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BOWLING PIN RESPOTTER

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5 Sheets-Sheet 2

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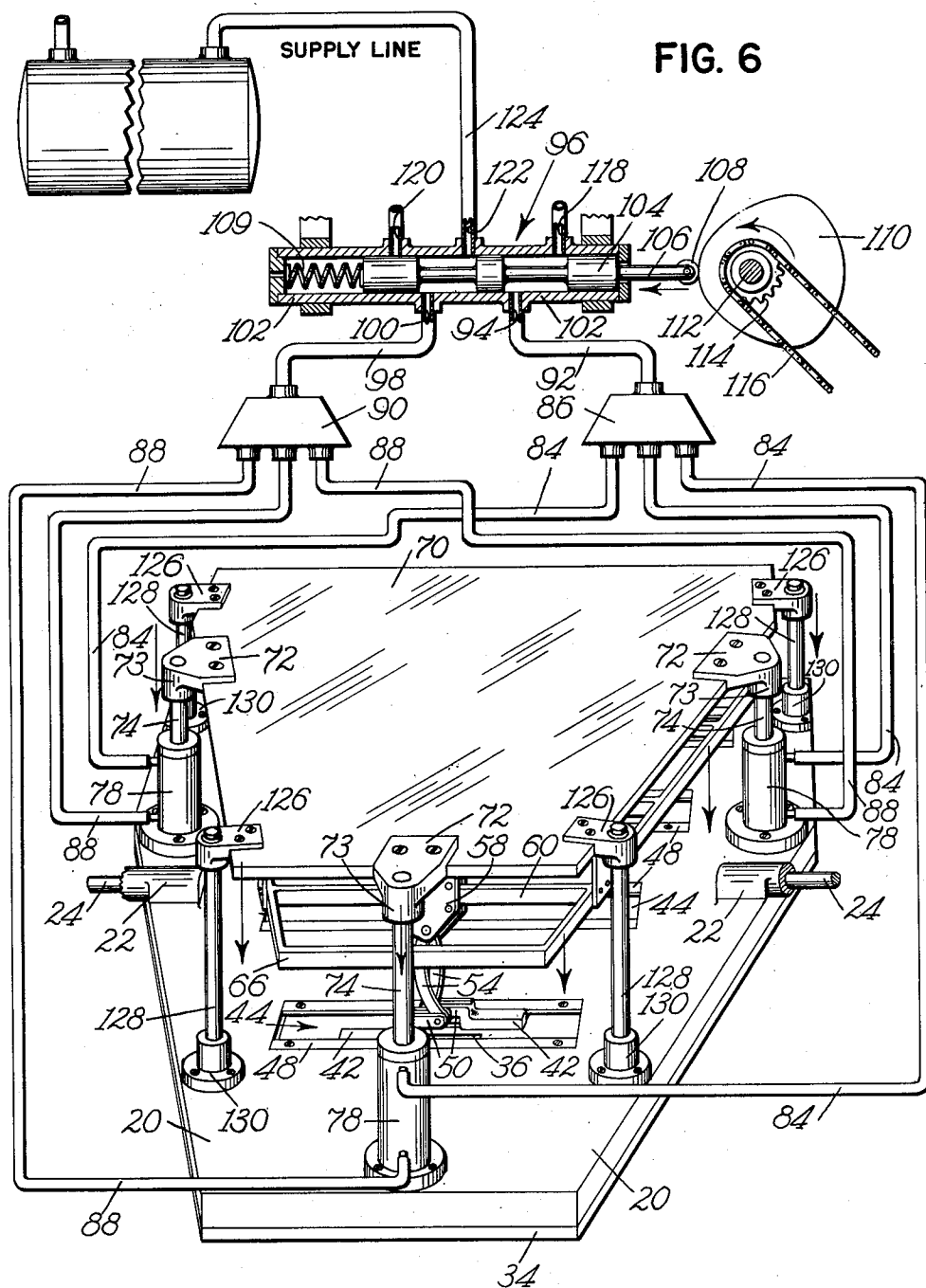
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FIG. 8

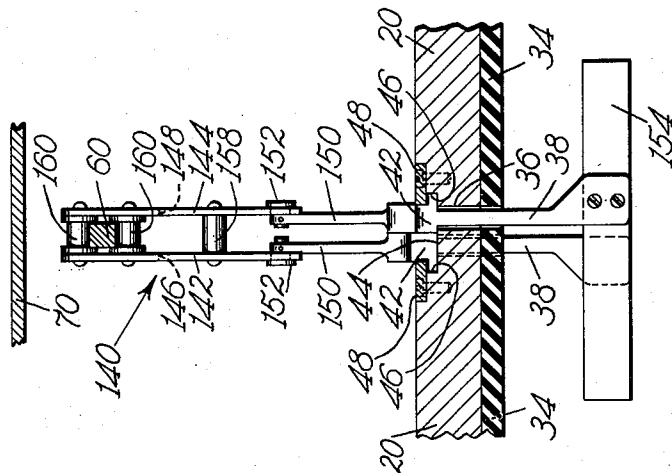
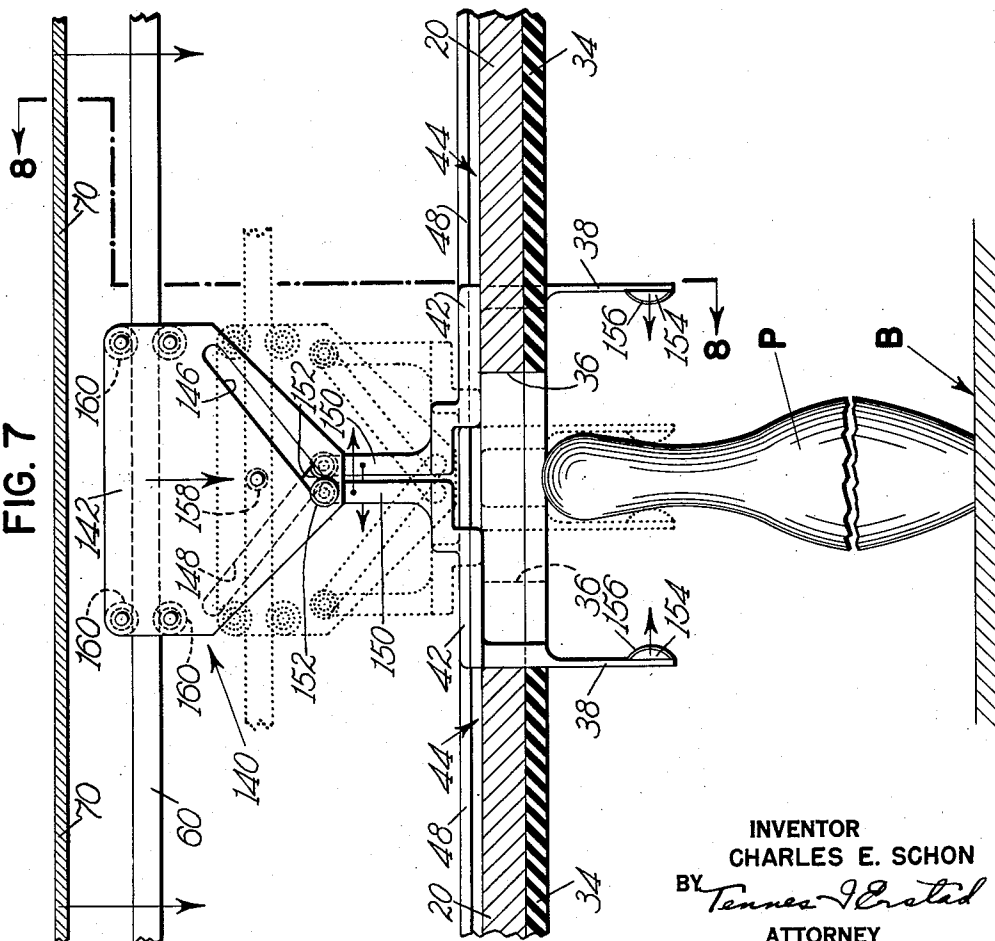


FIG. 7



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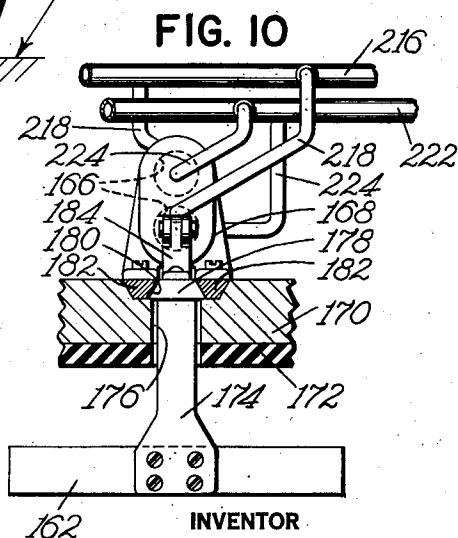
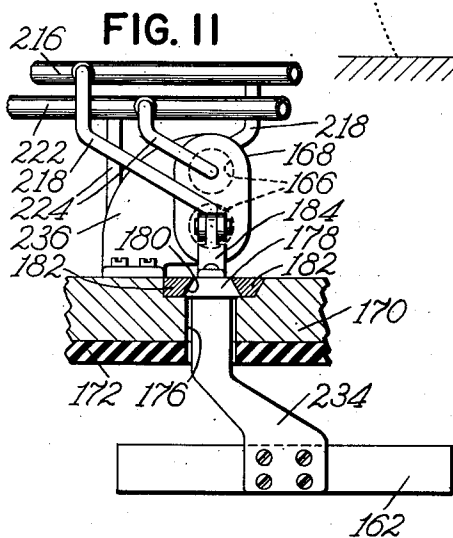
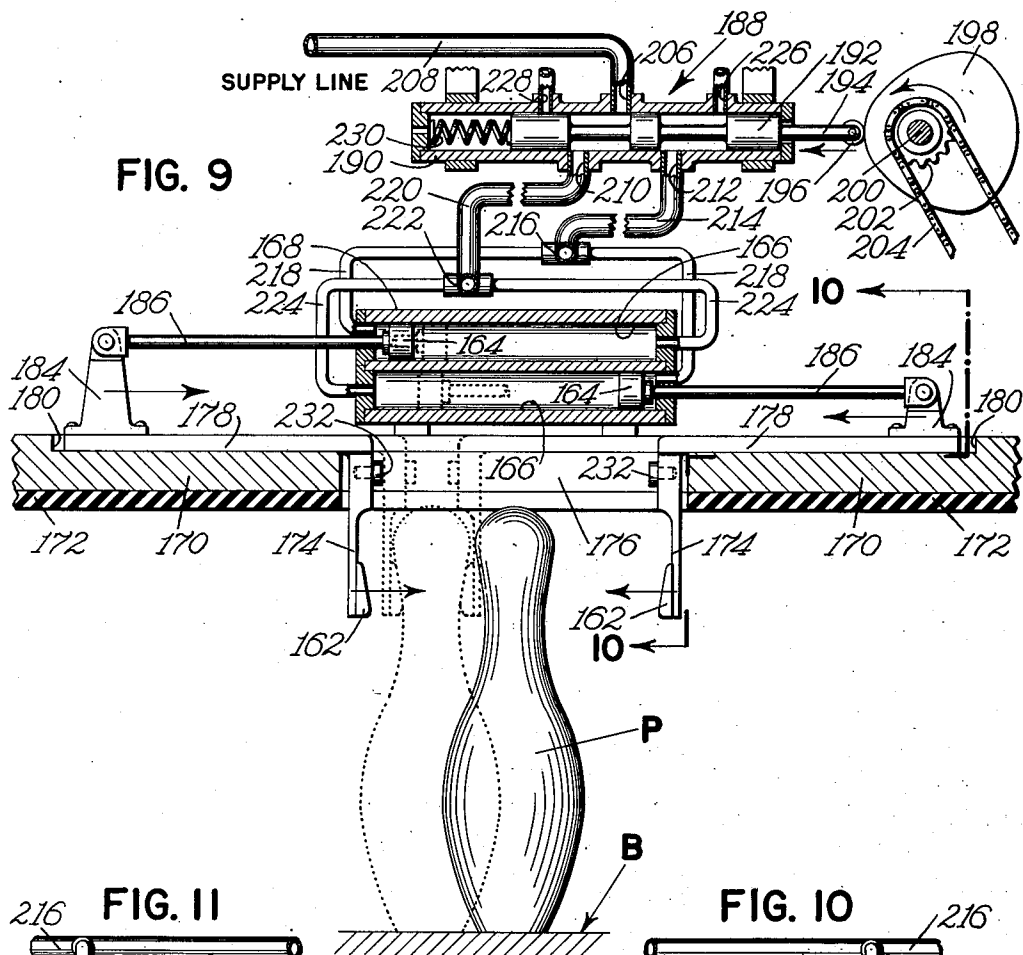
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UNITED STATES PATENT OFFICE

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BOWLING PIN RESPOTTER

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19 Claims. (Cl. 273-42)

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This invention relates to improvements in automatic pin-setting apparatus for bowling alleys, and more particularly to improvements in apparatus for gripping, lifting and respotting bowling pins on a bowling alley.

In bowling if, after the first ball is thrown all of the pins are not knocked over and there remains standing one or more pins, a second ball is required to be thrown. Because of the impact of the first ball and the falling pins, the pins which remain standing are sometimes displaced with respect to their original position. Before the second ball is thrown, it is necessary to lift the standing pins and then remove the fallen pins. In an automatic bowling pin spotting machine, this can be accomplished by a pin-gripping mechanism descending and engaging the standing pins, and lifting them up from the alley while suitable sweeping mechanism removes the pins which have fallen. After the fallen pins have been removed, the standing pins which were lifted above the alley, have to be replaced in exactly the same position they were in when engaged by the pin-lifting mechanism.

It is, therefore, an object of this invention to provide improved means for engaging and lifting bowling pins which remain standing in their original position and in "off spot" position and replacing these pins on the alley in the same position they were in before being lifted from the alley.

Another object is to provide improved means for clamping the standing pins to the alley in "off spot" and "spot" positions and improved means for bringing spaced grippers into contact with the clamped pins.

Another object is to provide improved and simplified bowling pin gripping mechanism which is constructed and arranged to grip standing pins on substantially any part of the "pin spotting" area, including pins which have been moved or have "walked off" a considerable distance from their original spotted position.

It is also an object to provide improved pin-engaging and gripping mechanism which is yieldable and provides a minimum of wear and tear on the pin and which will avoid damaging the machine if it comes into contact with a foreign obstruction in its path.

A further object is to provide improved pin-engaging mechanism which will hold pins of varying height free from lateral movement when being removed from or replaced on a bowling alley.

Another object is to provide a pin-gripping device wherein the adjoining supports for the pin

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grippers will be aligned with each other when in their most open position and will thus enable "off spot" pins to be gripped over a large area of the pin spotting area of a bowling alley.

A further object is to provide pneumatically actuated means for engaging and holding bowling pins.

A further object is to provide fluid operated pin respotting mechanism wherein a bowling pin gripper will be moved rectilinearly until it is stopped by its engagement with a standing bowling pin while an oppositely disposed gripper will continue its rectilinear movement until it, too, is stopped by its engagement with the same standing bowling pin, thereby gripping the pin between both grippers.

Another object is to provide a simplified pin gripping device adapted to grip pins in both "spot" and "off spot" positions and which will effectuate simultaneous gripping action of all grippers by moving two spaced members toward or away from each other.

Another object is to provide a carrier table, having narrow elongated slots, for clamping standing bowling pins to an alley while pin grippers, positioned below the carrier, are brought into pin-gripping position by shank which move in said slots, the slots being of such narrow width that the head of a clamped bowling pin could not enter the same.

Other objects and features of the invention will appear as the description of the particular physical embodiment selected to illustrate the invention progresses. In the accompanying drawings which form a part of this specification, like characters of reference have been applied to corresponding parts throughout the several views which make up the drawings.

Fig. 1 is a front elevation of a bowling pin respotting table, partly in section, illustrating the pin gripping apparatus;

Fig. 2 is a plan view of said apparatus seen from line 2-2 of Fig. 1;

Fig. 2A is a perspective view of a pair of adjacent pin grippers in their most open position;

Fig. 3 is a plan view of a bowling pin respotting table;

Fig. 4 is a side elevation, partly in section, of a pair of pin grippers, taken on line 4-4 of Fig. 1;

Fig. 5 is a sectional plan view of a pair of pin grippers, taken on line 5-5 of Fig. 1, illustrating the same in closed gripping position;

Fig. 6 is a perspective view of the bowling pin respotting table illustrating the operating mechanism;

Fig. 7 is a front elevation, partly in section, of a pair of pin grippers, illustrating a modified form of operating mechanism for the same;

Fig. 8 is a sectional side elevation of a said modified form, taken on line 8—8 of Fig. 7;

Fig. 9 is a sectional front elevation of a pair of pin grippers, illustrating another modified form of pin gripper operating mechanism;

Fig. 10 is a sectional side elevation of said modified grippers, taken on line 10—10 of Fig. 9; and

Fig. 11 is a sectional side elevation of the same type of gripper illustrated in Fig. 10 with the exception of showing the same connected to operating cylinders which are located off-center.

The pin respotting device consists of a table 20 which, by means of a pair of protruding lugs 22 (Fig. 3) and a pair of suitable studs or shafts 24, is attached to a pair of guide shoes 26 and 28. Suitable cables 27 are connected to guide shoes 26 and 28 which engage with vertical guide channels 30 and 32. Cables 27 lower and raise the table 20 in proper time relation with the operation of the bowling pin setting machine, in a manner similar to that disclosed in U. S. Patent No. 2,208,605 issued to Mr. G. J. Schmidt on July 23, 1940.

To the bottom side of said table 20 is secured a mat 34 of resilient material such as soft or sponge rubber or other suitable material. The table 20 is provided with narrow slots 36 through which protrude the shanks 38 of the pin gripper bars 40. The slots are of such narrow width that the head of a bowling pin would not project through the same if a pin should be positioned below the slot when the table 20 is lowered into engagement with standing pins. Each shank 38 has secured to its lower end a gripper bar 40. Inasmuch as the illustration is based on a ten-pin bowling game, the table 20 is equipped with ten pairs of pin grippers, each pair consisting of two coacting gripper bars 40. For the purpose of illustration, the gripping surfaces 41 of the gripper bars 40 in Fig. 1 have a contour which fits the surface of the handles of the pins P; however, the contour of the gripping surfaces could be round, half-round or any other shape suitable for satisfactory engagement with a bowling pin.

In order to provide the grippers with the greatest possible range for gripping pins that have moved or "walked off" varying distances from their original spotted position, the shanks 38 of adjoining grippers are staggered to permit alignment with one another when in their most open position. By aligning the shanks 38, as shown in Fig. 2A, the gripper bars 40 of adjoining grippers, when in their most open position will be close together. With this construction, there is a wider range of coverage and it will be very rarely that any standing pin moves so far from its spotted position that the descending gripper bars 40 will engage with the head of the standing pin.

The gripping surface 41 of the gripping bars 40 is finished with a suitable material which will minimize wear and tear on the bowling pin. This material could be rubber, fabric or other material which has been suitably processed for this purpose.

Each gripper bar shank 38 is secured to the bottom portion of a pin gripper operating member 42 and forms an integral part of the latter. Each pair of gripper operating members 42 is slidably supported in a track 44, formed by a groove or channel 46 in the top portion of table 20 and a pair of guide bars 48 (Figs. 2, 3, 4 and 5)

secured to the table 20. Integral with each gripper operating member 42 is a slotted or forked lug 50, protruding above the table 20 and carrying on its free end a stud 52 to which is pivoted one end of a curved link 54. The other ends of each pair of links 54 are pivoted to a common stud 56, each of which is secured to the lower portion of a carriage or trolley 58 suspended from a suitable cross bar or track 60. Each trolley 58 is provided with suitable rollers 62 which engage with said cross bar thus permitting the trolley to move horizontally. A separate trolley is provided for each of the ten pairs of grippers.

The arrangement of the pins in a ten-pin bowling game is such that four rows of pins are formed: namely, No. 1 pin in the first row; Nos. 2 and 3 pins in the second row; Nos. 4, 5 and 6 pins in the third row; and Nos. 7, 8, 9 and 10 pins in the fourth row. The carriages or trolleys 58, therefore, are also arranged in rows with four cross bars 64 employed to suspend said trolleys, each cross bar being located in the center line above a row of pins. These four cross bars 64 are welded together into a frame 66 which, by means of suitable brackets 68, is mounted to the lower side of a table top plate 70. The plate 70 is connected to and supported by three operating lugs 72, the protruding hubs 73 of each being fastened to the upper end of a vertical shaft 74. The lower end of each shaft 74 carries a piston 76 (Fig. 1) which engages with the walls of a vertical cylinder 78, all three of which are secured to the top side of table 20.

Each cylinder 78, at its top portion, is provided with a port 80 (Fig. 1) and, at its bottom portion, with a second port 82. All ports 80, by means of flexible tubings 84, are connected to a manifold 86; while all ports 82, by means of flexible tubings 88, are connected to a manifold 90. Both manifolds may be conveniently attached to a suitable portion of the main frame (not shown) of the automatic bowling pin setter.

Manifold 86 (Fig. 6) by means of a flexible hose 92, is connected to a port 94 of a conventional type slide valve 96; and manifold 90, by means of a flexible tubing 98, is connected to a port 100 of the aforementioned slide valve 96.

The slide valve 96 consists of a cylinder 102 and a three band spring tensioned valve plunger 104. The plunger 104 on one end is provided with an operating member 106, protruding from said cylinder. The operating member 106 carries a roller 108 which engages with a cam 110 mounted on a shaft 112 supported in suitable bearings (not shown) of the bowling pin setting machine. Roller 108 is maintained in constant engagement with cam 110 by means of spring 109 acting on the opposite end of plunger 104 as shown in Fig. 6. Shaft 112, by means of a sprocket 114 and a chain 116, is driven in proper time relation from the main drive shaft (not shown) of the pin setting machine.

Slide valve 96 is provided with two exhaust ports 118 and 120, and a supply port 122. The supply port 122 is connected, by means of duct 124, to a source of supply of a fluid under pressure, such as compressed air. Other suitable fluids could also be used, in which case, the exhaust ports would be connected to a suitable reservoir (not shown) to receive the discharged fluid. Exhaust port 118 serves manifold 86; while exhaust port 120 serves manifold 90 at the proper position of valve plunger 104.

Suitable guiding mechanism is provided to ren-

der the table top plate 70 more stable and to prevent it from cocking. This guiding mechanism is shown in Fig. 6 and consists of guide lugs 126, secured to and projecting from top plate 70, which slidably engage vertical guide rods 128. Guide rods 128 are rigidly attached to the top side of table 20.

The operation of the respotting table and pin gripper mechanism may be briefly described as follows:

After the first ball is thrown, the table 20 descends and comes to rest on the standing pins, thereby clamping said pins to the alley bed B. The resilient mat 34 on the bottom side of said table facilitates this clamping operation inasmuch as the tops of the handles of the standing pins embed themselves, to a certain extent, in the mat and the pins are thus held firmly against lateral movement when the table ascends. Considering the fact that bowling pins usually have some variation in height, this feature is particularly valuable because it allows for this variation in height. The resilient mat also has a softer action on the bowling pin so that wear and tear on the pin is minimized.

The operation of slide valve 96 is so timed that as soon as the table 20 has clamped the pins to the alley bed, the valve plunger 104 (Fig. 6) is moved in the direction indicated by the arrow. This closes exhaust port 118 and permits compressed air from port 122 to enter manifold 86 through port 94 and tubing 92. Tubes 84 then lead the compressed air from manifold 86 to the tops of cylinders 78, thereby causing pistons 76 (Figs. 1 and 6) to move downward.

The downward movement of the pistons 76 also effects a downward movement of the top plate 70 and cross bar frame 66 from which the carriages or trolleys 58 are suspended. The relative movement between the cross bar frame 66 and table 20 causes the curved links 54, interconnecting the trolleys 58 and lugs 50, to spread. The gripper operating members 42 are, as a result, moved horizontally in the directions of the arrows indicated in Fig. 1. Inasmuch as the shanks 38, carrying gripper bars 40, are connected to operating members 42, the gripper bars of each set of grippers are brought toward each other to engage the necks of the standing pins P which are clamped to the alley bed B.

In cases where a pin has "walked off" its original spot, as shown in dotted lines in Fig. 1, one of the gripper bars 40 will engage the clamped pin P first, causing the bar to stop. The continued relative movement of table 20 and frame 66 causes the trolley or carriage 58 to slide along its respective cross bar 60 due to the differential arrangement of the gripper operating mechanism described herein and all the operating action is automatically transferred to the other opposing gripper. This allows the opposing gripper bar 40 to continue its closing movement until it also engages with the clamped pin.

After the gripper bars have gripped the standing pins, the table 20 moves upward with the gripped pins to allow fallen pins to be swept from the alley. The pin grippers continue holding the pins during this operation until the table 20 descends again and re-sets the gripped pins on the alley.

Because of the timed operation of the slide valve 96, the compressed air is then changed from the top of the pistons 76 to the bottom of the same. This causes an upward movement of table top plate 70, cross bar frame 66 and trolleys 58,

which movement effects a release of gripper bars 40 from the pins P. After this operation, the entire table 20 moves upward again and the alley is ready for the second ball to be thrown by the bowler.

With reference to the modification shown in Figs. 7 and 8, the difference lies in a modified trolley 140, consisting of a pair of vertical cam plates 142 and 144 provided with cam tracks 146 and 148 respectively. The gripper operating members 42, in this case, are provided with vertical lugs 150 each of which carries on its free end a cam roller 152. In each pair of gripper operating members 42, the roller 152 on one of the lugs 150 engages with cam track 146 of cam plate 142, while the roller on the other lug engages with the cam track 148 of cam plate 144.

The gripper operating members 42 are of the same type and construction described hereinbefore, slidably mounted in the same type of respotting table 20 provided on its bottom side with a covering or mat 34 of flexible material. The table 20 is provided with the same type of narrow slots 36, mentioned heretofore, accommodating the shanks 38 extending from the bottom portions of members 42 and carrying on their lowermost ends their respective gripper bars. The latter, illustrated in Figs. 7 and 8, are a half-round bar type 154 covered with suitable material 156 such as rubber or other resilient material. Cam plates 142 and 144, forming the trolley 140, are held together by a suitable spacer 158 and are provided in their upper portion with four rollers 160 movably engaging said trolley with one of the cross bars 60 forming a cross bar frame 66, as mentioned heretofore.

The cross bar frame 66 is also attached to table top plate 70 and is supported and operated in the manner already described. After clamping the standing pin or pins P to the alley bed and upon a downward movement of plate 70 and cross bar frame 66, the movement or gripping action of bars 154 is effected by cam plates 142 and 144 instead of the linkage described previously herein. As the trolley 140 descends, the cam tracks 146 and 148 in cam plates 142 and 144 respectively force the vertical lugs 150 to move in the directions of the arrows shown in Fig. 7, thereby causing the members 42 and gripper bars 154 to move toward the clamped standing pin and grip the same as illustrated in dotted lines in Fig. 7. In case an "off spot" pin is to be gripped, the trolley is forced to move toward the center of the "off spot" pin as soon as one gripper bar 154 is stopped by said pin due to the differential arrangement of the operating mechanism, which causes a transfer of all operating action to the other gripper. The lifting, respotting and releasing of the pin are effected in the same manner as previously described.

Figs. 9, 10 and 11 illustrate another modified form of pin gripper operating means. In this case, the gripper bars 162, which are of the same type and shape as illustrated in Fig. 1, are actuated by means of a pair of pistons 164 each of which is reciprocated in a horizontal cylinder 166 by means of compressed air, oil or any other suitable fluid. Each pair of cylinders has a common housing 168 and forms an operating unit for one pair of gripper bars 162. Since there are ten pins in a ten-pin bowling game, ten operating units for ten pairs of gripper bars are mounted on a vertically reciprocating table 170, which is provided with suitable means for being vertically reciprocated such as that shown in

Fig. 3. The table, on its lower side, is also equipped with a cushion or mat 172 of resilient material, such as rubber, or other suitable material.

The elongated gripper bars 162, preferably extending lengthwise of the alley bed B, are secured to the lowermost ends of vertical shanks 174 protruding through suitable slots 176 in table 170. The upper portion of each shank 174 is attached to the bottom portion of a dove-tailed operating shoe 178 which is slidably mounted in the track formed by a channel 180, in the top side of table 170, and suitable guide bars 182 secured to the same. To the top side of each operating shoe 178 is mounted a bracket 184 with a piston rod 186 pivoted to its free upper end. To the other end of each piston rod 186 is attached a piston 164, mentioned above.

The action of all pistons is controlled by means of a slide valve 188 (Fig. 9) which is of the same type and construction as that shown in Fig. 6. The valve 188 consists of a cylinder 190 and a three band valve plunger 192 provided with an operating member 194 which protrudes from one end of said cylinder 190. Member 194 carries a cam roller 196 which contacts an open cam 198 mounted on a shaft 200, driven by means of a sprocket 202 and a chain 204, in proper time relation from the main drive of the bowling pin setting machine (not shown).

The slide valve 188 is provided with a supply port 206 which is connected to a source of supply (not shown) of compressed air, oil or other suitable fluid by means of a tube or pipe 208. Said valve has, furthermore, a port 210 and a port 212. Port 212, by means of a tube 214, is connected to a distribution pipe 216 having outlets leading to the cylinders which operate the pin gripper members at each pin spot position on the bowling alley. Tubes 218 are provided to connect the distribution pipe 216 which the bottoms of all pistons 164. Port 210, by means of a tube 220, is connected to a distribution pipe 222 having outlets leading to the cylinders which operate the pin gripping members at each pin spot position on the bowling alley. Tubes 224 are provided to connect the distribution pipe 222 with the tops of all pistons 164.

Therefore, if compressed air is forced through port 212 and tubes 218 against the bottoms of all pistons 164, the pistons 164 will be moved toward the opposite ends of the cylinders. This motion will, in turn, actuate, through the various pistons rods 186, the bowling pin grippers 162 and bring them together into gripping relation. When compressed air is forced through port 210 and tubes 224 against the tops of all pistons, the grippers of each pair of grippers 162 will be moved away from each other, thus effecting a release of gripper bars 162 from the standing pin P. Slide valve 188 is, furthermore, provided with two exhaust ports 226 and 228. Port 228, at the proper position of valve plunger 192, permits the compressed air in pipes 222 and 220 to escape; while exhaust port 226 serves the same purpose in conjunction with pipes 216 and 214.

In using fluids other than air, suitable conduits will be connected to ports 226 and 228 leading to a reservoir so that the fluid can be reused to operate the pistons 164. A spring 230, provided in cylinder 190 of valve 188, acts upon the bottom of valve plunger 192 and serves the purpose of keeping roller 196 in constant contact with the cam 198.

By using compressed air to operate the pin grippers, the pin is yieldingly gripped. The ten-

sion or pressure of the grippers can be regulated easily by changing the pressure of the compressed air. This feature has the advantage of minimizing wear and tear on the bowling pin and automatically takes into account variations in the diameters of the necks of bowling pins. Furthermore, if an obstruction should be encountered by the bowling pin grippers, they would automatically stop before any damage could be done.

The operation of this type of gripper mechanism, just described, is as follows:

After the first ball is thrown and some pins remain standing, the table 170 descends and clamps the standing pins to the alley bed in the same fashion as previously mentioned. The head portions of the standing pins embed themselves partly into the mat 172. This feature enables pins of various lengths to be securely held against lateral movement.

The valve plunger 192 is then actuated by the cam 198 to apply pressure to the bottoms of all pistons, thereby causing the gripper bars 162 to be advanced toward the standing pins and grip the same.

In the case of an "off spot" pin, one gripper bar contacts the clamped pin first and stops. The air pressure, however, keeps the second piston moving until the second gripper bar also contacts the standing pin. The pin is then firmly gripped between two yielding grippers.

After the pins are firmly gripped by said gripper bars, the table 170 moves upward and permits the fallen pins to be removed from the alley by a sweep or other suitable means. After this operation, the table 170 descends again and re-spots the pins on the alley in the same position they occupied before they were removed from the alley.

The slide valve 188 is then shifted through the coordinated action of spring 230 and cam 198 and air pressure is applied to the tops of all pistons 164 to effect a release of said pins, as mentioned heretofore. To provide noiseless and smooth operation, each shank 174 on its upper portion is provided with a rubber bumper 232 (Fig. 9). The bumpers 232 of opposing shanks 174 engage each other when no pin is standing to be gripped.

Due to the long stroke of gripper operating members 178, the latter and their operating cylinders cannot be placed in a row, but have to be staggered. Therefore, all gripper units which cannot be placed on the center line of the pin row must have a curved shank 234 which holds the gripper bar 162 as shown in Fig. 11. To avoid interference with the staggered arrangement of the dove-tailed operating shoes 178 of the pin gripper units, all cylinder housings 168 which cannot be placed on the center line of the pin row are provided with a modified or offset flange support 236 as shown in Figure 11.

The invention above described 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 embodiments of the same. The invention, therefore, is not to be restricted to the precise details of the structure shown and described.

What is claimed is:

1. An automatic bowling pin raising and lowering mechanism for bowling alleys comprising, a platform mounted for vertical movement toward and away from an alley, a compressible member mounted on the under side of said platform, means for lowering the platform and said com-

pressible member into clamping engagement with all standing pins on a bowling alley to clamp the same between the bowling alley and the platform, pin gripping members extending below said platform, and means for bringing said members into gripping engagement with standing bowling pins clamped between said platform and bowling alley.

2. A bowling pin handling apparatus comprising, a platform constructed and arranged to travel toward and away from a bowling alley; a sponge-like member mounted on the under side of said platform, a carriage adapted and arranged for horizontal travel mounted above said platform, gripper arms attached to said carriage having pin gripping members extending below said platform, means for lowering said platform and sponge-like member into clamping engagement with pins standing on a bowling alley to clamp the bowling pins between the bowling alley and the sponge-like member, and means for bringing said pin gripping members together into gripping engagement with a pin standing on said bowling alley by moving said arms toward each other.

3. Automatic bowling pin apparatus comprising, a table frame constructed and arranged for movement toward and away from a bowling alley, cushioning material mounted on the under side of said frame, a traveling carriage mounted above said table frame for horizontal movement with respect to said frame and having pin engaging members projecting below the cushioning material, means for lowering said frame and cushioning material mounted on said frame into engagement with bowling pins standing on the bowling alley to clamp the standing bowling pins between said cushioning material and the bowling alley, and means for bringing said pin engaging members into gripping engagement with standing bowling pins clamped between the bowling alley and the cushioning material of said frame.

4. An automatic bowling pin apparatus comprising, a movable platform positioned above that area of a bowling alley on which bowling pins are spotted; a cushioning member mounted on the under side of said platform; elongated slots formed in said platform and cushioning material adjacent the areas on which bowling pins are spotted; a trolley positioned above each pin spot position; trolley supporting means mounted above said platform constructed and arranged to permit said trolleys to move horizontally above said platform; connecting links pivotally connected at one end to each of said trolleys and at the other end to sliding supports coacting with said platform, said pivoted connecting links being constructed and arranged to move said supports relative to each other as the distance between said trolley support and said platform is varied; arms connected to said sliding supports and projecting through the slots formed in said platform and cushioning material; bowling pin engaging members connected to the lower end of said arms; means for changing the distance between said trolley supports and said platform to bring the bowling pin engaging members into gripping engagement with the standing bowling pins; means for first lowering said platform to bring the cushioning material into engagement with bowling pins standing on an alley; then elevating the platform and the gripped bowling pins to permit fallen bowling pins to be removed from the alley and for then lowering said platform to replace the lifted bowling pins in the same position they occupied before they were lifted; and means for changing the distance between said carriage support and said platform to release the bowling pin grippers from engagement with the standing pins.

5. In an apparatus for setting pins upon the bed of a bowling alley, an elevator adapted to be raised and lowered, a carriage support connected to said elevator for movement relative to the elevator, sliding members mounted on said elevator, carriages movably mounted on said carriage support, arms connected to said sliding members projecting below the elevator, a bowling pin contacting device formed on the lower end of each of said arms to grip a bowling pin between said devices, means interconnecting said carriages with said sliding members to vary the distance between said sliding members as the distance between said carriage support and elevator is varied; means for lowering said elevator into engagement with the heads of bowling pins standing on the alley to hold the pins between the elevator and the alley; and means for then changing the distance between said carriage support and the elevator to bring the bowling pin contacting devices into engagement with standing bowling pins.

6. An apparatus for setting pins upon a bowling alley comprising, a pin clamping platform; pairs of movable pin gripping members depending from said platform at each pin spot position, separate compressible fluid pressure means for yieldably moving each pin gripping member of each pair independently, means for lowering said platform to clamp pins standing on the alley, means for actuating each of said fluid pressure means to bring each member of each pair of gripping members independently into yieldable pin gripping engagement with the pins clamped to the alley.

7. In an automatic pin setting machine for setting bowling pins on a bowling alley, apparatus for gripping, lifting and replacing standing bowling pins on an alley comprising, a frame extending over the bed of an alley where pins are spotted, resilient material mounted on the underside of said frame, means for supporting said frame for travel toward and away from the bed of a bowling alley, pin engaging members movably mounted with respect to said frame, cushioning material mounted on the pin engaging surface of said pin engaging members, means for lowering said frame to bring the resilient material into holding engagement with the pins standing on the bowling alley, and pneumatic means constructed and arranged to apply a yielding force to each of said pin engaging members to move them independently along a predetermined rectilinear path of travel to bring at least two of said members into yieldable gripping engagement with each standing pin located in said path of travel.

8. In an automatic pin setting machine for bowling alleys, apparatus for engaging, lifting and replacing standing bowling pins on a bowling alley comprising, an elevator mounted for movement to and from a bowling alley; elongated bowling pin grippers positioned below said elevator parallel to the length of the alley and adjacent each of the areas on which bowling pins are spotted; movable arms depending from said elevator transversely connected to said elongated bowling pin grippers for moving said grippers together and apart; said arms being so constructed and arranged that the arms of adjoint

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ing grippers are aligned lengthwise of the alley, with the back of each gripper contacting the arm of the adjoining gripper when the grippers are in open position; means for moving said elevator toward a bowling alley to engage and clamp standing pins to the alley, and means for actuating said arms to bring said grippers into gripping engagement with the bowling pins clamped to the alley.

9. In a bowling pin setting machine for use with an alley having a pin supporting bed, apparatus for engaging, lifting and replacing bowling pins on said bed comprising, a frame adapted to move toward and away from the bed of a bowling alley; pairs of pin grippers depending from said frame over each of the pin spot positions on the alley; cylinders having pistons slidably mounted therein for operating each pin gripper independently of the other grippers; means for connecting each of said pistons with one of said pin grippers; means for clamping the standing bowling pins to the bowling alley each time said frame moves toward the bed of the bowling alley, said clamping means being connected to said frame for movement therewith; and means for applying fluid pressure separately to each of said pistons to cause the bowling pin grippers at each pin spot position to move toward each other to engage with standing bowling pins clamped to the bowling alley, said fluid pressure means being so constructed and arranged that when one gripper engages with a clamped bowling pin, it will stop while the other grippers will automatically continue their movement until they either engage standing bowling pins or each other.

10. In an automatic bowling pin setting machine, bowling pin engaging, lifting and replacing apparatus comprising, a support, ten pairs of pin gripping members depending from said support, ten pairs of cylinders for moving each pair of pin gripping members together and apart, pistons slidably mounted in each of said cylinders, connecting mechanism for connecting said pistons to the pin gripping members, and means for simultaneously applying fluid pressure from a single source to all of the cylinders at one time to bring the spaced pin engaging members of each pair together in gripping position.

11. In an automatic pin setting machine for use on bowling alleys, pin engaging, lifting and replacing mechanism comprising, a carrier table having narrow elongated slots formed in said table over each of the areas on a bowling alley where pins are spotted, shanks mounted for movement parallel to said table and extending through said slots, elongated pin engaging members mounted transversely at the lower end of each of said shanks, means for lowering said carrier table toward the bowling alley to engage the table with the tops of bowling pins standing on the alley to hold the same against the alley, and means for bringing said elongated pin engaging members into gripping engagement with the necks of the standing bowling pins held against the alley.

12. Automatic bowling pin gripping, lifting and respotting apparatus comprising, a platform mounted for movement toward and away from the bed of a bowling alley where bowling pins are positioned, resilient material mounted on and extending over substantially the entire under side of said platform, pairs of parallel rectilinearly movable pin engaging members extending below said platform for engaging the necks of stand-

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ing bowling pins, means for moving said platform toward the alley to embed the heads of standing bowling pins in said resilient material to hold the pins free from lateral displacement, means for moving the pin engaging members of each pair into and out of gripping engagement with the necks of standing bowling pins engaged by said resilient material, and means for moving said platform and the standing bowling pins held between said pin engaging members and said resilient material away from the bowling alley.

13. In an automatic pin setting machine for setting bowling pins on a bowling alley, apparatus for gripping, lifting and replacing standing bowling pins on an alley comprising, a platform mounted for movement to and away from the bed of a bowling alley, opposed pin engaging members positioned above each of the ten pin spot positions on a bowling alley, pressure means employing compressible fluid mounted on said platform for yieldably actuating each of said pin engaging members independently to move said opposed members in opposite directions into yieldable gripping engagement with standing bowling pins.

14. In an automatic pin setting machine for setting bowling pins on a bowling alley, apparatus for gripping, lifting and replacing standing bowling pins on an alley comprising, a platform adapted to be moved to and away from the bed of a bowling alley, pairs of opposed pin gripping members extending below said platform, compressible pneumatic means for yieldably moving each gripper member independently along a predetermined rectilinear path, means for holding standing bowling pins against the bed of a bowling alley, and mechanism for actuating said pneumatic means to cause the grippers of each pair to move in opposite directions along their predetermined paths of travel, to yieldably grip between at least two opposed grippers any pins standing in their path while they are held against the bed of the bowling alley and apply a predetermined yieldable pressure against any pin so engaged to effect a grip thereon, and means for raising and lowering said platform to lift and replace gripped pins on the bowling alley.

15. In an automatic pin setting machine for use on bowling alleys, pin engaging, lifting and replacing mechanism comprising, a carrier table constructed and arranged to travel toward and away from the bed of a bowling alley, a pair of opposed arms depending from said carrier table at each pin spot position on the alley, pin gripping bars mounted transversely on the lower end of said arms and arranged in parallel planes extending lengthwise of the alley, means for movably connecting said arms to the carrier table and offsetting the arms of adjoining pin spot positions with respect to each other to cause the adjoining arms to align with one another lengthwise of the alley when the adjoining bars are back to back and each bar engages the arm supporting the adjacent bar when in their most open position, and means for moving the opposed arms of each pair together to grip a pin between said pin gripping bars and away from each other to release any pin gripped therebetween.

16. Apparatus for gripping, lifting and replacing bowling pins on an alley comprising, a single unitary platform mounted for movement to and away from a bowling alley, rectilinearly movable arms depending from said platform, horizontal pin engaging members mounted transversely on the lower portions of said arms to form pairs of

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opposed parallel pin gripping members, means for lowering said platform into contact with standing bowling pins to engage and clamp standing bowling pins to the alley, and means for simultaneously moving the opposed horizontal pin engaging members by means of said arms into engagement with the clamped bowling pins.

17. Bowling pin engaging, lifting and replacing apparatus comprising, a lower support adapted to travel to and from the bed of a bowling alley, an upper support movably connected to said lower support for travel therewith, pin engaging devices positioned below said lower support and arranged lengthwise of the alley, arms attached to said pin engaging devices, the arms supporting adjoining pin engaging devices being staggered so that each device engages the arm supporting the adjacent device when said devices are back to back in open position, whereby the arms are aligned lengthwise of the alley, and means operated by the relative movement between said upper and lower supports to move said pin engaging devices by means of said arms into and out of engagement with standing bowling pins.

18. A bowling pin handling apparatus comprising, a movable platform positioned above the area of the bowling alley on which bowling pins are positioned, cushioning material mounted on the side of said platform facing the bowling alley, bowling pin engaging members projecting through said platform and beyond said cushioning material, fluid pressure means for moving pairs of said pin engaging members into and out of pin engaging position, mechanism for actuating said fluid pressure means, and a device for raising and lowering said platform to bring the cushioning material of said platform into and out of clamping engagement with bowling pins standing on a bowling alley.

19. An automatic bowling pin handling apparatus comprising, a platform movable toward

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and away from a bowling alley, cushioning material mounted on the side of said platform facing the bowling alley, a carriage support connected to said platform, means for mounting said platform and carriage support for movement relative to each other, a plurality of carriages positioned on said carriage support for free movement thereon in a direction parallel to the side of the platform, arms projecting through the platform beyond the cushioning material, pin engaging members mounted at the lower ends of said arms, actuating means interconnecting said carriages with said arms and arranged to be operated by relative movement between said carriage support and said platform to bring together and spread apart said pin engaging members, a control for operating said means for effecting relative movement of said carriage support and platform to bring said pin engaging members into and out of gripping relation with standing bowling pins, and a raising and lowering mechanism for lowering said platform and cushioning material into engagement with pins standing on a bowling alley to clamp standing pins between said cushioning material and said bowling alley and for raising the platform and the gripped bowling pins to permit removal of fallen pins from the bowling alley.

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