Feb. 12, 1957 R. L. HOLLOWAY ET AL 2,781,195

BOWLING PIN SPOTTING AND RESPOTTING MECHANISM

Filed Aug. 18, 1950 7 Sheets-Sheet 1

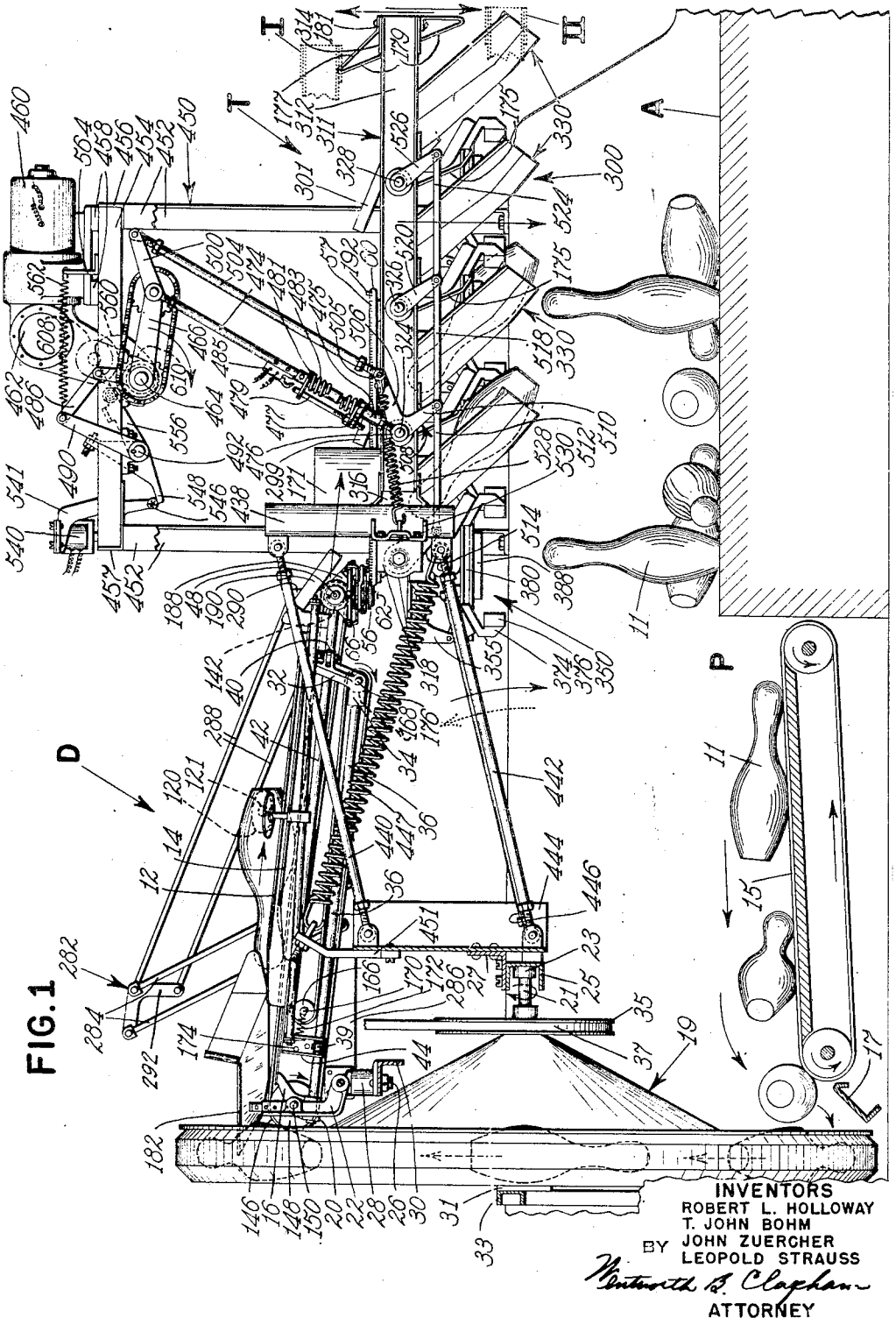


FIG. 1

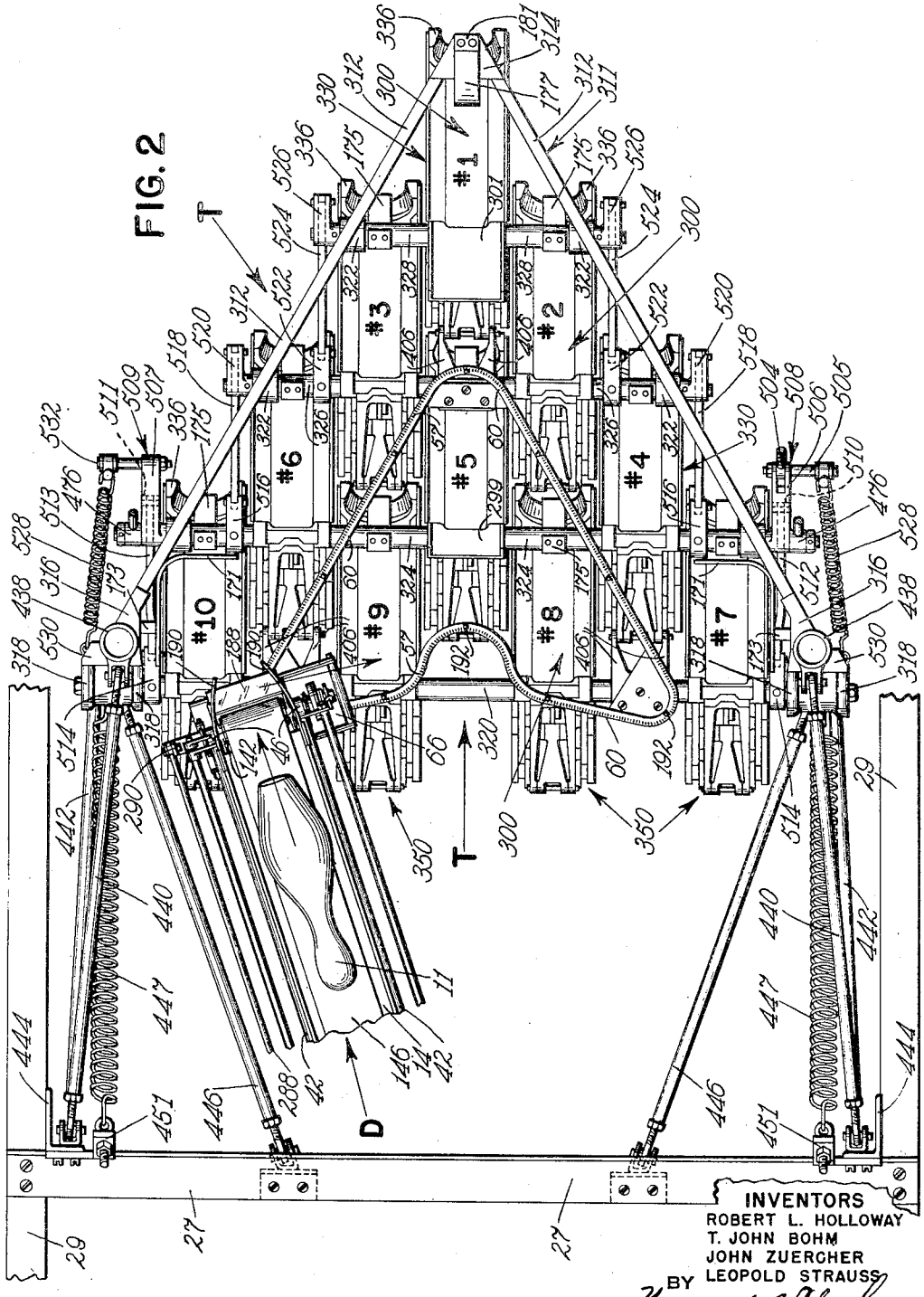
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BOWLING PIN SPOTTING AND RESPOTTING MECHANISM

Filed Aug. 18, 1950 7 Sheets-Sheet 2

FIG. 2



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BOWLING PIN SPOTTING AND RESPOTTING MECHANISM

Filed Aug. 18, 1950 7 Sheets-Sheet 3

FIG. 3

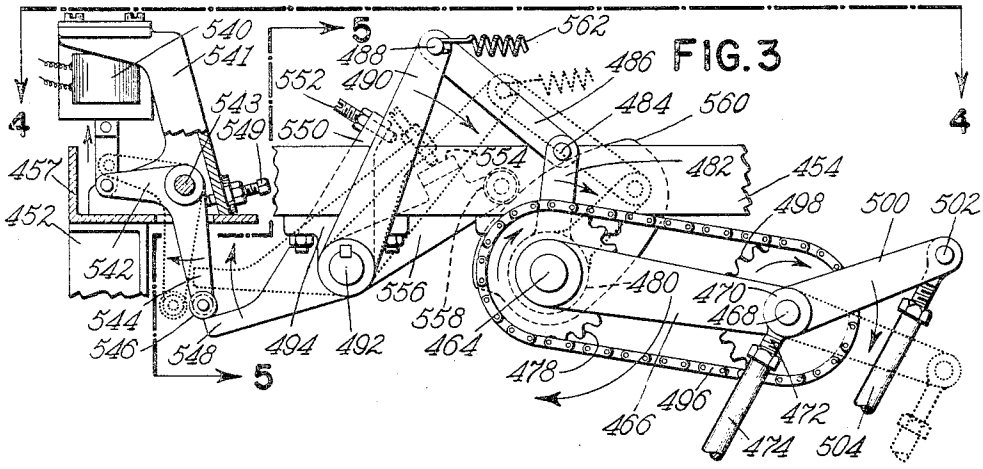


FIG. 4

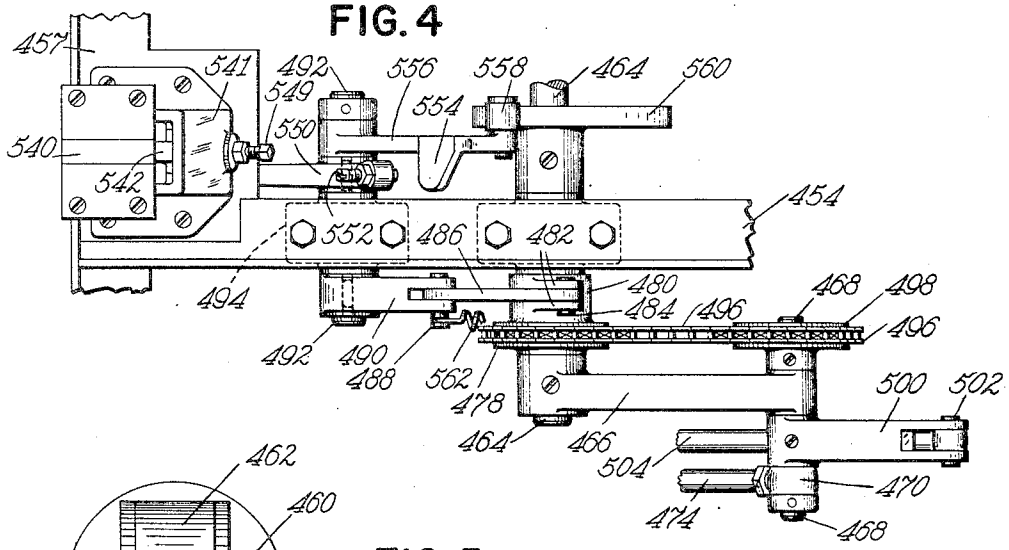


FIG. 5

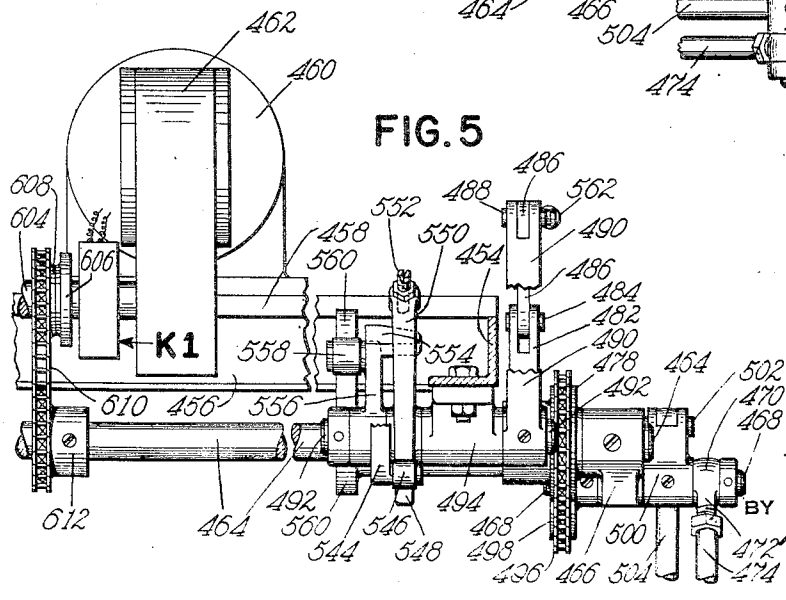
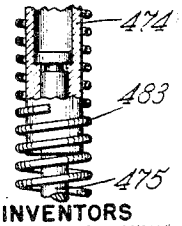


FIG. 6



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BOWLING PIN SPOTTING AND RESPOTTING MECHANISM

Filed Aug. 18, 1950 7 Sheets-Sheet 4

FIG. 7

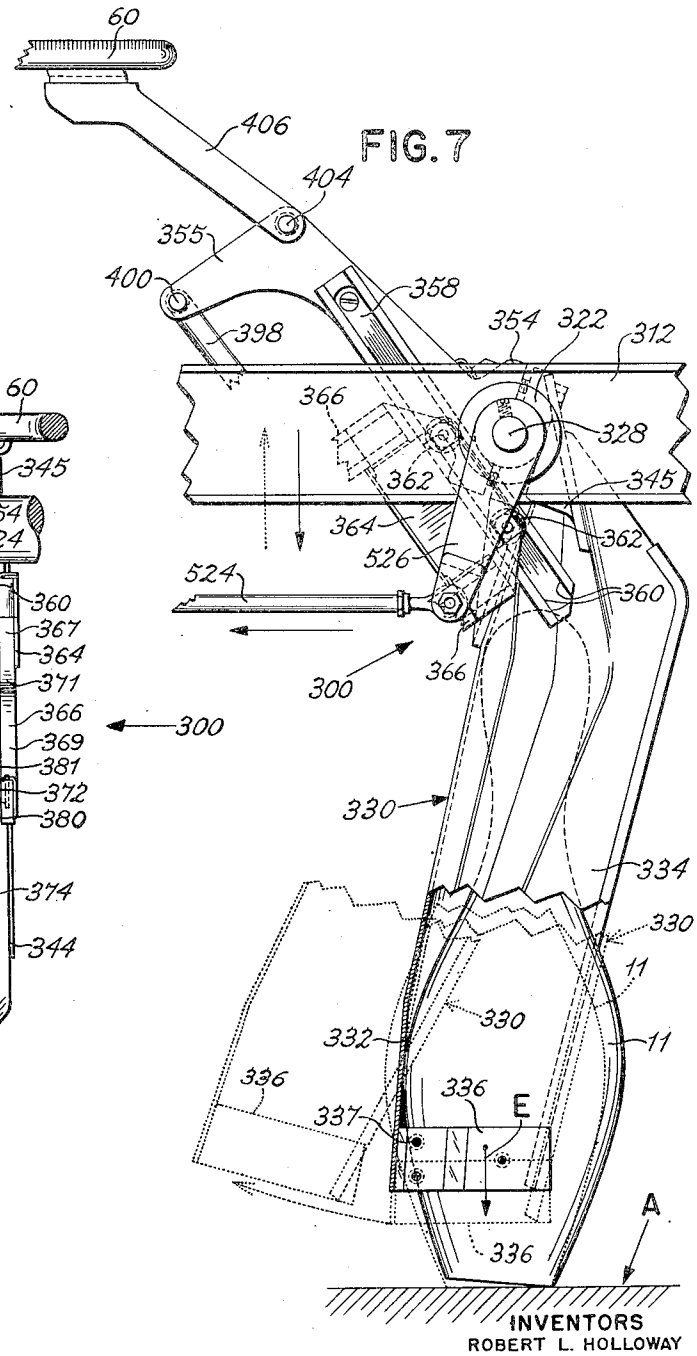
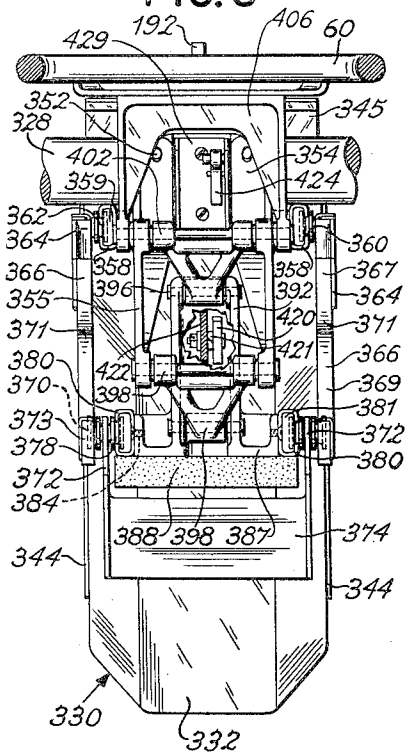


FIG. 8



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Feb. 12, 1957 R. L. HOLLOWAY ET AL 2,781,195

BOWLING PIN SPOTTING AND RESPOTTING MECHANISM

Filed Aug. 18, 1950 7 Sheets-Sheet 5

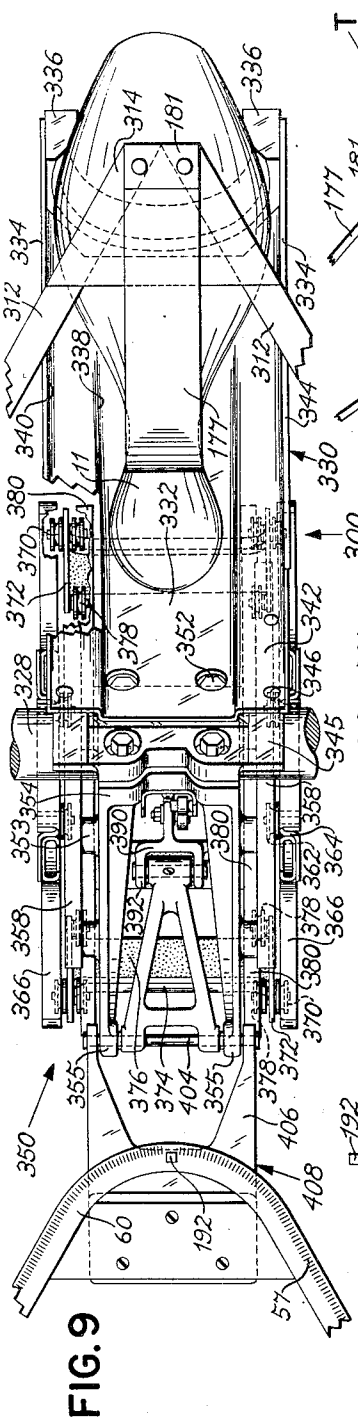


FIG. 9

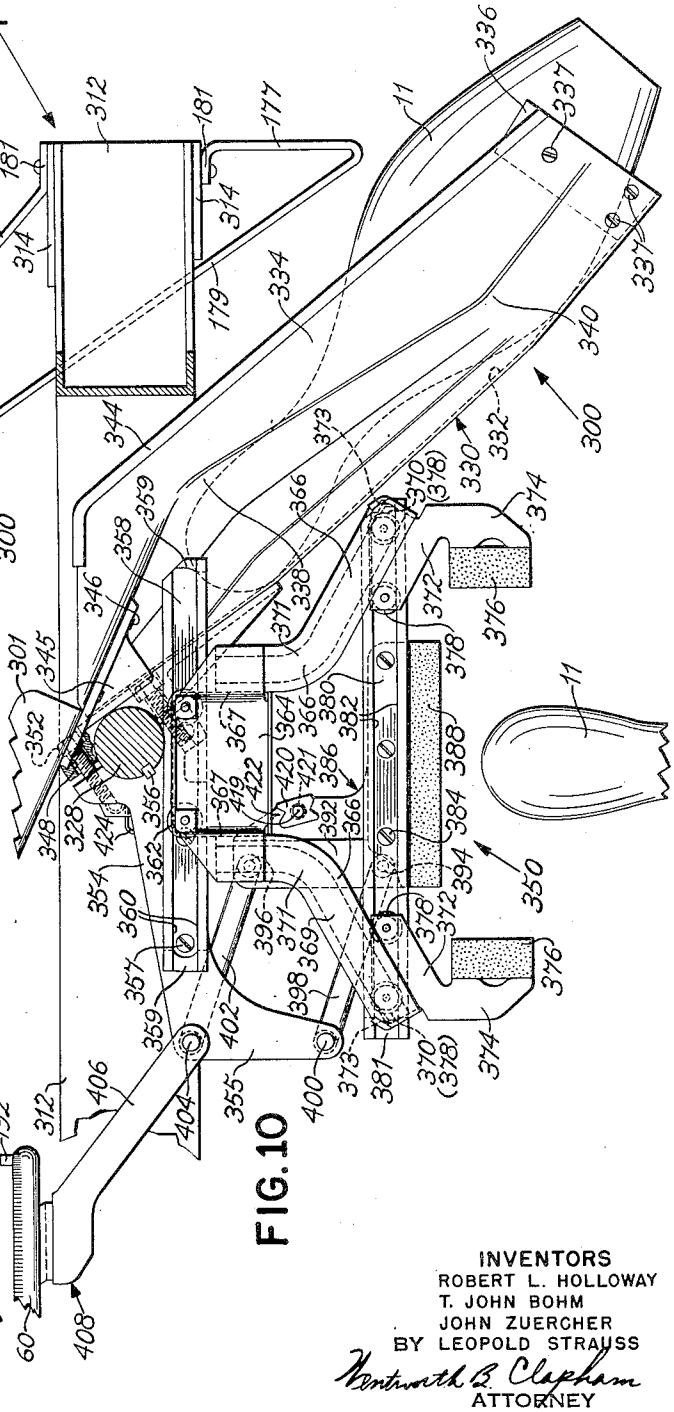


FIG. 10

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BOWLING PIN SPOTTING AND RESPOTTING MECHANISM

Filed Aug. 18, 1950

7 Sheets-Sheet 6

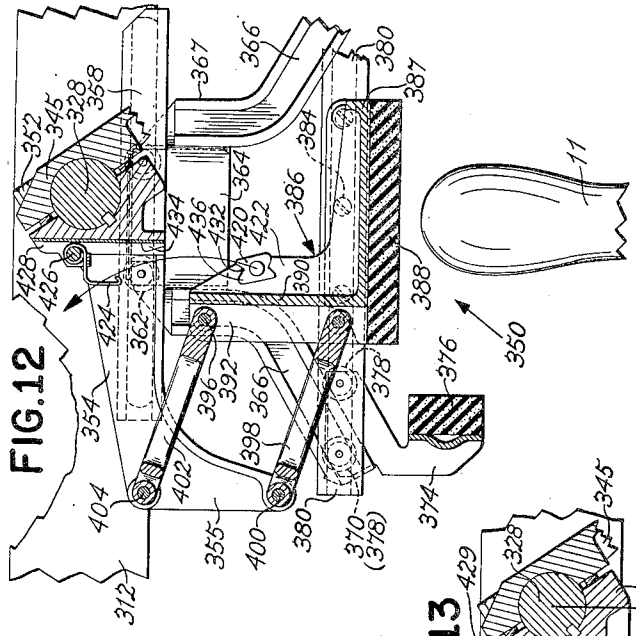


FIG. 12

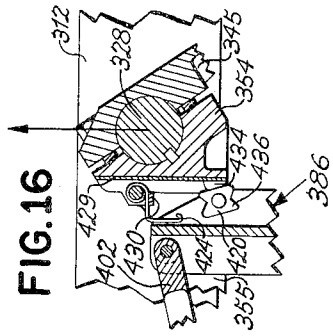


FIG. 16

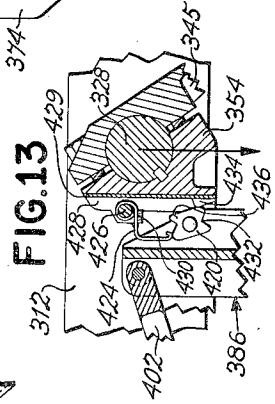


FIG. 13

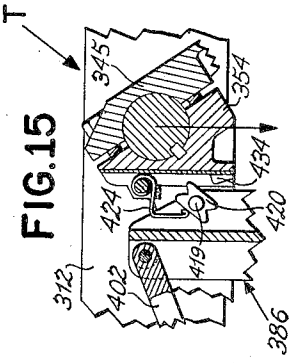


FIG. 15

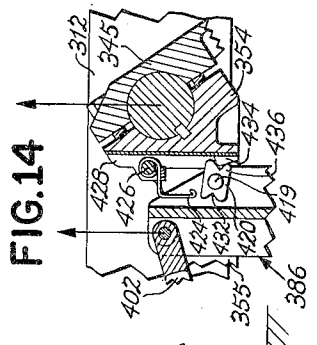


FIG. 14

FIG. 11

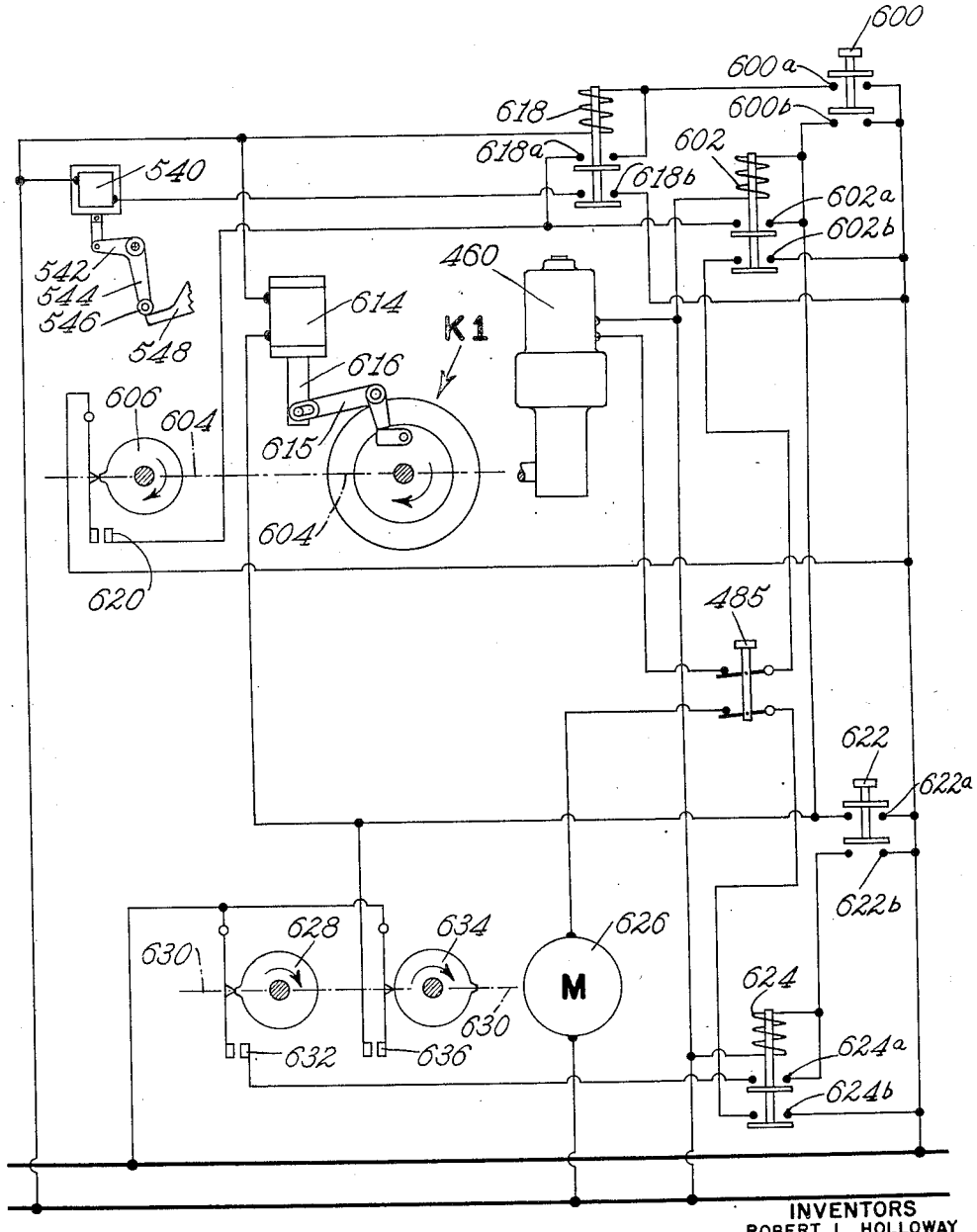
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BOWLING PIN SPOTTING AND RESPOTTING MECHANISM

Filed Aug. 18, 1950 7 Sheets-Sheet 7

FIG. 17



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United States Patent Office 2,781,195 Patented Feb. 12, 1957

2,781,195

BOWLING PIN SPOTTING AND RESPOTTING MECHANISM

Robert L. Holloway, Snyder, and Toivo John Bohm, John Zuercher, and Leopold Strauss, Buffalo, N. Y., assignors to American Machine & Foundry Company, a corporation of New Jersey

Application August 18, 1950, Serial No. 180,174

32 Claims. (Cl. 273—43)

This invention relates to bowling pin spotting machines, and more particularly to improvements in mechanisms for spotting and respotting bowling pins on the playing bed of a bowling alley, and means for rapidly effecting the delivery of bowling pins to the spotting mechanism without interrupting the movement of the latter relative to the bed of the bowling alley with which the machine is associated.

In bowling pin spotting machines, and especially in automatic bowling pin spotting machines, there are always present problems affecting the delivery of bowling pins from the pit of a bowling alley with which a pin spotting machine is associated, and distribution of the pins to a pin spotter operative to place pins in a predetermined playing arrangement upon the playing bed of a bowling alley. Many attempts have been made in the past to solve these problems, and means have been provided for automatically setting pins on the playing bed of a bowling alley. In such devices, complicated structure has been employed which resulted in an extremely heavy structure embodying pin spotting devices and pin respotting devices of such a nature that parts thereof are relatively inaccessible, and make repairs and adjustments both expensive and difficult.

The present invention is directed towards solving the above noted problems. The bowling pin spotting and respotting mechanism, constructed in accordance with the invention, is both simple and easy to operate and involves the use of a minimum number of parts for accomplishing these important purposes. The present invention includes a table or elevator which is movable to and from the playing bed of a bowling alley and which is provided with separate pin spotting units, and pin respotting devices operative to place bowling pins in playing arrangement on the bed of a bowling alley, and after the rolling of the first ball of any frame, if pins remain standing, such pins, whether standing in on or off-spot position on the playing bed of the alley, are automatically gripped, lifted and returned to substantially the same position each occupied before being lifted.

It is an object of the invention to provide an improved pin spotting and respotting mechanism which spots and respots pins accurately upon the bowling bed of a bowling alley.

It is a further object of the invention to provide improved spotting and respotting mechanism including a table which is moved to and from the playing bed of a bowling alley, which table is provided with pin spotting units, adapted to place a predetermined number of bowling pins, usually ten bowling pins, in a desired playing arrangement, such as the conventional triangular pin playing arrangement, and respotting units which respot any standing pins, after the rolling of the first ball of a frame in substantially the exact on or off-spot position each occupied prior to being lifted or respotted.

The invention is also characterized by a novel bowling pin spotting and respotting table movable to and from the

playing bed of a bowling alley, which table is furnished with a plurality of triangularly arranged movable spotting units adapted to place pins in playing arrangement upon the playing deck of a bowling alley and pin actuated respotting units operative in response to the movement of the table towards the bowling alley after the rolling of the first ball of a frame to operate the pin respotting units corresponding to standing pins for gripping such pins for lifting by the table as it moves upwardly away from the alley and which, in response to the replacement of such lifted bowling pins on the alley in their on or off-spot positions, are actuated to release such pins in order that when the table moves upwardly again, these pins remain in their respotted positions on the alley.

It is a further object of the invention to provide a spotting and respotting table which is moved to and from the playing bed of a bowling alley, and wherein the table is located at the same height above the bed both when spotting and respotting pins, thus making it possible to provide a simple harmonic drive for actuating the table.

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 side elevation illustrating a preferred embodiment of the invention;

Figure 2 is a plan view of a part of the mechanism shown in Figure 1;

Figure 3 is a side elevation illustrating a preferred embodiment of the respotter control mechanism;

Figure 4 is a plan view taken on line 4—4 of Figure 3;

Figure 5 is an end elevation taken on line 5—5 of Figure 3;

Figure 6 is a view, partly in section, of a detail of one of the table operating connecting rods;

Figure 7 is a side elevation of one of the spotter units in pin spotting position relative to the playing bed of a bowling alley;

Figure 8 is an end elevation of a spotting unit;

Figure 9 is a plan view of a spotting unit and a respotting unit;

Figure 10 is a side elevation of the same;

Figure 11 is a side elevation of a respotting unit gripping a pin to be lifted for respotting;

Figures 12 to 16 inclusive illustrate successive steps in the locking and unlocking of the grippers of a respotting unit; and

Figure 17 illustrates a suitable wiring diagram for operating the spotting-respotting table.

In the mechanism shown in Figure 1, a device for lifting pins from the pit of a bowling alley can be of similar construction and operation to that disclosed in co-pending application Serial Number 150,232, filed March 17, 1950, for Bowling Pin Elevating Mechanism by Robert L. Holloway and John Zuercher. Bowling pins lifted from the pit of a bowling alley are distributed by a distributing device of a type similar to that disclosed in co-pending application Serial Number 178,777 for Pin Handling Mechanism for Bowling Pin Spotting Machines filed August 11, 1950, by John Zuercher. If desired, however, the bowling pin spotting and respotting mechanism, which forms a part of the present invention, may be used with other types of bowling pin spotting machines with which it is adaptable. Therefore, it is not to be considered that the bowling pin spotting and respotting mechanism of the present application is limited

in use to the devices shown in the above referred to co-pending applications.

Referring to the drawings, Figure 1 illustrates a preferred embodiment of the invention. Pins 11 are spotted and respotted on the playing bed A of a bowling alley. Bowling pins 11 which are knocked down by a ball or by other pins, or which are removed from bed A by suitable means (not shown), fall into pit P upon the upper lap of conveyor 15, preferably continuously driven, which delivers them to a guide chute 17 extending transversely of the pit. Guide chute 17 directs the pins into a pin elevating mechanism, such as a rotary disc or drum designated generally 19.

The bowling pin elevating mechanism can be similar in construction and operation to that disclosed in co-pending application Serial Number 150,232. Disc 19 is mounted for rotation on a horizontal shaft 21 having one end journalled in a bearing 23 attached to a channel member 25 suitably secured to a cross frame member 27 extending transversely across the pit and bolted or otherwise suitably secured to the top of kickbacks 29. The other end of shaft 21 is journalled in a bearing 31 suitably secured to frame member 33. Disc 19 preferably is rotated continuously at a desired rate of speed by means of a pulley 35 secured thereto. Pulley 35 is driven by a belt 37 from a driving pulley (not shown) driven from a motor or other suitable source of power (not shown) at a desired rate of speed, in a manner similar to that described in co-pending application Serial Number 150,232.

Disc 19 is provided with a plurality of equally spaced pockets (not shown) into which pins are directed by chute 17, and wherein pins are retained by gripping rods (not shown) acuated by a cam (not shown) in such manner that each pin, seated and held in a pocket, is elevated from a position adjacent the delivery edge of chute 17 to a point substantially directly above, where it is released and falls free from its respective pocket into a pin receiving and orienting chute 182 of the distributing mechanism on the distributor, designated generally D. Bowling pins, discharged from pit P of the bowling alley in the manner described hereinabove and elevated by pin elevating mechanism 19, are delivered one by one by distributor D into pin spotting units or receptacles 300 carried by table T. The latter also is provided with respotting devices associated therewith and designated generally 350 adapted to respot bowling pins in on or off-spot playing arrangement on bed A of a bowling alley. Table T is mounted for movement to and from playing bed A of a bowling alley for spotting and respotting bowling pins thereon. Distributor D may be substantially the same in construction and operation as that shown and described in the above referred to co-pending Zuercher application Serial Number 178,777.

Referring to Figures 1 and 2, pin distributor D consists of a pair of U-shaped pin guide chutes 12 and 14, slidably arranged in a telescopic manner in order to provide a guide chute which can be automatically extended or retracted in order to deliver bowling pins one by one to the several pockets 300 of table T. Guide chute 12 at one end is secured to a pair of spaced brackets 16, one of which is shown in Figure 1. Each bracket 16 is provided with an extending hub rotatably supported in a bearing of frame bracket 22. Frame bracket 22 is provided with a stud 26 which engages with a vertical bearing bracket 28, the upper face of which also supports frame bracket 22. Bearing bracket 28 is secured to a horizontal cross frame member 30.

The other end of chute or guide channel 12 is secured to the upper portion of a U-shaped member 32, the lower portion of which is provided with a pair of hubs 34, one on each side of chute 12, although only one arm of member 32 and one hub 34 are shown in Figure 1. Secured in each hub 34 is an end of a rod 36, the other end of which is connected to a lug 20 forming an integral part of bracket 16. To the inner side of each arm of U-shaped member 32 is pivotally mounted a roller (not shown), each roller contacting and rolling on the top edge of a horizontal rod 42, the rods having one end attached to a vertical bracket 44 and the other end provided with a lug 46 (Figure 2) pivotally supported by a horizontal shaft 48. Also carried by member 32 are rollers 40 which contact and roll along the side edges of rods 42. Rods 42 are also connected to each other by means of a pair of tie rods (not shown) which maintain rods 42 parallel to each other and also provide a support for pin guide channel 14 which is secured thereto. To the inner side of each vertical bracket 44 is pivotally attached a guide roller (not shown) which engages with and is adapted to roll on the top edge of one of the rods 36, thereby providing a rolling support for rods 42 and consequently for pin guide channel 14 relative to rods 36. Each bracket 44 is also provided with a guide roller 39 which engages a side of its respective rod 36 and provides proper guide means for each bracket 44 as it moves along its respective rod 36.

The front or pin delivery end of pin distributor D is supported and guided by means of a beveled disc 56 and a guide roller (not shown) both of which engage and run on and along a horizontal track 60 suitably attached to the top of pin spotting and respotting table T. Beveled disc 56 is keyed to a vertical stud 62 rotatably supported in a suitable hub of a bearing member 66 mounted on the front end of distributor D. Stud 62 forms an integral part of a gear (not shown), driven by suitable gearing and clutch mechanism (not shown) to drive beveled disc 56 along track 60 at the proper time for effecting the extension or retraction of parts 12 and 14 of distributor D in the delivery of pins to each of the several pockets 300 mounted on table T. Stud 62 is supported in bearing member 66 by suitable swiveled members such that at all times during the operation of distributor D and even when table T is moving up and down, stud 62 is maintained in a vertical position and beveled disc 52 is properly associated with track 60 along which it moves by reason of the engagement of teeth or notches on beveled disc 56 engaging complementary teeth or notches 57 formed on the surface of track 60, as shown in Figure 2.

The mechanism for driving beveled member 56 includes a beveled gear (not shown) loosely mounted on shaft 48 coacting with a clutch (not shown) having its driven part attached to shaft 48, the latter being driven by a pulley 142 attached thereto. Pulley 142 is driven by means of the bowling pin conveyor belt 146 from a pulley 148 mounted on shaft 150 supported in suitable bearings in bracket 22. Shaft 150 is driven by a sprocket (not shown) attached thereto from a motor or other suitable source of power. Belt 146 which conveys pins through distributor D is led from pulley 148 to pulley 142 over the bottom of the U-shaped channel formed by guide chutes 12 and 14, over a tension pulley 166 and a guide pulley 168. Tension pulley 166 is freely mounted and floatingly supported by means of a stud 170 and a pair of springs 172 anchored to suitable pins 174 on brackets 44. Guide pulley 168 is rotatably supported on a stud 176, the ends of which are supported by the arms of U-shaped member 32.

Each bowling pin elevated by disc 19 when released therefrom drops into a receiving chute 182 mounted in pin receiving position relative to disc 19 and is oriented and guided thereby onto pin conveyor belt 146, where each pin is delivered butt end forwardly through chutes 12 and 14 for discharge therefrom into one of the pin spotting units 300.

An inclined guide plate 188 suitably attached to front bearing member 66, and two spaced guide members 190 attached to the front end of the side walls of U-shaped guide chute 14, insure the proper discharge of each pin into a unit 300.

As illustrated in Figure 2, pin spotter units **300** on table T are arranged in a substantially triangular pattern conforming to the positions pins occupy on bed A of the alley. Horizontal cam track **60**, mounted on table T, which guides and controls the movement of distributor D to and from all spotter units **300**, is of a heart-shaped design, Figure 2, and is provided with a number of pin stops **192** for stopping the movement of the distributor in proper discharge relationship relative to the several pin spotter units **300**. Since the starting and stopping of the distributor movement do not constitute a specific part of the invention, further description thereof is omitted in the interest of brevity. It is therefore deemed sufficient to state that after the delivery of a bowling pin to a spotter unit **300**, the drive of beveled member **56** is started and the distributor moves to the next empty unit **300** for the delivery of a pin thereto.

As bowling pins are being moved by belt **146** forwardly for discharge from distributor D into pin spotter units **300**, each pin engages a trip, such as a disc **120**, mounted on a shaft **121** connected to clutch operating means (not shown) which sets into operation the movement of distributor D along cam track **60**. As mentioned hereinabove, distributor D, while moving on heart-shaped track **60**, through the mechanism described, causes guide chutes **12** and **14** to move together or separate in a manner similar to the operation of the parts of a slide trombone. Pin guide chute **14** telescopes inwardly and outwardly beneath chute **12**. The mounting of pulleys **148**, **142**, **166** and **168** provides an automatic take-up and tensioning means for belt **146** and assures its proper operation regardless of the positions of guide chutes **12** and **14** when belt **146** is effecting the discharge of a pin into a selected spotting unit **300**.

Since distributor D, as stated, is designed to deliver pins to the several pinspotter units **300** not only when table T is stationary but also during its ascending and descending movements, there is provided a parallelogram designated generally **282** for maintaining that part of the distributor which supports beveled member **56** at the front or delivery end of the distributor in a horizontal position in order that beveled member **56** and its co-acting roller (not shown) may always be disposed properly relative to track **60**. Parallelogram **282** includes a pair of rods **284** pivoted to a horizontal stationary arm **286** which projects from and is mounted on frame bracket **22**. The other pair of rods **288** is pivoted to a vertical member **290** which forms an integral part of the front bearing member **66**. Both pairs of rods **284** and **288** are pivotally connected to a bell-crank lever **292**.

In the illustrated embodiment, table T consists of a generally triangular frame designated **311**. This frame is formed of side frame members **312** arranged to form what may be termed the sides of the triangle. The ends of members **312**, which converge and form the apex of frame **311**, are rigidly secured together, as by welding, by a plate **314**. The other ends of members **312** are secured rigidly to brackets **316** provided with spaced antifriction bearings in brackets **318** supporting the ends of a transverse rock shaft **320**, the latter forming the base of the triangle of frame **311**. Side members **312** and shaft **320** thus form a beam truss providing a light, rigid frame substantially resistant to any twisting or bending forces which might occur in the operation of the machine. Side frame members **312** are also provided with lugs **322** having bearings in which are mounted the ends of transverse rock shafts **324**, **326** and **328** which are parallel with rock shaft **320** and spaced apart equal distances one from the other.

As clearly shown in Figure 2, ten spotting units **300** are provided. These units are mounted on table T in triangular arrangement and are operated in such manner as to spot or place ten bowling pins in spotted playing arrangement on alley bed A. Obviously if desired, a different number of units **300** and a different arrangement on table T could be used. The arrangement shown conforms with approved rules of play.

Pin spotting units **300**, adapted to hold and spot bowling pins Numbers 7, 8, 9 and 10 corresponding spots on alley bed A are carried by rock shaft **320**. Shaft **324** carries spotting units **300** adapted to hold and spot Number 4, 5 and 6 pins in corresponding spots 4, 5 and 6 on alley bed A. Receptacles **300** for holding and spotting Number 2 and 3 pins on corresponding spots 2 and 3 on alley bed A are carried by shaft **326**. Shaft **328** supports spotting unit **300** which holds and spots pin Number 1 in its conventional spotted position on alley bed A.

As indicated in Figures 1, 2, 9, 10 and 11, adjacent each pin spotting unit **300** is located a guide which assists in the proper disposition of each pin in its respective unit **300**. Referring to Figure 2, it will be seen that spotting units, corresponding to pins #7 and #10, are provided with curved guides **171** mounted on lugs **173** on brackets **316**. These upstanding guides **171** insure that a pin ejected by belt **146** will be directed downwardly into pin spotting units **300** which hold pins which will be spotted in #7 and #10 positions on alley bed A. Mounted on shafts **324**, **326** and **328**, are downwardly inclined pin holding members **175** which act both as guides and means for resiliently holding bowling pins in trough members **330** of pin spotting units **300** corresponding to pins which are to be spotted in positions Numbers 2 to 10 inclusive on alley bed A. Each member **175** is provided with a bent tail portion which presses resiliently against the tapered portion of a pin resting in a trough **330** with which a member **175** is associated. Pinspotting unit **300**, which supports and spots pin #1, is provided with a pin guide member **177** having an inclined elongated guide portion **179** extending both below and above frame **311** of table T, and provided with end portions **181** suitably attached to brackets **314** secured to frame members **312**. Attached to brackets **345** of spotting units **300** corresponding to No. 1 and No. 5 pins, are bridge plates **301** and **299**, respectively. These plates bridge the distance from the station points #1 and #5 on cam track **60** and thereby facilitate the passage of pins from distributor D to the spotters indicated.

Since each of the several spotting units **300** is essentially the same in construction, it is deemed necessary to describe only one in detail. Referring to Figures 1, 2, 7, 8, 9 and 10, a typical spotting unit **300** includes an elongated, generally U-shaped trough like member or receptacle designated **330** which is greater in length than the length of a pin held therein for spotting. Receptacle **330** can be formed of sheet metal, wood, plastic, stiffened impregnated, or plastic coated fabric or combinations of such materials, or the like. Receptacle **330** may be formed in a single piece as illustrated in the above referred to figures, or may be made up of a plurality of parts, into a rigid structure which supports and spots a pin delivered thereinto in accurate playing arrangement on bowling alley bed A. A bowling pin **11** delivered from distributor D into a spotting unit **300** moves or slides along the bottom **332** of trough-like member **330** which is shaped to conform generally with the contour of a pin, and comes to rest thereon between spaced side walls **334** extending upwardly from bottom **332** with the tapered sides of the pin below its belly portion or section of maximum diameter resting upon and supported by a half ring support **336** suitably attached to bottom **332** and to the inner faces of walls **334** as by screws **337**. Side walls **334**, as shown in Figures 7, 9 and 10, preferably are shaped to act as guides for a pin delivered to a unit **300**, and also to provide reinforcing and pin positioning shoulders **338**, **340**, such that a pin held in a unit **300**, see Figures 9 and 10, has its belly portion located between shoulders **340** and its head and neck portion between shoulders **338**. Walls **334** also preferably are formed with flanges **342** and a stiffening bead **344** formed integrally with or attached thereto in any suitable manner. In this way, a through-like member or receptacle **330** may be formed of relatively thin mate-

rial and have sufficient rigidity to withstand hard usage, and accurate spotting of pins thereby is assured.

As indicated in Figures 1 and 10, the trough-like member or receptacle 330 of each spotting unit 300 is carried by table T with its longitudinal axis inclined with the horizontal when in its normal pin receiving and holding position. When bowling pins are to be spotted on alley A, each spotting unit 300 of the plurality of units carried by table T, is swung clockwise, as viewed in Figure 1, to the position shown by a single unit 300 illustrated in Figure 7. After the spotting units 300 have been swung to the position indicated in full lines in Figure 7 and as table T moves downwardly to place the bases of pins held therein on alley bed A, further downward movement of table T causes half ring support 336 to move downwardly away from pin 11 in the direction of arrow E, whereupon each pin 11 assumes an upright position on alley bed A, as shown in dotted lines in Figure 7. Spotting units 300 are then swung rearwardly to locate half ring supports 336 clear of all standing pins, and table T rises, leaving a new set of pins on alley bed A.

The upper end of each trough-like member or receptacle 330 is attached to a support bracket 345, as by rivets 346. Bracket 345 is provided with holes 348 through which extend bolts 352 threaded into support bracket 354 of a respotting device 350, one of which devices 350 is associated with each spotter unit 300. When bolts 352 are tightened in bracket 354, brackets 345 and 354 are securely clamped to their respective support shafts 320, 324, 326, and 328 and the sets of spotting units 300 and respotting devices 350 are held thereby clamped on table T.

A key 356 inserted in keyways formed in transverse shafts 320, 324, 326 and 328 and in support brackets 354 of each respotting device 350 insures the proper lateral positioning of each set of spotting units 300 and respotting devices 350 on table T. Holes 348 in bracket 345 are somewhat greater in diameter than the diameter of a bolt 352 which allows a limited amount of adjustment of receptacles 330. This adjustment can be made by selective tightening of bolts 352 to secure the desired final adjusted position of spotting devices 300. It will be evident that by merely unscrewing bolts 352, an entire cell can easily be removed for adjustment or repairs, or replaced by a new cell without disturbing the remainder of the table system.

Since there are ten triangularly arranged respotting devices shown in the embodiment of the invention selected for purposes of illustration, and each device 350 is identical in construction and operation, it is deemed sufficient to describe but one in detail. Referring to Figures 1, 2 and 7 to 16 inclusive, each bracket 354 which supports a respotting device 350, is formed with two spaced arms 355. The outer face of each arm 355 is provided with bosses 353 to which are attached, as by screws 357, a horizontal guide track 358 provided with guide rails 360, on which run rollers 362 rotatably mounted in spaced relation at the top of a gripper jaw cam carriage 364. In the illustrated embodiment, each cam carriage 364 is provided with a pair of spaced guide or cam tracks 366 formed integrally therewith and located along the side vertical edges of carriage 364. A roller 370 pivotally mounted on each upwardly extending arm 372 formed integrally with the transverse pin gripper jaw or clamping bar 374, engages with and runs upon each track 366. As indicated in Figure 8, clamping bar 374 is provided with two arms 372 formed integrally therewith at its ends.

Each respotting device 350 is provided with two opposed, independently movable elongated pin gripping jaws or clamping bars 374. Each arm 372 also mounts a roller 378 adapted to roll on an elongated guide member 380 mounted for parallel movement relative to horizontal guide tracks 358. Each guide member 380 is provided with rails 382 on which rollers 378 run. The axes of the pivots of rollers 370 and 378 lie in the same horizontal line, such that at all times during the movement of rollers 370 and 378 on guide tracks 366 and rails 382, respectively, pin gripping jaws or clamping bars 374 are maintained substantially parallel with the surface of alley bed A. Each pin gripping jaw or clamping bar 374 preferably is provided with a resilient gripping surface 376, such as sponge-rubber, felt, or other suitable resilient material in order to prevent damage to a pin when gripped thereby. In the embodiment illustrated, sponge rubber is used.

As shown in detail in Figures 10, 11 and 12, each cam track 366 on cam carriages 364 is provided with an upper generally straight portion 367 and a lower outwardly diverging straight portion 369 connected by a curved portion 371. The lower end of each cam track 366 is provided with a stop plate 373 preferably formed integrally therewith. Plates 373 prevent rollers 370 from running off rails 366. End plates 381 preferably formed integrally with guide member 380 prevent rollers 378 from running off rails 382. Plates 359 formed integrally with tracks 358 prevent rollers 362 from running off rails 360 of tracks 358. The design of cam tracks 366 is such that when gripping jaws 374 are in inoperative position, they are held apart, as shown in Figures 10 and 12. When, however, table T is moved downwardly and standing pins are to be lifted, each jaw 374 of a respotting device 350, which is operated, is moved, as described hereinafter, into gripping engagement with such pins, and held by upper portion 367 of cam tracks 366 in such engagement until a pin held thereby is respotted.

As shown in Figures 8, 9, 10, 11 and 12, each pair of opposed elongated gripping jaws 374 is adapted to grip for lifting and respotting standing bowling pins which are not only in on-spot position, but which have also walked or moved off-spot a substantial distance.

Each respotting device 350 includes a block member designated generally 386 which is pivotally linked to bracket 354 for substantially vertical movement. When gripping jaws 374 of a respotting device 350 are located in spaced or inoperative position, as shown in Figures 10 and 12, block 386 is located in its lower position for a purpose to be described hereinafter. Block member 386 is provided with a pin contacting or clamping portion having a flat under-surface 387 which serves to engage and clamp standing pins firmly upon the playing bed A of a bowling alley when such pins are to be gripped by elongated gripping jaws or clamping members 374 for lifting and respotting. The width of the flat undersurface of block member 386 is substantially the same as that of the gripping jaws 374, and as indicated in Figures 8 and 10, this width is such as to provide a wide contact clamping area relative to the head of a bowling pin standing on or off-spot on a bowling alley. This arrangement is such that when all ten respotting devices 350 are taken into consideration, bowling pins which have walked or have been moved off spot a substantial distance, will be gripped, lifted and respotted on their off-spot positions. In this manner, the positions of standing pins to be lifted may be laterally or longitudinally offset with respect to the normal or spotted position each pin occupies and each pin will be properly returned to substantially the exact position it occupied prior to being lifted. As described more in detail hereinafter, block member 386 also serves the dual purpose of locking gripping jaws 374 in pin gripping position, and effecting the release of the jaws for the delivery of pins held thereby when respotting the same in on or off-spot position on alley bed A.

When table T is lowered after the rolling of a first ball of a frame, and standing pins remain thereon for lifting and respotting, each such standing pin will be clamped firmly by a pad 388 even attached to the flat undersurface 387 of block 386. Pad 388 may be made of any suitable resilient material, such as sponge rubber, felt, or the like. In the illustrated embodiment, it is formed of sponge rubber. This allows each pin gripped by clamping jaws 374 to be held thereby between pads 376 with the top of the pin pressing against pad 388 on block 386

during the lifting operation of each pin and while it is being respotted on alley bed A. Block **386** is provided with an upwardly extending channel shaft projection **390** having spaced arms supporting vertically spaced pivot pins **394** and **396**. Pivotally attached to pivot pin **394** is a link **398** having its other end pivotally mounted on pin **400** in arms **355** of bracket **354**. Pivotally connected to pivot pin **396** is a link **402** which is parallel with link **398**. The other end of link **402** is pivotally connected to a horizontal pin **404** mounted in arms **355**, which pin is also connected to spaced arms **406** of a bracket **408** to which is secured track **60** on which runs the displacing mechanism of distributor D.

When table T is lowered by the operation of the table operating mechanism, described hereinafter, the downward movement causes pad **388** on the flat under-surface of block member **386** to engage with the upper ends of any standing pins which remain standing on alley bed A. This engagement stops the descent of each block member **386** engaging a standing pin through downward movement of table T while the latter continues its downward movement. If a bowling pin, or pins, below a respotting device **350** is or are lying on the alley, as shown in Figure 1, the operational position of such respotting device remains unchanged and undisturbed. However, if one or more of the pads **388** on under-surface **387** of a block **386** of a respotting device **350** contacts the head of a bowling pin in registration therewith regardless of the fact that it may be on or off-spot during the descent of table T, star cam **420** rotatably mounted on a pin **419** in a vertical flange **422** is engaged by an actuating finger **424** supported on a stud **426** extending from one of the flanges **428** of a channel member **429** attached to bracket **354**. Actuating finger **424**, as shown in detail in Figures 12–16 inclusive, may consist of a flat spring metal strip, such as steel, supported on pin **426** and held against excess downward movement by means of an abutment **430** formed integrally with one of the flanges **428**. In this manner, when upright pressure, due to the presence of a standing pin **11**, raises block **386** of the respotting device corresponding to the standing pin to its maximum normal vertical limit, finger **424** comes into engagement with star wheel or cam **420**, see Figure 13, and turns the wheel during the relative upward movement of block member **386** and downward movement of bracket **354** such that one of the two notches **432** is engaged by a cam lug **434** attached to or formed integrally with channel member **429**. A suitable friction or spring washer **421** on pin **419** holds star wheel or cam **420** against turning unless and until it is engaged by finger **424** or lug **434**. As shown in Figure 14, when a notch **432** on star wheel or cam **420** is in engagement with cam lug **434**, block **386** is locked against downward vertical movement relative to table T, and more specifically bracket **354**. The same locking relationship obtains in all respotting devices **350** which are positioned above standing pins.

As shown in Figures 9, 10, 11 and 12, an elongated guide bar **380** is secured, as by screws **384**, in substantially horizontal position to the opposite ends of transverse block members **386**. Each guide member **380** is provided with stops **381** at its ends to prevent rollers **378** from running off the tracks **382** formed thereon. During the downward movement of table T, described above, and the clamping of any standing pins by pads **388** attached to the under surface of blocks **386** as described above, there will be caused an inward movement of each of the opposed grippers **374** on each respotting device **350**. The inward movement of each pair of grippers begins as soon as a pin standing in on or off-spot position is engaged by a pad **388** of its respective spotting device. The downward movement of table T, which brings pads **388** in contact with the head ends of standing pins, causes the arrest of block **386** while table T continues its downward movement, resulting in the movement of cam rollers **370** along track portion **369** of cams **366** and a horizontal movement of rollers **378** of each gripper jaw **374** along horizontal tracks **380**, thereby causing rollers **370** to travel around curved portion **371** and finally move into vertically positioned portion **367** of cam tracks **366**, this taking place at approximately the time notch **432** of cam wheel **420** engages cam lug **434**. This operation results therefore not only in the locking of block **386** against downward movement, but also in the positive locking together of each pair of opposed gripping jaws **374** of a respotting device surrounding a standing pin.

In the description given directly above, the operation of the several respotting devices **350** has been stated according to the manipulation of the parts relative to on-spot pins to be gripped, lifted and respotted. In the event that a pin has walked off-spot either laterally or longitudinally, reference is made to Figure 10. If, for example, a pin has moved to the left of the position indicated in Figure 10, it is obvious that the left hand gripper **374** would be the first to engage the side of the neck portion of the pin. Therefore, although there would be continued downward movement of table T and relative upward movement of block **386**, movement of left hand gripping jaw **374** would cease, since the pin is held firmly upon alley bed A by pad **388** attached to under-surface **387** of block **386**. Notwithstanding this operation, however, the right hand gripper **374** would continue to move towards the right hand side of the neck of pin **11** until it engaged the same and coacted with left-hand gripper **374** to firmly grip the opposite sides of the head of pin **11**. This operation is made possible by the construction and operation of carriages **364** on which are mounted cam tracks **366** because when the movement of one gripper jaw is arrested because of its engagement with the side of a pin, carriage **364** shifts on rollers **362** which roll along tracks **360** and re-center gripper jaws **374** with respect to the longitudinal axis of a pin. In this manner, it is evident that whenever a pin is off-spot and is to be lifted, each set of cam carriages **364** of a respotting device **350** automatically re-centers the pair of gripping jaws **374** associated therewith for properly gripping pins for lifting and respotting in their exact off-spot positions.

Following the gripping of each standing pin, table T is raised, whereby the several actuated respotting devices lift the on or off-spot pins above alley bed A from which deadwood is removed by any suitable means (not shown). Table T is again lowered for respotting pins lifted thereby into proper respotted position on alley bed A. As soon as the butt ends of each pin engage alley bed A, continued downward movement of table T causes cam lug **434** to be moved out of its engagement with notch **432**, and finger **424** presses against one of two tails **436** on cam or star wheel **420**, turning it to the position shown in Figure 15. This effects the release of all respotted pins from the sets of gripping jaws **374** of the several respotting devices which were operated. As table T returns upwardly in the direction of the arrow shown in Figure 16, block **386** moves to the position shown in Figure 10, and relative separation between bracket **354** and tracks **358** carried thereby and tracks **380** carried by block **386**, effects the spreading apart of the gripping jaws **374** to the positions indicated in Figure 10. The downward movement of block **386** and the upward movement of bracket **354** as the result of upward movement of table T to its dwell position above alley bed A, cause cam lug **434** to engage a side of one of the tails **436** on cam wheel **420**. This repositions and readys cam wheel **420**, as shown in Figure 16, for the next locking operation of gripping jaws **374** as the result of the upward movement of block **386** when upon the next downward movement of table T, block **386** is engaged by the head end of a standing pin to be lifted and respotted.

Attached to or formed integrally with each bracket

316 is an elongated vertical extension 438, to each of which are pivotally connected upper and lower radius arms 440, 442 respectively, which maintain table T in a substantially horizontal plane at all times, both during its movement to and from alley bed A, and when table T dwells above alley bed A. Extensions 438 preferably are formed from tubular metal stock for strength and also because of their lightness as compared with solid metal. Radius arms 440, 442 are also pivotally connected to supports 444 attached to cross frame member 27. Also pivotally connected to brackets 316 in any suitable manner are stabilizing arms 446, the latter being pivotally joined to brackets attached to cross frame member 27. Stabilizing arms 446 prevent side sway of table T. Springs 447 each having one end attached to extension 438 and the other end attached to a bracket 451 on a support 444, balance the weight of table T and assist in assuring its smooth movement to and from alley bed A. As shown in Figures 1 and 2, radius arms 440 and 442, and arms 446 are provided at their ends with adjustable connections. This arrangement provides means for adjusting the position of table T longitudinally, and/or laterally, and also for leveling it. These adjustments, together with the adjustable supports of spotter units 300, and respotter devices 350, make it possible to obtain great accuracy in spotting and respotting pins on bed A.

Table T is supported above playing bed A of a bowling alley, as indicated in Figure 1, for movement to and from the alley bed for spotting and respotting pins thereon by a frame including spaced side frames 450 mounted on kickbacks 29 of the bowling alley. Each side frame is formed of two uprights 452 and a longitudinal frame member 454. The side frames are connected together by cross members 456, 457. Attached to members 454 are transverse strips 458 on which is mounted motor 460 which is responsible for the movement of table T to and from alley bed A. Motor 460 has operationally associated therewith a conventional gear reduction mechanism enclosed in housing 462, which mechanism through a conventional type one-revolution clutch K1, drives a shaft 604 at a desired rate of speed. The operation of clutch K1 and a cam 606, Figures 5 and 17, secured to shaft 604 will be described in detail hereinafter. Also secured to shaft 604 is a sprocket 608, Figure 5, tracking a chain 610 which drives, at a one to one ratio, a sprocket 612 secured to shaft 464. Attached to each end of shaft 464 is a crank arm 466, each crank arm mounting in its free end a stud shaft 468 to which is pivotally attached an eye 470 having formed integrally therewith a threaded rod portion 472 threadably secured in a connecting rod or table supporting rod 474, which rod at its lower end, see Figure 1, has threadably secured thereto an eye 476 mounted for free movement on the end of shaft 324. When, therefore, motor 460 is set into operation and shaft 464 is rotated, crank arms 466 will cause table T to be lowered and raised with respect to alley bed A for spotting and respotting pins thereon. This mechanism allows the spotting and respotting operations of table T to be effected at the same height above bed A, and permits the use of the simple harmonic drive described.

Referring to Figures 1, 3, 4 and 5, loosely mounted upon and adjacent one end of shaft 464 is a sprocket 478 having formed integrally therewith, or suitably attached thereto, a hub 480 provided with upstanding lugs 482 supporting a pivot pin 484 to which is pivotally connected one end of a link 486, the other end of link 486 being pivotally connected by a pin 488 in a fork formed in lever 490 keyed to a stud shaft 492 mounted in a bearing bracket 494 secured to the underside of one of the longitudinal side frame members 454. Sprocket 478 is tracked by a sprocket chain 496 running on a sprocket 498 fixed to shaft 468. Also attached to shaft 468 is a crank arm 500 provided with a fork supporting a pin 502 on which is pivoted a connecting rod 504, the other end of which is connected to a pin 505 in an arm 506 of a bell crank lever 508 secured adjacent one end of shaft 324. This bell crank lever is also provided with an arm 510 to which is connected a link 512 connected in turn to a lever 514 attached to shaft 320. Adjacent the other end of shaft 324 is a bell crank 509, similar in construction to bell crank 508, having an arm 511 to which is connected one end of a link 513, the other end of which is attached to a lever 514 secured to shaft 320. Also attached to shaft 324 are levers 516, to each of which is connected a link 518, these links being connected to levers 520 attached to shaft 326. Attached to shaft 326 are levers 522 having pivotally connected to their free ends links 524, which in turn are connected to levers 526 secured to shaft 328. The link and lever construction just described, provides for the simultaneous movement of each of the ten spotting units 300 from pin holding position indicated in Figures 1, 9 and 10, to pin spotting position indicated in Figure 7.

Springs 523 perform the function of balancing the weight of the several pin spotting units 300 and also assist in returning them to their pin receiving and holding positions after the spotting of a set of pins thereby on alley bed A. Also during the actual spotting operation, springs 523 are instrumental in effecting the release movement of spotting units 300, as shown in dotted lines in Figure 7.

One of the springs 528 has an end attached to pivot pin 505, the other end being attached to a bracket 530 secured to a bracket 316. The other spring 528, shown at the top of Figure 2, has one end secured to a pin 532 carried by arm 507 of lever 509, the other end of the spring being attached to a bracket 530 also attached to a bracket 316.

When bowling pins are to be spotted on bowling alley bed A, solenoid 540, mounted on a bracket 541 attached to cross frame 457, is energized. This causes the upward movement of the armature of solenoid 540 and rocks bell crank lever 542 to which the armature is attached on shaft 543 mounted in bracket 541 swinging arm 544 on lever 542 to the left, as shown in dotted lines in Figure 3, disengaging cam follower 546 on arm 544 from latching engagement with a cam surface formed on lock arm 548 of lock lever 550, the latter being keyed to shaft 492. An adjustable set screw 549 mounted in bracket 541 is provided in order to properly position cam follower 546 on lock arm 548. Lock lever 550 is provided with an adjustable pin 552 adapted to engage a lateral projection or extension 554 on cam lever 556 loosely mounted on shaft 492. Cam lever 556 is provided with a cam follower 558 tracking a cam 560 attached to shaft 464.

A spring 562 having one end attached to pin 488 and its other end suitably attached to a bracket 564 attached to a side frame member 454 tends to pull lever 490 to the right, as viewed in Figure 3, whereby whenever solenoid 540 is energized, pin 552 is held pressed against projection 554, and cam follower 558 on lever 556 is held resiliently against the surface of cam 560. It will be seen, therefore, that when solenoid 540 is energized, cam follower 558 is moved into engagement with cam 560 due to the pressure exerted thereon by spring 562. The movement of cam 560 with respect to cam follower 558 and the linkage and leverage described hereinabove, results in sprocket 478 being rotated in the direction of the arrow shown in Figure 3, which results in the rocking of crank arms 500, thereby effecting a turning of shafts 320, 324, 326 and 328, which when table T is located in position II, as indicated in Figure 1, results in the delivery of ten pins in spotted arrangement on alley bed A.

As shown in Figures 1 and 7, when rod 504 is moved downwardly due to the rocking of crank arm 500 and springs 528 move past the dead center of shaft 324,

springs 528 effect the rearward movement of each of the trough members or receptacles 330 away from the base of pins being positioned in spotted arrangement on the alley. This final movement does not take place until after the bases of the pins being spotted are actually on the alley bed A and ring portions 336 have moved from the full line position, shown in Figure 7, to the dotted line position indicated therein, at which time the gap between the ends of each ring is clear of the pin, the latter resting on the alley so that during the further movement of a trough-like member 330 to dotted position indicated in Figure 7, the pin is freed entirely from the receptacle 330 which supported it and placed it in spotted standing position on alley bed A. Following this action, and due to the continued rotating of shaft 464, and the action of cam 560 on cam follower 558, each trough member 330 of a spotting unit 300 is moved substantially vertically upward and then swung back to the pin supporting and holding position indicated in Figure 1.

On very rare occasions during the operation of the machine, it may happen that a bowling pin will "walk" or be moved so far off-spot that it cannot be gripped by gripping jaws 374 and will interfere with the downward travel of table T to position II. In order to prevent damage to the machine, such as breakage of parts, mechanism is provided for stopping the machine.

Referring to Figures 1 and 6, each rod 474 is provided with two telescoping parts, 474, 475. Part 475 carries a bracket 477 in which is fixedly mounted an adjustable rod 479 having its free end extending upwardly through an opening in a plate 481 having a hub attached to rod 474. A spring 483, encircling rod 474 and rod portion 475, bears against bracket 477 and plate 481, normally tending to urge them apart. If for any reason, such as described, downward movement of table T to position II is prevented, due to the telescopic arrangement shown in detail in Figure 6, spring 483 will be compressed and rod 479 will engage switch 485 in a normally closed circuit through the motor 460, breaking the circuit and stopping the machine, thereby preventing further downward movement of table T and preventing damage to the machine and breakage of parts.

Table T is mounted for movement to and from alley bed A after each first ball of a frame is rolled in order to test for the presence or absence of standing pins. If all pins are knocked down by the first ball and a "strike" is made, table T moves up and then down and spots a new set of pins on the alley. If pins remain standing after the first ball of a frame is rolled, and the game of tenpins or kingpins is being played, after lifting and respotting such standing pins in on or off-spot position on alley bed A, table T remains in its dwell position above alley bed A until after the second or last ball of the frame is rolled, and fallen and standing unwanted pins are removed by suitable means (not shown) and ejected into pit P. Table T then is moved downwardly to spot a new set of pins on alley bed A, after which it moves upwardly to its dwell position.

When each of the spotting units 300 is moved to its spotting position, each respotting device 350 is also swung in a clockwise direction, as shown in Figure 7. This operation causes rollers 362 to roll by gravity downwardly along tracks 358 and block 386 to move upwardly towards shaft 328 thereby moving carriages 364 and effecting a relative movement between jaws 374 and carriages 364 such that the left gripper jaw 374, as viewed in Fig. 10, moves towards the right gripper jaw, and gripper jaws 374 are thereby disposed out of centered relationship with respect to block 386. On the return movement of spotting units 300 to pin receiving and supporting position, see Figs. 1 and 10, rollers 362 roll back along tracks 358 because of the downward movement of block 386 away from shaft 328 due to its weight and gravity and the coaction between rollers 370 and cam tracks 366 of carriages 364. While rollers 362 are rolling along tracks 358, as described above, rollers 378 are rolling along tracks 382 on guide members 380 carried by blocks 386. When rollers 370 engage stops 381 at the ends of tracks 380, carriages 364 are recentered, and the gripper jaws are returned to open positions ready to grip pins to be lifted and respotted.

Assuming that each of the ten pin holding receptacles 330 of pin spotting units 300 holds a bowling pin, and table T is in its uppermost position, or position I, indicated by dotted lines in Figure 1, and also that there are no pins on the alley A, a new set of pins may be placed on the alley by the manual operation of push button 600. The closing of contacts 600*b* energizes relay 602 which closes contacts 602*b* and starts motor 460, which through a conventional type one-revolution clutch K1, drives shaft 604. The closing of contacts 600*b* also momentarily energizes solenoid 614 which results in the inward movement of armature 616 and a rocking of lever 615 which activates clutch K1 to connect shaft 604 with motor 460. The closing of contacts 600*a* energizes a relay 618 thereby closing contacts 618*b*, which energizes solenoid 540 and disengages cam follower 546 from lock arm 548 in the manner previously described. As shaft 604 rotates, cam 606, secured thereto, effects the closing of contacts 620 and causes relays 602 and 618 to be held in by their respective contacts 602*a* and 618*a*. Continued rotation of shafts 604 and 464 causes table T to descend to position II, Figure 1, by means previously described, place a set of ten pins on the alley, and then return to its starting position, at which time, clutch K1 disengages shaft 604 from motor 460 and arrests the rotation of shaft 604. At this time cam 606 opens its contacts 620, relays 602 and 618 fall out, motor 460 stops, and solenoid 540 is de-energized.

If, after a bowling ball has been rolled, a strike is made, the deadwood is removed by suitable conventional means, not shown and a new set of pins placed upon the alley in the manner described above.

When a strike is not made, push button 622 is depressed. The closing of its contacts 622*a* energizes relay 602 thereby closing contact 602*b* which makes a circuit through motor 460 thereby starting motor 460. The closing of switch contacts 622*a* also energizes the coil of solenoid 614 which actuates clutch K1 as previously described. The closing of contacts 622*b* energizes the relay 624. The closing of the latter's contacts 624*b* starts timing motor 626. The rotation of a cam 628, secured to shaft 630 of said timing motor, closes its contacts 632, which holds in relay 624 through its contacts 624*a*. The table descends, picks up standing pins in a manner previously described, returns to its starting position and stops when cam 606 opens its contacts 620. The table T dwells in this position for a period which is predetermined by the relative speeds of shaft 604 and 630. During this period, a sweep (not shown) removes any deadwood. This also takes place when pins remain standing after the second ball of a frame has been rolled. A cam 634, secured to shaft 630, then closes contacts 636 momentarily, which reengages clutch K1 as previously described. The table descends and respots the pins picked up in a manner heretofore described. The table then ascends and stops when cam 606 opens its contacts 620. Continued notation of cam 628 opens its contacts 632, relay 624 falls out, and timing motor 626 stops.

As previously mentioned, a safety switch 485 is provided. Referring to Figure 17, it will be seen that if switch 485 were to be opened, in the manner previously described, motor 460, or motors 460 and 626, would stop and prevent further downward movement of table T.

The above described invention may be varied in construction within the scope of the claims, for the particular device, selected to illustrate the invention, is but one of many possible concrete embodiments of the same. It is not therefore to be restricted to the precise details of the structure shown and described.

What we claim is:

1. A bowling pin spotting and respotting apparatus comprising a table, means for maintaining said table in a substantially horizontal position throughout its movement to and from the playing bed of a bowling alley for spotting and respotting bowling pins thereon, a plurality of pin spotting units mounted on said table, a plurality of pin respotting devices mounted on said table, means operatively connecting each of said units with one of said devices, said last-named means including a support normally positioning said unit in an inclined pin receiving and supporting position and said device in position to engage a pin standing on or off-spot on said alley bed, means mounting said supports on said table for movement relative thereto, and means for substantially simultaneously moving each of said supports to locate said devices in an inoperative position and to locate said units in upright pin delivery and spotting position relative to said bed.

2. A bowling pin spotting and respotting apparatus comprising a table, means mounting said table above the playing bed of a bowling alley, mechanism for moving said table to and from said alley bed for spotting and respotting pins thereon, a plurality of pin spotting units and a plurality of pin respotting devices carried by said table, a plurality of shafts mounted on said table, means attaching said units and devices to said shafts, and means for rocking said shafts in one direction to effect the simultaneous movement of all spotting units to pin delivery position and shift said respotting devices to inoperative position, and means operative when said table moves upwardly after a set of pins has been placed on said alley bed for rocking said shafts in the opposite direction to return said units to pin receiving and supporting position and locate said respotting devices in operative respotting position.

3. The apparatus defined in claim 2 wherein said mechanism for moving said table to and from said alley bed includes means for operating said mechanism after the rolling of the first ball of a frame to move said table downwardly to pin gripping position above said alley bed, and means actuated by the heads of standing on or off-spot pins for operating said devices to grip said standing pins for lifting and respotting.

4. The machine defined in claim 2 wherein said mechanism includes a drive shaft, an operating arm adjacent each end of said shaft and attached thereto, links connecting said arms to said table, and means for driving said shaft to rotate said arms and locate said table at the same distance above said alley for spotting and respotting pins thereon.

5. In a bowling pin spotting machine, a pin spotting and respotting table, a plurality of triangularly arranged pin spotting units carried by said table, each unit having a pin supporting member, a plurality of triangularly arranged respotting devices carried by said table, each device having opposed pin grippers, a plurality of movable supports, each mounting one or more of said units and respotting devices, said supports including means for positioning said members of said units at an angle with the plane of said table, and means for positioning said grippers of said respotting devices in a plane substantially parallel with the plane of said table, and means for moving said supports to locate said supporting members substantially at right angles with said alley for deposit of pins carried thereby on said alley, and for simultaneously locating said grippers in a plane inclined at an angle to the plane of said table.

6. The machine defined in claim 5 including means operative subsequent to the spotting of pins by said units for moving said supports to relocate said units and respotting devices in pin supporting and pin gripping positions, respectively, mechanism for effecting the movement of said table downwardly after the rolling of the first ball of a frame to position said grippers of said devices for gripping any standing on or off-spot bowling pins, and means actuated by the downward movement of said table relative to the heads of standing pins for moving said grippers into gripping engagement with opposite sides of the heads of said standing pins for lifting and respotting.

7. The machine defined in claim 6 wherein said last-named means includes a pin clamp associated with each respotting device, means actuated by said clamps for closing said grippers, and means for locking said grippers in gripping relationship against said pins.

8. A bowling pin spotting and respotting apparatus comprising a table, means mounting said table above the playing bed of a bowling alley, mechanism for moving said table to and from said bed to spot and respot pins thereon, a plurality of pin spotting units carried by said table, a plurality of pin respotting devices including pin grippers carried by said table, a plurality of shafts mounted on said table, means attaching said units and devices to said shafts with a spotting unit and a respotting device forming a spotting-respotting assembly, said shafts normally positioning said respotting devices in operative position, and means for actuating said mechanism, said mechanism including selectively operated means for turning said shafts to locate said units of said assemblies in pin spotting relationship with said alley bed and to locate said respotting devices in inoperative position when said spotting units are located in said pin spotting relationship, and means operative in response to the rotation of said shafts in the opposite direction to relocate said respotting devices of said assemblies in said normal position to grip and hold on or off-spot pins for lifting and respotting after said units have spotted pins on said alley bed.

9. The invention as set forth in claim 8 wherein said mechanism includes a drive shaft, cranks mounted on said drive shaft, links connecting said cranks to one of said shafts on said table, whereby when said drive shaft is rotated, said table is moved to and from said alley, said selectively operated means including a spotter unit actuating arm pivotally mounted on one of said cranks, operating arms mounted on each of said shafts on said table supporting said assemblies, links connecting said operating arms, a link connecting said spotter unit actuating arm and one of said operating arms, and selective means for rocking said spotter unit actuating arm during the rotation of said drive shaft to rock said shafts supporting said assemblies and locate each of said units in pin spotting position relative to said alley bed.

10. The invention as set forth in claim 9, including a cam mounted on said drive shaft, and means actuated by said cam for moving said spotter unit actuating arm in the opposite direction after a set of pins has been spotted on said alley bed.

11. A bowling pin spotting machine comprising a table, means mounting said table above the playing bed of a bowling alley, mechanism for moving said table to and from said bed, a plurality of substantially parallel shafts mounted on said table, a plurality of sets of pin spotting units and pin respotting devices supported by said shafts, means normally positioning each of said units in pin receiving and supporting position and each of said devices in respotting position relative to said bed of said alley, means for actuating said mechanism, and selectively operated means forming a part of said mechanism for rocking said shafts to swing all of said spotting units to spotting position relative to said alley bed when pins are to be spotted thereon.

12. The invention defined in claim 11, wherein said mechanism and said last-named means include a driven drive shaft, spaced cranks connected to said drive shaft, links connecting said cranks to one of said shafts on said table, a spotting unit actuating arm mounted on one of said cranks, an operating lever on one of said shafts carried by said table, a link connecting said actuating arm and said operating lever, an operating lever on each of said other shafts, means interconnecting said last-named

levers and said operating lever on said first-named shaft and selectively operated means for turning said spotting unit actuating arm to substantially simultaneously position all of said spotting units in pin spotting position.

13. The machine defined in claim 5 wherein the supports for said grippers of said respotting devices include elongated guides, gripper operating carriages movably mounted on said guides, and means on said carriages operative in response to the repositioning of said grippers in said substantially horizontal plane for locating said grippers of said devices in centered open positions for the reception of the handle end of a pin to be gripped by said grippers ready for lifting and respotting pins.

14. A bowling pin spotting machine comprising a pin spotting and respotting table, mechanism for moving said table to and from a bowling alley to spot and respot pins thereon, mechanism for maintaining said table in a substantially horizontal plane during its movement to and from said alley, a plurality of pin spotting units, a plurality of movable support means on said table, said means supporting said units and normally positioning said units in an inclined pin receiving and supporting position, a plurality of pin respotting devices also mounted on said movable support means and extending downwardly beneath said table, each of said support means being common to one of said units and one of said devices, and normally positioning said device in operative position, means for actuating said first-named mechanism including selectively operated means operative during the downward movement of said table for moving said movable support means relative to said table and thereby moving each of said pin spotting units from said inclined receiving and supporting position into substantially vertical pin spotting position relative to said alley and for simultaneously moving each of said respotting devices on said common support means to an inoperative position.

15. A bowling pin spotting and respotting machine comprising a table, supports mounting said table above the playing bed of a bowling alley, a plurality of triangularly arranged pin spotting and respotting assemblies mounted on said table, each of said assemblies including a pin spotter unit and a pin respotting device, a separate individually movable support for each of said assemblies, each of said units including an elongated pin receiving ing spotting trough, and means attaching said trough to said support with said trough normally inclined at an angle to the plane of said bed for receiving a pin therein, a pin engaging and retaining member mounted in each of said troughs, each of said devices including a pair of opposed individually movable gripping jaws, a pin clamp operatively connected to said jaws and means positioning said clamp in a plane substantially parallel with the plane of said alley bed, and mechanism for moving said table to and from said alley bed to spot or respot pins thereon, including means for moving said assembly supports to swing said troughs from said inclined pin receiving position into pin spotting position substantially vertical to the plane of said alley, and to move said troughs away from spotted pins on said alley bed and to locate said devices in inoperative positions when said units are spotting pins on said alley bed, means for returning said assemblies to normal position with said units in inclined pin receiving position and said devices in operative position for gripping and holding pins to be lifted and respotted, means operative in response to the movement of said table downwardly when pins are to be respotted for engaging said clamps with the heads of standing pins, and means actuated by said clamps in response to the downward movement of said table to close said jaws against the opposite sides of the handle ends of standing on or off-spot pins.

16. The invention defined in claim 15, wherein said last-named means includes a clamp actuated latch and a latch actuating device carried by each clamp for locking said gripper jaws against opening, and means for unlatching said latch when a pin is respotted on said alley bed, whereby said grippers are opened on the next upward movement of said table.

17. A pin spotting and respotting cell for use in a bowling pin spotting machine, comprising a pin spotting unit having means for supporting a bowling pin for spotting, a pin respotting device including pin holding means and support means common to said unit and said device for rotatably mounting the same on a pin spotting table, for selective movement to locate said unit either in an inclined pin receiving and supporting position or in a substantially vertical pin spotting position and to locate said respotting device in operative and inoperative positions, respectively, relative to said alley.

18. A table for spotting and respotting bowling pins upon the playing bed of a bowling alley comprising a substantially triangularly shaped frame, said frame including two elongated members forming the sides of said triangularly shaped frame, means joining one end of each of said members to the other, bearings carried by the free ends of each of said members, and a shaft having its ends journalled in said bearings and forming the base of said triangularly shaped frame, said members and said shaft forming a rigid beam truss frame substantially resistant to twisting and bending.

19. A bowling pin spotting machine comprising a pin spotting and respotting table, mechanism for moving said table to and from a bowling alley to spot and respot pins thereon, mechanism for maintaining said table in a substantially horizontal plane during its movements to and from said alley, a plurality of pin spotting and respotting cells on said table, each of said cells including a separate spotting unit normally disposed in an inclined pin receiving and supporting position and a separate respotting device normally disposed in an operative position, support means mounting said cells on said table for rotary movement relative thereto, means for actuating said first-named mechanism including selectively operated means operative during the downward movement of said table for rocking said support means relative to said table to locate said pin spotting units in a substantially vertical pin spotting position relative to said alley, and for simultaneously locating each of said respotting devices in an inoperative position relative to said alley.

20. In a bowling pin spotting machine, a pin spotting and respotting table, means mounting said table above the playing bed of a bowling alley, a plurality of substantially parallel shafts mounted on said table, a plurality of pin spotting and respotting assemblies, one or more of said assemblies being mounted on each of said shafts, each of said assemblies comprising a pin spotting device and a pin respotting unit, a crank carried by one of said shafts on said table, a drive shaft, spaced cranks carried by said drive shaft, a link connecting each of said cranks on said drive shaft to said one of said shafts, a stud shaft carried by one of said cranks on said drive shaft, an arm secured to said stud shaft, a link connecting said arm to said crank on said one of said shafts, a lever attached to said one of said shafts on said table, actuating levers carried by each of said other shafts on said table, links connecting said actuating levers and said lever on said one of said shafts, means for driving said drive shaft to move said table to and from said alley bed, and selective means for rocking said arm on said stud shaft to cause said link connecting said arm and said crank attached to said one of said shafts on said table to turn said shaft and thereby rock said lever on said one of said shafts and move said links connecting said actuating levers, whereby all of said shafts on said table mounting said assemblies are moved to swing said devices to pin delivery positions relative to the bed of said alley.

21. The invention defined in claim 11 wherein said mechanism and said last-named means include a drive shaft, table lifting and lowering cranks mounted on said drive shaft, links connecting said cranks to said table, a stud shaft supported by one of said cranks, a spotter unit

actuating arm secured to said stud shaft, a cam on said drive shaft, a bell crank lever mounted on one of said shafts on said table, a link connecting said spotter unit actuating arm and said bell crank lever, a plurality of cranks mounted on said shafts on said table, links connecting said last-named cranks, a second link connecting said bell crank lever and one of said last-named cranks, an intermediate shaft, a cam lever loosely mounted on said last-named shaft having a cam follower engaging said cam, a lock lever mounted on said last-named shaft, a spotting unit actuating lever also mounted on said last-named shaft, a lock arm on said lock lever, a latch member engaging said lock arm and normally holding said actuating lever against movement, means for moving said latch member out of engagement with said lock arm to release said lock lever for movement into engagement with said cam lever, means for biasing said lock lever, said last-named shaft and said actuating lever assembly into engagement with said cam lever, whereby during rotation of said drive shaft, said actuating lever is moved in response to the rotation of said cam, and driving connections between said actuating lever and said actuating arm for rocking said shafts on said table to swing said units to pin spotting position for depositing a set of pins on said alley bed.

22. The invention set forth in claim 21 wherein said means for moving said latch member out of engagement with said lock arm includes a selectively operated electric circuit, a solenoid in said circuit, and a link connected to the armature of said solenoid and to said latch member.

23. A bowling pin spotting machine comprising a frame, a pin spotting and respotting table, a plurality of pin spotting units mounted on said table, each of said units including a pin supporting and spotting trough projecting downwardly from said table, a plurality of pin respotting devices mounted on said table adjacent said units, supporting rods connecting said frame and said table and mounting said table for movement to and from the playing bed of a bowling alley and maintaining said table in substantially a horizontal plane, mechanism for moving said table to and from said alley, and means for operating said mechanism, movable supports each common to one of said units and one of said respotting devices, means mounting said supports on said table for independent movement relative thereto in selectively locating said troughs either in pin receiving and supporting position inclined at an angle with the vertical or in substantially vertical pin spotting position, and simultaneously locating said respotting devices in operative and inoperative positions, respectively, and means for moving said supports to move said troughs and said respotting devices to a selected one of said positions relative to said alley.

24. A spotting and respotting cell for use on the pin spotting table of a bowling pin spotting machine, comprising a support bracket, a pin spotting unit attached to said bracket, a respotting device, a bracket for said device, a common support for said brackets comprising means for attaching said brackets to said support, and means for mounting said support on a pin spotting table for movement between a first position in which the unit is inclined and supports a pin and the respotting device is in operative position, and a second position in which the unit is in vertical spotting position and the device is in inoperative position.

25. The spotting and respotting cell defined in claim 24 wherein said device includes a pair of individually movable pin gripping jaws, means mounting said jaws for gripping an on or off-spot pin standing on a bowling alley, and means for closing said jaws to grip said pin.

26. The invention defined in claim 24, wherein said respotting device includes individual movable opposed gripping jaws, means for moving said common support to said second position, and means operative subsequent to the spotting of said pin on said alley for moving said common support to said first position.

27. The spotting and respotting cell defined in claim 24 wherein said attaching means includes means for detachably and adjustably securing said brackets to said support, whereby the angular and lateral positions of said unit and device on said support may be adjusted as desired.

28. A spotting and respotting cell for use in a bowling pin spotting machine having a pin spotter table, comprising a single pin spotting unit, and a single respotting device, a common support for said spotting unit and said respotting device including means for mounting said common support on a pin spotter table for movement relative thereto into and out of a first position in which the spotter unit is inclined and supports a pin and the respotting device is in operative position, and a second position in which the unit is substantially vertically disposed for spotting the pin and the respotting device is in inoperative position.

29. The spotting and respotting cell defined in claim 28, including means for adjustably and detachably securing said spotting unit and said respotting device to said common support, whereby said unit and said device may be readily removed from said support, or their angular and lateral positions thereon may be adjusted as desired.

30. The machine defined in claim 23 including adjustable means connecting said supporting rods to said frame and table, said means including means adapted to increase and decrease the length of said rods as desired, whereby the lateral, longitudinal and vertical positions of said table relative to the pin spots on a bowling alley may be controlled accurately for spotting and respotting of pins by said units and devices.

31. The table defined in claim 18 including a plurality of bowling pin spotting and respotting cells mounted on said frame, and means for moving said table with a simple harmonic movement to and from pin spotting and respotting positions at substantially equal distances above said alley bed.

32. A pin spotting and respotting cell for use on the pin spotter table of a bowling pin spotting machine, comprising a pin spotting unit having means for supporting a bowling pin to be spotted, a pin respotting device including pin holding means for holding a pin to be respotted, mounting means on said unit, mounting means on said device, a common support, means for attaching said mounting means of said unit and said device to said common support, and means for mounting said support on a pin spotting table for movement between a first position in which the unit is inclined and supports a pin and the respotting device is in operative position, and a second position in which the unit is in vertical spotting position and the device is in inoperative position.

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