

March 29, 1955

J. M. FLUKE ET AL

2,705,145

BOWLING PIN RESPOTTING MECHANISM

Filed April 7, 1949

6 Sheets-Sheet 1

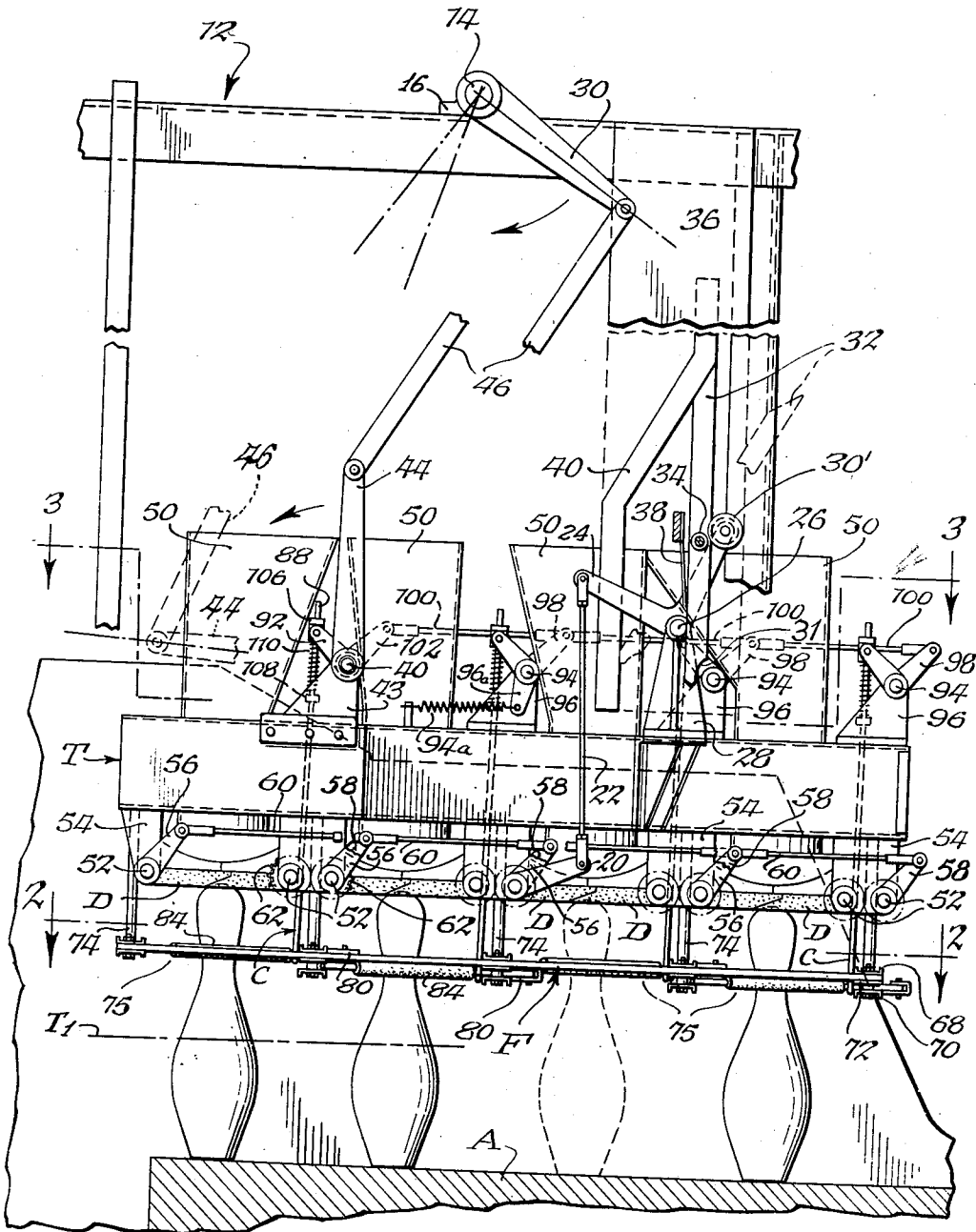


Fig. 1.

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6 Sheets-Sheet 2

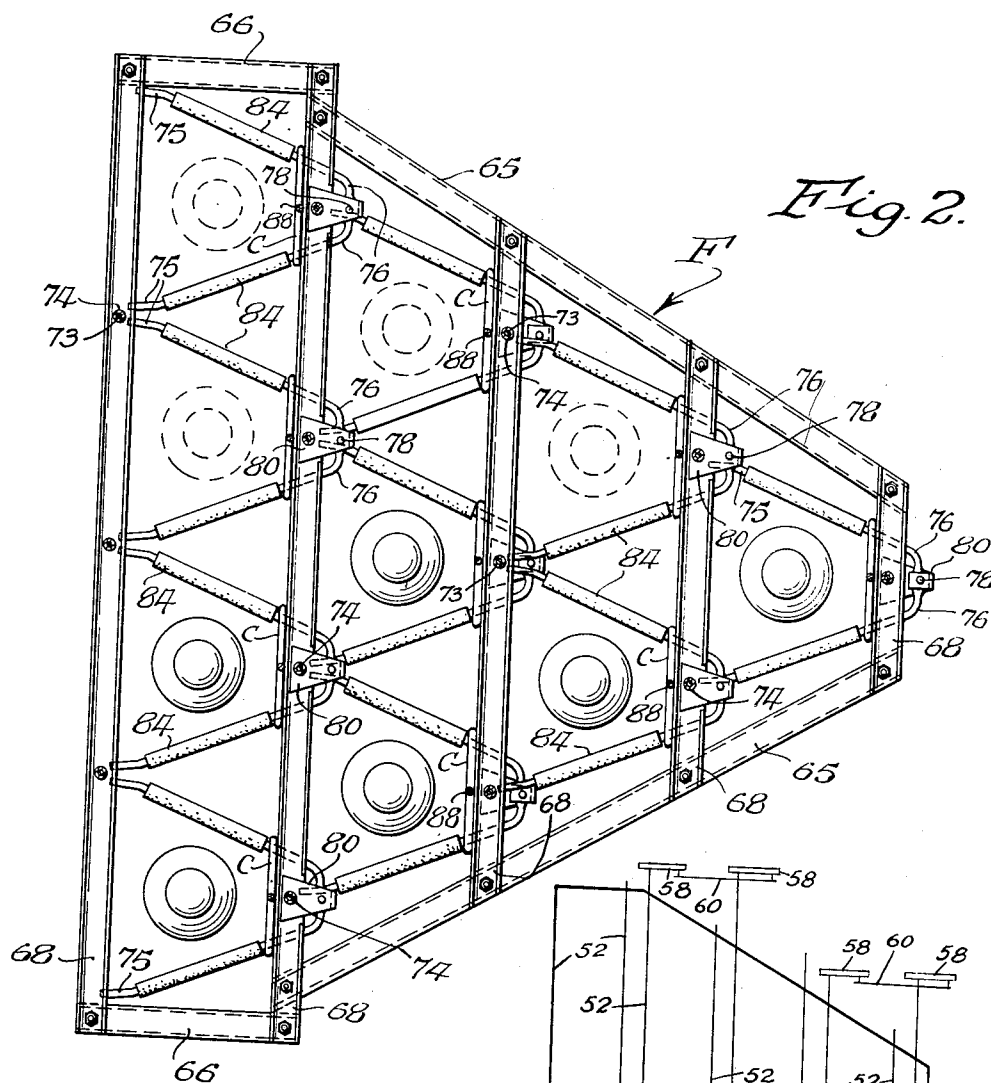
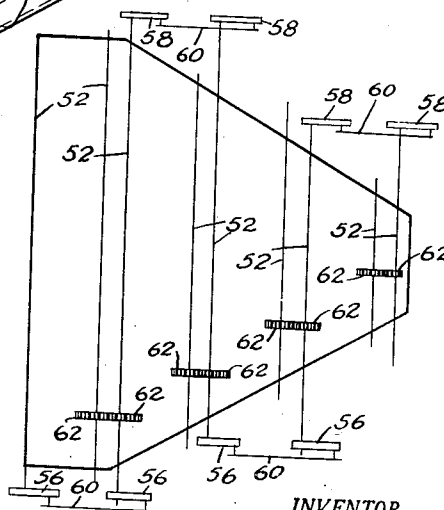


Fig. 1a.



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6 Sheets-Sheet 3

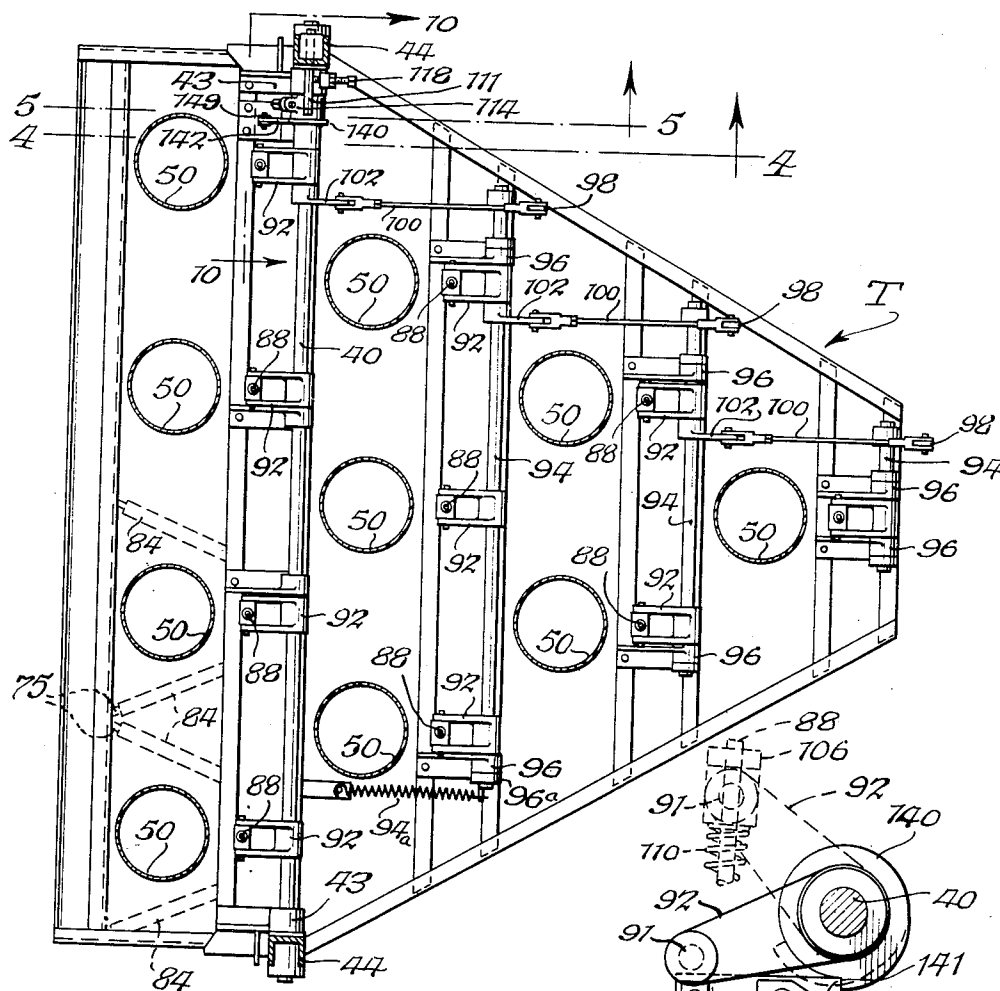


Fig. 3.

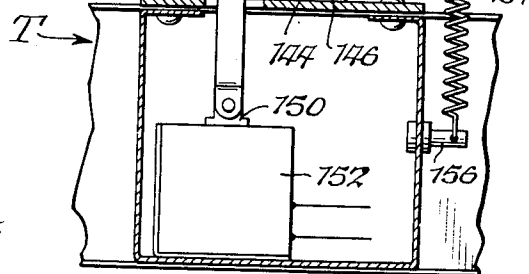


Fig. 7.

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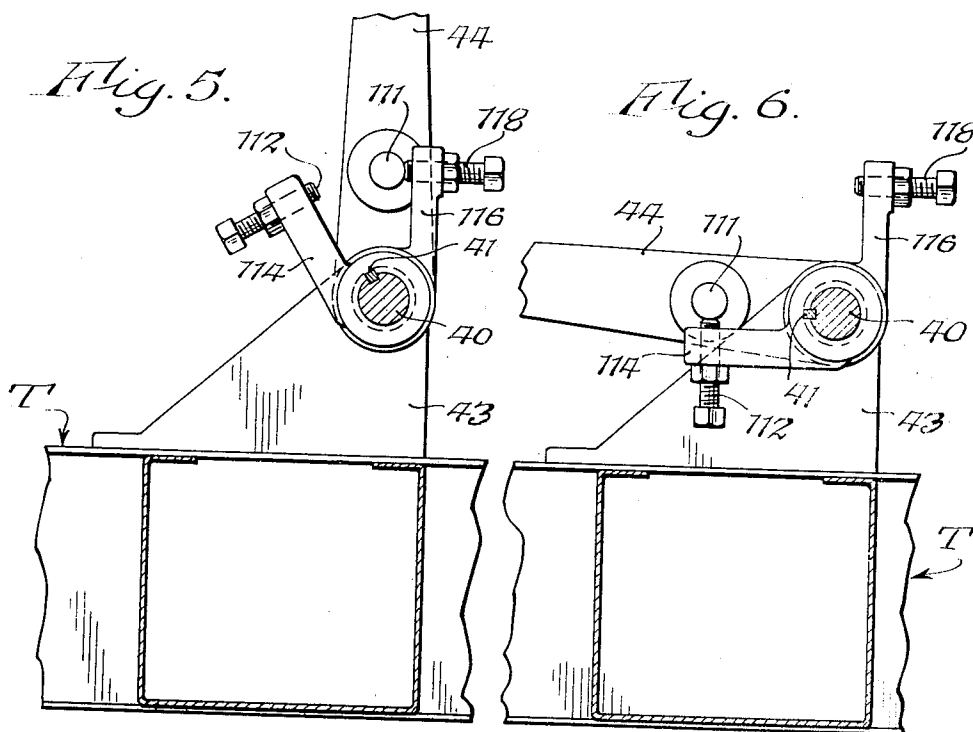
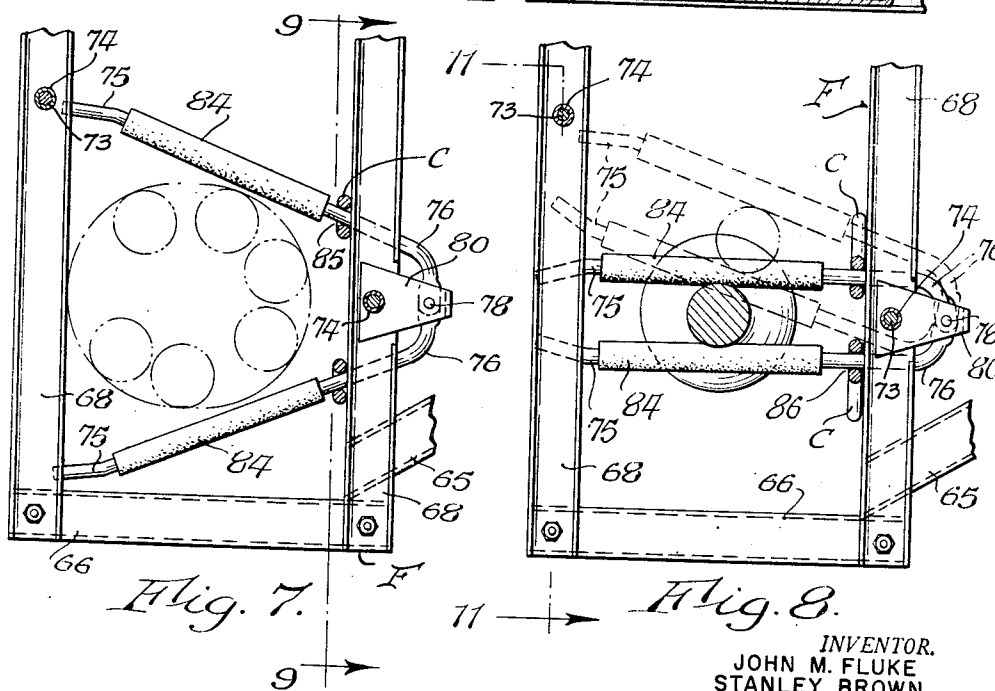
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BOWLING PIN RESPOTTING MECHANISM

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6 Sheets-Sheet 4



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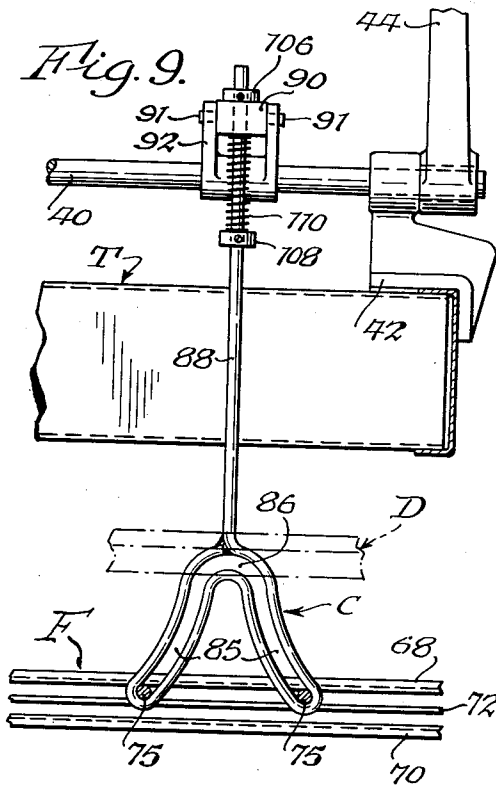
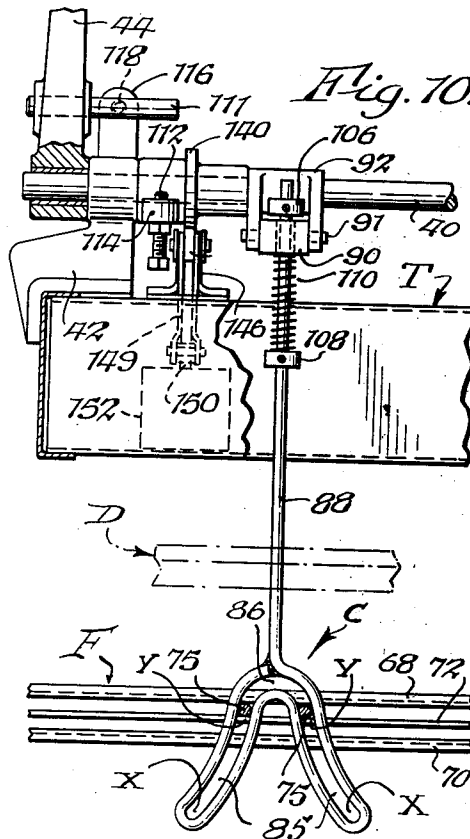
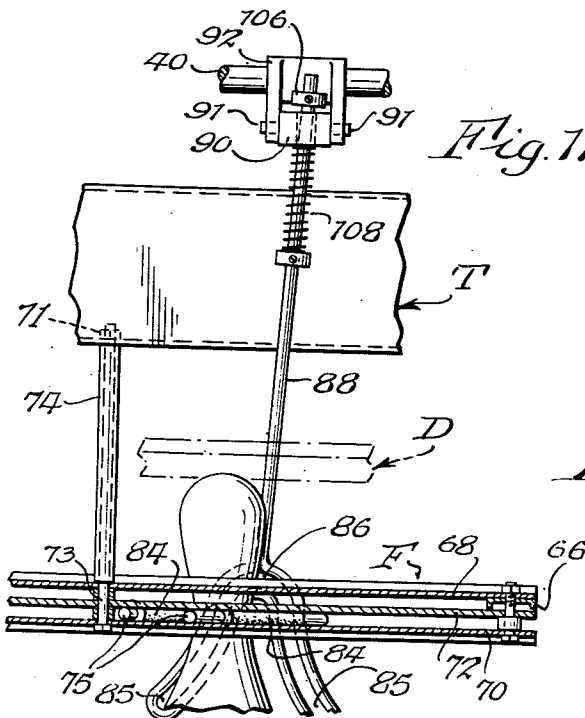
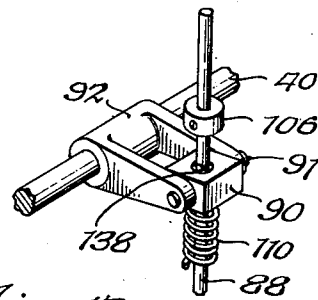
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BOWLING PIN RESPOTTING MECHANISM

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6 Sheets-Sheet 5



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2,705,145

BOWLING PIN RESPOTTING MECHANISM

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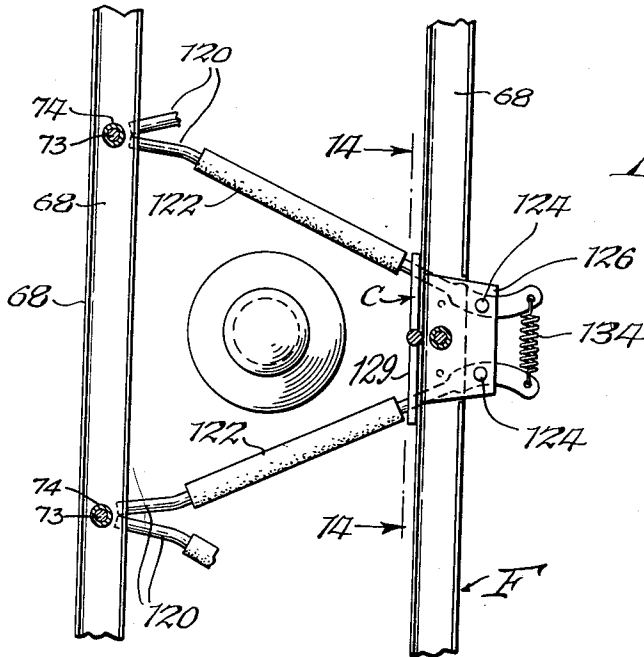


Fig. 13.

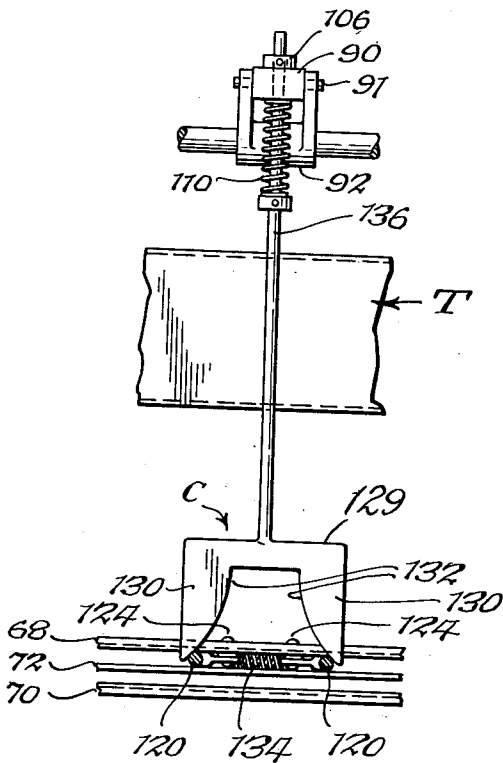


Fig. 14.

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2,705,145

BOWLING PIN RESPOTTING MECHANISM

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Application April 7, 1949, Serial No. 86,056

15 Claims. (Cl. 273—42)

This invention relates to bowling pin spotting machines, and to improvements in mechanism for spotting and respotting bowling pins in playing arrangement on the playing bed of a bowling alley; and the invention is particularly concerned with mechanism which respots bowling pins in the same on and off-spot positions each pin occupied on an alley after the first ball of a frame was rolled.

According to the invention, there are provided ten sets of substantially triangularly positioned relatively light weight gripper arms. Ten sets of arms are employed since this number conforms with the number of pins customarily used in bowling. A different number of sets of arms could be used, if desired. The arms of each set are swingably mounted for movement in a horizontal plane to and from each other. This construction is such that the opposed arms of each set of grippers have a floating, scissors-like movement whereby each pin is gripped "softly" when it is found by the arms of a set of grippers moving towards the pin when it is to be gripped for spotting or gripped and lifted for respotting. When the sets of gripper arms are employed for spotting pins in triangular arrangement on an alley, they firmly hold pins furnished thereto in the desired triangular arrangement so that when pins are placed on an alley and released, each pin occupies its proper on-spot position. The novel actuating mechanism which effects the movement of the arms to and from each other insures that each pin will be gripped without substantial lateral or longitudinal displacement. When, therefore, pins gripped in this manner are lifted and respotted, each pin is returned to substantially the same position it occupied prior to being lifted. The gripper arms of each set of grippers preferably are also so shaped that their operative range of action is substantially greater than that heretofore known. Hence, it is possible to grip and lift pins which have moved off-spot a considerable distance within the range of each set of gripper arms and return them to substantially the exact on or off-spot position each pin occupied.

As disclosed herein, the sets of gripper arms are mounted on a spotting-respotting table which is also provided with a plurality of pin spotting devices. The table is adapted to be raised and lowered relative to a bowling alley at proper times during the play of a game in order to spot and respot bowling pins thereon. In the illustrated embodiment, bowling pins are delivered from the several spotting devices through the table and onto the alley where they remain in standing triangular playing arrangement pending the rolling of the first ball of a frame. Following this operation, the table is again lowered and the sets of gripper arms, which are employed as respotting units, are actuated to grip any standing pins. The table is then raised and the alley is swept of dead wood or fallen pins, after which the table is returned to a position adjacent the alley so that the respotting units can effect the delivery of pins held thereby to the alley in the respective on or off-spot positions each pin occupied before being gripped and lifted.

The invention is not restricted in use to a pin spotter of the type briefly described above. It can be used with other known types of bowling pin spotting machines, such for example, as shown in Schmidt Patent 2,346,189. It can also be used for lifting bottles, cans, machine parts and other articles.

It is an object of the invention to provide improved bowling pin spotting and respotting mechanism including

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sets of opposed pivoted gripper arms moving in horizontal planes into and out of gripping positions relative to the necks of pins to be gripped and spotted on the playing bed of an alley.

It is also an object of the invention to provide a vertically movable pin spotting table having improved bowling pin spotting and respotting mechanism including opposed sets of pivoted gripper arms capable of use in spotting and/or respotting pins in on or off-spot playing positions on a bowling alley and cam actuated mechanism operatively connected with each of the sets of gripper arms for simultaneously actuating all of the sets of gripper arms to grip and hold bowling pins for spotting or respotting.

It is also an object of the invention to provide an improved bowling pin respotting mechanism having sets of opposed swingable gripping arms mounted on stationary pivots, capable of gripping and lifting bowling pins standing in on-spot or off-spot positions on a bowling alley.

It is a further object of the invention to provide a bowling pin spotting and respotting device having bowling pin spotting mechanism for spotting a plurality of bowling pins in triangular arrangement on a bowling alley, and respotting mechanism, including means for firmly holding pins standing on the bowling alley after the first ball of a frame is rolled and gripping arms for gripping such standing pins with substantially no lateral or longitudinal displacement from their on or off-spot position on the bowling alley.

The invention also consists in the provision of an improved bowling pin respotting mechanism having sets of opposed pivotally mounted gripper arms and actuating means therefor which cause each set of arms to find an on or off-spot pin standing on a bowling alley, and grip the same with a minimum of displacement for lifting and replacing the pin in substantially the same position occupied before being gripped and lifted.

The invention also consists in the provision of a bowling pin spotter having pin clamping mechanism coacting with sets of opposed triangularly arranged elongated gripper arms mounted on the spotter, and actuating means which simultaneously actuate all of the sets of gripper arms to grip clamped standing on or off-spot pins with a minimum of lateral and/or longitudinal displacement.

It is a further object of the invention to provide bowling pin respotting mechanism having a plurality of sets of triangularly arranged pivotally mounted bowling pin gripping arms and a plurality of cams provided with diverging cam tracks for operating each set of arms individually to grip and hold bowling pins to be placed in substantially triangular arrangement upon the playing bed of a bowling alley.

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

In the accompanying drawings, which form a part of this specification, and in which like characters of reference indicate the same or like parts:

Figure 1 is a fragmentary side elevation of a part of a bowling pin spotting and respotting mechanism embodying the invention.

Figure 1A is a diagrammatic plan view showing the relationship between the operating arms of the respotting mechanism.

Figure 2 is a horizontal section, on line 2—2 of Figure 1, illustrating the pairs of gripping elements in wide open position.

Figure 3 is a plan view, partly in section, taken on line 3—3 of Figure 1, showing the operating means for the respot mechanism.

Figure 4 is a fragmentary longitudinal, vertical section on line 4—4 of Figure 3, illustrating the means for locking the pairs of gripper elements or bars in closed position for gripping, lifting and lowering standing pins after a first ball has been thrown.

Figure 5 is a fragmentary vertical section, on line 5—5 of Figure 3, illustrating the means for rotating the shaft which actuates the sets of gripper arms or elements.

Figure 6 is a view similar to Figure 5 showing the same mechanism in a different operating position.

3 Figure 7 is a plan view, shown partly in section, of a pair of gripper bars in open position.

Figure 8 is a similar view showing, in full lines, a pair of gripper bars in closed position in operative engagement with an on-spot pin, and in broken lines, the same pair of bars in operative relation to a pin which is off-spot.

Figure 9 is a transverse, vertical sectional elevation, taken on line 9—9 of Figure 7, illustrating the operating mechanism holding a pair of gripper bars in open position.

Figure 10 is a view similar to that shown in Figure 9, taken approximately on line 10—10 of Figure 3, illustrating the operating mechanism holding a pair of gripping bars in pin gripping position, and also illustrating the shaft rotating means shown in Figures 5 and 6.

Figure 11 is a view similar to that shown in Figure 9 disclosing gripper bar operating mechanism in relation to an off-spot pin and illustrating, in section, the means for guiding the free ends of a pair of gripping bars.

Figure 12 is a perspective view showing the floating mount of a gripper unit operating cam.

Figure 13 is a fragmentary plan view illustrating a pair of respot bars and having associated camming means of modified construction.

Figure 14 is a transverse vertical section taken on line 14—14 of Figure 13.

In Figure 1 of the drawings, there is shown a portion of the side frame 12 of a suitable bowling pin spotting machine with which the pin spotting and respotting mechanism of the present invention is operatively associated. Side frames 12 are suitably supported on the alley kickbacks (not shown). Mounted in brackets 16 attached to longitudinal members of side frames 12 is a transverse shaft 14, which is rotated at proper times during the operation of the machine in order to move table T which supports pin spotting cups or funnels 50 and sets of gripper arms 75 to and from the playing bed of alley A. Mounted at opposite ends of shaft 14 are arms 30 to which are secured links 46 which in turn are pivotally connected to rock arms 44 loose on shaft 40, see Figures 5 and 6, which is journaled in brackets 43 fixed to side frame members of table T. Rotation of shaft 14 and the concurrent rotation of arms 30 cause table T to move between vertically spaced positions to and from alley A for spotting and respotting pins thereon.

The movement of arms 30 is such that table T occupies three positions, depending upon the cycle of operations of the machine. Table T, which preferably has a substantially triangular shape, has secured to its upper face ten pin receiving cups or funnels 50, the lower ends of which are of circular cross section, see Figure 3, and the centers of which correspond to the centers of the spotted or pin playing positions on the alley.

If all pins are knocked down by the first ball, table T rises to its uppermost or pin receiving position where a set of pins is delivered to spotter cups or funnels 50. Following this operation, arms 30 lower table T to its lowermost position adjacent alley A, whereupon pins in spotter cups 50 are discharged from spotter cups 50 by suitable mechanism (not shown) in spotted arrangement on the playing bed of the alley. Shaft 14 is then rotated to cause arms 30 to locate table T at its dwell position above the alley. In the position of the parts illustrated in Figure 1, table T occupies its intermediate position corresponding to that where standing pins are detected and clamped to the alley after a first ball of a frame is rolled. Since the specific mechanism for raising and lowering table T and control mechanism therefor does not form a specific part of the present invention, further description and showing thereof are omitted in the interest of brevity.

In the illustrated embodiment, suitably attached to and extending downwardly from the lower side of table T are brackets 54 in which are mounted transverse shafts 52 to which are secured pairs of pin supporting doors D, Figure 1, which support pins to be spotted in cups 50. Doors D, when closed, are also operative to engage the head ends of pins standing on alley A after the first ball of a frame is rolled in order to clamp such pins so that they can be gripped by arms 75 in or off-spot position.

As shown in Figures 1 and 1A, certain of the transverse shafts 52 at one end are provided with crank arms 56 having their free ends connected by links 60. At the other end of certain of the shafts 52 are secured

crank arms 58 having their free ends connected by links 60. Pinions 62 on shafts 52 operatively connect adjacent shafts 52 of doors D for simultaneously actuating all doors D as described hereinbelow. Thus by rotating crank arms 56 and 58, doors D can be opened downwardly to release pins held in cups 50 and can be closed in unison to clamp pins standing in the alley when pins are to be lifted for removal of dead wood and be respotting during the operation of pin gripping arms 75 for lifting and respotting. The mechanism for actuating all of the doors D in unison is operatively connected to one of the shafts 52.

To spot the pins, table T descends until the lower face thereof is in the plane T₁ indicated in Figure 1. In this position the doors D, on which the pins are resting while in cups 50, are opened to enable the pins to descend through the opened doors.

Any suitable mechanism, such as indicated in Figure 1, may be used to open doors D. In the illustrated embodiment, this includes an arm 20 fixed to one of the door actuating shafts 52 and which, at its free end, is connected by a link 22 to one arm of a bell crank 24 pivoted at 26 to an upstanding bracket 28 on table T. The other arm of crank 24 carries a roller 30' which, in the up and down movements of table T, engages with a cam track structure including a cam bar 32 pivoted at 34 on a fixed part of the machine frame, such as a plate 36. In a portion of the up and down movements of the table, doors D are closed, as shown in Figure 1, the operating mechanism being then in the position shown. When table T reaches plane T₁, the doors are opened for spotting the pins.

During the closed condition of the doors, the roller 30' is disposed above the pivot 34 of cam bar 32 which causes that bar to stand in the vertical position indicated, since the weight of the doors and connections presses the roller against the bar.

As table T descends, roller 30' passes below pivot 34 at a selected time, and the weight of the door mechanism will cause the lower end of cam bar 32 to swing to an angular position toward the left, during which time roller 30' remains in engagement therewith. This causes bell crank 24 to swing about its pivot 26 so that, through link 22, the free end of the connected arm 20 will be lowered. This action, through shaft 52, will cause all door operating arms 56, 58 and links 60 to simultaneously move all doors D into open position. During the downward movement of table T, doors D are only partially open so long as roller 30' runs on the straight portion of cam 32. Upon further downward movement of table T, roller 30' runs onto relief portion 31 of cam bar 32 whereupon all doors D open wide to deposit pins in spotter cups 50 on alley A. At the lowermost position T₁ of table T, roller 30' eventually passes below the lower end of pivoted cam bar 32, whereupon the latter returns to vertical position under the influence of spring 38, which it has deflected in swinging to angular position. The doors remain open on the return or upward movement of table T by the engagement of roller 30' with the second cam bar 40, the upper end of which is offset to carry roller 30' back to door closing position. It eventually passes over the top of bar 32 to its outer side for the next downward movement of table T.

The pin engaging bars or arms 75 of the preferred embodiment of this invention are mounted on a substantially triangular frame F secured to the under side of table T, see Figures 1, 2, 7 and 8. Frame F includes converging horizontal side members 65 and parallel side bars 66, all of which are connected by spaced upper and lower transverse channel bars 68 and 70 and intermediate rails 72. Frame F is attached to table T by nuts 71 and long bolts 73. The heads of bolts 73 are suitably mounted in frame F and extend upwardly therefrom through spacing sleeves 74 located between the underside of table T and the upper face of frame F.

As shown in Figures 2, 7 and 8, each pin gripper unit comprises a pair of elongated opposed bars, preferably in the form of round metal rods 75 operatively disposed in a horizontal plane and provided with off-set or curved end portions 76. Although round bars or arms have been found to give satisfactory results, other cross sectional shapes and materials may be used. Rods 75 are relatively light in weight. They are mounted on a single vertical pivot 78 and can move to and from each other travelling towards or away from pins which occupy on

or off-spot positions on the playing bed of an alley. The construction of arms 75 is such therefore, that when they travel toward and engage a pin clamped by clamping members D on the alley, they will press with an easy grip against the neck of the pin and therefore not displace it as the arms actually grip the pin for lifting. This is due to the fact that the light weight of the bars or jaws reduces inertia forces to a minimum as the jaws or bars move against the neck of a pin to be gripped.

It will be evident that the gripper arms or bars form a "closed" system whose equilibrium is not dependent upon whether an article, such as a bowling pin, is clamped against a supporting surface when it is to be gripped.

Each of the pivot pins 78 is mounted in spaced upper and lower parts of a plate 80 secured to the adjacent upper channel 68 in a manner to permit the reduced portions of ends 76 of the bars to be confined between the spaced portions of plate 80. This arrangement gives each of the pivots 78 ample support. Although in the form illustrated, arms 75 are mounted upon pivot pins 78, it is obvious that other known types of swingable mounts could be employed. If desired, the terminal end of each arm 75 could be provided with a stud (not shown) formed integrally therewith or attached thereto, which stud could be journaled for rocking movement in support plates 80.

On account of space limitations, the free ends of rods 75 can be bent inwardly, as shown, thus allowing the rods 75 to swing wider apart and be operative over a larger area. As mentioned hereinabove and as indicated in Figures 9, 10, 11 and 12, both bars of each set of gripper bars 75 move in the same horizontal plane. This is especially valuable when a pin is being gripped because it insures against canting of a pin due to the fact that the lines of grip of both arms 75 engaging the neck of a pin, are in the same horizontal plane. The desired coplanar relationship of the two arms 75 of each gripper unit is due to the mounting of each off-set end 76, which is reduced such that the combined thickness of the complementary reduced parts 76 at the pivot point is equal substantially to the diameter or thickness of a single bar.

The construction above described substantially eliminates rolling of a pin about its longitudinal axis when gripper arms 75 grip a pin to be lifted and respotted. Accordingly, this prevents displacement of the pin from its standing position and insures great accuracy in respotting.

Each pivot 78 is disposed on a longitudinal line passing through the center of the alley spot and the axis of an associated on-spot pin. Between its ends, each rod 75 may have secured about it a pin holding sleeve 84. This may be made of a resilient material such as rubber, felt or the like, or other material which provides a firm grip upon the neck portions of pins to be gripped and held with a minimum of damage or discoloration thereto.

As shown in Figures 1, and 9 to 11, alternate transverse rows of gripper bars 75 of the ten triangularly arranged gripper units are arranged in different, but closely adjacent horizontal planes. By this means, the free ends of gripper bars 75 in any one row can clear the pivotal mounting of the gripper bars in an adjacent row, thus permitting gripper bars 75 to be of maximum length and have a maximum range of action relative to pins to be gripped and respotted. The first and third rows of gripper bars 75, as seen in Figure 1 viewing from left to right, are disposed in the upper of the two planes just mentioned, whereas bars 75 in the second and fourth rows are disposed in the lower of the two planes. This relative position of the sets of gripper bars 75 does not interfere with their proper pin gripping action since all sets of bars are so arranged as to grip pins slightly above their smallest neck diameter as shown in Figure 1. The returned free ends of rods 75 shown, permit adjacent transverse pairs of gripper bars to have the widest possible expanse without interference. In this manner, the greatest possible area of the pin supporting bed of alley A is covered, and substantially any existing condition of standing pins can be lifted and respotted. As seen in Figure 7, there is shown a series of broken line circles indicating the neck diameters of pins and the extent to which they could be off-spot while still being within reach of a given pair of gripper bars 75.

As shown in Figures 7, 8 and 9, the free ends of the upper sets of gripper bars 75 are confined for movement into and out of gripping relationship between top transverse channel bars 68 and intermediate cross rails 72. 85

Likewise, the free ends of arms 75 of the lower gripper units are confined for movement between transverse channel bars 70 and intermediate cross rails 72. The guiding of bars 75, however, in open or closed position or in extreme off-spot position, as shown in Figure 8, is such that the ends of bars 75 are confined at all times between either channel 68 or 70 and the intermediate member 72.

Each pair of gripper bars or arms 75 is moved into open and closed or gripping positions by a cam member or device C. In the preferred construction illustrated in Figures 9 to 11 inclusive, each cam gripper unit operating member C has an inverted substantially Y-shaped form. In its preferred form, cam member C is made of bent rod stock shaped to provide opposed arcuate guide slots or channels 85 connected at the top by a semi-circular portion 86. Obviously cam members C can be made of other materials and by other methods, if desired. As seen clearly in Figures 1, 2, and 7 to 11 inclusive, each of the operating devices C is located in a substantially vertical plane adjacent the channel members 68 and 70. The inner portions of rods 75, adjacent curved portions 76, pass through cam portions 85.

Since ten cam members C are employed, and all are identical in construction, only one is described in detail. As indicated particularly in Figure 10, each of the two downwardly extending legs of a cam member C can be characterized as having two main cam portions X and Y. The slope of portion X is less steep than the slope of portion Y of the cam track. When, therefore, cam member C is moved downwardly to bring gripping bars 75 into gripping and holding engagement with a bowling pin to be gripped and held, a relatively rapid motion takes place as cam portions X move relative thereto. As cam portions Y move downwardly over gripper bars 75, the slope is steeper and the rate of movement of bars 75 towards each other is slower. At the points at which the bars 75 are clamping a pin, the slope of cam tracks 85 is quite steep, so that a good mechanical advantage is obtained, equal to a wedging action. In the preferred embodiment the path of portions Y is so designed that substantially a locking effect is obtained when cam members C are moved to shift gripping arms 75 to operative relationship with pins to be gripped and spotted or respotted. This construction reduces the holding force necessary to be applied to each of the cam supporting and activating rods 88, and also assists in effecting a compression of resilient sleeves 84 which encircle gripping bars 75 about the portion of each pin gripped.

Each cam supporting and actuating rod 88 extends upwardly from, and preferably is formed integrally with, its respective cam member C. The upper end of each rod 88 passes through a vertical bore 138 in a horizontal, pivoted bearing member 90. Each member 90 is pivoted on pins 91 mounted in the free ends of spaced arms of levers 92 of which there are ten. Some of the levers 92 are arranged transversely in groups corresponding to the number of pairs or sets of gripping bars 75 in the first three rows and are fixed on horizontal shafts 94 mounted in bearings 96 extending upwardly from and secured to the table T, see Figures 1 and 2. There are six levers 92 so mounted. The remaining four levers 92, constituting the rear group or row, are similarly mounted on operating shaft 40 on which the crank arms 44 are journaled.

As shown in Figures 1 and 3, each of the shafts 94 just mentioned is also provided with a crank arm 98. Each arm 98 is connected by a rod or link 100 to a rock arm 102 secured to an adjacent shaft 94 or to shaft 40. In this way when shaft 40 is rotated, shafts 40 and 94 are rocked in unison.

The mounting of the upper ends of rods 88 in bearing members 90 is such that, upon actuation of shaft 40 and shafts 94, all cam members C are moved in unison upwardly or downwardly in a substantially vertical plane. The upper end of each rod 88 of a cam member C has secured on it a collar 106 which is engageable with the upper portion of bearing 90. Spaced below bearing 90, rod 88 has adjustably secured thereto another collar 108 between which and bearing 90 is arranged a coil spring 110 encircling rod 88. This arrangement constitutes a yielding safety device against abnormal conditions, and also permits individual setting of each device during assembly and without the need for extensive precision work, by adjustment of collar 108. The spring mounting of cam actuating rods 88 also provides for self adjustment of gripper arms 75 relative to the neck of pins being

gripped because the spring serves to permit continued movement of the actuating means after the pin is gripped. This is of special advantage when there are variations in neck diameters of pins being gripped.

In Figure 9, one cam member C is shown in its uppermost position wherein the gripping rods or bars 75 are at the lower ends of guide slots 85, thereby effecting widest separation of rods 75. See also Figure 7. Appropriate rocking of shafts 40 and 94 will cause all of the cam members C to be shifted from the uppermost position, Figure 9, to a selected lower operating position such as shown in Figure 10 wherein the several pairs or sets of gripper rods 75 have been urged by their respective cam members into substantially parallel positions as shown in Figure 8. In such a position, a pin, if standing on alley A in on or off-spot position, will be securely gripped by bars 75, and held thereby between compressed rubber sleeves 84. When cam members C move gripper bars 75 to operative pin gripping and holding position after the first ball of a frame is rolled, cam members C are retained by suitable means described hereinafter in the position illustrated in Figure 10, so that all standing on and off-spot pins which have been thus gripped by pairs of gripper rods 75 will be elevated by table T when it moves upwardly to a position above the alley such that sweeping of dead wood may be effected. The pins are subsequently returned to the alley and released by the opening of the pairs of grippers 75 under automatic control, as will be explained. Since the specific mechanism for raising and lowering table T does not form a part of the present invention, further description and showing are omitted in the interest of brevity.

In view of what has been stated above, it is evident that as shown in Figure 9, when an on-spot pin is to be gripped by gripping arms 75, cam portions 85 of cam member C effect a substantially equal translatory movement of each arm 75 towards the bowling pin to be gripped and held for lifting and respotting. However, in the case of an off-spot pin, after table T is lowered so that doors D clamp the pin against the alley, due to the downward movement of its cam member C, the arms 75 of one set of arms start moving towards the pin. One of the arms, say the left gripper arm 75, first finds the pin and presses against the neck thereof, and the movement of this arm thereupon stops. Rod 88 continues to move downwardly and accordingly moves cam member C farther downwardly. As this action continues, because of the fact that left gripper arm 75 is stationary, rod 88 tilts out of its vertical plane and the cam portion 86 thereof, which is moving downwardly relative to right gripper arm 75, causes the latter to swing into engagement with the neck of the pin opposite to the portion which is engaged by the first mentioned arm 75. In this manner, any off-spot pin within the range of action of a set of arms 75, can be gripped and respotted in substantially the same position it occupied before being gripped and lifted.

The rocking of shaft 40 and the concomitant rotation of shafts 94 are effected by a stud 111 carried by and projecting inwardly from one of the rock arms or cranks 44. At the appropriate time in the cycle of operations, crank 44 will move counterclockwise with respect to the full line position, Figures 1 and 5, to the dotted line position Figure 6 which corresponds to the dotted line position of arm 44 shown in Figure 1. In this movement, stud 111 after a selected interval, comes into engagement with an adjustable stop screw 112 on an arm 114 suitably secured, as by a key 41, to shaft 40. Stop screw 112 is so adjusted that shaft 40 is rocked the required amount to move cam members C to close the several sets of gripper bars. Return movement of gripper bars 75 to open position is effected by spring 94a. Thus, by and through the connections described, appropriate rotation of all of the shafts is effected for shifting all of cam members C up and down, as explained.

In Figures 5 and 6 there is also shown another arm 116 mounted on or formed integrally with bracket 43, which carries a stop screw 118 adapted to be engaged by stud 111 when crank arm 44 is in upright position. This is provided for the purpose of preventing crank arms 44 and associated connections 46 and 30 from overrunning to a position where arms 44 might get on or beyond dead center. This arrangement generally forms no part of

the invention as concerns the actuation of the respot mechanism.

While in the preferred embodiment shown in Figures 1 to 11 inclusive, each pair of gripper arms 75 is mounted on a single pivot, the invention can take other forms. For example, as illustrated in Figures 13 and 14, each of the ten sets of grippers consists of a pair of gripper bars 120. Each bar 120 is mounted on an individual pivot 124. Pivots 124 are mounted in transversely spaced relation in a bracket or support 126 equidistant from the longitudinal center of the device. In this construction, cam member C, having a closed cam track 86, shown in the preferred construction, is made in the form of an open cam structure 129 of fork-like form including spaced legs 130 having opposed inner cam portions 132. Cam portions 132 may correspond generally in shape to an edge of the cam slot portions 85 of the cam C, and are disposed so as to straddle each pair of gripper bars 120 in such manner as to cause cams 132 to engage operatively the outer sides of a pair of bars 120. Thus by moving cam 129 downwardly, from the upper position shown in Figure 14, bars 120 will be forced by legs 130 towards each other into substantially parallel relation for gripping the pin therebetween, as in the first construction. Since, in this construction, the inner sides of the gripper bars 120 are free from contact with cam 129, a tension spring 134 is connected to and between extensions of bars 120 projecting beyond pivots 124. This arrangement causes bars 120 to yieldingly engage and follow cam faces 132 at all times.

It will be noted that the mounting of the upper ends of rods or stems 136 is exactly the same as that described for rods 88 in the preferred construction shown in Figures 1 to 12 inclusive.

In Figures 8 and 11, the cam member C illustrated is shown in the position it occupies when an off-spot pin is being gripped by bars 75. Under such conditions, see Figure 11, cam member C is tilted in order to permit cam tracks 85 to follow bars 75 and conform with their required angular position with respect to the longitudinal center. This action takes place freely and without binding for all cam members C because holes 138 in pivoted bearings 90 through which the cam actuating rods 88 or 136 pass, have a greater diameter than that of rods 88 or 136. However, since the mounting of the upper ends of rods 88 or 136 is at a considerable distance from the lower or cam portion of cam member C or cam 129, their angular displacement is relatively slight. Therefore, it follows that the action of cam grooves 85 on a pair of gripper bars 75 is not modified to an undesirable extent. This is made clear in Figure 11 where a pair of gripper bars is shown in perspective in angular or off-spot position, and also in Figure 12 which shows an enlarged perspective view of the support for cam rod 88.

Suitable mechanism, preferably electrically actuated at a selected time in the cycle of operations of the machine, is provided to cause the sets of gripper bars 75 (or 120) which have closed upon standing on or off-spot pins after the first ball of a frame is rolled, to remain locked in closed position such that pins can be securely held thereby during the upward movement of table T while sweeping takes place and to retain the pins in such locked position until the table descends and the lifted pins are replaced in their respective on and off-spot positions on alley A.

A suitable construction for this purpose is illustrated in Figures 3 and 4. A single tooth ratchet 140 is secured to the hub of arm 114 which is keyed to shaft 40 as seen in Figures 4 and 5. Operatively associated with ratchet 140 is a latch or pawl 142 which is pivotally mounted between its ends at 144 (Figure 4) on a bracket 146 rising from a plate on the upper face of table T. Latch 142 is provided with a shoulder 148 engageable with the ratchet tooth to hold the shaft 40 stationary when turned to a position in which the gripper bars are in pin gripping position. To effect the locking relation between ratchet and pawl, one end of the pawl is pivoted to a link 149 operatively connected to armature 150 of a solenoid 152 mounted, as shown, on table T. The opposite end of latch 142 has connected thereto a tension spring 154, the lower end of which is secured to a stud 156 fixed to one of the cross members of table T. To place the foregoing structure in the locking relation shown in Figure 4, solenoid 152 is energized thereby pulling the end 85 of the latch to which it is connected downwardly, thus

swinging latch 142 about pivot 144 against the downward pull of spring 154. This will move shoulder 148 into a position in which the ratchet tooth 141 will interlock with it when shaft 40 is turned to the position illustrated in Figure 4.

Under all other conditions, the solenoid is de-energized thereby enabling the spring 154 to swing the latch in the opposite direction. This moves the latch to a position in which shoulder 148 thereof is entirely out of the path of travel of the ratchet tooth 141. Thus, after the second ball of a frame has been thrown, or after a strike, gripper bars 75 or 120 will be moved toward each other into position to engage such pins as may be standing, but since at this time, the electric control circuit does not actuate solenoid 152, gripper bars 75 or 120 are immediately opened again in order to release any standing pins before table T starts its ascent, whereupon a suitable sweep (not shown) sweeps any standing pins as well as dead wood, from the alley into the pit.

Shaft 40, and shafts 94 which coast therewith, are normally held in gripper open positions by means of spring 94a having one end attached to the frame of table T and the other end attached to an arm 96a secured to one of the shafts 94. Spring 94a acts to rotate that shaft, and all other shafts 94 and shaft 40 to gripper open positions. When, therefore, solenoid 152 is de-energized, spring 94a contracts, thereby rocking the several shafts 94 and 40 and causing arms 75 to move to open positions.

The mechanism described hereinabove can also be used for the dual purpose of spotting and respotting bowling pins on a bowling alley. In this case spotter cups 50 are not used. Sets of gripper arms or bars 75 (or 120), which are mounted in triangular arrangement beneath table C are operated to grip and hold ten triangularly positioned pins delivered thereto. Mechanism for assembling, and effecting the delivery of pins to sets of grippers 75 or 120 can be similar in construction and operation to that shown and described in Rundell Patent 2,388,709 issued November 13, 1945. Following the delivery of a set of pins to sets of gripper arms 75 or 120, the pin conveying and triangularizing mechanisms (not shown) move clear of table T which then descends to pin spotting position adjacent the alley. Gripper arms 75 or 120 are then opened to release pins held thereby. When table T rises to its intermediate dwell position above the alley, the pins remain standing in proper spotted arrangement on the alley.

After the first ball of a frame is rolled, table T moves down and gripper arms 75 or 120 are operated to grip and hold any on or off-spot standing pins. The table rises during the alley sweeping operation, then descends. Gripper arms 75 are moved to open position to release any pins held thereby and return them to the on or off-spot position each pin occupied before being lifted. After this takes place, table T is raised and dwells above the alley pending delivery of the next set of pins thereto.

The invention above described may be varied in construction within the scope of the claims, for the particular embodiments selected to illustrate the invention are but a few of the possible concrete forms which our invention may assume. The invention, therefore, is not to be restricted to the precise details of the structures shown and described.

What we claim is:

1. In a bowling pin spotting machine, in combination, a movable support, a plurality of vertically spaced sets of guide members mounted on and extending transversely across the underside of said support, a plurality of substantially triangularly arranged sets of grippers, each of said sets of grippers including a pair of opposed, elongated gripper jaws, each of said jaws having one end swingably mounted on said support, and the other end movably positioned between a set of said guide members, means for simultaneously actuating all of said grippers to grip and hold on or off-spot bowling pins, said last-named means comprising a plurality of vertically movable cams, each of said cams having a cam face engaging one of said jaws of one of said sets of opposed jaws, an actuating rod mounted on each of said cams, and a swivel block for the free end of each of said rods, and means for loosely and resiliently supporting each of said free ends of said rods in said swivel blocks, whereby each set of gripper jaws may adjust itself to the on-spot or off-spot position of bowling pins to be gripped, and to any variation in pin neck diameter.

2. In a bowling pin respotting mechanism, a pair of opposed gripper jaws, an actuating device for said gripper jaws comprising a cam member provided with a pair of divergent similarly shaped camming elements for operating said jaws, and an actuating rod attached to the top of said member, each of said camming elements being formed with at least two adjoining cam face portions engaging with and movable along a gripper jaw substantially at right angles to the plane of movement of said jaws and a top and bottom end, the slope of said face portions adjacent the bottom end of said camming element being at a smaller angle with the horizontal than the slope of the portions adjacent the upper end of said element, said portions being so constructed and arranged that in response to the movement thereof along said jaws the initial movement of said jaws towards each other is more rapid than their final movement, and means for moving said actuating rod to displace said camming elements across said jaws.

3. In a bowling pin spotting machine, a bowling pin setter table adapted to be moved vertically between a pin spotting position, a pin gripping position, and a pin holding position above a bowling alley for spotting and respotting pins on said alley, a plurality of substantially triangularly arranged sets of elongated gripping arms mounted on said table with the free ends of said arms extending in the same general direction, spaced sets of transverse guides, means mounting said sets of guides in longitudinally spaced relationship on the underside of said table, including supports positioning alternate sets of guides in vertically spaced horizontal planes, gripper supports mounted on said guides, means mounting said sets of gripping arms on said supports with the arms of alternate longitudinally spaced sets of gripping arms extending below the supports of adjacent sets of arms and with the ends of said arms of said sets movable between and supported by said spaced sets of transverse guides, whereby the ends of gripping arms of alternate sets of gripping arms may move freely beneath gripper supports of adjacent sets of gripper arms, an actuating device operatively associated with each of said sets of gripping arms, means for locating said table at said pin gripping position, clamping devices on said table operative when said table is located at said last-named position for firmly holding any pins standing on said alley against substantial lateral and longitudinal movement, and mechanism also operative when said table occupies said last-named position for simultaneously and individually moving each of said sets of arms into gripping relationship with on and off-spot pins standing on said alley.

4. A gripping device comprising a pair of opposed individually operable elongated pin gripping arms, a support for one end of each of said arms, means mounting said arms for movement to and from each other in the same substantially horizontal plane, a cam having slotted wedge tracks, said arms extending through said tracks each of said tracks being provided with an upper and a lower gripper arm actuating portion, said lower slotted portion being inclined at a smaller angle with the horizontal than said upper slotted portion, means mounting said cam with said lower slotted actuating portions normally in engagement with said arms when said arms are in open inoperative positions and means for effecting relative movement between said arms and said cam for closing said arms to grip and hold an article, said lower slotted actuating portions of said tracks being operative during said movement to impart an initial more rapid movement of said arms towards each other, and said upper slotted actuating portions being operative to impart a slower final movement of said arms into gripping relationship with said article.

5. A gripping device comprising a pair of gripper jaws having elongated substantially straight gripping surfaces, a cam member having a pair of diverging slotted angularly inclined cam surfaces, means mounting said cam member with one of said jaws extending through each of said slots of said cam member, and mechanism for moving said cam member in a plane substantially at right angles to the plane of movement of said jaws to cause said slots to travel across said jaws and close and open said jaws.

6. The combination with a support, of means mounting said support for movement to and from the pin supporting bed of a bowling alley, a plurality of pin gripping devices mounted on said support, each of said grip-

ping devices comprising a set of opposed pin engaging and gripping arms, pivot means supporting one end of each of said arms for movement in a substantially horizontal plane relative to a surface supporting bowling pins to be gripped, a separate actuating device for each of said sets of arms, said device having cam members, each directly engaging and movable along an arm of the set of arms, means for effecting relative movement of said arms and said devices to displace said cam members along said sets of arms and thereby effect the movement of said arms towards each other, and means for returning said arms to their original positions upon reverse relative movement of said devices and arms.

7. The combination with a support, of means mounting said support for movement to and from a bowling alley, a plurality of pin gripping devices, each of said gripping devices comprising a set of opposed pin engaging and gripping arms, means mounting the arms of each set of arms on said support for movement to and from each other in a substantially horizontal plane relative to said bowling alley supporting pins to be gripped, a separate actuating device for each of said sets of arms, said device having cam members, each directly engaging and movable along an arm of the set of arms, means for effecting relative movement of said arms and said devices to displace said cam members along said sets of arms and thereby effect the movement of said arms towards each other, and means for returning said arms to their original positions upon reverse relative movement of said devices and arms.

8. A bowling pin spotting and respotting mechanism for use in a bowling pin spotting machine, comprising a movable substantially horizontally positioned support, means mounting said support for movement to and from a bowling alley, a plurality of vertically spaced sets of upper and lower guide members mounted on the under side of said support, a plurality of sets of gripper devices mounted in substantially triangular pin playing arrangement on the under side of said support, said sets of gripper devices comprising at least two groups, one group being disposed at a lower level than the other relative to said support, portions of said gripper devices in the lower group underlying portions of said gripper devices in the other group, each of said sets of gripper devices including a fixed pivot and a pair of swingably mounted elongated gripper jaws having one end pivotally mounted on said pivot, said pivoted jaws being supported adjacent both ends by longitudinally spaced guide members of the corresponding sets of guide members, the other end thereof extending between their respective guide members, a common positively operated actuating device having operating means directly engaging each of said pairs of gripper jaws, and means responsive to movement of said support to a pin gripping position above said bowling alley for moving said actuating devices to close said jaws about standing pins to be gripped.

9. The combination with a support, of means mounting said support for movement to and from the pin supporting bed of a bowling alley, a bowling pin gripping device mounted on said support, said device comprising two opposed individually movable gripping arms, each of said arms having an elongated substantially straight portion and an offset and reduced terminal portion provided with an opening, pivot means extending through said openings in said terminal offset portions of said arms mounting said arms on said support for movement in a substantially horizontal plane, actuating means for said device, said means having a cam member, means mounting said cam member in a plane substantially at right angles with the plane of movement of said arms and in direct engagement with and movable along said arms of said gripping device, means for effecting relative movement between said cam member and said arms for moving said arms into gripping relationship, and means for moving said arms away from each other upon reverse relative movement between said cam member and arms.

10. The combination with a support, of means mounting said support for movement to and from the pin supporting bed of a bowling alley, a bowling pin gripping device mounted on said support, said device comprising two opposed individually movable gripping arms, means mounting said arms on said support for movement towards and from each other in a substantially horizontal plane, actuating means for said device, said means

having a cam member, means mounting said cam member in a plane substantially at right angles with the plane of movement of said arms and in direct engagement with and movable along said arms of said gripping device, means for effecting relative movement between said cam member and said arms for moving said arms into gripping relationship, and means for moving said arms away from each other upon reverse relative movement between said cam member and arms.

11. The invention defined in claim 10 including means operative in response to the movement of said gripping arms to pin gripping position for locking said gripping arms against separating movement.

12. The combination with a support, of means mounting said support for movement to and from a bowling alley, a plurality of pin gripping devices mounted on said support, each of said gripping devices comprising a set of opposed pin engaging and gripping arms, means swingably supporting one end of each of said arms for movement in a substantially horizontal plane relative to the alley surface supporting pins to be gripped, a separate actuating cam member loosely engaging and movable along each arm of said sets of arms, means mounting said actuating members in a plane substantially normal to the plane of movement of said gripping arms, means for effecting relative movement between said arms and said cam members, whereby said members moving along said arms close said arms to grip and hold a pin, and means for returning said arms to their original positions upon reverse relative movement of said cam members and said arms.

13. In a bowling pin spotting machine, a pin setter table adapted to be moved between vertically spaced operating positions above a bowling alley including a pin engaging and gripping position, a plurality of sets of opposed elongated pin gripper arms mounted in substantially triangular arrangement on said table having their free ends extending in the same general direction, means constraining each of said sets of arms to move to and from each other in horizontal planes, said means including transverse guides for said free ends of said arms mounted on said table, a plurality of actuating cams mounted on said table, each of said cams having opposed gripper arm actuating surfaces, means positioning said cams on said table in planes substantially at right angles with the planes of movement of said arms and with said actuating surfaces thereof in actual engagement with and movable along said opposed gripper arms, mechanism for raising and lowering said table to locate said table at said pin engaging and gripping position, and means operated by said mechanism for effecting relative movement between said cams and said arms to close said arms to grip any pins standing on said alley, said last-named means being operative to cause said gripper arms to remain closed and locked against the necks of bowling pins lifted and to cause said gripper arms to open and release such pins when said table moves to pin spotting position adjacent said alley.

14. In a bowling pin spotting machine, a pin setter table adapted to be moved between vertically spaced operating positions above a bowling alley, including a pin engaging and gripping position, a plurality of gripper units mounted in substantially triangular arrangement on said table, each of said units comprising a set of opposed elongated pin gripping jaws having their free ends extending in the same general direction, and longitudinally spaced supports for said sets of gripping jaws, said units being arranged in longitudinally spaced rows of four, three, two and one units, respectively, with the jaws of alternate rows of units positioned for operation in closely spaced different horizontal planes, portions of the jaws in one row underlying portions of the jaws in another row, whereby to increase the operative area of the jaws of each set of gripper jaws, spaced transverse guides extending across the under side of said table and constructed and arranged to guide and support said free ends of said elongated pin gripper jaws, mechanism for lowering said table to locate said table at said pin engaging and gripping position, means operative when said table is located at said position for actuating all of said units to move said jaws into closed gripping relationship, locking mechanism for maintaining said gripper jaws closed when said table and pins held by said gripper jaws are located above said alley, means for releasing said locking mechanism, and means for opening said jaws

when said table has been moved to pin delivery position relative to said alley.

15. The invention defined in claim 1 including spring means connected to said arms in such manner as to normally bias said arms to inoperative position.

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