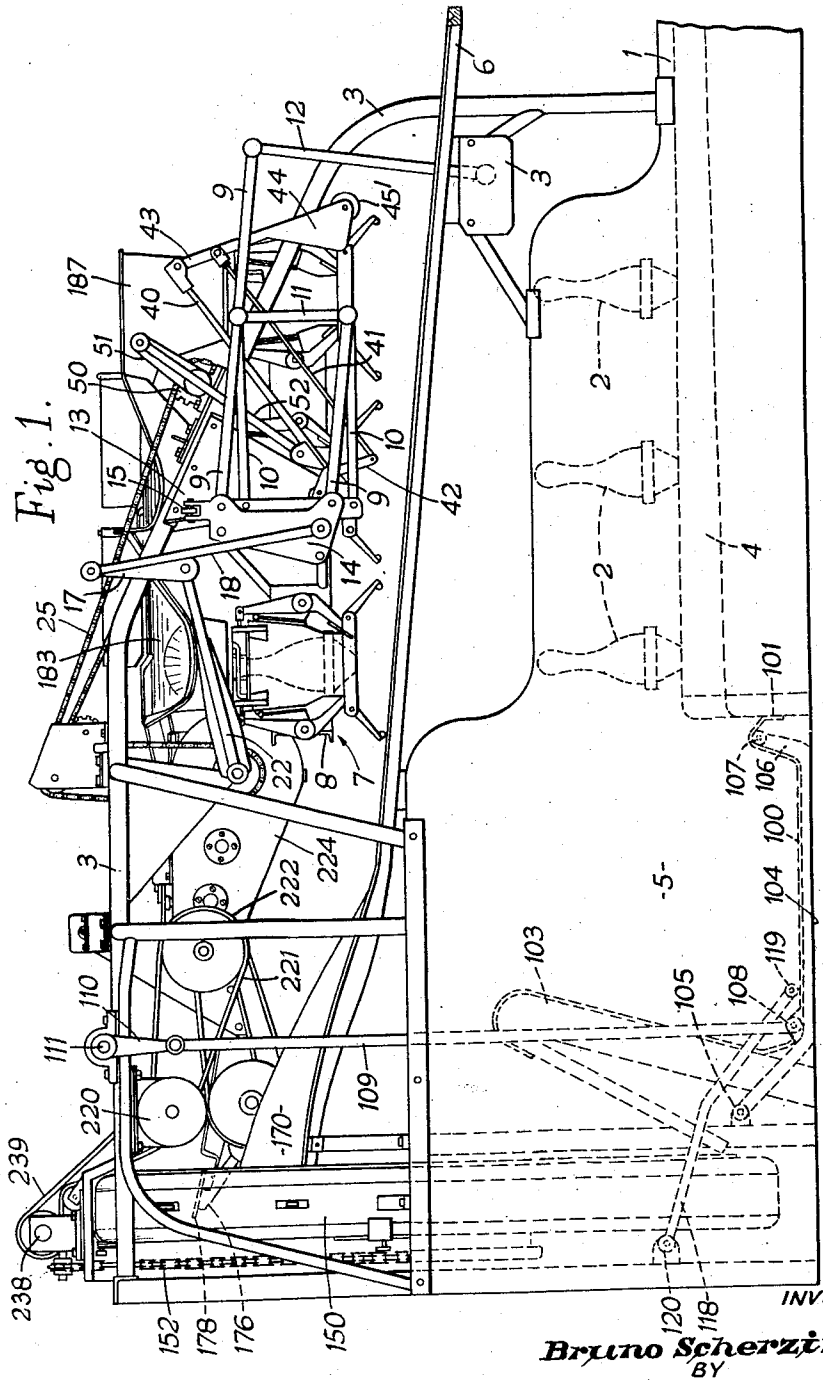
Nov. 3, 1959 B. SCHERZINGER 2,911,218

BOWLING ALLEY PIN RESETTING MACHINE

Filed Aug. 16, 1955 17 Sheets-Sheet 1

Fig. 1.



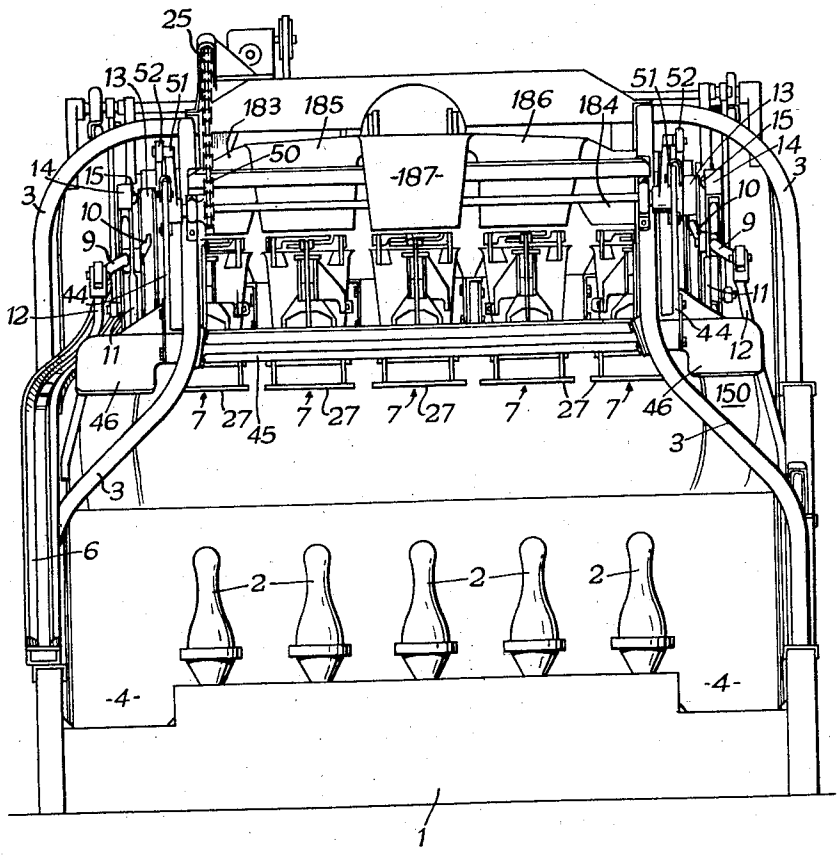
INVENTOR:
Bruno Scherzinger,
BY
Cushman, Darby & Cushman
ATTORNEYS

Nov. 3, 1959 B. SCHERZINGER 2,911,218

BOWLING ALLEY PIN RESETTING MACHINE

Filed Aug. 16, 1955 17 Sheets-Sheet 2

Fig. 2.



INVENTOR:

Bruno Scherzinger,

BY

Cushman, Darby & Cushman

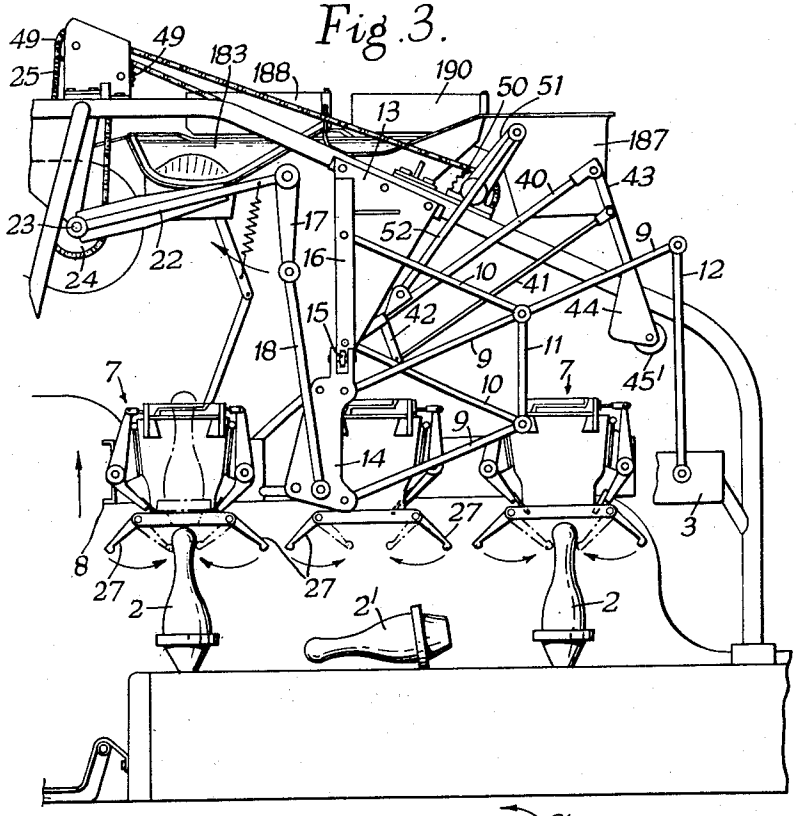
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BOWLING ALLEY PIN RESETTING MACHINE

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Fig. 3.



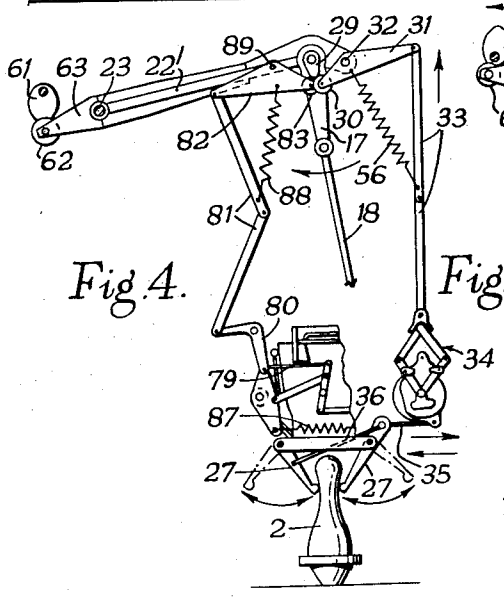


Fig. 4.

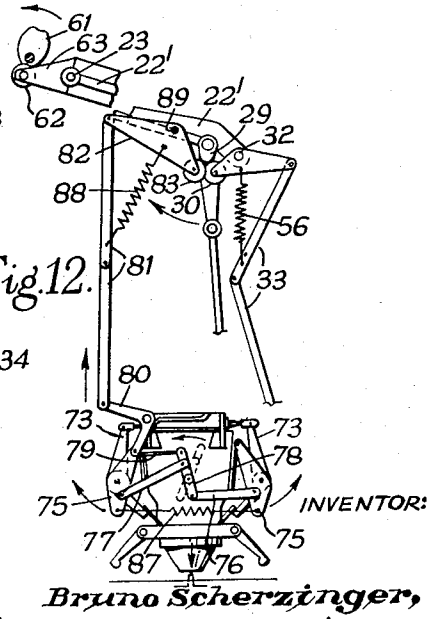


Fig. 12.

INVENTOR:
Bruno Scherzinger,
BY Cushman, Darby & Cushman
ATTORNEYS.

Nov. 3, 1959 B. SCHERZINGER 2,911,218

BOWLING ALLEY PIN RESETTING MACHINE

Filed Aug. 16, 1955 17 Sheets-Sheet 4

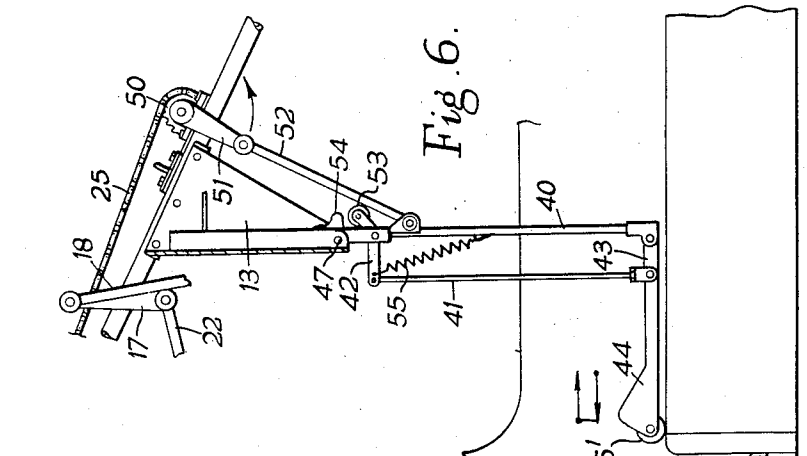


Fig. 6.

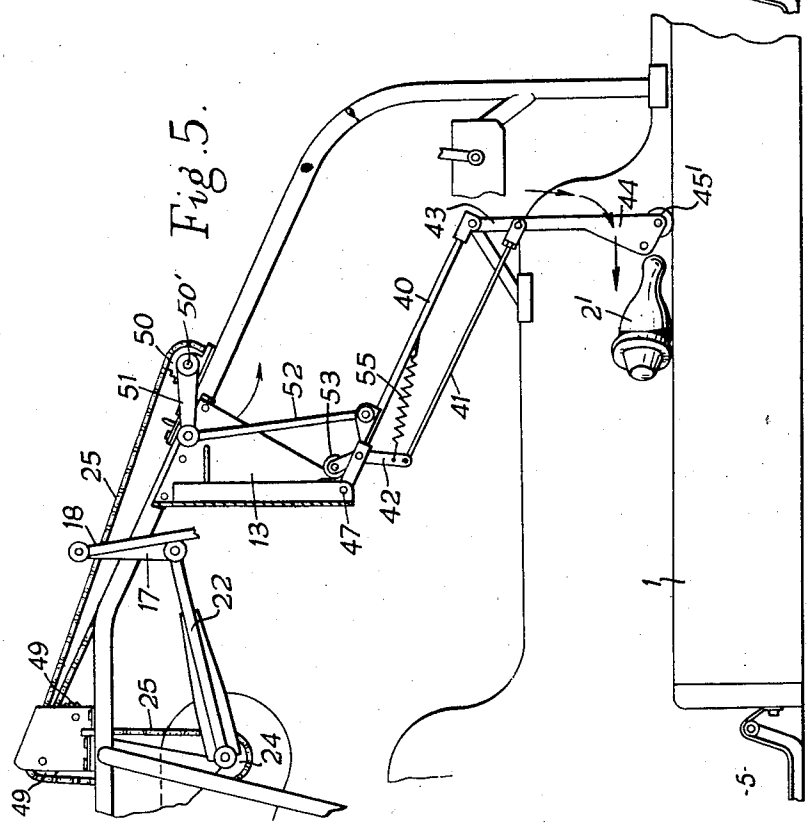


Fig. 5.

INVENTOR:

Bruno Scherzinger,

BY

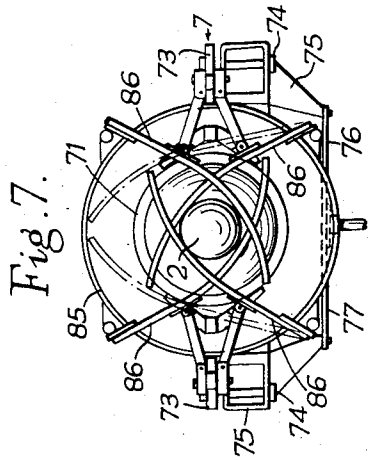
Cushman, Darby & Cushman

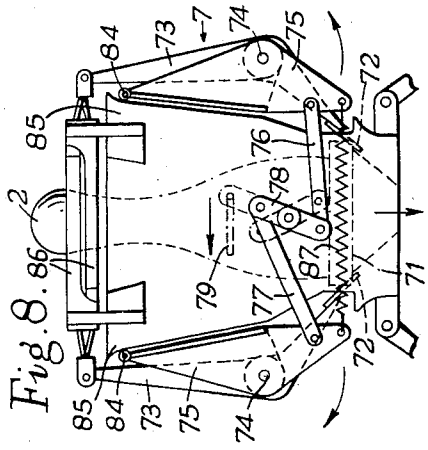
ATTORNEYS

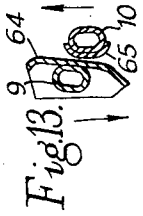
Nov. 3, 1959 B. SCHERZINGER 2,911,218

BOWLING ALLEY PIN RESETTING MACHINE

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INVENTOR:
Bruno Scherzinger,
BY
Cushman, Darby & Cushman
ATTORNEYS.

Nov. 3, 1959 B. SCHERZINGER 2,911,218

BOWLING ALLEY PIN RESETTING MACHINE

Filed Aug. 16, 1955 17 Sheets-Sheet 6

Fig. 11.

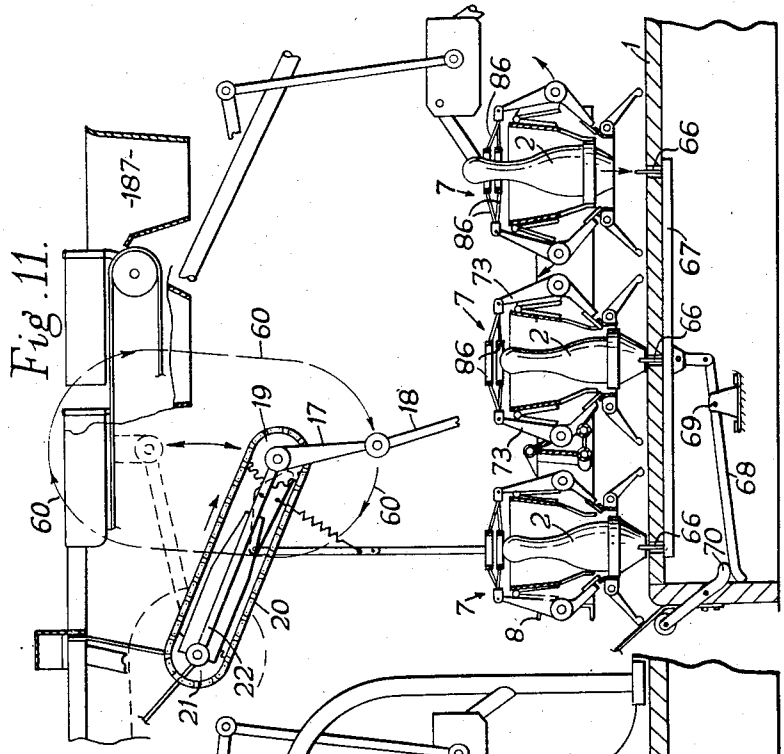
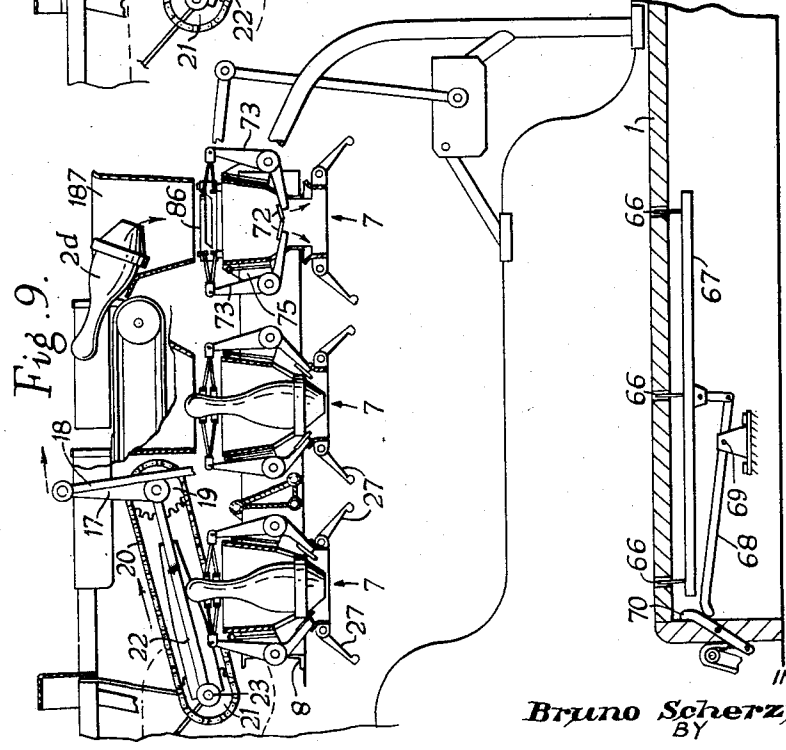


Fig. 9.



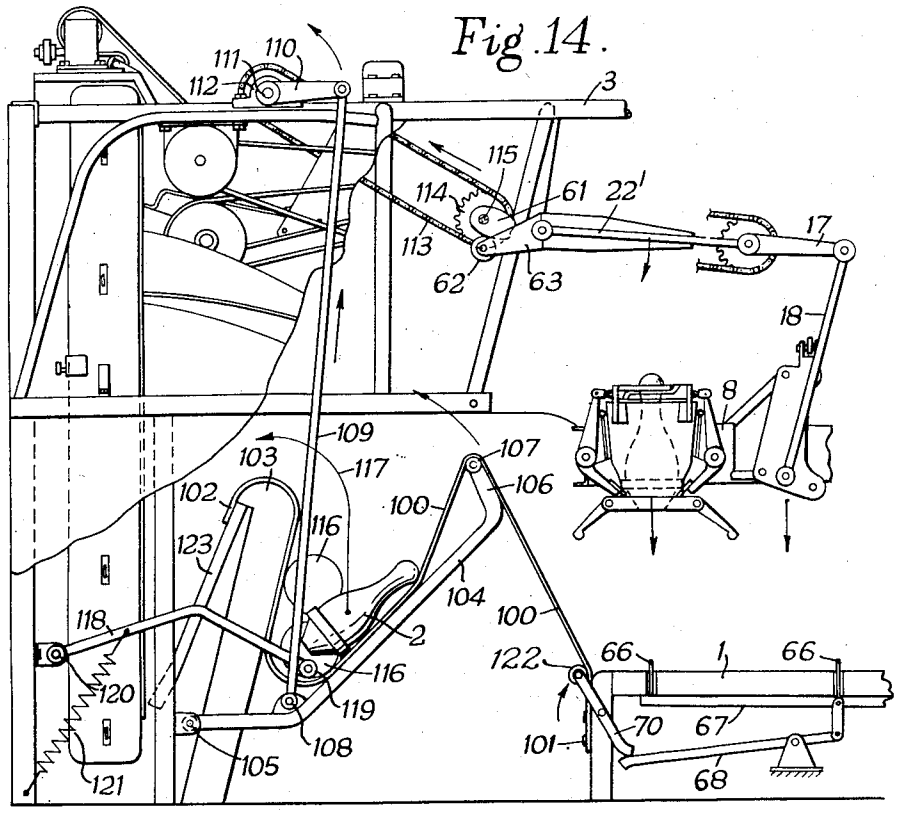
INVENTOR:
Bruno Scherzinger,
BY
Cushman, Darby & Cushman
ATTORNEYS.

Nov. 3, 1959 B. SCHERZINGER 2,911,218

BOWLING ALLEY PIN RESETTING MACHINE

Filed Aug. 16, 1955 17 Sheets-Sheet 7

Fig. 14.



INVENTOR:

Bruno Scherzinger,

BY

Cushman, Darby & Cushman

ATTORNEYS.

Nov. 3, 1959 B. SCHERZINGER 2,911,218

BOWLING ALLEY PIN RESETTING MACHINE

Filed Aug. 16, 1955 17 Sheets-Sheet 8

Fig. 15.

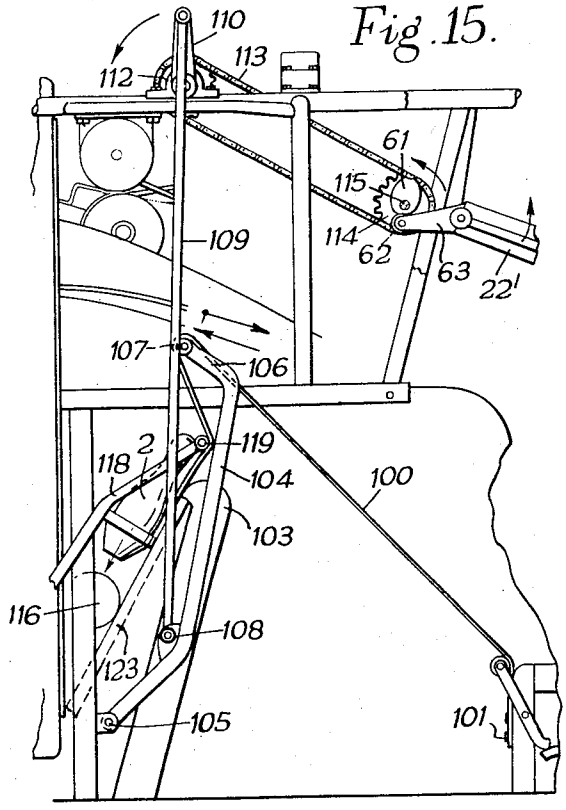
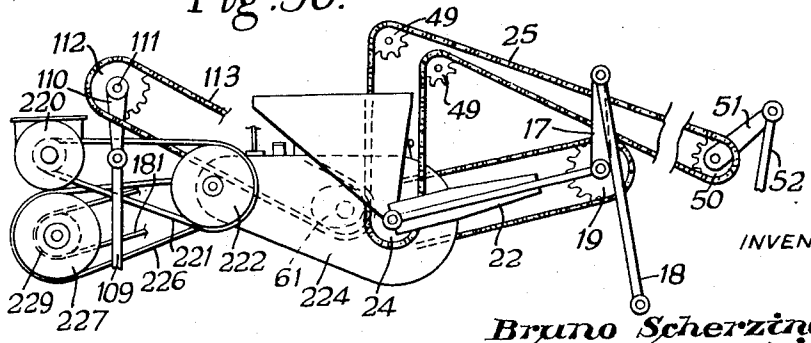


Fig. 36.



INVENTOR:

Bruno Scherzinger,

BY Cushman, Darby & Cushman

ATTORNEYS.

Nov. 3, 1959 B. SCHERZINGER 2,911,218

BOWLING ALLEY PIN RESETTING MACHINE

Filed Aug. 16, 1955 17 Sheets-Sheet 9

Fig. 16.

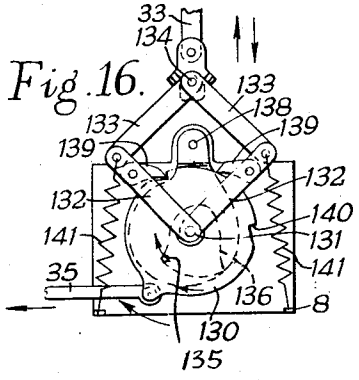


Fig. 17.

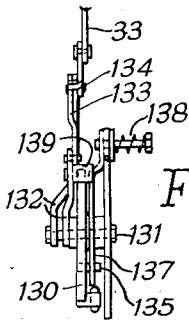


Fig. 18.

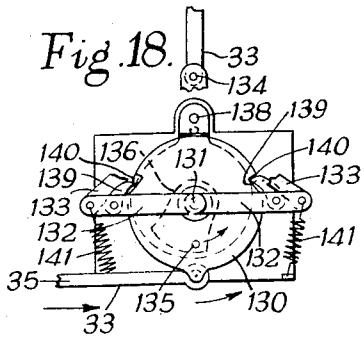


Fig. 23.

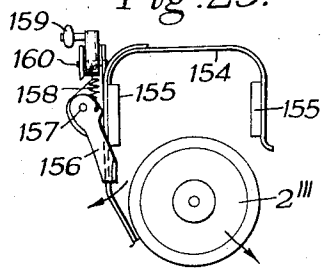


Fig. 24.

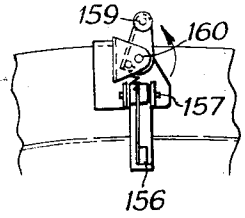


Fig. 25.

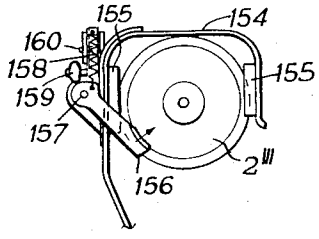
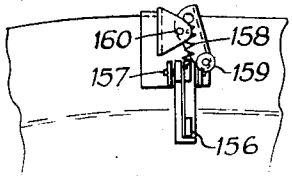


Fig. 26.



INVENTOR:

Bruno Scherzinger,

BY

Cushman, Darby & Cushman

ATTORNEYS.

Nov. 3, 1959 B. SCHERZINGER 2,911,218

BOWLING ALLEY PIN RESETTING MACHINE

Filed Aug. 16, 1955 17 Sheets-Sheet 10

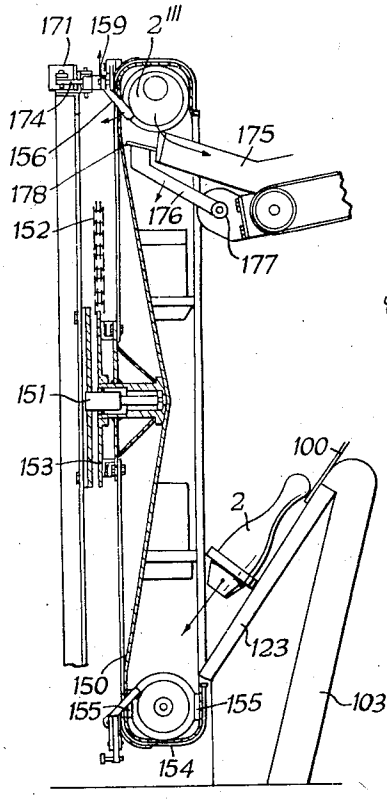


Fig. 19.

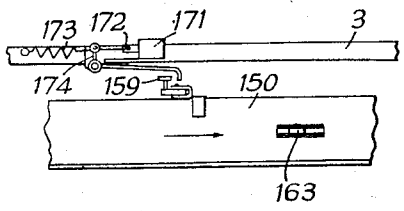


Fig. 20.

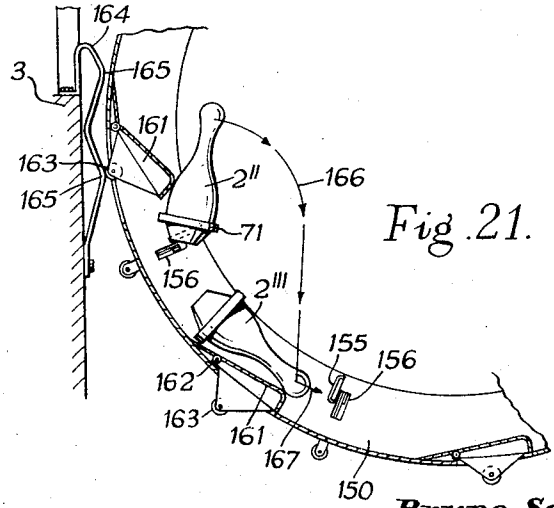


Fig. 21.

INVENTOR:

Bruno Scherzinger,

BY

Cushman, Darby & Cushman

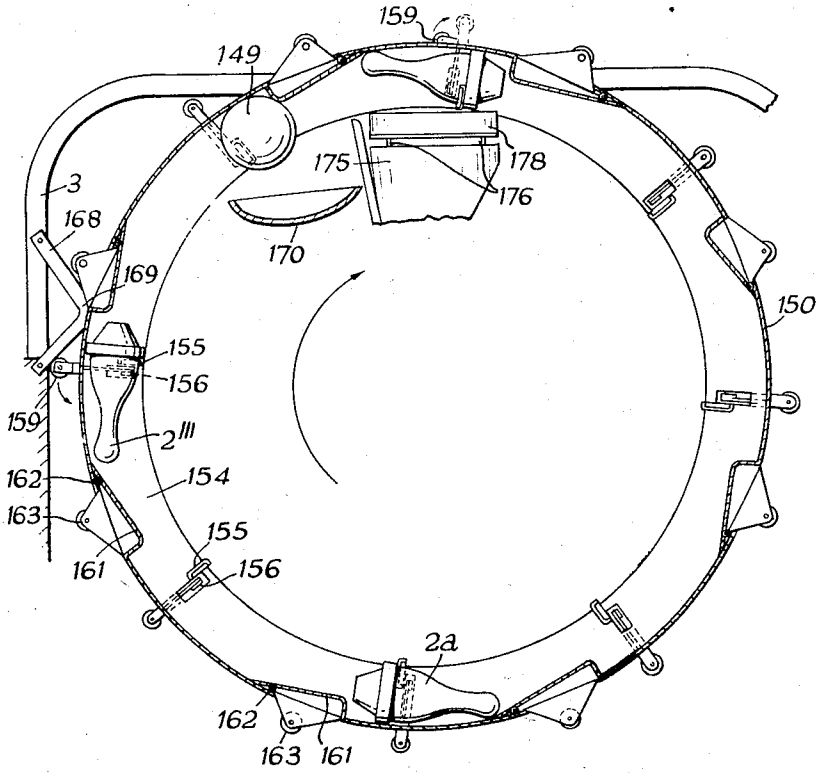
ATTORNEYS.

Nov. 3, 1959 B. SCHERZINGER 2,911,218

BOWLING ALLEY PIN RESETTING MACHINE

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Fig. 22.



INVENTOR:

Bruno Scherzinger,

BY

Cushman, Darby & Cushman

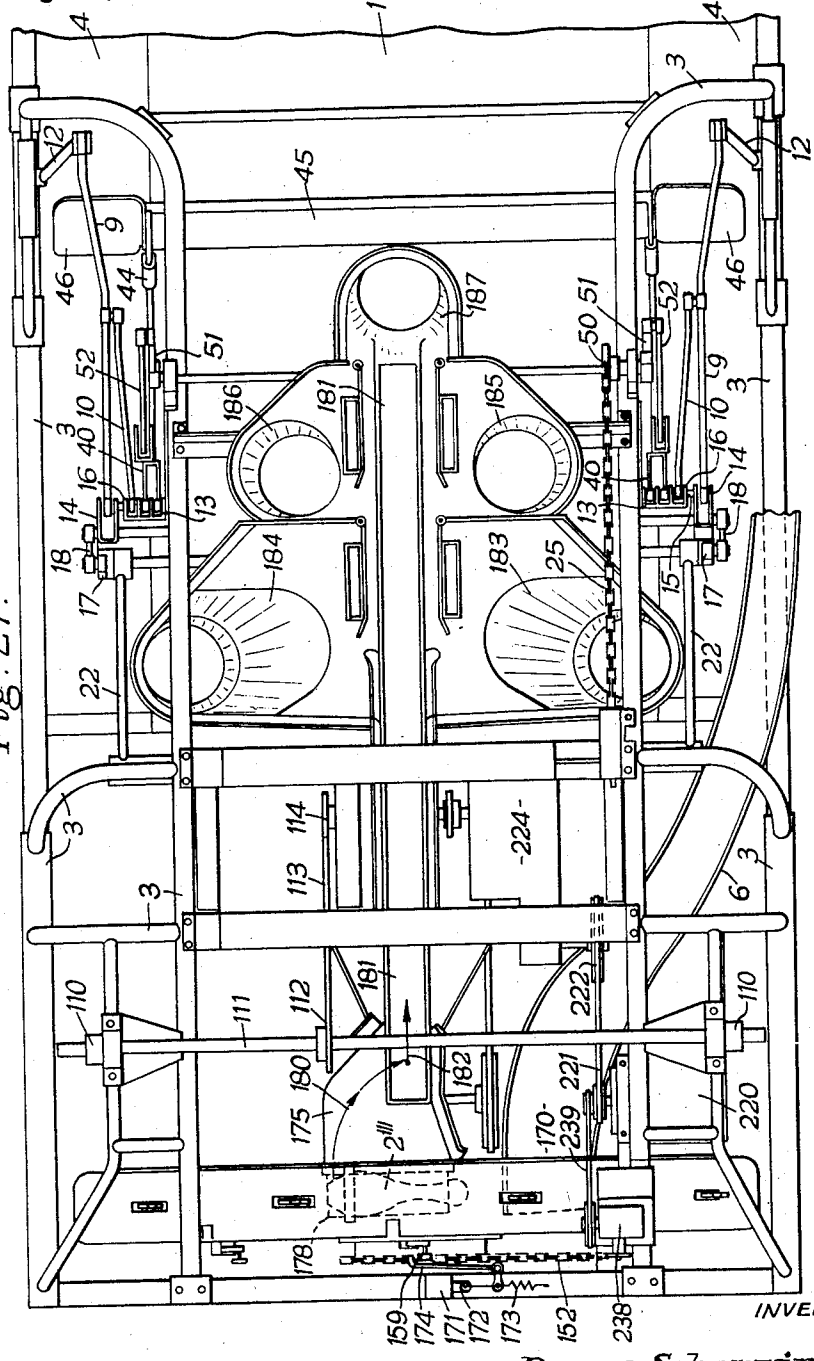
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BOWLING ALLEY PIN RESETTING MACHINE

Filed Aug. 16, 1955 17 Sheets-Sheet 12

Fig. 27.



INVENTOR:
Bruno Scherzinger,
BY
Cushman, Darby & Cushman
ATTORNEYS.

Nov. 3, 1959 B. SCHERZINGER 2,911,218

BOWLING ALLEY PIN RESETTING MACHINE

Filed Aug. 16, 1955 17 Sheets-Sheet 13

Fig. 28.

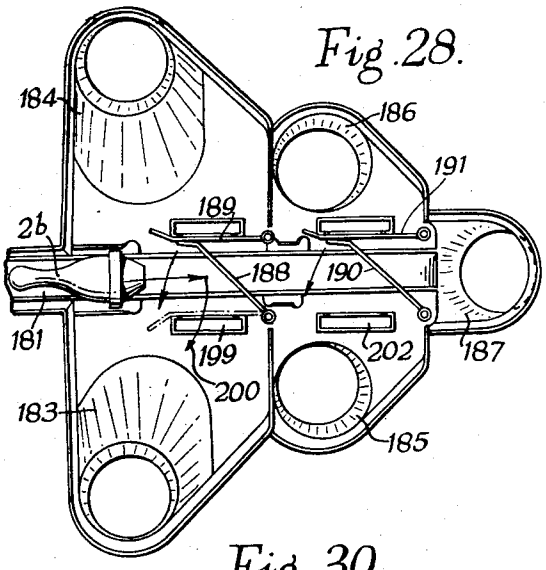


Fig. 30.

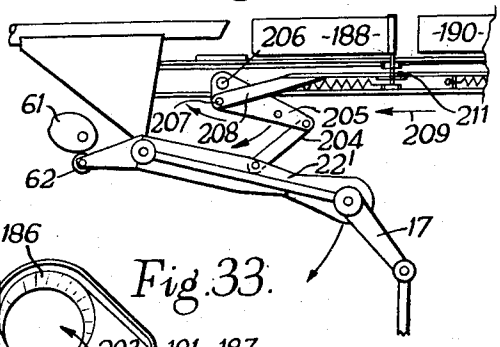
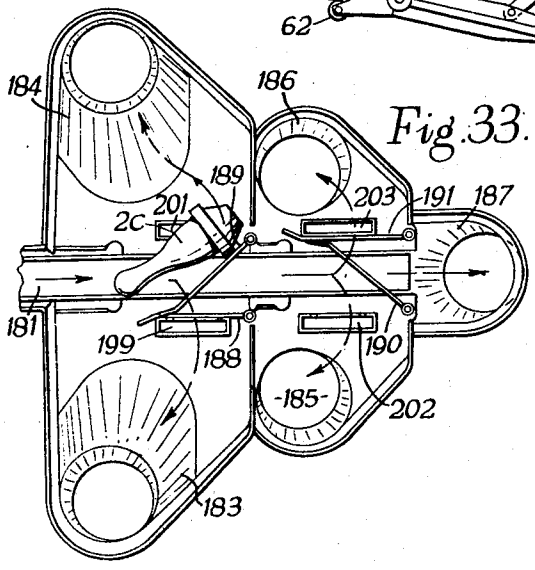


Fig. 33.



INVENTOR:

Bruno Scherzinger,

BY Cushman, Darby & Cushman

ATTORNEYS.

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BOWLING ALLEY PIN RESETTING MACHINE

Filed Aug. 16, 1955 17 Sheets-Sheet 14

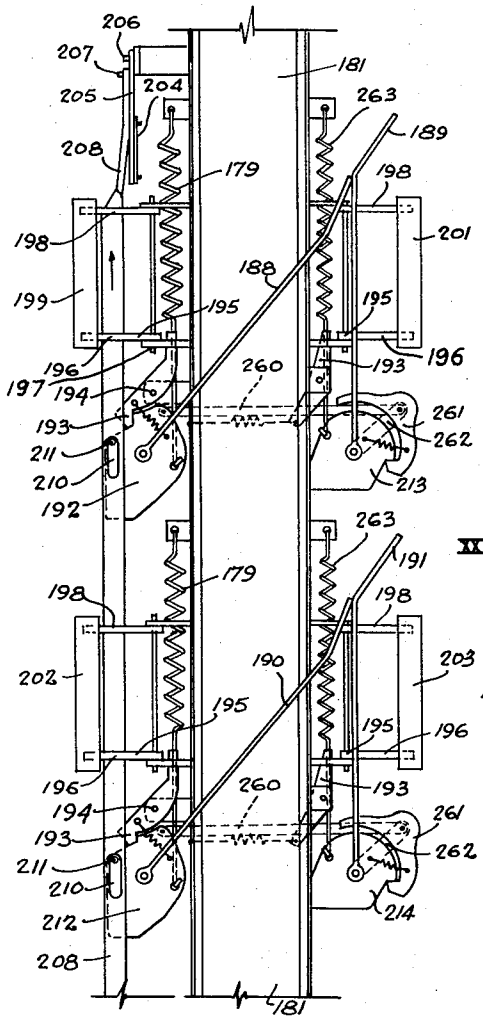


Fig. 29.

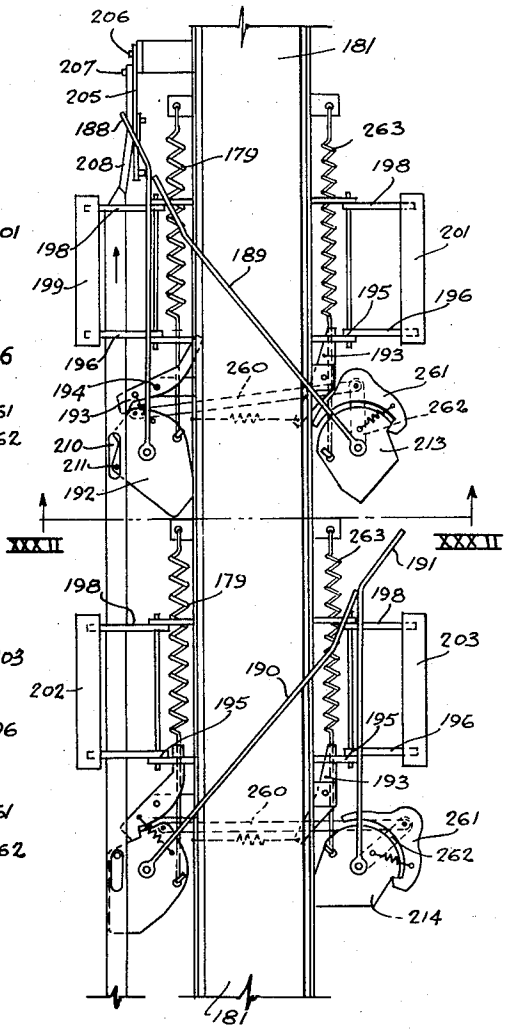


Fig. 31a.

INVENTOR
Bruno Scherzinger

BY Cushman, Darby & Cushman
ATTORNEY

Nov. 3, 1959 B. SCHERZINGER 2,911,218

BOWLING ALLEY PIN RESETTING MACHINE

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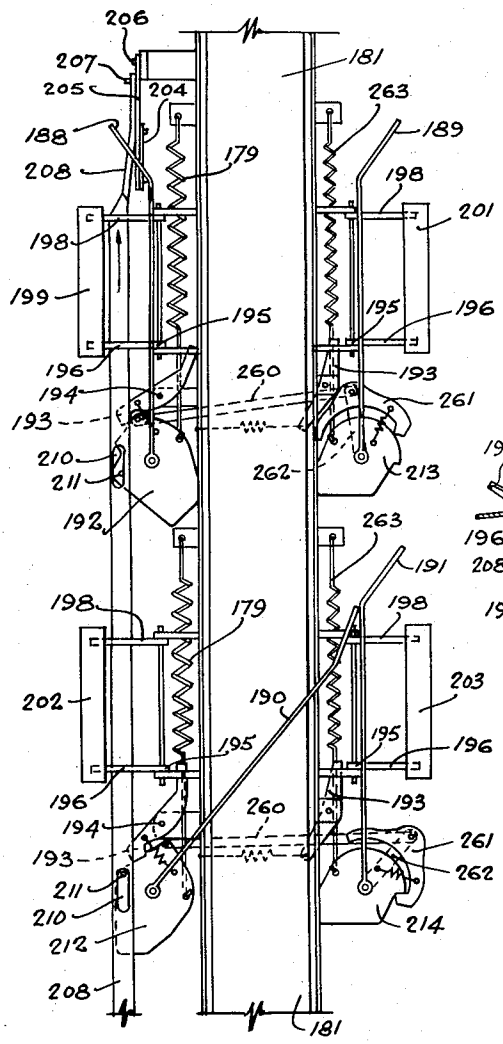


Fig. 31b.

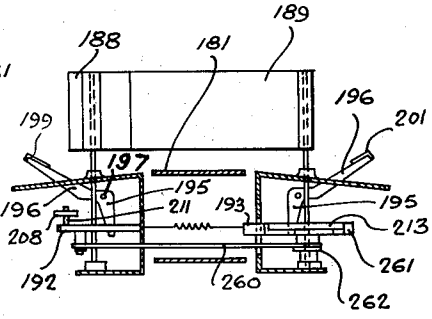


Fig. 32.

INVENTOR
Bruno Scherzinger

BY Cushman, Darby & Cushman
ATTORNEYS

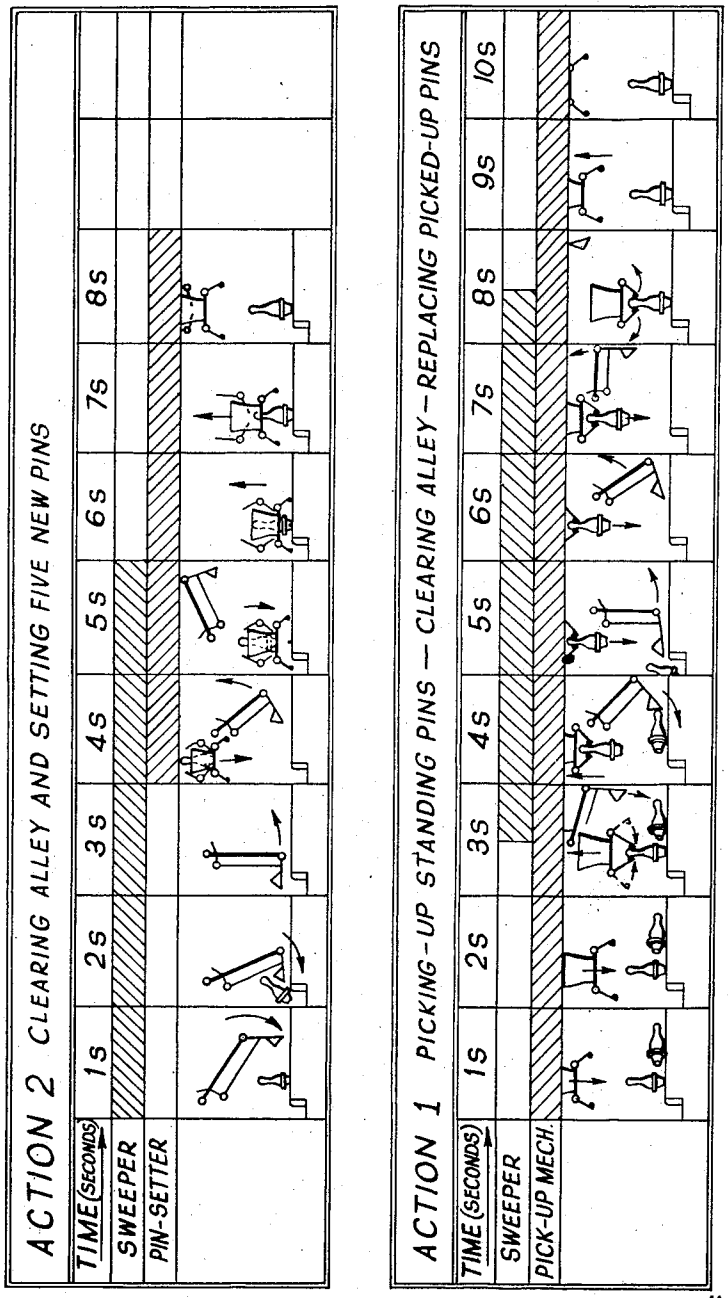
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BOWLING ALLEY PIN RESETTING MACHINE

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Fig. 34.

TIME PLAN



INVENTOR:

Bruno Scherzinger,

BY

Cushman, Darby & Cushman

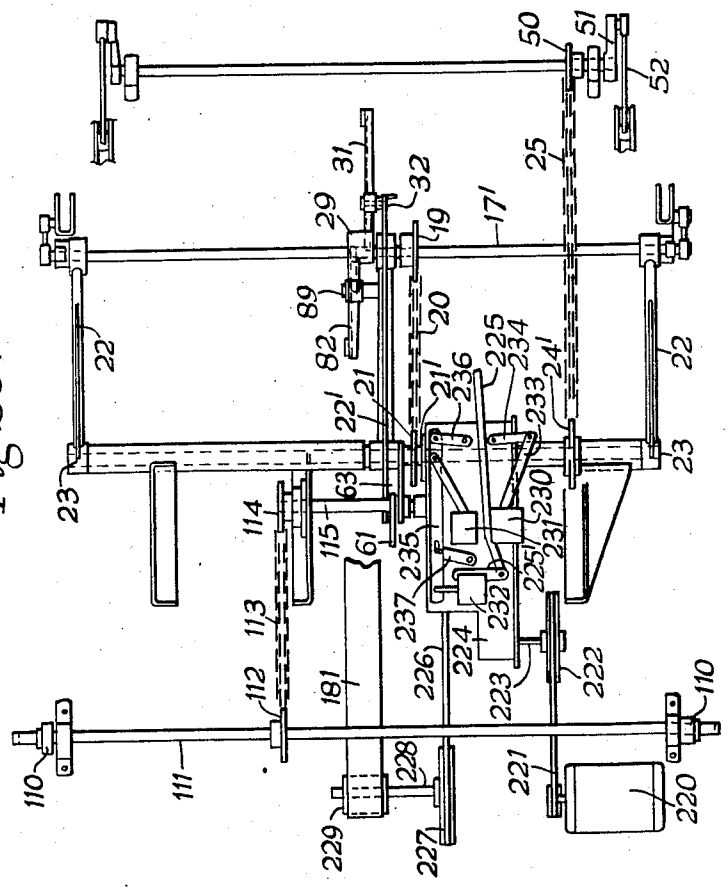
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Nov. 3, 1959 B. SCHERZINGER 2,911,218

BOWLING ALLEY PIN RESETTING MACHINE

Filed Aug. 16, 1955 17 Sheets-Sheet 17

Fig. 35.



INVENTOR:

Bruno Scherzinger,

BY

Cushman, Darby & Cushman

ATTORNEYS.

United States Patent Office 2,911,218 Patented Nov. 3, 1959

2,911,218

BOWLING ALLEY PIN RESETTING MACHINE

Bruno Scherzinger, Calgary, Alberta, Canada, assignor to Mechanical Pin Resetter Co., Ltd., Calgary, Alberta, Canada

Application August 16, 1955, Serial No. 528,711

Claims priority, application Canada September 17, 1954

5 Claims. (Cl. 273—43)

This invention relates to improvements in machines for resetting the pins in a bowling alley between frames and sweeping the alley clear of fallen pins and balls during the balls of a frame.

The invention is concerned with a machine suitable for use with pins of the type having a projecting peripheral band, i.e. the type of pin used in the five-pin game, and is exemplified below with reference to pins and balls of the five-pin type, although the parts of the machine for which protection is sought are suitable for use with pins not having such a band, as used in the ten-pin game, and with the larger balls used in the ten-pin game.

The machine which will be described in detail below as furnishing an example of the invention, may for convenience be divided into five sections, these sections being in turn sub-divided into individual mechanisms or parts. The five main sections are broadly as follows:

(A) The pin setting unit—this comprises five individual pin holding mechanisms;
(B) An alley sweeping mechanism and the control linkages for such mechanism;
(C) The pit clearing unit which acts to clear the pit of balls and pins and to feed them to the fourth section (D);
(D) The reloading wheel and its associated parts which receives the pins and balls, feeds the latter to the return rails and the former to the fifth section (E); and
(E) The conveyor and "recharging" unit which feeds the pins back to the pin setting unit and arranges the travel of individual pins to the several pin holding mechanisms.

Inevitably, there will be some overlap between sections and no attempt has been made to set up rigid divisions. It is believed, however, that understanding of the machine will be greatly facilitated by reason of this sectionalization, and, in the description which follows, each section will be described both in structure and operation, before consideration is given to the next section. Then finally, the overall operation of the machine will be described.

In the preparation of the annexed drawings illustrating the machine, to which reference will be made in the description, the same policy has been followed. There are a few views of the whole machine to show the interrelation of the various sections, and a number of fragmentary views each concerned with one particular section at a time.

The complexity of the machine has led to some of the details shown in a view concerned, for example, with the operation of a particular part, being omitted from other views in which the same part may appear, but which are furnished primarily to illustrate the operation of other parts. It follows that exact correspondence does not always exist between the various figures, but it is believed that such sacrifice has been made to the benefit of a clear appreciation of the important features of operation of the machine as a whole.

In these annexed drawings:

Figure 1 shows a general side view of the whole machine with the parts in withdrawn or rest positions;

Figure 2 shows a general end view of the whole machine as seen from the bowling alley itself, i.e. from the right in Figure 1;

Figure 3 is a fragment of the view of Figure 1, showing section (A), the pin setting unit, in its lowered position for Action 1, i.e. the action whereby the alley is cleared of fallen pins before completion of a frame by the bowler;

Figure 4 is in turn a fragment of the pin setting unit illustrating operating parts not shown in Figure 3;

Figure 5 is a fragmentary side view of the alley sweeping mechanism that forms section (B);

Figure 6 is a view similar to Figure 5, showing the alley sweeping mechanism in a different position;

Figure 7 is a plan view on an enlarged scale of an individual pin holding mechanism;

Figure 8 is a side view of the pin holding mechanism of Figure 7, showing details of the holding and release mechanism;

Figure 9 is a further side view of the pin setting unit, showing the same in a retracted position in which it receives pins from section (E), the recharging unit therefor;

Figure 10 is a view similar to Figure 9, showing the pin setting unit in a lowered position just preparatory to Action 2 in which a fresh set of pins is set up for the next frame of balls;

Figure 11 is a view generally similar to Figure 10 but with the parts in the positions assumed a moment later, exactly at the moment of resetting;

Figure 12 is a fragmentary exploded view of the parts seen in Figure 4, demonstrating their operation at the moment of resetting seen in Figure 11;

Figure 13 is a fragmentary section on the line XIII—XIII in Figure 10;

Figure 14 is a fragmentary side view of the machine showing principally section (C), the pit clearing unit, but also including parts of the pin setting unit;

Figure 15 is a view of the pit clearing unit of Figure 14 in a second position;

Figure 16 is a fragmentary view of a detail of the mechanism shown in Figure 4;

Figure 17 is a side view of the parts shown in Figure 16;

Figure 18 is a view similar to Figure 16, but showing the parts in different positions;

Figure 19 is a side view of section (D), the reloading wheel;

Figure 20 is a fragmentary plan view of the top of the reloading wheel seen in Figure 19, and associated parts;

Figure 21 is a detail end view of a part of the reloading wheel as seen from the right of Figure 19, demonstrating the method by which a misaligned pin is repositioned.

Figure 22 is an end view of the whole reloading wheel as seen from the righthand side of Figure 19;

Figure 23 is a sectional view of the wheel shown in Figure 19, showing details of the pin gripping parts;

Figure 24 is a side view of the parts shown in Figure 23;

Figure 25 is a view similar to Figure 23, showing the parts in a second position;

Figure 26 is a side view of the parts shown in Figure 25;

Figure 27 is a general plan view of the whole machine, showing more particularly the conveyor and recharging unit, section (E) and its relationship to the preceding section, the reloading wheel;

Figure 28 is a plan view of the recharging unit alone in a first operating position;

Figure 29 is a fragment of the unit shown in Figure 28, illustrating details of certain operating parts and their movements;

Figure 30 is a side fragmentary view of the parts shown in Figure 29, including also details of a linkage between these parts and the pin setting unit;

Figure 31*a* is a view similar to Figure 29 showing the parts in different positions;

Figure 31*b* is a further view similar to Figure 29 showing the parts in still further positions;

Figure 32 is a section on the line XXXII—XXXII in Figure 31*a*;

Figure 33 is a plan view similar to Figure 28, showing the operation of the parts when in the position of Figure 31*a*;

Figure 34 is a time plan diagrammatically illustrating the operations of the pin setting unit;

Figure 35 is a fragmentary plan view of the driving and transmission parts of the machine; and

Figure 36 is a side view of the parts seen in Figure 35, as seen from the bottom of such latter figure.

As best appreciated from the general views of Figures 1, 2 and 27, the machine is situated at the remote end of a bowling alley **1**, the pin setting unit being supported over the five pins **2** by a suitable straddling framework **3**. The alley **1** has the usual gutters **4** at each side and a pit **5** at the rear. The return rail whereby the balls are returned to the bowler is shown by the reference numeral **6**.

The construction of the pin setting unit (A) will now be described with particular reference to Figures 1, 3 and 4. Five pin holding mechanisms **7** are secured to a carriage **8** in a triangular array corresponding to the arrangement of the pins **2** so that one such mechanism **7** is disposed above the position occupied by each pin. The carriage **8** is mounted on the main framework **3** of the machine for vertical straight line motion from the retracted position shown in Figure 1, to various lowered positions, that of Figure 3 for example. True vertical movement of the carriage **8** is ensured by a pair of link mechanisms each consisting of two pairs of parallel links **9** and **10** pivotally connected together by means of a link **11**, a further link **12** pivotally connecting one of the links **9** to the framework **3** of the machine. These parts can also be seen in Figures 2 and 27. The free ends of links **10** are secured to a bracket **13** fixed to the framework **3**, and the free ends of the links **9** are secured to a bracket **14** attached to the movable carriage **8**. This latter bracket **14** carries a roller **15** that runs along a surface **16** of the former bracket **13**. These parts are duplicated on the remote side of the machine as it is seen in Figures 1 and 3, as may be observed from Figures 2 and 27.

While the parallel link mechanisms ensure accurate straight line vertical movement of the carriage **8**, they do not impel such carriage. This latter function is carried out by a crank arm **17** connected to the bracket **14** on the carriage **8** by a connecting rod **18**. These parts are similarly duplicated on the remote side of the machine, but, for simplicity, only one set of parts will be described. At this point reference should be made to any one of Figures 9, 10 and 11 and Figures 35 and 36 for illustration of the means driving the crank arms **17**, since these parts have been omitted from Figures 1 and 3.

Each crank arm **17** is rigidly secured to one end of a shaft **17'** extending across the machine. Near the centre of this shaft **17'** is mounted a sprocket wheel **19** connected by means of a chain **20** to a further sprocket wheel **21** mounted on a sleeve **21'** (Figure 35) freely rotatable about a transverse shaft **23**, to each end of which is secured an arm **22**. The two arms **22** carry the shaft **17'** on which the crank arms **17** are mounted. These arms **22** are rocker arms, their oscillation being controlled by means later to be described. There is also secured to approximately the centre of the shaft **23**, a further rocker arm **22'**. This rocker arm **22'** extends parallel to the rocker arms **22**, and at its end serves also to support the shaft **17'**. In addition, however, the rocker arm **22'** carries an extension **63** bearing a cam follower **62** which, as later described, co-operates with a cam **61**.

The carriage **8** is capable of two types of vertical downward motion. The first type of motion, which is employed for Action 1 of the pin setting unit, i.e. the action desired when the alley is to be cleared of fallen pins before completion of a frame of balls, is brought about by rotation of each crank arm **17**, with the rocker arms **22** and **22'** held stationary in their upper position, i.e. as shown in Figure 1. Figure 3 indicates this action, the crank arm being shown in this latter figure after a one-half revolution from the position shown in Figure 1. Such rotation of the crank arms **17** which brings the carriage **8** to the position shown in Figure 3, ensures that pivotally mounted grippers **27** arranged at the bottom of the pin holding mechanisms **7** then come into register with the necks of any erect pins **2**. Any fallen pins such as the one shown at 2' in Figure 3 are out of reach of such grippers **27**. The grippers **27** each consist of a bar extending between a pair of fingers, as best seen from Figure 2. On the other hand, reference should be had to Figure 4 to observe their operation, from which figure it will be seen that the rocker arm **22'** supports at its end a cam **29** connected to rotate with the shaft **17'** driving the crank arms **17**. This cam **29** is also seen in Figures 12 and 35. In the position shown in Figure 4, the rise of this cam **29** is bearing against a cam follower **30** mounted on a lever **31** pivoted to an extension of the arm **22'** at **32**. The free end of this lever **31** is connected by means of articulated links **33** to a gripper actuating mechanism shown generally in Figure 4 at **34**. This mechanism is connected by a rod **35** to one of the grippers **27**. The other gripper **27** is arranged to rotate with the first such gripper by means of a connecting rod **36**. A spring **56** acts to keep the links **33** normally inwardly articulated.

Details of the gripper actuating mechanism **34** are shown in Figures 16, 17 and 18. The mechanism comprises a main plate **130** mounted to rotate about a central axis **131**. A pair of levers **132** is also mounted to rotate about this axis **131**, each of such levers being pivoted to a further lever **133**. The two levers **133** are pivotally connected together and to the lower link **33** at the point **134**. The plate **130** bears a pin **135** projecting into an aperture **136** formed in a further plate **137**, termed the "switch plate," mounted in a plane parallel to that of the main plate **130**, but arranged to pivot about an axis **138** extending parallel to but above the axis **131**. The rod **35** is connected to a lower point on the plate **130**. The levers **132** each carry a spring-urged pawl **139** adapted to co-operate with respective recesses **140** in the plate **130**. A pair of springs **141** connect the points of connection of the levers **132** and **133** to fixed points on the carriage **8**, so that the levers **132** are urged to rotate downwardly and outwardly about their axes **131**.

Assuming the parts to be in the position shown in Figure 16, relaxation of tension in the lower link **33** will permit such downward movement of the levers **132** and ultimately the righthand pawl **139** will fall into its recess **140**. Subsequent upward movement of the links **33** will act to draw this righthand pawl **139** upwardly and thus rotate the plate **130** in an anti-clockwise direction, thus pulling the rod **35** to the right and bringing the grippers **27** into engagement with the neck of a pin **2**. Figure 18 shows the parts of the gripper actuating mechanism **34** with this operation partly completed. The plate **137** is canted to the left and thus prevents left-hand pawl **139** entering the left-hand recess **140**. As the parts move towards the extreme upward position (i.e. as shown in Figure 16 except that the plate **130** will now be in its opposite position with the righthand recess **140** higher than the left-hand recess **140**), the pin **135** presses against an edge of the aperture **136** so as to swing the switch plate **137** to the right, pivoting about the axis **138**. The effect of this movement of the switch plate **137** is to bring a portion of its periphery into register with the righthand recess **140**

(thus forcing the pawl 139 which has until now been engaged in the righthand recess 140 out of such recess) while leaving clear the lefthand recess 140 so that on the next downward movement of the links 33 the lefthand pawl 139 can fall into its recess, whereas the righthand pawl 139 is prevented from similar movement. This ensures that the next upward pull on the links 33 acts to reverse the movement just taken place, pushing the rod 35 to the left and releasing the necks of the pins 2. Thus, successive upward movements of the lower link 33 act respectively to engage and release the grippers 27 from the pins 2. Only one mechanism 34, containing the parts just described, is included in the machine, the rod 35 acting on the grippers 27 of each of the pin holding mechanisms 7, by suitable linkage connections not shown in detail.

The timing of the various parts in such that when the machine is set for Action 1 (see the lower diagram of the time-plan shown in Figure 34), the carriage 8 moves downwardly from the Figure 1 position to the Figure 3 position; the grippers 27 are operated to grasp the necks of any pins still standing; the carriage rises again due to continued rotation of the crank arm 17, lifting such pins with it clear of the alley; the alley sweeping mechanism operates to sweep any fallen pins or any balls remaining on the alley into the pit; the alley sweeping mechanism is retracted; the carriage 8 descends again to reset the pins previously picked up; and finally the carriage 8 is withdrawn upwardly. The alley is then ready for the remaining balls of the frame to be played.

The construction and operation of the alley sweeping mechanism will now be described with reference to Figures 1, 2, 3, 5, 6, 27, 35 and 36. This mechanism consists essentially of a pair of parallel link mechanisms arranged one on each side of the machine. Only the link mechanism on the near side of the machine is seen in Figures 1, 3, 5 and 6 and only this mechanism will be described, it being understood that the mechanism on the remote side is identical. Each such parallel link mechanism consists of parallel links 40 and 41 connected respectively at each end to parallel links 42 and 43, the link 43 extending downwardly from its connection to the link 41 to provide an extension 44. A sweeping bar 45 on two rolling castors 45' extends across the machine between the two members 44 and sideways extensions 46 are also provided in register with the gutters 4. These gutter-clearing extensions 46 are shown in Figures 2 and 27, having been omitted from the other views for the sake of simplicity. The link 40 is secured at its end remote from its connection to the link 43, to the inner surface of the bracket 13 at the point 47, so that the whole mechanism rotates about such point. The driving means for the alley sweeping mechanism consists of a chain 25 driven from a sprocket wheel 24 mounted on a sleeve 24' (Figure 35) rotatable about the shaft 23, this chain 25 driving over idler sprocket wheels 49 to a sprocket wheel 50 mounted on a shaft 50' the ends of which carry crank arms 51 which each drive one of the parallel link mechanisms through a connecting rod 52 pivotally secured to the link 40. The link 42 carries on an extension a roller 53 cooperating with a cam surface 54 (see Figure 6) on the bracket 13. A spring 55 connects intermediate points of the links 40 and 42.

The withdrawn position of the alley sweeping mechanism is shown in Figures 1, 2 and 3, with the bar 45 raised well clear of the alley 1 and the pins 2 thereon. As above explained and as illustrated in the lower diagram of the time-plan of Figure 34, a downward and rearward sweeping movement of the alley sweeping mechanism is co-ordinated with the Action 1 movement of the pin setting carriage. The first stage in this movement is shown in Figure 5, the crank arm 51 having moved the mechanism downwardly until the rollers 45' bear against the surface of the alley 1. By this time the roller 53 has begun to ride upwardly on the cam surface 54 so as to rotate the link 42 clockwise about its connection to the link 40. This motion is transmitted through the link 41 to the link 43 and its extension 44 so that the latter is moved to the left in Figure 5 as the crank arm 51 continues to rotate and move the link 40 clockwise about its pivotal point 47. Finally, the parts assume the position shown in Figure 6, the sweeping bar 45 having by this time swept any fallen pins 2' and any balls remaining on the alley or in the gutters into the pit. Continued rotation of the crank arm 51 returns the parts to their initial position, the spring 55 ensuring that the roller 53 is pressed against the cam surface 54.

At the conclusion of a frame of balls the machine is required to reset five pins in their appropriate positions on the alley, and this is accomplished by a different operation of the carriage 8 and the parts supported thereon, termed Action 2. The sequence of events of Action 2 is illustrated diagrammatically in the upper portion of the time-plan of Figure 34. For consideration of details of the movements of the parts during Action 2 reference should be made particularly to Figures 9, 10, 11, 12 and 13. In this action there is oscillation of the rocker arms 22 and 22' in addition to rotation of the crank arms 17, so that the point of connection betwen each crank arm 17 and its connecting rod 18 follows the path indicated in Figure 11 by the arrows and lines 60, control of the oscillation of the rocker arms 22 and 22' which are all fixed on the shaft 23 being provided by the cam 61 (see especially Figure 4, Figure 10 or Figure 12) acting on the cam follower 62 mounted on the extension 63 of the rocker arm 22'. Commencing in the withdrawn position shown in Figure 9, the carriage 8 is lowered by the simultaneous rotation of the crank arms 17 and downward oscillation of the shaft 17' by the rocker arms 22 and 22' until the parts assume the position shown in Figure 10 with the carriage 8 positioned slightly above the surface of the alley 1. At this point a pair of co-operating surfaces 64 and 65 provided respectively on the links 9 and 10 of the parallel link mechanism of the carriage 8, come into contact with one another as illustrated in Figure 13. The purpose of these parts, which it will be seen tend to bind together as the carriage is finally lowered the last few inches from the Figure 10 position to that shown in Figure 11, is to ensure positive locking of the carriage 8 in its exact position for the actual pin resetting operation. As appears from Figure 11, each of the pin holding mechanisms 7 is actuated when the carriage 8 assumes its lowermost position, to deposit five pins on the alley 1 in register with spikes 66 which at this time are projecting upwardly through holes in the floor of the alley 1 to engage recesses in the bases of the pins 2. These spikes 66 form part of a conventional bowling alley, being mounted on a common plate 67 connected to a lever 68 pivoted at 69. With the present machine the lever 68 is controlled at its free end by a further lever 70 operated in the manner later to be described.

For the purpose of illustration, two of the pin holding mechanisms 7 are shown in Figure 11 with the pins released therefrom, while the third such mechanism shows its pin just at the moment of release, although, of course, in fact, all the pins are released simultaneously.

The release mechanism of the individual pin holding mechanisms 7 is shown in detail in Figure 8. While in position in the mechanism 7, the pin 2 rests with its rubber band 71 against a pair of pads 72 mounted at the lower ends of levers 73, each such lever being pivoted at 74 to an intermediate point on a further lever 75 and being urged to rotate by a spring (not shown) operative to move the pads 72 inwardly towards one another. The pads 72 are arcuate sufficiently to follow the circumferential contour of the pin 2. One end of each lever 75 is connected to a link 76, 77 respectively, and these two links are connected to opposite ends of a centrally pivoted arm 78 rotation of which is controlled by a rod 79 shown

in broken lines in Figure 8. Reference to Figure 12 will, however, show that such rod 79 (and, in fact, each of the five rods 79 of the fine pin holding mechanisms 7, these not being separately illustrated) is itself controlled by a common bell-crank lever 80 forming together with articulated links 81 the drive means to the pin holding mechanisms 7 from a lever 82 pivoted at 89 to the rocker arm 22' and bearing a cam follower 83 engaged by the cam 29, which is the same can as has previously been described with reference to the operation of the grippers 27 of each pin holding mechanism. As best seen from Figure 8, the upper ends of the levers 75 are pivoted at 84 to the upper part of a shell or "pocket" 85 surrounding the pin 2 in each pin holding mechanism 7. The upper ends of the levers 73 are each connected to a pair of fingers 86 adapted to engage lightly the neck of the pin 2. The shape of these fingers 86 will be best seen from Figure 7. When the carriage 8 has assumed the position shown in Figure 11, the cam 29 acts on its follower 83 to move the rod 79 to the left and thus rotate the arm 78 anti-clockwise. This forces outwardly the lower ends of the levers 75, which thus rotate about 84. This movement of the levers 75 also carries outwardly the pivotal points 74 of the levers 73 so that the pads 72 are moved out of engagement with the band 71 of the pin 2. This is the position of these parts illustrated in Figure 11. Simultaneously pressure is removed from the upper ends of the levers 73, so that the fingers 86, which never grip the pins tightly but merely ensure that they stand erect, allow the neck of the pin 2 to pass therethrough so that such pin falls down onto the spike 66 in the manner illustrated. It should be noted that the angle of inclination of the pads 72 to the vertical is sufficiently small to ensure that the rubber band 71 can slide along such pads as they commence to move apart, to allow the pin to pass smoothly out of the pocket 85.

The difference between the operation illustrated in Figure 4 and that illustrated in Figure 12 should be appreciated. In the Figure 4 position, where the rocker arm 22' is in its upper position for Action 1, the position of the pivotal point 32 of the lever 31 controlling the gripper actuating mechanism 34, relatively to the axis of the cam 29, is such that the cam 29 when it forces the cam follower 30 downwardly acts to straighten the articulated links 33 and thus actuate the mechanism 34; whereas, in the Figure 12 position, in which the rocker arm 22' moves to its lower position for Action 2, the position of the pivotal point 32 relatively to the axis of the cam 29, is such that the links 33 never become fully straightened even when the cam follower 30 is riding up on the rise of such cam. Consequently the mechanism 34 is operative during Action 1 and inoperative during Action 2.

Similarly, in the Figure 4 position for Action 1, the lever 82 does not straighten the articulated links 81 to release a pin from the pin holding mechanisms, even when the cam follower 83, rides up on the rise of the cam 29, by virtue of the low position of the pivotal point 89 of such lever 82 in relation to the axis of the cam 29, since the rocker arm 22' is in its upper position. This lever 82 is, on the other hand, effective in actuating the pin release parts for Action 2 when the rocker arm 22' is in its lower position shown in Figure 12, and the pivotal point 89 is thus raised relatively to the axis of the cam 29. Thus, conversely to the gripper actuating mechanism 34, the release of the pin holding parts takes place Action 2 but not during Action 1.

The rotation of the crank arms 17 and the oscillation of the rocker arms 22 and 22' which cause the movement of the connecting rods 18 indicated by the arrows 60, Figure 11, is continued, so that the carriage 8 immediately begins to lift again with the empty pin holding mechanisms 7. In due course the cam 29 rotates clockwise to permit the parts whereby the pin holding pads 72 were separated to be returned to their initial positions under the force of a spring 87 connecting the lower ends of the brackets 75. A spring 88 ensures that the links 81 turn into the position shown in Figure 4.

Consideration will now be given to the pit clearing unit, i.e. section (C) referred to above. This unit, visible in broken lines in Figure 1, is more particularly described with reference to Figures 14 and 15. A canvas sheet 100 extends across the pit 5 from a forward connection at 101 to the end wall of the alley 1, to a rear connection at 102 to an upwardly projecting cushion 103 secured to the framework of the machine. Beneath the sheet 100 there are arranged, one on each side of the machine, pit discharge levers 104 which in the rest position shown in Figure 1 lie flush against the bottom of the pit 5. Each lever 104 is pivoted to the framework 3 at a point 105 towards the rear of the machine, and at its free end it has an upturned short portion 106. A roller 107 extends across the machine from one upturned portion 106 to the other. At an intermediate point 108 each lever is pivotally secured to a connecting rod 109 driven by a crank arm 110 mounted on a common shaft 111 at the top of the framework 3 (see also Figures 27, 35 and 36). The shaft 111 is connected to a sprocket wheel 112 engaging a chain 113 that passes over a further sprocket wheel 114 mounted on the same shaft 115 as the cam 61 that controls the arm 22'.

The initial position of the pit clearing mechanism is shown in Figure 1 with the crank arms 110 extending vertically downwardly. When these arms are rotated anti-clockwise to the position shown in Figure 14, the connecting rods 109 pull the pit discharge levers 104 upwardly. Figure 14 indicates the effect that this will have on the canvas sheet 100 which lifts balls 116 and pins 2 that have previously been knocked into the pit by the bowler, or swept thereinto by the alley sweeping mechanism already described. Continued upward swinging movement of the levers 104 brings the parts to the position shown in Figure 15, the cavity in the canvas sheet 100 previously existing between the levers 104 and the cushion 103, being caused to disappear by the tension in the sheet 100 as the roller 107 moves upwardly and to the left. The movement that this imparts to the balls and pins in the cavity is indicated by the arrow 117 in Figure 14.

A further pair of arms 118 (only one shown) is provided, joined by a roller 119 bearing against the upper surface of the canvas sheet 100 by virtue of springs 121 pulling downwardly on the arms 118. During the initial stages of the movement of this unit such arms 118 ride upwardly, rotating anti-clockwise about their pivotal points 120 on the framework 3, until, when the parts reach the final position shown in Figure 15, the roller 119 presses against that section of the sheet 100 lying between the roller 107 and the connection at 102. This action holds the canvas taut at all times and in particular ensures that during the downward return movement of the pit discharge levers 104, the sheet 100 is caused to lie tightly against the top rounded surface of the cushion 103. It will be evident from Figure 15 how the pins 2 and balls 116 are caused to fall from the canvas sheet 100 down the surface of an apron 123 into the reloading wheel which is arranged immediately to the rear of the pit clearing unit.

Figure 14 also demonstrates how the upward movement of the pit discharge levers 104 allows a roller 122 arranged beneath the canvas sheet 100 and secured to the lever 70 to move upwardly and thus allow clockwise rotation of such lever 70 from the position shown in Figure 9, with the spikes 66 withdrawn, to the position of Figures 11, 14 and 15 with the spikes 65 raised for receiving a new set of pins. The parts tend to assume this latter position by reason of the weight distribution of the spike operating parts, the left-hand end of the lever 68 being of a weight just insufficient to overbalance its own right-hand end and the plate 67 and the other parts

secured thereto, so that, as shown in Figure 9, when the lever 70 is held in the Figure 9 position, the spikes 66 remain withdrawn. This small weight difference is, however, more than offset by the lever 70 which is heavily weighted at its inner end which engages the lever 68, so that, on being released by the sheet 100, the lever 70 forces the parts to the position shown in Figure 11. Return movement of the levers 104 causes their extensions 106 to press against the roller 122 and move the lever 70 anti-clockwise thus withdrawing the spikes 66. The timing and co-ordination of these movements will be described later in connection with the overall operation of the machine.

Reference should now be made to Figures 19 to 26, illustrating section (D) of the machine, namely the reloading wheel and its associated parts. As appears from Figure 19, the reloading wheel 150 is continuously rotated about a stub axle 151 by means of a chain 152 engaging a sprocket wheel 153 secured to said wheel 150. A part of the pit clearing unit is illustrated in Figure 19, to demonstrate how a pin 2 falls into a channel 154 extending around the entire periphery of the wheel 150. The balls fall similarly into the lowermost section of this channel 154. Spaced around such channel 154 at convenient intervals are pairs of lips 155, which may be more clearly seen in Figures 23 and 25. Positioned adjacent each such pair of lips 155 is a locking lever 156 pivotally mounted on the wheel at 157 and connected by means of a spring 158 to a discharge lever 159 pivotally mounted on the wheel at 160. These parts also appear in detail in Figures 24 and 26. The lever 159 can occupy either the extended position shown in Figure 24 or the withdrawn position shown in Figure 26, being in equilibrium in both positions by virtue of the point of connection of the spring 158 to such lever 159 in relation to the axis 160. As the lever 159 is pushed inwardly from the Figure 24 position to the Figure 26 position, the direction of pull of the spring 158 crosses the line joining the point of connection of such spring to the locking lever 156 and the pivotal axis 160, so as to retain the lever 159 in its inner position.

Returning to Figures 21 and 22, it will be seen that the wheel 150 also carries a number of knock-out levers 161 each pivoted to the wheel at a point 162 and each carrying a roller 163 projecting radially from the outer periphery of the wheel 150. To co-operate with these knock-out levers 161, the framework 3 of the machine includes a fixed bracket 164 (Figure 21 only) which has two elbows 165 extending into the path of the rollers 163. The function of these knock-out levers 161 is demonstrated in Figure 21. Firstly, it should be explained that it is essential for the subsequent release of the pins from the wheel 150, that such pins should all be oriented in the channel 154 of the wheel with their bases leading, i.e. as shown in Figure 22 in which view the wheel rotates clockwise. Should a pin such as the pin 2'' in Figure 21 come to lie with its head leading, its band 71 lying against the lips 155, the inward swinging motion of the adjacent knock-out lever 161 when the roller 163 thereof reaches the first elbow 165, will act to force such pin 2'' inwardly and tilt the same so that it falls down into the position indicated at 2''', the arrow 166 tracing out the path of movement of the head of such pin during this movement. The second elbow 165 is provided to ensure correct operation by duplication of such knock-out action, should the pin 2'' not topple over the first time.

Once the pin has been thus correctly oriented within the channel 154, or if it should initially come to lie in the correct position, the upward movement of this side of the wheel 150 will cause such pin to slide downwardly as indicated by the arrow 167 in Figure 21 until its band 71 has come to rest against the two lips 155.

A second bracket, a locking bracket 168, is also provided on the framework 3 of the machine. This bracket is shown only in Figure 22 and includes an elbow 169 projecting radially inwardly towards the wheel and positioned so as to co-operate with the discharge lever 159 of each locking lever 156. As appears from Figure 22, as each discharge lever 159 comes into engagement with the elbow 169 of the bracket 168, the lever 156 is drawn from the position shown in Figures 23 and 24 to that shown in Figures 25 and 26, in which latter position it bears against the surface of the pin 2''' and positively prevents the same from falling out of the channel 154. As already pointed out, the locking lever 156 is held in this position by tension in the spring 158 and the discharge lever 159 is also held inwardly by such spring 158 by virtue of the overcentre mounting of such spring.

Simultaneously, any balls that have been discharged into the wheel from the pit discharge unit will be carried up by the wheel in a like manner, except that such balls will simply rest against the lips 155 while being out of reach of the locking lever 156. Consequently, when each ball reaches a position about 45° before the top point of the wheel, it will roll out of the channel 154, as demonstrated by the ball 149 in Figure 22, onto a broad dished surface 170, which may also be seen in the plan view of Figure 27. From this surface 170, the balls roll downwardly under gravity into the return rail 6 which forms a continuation of the surface 170.

The pins, however, by reason of their being positively held within the channel 154 by the lever 156 continue to travel with the periphery of the wheel. A counting mechanism the actuation of which will later be described, determines whether each pin as it reaches the uppermost position on the wheel should be detached therefrom for subsequent feeding to a pin holding mechanism, or whether such pin should be allowed to continue to remain in the wheel. The latter situation would arise if all five pin holding mechanisms 7 were already full. Such a pin that has been around the wheel a full revolution is indicated as 2*a* in Figure 22. If the counting mechanism determines that a pin is required, then it so arranges the control circuits of the machine (not shown) that a solenoid 171 arranged at the head of the wheel is energized. As best seen from Figure 20, this causes movement to the right of the armature 172 of the solenoid 171 against the pull of a spring 173. The armature 172 is connected to a bell-crank lever 174 pivoted to the framework 3, the free arm of such bell-crank lever 174 being arranged to move into and out of the path of travel of the discharge lever 159. It follows that if the solenoid is actuated to move the parts to the position illustrated in Figure 20, such lever 174 will act to trip the discharge lever 159 as this point on the wheel moves past the solenoid 171. This will immediately reverse the previous action of the discharge lever 159 and will allow the locking lever 156 to re-occupy the position shown in Figure 23 and thus allow the pin 2''' to fall out of the channel 154 onto a receiving tray 175 from which it passes to the conveyor mechanism shortly to be described. This discharge operation of the pin is also illustrated in Figure 19, which shows arms 176 bearing a transverse bar 178 that is momentarily depressed to rotate a shaft 177 as the pin 2''' falls into the tray 175. This shaft 177 actuates the counting mechanism previously referred to and not shown in further detail, since its mode of operation is conventional. An arm 176 is also visible in broken lines in Figure 1, and the shape of the bar 178 can be seen from Figure 22 and its dotted representation in Figure 27.

As best seen from Figure 27, the pin 2''' as it is released from the wheel, rolls into the tray 175 while rotating about a vertical axis extending approximately through its head portion. In other words, the base portion of the pin travels in the arc represented by the arrow 180. This brings the pin to lie with its major axis parallel to the length of the bowling alley, with the base of the pin turned towards the conveyor and recharging unit, section (E),

whereby such pin is returned to the pin setting unit, section (A).

This conveyor and recharging unit, is shown in plan view in Figure 27, and various detailed views are also included as Figures 28 to 33. The first portion encountered by the pin is a conveyor belt 181 onto which the pin is fed from the tray 175. This is a conventional conveyor belt consisting of an endless band passing over rollers at each end. The arrow 182 in Figure 27 indicates the movement of the pin as it is picked up by the conveyor belt 181 and carried upwardly and along the top of the machine towards the recharging unit.

The recharging unit consists of five funnels 183, 184, 185, 186 and 187 arranged in a triangular array corresponding to and located above the respective pin holding mechanisms 7 of the pin setting unit, a feature of the machine which may be appreciated from Figures 1, 2, 3, 9, 10 and 11, in addition to Figures 27 to 33 to which specific reference is now being made. The purpose of the recharging unit is to feed successive pins as they are received from the conveyor belt 181, each to one of the funnels 183 to 187. For this purpose four deflecting fingers 188, 189, 190 and 191 are pivotally mounted for swinging into the path of the travelling pins. When the unit is in its initial position prior to receiving the first pin, indicated in Figure 28 as 2*b*, the deflecting fingers 188 and 190 are turned to lie across the path of travel of the conveyor belt 181, whereas the two deflecting fingers 189 and 191 on the other side of the belt are held back in positions clear of any pins travelling along such belt. As will be seen from Figures 29, 31*a*, 31*b* and 32, the deflecting finger 18 is secured to a recessed disk 192 pivotally mounted on the framework of the machine and by a spring 179 urged into the position in which such finger 188 is withdrawn from the conveyor belt 181. Such movement of the recessed disk 192 is prevented by a detent lever 193, the end of which engages the recess in such disk 192. The detent lever 193 is pivotally mounted on the framework 3 at 194 and its other end abuts against a depending arm 195 (Figure 32) of a lever 196 pivoted to the framework 3 at 197 and carrying at its free end, in conjunction with a similar, axially displaced lever 198, a bar 199 that projects upwardly into the path of travel of a deflected pin (Figure 32). This bar 199 is also visible in Figure 28 which demonstrates the deflection of the first pin, and from this figure it will be apparent how such pin strikes against the deflecting finger 188, rolls sidewardly in the manner indicated by the arrow 200 and finally topples into the funnel 183 to fall into a pin holding mechanism 7 in the manner later to be described, such pin pressing down on the bar 199 while in transit and thus rotating the detent lever 193 clockwise and releasing the recessed disk 192 so that the spring 179 may take charge thereof and swing the deflecting finger 188 anti-clockwise to bring the same out of register with the path of travel of the next pin on the conveyor belt 181.

The parts controlling deflecting finger 190 are identical with those just described in relation to deflecting finger 188.

The mechanism that controls the deflecting fingers 189 and 191 is also generally similar to that controlling the deflecting fingers 188 and 190, and each pair of mechanisms is interlinked by means of a connecting rod 260 extending underneath the upper span of the conveyor belt 181. The deflecting finger 189 is mounted on a recessed disk 213 (Figure 29) similar to the disk 192, and such disk 213 is under the control of a detent lever 261 which is generally similar to the detent lever 193 except that it is pivotally mounted on one end of a link 262 that pivots about the axis of finger 189 and forms an articulated extension of the connecting rod 260 instead of on the framework 3 of the machine. The other end of this connecting rod 260 is pivoted to the disk 192 of the deflecting finger 188. The disk 213 bearing the deflecting finger 189 is provided with a spring 263 urging such disk to turn clockwise, i.e. to bring the finger 189 out of the path of the conveyor belt 181, but this spring is considerably weaker than the spring 179 which acts on the disk 192 and thus through the connecting rod 260 on the disk 213.

Thus, when the deflecting finger 188 is moved out of the path of the conveyor belt 181 by the spring 179 by operation of the bar 199 with anti-clockwise rotation of the disk 192, in the manner just described, the connecting rod 260 will be pulled transversely across the assembly and through link 262 will move the detent lever 261 co-operating with the disk 213 so as to rotate such disk anti-clockwise and move the finger 189 across the conveyor belt 181 into the path of the next pin. This is the position shown in Figure 31*a*. When such next pin, indicated in Figure 33 as 2*c*, arrives at the deflecting finger 189, it is turned aside from the conveyor belt 181 and directed into the second funnel 184. A bar 201, similar to the bar 199 is arranged in this deflected path of travel of the pin 2*c*, and the bar 201 acts on mechanism similar to that described with reference to Figure 29 to rotate the detent lever 261 co-operating with the disk 213 about its pivotal connection on the link 262. This mechanism which is shown in Figures 29, 31*a* and 31*b* in three operational stages comprises levers 196 and 198, a depending arm 195 on the lever 196, and a lever 193 that, when rotated anti-clockwise by the depending arm 195, rotates the detent lever 261 to release the disk 213 to take up the position shown in Figure 31*b* under the action of the spring 263. The deflecting finger 189 is thus moved into the withdrawn position after the pin 2*c* has passed over the bar 201 and fallen into the funnel 184. The parts are now in the Figure 31*b* position.

Both the deflecting fingers 188 and 189 are now withdrawn and the next pin to be fed along the conveyor belt 181 strikes the third deflecting finger 190 so as to be discharged into the funnel 185. A similar bar 202 is again operated by the deflected pin to release the finger 190 and thus draw the finger 191, by means of a second connecting rod 260 acting similarly to the connecting rod 260 linking the deflecting fingers 188, 189, across into the path of travel of the fourth pin. The latter is then similarly deflected into the funnel 186. In its travel it passes over a fourth bar 203 similar to the bars 199, 201 and 202, and this in turn trips the detent lever 261 holding a recessed disk 214 on which the deflecting finger 191 is mounted, so that the fifth pin passes straight along the belt 181 and into the final funnel 187. Resetting of the parts is described below in connection with the resetting operation.

The manner in which these five pins fall into their respective pin holding mechanisms 7 should be clearly apparent, but reference may be made to Figure 9 which has been drawn to show the operation that takes place as the fifth pin, here shown as 2*d*, falls through the funnel 187 and into the pin holding mechanism 7 positioned below such funnel.

The detailed construction of the pin holding mechanisms 7 has already been fully set forth above, and it will therefore require no preliminary explanation to state that by virtue of the springs acting on the levers 73 the pads 72 of such levers 73 are directly positioned in the falling path of the pin 2*d* and that the fingers 86 positioned at the upper ends of these levers 73 are opened wide to allow the full girth of the pin to pass therethrough. The levers 75 on which the levers 73 are mounted, remain stationary during this operation in their position lying hard against the pocket 85 of the pin holding mechanism. Consequently, the weight of the pin 2*d* falling against the pads 72 will cause the levers 73 to rotate until they take up the positions of the levers 73 shown in the two lefthand pin holding mechanisms 7 of Figure 9. Since the levers 75 are held firmly in their inner positions by the spring 87 (see Figure 8) the levers 73 are prevented from rotating sufficiently to allow the

pin to fall right through the mechanism 7. Accordingly, the pin comes to rest with its band 71 resting against such pads 72 and with the fingers 86 pressing lightly against the neck of the pin. As demonstrated by the broken lines in Figure 7, the fingers 86 are sufficiently long that even when in their fully open positions they leave no appreciable gap between their ends. This ensures that even if the pin 2 should fall into the pocket 85 at an inclination to the vertical, i.e. with its head near the top perimeter of the pocket 85, the fingers 86, during their inward movement, cannot fail to engage the pin and move it to its correct upright position. The five pin holding mechanisms 7 are thus loaded and ready to perform a pin setting operation in the manner already described.

It will be necessary to return for a moment to consideration of the conveyor recharging unit and particularly to the operation thereof illustrated in Figures 29 to 32, to appreciate the operation of re-cocking the deflecting finger mechanisms. This operation is performed by means of the rocker arm 22', the oscillating movement of which has already been described. As best seen in Figure 30, this arm 22' has pivotally connected to it a link 204 (see also Figure 29) which in turn is pivoted to a lever 205 mounted to rotate about a pin 206 secured to the framework 3. The lever 205 carries a pin 207 threaded through a hole in the end of a member 208 which is mounted for sliding reciprocal movement in a plane lying parallel to and above the recessed disk 192 of the deflecting finger 188 and the corresponding disk 212 of the deflecting finger 190. Downward rocking of the arm 22' will draw on the link 204 to turn the lever 205 clockwise and thus move the member 208 to the left as indicated by the arrow 209. Slots 210 in the member 208 engage upstanding pins 211 on the disks 192 and 212. Accordingly, the leftward sliding motion of the member 208 will act to turn the disks 192 and 212 clockwise as seen in Figures 29, 31*a* and 31*b*, so as to reposition the deflecting fingers 188 and 190 in the original position shown in Figures 28 and 29. This clockwise movement of the disks 192 and 212 will move the two connecting rods 260 to the right across the conveyor belt 181 and will thus cause the detent levers 261 mounted at the ends of the links 262 connected to such connecting rods 260 to reengage their respective recessed disks 213 and 214. The mechanism will thus be fully re-cocked with the deflecting fingers 188 and 190 extending across the conveyor 181 and the deflecting fingers 189 and 191 ready to be drawn again into the path of the conveyor belt 181 on subsequent anti-clockwise rotation of the disks 192 and 212, respectively.

Having now described in detail the construction and operation of the five sections of the machine, consideration will be given to the function of the machine as a whole.

Motive power for the machine is supplied by a motor 220 (see Figures 1, 27, 35 and 36, especially the two latter figures), which motor drives through a belt 221 to a wheel 222 connected to a shaft 223 extending into an enclosed casing 224 in which clutches (not shown) controlling the transmission are housed. Power is transmitted through a first clutch from the shaft 223 to a belt 226 which drives a wheel 227 mounted on a shaft 228 which also carries a roller 229 over which the conveyor belt 181 passes. This first clutch is controlled by a rod 225 and link 225', the rod 225 being connected to means (not shown) whereby it is automatically operated to disconnect the clutch and stop the conveyor 181 whenever the carriage 8 moves down from its uppermost position.

Mounted on the top of the transmission housing 224 are three solenoids 230, 231, and 232. The solenoid 230 acts on a rod 233 connected to a link 234 controlling a second clutch. This second clutch controls the drive from the incoming shaft 223 to the sleeve 24' on which the sprocket wheel 24 is mounted. Thus the solenoid 230 controls the alley sweeping mechanism.

The solenoids 231 and 232 act jointly on a bar 235 which is pivoted to a link 236 controlling a third clutch mounted within the casing 224. This third clutch controls the drive from the incoming shaft 223 to the sleeve 21' on which the sprocket wheel 21 is mounted. The bar 235 also has a connection with a link 237 controlling a fourth clutch which determines when power is transmitted from the incoming shaft 223 to the shaft 115. This latter connection is effected by means of a pin on the link 237 engaging an L-shaped slot in the bar. When the solenoid 232 is energized, the bar 235 is pulled downwardly, as seen in Figure 35, and the pin engages the narrow portion of the slot so that movement of the bar 235 to the left on energization of the solenoid 231 swings both the link 236 and the link 237. When the solenoid 231 is energized without the solenoid 232 being energized, only the link 236 is pivoted, the pin on the link 237 moving in the slot in the bar 235. Thus both solenoids 231 and 232 are energized for Action 2 when both the shaft 17' and the shaft 115 are to be rotated, and only solenoid 231 is energized for Action 1 when only the shaft 17' is to be rotated.

Action 1, which is the action required between the individual balls of a frame of balls, has already been described with reference to Figure 34. For this action, the control means act to operate the solenoids to control the parts in the following manner:

(*a*) the cam 61 is kept stationary in the position illustrated in Figure 4, thus holding the rocker arm 22' in its upper position;
(*b*) the chain 20 is driven to drive the shaft 17' and thus rotate the crank arms 17 and lower the carriage 8 to the position illustrated in Figure 3;
(*c*) simultaneously the cam 29 is rotated to operate the gripper actuating mechanism 34 and lift the pins, this taking place in the 3rd second as shown by the lower diagram of Figure 34;
(*d*) after about half a revolution of the crank arms 17 the chain 25 is driven to rotate the crank arms 51 and commence to lower the alley sweeping mechanism, so that, as the pins are lifted free of the alley, any fallen pins or balls thereon are swept into the pit as the crank arms 17 and 51 continue to rotate;
(*e*) after the crank arms 51 pass their dead centre position, their continued rotation causes retraction of the alley sweeping mechanism thus leaving the alley free for the replacing operation;
(*f*) the chain 20 is further driven to rotate the crank arms 17 for a second time and again lower the carriage 8;
(*g*) the carriage again reaches the position illustrated in Figure 3;
(*h*) the cam 29 again operates the gripper actuating mechanism 34 which this time acts to release the pins 2 held by the grippers 27;
(*i*) such pins take up their positions again on the alley and the carriage 8 rises again with continued rotation of the crank arms 17;

While these movements have been going on, the wheel 150 has been rotated by the chain 152 (driven through worm gearing 238 and belt 239 from the motor 220, as best seen in Figures 1 and 27), the wheel carrying pins around in its channel 154 in readiness for release by the solenoid 171. The wheel 150 has also been returning balls to the return rail 6 via the surface 170.

The solenoid 171 is energized, and as each pin passes the head of the wheel it is dropped into the tray 175 and onto the conveyor belt 181. Each pin is then diverted by the deflecting fingers to one of the pin holding mechanisms 7 in the manner already described. After five pins have been thus released from the wheel, the counting mechanism acts to de-energize the solenoid 171, so that

no further pins are released. For this purpose the counting mechanism may conveniently consist of a ratchet type disk mechanism (not illustrated) that is advanced one notch each time the shaft 177 is rotated by a pin falling from the wheel 150, until after five such movements a member controlling energization of the solenoid 171 is allowed to move into a recess in the disk and de-energize such solenoid. Then, when the rocker arm 22' is moved downwardly during Action 2, the disk is notched forward still further by a suitable linkage (not shown) attached to the rocker arm, so as to move the recess again out of register with the solenoid operating member.

The recharging of the pin holding mechanisms 7 is, of course, carried out while the carriage 8 is in its upper position (see Figure 9). The rod 225 acts when the carriage 8 is lowered to disconnect the drive to the conveyor belt 181 to prevent pins being fed along the conveyor to the funnels 183—187, except when the carriage 8 is in its upper position.

Assuming all five pin holding mechanisms to be loaded, the operation of the parts for Action 2 is as follows:

(*j*) the alley sweeping mechanism is first operated alone to clear any remaining pins or balls, in the same manner as before;

(*k*) after approximately three seconds (see the upper diagram in Figure 34) and during the withdrawal movement of the alley sweeping mechanism, the cam 61 commences to rotate (see Figure 10) to lower the rocker arm 22';

(*l*) simultaneously the crank arms 17 are rotated and the carriage 8 descends;

(*m*) also simultaneously, the pit clearing unit commences to rise and thus allows the spikes 66 to move upwardly in readiness for the pins;

(*n*) the carriage 8 finally reaches its lowermost position (Figure 11), when the cam 29 becomes effective, this time against its follower 83, and thus the pin release operation is performed (Figure 12);

(*o*) the downward movement of the rocker arm 22' recocks the deflecting finger mechanisms (Figure 30);

(*p*) the carriage 8 begins to rise again leaving the pins set on the spikes 66;

(*q*) the rise of the cam 29 moves away from the follower 83 thus releasing the levers 75, while the levers 73 assume the position shown in the righthand mechanism 7 seen in Figure 9, i.e. ready to receive a fresh pin from the recharging unit;

(*r*) the pit clearing unit returns to its rest position and retracts the spikes 66;

(*s*) after approximately eight seconds the carriage 8 is fully withdrawn and the alley is ready for the next frame;

(*t*) the cam 61 and the chain 20 are stopped with the parts they control in the withdrawn position;

(*u*) simultaneously the control circuit for the solenoid 171 is actuated so that the recharging of the pin holding mechanisms may commence as soon as possible.

It will be observed that in the above described operation for Action 2, the pit clearing unit is operated simultaneously with lowering of the carriage 8 by the rocker arm 22', since both these operations are controlled by the shaft 115. The power necessary to raise the parts of the pit clearing unit is preferably made as nearly as practical the same as the power recovered from the carriage 8 in falling the distance corresponding to movement of the rocker arm 22'. Thus the carriage 8 and the pit clearing unit act as counterweights for each other. This greatly reduces the power that it is required to supply from the motor 220 and consequently the size of motor that need be installed.

Should the recharging operation not be completed before the machine is again called upon to carry out Action 1, then it may be arrested while an Action 1 operation is effected and restarted at the conclusion of such Action 1. Clearly it must be completed before another Action 2 operation can be carried out, and the control circuits will be interlocked accordingly. Such control circuits will normally consist of electrically interlocked relays controlled both by a pair of manually operated push button switches provided at the bowling end of the alley for selection of Action 1 or Action 2 and by a number of microswitches (not illustrated) disposed in various locations throughout the machine and adapted to be operated by the different moving parts such as the carriage, alley sweeping mechanism and pit clearing mechanism. These relays operate the solenoids so that the correct sequence of events just described will take place, once the required action has been selected by one of the push button switches. These switches will be so interlocked that one action cannot be started once the other action has been started and before its completion.

What I claim is:

1. In a bowling alley pin resetting machine, the combination of five pin holding mechanisms and apparatus for recharging successively said pin holding mechanisms disposed in a horizontal V array corresponding to the arrangement of the pins on the alley in the five-pin game, said apparatus comprising a conveyor and a plurality of deflecting members each movable between an extended position in which it projects across the conveyor and a withdrawn position in which it permits free passage of a pin along said belt, such members being arranged in two pairs disposed along the conveyor and the members of each pair being aligned with one another on opposite sides of the conveyor, means for moving one deflecting member of the first pair thereof into its extended position to deflect a pin into a pin holding mechanism, means actuated by passage of such deflected pin for moving said one deflecting member of the first pair to its withdrawn position and the other deflecting member of the first pair to its extended position to deflect a second pin into a second pin holding mechanism, means actuated by passage of such second deflected pin for moving said second deflecting member to its withdrawn position, means for moving one deflecting member of the second pair thereof into its extended position to deflect a third pin into a third pin holding mechanism, means actuated by passage of such third deflected pin for moving said one deflecting member of the second pair to its withdrawn position and the other deflecting member of the second pair to its extended position to deflect a fourth pin into a fourth pin holding mechanism, and means actuated by passage of such fourth deflected pin for moving said other deflecting member of the second pair to its withdrawn position whereby to permit free passage for a fifth pin along said conveyor to the fifth pin holding mechanism.

2. In a bowling alley pin resetting machine, the combination of five pin holding mechanisms disposed in a horizontal triangular array, and apparatus for recharging said mechanisms successively, said apparatus comprising a conveyor and a plurality of deflecting members each movable between an extended position in which it projects across the conveyor and a withdrawn position in which it permits free passage of a pin along said conveyor, means for feeding pins onto said conveyor, means for positioning a first said deflecting member into its extended position to deflect a pin from said conveyor into a first of said pin holding mechanisms, means actuated by passage of such first deflected pin for moving said first deflecting member to its withdrawn position and for moving a second of said deflecting members to its extended position to deflect a second pin from said conveyor into a second of said pin holding mechanisms, means actuated by passage of such second deflected pin for moving said second deflecting member to its withdrawn position, means for positioning a third of said deflecting members in its extended position to deflect a third pin from said conveyor into a third of said pin holding mecha-

nisms, means actuated by passage of such third deflected pin for moving said third deflected member to its withdrawn position and for moving a fourth of said deflecting members to its extended position to deflect a fourth pin from said conveyor into a fourth of said pin holding mechanisms, means actuated by passage of such fourth deflected pin for moving said fourth deflecting member to its withdrawn position to permit a fifth pin to travel to a fifth of said pin holding mechanisms.

3. The combination of claim 2 including a vertically movable carriage disposed above the alley, said pin holding mechanisms being secured to said carriage, means for oscillating said carriage between an upper recharging position and a lower pin setting position adjacent the surface of the alley, and means sensitive to the position of said carriage to arrest movement of said conveyor whenever said carriage is displaced from said recharging position.

4. The combination of claim 2, including a vertically movable carriage disposed above the alley, said pin holding mechanisms being secured to said carriage, means for oscillating said carriage between an upper recharging position and a lower pin setting position adjacent the surface of the alley, and means sensitive to downward movement of said carriage for resetting said first and third deflecting members each into its extended position in readiness to cause a further pin fed by said conveyor to travel from said conveyor into said first pin holding mechanism.

5. In a bowling alley pin resetting machine, the combination of a conveyor, a first deflecting finger disposed alongside said conveyor and movable between an extended position in which it projects across the path of said conveyor and a withdrawn position in which it permits free passage of a pin along said conveyor, a second deflecting finger disposed in alignment with said first deflecting finger on the opposite side of said conveyor to said first deflecting finger, said second deflecting finger being movable between an extended position in which it projects across the path of said conveyor and a withdrawn position in which it permits free passage along said conveyor, first spring means acting on both said fingers to urge said first finger to withdrawn position and said second finger to extended position, means for retaining said fingers against the action of said first spring means with said first finger in extended position and said second finger in withdrawn position, means sensitive to deflection of a first pin from said conveyor by said first finger effective to release said retaining means to allow said first spring means to move said first finger to withdrawn position and said second finger to extended position, second spring means acting on said second finger to urge it to withdrawn position, said second spring means being weaker than said first spring means and being overcome thereby whenever said first spring means acts on said second finger, and means sensitive to deflection of a second pin from said conveyor by said second finger effective to release said second finger from said first spring means whereby to allow said second spring means to move said second finger to withdrawn position.

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