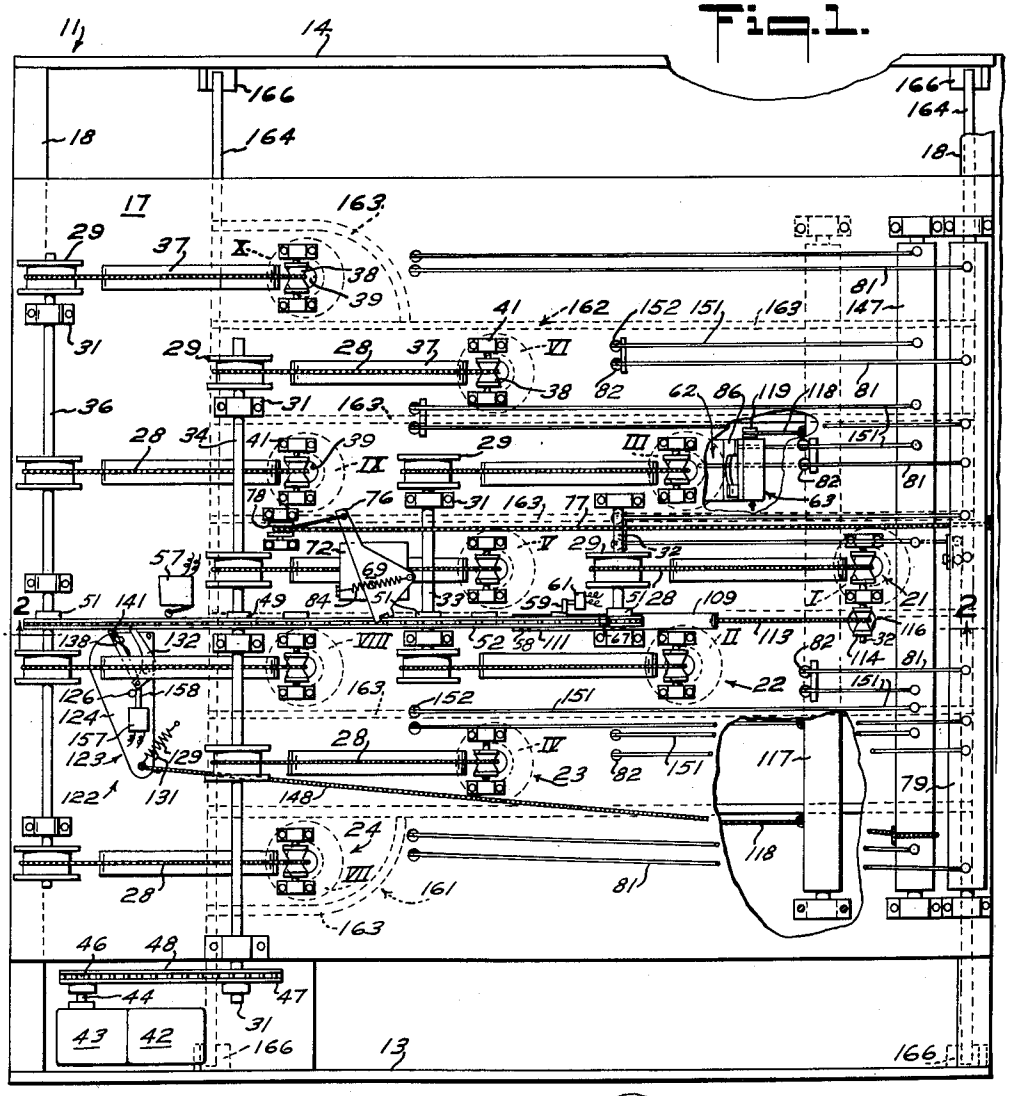
Jan. 15, 1963 F. M. EYRE 3,073,596

PINSPOTTING APPARATUS

Filed Nov. 10, 1960 3 Sheets-Sheet 1

Fig. 1.



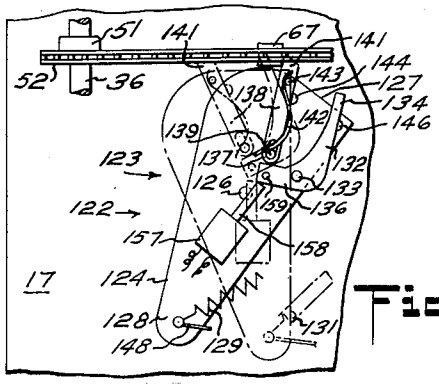


Fig. 5.

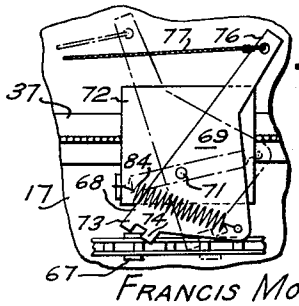


Fig. 7.

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PINSPOTTING APPARATUS

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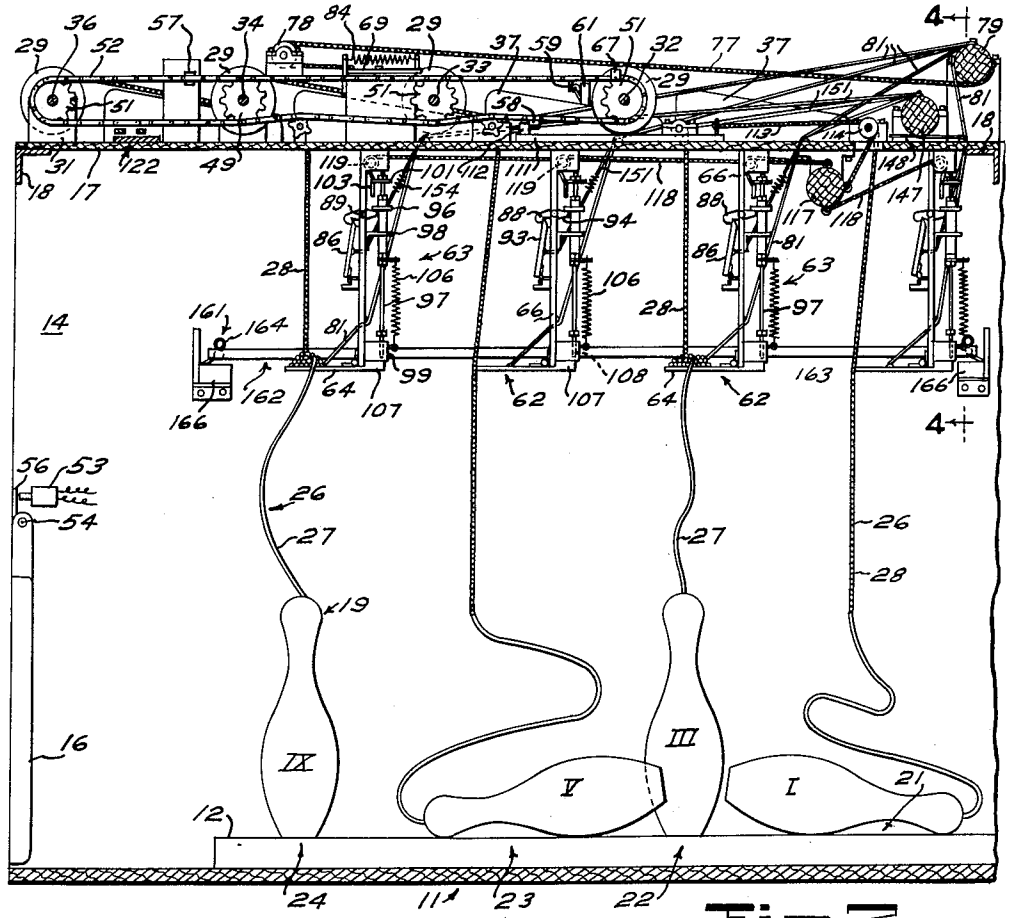

Fig. 2.

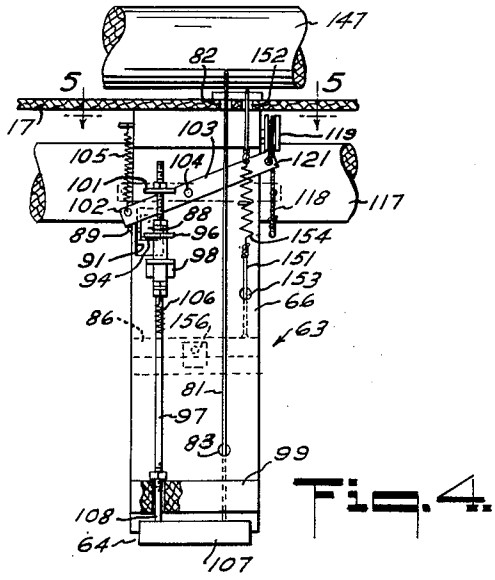

Fig. 4.

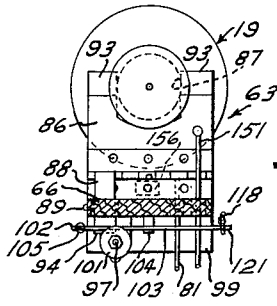

Fig. 5.

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PINSPOTTING APPARATUS

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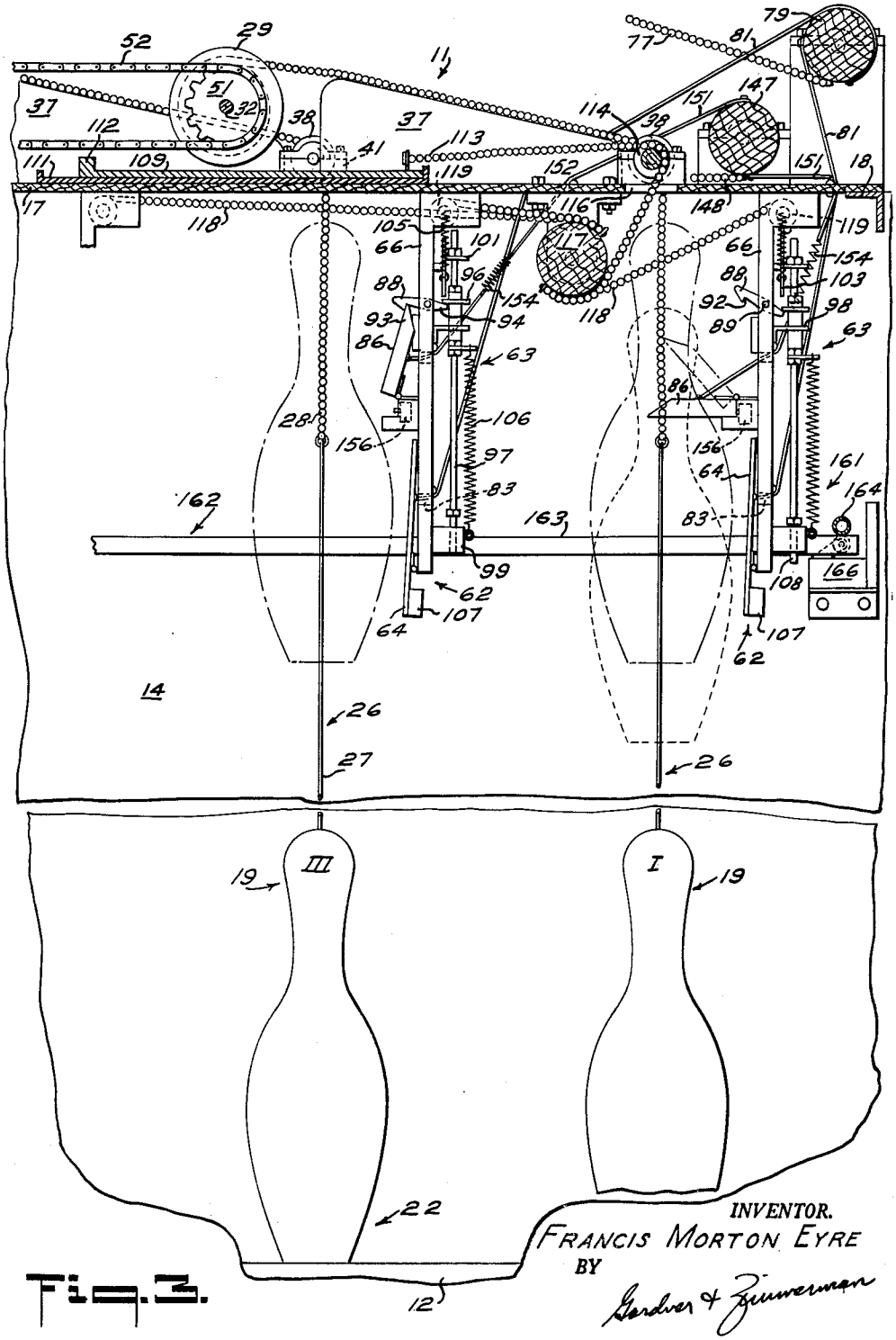

Fig. 3.

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United States Patent Office 3,073,596 Patented Jan. 15, 1963

3,073,596

PINSPOTTING APPARATUS

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Filed Nov. 10, 1960, Ser. No. 68,451
20 Claims. (Cl. 273—44)

The present invention relates to automatic pin setting apparatus for bowling alleys, and is more particularly directed to such a pin setting device having novel means for removing the knocked down pins and resetting the standing pins after a first ball is thrown, and subsequently resetting all the pins after a second ball has been thrown or after a strike has been scored.

Numerous pin setting devices have been developed in recent years for automatically resetting pins in order to eliminate the necessity of employing pin boys therefor. Several of such automatic devices have in general proved successful as evidenced by the ever increasing number of bowling alleys installing them.

Such equipment, however, has been especially designed to meet definite requirements of accuracy in regard to pin setting which are set up by various bowling associations so as to meet specified standards for competition bowling. As one example of such requirements, it is necessary in competition bowling that a standing pin which may have been moved a fraction of an inch from the pin spot by the first ball or by falling pins must be returned to the identical position to which it was moved for the throwing of the second ball.

It will be appreciated that in order to provide equipment capable of insuring such accuracy a highly complex mechanism is required which is initially expensive to install in a bowling alley and which requires the services of an experienced repairman whenever the apparatus gets out of adjustment. Additionally, the presently available equipment requires considerable space so that many bowling alleys have found it necessary to reduce the number of lanes.

For those bowling alleys desiring to especially cater to expert bowlers the foregoing equipment is advantageous. There is an ever increasing number of people, however, who enjoy the sport of bowling as a hobby or recreation without ever aspiring to competitive standing in the field. The requirements of such individuals could be satisfactorily met by a simpler, less expensive, more compact apparatus having the same pin setting speed of the present devices but lacking their high degree of accuracy. Such equipment could be installed and maintained at a minimum of expense and without reducing the number of lanes in an existing bowling alley. The cost of bowling could thus be reduced so as to attract especially more women and children to the sport. Furthermore, such contemplated device could be used to advantage in outdoor installations where the year round climate permits.

It is accordingly an object of the present invention to provide a pin setting device which shall realize, in large measure, the last named advantages.

It is another object of the present invention to provide pin setting apparatus of the character described in which pins that are knocked over by a ball automatically set pin sensing means in an operative condition.

Still another object of this invention is to provide a pin setting device in which pin supporting means are operative to retain those pins which were knocked down by the first ball of a game in an elevated position remote from the line of play while the second ball is being thrown.

It is a further object of the present invention to provide sensing means which may be set in an operative condition by virtue of pins being knocked over by the first ball of a frame whereby pin supporting means are selectively brought into a pin engaging position for the retention of knocked over pins in vertical alignment with their respective pin spots on the floor but out of the line of play during the throwing of the second ball.

A still further object of the present invention is to provide pin setting apparatus of the type described in which the positioning of all of the pin supporting means in a pin engaging position is operative to move all of such pin supporting means into an inoperative position wherein the pins are all respotted on the floor in their proper position for the next ball.

Yet another object of the present invention is to provide means associated with the pin sensing and pin supporting means whereby the pins which are knocked over are elevated from the floor simultaneously with the upstanding pins in order to eliminate the use of a sweeper to clear the alley floor after each ball has been thrown.

Still another object of the present invention is to provide cable means attached to the pins for elevating them above he floor in which such means are effectively prevented from becoming entangled or fouled up with the pins at such times as the pins are disposed in an upstanding position on the floor as well as when they are supported above the floor by the pin support means.

It is another object of the present invention to provide pin setting apparatus of the character described in which the sensing means are operatively disposed in a plane intercepting the vertical path of pin travel but which are automatically movable therefrom to an inoperative position during reciprocal vertical pin movement.

Yet another object of the present invention is to provide cable means secured to the pins whereby the pins may be removed from the alley floor as required during the course of a game, such means being arranged so as not to prevent or impede the pins from freely falling and moving throughout the entire pin area when struck by a ball.

Referring to said drawings:

FIGURE 1 is a top plan view of a pin setting apparatus embodying the present invention with portions thereof being broken away.

FIGURE 2 is a vertical cross-sectional view taken on the line 2—2 of FIGURE 1 and illustrating the apparatus after a first ball has been thrown.

FIGURE 3 is an enlarged cross-sectional view of the forward portion of the apparatus wherein the sequence of various operations are illustrated.

FIGURE 4 is a vertical cross-sectional view taken substantially on the plane 4—4 indicated in FIGURE 2, showing details of the pin supporting means in another position from that illustrated in FIGURE 2.

FIGURE 5 is a horizontal cross-sectional view taken on the line 5—5 of FIGURE 4 but showing the pin supporting means in a pin engaging position.

FIGURE 6 is a fragmentary top plan view on an enlarged scale of the cam lever mechanism shown in FIGURE 1 but here illustrated in different positions.

FIGURE 7 is a fragmentary top plan view on an enlarged scale of the sensing plate control mechanism shown in FIGURE 1.

In broad terms, the invention, as herein embodied, will be seen to comprise means for resetting pins in a bowling lane after the throwing of a first and second ball of a frame as well as after a strike has been scored. More particularly, the throwing of a first ball actuates mechanism whereby all pins are raised from the floor of the bowling lane. Those pins which have been knocked over by the first ball are then removed and retained in a position remote from the line of play while the pins which have been left standing are first removed and then repositioned on their respective spots on the floor of the

lane ready for the second ball to be thrown. Throwing of the second ball again actuates the mechanism for raising from the floor all the pins which were reset after the first ball and returning the full complement of ten pins to the alley floor ready for the next frame. In the event a strike has been scored by the first ball, means are additionally provided whereby all the pins are immediately reset for a new frame, thus bypassing those operations that otherwise occur after the first ball has been thrown.

Referring now particularly to FIGURES 1 and 2 of the drawings there is shown one end of a conventional bowling lane **11** wherein is contained the apparatus of the present invention and comprising a floor **12**, sidewalls **13** and **14** and a back plate **16**. An upper deck **17** is supported at the top of the lane **11** such as by cross members **18** extending between and secured to the sidewalls **13** and **14**. A set of ten bowling pins **19** are disposed on pin spots provided on the floor **12** in a conventional equilateral triangular pattern. As is well known to those familiar with the game the pins are disposed in this pattern in such a way that the number I pin is positioned at the apex **21** of the triangle as shown in FIGURE 1 which points to the front or playing end of the lane. The remaining pins are spaced rearwardly from the number I pin in three rows **22**, **23** and **24** disposed transversely of the lane so that pins number II and III are set in row **22**, pins number IV, V and VI are set in row **23**, and pins number VII, VIII, IX and X are set in row **24**.

The apparatus of the present invention provides means by which the pins **19** may be elevated from the floor to a position adjacent the upper deck **17** after a ball has been thrown. To this end, a cable **26** comprising a cord portion **27** attached to a chain portion **28** is provided whereby the free end of the cord portion **27** is secured to the top of a pin while the free end of the chain portion **28** is fixed to a sheave **29**. The sheaves are mounted on shafts rotatably journalled on bearing blocks **31** on the top surface of the deck **17**. More particularly, a shaft **32** carries the sheave which is associated with the number I pin, a shaft **33** carries the number II and III pins, a shaft **34** carries the sheaves for the number IV, V and VI pins, and the sheaves for the number VII, VIII, IX and X pins are mounted on a shaft **36**. It will be seen that the sheaves are thus mounted on the deck **17** in a triangular pattern similar to that of the pin spots on the floor **12** but with their axes offset rearwardly therefrom.

The cable **26** for each pin extends forwardly from its sheave, as seen in FIGURE 1, over a guide member **37** and a roller **38**, through an aperture **39** provided in the deck, and thence down to the pin. Rotation of the sheaves in a counter-clockwise direction as viewed in FIGURES 2 and 3 will act to wind the cables around the sheaves thereby raising the pins from the floor to a position adjacent the undersurface of the deck **17**. In this respect it will be seen that the apertures **39** are disposed substantially in registration with the pin spots on the floor and the rollers are journalled in bearing blocks **41** so positioned that the cables **26** depend downwardly from the rollers in vertical alignment with the pin spots so that the path of travel of the pins is a substantially vertically extending line from the pin spots to the deck **17**.

Drive means are provided whereby the sheaves may be rotated in a counter-clockwise direction so that the pins may be elevated at the required time. Such means will be seen to comprise a motor **42** coupled to a gear reduction unit **43**. A power output shaft **44** extending from the gear reduction unit carries a sprocket wheel **46**. A sprocket wheel **47** is mounted on one end of the shaft **34** and an endless chain **48** connects the two sprockets so as to transmit rotational movement to the shaft **34**. A second sprocket wheel **49** is mounted medially of the shaft **34** and the shafts **32**, **33** and **36** are each provided with a sprocket wheel **51** in longitudinal alignment with the sprocket **49**. A drive chain **52** couples the sprockets **51** to the sprocket **49** for unitary rotation of the four shafts.

The motor **42** is electrically connected to and actuated by means of a switch **53** mounted on the sidewall **14** adjacent the back plate **16** which is pivotally mounted, as indicated at **54** on FIGURE 2 at the upper portion thereof between the sidewalls **13** and **14**. An arm **56** carried by the back plate extends above the pivot **54** and terminates adjacent the switch **53**. When a ball is thrown the lower portion of the back plate is hit either by a ball or falling pins or both so as to rotate the back plate about the pivot **54** whereby the arm **56** engages the switch **53** to actuate the motor.

In order to return the pins to the floor **12** of the bowling lane, a reversing switch **57** is mounted on the rear portion of the deck **17** and spaced somewhat above the drive chain **52**. A vertically disposed lug **58** is attached to the drive chain at such a position thereon that when the pins have reached the uppermost limit of their vertical travel the lug will actutate the switch **57** to reverse the rotational direction of the motor.

Cut-off means are likewise provided whereby the motor circuit is broken when the cables **26** have been completely unwound from the sheaves **29** and the pins are thus reset on the floor. In particular, a laterally extending lug **59** is provided on one side of the drive chain and is adapted to engage a cut-off switch **61** to de-energize the motor when the pins are returned to the floor **12** of the lane.

When the first ball of a frame has been thrown and certain pins have been knocked down, as for example, pins I and V in FIGURE 2 of the drawings, sensing means **62** are operative to selectively actuate pin supporting means **63**, whereby such pins will be maintained remote from the line of play when the second ball is thrown. Such sensing means comprises a plurality of sensing plates **64**, mounted for pivotal movement from a horizontal position intersecting the vertical path of pin travel to a substantially vertical position out of the way of the pins during vertical movement thereof. More particularly, a plurality of downwardly depending brackets **66** are mounted on the undersurface of the deck **17**, each bracket being spaced centrally forward of its respective pin. The sensing plates **64**, which are generally rectangular in shape, are pivotally mounted adjacent the forward edges thereof on the free lower ends of the brackets.

As an important feature of the present invention, the sensing plates **64** are disposed in a horizontal position for approximately the latter half of the downward descent of the cables **26** as well as for the first half of the upward travel thereof. In this respect it will be seen that the cables **26** are considerably longer than is necessary for moving the pins from the floor to their uppermost position. The chain portions **28** in particular are provided with excess lengths which are deposited on the sensing plates during the downward descent of the cables after the pins have been set up on the floor. When a pin is knocked over by the ball, the chain is readily pulled off the sensing plate as shown by the chains of pins I and V in FIGURE 2. In order that the pins may fall freely without any resistance being exerted thereagainst, the cord portions **27** are also provided with a certain amount of slack and are preferably made of substantially stiff light weight line such as nylon or the like so as to eliminate knotting or tangling thereof.

From the foregoing, it will be clear that the weight of the chain on a sensing plate will exert a downward pressure thereon which will counteract an equal pressure exerted thereagainst in an opposite or upward direction. When such an upward pressure is directed, however, against a plate which contains no chain due to the pin having been knocked over no resistance is encountered and the plate is free to be pivotally displaced by such pressure. In this manner and as will subsequently be more fully described the absence of the chain on the sensing plate **64** acts to bring the pin supporting means **63** into an operative position.

The sensing plates remain in a horizontally disposed position until the slack in the cables **26** have been wound up on the sheaves. The plates are then pivoted into a vertical position as shown in FIGURE 3, at substantially the same time the pins leave the floor to commence their upward travel. To this end, a U-shaped dog **67** is provided on the drive chain **52** and spaced in advance of the lug **58** in relation to the substantially counter-clockwise travel of the drive chain as viewed in FIGURE 2. When the drive chain has traversed approximately half of such travel the dog **67** engages one end **68** of an actuating lever **69** which is pivotally mounted, as indicated at **71** in FIGURES 1 and 7, at a medial portion thereof on a block **72** above the deck **17** between the shafts **33** and **34**. The end **68** of the lever is slotted so as to provide a pair of legs **73** and **74** which are spaced above the drive chain **52** in angularly disposed relation thereto. Thus the dog **67** engages the leg **73** as the drive chain travels rearwardly to pivot the actuating lever from the dot-and-dashed position shown in FIGURE 7 to the full line position. The other end **76** of the actuating lever has secured thereto a cable **77** which extends rearwardly of the deck to encircle a freely rotatably mounted pulley **78**, the cable thence extending forwardly to be secured at its free end to a spring loaded rocker shaft **79** mounted at the extreme forward end of the deck **17**. The longitudinal axis of the rocker shaft is disposed transversely of the deck and is of such a length as to extend substantially across the full width of the deck. Secured along the length of the rocker arm at appropriate locations are a plurality of flexible lines **81**, each one of which has its free end passing through an aperture **82** in the deck and extending downwardly through an opening **83** in the bracket **66** to be attached centrally of the sensing plate **64**.

From the foregoing it will be seen that when the dog **67** engages the end **68** of the actuating lever **69** the other end **76** thereof is rotated about the pivot **71** so as to cause the cable **77** to rotate the rocker shaft **79** in a clockwise direction. Such rotation of the rocker shaft operates to wind the lines **81** around the rocker shaft thereby raising the sensing plates to the vertical position shown in FIGURE 3.

The actuating lever **69** is retained in the full line position of FIGURE 7 against the tension of the spring loaded rocker shaft by means of a coil spring **84**, one end of which is attached to a central, forwardly extending portion of the actuating lever **69** while the other end is secured to the mounting block **72**. Thus the sensing plates are maintained vertically disposed during the remainder of counter-clockwise travel of the drive chain as well as during an equal length of reversed clockwise travel thereof. The sensing plates are returned to a horizontal position due to the dog **67** engaging the leg **74** of the actuating lever **69** so as to pivot the end **76** thereof rearwardly. Such rotation of the lever releases the tension exerted by the cable **77** on the rocker shaft **79** so as to permit the spring loading of the shaft to rotate it in a counter-clockwise direction thus unwinding the lines **81** to allow the sensing plates **64** to gravitationally assume their horizontal position ready for the depositing thereon of the chain portions **28** of the cables **26**.

As previously mentioned the foregoing sensing means **62** is operative to selectively actuate pin supporting means **63** whereby those pins which have been knocked over by the first ball of a frame may be disposed above the floor **12** of the bowling lane while the second ball is being thrown. Such means will be seen to include a plurality of pin hangers **86** one being mounted on each bracket **66** above the sensing plate **64** and pivotable from a raised substantially vertical inoperative position to a horizontally disposed operative position intersecting the vertical path of pin travel. As seen in FIGURE 5 the hangers are bifurcated as indicated at **87** for the reception therein of the heads of those pins that are to be supported above the line of play during the throwing of the second ball.

Each hanger is normally retained in a vertically disposed position by means of a latch member **88** which is pivotally mounted, as indicated at **89** within an aperture **91** provided in the bracket **66** in substantially right angular relation thereto. One end of the latch **88** which extends rearwardly of the bracket is notched as shown at **92** and is disposed so as to engage one of the legs **93** defining the bifurcation **87** of the hanger. The other end **94** of the latch **88** is positioned forwardly of the bracket and is engageable with an actuating lug **96** fixed to the upper portion of a vertically disposed latch release shaft **97**. Such shaft is mounted for guided vertical reciprocal movement by means of a mounting flange **98** extending from an intermediate portion of the bracket **66** and a block **99** disposed adjacent the lower end of the bracket. Aligned apertures extend through the flange **98** and the block **99** to receive the shaft **97**. When the hanger is vertically disposed the shaft is supported in such a position that the actuating lug **96** is out of operative engagement with the end **94** of the latch. To this end a washer **101** is adjustably carried at the upper threaded end of the shaft and is engaged on its undersurface in supporting relation by one end **102** of a control lever **103** which is mounted centrally thereof to the bracket **66** by a pivot pin **104**. A coil spring **105** extends from the bracket **66** to the end **102** of the control lever whereby the lever is normally disposed in a substantially horizontal plane as shown in dot-and-dashed lines in FIGURE 4, so that the actuating lug **96** is positioned out of operative engagement with the latch member **88** at such times as it is required that the hanger be inoperatively vertically disposed.

The control lever **103** is movable about the pivot **104** from the horizontal position hereinabove described to one angularly disposed thereto as shown by the full line position of the lever in FIGURE 4. Thus the end **102** of the lever **103** moves downwardly to permit the latch release shaft **97** also to move downwardly by virtue of the tension of a spring **106** exerted thereagainst which is connected between the shaft and the bracket **66**. Such movement of the latch release shaft causes the actuating lug **96** secured thereto to engage the end **94** of the latch member **88** so as to pivot the notched end **92** thereof upwardly to release the hanger whereby it gravitationally falls to the horizontal position for reception of a pin in the bifurcation **87**.

As an important feature of the present invention the latch release shafts **97** are operative to unlatch the hangers **86** for only the pins which have been knocked over by the first ball. In this respect it will be seen that each sensing plate is provided forwardly of the pivot with a weighted portion **107** which is juxtaposed below the block **99** when the plate is horizontally disposed in a chain supporting position. Further, the lower ends **108** of the release shafts, in their inoperative position, terminate in substantially coplanar relation with the lower surfaces of the blocks **99**. Downward movement of the shafts therefore causes the ends **108** thereof to abut the weighted portions **107** of the sensing plates. In this respect, if a pin has been knocked over so that the chain portion of the cable **26** has been pulled off the sensing plate, the spring loading of the shaft as here provided is strong enough to overcome the downward forces exerted on the cable supporting portion of the plate **64** whereby the weighted end thereof pivotally moves downwardly with the shaft and the actuating lug **96** thereof pivotally releases the latch from engagement with the pin hanger **86**. If, on the other hand, the pin has not been knocked over so that the chain is still supported on the sensing plate, the downward pressure exerted by the shaft is insufficient to pivot the plate due to the pressure exerted thereon by the weight of the chain. Thus, the weighted portion **107** of the sensing plates effectively acts as a stop means to prevent downward movement of the shaft so that the pin hanger may not be released thereby.

Means are provided whereby the control lever **103** may

be automatically pivoted to permit selective downward travel of the latch release shaft as hereinabove explained, shortly after the first ball has been thrown. In this respect it will be seen that a slide bar **109** is mounted for reciprocal horizontal movement in a guide member **111** on the deck **17**. More particularly, the rearward end of the slide bar is provided with a vertical extension **112** and is arranged to underlie the forward portion of the drive chain **52**. As shown in FIGURE 2, the slide bar is held in an inoperative position by means of the lug **58** engaging the extension **112**. A cable **113** fixed to the forward end of the slide bar extends forwardly around a freely rotatably mounted roller **114**, through an opening **116** in the deck and is secured to a second spring loaded rocker shaft **117** similar to the rocker shaft **79** but mounted on the undersurface of the deck **17**. A plurality of lines **118** are attached along the length of the rocker shaft **117**, one line each passing around a roller **119** mounted for free rotation at one side of each bracket **66** and is thence secured to the end **121** of the control lever **103** opposite the end **102** thereof.

By virtue of the foregoing it will be apparent that upon counter-clockwise travel of the drive chain **52**, forward movement of the lug **58** will release the slide bar **109** for forward travel due to the tension exerted thereon through the cable **113** by the spring loaded rocker shaft **117** rotating in a clockwise direction. Such rotation of the rocker shaft **117** winds the lines **118** around the shaft to pivot the end **121** of the control lever **103** upwardly and hence the end **102** thereof downwardly so as to permit selective downward travel of the latch release shafts **97**.

The control lever is held in the inoperative position by means of the spring loading of the rocker shaft **117** while the drive chain completes its counter-clockwise travel to raise the pins as well as during a major portion of the reversed clockwise traverse of the drive chain when the upstanding pins are being reset. Toward the end of such clockwise traverse of the drive chain the lug **58** thereon engages the extension **112** of the slide bar **109** to move it rearwardly, thus rotating the rocker shaft **117** in a counter-clockwise direction against the tension of the spring thereof. The lines **118** are hence unwound from the rocker shaft to permit the spring **105** to pivot the control lever **103** to its horizontal position in which the latch release shaft **97** is raised to an inoperative position with the actuating lug **96** out of engagement with the latch member. In such manner the notched end **92** of the latch member gravitationally pivots downwardly to retain the hanger in its vertically disposed position.

Pin hanger raising means **122** are additionally provided so as to be operative to raise the pin hangers out of the line of vertical pin travel at the end of each frame; i.e., either after the second ball has been thrown or if a strike has been scored by the first ball. Such means will be seen to comprise a cam actuated lever mechanism **123** which is arranged for operative engagement by the drive chain dog **67** at the end of the counter-clockwise travel of the drive chain. The lever mechanism **123** will be seen to include a plate **124** mounted centrally thereof on the deck **17** adjacent the rearmost sprocket wheel **51** of the drive chain **52** by means of a pivot **126**. One end **127** of the plate, in its normally inoperative position, is disposed substantially parallel with the drive chain but vertically spaced below the plane of the lower reach thereof. The other end **128** of the plate has affixed thereto one end of a coil spring **129** the other end of which is attached to the deck **17** forwardly of the plate. The spring normally urges the plate into engagement with a stop member **131** which extends vertically from the deck to thus limit counter-clockwise rotation of the plate as shown in FIGURES 1 and 6 of the drawings. A bell crank **132** is pivotally mounted as shown at **133** on the end portion **127** of the plate adjacent the forward edges thereof and has one leg **134** disposed below the chain drive **52** when the lever mechanism **123** is inoperatively positioned. A second leg **136** of the bell crank extends in right angular relationship to the leg **134** and abuts the slotted end **137** of a cam arm **138**. A pivot **139** carried on the plate is disposed within the slot of the end **137** of the arm whereby the arm is afforded sliding as well as rotational movement relative to the pivot pin. With the lever mechanism disposed in the inoperative position as shown in FIGURE 1, the free end **141** of the arm is disposed in a common plane with, but spaced from the leg **134** so as to be positioned adjacent the drive chain but not underlying it. A leaf spring **142** extending from the pivot pin **139** to a lug **143** provided on the free end **141** of the arm normally urges such arm against a stop member **144** provided on the plate **124**.

With the cam lever mechanism **123** provided as described above, it will be understood that following the throwing of the first ball and at the end of the counter-clockwise movement of the drive chain such mechanism is operatively set, by means of the drive chain dog **67** to effect the raising of all the pin hangers **86** after the second ball has been thrown. More specifically, shortly before the drive chain lug **58** trips the reversing switch **57**, the U-shaped dog **67** will bypass the free end **141** of the cam arm to engage the leg **134** of the bell crank **132** so as to rotate it about the pivot **133** into abutting relation with a stop member **146** provided on the plate **124**. Such rotation of the bell crank causes the leg **136** thereof to slidingly move the cam arm **138** relative to the pivot pin **139** and by virtue of the slot in the end **137** of the cam arm, into a position wherein the free end **141** thereof underlies the lower reach of the chain drive as shown in the dot-and-dashed position of FIGURE 6. The bell crank **132** is thus pivotally moved to the limit of its clockwise rotation at the same time the drive chain lug **58** engages the reversing switch **57** to reverse the directional traverse of the drive chain. In such manner the cam lever mechanism is set so as to be operative to raise the pin holders after the second ball has been thrown.

When the drive chain commences to travel in a clockwise direction due to the actuation of a reversing switch, the drive chain dog **67** moves out of engagement with the bell crank leg **134** to be intercepted by the free end **141** of the cam arm **138** which, as previously explained, is now disposed so as to underlie the lower reach of the drive chain. Continued movement of the drive chain causes the dog **67** to pivot the cam arm about its pivot **139** until the dog has traveled out of engagement with the free end **141**. The tension of the leaf spring **142** then acts to return the cam arm to its pre-set position in abutment with the stop member **144**.

After the second ball of a game has been thrown it is necessary to reset the full complement of ten pins on the floor in readiness for the next game. It is therefore required that all the pin holders be removed from the vertical line of pin movement before the pins commence their downward travel. To this end, after the second ball has been thrown the dog **67** at the end of the counter-clockwise travel thereof engages the free end **141** of the cam arm at the side opposite from the stop member **144**. Since clockwise rotation of the cam arm is prevented by such stop member the plate **124** is therefore caused to rotate about its pivot **126** so as to reach the full line position shown in FIGURE 6 at the same time the drive chain lug **58** trips the reversing switch.

Such pivotal rotation of the plate **124** is effective to rotate a third spring loaded rocker shaft **147** similar to the shafts **79** and **117** in a clockwise direction by means of a cable **148** extending from the shaft **147** to the end **128** of the plate **124**. A plurality of lines **151** are secured along the length of the rocker shaft **147**, each line extending through an opening **152** in the deck **17** and an aperture **153** in each bracket **66** to be terminally secured to a pin hanger **86**. Thus, it will be seen that clockwise rotation of the rocker shaft **147** acts to raise the pin hang-

ers 86 out of the vertical line of pin travel by means of the lines being wound around the shaft.

When the drive chain direction of travel is reversed so that the dog 67 no longer engages the bell crank leg 134 the spring 129 acts to return the cam lever mechanism to the inoperative position shown in FIGURE 1. The cable 148 is then taken up by the rocker shaft 147 rotating in a counter-clockwise direction due to the spring loading thereof while the lines 151 are provided with resilient means so as to afford selective take-up and extension of such lines when the pin supporting means 63 is released as well as during the clockwise rotation of the rocker shaft 147. Such resilient means will be seen to include a plurality of light weight coil springs 154, one each being connected into a line 151 adjacent the end connection thereof to the pin hanger. As shown in FIGURE 2 wherein the hangers are vertically disposed prior to selective release of certain of the pin supporting means 63, the springs in all the lines 151 are contracted. It is important to note here, however, that the weight of the hangers as they gravitationally assume a horizontal position is sufficient to overcome the tension of the springs 154. Thus, upon release of selected pin hangers from their latch members 88 the springs 154 in the lines connected to such hangers become extended in order to permit the hangers to assume the horizontal pin intercepting position as shown in connection with the number I pin in FIGURE 3. Additionally, when the cam lever mechanism 123 is actuated so as to raise the pin hangers from the horizontal to vertical position, the springs in such lines are maintained fully extended during clockwise rotation of the rocker shaft 147. In case the pin hangers have not been released to the horizontal position, however, the lines are extensible so as to be wound about the rocker shaft by extension of the springs connected into those lines. It will, therefore, be clear that when the rocker shaft is rotated to the limit of its clockwise rotation all of the springs 154 of the lines are extended.

In the event a strike has been scored, i.e., all the pins have been knocked down by the first ball of a frame, means are provided whereby the pin supporting means 63 are automatically rendered inoperative to intercept all of the pins during downward travel thereof so that the pins are immediately reset for the next game. Such means include a plurality of micro switches 156, one being mounted on each bracket 66 so as to be engageable with a pin hanger 86 when it is disposed in its horizontal pin engaging position. Simultaneous actuation of all ten micro switches is operative to complete a circuit whereby a solenoid 157 sets the cam lever mechanism in its operative position for raising the pin hangers out of the vertical line of pin travel thereby eliminating the necessity of such setting by the drive chain dog 67 as previously set forth. In this respect the solenoid 157 is carried on the plate 124 of the cam lever mechanism adjacent the bell crank leg 136 and is provided with a slidably movable arm 158 engageable with a pin 159 mounted on the leg 136. Therefore, when the solenoid is energized by virtue of the ten micro switches being simultaneously actuated, the arm 158 acts against the pin 159 to rotate the bell crank leg 136 against the slotted end 137 of the cam arm to thus move the arm into its operative position underlying the lower reach of the drive chain. In this manner the cam lever mechanism is operatively set to raise the pin hangers after the first ball has been thrown rather than after the throwing of the second ball so that a new frame may start immediately.

If several adjacent pins are knocked over at the same time, the lines thereof may be intertwined due to rolling of the pins before they reach a position of rest. It will be apparent that the pins will subsequently unentangle themselves during upward vertical pin traverse. In certain instances, however, where the intertwining is complex, a longer period of time may be required for pin separation than is provided during normal upward pin travel. In order to selectively allow such additional time when required, overload means 161 are provided whereby the motor may be de-energized until the lines become unentangled and the pins may hang freely and independently therefrom. In this respect a rectangular frame work 162 is mounted over that portion of the floor 12 on which the pins are positioned in a substantially common plane with the horizontal disposition of the sensing plates 64. As best shown in FIGURE 1, the frame work 162 comprises a plurality of longitudinally extending tubular members 163 so arranged that each pin in the transverse pin rows 21—24 are separated from adjacent pins in the same row as well as from pins in adjacent rows by a pair of such tubular members. Thus the frame work extends across the width of the lane and terminates longitudinally forward of the pin row 21 and rearwardly of the row 24. Tubular cross members 164 tie the frame work together at the longitudinal ends thereof. A pair of overload switches 166 are mounted in spaced relation to one another on each of the sidewalls 13 and 14 in such manner that each switch supportingly engages one corner of the frame work 162. The switches 166 are connected into the circuit so as to be normally closed by virtue of the frame work resting on them to maintain the circuit to the motor closed. In the event the frame work is elevated out of engagement with any one of the switches the circuit is thereby opened to cut off the motor. It will be seen that line entanglement can only occur substantially adjacent the pins and below the plane of the frame work. Thus, if two or more cables are entangled during upward pin traverse such cables will engage one or more of the tubular members 163 at the point of line entanglement to elevate the frame work out of engagement with at least one of the overload switches so as to cut off the motor. Once the individual lines have sufficient time to become separated the framework will be released so as once more to engage all the switches whereby the circuit is closed to permit resumption of the cycle of operation.

Commencing now with a complete cycle of operation during a frame in which two balls are thrown, the full complement of pins are set up on the floor 12 of the bowling lane. A first ball is thrown from the forward end of the lane whereby certain pins may be knocked over, as for example the number I and V pins as illustrated in FIGURES 2 and 3 of the drawings. The falling of such pins acts to pull the chain portions 28 of the pin cables 26 off their sensing plates 64 whereby the pin supporting means 63 associated therewith will be subsequently operative to support the pins above the line of play when the second ball is thrown. Throwing of the ball also serves to set the apparatus in operation by striking the lower portion of the back plate 16, as may also certain of the falling pins, to rotate the back plate about the pivot 54 so that the arm 56 engages the starter switch 53 to energize the motor 42. Energization of the motor operates to drive the shafts 32—36 carrying the sheaves 29 in a counter-clockwise direction so as to wind the cables 26 around the sheaves.

In view of the fact that the sprocket wheels 49 and 51 are also carried on the shafts 32—36, the drive chain likewise moves in a substantially counter-clockwise direction. Such movement of the drive chain carries the U-shaped dog 67 thereof out of engagement with the extension 112 of the slide bar 109 so as to effect selective operation of the pin support means 63 substantially immediately the apparatus is set in motion. To this end, release of the slide bar 109 from the dog 67 permits the rocker shaft 117 to rotate in a clockwise direction. The lines 118 which are connected from the shaft to the control lever 103 of the pin supporting means 63 are thus wound around the shaft to rotate the end 102 of the control lever in a substantially downward direction about the pivot 104 whereby the latch release shaft 97 is urged downwardly by means of the compression spring 106. If the chain portion of a cable 26 is positioned on a sensing plate (i.e.

the pin has not been knocked over, as for example pins number III and IX of FIGURE 2) downward movement of the latch release shaft **97** is prevented so that the pin hangers **86** remain held in a vertical position so as to be inoperative to engage such pins during downward travel thereof.

In such cases, however, where the pins have been knocked over so that the chain portion of the cables **26** have been off their sensing plates, the spring tension of the latch release shafts now is sufficient to overcome the upward forces applied to the weighted ends **107** of the sensing plates so that the shafts may move downwardly as illustrated in FIGURE 4. Thus the shaft actuating lugs **96** may now engage the latch members **88** to pivotally rotate the notched ends **92** thereof out of engagement with the legs **93** of the hangers which then may gravitationally fall into a horizontal position whereby the heads of the knocked down pins will be engaged within the bifurcations **87** of the hangers upon downward pin travel.

It is important to note that during the operation of the foregoing selective pin hanger release step, the chain portions **28** of the cables have continued to wind up on the sheaves **29**. It will be seen, however, that the pins are still disposed on the floor **12** and are not elevated therefrom until the drive chain **52** has completed substantially half of its counter-clockwise rotation. At approximately the moment the pins are raised off the floor the sensing plates **64** are pivoted to their vertically disposed position so that the pins will not be obstructed thereby during their upward travel. Such movement of the plate is effected by means of the drive chain dog **67** engaging the slotted end of the actuating lever **69** to move it so that the cable **77** rotates the rocker shaft **79** in a clockwise direction. Such rotation of the rocker shaft acts to wind the sensing plate lines **81** around the shaft to thus pivotally raise the sensing plates **64** out of the vertical path of pin travel.

As the drive chain nears the end of its first cycle of counter-clockwise movement the cam lever mechanism **123** is set so as to be operative to actuate the pin hanger raising means **122** at the termination of the next succeeding cycle of counter-clockwise travel of the drive chain. In this respect it will be seen that the drive chain dog **67** engages the bell crank leg **134** to pivotally move the second leg **136** of the bell crank into engagement with the cam arm **138** which is thus slid to a position underlying the drive chain whereby it may be engageable with the dog **67** as shown by the dot-and-dashed position of FIGURE 6.

By the time the dog **67** has thus effected the operative setting of the cam lever mechanism **123**, the pins will have been elevated to the limit of their upward travel adjacent the deck **17** as shown by the dot-and-dashed pin position in FIGURE 3. The chain lug **58** then trips the reversing switch **57** so as to reverse the directional travel of the drive chain. As will be apparent, clockwise movement of the drive chain acts to unwind the pin cables **26** from the sheaves **29** in order to return selected pins to the floor while other pins may be engaged in the pin hangers. In this respect during upward travel of the pins, the heads thereof will abut the horizontally disposed hangers and pivotally move them upwardly until the bifurcations **87** thereof my become disposed in a neck engaging position about the pins as shown in connection with the dot and dashed position of the number I pin in FIGURE 3. As the pins start to travel downwardly the hangers will pivotally move with them to a horizontal position and the pins thereafter will move relative to the hangers until a diameter of the pin heads larger than the width of the bifurcations prevents further downward pin travel. In this manner the pins which were knocked down by the first ball will be supported within the hangers a substantial distance above the floor.

With certain pins thus supported adjacent the deck **17**, it is desirable that the cables **26** of such pins remain disposed above the deck upon being further unwound from the sheaves so as to prevent them from extending from the heads of the pins downwardly into the line of play. For this reason, when the pins reach the position at which they are supported by the pin hangers the cord portions **27** of the cables are of such a length as to extend from the sheaves to the pin heads so that the chain portions **28** are still wound around the sheaves but ready to commence being unwound therefrom. The cord portions **27**, as previously mentioned are provided as light-weight lines while the chain portions **28** are comparatively heavy. Therefore, as the chain portions unwind from the sheaves **29** so as to provide slack in the cables the weight of each chain causes it to drop down between the sheave and its guide member **37** on the upper surface of the deck **17**.

When the drive chain has traversed approximately half of its clockwise travel the dog **67** comes into operative engagement with the actuating lever **69** which causes the rocker shaft **79** to rotate in a counter-clockwise direction so that the sensing plate lines **81** unwind to permit the sensing plates **64** to return to a horizontal chain receiving position. The pins contact the floor at substantially the same time the sensing plates are horizontally positioned so that as the cables **26** continue unwinding from the sheaves **29** the chain portions **28** are intercepted by the plates and are supported thereon.

Thereafter, as the drive chain nears the end of its clockwise travel the dog **67** engages the extension **112** of the slide bar **109** to slide it rearwardly along the guide member **111**. The slide bar pulls the cable **113** rearwardly also to effect counter-clockwise rotation of the rocker shaft **117** so as to release the lines **118** and thus permit the return of the control lever **103** by virtue of the spring **105** connected thereto to the normal dot and dashed line position of FIGURE 4 in which the lever **103** supports the latch release shaft **97** in its inoperative position. With the return of the slide bar to its normal position the laterally extending lug **59** of the drive chain trips the cut-off switch **61** whereby further operation of the apparatus is halted until the second ball has been thrown.

It will be understood that in the event the first ball has failed to knock down any of the pins, the cycle of operation will proceed as hereinabove described except for the fact that none of the pin hangers will be horizontally disposed by virtue of the chain portions of the cables remaining in position on all the sensing plates. Thus after the pins have been raised to their uppermost position they will all be reset on the floor in preparation for the second ball.

As will be clear from the foregoing the pins which were knocked over by the first ball are now positioned within the pin hangers adjacent the deck **17** while the pins which were left upstanding have been reset on their respective spots on the floor so that the game may continue.

The throwing of the second ball again serves to actuate the starter switch **53** and the drive chain begins its second cycle of counter-clockwise movement. As previously occurred, the cables **26** wind up on the sheaves **29** and the drive chain dog **67** releases the extension **112** of the slide bar **109** so as to place the pin supporting means **63** in a selectively operative position. Next, the dog **67** engages the actuating lever **69** whereby the sensing plates **64** are pivoted to a substantially vertical position. It will thus be seen that the foregoing operations are carried out with each cycle of counter-clockwise movement of the chain drive.

As an important aspect of the present invention, however, it should be especially noted that the cam lever mechanism is operative to raise the pin hangers after the second ball has been thrown and when the pins are disposed at the limit of their upward travel. Therefore, at the end of the second cycle of counter-clockwise drive chain travel the dog **67** engages the cam arm **138** so as to pivotally rotate the entire cam lever mechanism **123** whereby the cable **148** rotates the rocker shaft **147** in a clockwise direction to wind the pin hanger lines **151** around the shaft and pull the pin hangers up into a vertical

position. Thereupon the lug 58 trips the reversing switch and the direction of travel of the drive chain is reversed.

It will be seen that as the dog 67 travels out of engagement with the cam arm 138 the cam lever mechanism 132 returns to its normal position as shown in FIGURE 1 of the drawings by means of the spring 129. The operations which take place during the second cycle of clockwise drive chain travel are identical to those detailed above for the first cycle of clockwise travel except for the fact that all the pin hangers are now vertically disposed out of the path of vertical pin travel so that all the pins are permitted to be returned to the floor. Thus, the sensing plates 64 are again positioned horizontally to intercept the chains 28 of the cables, the pin supporting means are returned to an inoperative position and the lug 58 trips the cut-off switch.

Considering now the operation of the apparatus when a strike has been scored, it will be seen that the starter switch actuates the drive chain in the usual manner and the pin supporting means is actuated to release the pin hangers. In this case, however, since all the pin hangers are released to a horizontal position due to the fact that all the pins have been knocked down the ten micro switches 156 are simultaneously actuated to close the circuit to the solenoid 157 so that the arm 158 thereof sets the cam arm 138 in an operative position to be subsequently engaged by the dog 67. The sensing plates are raised to a vertical position and the dog 67 next engages the cam arm 138 in the same manner as otherwise occurs during the second cycle of counter-clockwise rotation to move the pin hangers out of the vertical path of pin travel. During subsequent clockwise movement of the drive chain all the pins are respotted on the floor, the sensing plates return to a horizontally disposed position, the pin supporting means is inoperatively positioned and the motor cut off, all as previously described in connection with the second cycle of clockwise drive chain travel.

What is claimed is:

1. Automatic pin setting apparatus for setting up pins on a bowling lane comprising a deck adapted to be supported above one end of said lane, a plurality of shafts journaled on said deck, at least one sheave mounted on each of said shafts for rotation therewith, a plurality of freely rotatable rollers one each being mounted on said deck in horizontal spaced relation to one of said sheaves, a plurality of guide members one of each being mounted on said deck between one of said sheaves and one of said rollers, means defining apertures in said deck in substantially vertical alignment with each of said rollers and each of said pins, a plurality of cables each comprising a light-weight substantially stiff cord portion and a heavier chain portion, said two portions being interconnected at one of their respective ends, the other end of said cord portion being adapted to be secured to one of said pins and the other end of said chain portion being connected to one of said sheaves, means operatively coupled to said shafts for unitary rotation and including a reversing switch thereof whereby said cables may be wound upon and unwound from said sheaves whereby said pins may be reciprocally moved in a substantially vertical path of travel from a lowermost position on said lane to an uppermost position adjacent said deck, a plurality of sensing means one each being associated with each of said pins and movable from an operative position intercepting said vertical path of travel when said pins are positioned on the lane to an inoperative position remote from said path of travel when said pins are reciprocally moved from said lowermost to said uppermost position, said sensing means in said operative position being adapted to support said chain portions of the cables when said pins are upstanding on the lane, said chain portions being removable from said sensing means when said pins are knocked over, and a plurality of pin support means one of each being associated with each of said pins and movable from a first inoperative position to a second pin engaging position intersecting said vertical path of pin travel, and said pin support means being selectively operative to intercept said pin on its downward travel if said chain portion has been removed from said sensing means by the throwing of a first ball of a frame.

2. Apparatus as set forth in claim 1 including means for moving all of said pin support means to an inoperative position when said pins are moved to said uppermost position and after a second ball of a frame has been thrown whereby all of said pins are returned upstanding to said lowermost position.

3. Apparatus as set forth in claim 1 including means for moving all of said pin support means to an inoperative position when said pins are moved to said uppermost position after a first ball of a frame has been thrown and all of the pins knocked down thereby.

4. Apparatus for spotting pins on a bowling lane including a plurality of cables with each of said cables being adapted to be attached to the upper end portion of the respective pins, means for selectively raising and lowering said cables to thereby raise the pins to a position spaced from said lane and lower them to a position in which the pins are supported on said lane, pin engaging means positioned in vertically spaced relation to said lane and movable from a first inoperative position wherein said pins may be freely raised and lowered to a second operative position whereing selected ones of said pins may be intercepted and retained in an upper inoperative position in spaced relation to said lane, and means for actuating said pin engaging means to move the same between said first and second positions thereof, said last named means including a sensing element adapted to support an intermediate portion of each of said cables and operative to move said pin engaging means into pin intercepting position upon such cable portion being removed from the sensing element when its associated pin is knocked down.

5. Apparatus as set forth in claim 4 including switch control means disposed rearwardly of said pins and adapted to be actuated by the striking of a bowling ball thereagainst to effectuate movement of said cable raising and lowering means.

6. Apparatus for spotting bowling pins on a bowling lane including a plurality of cables with each of said cables being secured adjacent one end thereof to an upper end portion of the respective pins, means for selectively raising and lowering said cables so as to selectively raise said pins from the lane and reposition the pins in an upstanding position on said lane, a plurality of bifurcated members disposed in vertical spaced relation above the respective pins when the same are in proper playing position on the lane, said members being mounted for movement from a first generally vertical inoperative position out of the vertical path of travel of said cables and pins to a second operative position wherein said members will intercept and support selected ones of said pins during downward travel thereof, and means for moving said members between said positions including a cable supporting element operatively associated with each of said members and operable upon removal of the cable therefrom to move the member into said second operative position.

7. Apparatus for spotting bowling pins on a bowling lane comprising a plurality of cables adapted to be secured at one end thereof to the respective pins, means for selectively raising and lowering said cables and the pins carried thereby, pin intercepting and suporting means disposed above said lane and movable from a first inoperative position to a second operative position for retaining selected ones of said pins in spaced relation to said lane, a plurality of members positioned to receive and support an intermediate portion of each of said cables when said pins are upstanding in operative position on said lane, means operatively connecting said members and

said pin support means whereby removal of said cable portion from the member upon the falling of a pin will actuate said pin support means and move the same into operative pin intercepting and supporting position.

8. Apparatus as set forth in claim 7 in which said members are movable between a first inoperative positive out of the path of vertical movement of said cables and pins and a second operative position wherein said cable portion is deposited thereon during downward movement of the cable after the pins have been spotted on the lane.

9. Apparatus for spotting pins on a bowling lane including a plurality of cables with each of said cables being adapted to be attached to the upper end portion of the respective pins, means for selectively raising and lowering said cables to thereby raise the pins to a position spacd from said lane and lower them to a position in which the pins are supported on said lane, pin engaging means positioned in vertically spaced relation to said lane and movable from a first inoperative position wherein said pins may be freely raised and lowered to a second operative position wherein selected ones of said pins may be intercepted and retained in an upper inoperative position in spaced relation to said lane, means for actuating said pin engaging means to move the same between said first and second positions thereof, and means disposed intermediate said lane and said pin engaging means and operable to disengage said cable raising and lowering means to thereby interrupt raising of said cables where two or more of such cables are twisted during the raising thereof.

10. Bowling pin spotting apparatus adapted for positioning over a bowling lane and including a plurality of drum members positioned in vertically spaced relation to said lane, a plurality of cables secured to said drum members for selective winding and unwinding thereon, each of said cables having an end portion adapted to be secured to the respective bowling pins, means rotating said drum members in a direction to wind said cables thereupon and raise said pins from said lane, means automatically reversing the rotation of said drum members for lowering said pins upon full raising thereof, switch means disposed in the path of travel of a bowling ball and operatively connected to said first named drum rotation means for rotating the same to raise the cables upon engagement of said switch means by such ball, a plurality of members movable from a first inoperative position out of the path of travel of said cables and pins to a second operative position for supporting and retaining selected ones of said pins in an elevated position upon normal downward travel of the pins, means positioned over the respective pins and adapted to receive and support an intermediate portion of the respective cables upon unwinding thereof from the respective drum members, said last named means being operatively connected to said pin supporting and retaining members for moving the latter into an operative position upon removal of said intermediate cable portion from said cable receiving and supporting means as when a pin is knocked down by the ball.

11. Apparatus as set forth in claim 10 in which said drum members are positioned rearwardly of the respective pins which they are adapted to support, means for guiding said cables in a generally vertical direction in alignment with said pins, and at least said intermediate portion of the cables being formed of a highly flexible and minimum frictional resistance character whereby the same may be readily deposited on said cable support means and readily removed therefrom upon the falling of a pin.

12. Apparatus as set forth in claim 10 including latch means normally locking said pin supporting and retaining members in said inoperative position.

13. Apparatus as defined in claim 6 including switch means automatically actuated when all of said bifurcated members are moved to said pin supporting position and operative to effect raising of said bifurcated members to said first position.

14. Apparatus as set forth in claim 6 in which said means for moving said bifurcated members between said positions includes means for automatically raising said members from said second pin engaging position to said first position and operative when said pins have been raised from the lane after a second ball of a frame has been thrown.

15. Apparatus as set forth in claim 7 in which said cables include substantially stiff light weight portions adjacent the respective pins.

16. Apparatus as set forth in claim 7 in which said last named means comprises a plurality of latch members normally locking respective pin support means in said first inoperative position, and latch actuating means operative to move said latch members out of locking engagement with said pin support means when said cable portions have been removed from said respective cable receiving members whereby said pin support means may move to said second pin engaging position.

17. Apparatus as defined in claim 9 in which said last named means includes a horizontally disposed framework adapted to be movable by said cables where two or more of such cables are entangled during the raising thereof, and switch means supporting at least one portion of said framework whereby movement of said portion from said switch means interrupts operation of said means for raising the cables.

18. Apparatus as set forth in claim 10 including means for retaining selected ones of said cables remote from the bowling lane when the pins secured to such cables are supported in said elevated position.

19. Apparatus for spotting pins on a bowling lane comprising a plurality of drum members positioned in vertically spaced relation to said lane, a plurality of cables secured to said drum members each of said cables having an end portion adapted to be secured to the respective bowling pins, means rotating said drum members so as to selectively wind and unwind said cables thereon and thereby selectively raise and lower the pins, a plurality of pin intercepting and supporting members positioned in vertical spaced relation to the lane, means for moving selected ones of said pin supporting members from a first inoperative position to a second pin intercepting and supporting position, and means operatively connected to said pin supporting members for selectively moving same from said second position to said first position, said last named means including an actuating member adapted to be operative when said drums are rotated to raise the pins, an arm element movable between an operative position selectively engageable with said actuating member and an inoperative position remote therefrom, cam means selectively actuated by said actuating member for moving said element from said inoperative to said operative position, and said actuating member being operative to selectively engage said element in said operative position whereby said pin supporting members are moved to said first position.

20. Apparatus as set forth in claim 7 in which said intermediate portions of said cables are formed of chain-like material.

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