

Nov. 21, 1950

S. A. FRYE

2,530,385

BOWLING PIN RAISING AND LOWERING MECHANISM

Filed July 11, 1944

8 Sheets-Sheet 1

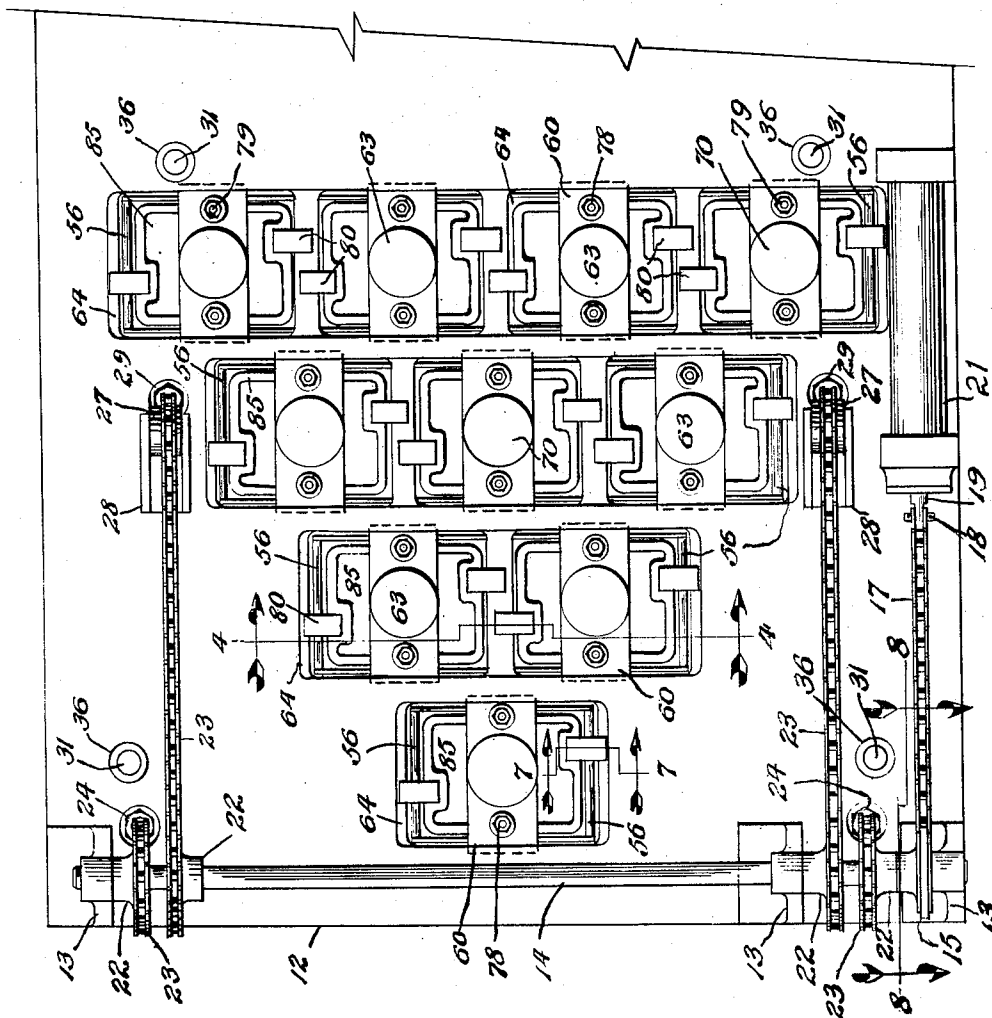


Fig. 1.

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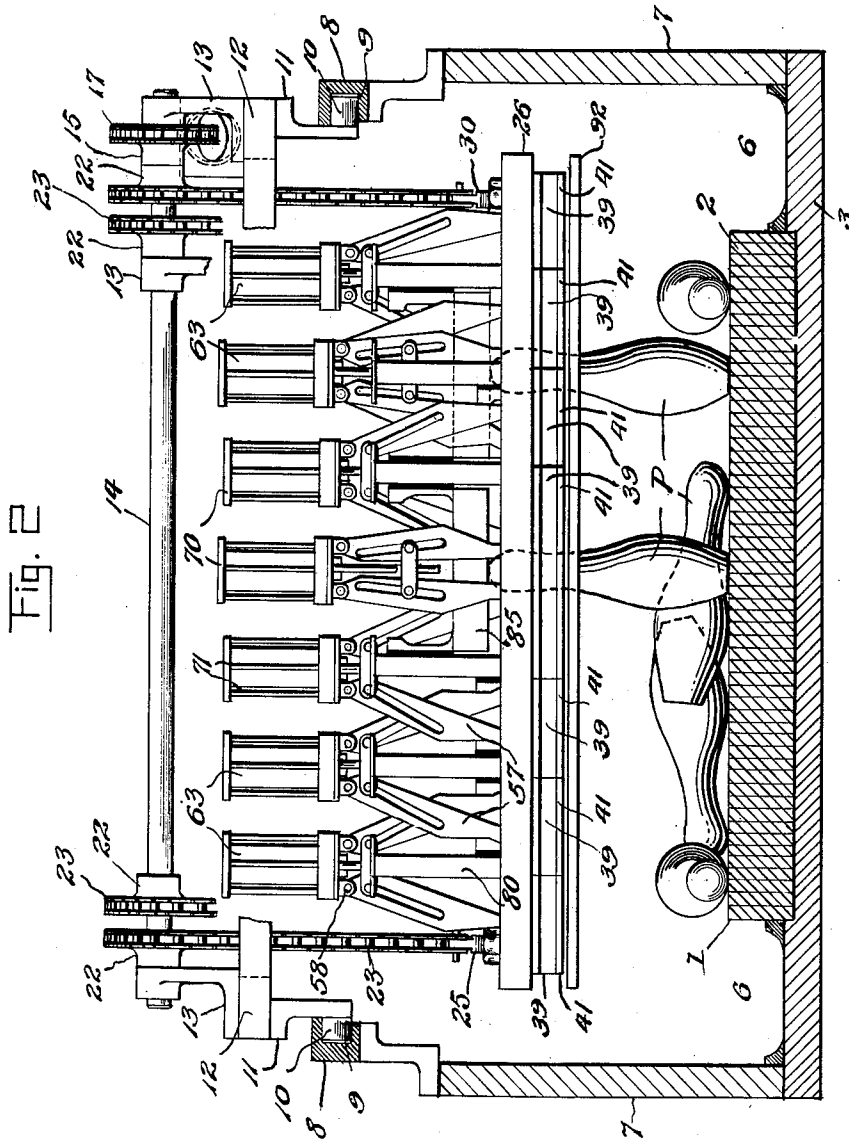
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BOWLING PIN RAISING AND LOWERING MECHANISM

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8 Sheets-Sheet 2



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BOWLING PIN RAISING AND LOWERING MECHANISM

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8 Sheets-Sheet 3

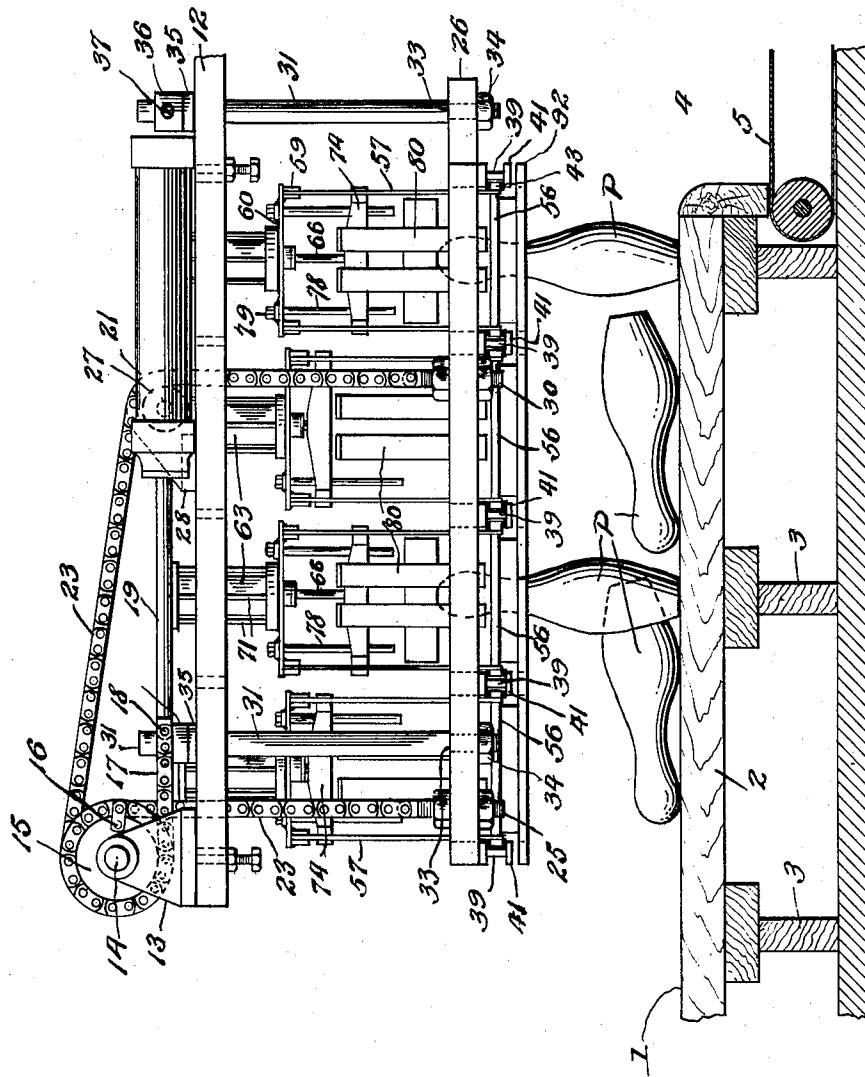


Fig. 3

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BOWLING PIN RAISING AND LOWERING MECHANISM

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8 Sheets-Sheet 4

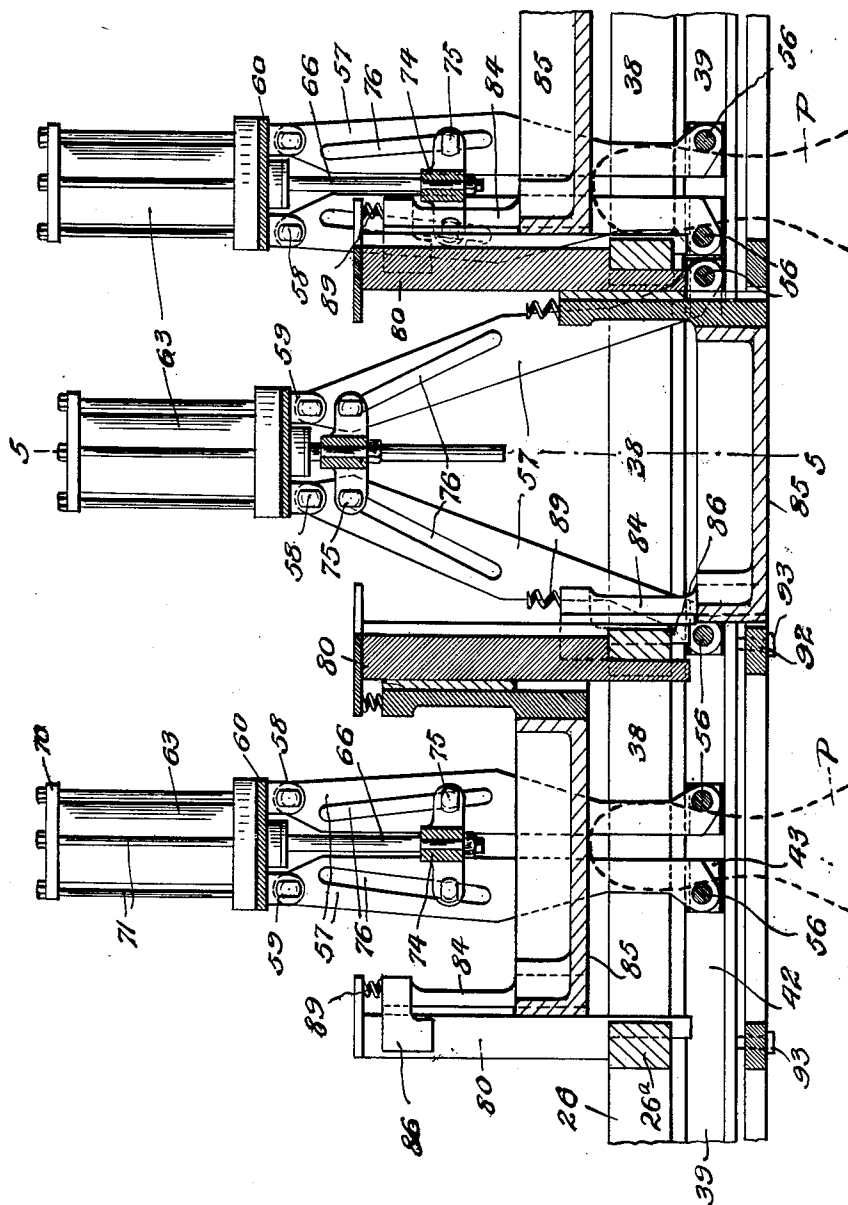


Fig. 4

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BOWLING PIN RAISING AND LOWERING MECHANISM

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8 Sheets-Sheet 5

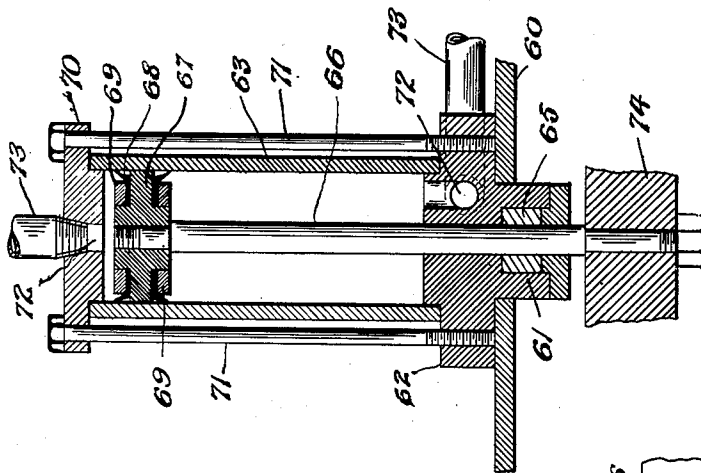


Fig. 6

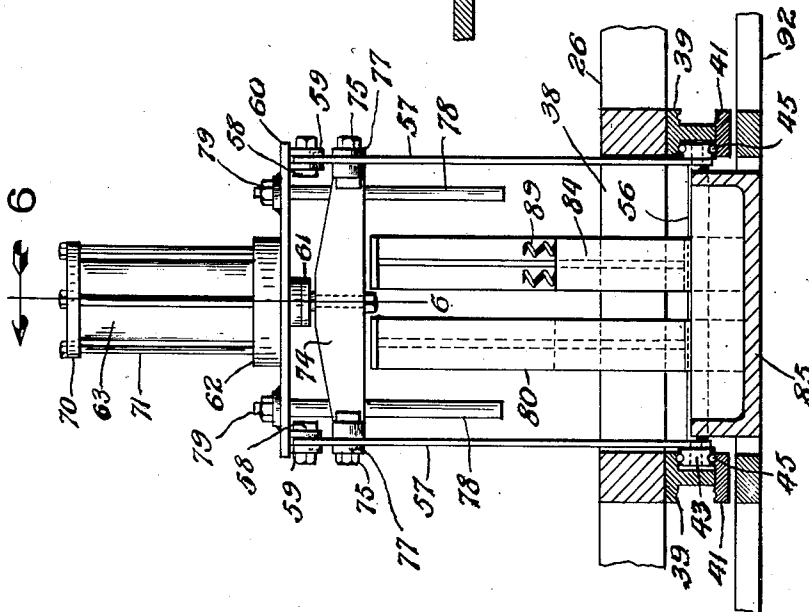


Fig. 5

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BOWLING PIN RAISING AND LOWERING MECHANISM

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8 Sheets-Sheet 6

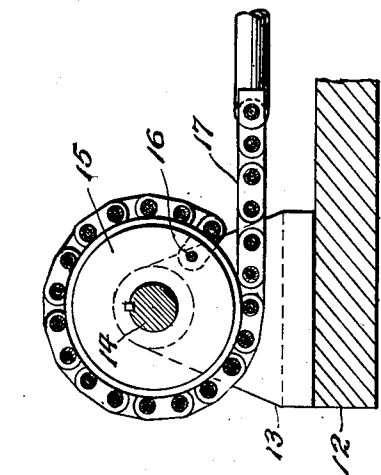


Fig. 8

Fig 9

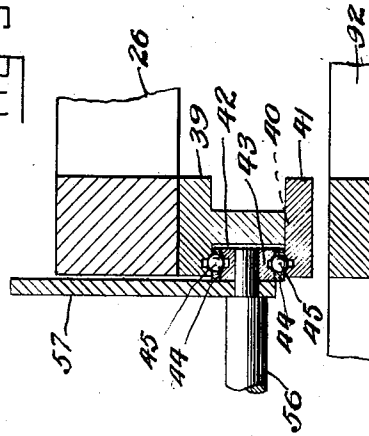
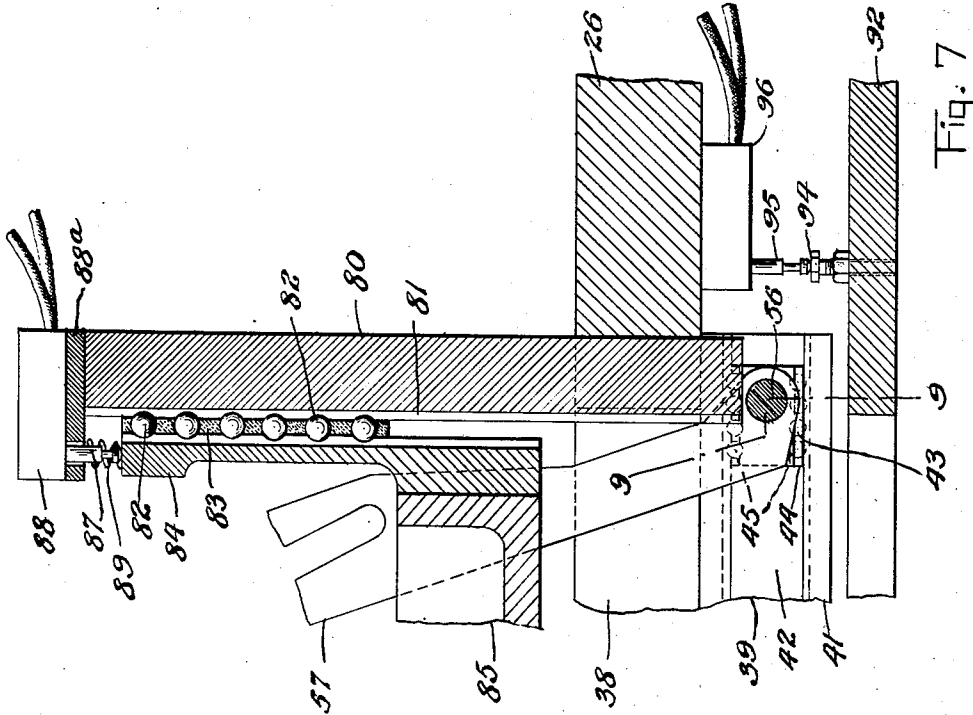


Fig. 7

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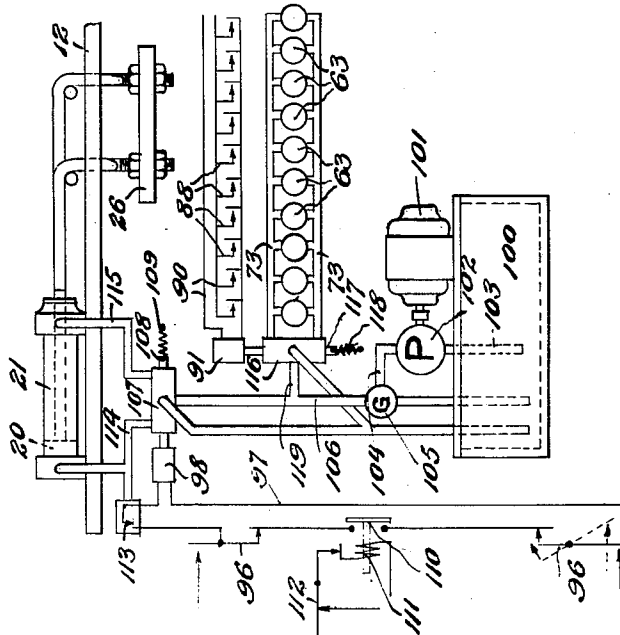
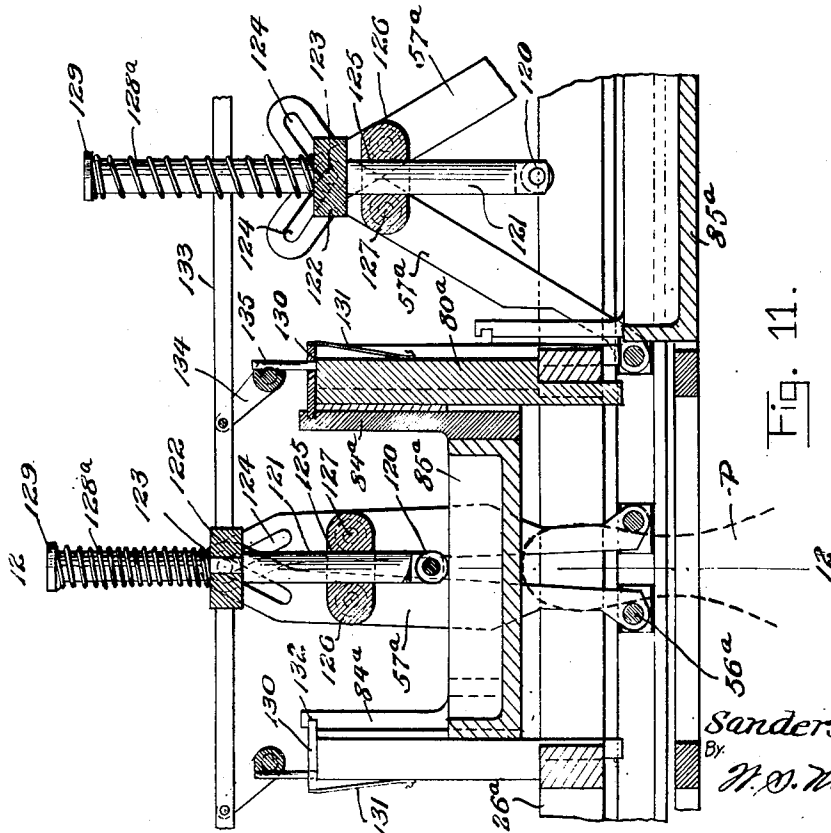
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BOWLING PIN RAISING AND LOWERING MECHANISM

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8 Sheets-Sheet 7



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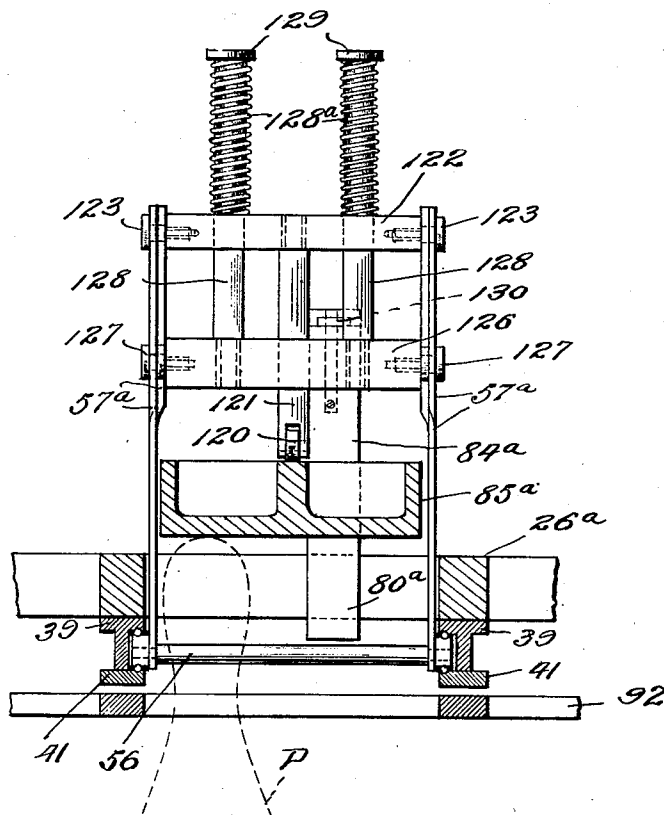
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BOWLING PIN RAISING AND LOWERING MECHANISM

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8 Sheets-Sheet 8

Fig. 12.



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UNITED STATES PATENT OFFICE

2,530,385

BOWLING PIN RAISING AND LOWERING
MECHANISM

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Application July 11, 1944, Serial No. 544,381

25 Claims. (Cl. 273—43)

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This invention relates to pin-handling mechanism for bowling alleys, having particular reference to automatic mechanism of the type dispensing with manual attendants in the operations of placing bowling pins on alleys and removing knocked down pins therefrom during and between periods of play.

In the game of ten pin bowling, the rules provide that a player is allowed in a given "frame" to roll two (sometimes three) balls over the surface of a bowling alley toward the standing pins arranged at the far end of the alley. It is a common occurrence that the first ball rolled by the player, upon striking the triangular group of standing pins, will not knock down all the pins but that one or more of such pins remains upright, depending upon how the rolled ball enters and traverses the group of pins. The pins which fall or topple over often remain on the bowling surface of the alley, and before the player can roll again, it is necessary for the fallen pin or pins to be removed from the alley so that they will not interfere with the second or succeeding balls bowled by a player in a given frame. Usually the removal of fallen pins is effected manually, and such devices that have been proposed for effecting such an operation mechanically have not proved practical or commercially useful so far as we are aware.

It is, therefore, an object of the invention to provide, in an automatic system for gathering and setting bowling pins, an improved mechanism, operative between intervals of ball rolling, to engage, grip and elevate pins remaining in a standing position on the alley in order that such pins may be held above the alley surface and in such spaced relation thereto as to permit the pins which have been knocked down by a rolled ball to be removed from the alley surface; and following such removal of the prone pins, to operate said mechanism so as to restore automatically the untoppled or vertical pins held by said mechanism to their upright positions on the alley surface, and releasing the mechanism from engagement therewith to present the pins to the bowler for further play.

It is another object of the invention to provide bowling pin gripping, raising and lowering mechanism of the character set forth and wherein said mechanism is so constructed that pins gripped and handled thereby are restored, after previous gripping and elevation, to substantially exactly the same positions on the bowling alley as the pins assumed immediately prior to having been engaged by said mechanism.

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In connection with this latter object, it may be noted that often during the game of bowling, the first ball rolled in a given frame will leave, upon penetrating a group of such pins, one or more pins in an upright position. Such an upright pin (or pins) quite often is dislodged laterally with respect to its normal or "spot" position on the alley, and its final standing position may be either favorable or unfavorable to further play on the part of the bowler. Therefore, it is important that after the prone pins have been cleared from the alley, that the elevating mechanism should function to restore the upright pin (or pins) gripped thereby to the precise position which the same occupied immediately before being engaged by the mechanism, and, in accordance with the present invention, improved means are provided for carrying out such an operation in a purely automatic manner.

For a further understanding of the invention, reference is to be had to the following description and the accompanying drawings, wherein:

Fig. 1 is a top plan view of the bowling pin-lifting mechanism comprising the present invention;

Fig. 2 is a front elevational view of the pin-lifting mechanism and showing the associated bowling alley in transverse section;

Fig. 3 is a side elevational view of the pin-lifting mechanism and disclosing the associated alley in vertical section;

Fig. 4 is a vertical transverse sectional view taken on the plane indicated by the line 4—4 of Fig. 1;

Fig. 5 is a vertical transverse sectional view taken on the plane indicated by the line 5—5 of Fig. 4;

Fig. 6 is a vertical sectional view taken through one of the fluid actuated cylinders for operating the pin-gripping means, the plane of the figure being indicated by the line 6—6 of Fig. 5;

Fig. 7 is a detail sectional view on the line 7—7 of Fig. 1;

Fig. 8 is a sectional view on the plane disclosed by the line 8—8 of Fig. 1;

Fig. 9 is a sectional view on the line 9—9 of Fig. 7;

Fig. 10 is a diagrammatic view disclosing the electrically controlled fluid actuated means for the operation of my improved bowling pin raising and lowering mechanism;

Fig. 11 is a vertical sectional view disclosing a modified type of pin-gripping mechanism;

Fig. 12 is a sectional view on the line 12—12 of Fig. 11.

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The automatic bowling pin gripping and raising and lowering mechanism constituting the present invention is adapted primarily for use in conjunction with automatic pin-gathering and setting machines which dispense with the services of manual attendants or pin boys employed in most bowling establishments. The present invention, however, is concerned with a pin gripping and raising and lowering mechanism for use in conjunction with such systems, whereby to permit pins which have been knocked down during play to be removed from the alley without interfering with the active positions of upright pins remaining on the alley after a given play. Therefore, the present disclosure is limited to the pin-gripping, raising and lowering mechanism per se without reference to other associated mechanisms, such as pin-gathering, setting and ball-returning devices, although it will be understood that the present invention is adapted for use in conjunction therewith.

In the drawings, the numeral 1 designates the pin-receiving region of a standard bowling alley, the alley being composed of the hardwood flooring 2 supported on suitable base members 3. The end of the alley terminates in a pit 4 in the bottom of which may be arranged an endless conveyor 5 adapted to convey pins removed from the alley to the hopper of a pin-setting mechanism, not shown. At each side of the flooring 2, there may be provided the usual ball gutters 6 and, adjacent to the region 1, the alley is provided with upstanding side boards 7.

Mounted upon the upper edges of the side boards 7 are stationary, horizontally disposed tracks 8, the latter being formed with open sided channels 9. Movably received within these channels are rollers 10 which are provided at spaced intervals on rails 11 which depend from a horizontally positioned bed plate 12. This plate is shiftable longitudinally of the channels provided in the tracks 8 in order to bring the pin-gripping, raising and lowering mechanism constituting the present invention into vertical registration with the pin-receiving region of the bowling alley and, also, when shifted, to bring the pin-setting mechanism carried thereby, and which has not been illustrated herein, into selective registration with the region 1.

Mounted upon the upper surface of the bed plate at the forward edge of the latter is a plurality of spaced bearing brackets 13, the latter supporting for rotation a horizontally disposed shaft 14. Fixed to this shaft at one end thereof is a wheel 15 having a plain circular and un-toothed peripheral edge. Linked as at 16 to the wheel 15 and trained about the periphery of the latter is one end of a chain 17, the opposite end of this chain being pinned as at 18 to the outer end of a piston rod 19. The inner end of this piston rod is connected with a piston 20 which is mounted for movement in a cylinder 21, the said cylinder being mounted on the upper surface of the bed plate 12 contiguous and parallel to one of the side edges thereof. A fluid under pressure enters and leaves, through the operation of suitable valve means, the ends of the cylinder on opposite sides of the piston 20 (Figure 10), in order to effect controlled reciprocation of the latter. It will be observed that the reciprocation of the piston imparts movement to the chain 17, and since the latter is connected with the wheel 15, controlled rotation may be imparted to said wheel and its shaft 14.

Also mounted on the shaft 14 for rotation therewith are a plurality of wheels 22, corre-

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sponding to the wheel 15. The wheels 22 have secured thereto the forward ends of a plurality of chains 23, four in number. The forward pair of the chains 23 pass downwardly through guide openings 24 provided in the bed plate 12 and at their lower ends are connected with eyes provided in the upper ends of a plurality of bolts 25, these bolts having threaded engagement with a vertically adjustable, horizontally disposed pin-lifting frame 26. Also, the rearwardly extending pair of the chains 23 pass around rollers 27 supported by bearing brackets 28 mounted on the upper surface of the bed plate 12. After passing around the rollers 27, the rearwardly extending pair of chains 23 are directed downwardly through openings 29 formed in the bed plate and have their lower ends, in turn, connected with eyes provided in the upper ends of a pair of bolts 30 which have threaded connection with intermediate portions of the pin-lifting frame at the sides of the latter.

The frame 26 is guided for confined vertical movement by the provision of a plurality of vertically disposed rods 31. The lower ends 32 of these rods are diametrically reduced to provide seating shoulders 33, Figure 3, the reduced lower ends extending through openings provided in the frame 26 and being threaded for the reception of securing nuts 34. The upper ends of the rods 31 are slidably received in bushings 35, which are carried by the bed plate 12. Secured to the upper ends of said rods are adjustable collars 36, which engage with the upper surfaces of the bushings 35 to limit downward movement of the frame 26, the said collars being held in fixed positions on the upper ends of said rods by means of set screws 37 or their equivalent. Preferably, four of the rods 31 are used, the same being connected with the four corners of the frame 26.

The pin-lifting frame 26 is provided with a plurality of rectangular openings 38, which are arranged in triangular order so that they will register with the spotted positions of the ten pins P placed at the end of the alley 1. At the sides of each of these openings, the frame 26 is provided with fixed horizontally extending T-shaped bars 39, the lower edges of these bars being connected as at 40 with removable and stationary horizontally extending strips 41. The strips 41 coact with the bars 39 on each side of each of the openings 38 to form channels 42. See Figures 7 and 9. For each of the openings 38, the channels 42 associated therewith carry longitudinally movable runners. The upper and lower edges of each of these runners are provided with ball-retaining strips 44, the latter receiving antifriction ball bearings 45 by means of which the runners move freely in their respective channels. Each complementary pair of runners carries the diametrically reduced ends of a bowling pin gripping rod 56, the latter extending transversely across the opening 38.

The rods 56 are positioned in openings provided in the lower ends of a plurality of rod-actuating arms 57. A pair of these arms is arranged at each side of each of the frame openings 38. The upper ends of these arms are pivotally mounted on bolts 58, the latter passing through registering openings provided in ears 59 which depend from a plurality of cross plates 60. Intermediately of their length, each of the plates 60 is formed with an opening for the reception of a circular extension 61, the latter being integrally provided on the base members 62 of a plurality of vertically disposed cylinders 63.

These cylinders are arranged centrally above the openings 38 of the frame 26 and project through rectangular openings 64 provided in the bed plate 12. By means of the runners 43 and the arms 57, the cylinders may move longitudinally of the openings 64 from one end of the latter to the other, depending upon the positions of the standing bowling pins gripped by the rods 56.

The extensions 61 of the cylinder base members may be provided with fluid-retaining packings 65 which engage with slidable piston rod 66 of each of the cylinders 63. The upper end of each rod 66 is shouldered for the reception of a piston 67 slidably mounted in each cylinder. Each of these pistons carries flexible packing disks 68, which engage with the internal cylinder walls, as usual, to prevent fluid seepage from one side of each piston to the other, these disks being held in place by means of clamping rings 69. The upper end of each of the cylinders 63 is provided with a removable top closure member 70, each of the latter being joined with the associated base member 62 by means of vertical tie bolts 71. The base member 62 and the top member 70 of each cylinder are provided with fluid passages 72, which communicate with valved fluid conducting lines 73, whereby a fluid may be delivered under pressure, as desired, to either end of each cylinder to control the direction of movement of the piston 67 contained therein.

The lower end of each of the piston rods 66 is connected with a cross head 74. The outer ends of these cross heads terminate in lateral extensions which are apertured to receive bolts 75. The shanks of these bolts are received in elongated slots 76 provided in the four arms 57 associated with each of the cylinders 63. Also, the shanks of the bolts 75 pass through apertures formed in links 77 arranged at the outer sides of the arms 57.

The cross plates 60 are provided with depending guide pins 78. These pins are received in openings formed in each of the cross heads 74, the upper ends of said pins being shouldered and provided with reduced threaded extensions which project through openings provided in the cross plates. These threaded extensions receive nuts 79 which hold the pins in rigid positions in connection with said cross plates. It will be evident that the pins constitute guides providing for confined vertical movement of the cross heads 74, preventing turning or twisting thereof as the same are raised or lowered by the operation of the cylinder pistons.

Carried by the pin-lifting frame 26 on opposite sides of each of the openings 38 therein is a pair of extensions 80. The inner faces of these extensions are provided with vertical channels 81, (Figure 7) which receive antifriction elements 82 mounted in openings formed in retaining strips 83. These strips are fixed to the outer surfaces of upright bar extensions 84 formed at their lower ends with pin-engaging heads 85. Normally, the heads 85 are seated by means of stops 86 which are secured to the uprights 84 and engage the upper surfaces of the frame 26.

When the frame 26 is lowered by the operation of the cylinder 21 and the rotation of the shaft 14, the ensuing downward movement causes the heads 85 to engage with the upper ends of the bowling pins P which remain standing on the alley 1. This engagement stops the descent of the engaged head or heads during further downward movement of the frame 26. If the bowling pin or pins below a given head should be

in a prone position, as shown in Fig. 2, the operational position of such a head with respect to the frame 26 remains undisturbed. However, when one or more of the heads 85 contacts the end of a bowling pin in registration therewith, during the descent of the frame 26, the bar extensions 84, as shown in Fig. 7, come into engagement with an operating plunger 87 of a circuit controlling switch 88. These switches are mounted on the upper edges of the frame extensions 80, there being one of such switches for each of the cylinders 63.

When upright pressure, due to the presence of a standing pin P raises the head 85 to nearly its maximum vertical limit, a spring 89, which is secured to the extension 84, comes into contact with the switch plate 88a, the latter being mounted on the upper end of the upright 80. Under these conditions, the spring 89 compresses and imparts holding pressure to the pins P as well as cushioning the engagement of extension 84 with the switch plunger 89. Such engagement operates one or more of the switches to complete one or more of a plurality of electrical circuits 90. Included in these circuits is a solenoid valve 91 which controls the flow of fluid under pressure to each of the cylinders 63 in order to force the pistons 67 therein downwardly. While fluid under pressure is thus introduced into all of the cylinders 63 simultaneously, it is only those cylinders which are disposed above standing bowling pins P that function to close the arms 57, so that the gripping rods 56 may be brought into engagement with the head portions of standing bowling pins to grip the latter, since the heads 85 when in their lowered position prevent inward movement of the pin-gripping rods 56.

When this engagement has been secured, the flow of the actuating fluid to the cylinder 21 is reversed, so that the shaft 14 will be rotated in a direction to elevate the frame 26, and, together therewith, the bowling pins held in contact with the arm-carried rods 56. The bowling pins so gripped are raised from the alley floor a suitable distance, for example, 12 inches. With the bowling pins so elevated, and the frame 26 retained in a stationary position, the fallen pins may be removed from the alley surface by any suitable means, not shown. Following the removal of the fallen pins, the frame 26 is again lowered to redeposit the vertically disposed pins held thereby on the alley surface. When so replaced, the cylinders 63 are actuated to release the pins and the frame 26 is again elevated to its normal or starting position.

A particular feature of the present invention resides in the fact that the pins gripped by the mechanism are redeposited on the alley surface in substantially exactly the same positions as they occupied immediately prior to their initial engagement with the arm-carried rods 56. Thus when a bowler delivers the first ball of a given frame, it often happens that one or more pins will remain standing. The standing pin may be dislodged from its original position by the delivered ball, and this position may be favorable or unfavorable to the bowler when the second ball of the frame is rolled. Therefore, the pin-handling mechanism comprising the present invention has been so designed that when the standing pin or pins are elevated, as described, to permit of the removal of the fallen pins, the said standing pins will be returned to the alley in virtually the same positions as they occupied prior to lifting thereof. It will be understood that these

positions of the pins, for reasons specified, may be laterally offset with respect to the normal or spotted positions which the pins occupied prior to the rolling of the first ball of a given frame.

For example, as shown in Fig. 4, as the frame 26 descends, a bowling pin positioned as at the far right of Fig. 4 contacts one of the heads 85 immediately thereabove, arresting the descent of the engaged head and closing the electrical circuit 90 associated therewith to cause actuation of the pistons contained in the cylinders 63. The descent of the piston rod 56 immediately above the pin-engaged head first causes the arms 57 to operate so that the rod 56 thereof at the left of the pin so engaged comes into contact with the bowling pin. Since the pin cannot move laterally, as it is clamped by the head 85 engaging therewith on the floor of the bowling alley, the left rod 56 stops as soon as it engages the bowling pin. Thereafter, further descent of the piston over the engaged head causes the rod 56 at the right of the bowling pin to move a considerable distance inwardly before it engages said pin. This movement, through the use of the ball bearing runners 42, is easily effected, and it will be observed that the cylinder 63 over the engaged head shifts laterally with the movement of the rod 56 at the right of the engaged pin, such shifting movement of the cylinder continuing until its axis is in vertical registration with the engaged pin. By this arrangement, the standing pin is gripped by the apparatus in the position which it occupies on the floor surface of the alley, is lifted and then restored to the alley surface without lateral displacement. Each of the heads 85 may possess dimensions of the order of 9 by 10½ inches, so that considerable lateral dislodgement of the standing pin or pins may take place and yet vertical registration of the head or heads 85 therewith retained.

During the descent of the frame 26 toward its pin-engaging position, if it should happen that a standing pin is aligned vertically with those portions of the frame 26 marginally bounding the openings 38 therein, further descent of the frame 26 is arrested automatically. This is accomplished by means of a switch-actuating grid 92 which is supported for limited vertical movement by and beneath the frame 26 by means of headed pins 93. The bars of the grid 92 are so disposed as to register exactly with the bar elements 26a of the frame 26. The engagement of the upper end of a bowling pin with the grid 92 causes an adjustable screw or screws 94 to contact a movable operating plunger 95 of one or more circuit-controlling switches 96 carried by the frame 26. A plurality of the switches 96 may be used to compensate for variations in position of the grid 92 from the horizontal. Such operation of one or more of the switches 96 interrupts an electrical circuit 97 in which a solenoid valve 98 is positioned, the valve 98 being employed to control the flow of fluid under pressure to the cylinder 21, thus causing the closure of said solenoid valve and preventing further descent of the frame 26 and the mechanism carried thereby.

To supply the cylinders 21 and 63 with fluid under pressure at timed intervals, there has been provided, as shown in Fig. 10 a diagrammatic view of the electrically actuated hydraulic control mechanism. This mechanism comprises an oil reservoir 100. Mounted on this reservoir is an electric motor 101 which operates a pump 102. The inlet 103 of this pump extends into the body of

liquid contained within the reservoir, while the discharge side of the pump leads, as at 104, to a combined pressure relief valve and gauge 105. Under normal pressure conditions, fluid passes from the valve 105 through a pipe line 106, which leads to a slide valve 107. The valve 107 is provided with a stem 108, one end of which is connected with a spring 109, while its other end functions as a core or armature in the solenoid 98. The solenoid 98 is positioned in the electric circuit shown at 97 and this circuit is closed by a relay switch 110, the latter having a coil 111 joined with a circuit 112. This circuit is energized by the bowling ball striking the backboard, not shown, of the bowling alley. The impact of the bowling ball on the backboard operates a switch which closes the circuit 112, thus exciting the coil 111 of the relay switch and causing the latter to sustainingly hold the head 110 of the switch in a position to close the circuit 97 until the coil 111 is deenergized. Also positioned in the circuit 97 is a normally closed switch 113 which is responsive to fluid pressure transmitted through the pipe line 114 leading from the valve 107 to one end of the cylinder 21.

It will be evident that when the relay switch 110 is closed, the solenoid 98 will be energized, attracting the stem 108 of the piston valve 107 against the influence exercised thereon by the spring 109. This causes the valve 107 to be positioned so that fluid under pressure will be transmitted through the line 106, valve 107 and the pipe line 114 to the cylinder 21, advancing the piston 20 in said cylinder in a direction to cause the lowering of the pin-lifting frame 26. Assuming that one or more bowling pins remain standing on the alley surface 1, such standing pin or pins will engage with the heads 85, and during descent of the frame 26 toward its fully lowered position, the extensions 84 of said heads will engage the switch or switches 88 in registration with the standing pins. This operation completes the circuit 90 in which the solenoid 91 is located. This solenoid is employed to operate a balanced pressure sliding valve 116, the stem 117 of said last-named valve being at one end formed to constitute the core or armature of the solenoid 91, while at its other end, the stem 117 is retracted when the solenoid is deenergized by a coil spring 118. When one or more of the switches 88 is closed, the circuit 90 is complete, energizing the coil of the solenoid 91 and attracting the stem 117 of the valve 116 to cause fluid to pass from the pressure line 106 and through a communicating branch 119, through the valve 116 and thence through the pipe connections 73 to the upper ends of each of the cylinders 63. Thus with the frame 26 in its lowered position in registration with one or more standing bowling pins, means are provided whereby the pistons 67 in the cylinders 63 are moved downwardly to bring the rods 56, as previously explained, into gripping contact with the upper end portions of the standing pin or pins. As the fluid pressure builds up on the pressure switch 113 by the continued operation of the pump 102, the switch 113 is opened to break the circuit 97, thus deenergizing the solenoid coil 98 and diverting the flow of fluid from the pipe extension 114 to the pipe extension 115, which causes reverse movement of the piston 20 in the cylinder 21 and elevates the cylinder frame 26, carrying with it the engaged bowling pin or pins. Fluid pressure on the switch 113 is maintained by the closing of the valve 107 with respect to the pipe line 114.

When the cylinder frame is thus elevated, a sweeper mechanism, not herein shown, functions to remove the fallen pins from the surface 1 of the bowling alley, and upon return movement of this sweeping mechanism to its normal or initial position, the circuit 97 is again closed to cause the frame 26 to descend through movement of the piston 20. When the pins supported by the rods 56 and arms 57 are redeposited on the alley surface 1, the solenoid 91 is deenergized by the opening of the circuit 98 through the operation of an automatic sweep mechanism, not shown, and the valve 116, under the influence of the spring 118, assumes a position providing for upward movement of the pistons 67 in the cylinders 63, releasing the pins on the same spots from which they were removed by the previous operation of the gripping and lifting mechanism. By the operation of the pressure switch 113, which is open as the result of building up of fluid pressure thereon as described hereinabove, the circuit 97 is then opened and the cylinder frame is again elevated to its normal or raised position, completing the operating cycle.

In the modified form of the invention disclosed in Figures 11 and 12, in lieu of employing the cylinders 63 for operating the heads 85, I utilize spring operated means. Thus, in Fig. 11, when the bowling pin shown at P is brought into contact with the under surface of the head 85a upon descent of the frame 26a, the upper surface of the head 85a is brought into contact with a roller 120. This roller is mounted on the lower end of a plunger 121, the upper end of said plunger being connected with a top bar 122. Each of the bars 122 at its ends is provided with pins 123 which project into slots 124 provided in the lever arms 57a. The plungers 121 are slidably received in openings 125 formed in cross members 126, the ends of these cross members being equipped with pins 127 upon which the arms 57a have swinging movement. The cross members 126 carry upstanding stems 128, the latter being headed at their upper ends as at 129 and against the under sides of these heads the upper ends of the springs 128a bear, the lower ends of said springs bearing on the cross bars 122.

It will be seen that as the heads 85a move upwardly to engage with the pin or pins P or, stated in another way, if the heads 85a remain stationary while the frame 26a and its associated parts move downwardly, the pins 123 will be advanced in the slots 124 against the pressure of the springs 128a to cause the arms 57a to rock about their pivots 127, and thereby bring the gripping rods 56a at the bottom of said arms into holding contact with the pins P. When the heads 85a have been fully elevated, or the frame 26a fully lowered, sliding latch plates 130, carried by the frame uprights 80a, are forced by the pressure of flat springs 131 into grooves 132 formed in the vertical head extensions 84a, thus holding the heads 85a in their elevated positions so that the pins P can be lifted from the floor, and until the pins are again deposited on the alley floor surface. Then a solenoid attracts a link 133 and reciprocates the same. The link is provided with arms 134 which engage with upstanding pins 135 carried by the plates 130, removing the plates from the grooves 132, so that the heads 85a may return to normal positions through expansion of the springs 128a.

I claim:

1. Bowling alley apparatus comprising a vertically movable frame mounted above the pin-receiving section of an associated alley, said frame

being formed with a plurality of pin-receiving openings disposed for registration with bowling pins standing on the alley, vertical and horizontal guides formed with said frame adjacent to each of said openings, a movable head arranged in each of said openings and cooperative with said vertical guides, each of said heads having a substantially flat extended undersurface providing a wide contact clamping area relative to the head of a pin standing on or off-spot on said alley, means for raising and lowering said frame to bring the under surfaces of said heads into clamping engagement with the upper ends of bowling pins standing on said alley whereby to maintain the heads clamping pins relatively stationary during lowering movement of said frame, movable pin-gripping members, means mounting said gripping members for linear movement in said horizontal guides, and positively actuated means operated by a head or heads in response to the downward movement of said frame relative to a pin or pins clamped by said pin clamping head or heads upon said alley against displacement thereon for effecting the movement of said grippers in said horizontal guides into pin-gripping engagement with an on or off-spot standing pin or pins clamped by said head or heads on said alley.

2. Bowling alley apparatus comprising a vertically movable frame mounted above the pin-receiving section of an associated alley, said frame being formed with a plurality of pin-receiving openings, each of the latter having horizontally and vertically disposed guides, a pin-engaging head slidably mounted in the vertical guides of each of said openings, a pair of pin-gripping elements slidably mounted in the horizontal guides of each of said openings, a relatively stationary support arranged above said frame, means mounted on said support for raising and lowering said frame, a pair of pivoted arms connected with the pin-gripping devices of each of said openings, fluid actuated means for moving said arms to bring said gripping devices into holding contact with bowling pins engaged with said heads, and means operative upon the descent of said frame and the engagement of one or more of said heads with a standing bowling pin or pins to cause operation of said fluid-actuated means.

3. In automatic bowling alley apparatus, a support arranged over the pin-receiving section of an associated alley, a pin-raising and lowering frame arranged beneath said support, means mounted on said support for raising and lowering said frame, the latter being formed with a plurality of pin-receiving openings, a vertically movable pin clamping head supported by said frame in registration with each of said openings, each of said heads provided with a pin clamping surface having a wide contact pin clamping area substantially coextensive with each of said openings, opposed spaced relatively movable pin-gripping devices carried by said frame in registration with each of said openings, and means actuated by relative movement between said frame and heads for positioning said heads in pin clamping relationship with any standing on or off-spot pins, and operating connections between said heads and opposed pin-gripping devices responsive to the downward movement of said frame after said heads have clamped any standing pins on said alley against displacement during downward movement of said frame for moving said gripper devices into holding engagement with said pins clamped by said heads on said alley;

4. Automatic bowling pin handling apparatus comprising a support arranged over the pin-receiving section of a bowling alley, a frame having a multiplicity of pin-receiving openings formed therein, means carried by said support and connected with said frame for raising and lowering the latter relative to the pin-receiving section of the alley, a pin-contacting head slidably supported for vertical movement by said frame in registration with each of said openings, said heads having flat under surfaces, horizontally and linearly movable pin-gripping devices carried by said frame in registration with each of the openings therein, an operating cylinder for each pair of said devices, slotted arms pivotally connected at their upper ends with said cylinders and at their lower ends with said gripping devices, a fluid actuated piston in each of said cylinders, a rod extending from each of said pistons, and a crosshead carried by the outer end of each of said piston rods, said crosshead having engagement with the slots in said arms, whereby upon reciprocation of the associated piston said arms are oscillated to bring said gripping devices into and out of engagement with standing bowling pins engaged with one or more of said heads.

5. Automatic bowling pin handling apparatus comprising a support arranged over the pin-receiving section of a bowling alley, a frame having a multiplicity of pin-receiving openings formed therein, means carried by said support and connected with said frame for raising and lowering the latter relative to the pin-receiving section of the alley, a pin-contacting head slidably supported for vertical movement by said frame in registration with each of said openings, said heads having flat under surfaces, horizontally and linearly movable pin-gripping devices carried by said frame in registration with each of the openings therein, an operating cylinder for each pair of said devices, slotted arms pivotally connected at their upper ends with said cylinders and at their lower ends with said gripping devices, a fluid actuated piston in each of said cylinders, a rod extending from each of said pistons, a crosshead carried by the outer end of each of said piston rods, said crosshead having engagement with the slots in said arms, whereby upon reciprocation of the associated piston said arms are oscillated to bring said gripping devices into and out of engagement with standing bowling pins engaged with one or more of said heads, and means actuated by movement of said frame relative to a pin-contacting head or heads to cause flow of fluid under pressure into said cylinders.

6. Automatic bowling pin apparatus comprising a support arranged above the pin-receiving section of a bowling alley, a vertically movable pin raising and lowering frame disposed beneath said support, means mounted on said support and connected with said frame for raising and lowering the latter, a plurality of vertically movable heads carried by said frame, said heads having flat under surfaces adapted for engagement with the upper ends of bowling pins standing on said alley when said frame is lowered, a pair of pin-gripping devices carried by said frame in registration with each of said heads, guide devices formed with said frame in which said gripping devices are disposed for horizontal and linear movement, upstanding actuating units for said devices, said units being shiftable horizontally into vertical registration with a bowling pin in

contact with any part of the flat under side of an associated head, and means disposed to cause relative movement between one or more of said heads and said frame upon descent of the latter to actuate said units to bring said gripping devices into holding engagement with one or more pins in contact with said heads.

7. Bowling alley apparatus comprising a vertically movable frame mounted above the pin-receiving section of an associated alley for movement towards and from said alley, a plurality of vertically movable pin clamping heads carried by said frame, said heads being operative upon descent of said frame to engage with the upper ends of standing bowling pins positioned on the alley in registration therewith and clamp said pins against lateral displacement on said alley, each of said heads having flat extended under surfaces providing a wide contact area with said pins, a pair of opposed horizontally and linearly movable pin-gripping elements carried by said frame in registration with each of said heads, movable support means mounting each of said pairs of gripping elements for movement in a plane substantially parallel with the plane of said clamping surface of a clamping head, and mechanism operative in response to the downward movement of said frame and after a head has engaged and clamped a standing pin on said alley against movement along said alley for shifting said support means adjacent a head clamping a pin to center said gripping elements relative to a clamped standing pin, including means for moving said elements into gripping engagement with the opposite sides of the head of said clamped standing pin.

8. In automatic pin-raising and lowering mechanism for bowling alleys, a support disposed over the pin-receiving section of an associated bowling alley, a frame arranged beneath said support and above said alley, means carried by said support and connected with said frame for raising and lowering the latter relative to said alley, said frame being formed with a multiplicity of regularly spaced pin-receiving openings, spaced uprights carried by said frame in registration with each of said openings, a pin-contacting head slidably supported with said frame in registration with each of said openings, each of said heads being formed with vertical extensions complementary to the uprights of said frame, anti-friction guide devices disposed between said frame uprights and the vertical extensions of said heads, horizontal guides carried by said frame adjacent to each of said openings, runners slidably mounted for horizontal and linear movement in said guides, a pair of pin-gripping rods carried by said runners for each of said frame openings, slotted ears having their lower ends connected with said rods, a fluid pressure cylinder in registration with each of said openings, pivotal connections between the upper ends of said arms and said cylinders, a piston mounted in each of said cylinders, a piston rod extending downwardly from each of said pistons and a crosshead connected with the lower end of each of said piston rods, said crosshead having connections with the slots in said arms, whereby upon reciprocation of an associated piston, said crosshead will be actuated to move said arms to bring said pin-gripping rods into and out of engagement with standing bowling pins contacting said heads.

9. Bowling pin handling apparatus comprising a support disposed over the pin-receiving section

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of a bowling alley, a frame arranged beneath said support and above said alley, a plurality of movable pin-engaging and clamping heads carried by said frame, a set of opposed elongated grippers coacting with each of said heads, supports mounting each of said sets of grippers for movement in a substantially horizontal plane beneath a head engaging and clamping a pin against movement on said alley, mechanism carried by said support for lowering said frame thereby bringing said heads into clamping engagement with pins standing on or off-spot on said alley, and operating mechanism for said sets of grippers, including means responsive to the continued downward movement of said frame towards said alley after the clamping of standing pins by said heads against movement on said alley for actuating said gripper operating mechanism to cause said opposed grippers of said sets of grippers to move into gripping and holding engagement with said clamped pins, means operable upon the gripping of said pins to cause said first-named mechanism to elevate said frame and the pins held in connection therewith, and means operable subsequent to the raising of said frame to re-lower the same to restore said pins to the bowling alley surface in precisely the same positions as the said pins occupied when first engaged by said heads.

10. Bowling pin manipulating apparatus comprising a bowling pin respotting frame, means for moving said frame to and from the pin supporting bed of a bowling alley, a plurality of independently movable pin engaging and clamping heads mounted on said frame, each of said heads having an extended undersurface providing a substantial clamping area said heads being constructed and arranged for independent differential vertical movement in accordance with the height of pins engaged and clamped thereby upon said bed, a set of opposed pin grippers coacting with each of said heads, gripper operating mechanism, and means operative in response to the downward movement of said frame after a head of a pin has been engaged and clamped on said bed and the relative upward movement of said head clamping said pin on said bed for actuating said gripper operating mechanism for moving said grippers of each set of grippers coacting with a head clamping a standing pin into gripping and holding relation relative to said clamped pin and means for maintaining each set of grippers in gripping engagement with a pin gripped thereby.

11. Bowling pin manipulating apparatus comprising a bowling pin respotting frame, means for moving said frame to and from the pin supporting bed of a bowling alley, a plurality of independently movable pin-clamping heads mounted on said frame, each of said heads having a substantially flat extended polygonal undersurface providing a wide contact clamping area with respect to the head of a pin standing on or off-spot on said alley, supports mounting each of said heads on said frame for independent differential vertical movement in accordance with the height of pins clamped thereby upon said bed, opposed elongated substantially parallel opposed pin gripping bars of a length substantially equal to the width of said clamping surface of a clamping head coacting with each of said heads, supports mounting said opposed grippers for movement to and from each other a distance approximately equal to the length of said clamping head, said grippers being operative to grip and

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hold a pin standing in on spot or any off-spot position within the clamping area of said clamping surface of said head, and positively actuated mechanism coacting with a head clamping a pin to said bed against displacement thereon operative after a pin has been clamped to said bed for moving only said gripping bars into gripping and holding relation relative to said clamped pins.

12. Bowling pin manipulating apparatus comprising a bowling pin respotting frame, a plurality of independently movable pin-clamping heads mounted on said frame, each of said heads being constructed and arranged for independent differential vertical movement in accordance with the height of pins to be clamped thereby upon said bed mechanism for lowering said frame to engage said heads in clamping relationship with the tops of any pins standing on or off-spot on the pin supporting bed of a bowling alley, and maintain said pins against displacement as said frame is lowered towards said alley, opposed sets of gripper arms associated with each of said heads, means mounting said gripper arms for horizontal and linear movement relative to said heads, and gripper operating mechanism including separate operating connections between each of said heads and grippers associated therewith responsive to the clamping of any standing bowling pins in an on or off-spot position on said alley bed by said heads and the downward movement of said frame for effecting relative shifting movement between each set of said gripper arms to close and grip said clamped standing on or off-spot pins.

13. Bowling pin manipulating apparatus comprising a vertically movable pin-lifting frame, mechanism for raising and lowering said frame for lifting and respotting bowling pins in on or off-spot positions on the bed of a bowling alley, a plurality of pin gripping units, each unit including horizontally and linearly movable opposed pin-gripping bars, means mounting said units on said frame in spotted pin-playing arrangement, separate means for actuating only said bars located in position to grip standing on or off-spot pins to grip on-spot pins and to shift said bars for gripping off-spot pins when said frame is in lowered position, and means carried by said units for repositioning said bars in position to grip on-spot pins after each lifted pin is respotted in said on or off-spot position.

14. Bowling pin manipulating apparatus comprising a vertically movable pin-lifting frame, mechanism for raising and lowering said frame for clamping an off-spot pin and for lifting and respotting bowling pins in on or off-spot positions on the bed of a bowling alley, horizontally and linearly movable pin-gripping devices including spaced sets of grippers mounted on said frame in substantially triangular pin-playing arrangement, means for actuating said devices for gripping standing pins, means operable to shift said last-named means when one gripper thereof engages a clamped standing off-spot pin for gripping said pin to cause the elevation thereof upon subsequent upward movement of said frame, a latch associated with each of said sets of grippers, means responsive to the downward movement of said frame for actuating latches corresponding to each set of grippers engaging a pin to hold said grippers in gripping relationship with a standing pin to be respotted on said alley, and means responsive to the next downward movement of said frame for respotting said

pins to unlatch said latches and effect the release of said pins from said grippers.

15. Bowling pin manipulating apparatus comprising a vertically movable pin-lifting frame, mechanism for raising and lowering said frame for lifting and respotting bowling pins in on or off-spot positions on the bed of a bowling alley, horizontally and linearly independently movable pin-gripping devices including spaced sets of opposed elongated gripper bars mounted on said frame in substantially triangular pin-playing arrangement and extending longitudinally of said bed, means for actuating only said devices located adjacent standing pins for gripping said standing pins, and means responsive to the actuation of said devices to shift a device when one gripper thereof moves laterally relative to said bed into engagement with a standing off-spot pin for gripping said pin to cause the elevation thereof upon subsequent upward movement of said frame.

16. Bowling alley apparatus comprising a vertically movable frame mounted above the pin-receiving section of an associated alley, said frame being formed with a plurality of pin-receiving openings, each of the latter having horizontally and vertically disposed guides, a pin-clamping head slidably mounted in the vertical guides of each of said openings, opposed pin-gripping elements slidably mounted in the horizontal guides of each of said openings, a relatively stationary support arranged above said frame, means mounted on said support for raising and lowering said frame, a pair of pivoted arms connected with the pin-gripping devices of each of said openings, and means operative by said heads in response to the descent of said frame and after the engagement of one or more of said clamping heads with a standing bowling pin or pins for moving said arms of said gripping elements associated with said heads clamping pins on said alley to move said gripping elements connected to said arms into gripping engagement with said clamped pins.

17. Bowling alley apparatus comprising a vertically movable frame mounted above the pin-receiving section of an associated alley, a plurality of vertically movable pin-contacting heads carried by said frame, said heads being operative upon descent of said frame to engage with the upper ends of standing bowling pins positioned on the alley in registration therewith and clamp said pins against displacement on said alley, each of said heads having surfaces providing a wide contact area with said pins, a pair of horizontally and linearly movable pin-gripping devices carried by said frame in registration with each of said heads, supports mounting each of said gripping devices for separate shifting movement relative to a pin clamped on said alley by its associated head, and operating means for actuating said devices after a pin or pins have been clamped by a head or heads, said operating means including operating connections between said heads and gripping devices responsive to the downward movement of said frame to cause said devices to move into gripping engagement with a clamped standing pin regardless of the position of engagement of said pin with the under surface of the associated head.

18. The apparatus defined in claim 17 including a pin head contacting member carried by and arranged below said frame and having pin head engaging portions beyond the limits of said heads, an operating circuit for said apparatus, a switch

in said circuit, and means operative in response to the engagement of said member with the head of a standing pin located beyond the range of operation of said gripping devices for actuating said switch to break said circuit and stop the operation of said apparatus.

19. Bowling pin manipulating apparatus comprising a pin-lifting frame, means for moving said frame to and from a bowling alley to lift and respot bowling pins in on or off-spot positions on the pin supporting bed of said alley, sets of opposed elongated parallel gripper elements carried in substantially triangular arrangement on said frame, spaced substantially parallel support means mounting the ends of each of said gripping elements for substantially parallel horizontal floating movement relative to bowling pins standing in on or off-spot position on said alley, separately operated mechanism for actuating only the sets of grippers located in position to grip standing pins to move said gripping elements into gripping relationship with pins to be lifted and respotted, said mechanism including means for controlling the movement of each of said grippers in conformity with its travel into gripping relationship with an on or off-spot pin on said alley, and means operative after on or off-spot pins have been respotted on said bed of said alley for releasing said pins.

20. Bowling pin manipulating apparatus comprising a support, a vertically movable pin lifting frame disposed beneath said support, a plurality of individually substantially vertically movable pin contacting and clamping heads attached to said frame, each of said heads having a substantially flat extended undersurface providing a wide contact clamping area relative to the head of a pin standing on or off-spot on said alley, a set of opposed pin grippers carried by said frame in coacting relationship with each of said heads, means mounting said grippers of each of said sets of grippers for substantially horizontal and linear movement into and out of gripping engagement with the opposite sides of a standing bowling pin clamped by a head on or off-spot on said alley against displacement, mechanism for lowering said frame to cause said heads to engage and clamp any pins standing on or off-spot on said alley and position said grippers of said sets of grippers for movement into gripping engagement with said opposite sides of said standing pins, and means including operating connections between said heads and grippers operative in response to the continued downward movement of said frame relative to said heads clamping said standing pins on said alley for causing said grippers of said sets of grippers positioned on opposite sides of said clamped standing pins to move into gripping engagement with said pins.

21. Bowling pin handling apparatus for use with a bowling alley having a pin supporting bed comprising a support, a pin lifting frame arranged beneath said support, means mounted on said support for raising and lowering said frame relative to said alley bed, a plurality of pin handling units mounted on said frame, each of said units comprising a pin engaging and clamping head, means mounting each of said heads for substantially vertical movement by and with respect to said frame, opposed pin grippers associated with each of said heads, movable supports mounting said opposed grippers for horizontal and linear movement in a plane substantially at right angles to the line of force applied by said

heads to a pin clamped thereby on said alley bed, and mechanism actuated by relative movement between a head clamping a pin on said alley and said frame for moving said gripper supports to center said grippers relative to said clamped pin, said mechanism including means operative after said grippers have been centered for moving said grippers into gripping engagement with opposite sides of the head of said clamped pin.

22. Bowling alley apparatus comprising a vertically movable frame mounted above the pin-receiving section of a bowling alley, a plurality of triangularly arranged pin handling units mounted on said frame, each of said units including an individually movable pin-clamping head, supports mounting each of said heads on said frame for independent differential vertical movement in accordance with the height of a pin to be clamped thereby upon said alley, and a set of movably mounted opposed pin-gripping elements coacting with each of said heads, means normally positioning said opposed pin gripping elements in spaced apart open relationship, whereby the head of a pin may pass freely therebetween into clamping engagement with a clamping head as said frame is lowered to pin gripping and releasing position above said alley, means for lowering said frame to engage said clamping heads with the tops of any pins standing on said alley to prevent said pins from being displaced from their on or off-spot positions on said alley as said frame moves downwardly towards said position, and means operated by each of said heads clamping a pin on said alley in response to the descent of said frame to said position for moving said sets of grippers coacting with said heads clamping said standing bowling pin or pins on said alley into gripping engagement with said clamped pins.

23. Automatic bowling pin apparatus comprising a support arranged above the pin receiving section of a bowling alley, a vertically movable pin raising and lowering frame disposed beneath said support, means mounted on said support and connected with said frame for raising and lowering the latter, a plurality of pin clamping heads, support means mounting each of said heads on said frame for independent substantially vertical movement in a fixed path of travel, each of said heads having an undersurface providing a substantial clamping contact area adapted to engage the head of a pin standing on said alley in on or off-spot position and clamp said pin firmly against displacement from said on or off-spot position, a pin gripping device carried by said frame in registration with each of said heads, each of said devices including spaced, individually movable, opposed pin gripping bars, and shiftable mounts supporting said gripper bars for horizontal and linear movement into and out of gripping engagement with a pin clamped by a head on said alley, and operating mechanism actuated by a head clamping a standing pin on said alley responsive to the relative vertical movement between said head in said fixed path of

travel and said frame after a standing pin has been clamped by said head upon said alley and descent of said frame to shift said mounts and move said gripping bars associated with said head into engagement with said standing pin held by said head upon said alley.

24. The apparatus defined in claim 17 including a movable grid having openings permitting entry of standing pins within the range of operation of said gripping devices, means mounting said grid on the underside of said frame for engagement by the handle ends of pins beyond the range of operation of said gripping devices, and mechanism actuated by said grid responsive to the engagement of a standing pin by said grid on downward movement of said frame for stopping the operation of said apparatus.

25. Bowling pin manipulating apparatus comprising a pin lifting frame, mechanism moving said frame to and from the pin supporting bed of an alley, a plurality of pin clamping members carried in substantially triangular arrangement on said frame, means mounting each of said members for individual substantially vertical movement on said frame, a set of opposed elongated gripping elements associated with each of said members, means mounting each of said gripping elements for substantially horizontal movement beneath its respective clamping member, gripper actuating means, movable supports mounting said gripper actuating means, mechanism actuated in response to the downward movement of said frame and the engagement of one of said gripping elements of a set of gripping elements with a standing on or off-spot pin clamped by its associated clamping member against movement on said alley to move said supports and center said gripping elements relative to said clamped pin and cause said gripping elements to grip said clamped pin, means operable upon the gripping of a pin to cause said frame moving mechanism to elevate said frame and pin or pins held by said sets of gripping elements, means operable subsequent to the raising of said frame to re-lower said frame to relocate said lifted pins in their respective on or off-spot positions on said alley, means for releasing said pin or pins from said gripping elements, and means for recentering said gripping elements.

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