to a rod 240'', similar to the rod 240 of Figs. 13 and 14. This rod passes through an opening in the frame on which is mounted a coil spring 264' that is adapted to engage the head 265'' of the rod. This spring prevents the rod from moving downward as far as the basket. Thus, the keeper 235'' is disengaged from the pin 238'' at the end of downward travel of the basket, allowing the basket to open under the weight of the bowling pin carried by it and allowing the pin to be deposited on one of the spots 33 on the alley.

The piston rods 252 are all alike and actuated alike. Each is secured at its upper end to a piston 253 which reciprocates in a cylinder 254, that is suitably mounted on the frame. Air is supplied to the under sides of the pistons 253, to raise the piston rods 252 and the baskets 224, from a supply duct 255 through a control valve denoted generally at 256, Fig. 15. A duct 257 leads from this valve to ducts 258 which connect with each of the cylinders 254 through ducts 260. Each piston rod 252 normally is held in its uppermost position by a ball-shaped spring-pressed detent 262 (Fig. 12) which is housed in a boss at the lower end of each cylinder 254 and which engages in a recess in the piston rod.

The coil spring, which actuates each detent 262, is strong enough to hold the associated piston-rod 252 and basket 224 in uppermost position, but when a bowling pin is dropped into the basket from the associated chute 220, the weight of the pin is enough to overcome the detent, and the basket drops down to set the pin on the alley. Since a pin is dropped into a chute only when a trap-door 185 (Fig. 11) is opened, it will be obvious that with the construction shown only those bowling pins will be placed on the alley,

after the rolling of a ball, which require to be set there in the course of the bowling game.

After the bowling pin or pins required have been placed on the alley, the basket or baskets 124 are raised by air-pressure on the under side of piston or pistons 253.

The valve for controlling the air ducts to cylinders 254 may be of the structure shown in Fig. 18. It has a valve stem 270 and two valve heads 271 and 272. A coil spring 273 is interposed between the cap 274, that encloses one end of the valve casing, and a washer 275, that is secured to the valve stem. This spring normally presses the valve upwardly to the position shown, where the valve head 272 is seated and closes off the connection between the air supply duct 255 and the duct 257 that leads to the cylinders 254. The ducts 260 are then on exhaust through the duct 257 and the vent 276 in the cap 274 that covers the upper end of the valve casing.

The valve 256 is operated by a cam 280. This cam is secured to the shaft 101 (Fig. 21) and is adapted, therefore, to rotate in time with the movement of the sweep 65. When the sweep motor 90 is started, the shaft 101 starts to rotate in a clockwise direction as viewed in Fig. 18, as already stated. The ducts 260 are therefore on supply, and the baskets 124 are held positively in their raised positions. They are so held until the sweep 65 approaches the end of its operating stroke. Then the follower 275 rides onto the low portion of the cam 280, and the cylinders 254 are put on exhaust. Then, the baskets 224 are held up only by the detents 262 (Fig. 12), and as soon as a bowling pin is dropped into a basket, in the further operation of the machine, the basket drops down to set the pin on the alley. After the sweep has returned to the position shown in dotted lines in Fig. 1, the follower 275 rides up on the high part of the cam 280, again to put the cylinders 254 on supply to raise the baskets 224 again to their uppermost position.

The pin-setting mechanism is, as previously stated, preferably put into operation by the rolling of a ball and the dropping of that ball onto the elevator floor (Fig. 1) to close switch 86. This starts the sweep motor 90. Thereafter the operations are controlled from the functioning of this motor and the parts which are actuated thereby.

One way in which the machine may be wired to accomplish its purpose is illustrated diagrammatically in Fig. 25.

L_1 and L_2 denote the main lines. These lines are connected by lines 321 and 322 with a step-down transformer 320. At the start of a bowling game, of course, ten pins are on the ten spots 33 (Fig. 4). As long as these pins are on the spots, all ten of the switches 36 are closed by the attraction of the discs 46 (Fig. 5) for the permanent magnets 35 (Fig. 3). A circuit is then made through each switch arm 36 from transformer 320 through line 324, switch arm 36, line 37, line 325, electromagnet 326, line 327, line 328, and line 329 to the transformer 320. This energizes each of the electromagnets 326, closing the switch arms 330 and 331 and opening the switch arm 332. The ten switch arms 36 and ten electromagnets 326 are shown in Fig. 25 but the circuits through all are similar and only one has, therefore, been specifically described.

A lamp 335 is provided for each pin. This is lighted when the pin is on its spot, the circuit to the lamp being made from the line 329 through the line 336, the lamp, the line 325, the line 37, switch 36 and the line 324 back to the transformer 320. The lamp circuits are identical, so one only need be described. The lamps may be mounted on a board above the alley or at any other suitable spot so that the bowler can tell at a glance what pins are standing.

If any of the pins are knocked down when a ball is rolled down the alley, the switches 36 associated with the spots, on which those pins have been positioned, open; the circuits to the electromagnets 326 associated with those spots are broken; and the lights 335 corresponding to those spots are extinguished. When the ball falls into the elevator 75 it closes by its weight the switch 86 (Figs. 1 and 25). A circuit is thus made from the main line L_1 through the switch 86, the line 87, the line 300, a standard controller 301, and the line 302 to the main line L_2. This causes controller 301 to close the circuit to and start a time relay 304. The time relay, which may be of standard construction, starts motor 90, a circuit being made to that motor from the time relay through the line 305, the motor itself being connected by line 306 with line L_2. The motor 90 drives the sweep arms 61 and shaft 101 as already described.

When the shaft 101 has rotated far enough for the follower 296 (Fig. 18) to ride off of the low part of cam 295 onto the high part of that cam, switch 298 will be closed. This occurs before the sweep 65 can strike a bowling pin and when the sweep is about in the position shown in full lines in Fig. 1. The closing of switch 298 causes a circuit to be made from the line 324 through lines 375 and 386, switch 298, line 297, a normally-closed switch 355, lines 381 and 382, solenoid 370, and lines 376, 328 and 329 back to transformer 320. This energizes solenoid 370, actuating a pawl 369 that is connected to the core of the solenoid. The pawl engages a ratchet wheel 368 (Figs. 25 and 26) which is mounted on the same shaft 372 as a cam 366. This cam has a plurality of high spots and a plurality of low spots. It is engaged by a follower 367 which is adapted to operate switch 365.

The switch 365 is normally open, and at the start of the bowling game, the follower 367 is riding on one of the low spots of cam 366 so that switch 365 is actually open. When solenoid 370 is energized, however, as described above, shaft 372 is rotated through a slight angle by action of pawl 369 and ratchet wheel 368. This causes follower 367 to ride up on a high spot of cam 366 and close switch 365.

This completes a hold-in circuit to each of the electromagnets 326 corresponding to the bowling pins that have been left standing on the alley. This circuit is similar for each electromagnet 326 and is from line 329 through lines 328 and 327, electromagnet 326, lines 325 and 337, switch arm 330, lines 338 and 380, switch 365, and lines 393, 375 and 324 back to transformer 320. Thus the electromagnets 326, corresponding to the pins left standing, after rolling of the first ball of a frame, will remain energized even after those standing pins have been subsequently swept down and off the alley by the sweep 65 in its operation. It is to be noted, also, that the lights 335 corresponding to these pins left standing will remain lighted, the circuits to these lights being made in each instance from line 329 through line 336, lamp 335, line 325, and thence

as described above for the circuit to the corresponding electromagnet 326.

All this occurs before the sweep contacts a pin and when, as stated, it is about in the full line position shown in Fig. 1. When the sweep arms have swung far enough for the sweep 65 to sweep the pins off of the alley, the cam 110 (Figs. 18 and 21) will have rotated far enough to close the switch 112. This closes a circuit from the main line L_1 through the line 312 (Fig. 25), the line 314, the switch 112, the line 315, a standard controller 316, the line 317, the motor 115, and the line 318 to the main line L_2. This causes the elevator motor 115 to be started to raise elevator 75 as already described. The pins and ball are raised by the elevator and dumped out when the elevator nears the top of its travel. Then the follower 111 rides up on the high part of cam 110 (Fig. 18) again; switch 112 is opened; elevator motor 115 is stopped; and the elevator drops back to the pit floor to the position shown in Fig. 1.

Meantime the ball will be returned to the bowler and ten pins will be carried by belts 135, 136, 140 and 210 (Figs. 16 and 21) onto the ten trap-doors 185 (Figs. 3 and 11). Meantime, also, the sweep will have been reversed through operation of crank 102 (Figs. 21 and 24) and will be making its idle return stroke. When it has again reached the position shown in full lines in Fig. 1, the shaft 101 will have rotated far enough for cam 290 to have closed switch 292. This will close a circuit to each of the electromagnets 205 associated with the hold-in circuits previously established as described above.

The circuits to the electromagnets 205 are identical and only one of them, therefore, need be described. This circuit is from line 323 through line 293, switch 292, lines 343 and 344, electromagnet 205, line 342, switch arm 331, lines 341, 340 and 324 back to transformer 320. The electromagnets 205 thus energized release the associated trap-doors 185 and the bowling pins on the trap-doors, which are released, will drop down the chutes 220, which are associated with those trap-doors into the baskets 224 which are associated with those chutes. The weight of the pin in each basket will cause the basket to drop by gravity and set the pin on the floor. Thus, pins will be reset on spots 33 corresponding to the pins that were left standing after the ball was rolled.

In order to allow time for setting of the pins and prevent the baskets from being damaged by a careless bowler rolling a ball down the alley while the baskets are still in their lowered positions, setting up the pins, the time-relay 304, already referred to is provided. This stops the sweep motor 90 during the time electromagnets 205 are energized and for a sufficient period to permit the lowering of the baskets 224; then it automatically restarts the motor again. Stoppage occurs when the sweep plate 65 is in the full line position shown in Fig. 1 where it can protect a lowered basket, such as is shown in dotted lines in that figure, from being hit by a ball should the bowler inadvertently roll the ball down the alley at this stage.

As soon as motor 90 is restarted, follower 275 (Fig. 18) rides up on the high part of cam 280 and air pressure is applied to the pistons 253 (Fig. 12), associated with the lowered baskets, to raise those baskets again. In the continued rotation of shaft 101, follower 291 rides off the low part of cam 290 to deenergize the electromagnet or electromagnets 205 which were just previously energized; and the sweep is swung up to the dotted line position shown in Fig. 1. The shaft 101 makes one revolution per cycle of operation of the machine, and at the end of its revolution, the follower 296 rides down onto the low part of cam 295, allowing switch 298 to open, thus breaking the hold-in circuit to the electromagnet or electromagnets 205 previously energized. The time relay 304 will now have completed its cycle and will stop motor 90.

The required pins have now been reset and the mechanism is now ready for the bowler to roll the second ball of the frame. Of course the pins which have been reset will close the switches 36 under the spots 33 on which they are reset, and circuits will, therefore, be remade to the corresponding electromagnets 326 in the manner above described.

The pin-setting mechanism may again be put in operation by the rolling of the ball down the alley and its dropping into elevator 75 to close switch 83. This starts sweep motor 90 in the manner above described, causing the shaft 101 to rotate and the sweep to be swung down as above described. The switch 298 is again closed through rotation of cam 295 as above described, again thereby closing a circuit to solenoid 370 in the manner above described. This again causes shifting of cam 366 by rotation of ratchet wheel 369 under actuation of pawl 369. On this shift of cam 366, however, follower 367 rides down onto a low portion of the cam and switch 335 is opened. This prevents a hold-in circuit being made for any of the electromagnets 326.

If any of the pins are knocked down by the second ball, the switches 36 corresponding to those pins are thereby opened, and the associated electromagnets 326 are thereby deenergized. This causes the associated switch arms 330 and 331 to drop out of engagement and the associated switch arm 332 to make contact.

If all of the pins left standing by the first ball of a frame are knocked down by the second ball, all of the electromagnets 326 will be deenergized; all of the switch arms 330 and 331 will drop out; and all of the switch arms 332 will close. But even though some of the pins remain standing after the second ball has been rolled, this same result will be effected, for when the sweep plate 65 in its movement sweeps these remaining pins off the alley, the electromagnets associated with these remaining pins will also be deenergized, for the hold-in circuit to these pins, which was operative on rolling of the first ball of the frame, is now open through opening of switch 305. After the second ball of a frame has been rolled, then, whether all of the pins have been knocked down or not, all of the electromagnets 326 are deenergized; all of the switch arms 330 and 331 drop out; and all of the switch arms 332 close.

When all of the switch arms 332 are closed, a circuit is made from line 324 through line 345, switch 332, line 347 and in series through each of the switches 332 and their connecting lines, and through line 348, electromagnet 350, and lines 351, 328 and 329 back to transformer 320. This energizes electromagnet 350 causing switch arm 355 to be opened and the ten switch arms 353 and a switch arm 369 to be closed.

After shaft 101 has rotated far enough for cam 110 to close switch 112 (Fig. 18), the elevator motor 115 is started as before; the ball and pins are lifted up and dumped; the ball is returned to the front end of the alley; and the pins are carried by the belts 135, 136, 140 and 210 (Fig. 21)

onto the trap-doors 185. When the shaft 101 has rotated far enough, cam 290 again closes switch 292. On this second cycle of the frame, however, the closing of switch 292 completes a circuit to each of the electromagnets 205. These circuits are all identical and only one need therefore be described. This circuit is from line 329 through line 293, switch 292, lines 343, and 344, electromagnet 205, line 387, now closed switch arm 356, lines 359, 357, 340 and 324 back to transformer 320. Thus all ten of the electromagnets 205 are energized; all ten of the trap-doors are opened; and ten pins are dropped through chutes 220 into baskets 224, lowered, and placed on the alley. The pins are therefore reset ready for the next frame.

The switch arm 389 is provided to close at this time a circuit to a standard counter 385. This circuit is from line 329 through counter 385, line 388, switch 389, and lines 358, 357, 340 and 324 to transformer 320. The counter is provided so that the proprietor or operator of the alley may have a record of the frames rolled by the bowler.

The sweep is stopped by action of time relay 304, as before, while the pins are being lowered onto their spots. Then, as before, the pin-baskets are raised again by air-pressure; switch 292 is opened to break the circuits to electromagnets 205; the sweep is returned to its inoperative position; and sweep motor 90 is stopped by time-relay 304. When the ten pins have been positioned on the spots, all the switches 36 are closed. This re-energizes electromagnets 326, closing switch arms 330 and 331 and opening switch arms 332. The opening of switch arms 332 breaks the circuit to solenoid 350; switch arms 356 drop out and switch arm 355 closes.

If all of the pins are knocked down by the first ball of a frame, that is, if a strike is rolled, then all of the switches 36 are opened. All of the switch arms 330 and 331 drop out and all of the switch arms 332 close. The same sequence of operations takes place, therefore, as has just been described with reference to the rolling of the second ball of a frame. Arms 332 close a circuit to electromagnet 350; switch arm 355 is opened; and the ten switch arms 356 and single switch arm 389 are closed. When the switch 292 is subsequently closed, then, in the operation of the mechanism, the ten electromagnets 205 are energized, and ten pins are reset on the alley, ready for the next frame. The proper sequence of cycles is maintained even though a strike be rolled, because when all the switch arms 330 are opened, the circuit to solenoid 370 is broken by the opening of switch arm 355. Therefore in this cycle of operation of the mechanism, the solenoid 370 is not energized; the shaft 372 and cam 366 are not rotated; and the switch 365, which is always open at the beginning of a frame, remains open. The mechanism is in its proper relation for rolling of a new frame.

Occasionally a bowler will roll the first ball of a frame into the gutter and not knock down a single pin, but with his second ball he will knock down all of the pins, scoring a spare. Ordinarily, when a pin is left standing after the rolling of the first ball of a frame, the solenoid 370 is energized, as above described, and pawl 369 advances ratchet wheel 368 to cause cam 366 to close switch 365 and when the second ball of the frame is rolled, this solenoid is again energized to advance ratchet wheel 368 to allow switch 365 to open. When all of the pins are knocked down by a single ball, however, electromagnet 350 is energized; switch 355 is opened and solenoid 370 cannot be energized. When a strike ball is thrown as the second ball of the frame, the switch 365 would ordinarily remain closed. This would put the whole mechanism out of time, because at the beginning of the next frame switch 365 would be closed whereas it should be open at the beginning of each frame.

To keep the mechanism in time, I therefore provide a second cam 390 on shaft 372 (Figs. 25 and 26). This cam may be identical with cam 366 and the high parts of both cams are in registry with one another, and the low parts of both cams are in registry with one another. The cam 390 controls a normally-open switch 391. When a high part of the cam is in engagement with the switch, the switch is closed, and when the switch is riding on a low part of the cam, the switch is open. When switch 365 is closed, then, switch 391 is closed and vice versa.

If the first ball of a frame is a gutter ball, then, solenoid 370 can be energized in the manner already described to advance ratchet wheel 368. This will cause cam 366 to close switch 365 and simultaneously cam 390 will close switch 391. If the second ball of a frame is a strike-ball, then, solenoid 370 will again be energized, even though the circuit to solenoid 370 through switch 355 is broken by opening of switch 355 on energization of solenoid 350, for, as soon as switch 298 is closed by cam 295 (Fig. 18), a circuit will be made to the solenoid through now-closed switch 391. This circuit is from line 329 through lines 328 and 376, solenoid 370, line 382, now-closed switch 391, line 392, now-closed switch 298, and lines 386, 375 and 324 back to transformer 320. Ratchet 368 is therefore advanced on the throwing of the strike-ball as the second ball of a frame, and cam 366 is therefore also advanced allowing switch 355 to open ready for the next frame. Switch 391 is incidentally allowed to open also. The proper sequence of machine cycles is, therefore, made possible.

Operation

While the operation of the above described embodiment of the invention will be understood from the preceding description, it may briefly be summed up here. Assuming that ten pins are on the spots, the mechanism is set into operation when a ball, that is rolled down the alley, drops into the elevator 75 closing switch 86 (Fig. 1). This starts sweep motor 90 and drives shaft 101 and the crank 102 which actuates the sweep.

If any of the pins are knocked down, the switches 36 associated with those pins open and the electromagnets 326 associated with those pins are deenergized. When the cam 295, which is driven by shaft 101, closes switch 298, however, if there are pins left standing, hold-in circuits are made to the electromagnets 326 corresponding to those pins through energization of solenoid 370 and advance of ratchet wheel 368 which causes cam 366 to close switch 365. When the standing pins are subsequently knocked off their spots, then, by sweep 65, the electromagnets 326, corresponding to the pins that were left standing, remain energized.

If all of the pins are knocked down by the first ball, all of the switches 36 open; and all of the electromagnets 326 are deenergized, allowing all arms 332 to close. This causes electromagnet 350 to be energized, opening switch arm 355 and preventing energization of solenoid 370 and closing of switch 365.

Thereafter as the shaft 101 rotates, the sweep carries off of the alley all of the pins, any left standing as well as any knocked down by the ball. Then cam 110 closes switch 112, starting elevator motor 115, and lifting the pins and ball. These are dumped when rollers 84 (Fig. 20) engage brackets 126. The pins are then carried to the trap doors 185 by belts 135, 136, 140 and 210. Switch 112 is opened by cam 110, as soon as the pins have been dumped, and the elevator 75 drops down by gravity.

Regardless of whether some or all of the pins were left standing after the ball was rolled, or whether all were knocked down, when the shaft 101 has rotated far enough for the cam 290 to close switch 292, circuits will be made to electromagnets 205. If all of the pins were left standing after the ball was rolled, hold-in circuits will have been made to all of the electromagnets 326, holding switch arms 331 closed; consequently when switch 292 is closed all of the electromagnets 205 will be energized to open all of the trap-doors 185 to release pins to all of the baskets 224 and permit those baskets to reset, as required, all of the pins on the alley. If some only of the pins were left standing, then only the switch arms 331 corresponding to those pins will be held closed by hold-in circuits through electromagnets 326, and when switch 292 is closed only the electromagnets 205 corresponding to those pins will be energized and only the corresponding trap-doors 185 will be opened. If all of the pins were knocked down, circuits will be made to all of the electromagnets 205 through the now-closed switches 356, when the switch 292 is closed, and all of the trap-doors 185 will be opened to release pins.

The pins released from the trap doors fall into baskets 224 and the pin-containing baskets drop by gravity to the floor, the weight of a pin overcoming detent or detents 262. If the basket is of the type shown in Figs. 9 and 10, as soon as projection 245 hits the floor, the pin carried by the basket is released. If the basket is of the type shown in Figs. 12 and 14, the pin is released when flange 265'' or 265 hits spring 264' or 264.

Motor 90 is stopped during lowering of the baskets, but is restarted again by the time relay as soon as the pins are on the floor. Then cam 280 trips valve 270 and the baskets are raised again. While the baskets are being lowered, sweep 65 will be held in the full line position shown in Fig. 1 to which it has been returned by crank 102. When the motor 90 is restarted, the crank is restarted also, and the crank returns the sweep to its inoperative position shown in dotted lines in Fig. 1. Then the time relay 304 stops motor 90 and the cycle of the machine is completed.

If some or all of the pins were left standing after rolling of the first ball, the bowler rolls a second ball to complete the frame. The operation of the mechanism is the same as for the first ball except that this time when the solenoid 370 is energized by closing of switch 298, the switch 365 is allowed to open and no hold-in circuits are made to any of electromagnets 326. Hence, when any pins, which may be left standing by the second ball, are swept off the alley by the sweep, all of the electromagnets 326 are deenergized allowing all of switch arms 332 to close. This energizes electromagnet 350 and as in the case of a strike, when switch 292 is closed, all of trap doors 185 are opened and a whole set of ten pins are positioned on the alley.

Cam 390 insures that the timing of the machine is maintained even if no pins be knocked off the alley by the first ball of a frame and all of the pins be knocked off by the second ball of that frame, for it insures that switch 391 be closed to permit energization of solenoid 370 after rolling of the second ball as well as after rolling of the first. Of course, if the first ball of a frame is a strike, solenoid 370 is not energized, for all switch arms 332 close, closing a circuit to electromagnet 350, opening switch 355 and closing switches 356. When switch 292 is closed, then, all the pins are reset.

The pin-setting mechanism can be operated with ten pins alone. However, if it is desired to shorten the time of operation of the apparatus an additional set of ten pins may be provided. There is room enough on the belts 135, 136 and 140 to carry these extra pins while ten pins are on the trap doors 185. The belt 210 is close enough to the belt 140 to prevent piling up of the pins on the trap doors. If all of the pins are knocked down by a ball, the pins on the trap doors are dropped into the chutes, and as soon as the belts start to move again, on restarting of motor 90, the extra pins on the belts are carried on to the trap doors, ready for use in the next cycle of operation of the machine. If only part of the trap doors are opened to drop less than a set of pins into the chutes, when belt 210 starts to move again it carries the pins remaining on the trap doors over to the left, as viewed in Fig. 2, covering successively each trap door from the left with a pin, and then belt 210 and belts 140, 136 and 135 supply pins to the uncovered trap doors. The extra pins then just ride idly on the belts during the rest of the cycle.

While the mechanism has been described as being put into operation for a cycle by the dropping of a ball onto the floor of elevator 75, it might be put into operation manually by the bowler. Thus, switch 86 might be eliminated and a standard start-button 310 (Fig. 25) used instead. This button can be mounted at a convenient point at the head of the alley, readily accessible to the bowler. When a ball is rolled and drops into the elevator, the bowler can press in button 310, starting sweep motor 90, and the mechanism will from that point on go through its cycle exactly as when switch 86 is employed. Button 310 is adapted to close a circuit to line 300 from line 396, which is connected to line L_1.

Under the conventional rules, if a bowler rolls a strike with the first ball of the tenth or final frame of a game, he is entitled to roll two other balls. If he rolls a strike on the second ball but leaves some pins up after the third ball, the machine would ordinarily reset pins corresponding to those left standing. However, with the game ended, what is desired is that a whole new set of pins be reset ready for the first frame of the new game. To permit this to be done, the bowler can press in button 410 which is connected with line 324 by line 411 and with line 348 by line 412. When this button is pressed in, electromagnet 350 is energized to open switch 355 and close switches 356 to cause all of the trap-doors to be opened in the machine cycle that is started by the dropping of the third ball of the tenth frame of the game onto the floor of elevator 75.

If through inadvertence the bowler fails to press button 410 in time in the machine cycle, he can press in button 310 and run the machine through another cycle to sweep all the pins off the alley and set up a new set.

Buttons 415 and 420 are provided to take care of fouls. Button 415 is adapted to connect main line L_1 with line 88. Button 420 is adapted to connect line 411 with line 412 through line 421. If the bowler commits a foul, as for instance by sliding over the foul line at the head of the alley when delivering a ball, the referee sitting in the foul box may push in the foul buttons 415 and 420 to put the machine through another cycle of operation if the cycle initiated by the foul ball does not provide the proper setting of pins for continuation of the game. Switches 415 and 420 are preferably connected so that both are pressed in simultaneously.

In the event that the bowler fouls on the first ball of a frame, but his ball knocks all of the pins down, the pressing in of foul button 420 will take care not only of resetting of the pins but also of proper timing of the machine, for when either button 410 or 420 is closed, solenoid 370 is energized and pawl 369 and ratchet 368 advance cam 366. Ordinarily, on a strike ball, cam 366 is not advanced because solenoid 350 is energized and switch 355 is opened as above described, but when button 420 is pushed in a circuit is made to solenoid 351 from line 324 through line 411, button 420, lines 421, 412, 381, and 382, solenoid 370, and lines 376, 328 and 329 back to transformer 320.

To prevent operation of the mechanism if the air-pressure is cut off or fails, a normally open switch 425 is provided in line L_1. When the air-pressure is sufficient to raise the baskets 224, the switch will be closed, but should the pressure fall below the working minimum, then the switch will open.

While the invention has been described in connection with a game of ten-pins, it is obvious that it may be used also for games of nine-pins, duck-pins, candle-pins, etc. by suitable arrangement of the baskets, spots, controls, etc. to suit the game to be played, as will be clear to those skilled in the art. It will further be understood that while the invention has been described in connection with a particular embodiment thereof, it is capable of further modification, and this application is intended to include any variations, uses, or adaptations of the invention following, in general, the principles of the invention and including such departures from the present disclosure as come within known or customary practice in the art to which the invention pertains and as may be applied to the essential features hereinbefore set forth or as fall within the scope of the invention and the limits of the appended claims.

Having thus described my invention, what I claim is:

1. In an automatic pin setting mechanism, the combination with an alley having a plurality of pin receiving spots, of a normally open switch mounted beneath each spot and adapted to be closed as long as a pin is on the spot, oscillatable means for sweeping pins off the spots, a plurality of trap doors, one for each pin of a set, means for normally holding the trap doors closed, pin setting means associated with the trap-doors and positioned to receive the pins discharged from said trap-doors when the trap-doors are opened, said pin setting means being constructed to be operated upon receipt of pins to lower and position the pins on the alley, electrically actuated means associated with each trap door for releasing that trap door to discharge a pin into the pin setting means, means for actuating the sweep means to effect operative and return strokes thereof, means actuated by the sweep means in its movement at a predetermined point in the operating stroke of the sweep means and before the sweep means strikes a pin to close partially a circuit to the corresponding release means through the switches under the spots on which the pins have been left standing after rolling of a ball, and means actuated by the sweep means in its movement after completion of the sweeping operation for completing those circuits to the release means which have previously been partially closed whereby pins corresponding to those left standing after rolling of the ball are discharged into the pin setting means.

2. In an automatic pin setting mechanism, the combination with an alley having a plurality of pin receiving spots, of a normally open switch mounted beneath each spot and adapted to be closed when a pin is on the spot, pin setting means for depositing pins on the spots, an electrically actuated device associated with each switch, each electrically actuated device being operatively connected to said pin setting means to control said pin setting means and determine whether a pin is to be set on the spot associated with a particular switch, means for sweeping pins from the alley, means actuated on rolling of a ball for actuating the sweeping means, an electromagnet associated with each spot, a pair of switches associated with each electromagnet, one of which is adapted to be closed when the electromagnet is energized and the other of which is adapted to be closed when the electromagnet is deenergized, each of the electromagnets being wired to be energized when a pin is on a spot, means actuated after rolling of a ball and before the sweeping means strikes a pin for closing hold-in circuits through the switches beneath the spots to the electromagnets associated with any pins left standing after the rolling of the ball to maintain each such electromagnet energized, and means actuated after all of the pins have been swept from the alley to complete parallel circuits to the electrically actuated devices through the switches which have been held closed by the energized electromagnets, whereby to cause the pin setting means to place on the alley pins corresponding to those that were left standing by the ball, and means actuated if all of the electromagnets are deenergized, to establish separate parallel circuits to all of the electrically actuated means through the switches which are closed upon deenergization of the electro-magnets to cause all of the pins to be set on the alley.

3. In an automatic pin setting mechanism, the combination with an alley having a plurality of pin receiving spots, of a normally open switch mounted beneath each spot and adapted to be closed when a pin is on the spot, pin setting means for depositing pins on the spots, an electrically actuated device associated with each switch, each electrically actuated device being operatively connected to said pin setting means to control said pin setting means and determine whether a pin is to be set on the spot above the switch associated with said particular electrically actuated device, means for sweeping pins from the alley, means actuated on rolling of a ball for actuating the sweeping means, an electromagnet associated with each spot, a pair of switches associated with each electromagnet, one of which is adapted to be closed when the electromagnet is energized and the other of which is adapted to be closed when the electromagnet is deenergized,

a circuit to each of said electromagnets being closed through the first named switch under a spot when a pin is on the spot, means actuated after rolling of the first ball of a frame and before the sweeping means strikes a pin for closing hold-in circuits through the associated switches under the spots to the electromagnets corresponding to any pins left standing after the rolling of the ball to maintain said electromagnets energized, means actuated after all of the pins have been swept from the alley to complete circuits to the electrically actuated devices through the switches which have been held closed by the energized electromagnets, whereby to cause the pin setting means to place on the alley pins corresponding to those that were left standing by the ball, and means actuated after the rolling of the second ball of a frame to cause all of said electromagnets to be deenergized to establish circuits to all of the electrically operated means through the switches which are closed by the deenergization of the electromagnets, whereby to cause the pin setting means to place a full set of pins on the alley.

4. In an automatic pin-setting mechanism, the combination with an alley having a plurality of pin-receiving spots, of a normally open switch mounted beneath each spot and having a piece of permanently magnetized material secured thereto which is adapted to be attracted when a pin is on the spot to close said switch, means for sweeping pins from the alley upon rolling of each ball down the alley, pin-setting means, means for delivering pins to the pin-setting means comprising a plurality of trap doors corresponding in number to the number of pins of a full set, means for depositing a pin on each trap door, electrically actuated mechanism for opening each trap door to discharge a pin therefrom into the pin-setting means, means for actuating the sweeping means, means, including the switch under each spot on which a pin has been left standing, and means actuated by the sweep means after the rolling of the first ball of a frame and before the sweep means strikes a pin, for partially closing a circuit to the electrically actuated mechanism for each pin that has been left standing, means actuated by the sweep means, after the pins have been swept from the alley, to close the circuits, which were previously partially closed, whereby to cause a pin to be delivered to the pin-setting mechanism for each pin left standing by the ball, and means actuated at a predetermined point in the operation of the sweep means after the rolling of the second ball of a frame to complete circuits to all of the electrically actuated mechanisms whereby to deliver a full set of pins to the pin-setting means.

5. In an automatic pin-setting mechanism, the combination with an alley having a plurality of pin-receiving spots, of a normally open switch mounted beneath each spot and adapted to be closed when a pin is on the spot, a movable sweep for sweeping pins from the alley, means for moving the sweep, a pin-setting device for setting pins on the alley, a plurality of electrically-actuated mechanisms for supplying pins to the pin-setting device, said mechanisms corresponding in number to the number of pins in a set, means actuated by the ball and including the switch under each spot on which a pin has been left standing after the ball is rolled, for partially closing an electrical circuit to one of said electrically-actuated mechanisms for each pin left standing, before the sweep strikes a pin, a member operatively connected to said electrically-actuated mechanisms to be advanced a step when a partial circuit is established, means actuated, when the sweep has engaged the pins, for completing the previously partially-closed circuits, means actuated on opening of all the switches for establishing circuits to all the electrically-actuated mechanisms to actuate the same, and means actuated when said member has been advanced a predetermined plural number of times for also establishing circuits to all the electrically-actuated mechanisms.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,292,738	Estabrook	Jan. 28, 1919
1,615,064	Bishop	Jan. 18, 1927
1,911,436	Cone	May 30, 1933
2,194,146	Kaiserman	Mar. 19, 1940
2,231,473	Kaufman	Feb. 11, 1941
2,293,018	Hagquist	Aug. 11, 1942
2,310,218	Davis	Feb. 9, 1943
2,341,475	Parra et al.	Feb. 8, 1944
2,389,643	Schmidt	Nov. 27, 1945
2,411,348	Turner	Nov. 19, 1946