

March 17, 1970

D. F. UECKER
BALL RETURN APPARATUS WITH SELECTIVE DIRECTION
OF BALLS TO ACCESSIBLE PICKUP AREAS

3,501,147

Filed April 10, 1964

7 Sheets-Sheet 1

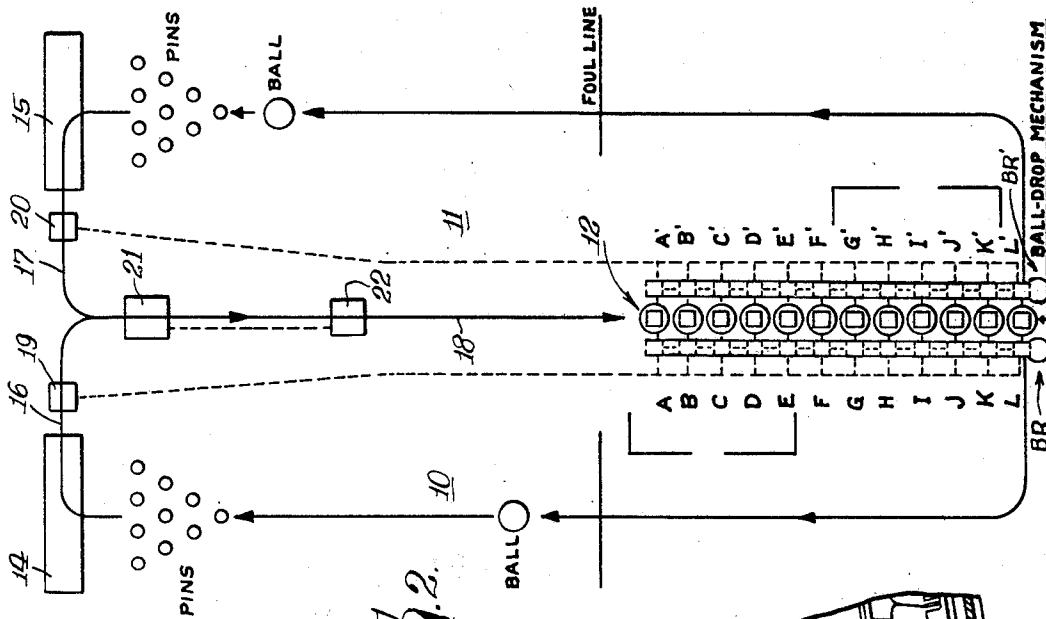


Fig. 2.

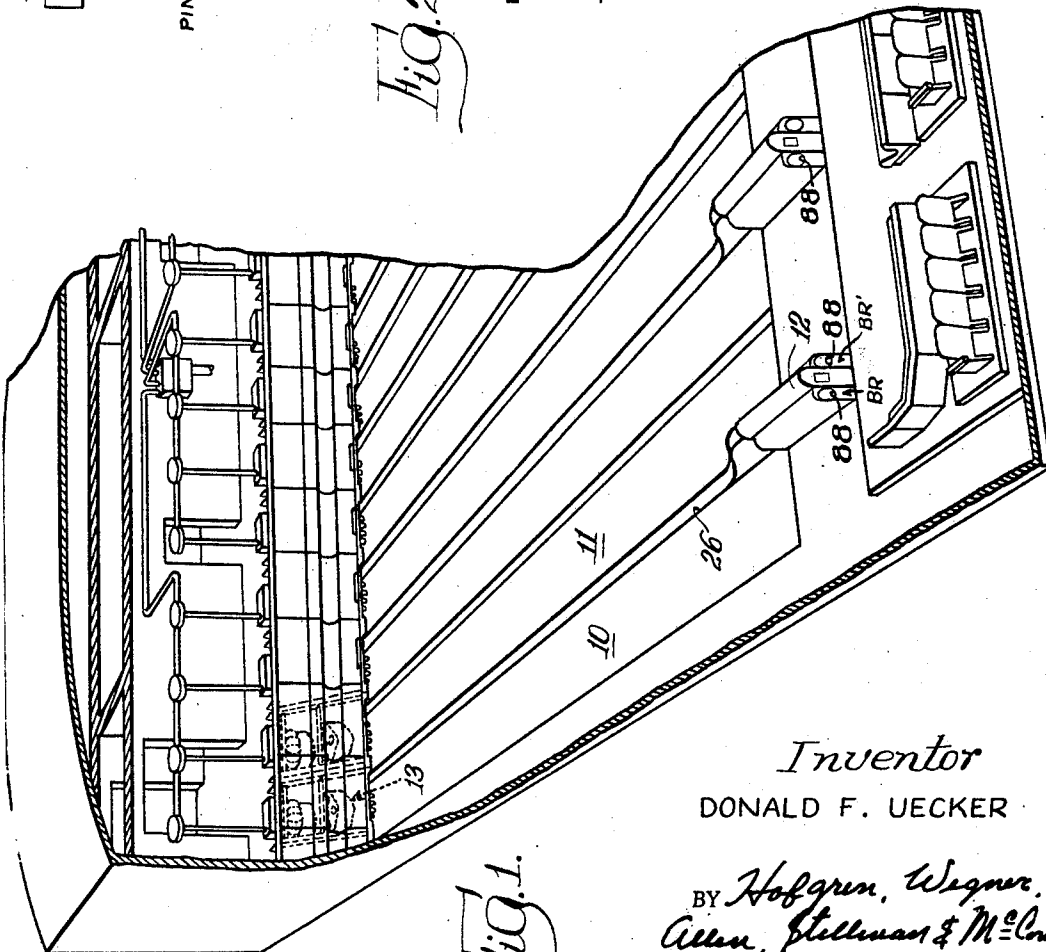


Fig. 1.

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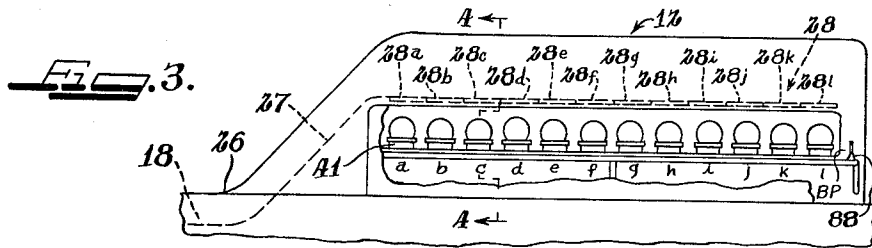
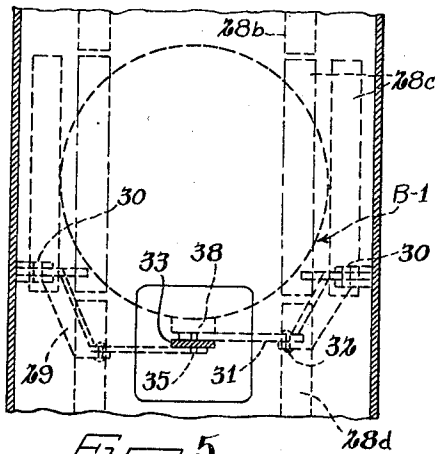
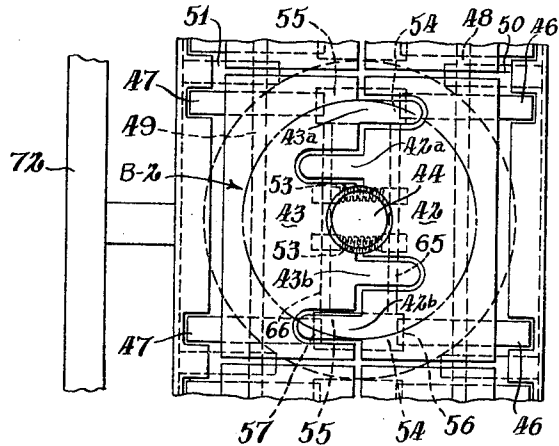
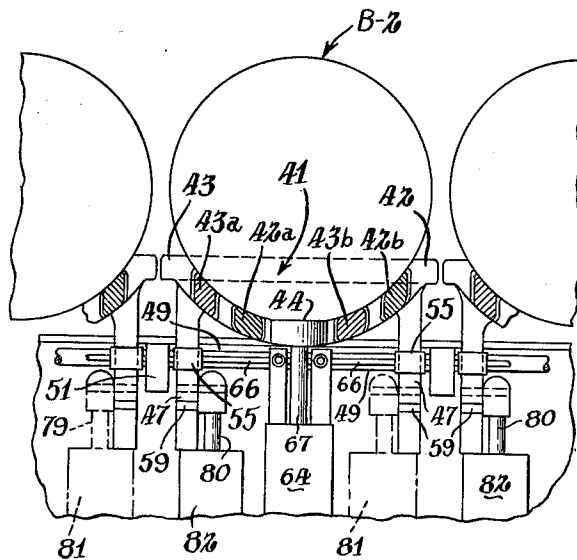
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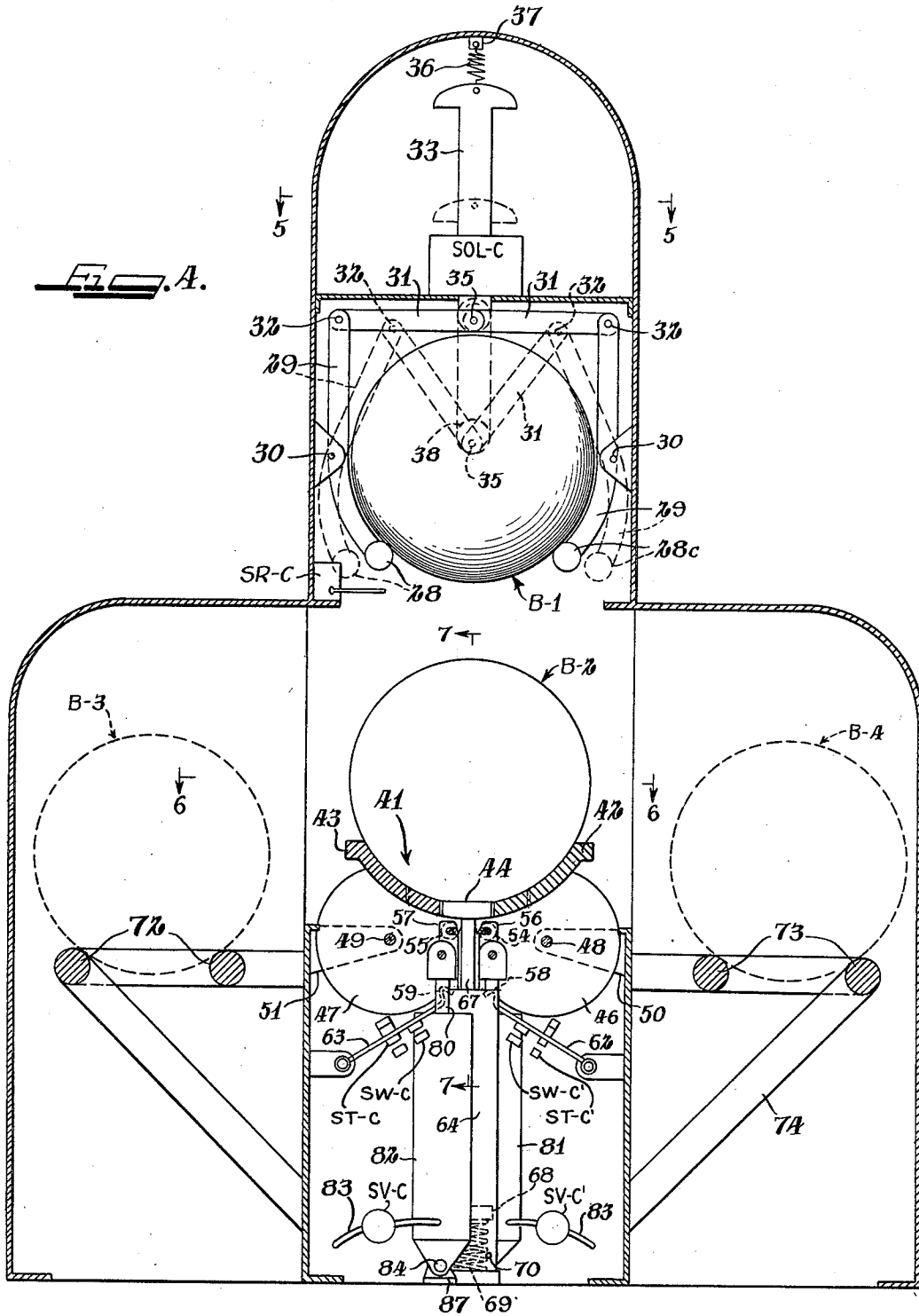
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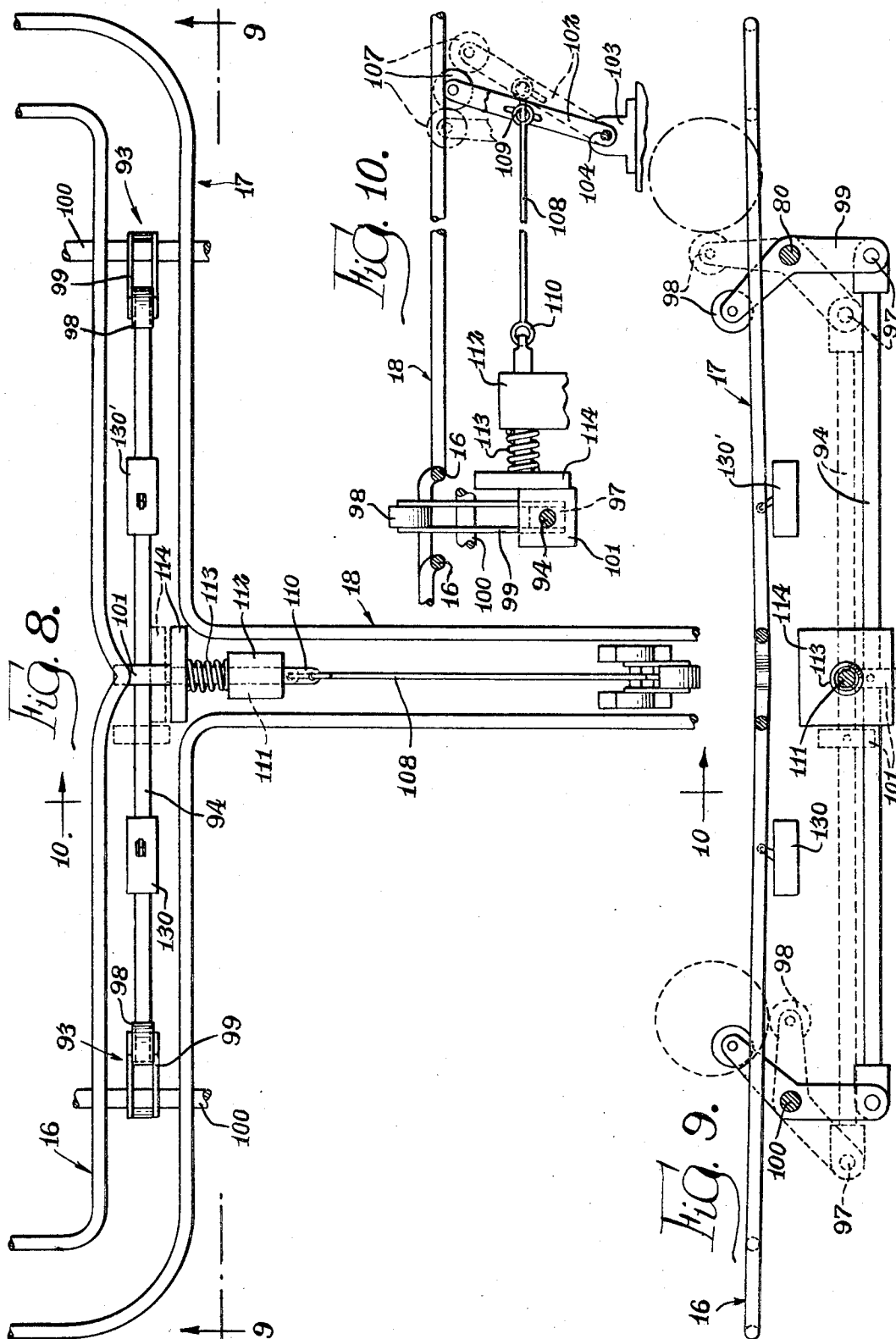
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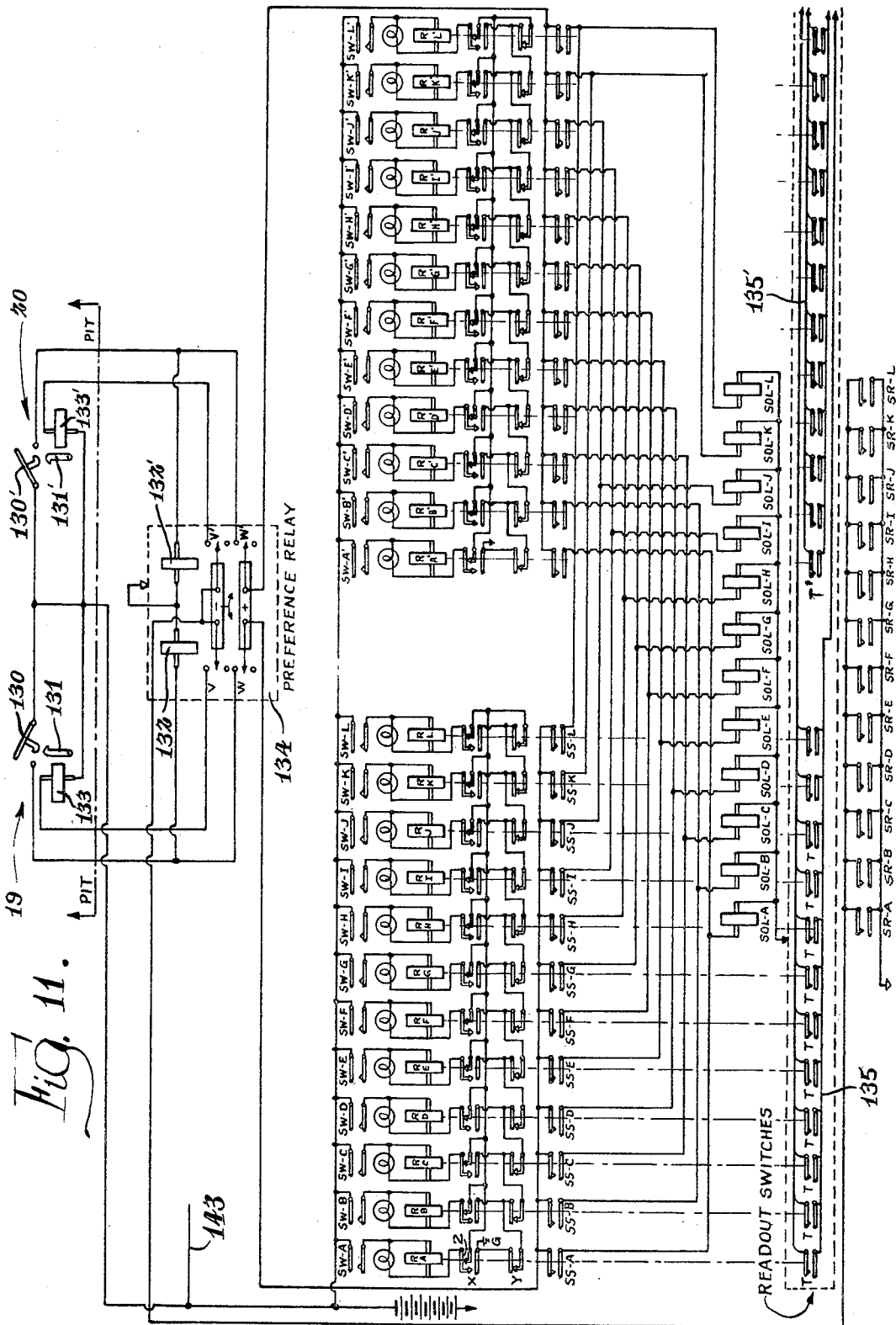
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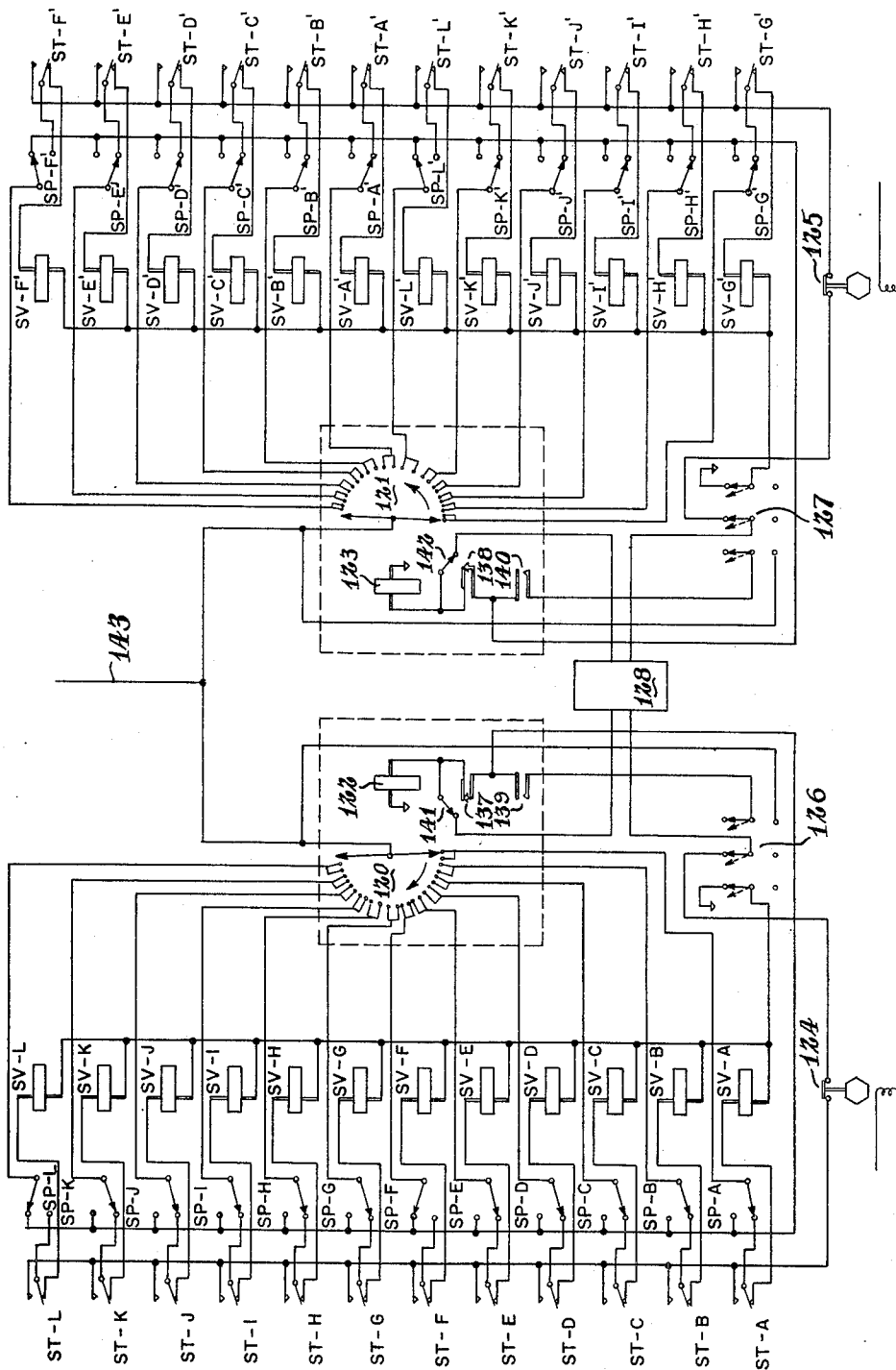
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Fig. 1b.



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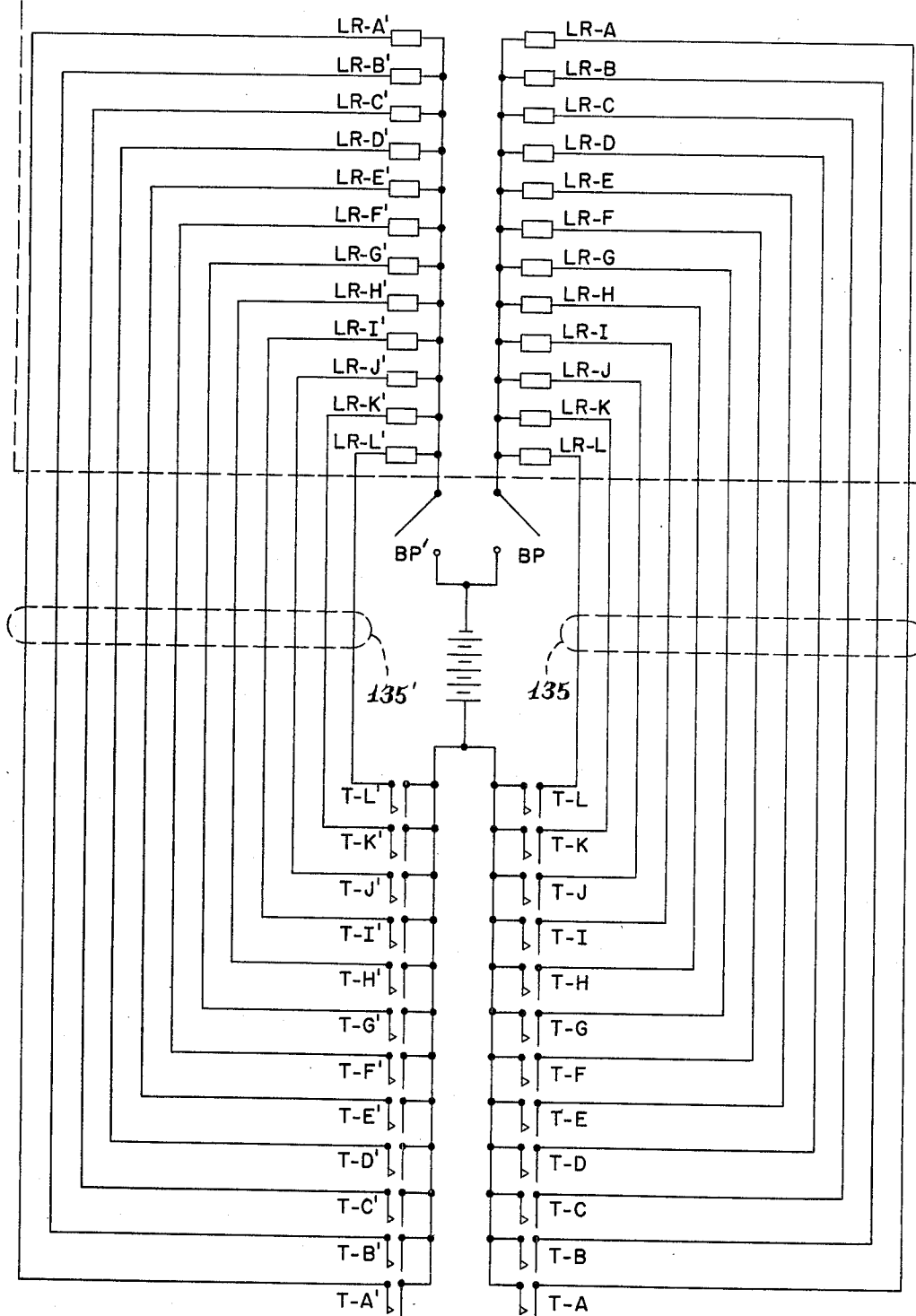
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Fig. 13.



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BALL RETURN APPARATUS WITH SELECTIVE DIRECTION OF BALLS TO ACCESSIBLE PICK-UP AREAS

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23 Claims

This invention relates to the the control of travel along predetermined paths or tracks. More particularly, the invention relates to systems for controlling the return of bowling balls for use in combination with a bowling lane or pair of adjacent bowling lanes and further relates to rendering such bowling balls accessible for use in a predetermined order or progression.

In the game of bowling, and particularly where more than one bowler is using a given lane, it is highly desirable to provide a system for correlating a given bowler with his bowling ball and rendering bowling balls accessible for use in accordance with a predetermined or preselected order or progression. Such system would make it unnecessary for a bowler to hunt for his ball prior to bowling in that the ball could be delivered to a bowler pick-up station for pick-up and use by the bowler in accordance with the predetermined order, e.g. when it is his turn to bowl. It is also desirable to provide such a system for control of ball handling with features adapting the system for operation in accordance with a predetermined order or progression corresponding to or closely correlated with the normal bowling order of a plurality of bowlers on a single bowling lane or pair of adjacent bowling lanes.

It is a general object of this invention to provide a new and useful system for controlling travel along the path.

It is also the general object of this invention to provide new and useful ball handling apparatus which is usable in association with a bowling lane establishment.

It is another object of this invention to provide a new and useful system capable of rendering bowling balls accessible, e.g. to bowlers on either of two adjacent lanes, in accordance with a preselected or predetermined order, in a normal operation of which the necessity of a bowler to search for his ball is eliminated.

It is a still further object of this invention to provide such a system wherein a plurality of ball receiving and holding stations, e.g., one for each bowler, is provided and including positive action for release of balls from the stations in accordance with the desired predetermined order.

Yet another object of this invention is to provide a system in accordance with any of the foregoing objects which is capable of delivering the bowling balls to one or more common ball pickup stations, e.g., one for each of two adjacent lanes, for pick-up and use by a bowler.

Still other objects of this invention include provision or adaptation of the system in accordance with any of the foregoing objects for permitting each bowler to bowl twice in succession before progressing to the next bowler, for overriding the last-mentioned provision so that upon bowling of a strike or during the 11th and/or 12th frames of the game the progression proceeds without waiting for a second ball, separate circuit means corresponding to each ball storage station and scanning means for sequentially energizing each circuit for delivery of balls to the bowlers in accordance with the preselected or predetermined plan and/or override of the delivery of balls in accordance with the preselected order so that the preselected order may be stopped as is desired for permitting bowlers to bowl out of turn.

Another object of this invention is to provide new and useful ball holding or receiving pockets at the ball receiving

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ing stations adapted to receive a ball and hold the ball in the storage station but movable to a ball ejection or release position for delivery of the ball to a bowler.

An additional object is to provide a new and useful system including electric circuit means, e.g., separate electric circuits for each adjacent lane, adapted upon energization to control return of a ball to any ball position readied by removal of a ball for use on the lane corresponding to the energized circuit, preference relay means responsive to the returning of a ball from either lane pit by the ball return means for energizing the electric circuit corresponding to the lane from which the ball is returning and means responsive to return of a ball to its storage station enabling the preference relay means to energize the electric circuit for the corresponding lane to advance the progressive bowling order.

And another object is to provide new and useful ball return control means for association with separate branch tracks or paths leading from adjacent bowling lanes to a common track or path for return of balls to the ball holding or receiving stations.

Still other objects will be apparent to those in the art from the following descriptions and from the drawings, in which:

FIG. 1 is a perspective view showing a plurality of adjacent bowling lanes in a bowling establishment with the general location of major attendant equipment;

FIG. 2 is a schematic diagram of two adjacent lanes, as illustrated in FIG. 1, with attendant equipment and adapted for use in accordance with one embodiment of this invention;

FIG. 3 is a side view of a ball storage rack portion of the equipment of FIG. 1, with a part of the cover broken away to show ball storage station;

FIG. 4 is a vertical section through the rack of FIG. 3 taken along line 4—4;

FIG. 5 is a partial horizontal section taken along line 5—5 of FIG. 4;

FIG. 6 is a partial horizontal section through the storage rack taken along line 6—6 of FIG. 4;

FIG. 7 is a partial vertical section of the rack taken along line 7—7 in FIG. 4;

FIG. 8 is a perspective plan view of a portion of a ball return track system usable in the present invention for return of balls from adjacent bowling lane pits to the storage rack of FIG. 3;

FIG. 9 is a vertical section of the system of FIG. 8 taken along line 9—9;

FIG. 10 is a vertical section of the system of FIG. 8 taken along line 10—10;

FIG. 11 is a schematic diagram, including a wiring diagram, of a ball return control system of the present invention;

FIG. 12 is a schematic diagram illustrating a ball sequence control system usable in accordance with this invention; and,

FIG. 13 is a schematic diagram illustrating wiring for readout from the wiring of FIG. 11 to a computer.

While this invention is susceptible of embodiment in many different forms, there is shown in the drawings and will herein be described in detail specific embodiments of the invention with the understanding that the present disclosure is to be considered as an exemplification of the principles of the invention and is not intended to limit the invention to the embodiments illustrated.

The ball handling system of the present invention is intended for use especially in the game of bowling. Accordingly, the system may be used in conjunction with a bowling lane or plurality of bowling lanes including two adjacent bowling lanes 10 and 11 as shown in FIG. 1. In such use, a ball storage rack 12 is provided for receiving balls from adjacent lane pits where the balls are

gathered by suitable ball gathering structure or mechanism as a part of a pinsetter structure such as is indicated by reference numeral 13. Balls are returned from the bowling lane pits by means of ball return paths such as tracks located beneath the level of the bowling lanes illustrated in FIG. 1. The ball storage rack is accessible from two sides to serve two adjacent lanes and is located at the bowler's end of the lanes, preferably between the two adjacent lanes.

In bowling, the bowler's ball is released, e.g. ejected from a storage station to a pick-up station in rack 12. The bowler bowls the ball down the lane toward a set-up of pins at the other end. The pins are handled by the pinsetter structure 13 for the purpose of progressing the game and the ball is returned through the ball return track to the ball storage station in rack 12 from whence the ball may again be released for bowling. The bowling lanes, pinsetter structure including the ball gathering structure, and the like, are conventional structures well known in the art. The ball return tracks are also basically conventional but may be modified in accordance herewith, such as will be shown in discussion hereinbelow.

An embodiment of a ball handling apparatus of this invention in its general application and in its function for proper return of bowling balls from adjacent lane pits may be understood with reference to the schematic diagram of FIG. 2. Ball storage means 12 is shown schematically at the bowler's end of the two adjacent lanes between the adjacent lanes. Balls are shown in the storage rack in each of twelve storage stations in linear array and each ball may be released from either side of the rack for bowling in the respective adjacent lanes as indicated by ball release positions A through L and A' through L' for lanes 10 and 11, respectively. The bowler may pick up from a ball removal station BR or BR' (FIG. 1) to which the ball travels after its release.

Assuming that a ball is released through one of the release positions A through L, is picked up from station BR, and is bowled in lane 10, the ball travels in the direction of the arrow on the lane to the pit, is picked up or gathered by a conventional ball gathering and elevating structure in the lane pit indicated generally at 14 and directed to side track 16 and common track 18 back to storage rack 12. Similarly, a ball released from one of the release positions A' through L', removed from station BR', and bowled down lane 11 is directed by a ball elevating structure in pit 15 to side track 17 and common track 18 back to ball storage rack 12.

Assuming now that two balls are bowled on the adjacent lanes in quick succession, and the ball on lane 11 reaches pit 15 before the ball on lane 10 reaches pit 14, and assuming that the ball in pit 15 is picked up first and deposited on the side track 17, the ball passes ball sensor or detector 20 before the ball from pit 14 passes detector 19. The ball from track 17 reaches common track 18 before the ball from track 16 and travels down track 18 triggering a ball delay mechanism shown on the common track at 21. The ball delay mechanism then stops the ball from track 16 until the ball from track 17 passes a ball delay reset mechanism 22 which releases ball delay structure 21 permitting the second ball to again begin its journey toward storage rack 12.

The release of the ball from the storage rack for bowling purposes from one of the ball storage stations *a* through *l* (FIG. 3) at one of the ball release positions for bowling on alley 11, for example, from storage station *i* (FIG. 3) through ball release position *I'*, causes the station, station *i*, to be prepared for activation for return of a ball thereto. Similarly, the release of balls from storage station *c* (FIG. 3) via release position *C* for bowling on lane 10 has prepared storage station *c* for being activated to receive a ball. The passage of the ball on track 17 over detector 20 prior to the passage of ball 16 over detector 19 completes the activation of station *i* for receiving a ball and locks station *c* closed against re-

ceiving a ball. Thus, the first ball returned via common track 18 to ball rack 12 will be returned to station *i*, the same station from which it was released. The purpose of the delay mechanism 21 is to provide adequate delay of the second ball returned to rack 12 to permit the first ball to find its home station prior to entry of the second ball into the rack. Upon placement of the first ball in station *i*, the closing of station *c* by detector 20 is cancelled and since the second ball has already passed detector 19, station *c* is now completely ready to receive a ball. Thus, the ball from track 16 enters rack 12 and becomes deposited in station *c*, the exact station from which it was originally released.

With the foregoing general description of the embodiment and its function, the particular construction of the ball storage rack and ball return track and associated structures will next be discussed in more detail. These structures will then be linked up with more particular reference to the combination and the control circuitry.

Attention is now directed particularly to FIGS. 3-7 for more particular description of ball storage racks and associated structures. Common ball return track 18, normally a straight-line track disposed between adjacent bowling lanes, e.g. partly beneath the lane division indicated generally by reference numeral 26 (FIGS. 1 and 3) between gutters of adjacent lanes, enters ball rack 12 and proceeds in an upward deviation 27 into the rack proper as a segmented extension 28 of track 18 and upward deviation 27, traversing the length of rack 12 above and along all ball storage stations *a* through *l* within rack 12. Segmented track 28 is made up of a plurality of aligned track sections 28-*a* through 28-*l* corresponding to ball storage stations *a* through *l*.

Each section of track is supported on the lower end of a lever 29 which is pivotally connected at 30 to a bracket mounted on the side casing of rack 12. The lever 29 is in turn pivotally connected at 32 to a link 31. A lever 29, pivot 30, link 31 and pivotal connection 32 is provided for each of the segments of the two track rails, e.g. segments 28-*c*. The two links 31 are pivotally connected to solenoid motor member 33 of solenoid SOL-C, the pivotal connection being indicated at 35. The solenoid motor member is biased by spring 36 to maintain the rails by way of the above described linkage in a normal ball supporting station as a section of the normally continuous segmented track 28. Thus, spring 36 is a tension spring having one end connected to solenoid motor member 33 and the other end secured at 37 to the top casing of rack 12 thereby urging motor member 33 upward. Upon actuation of SOL-C, motor member 33 is moved downward spreading rails 28-*c* to permit a bowling ball traveling along the track over other stations in the position shown at B-1 to drop at station *c* to the position shown at B-2. In effect, such movement removes a section of a segmented track 28. Further, such movement causes a resilient stop member 38 which may be composed of, for example, hard rubber, into the path of track 28 so that a bowling ball traveling along track 28 will drop through track 28 wherever a ball drop solenoid, e.g. SOL-C has been actuated. The rubber stop member or pad 38 assures blocking of the ball for dropping purposes and protects the ball from being scratched by the metal links and pivotal connection 35.

Although only one ball station is shown in section in FIGS. 4 through 7, it is to be understood that each of the ball stations *a* through *l* includes similar or like operative members so that a ball may be dropped from track 28 at any of the ball storage stations by actuation of the corresponding solenoid SOL-A through SOL-L.

For assisting the lowering of the ball, which if dropped to the pocket, may hit the pocket with sufficient impact to disturb other bowlers in adjacent lanes, pneumatic cylinder 64 is provided. Pneumatic cylinder 64 includes a rod 67 by which pocket bottom 44 is supported. Cylinder 64 is of the type having a plunger 68 secured to the

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lower end of rod 67 and biased upward by compression spring 69 and having a dash pot effect provided by a port as indicated by the reference numeral 70. Upon removal of a bowling ball from a given station, e.g. station c, spring 69 of pneumatic cylinder 64 drives rod 67 upward carrying pocket bottom 44 to a raised position below the ball position B-1. Thus, as the ball is returned over track 28 it drops onto pocket bottom 44, which, due to the added weight of the ball, then descends against the urging of spring 69 and air within the dash pot escaping through port 70. As the ball descends from position B-1 to position B-2, it momentarily trips switch SR, e.g. SR-C, at the corresponding station.

In position B-2, the bowling ball is held in a storage station within a pocket indicated generally at 41. Pocket 41 is formed by a pair of cooperating pivotal pocket halves 42 and 43 and a cooperating pocket bottom member 44, each fitted for cooperation with each other to form a pocket while still being free to move independently of each other as will be described hereinbelow. Pocket bottom member 44 is generally cylindrical with a dished upper surface for supporting a bowling ball.

Pocket halves 42 and 43 are secured to cam members 46 and 47, respectively, each pocket half being secured to two such cam members. Cam members 46 are pivotally mounted on rod 48 and cam members 47 are pivotally mounted on rod 49. Rods 48 and 49 each extend the length of the linear array of ball storage stations within the ball rack 12 with each pocket half in the linear array being secured to cams pivotally connected to one of the rods 48 or 49, which are in turn supported by suitable brackets. Pocket half 42 is pivoted with cam member 46 and pocket half 43 is pivoted with cam member 47. Detents are provided to normally hold the cam against pivoting. Accordingly, spring loaded rollers 54 and 55 are normally urged into cam notches 56 and 57 respectively by means of compression springs 53. The latter are mounted on the stationary frame of pneumatic cylinder 64 by means of rod and bracket members 65 and 66 and hold the cam members in position so that the pocket halves are in pocket forming association. Also provided on cam members 46 and 47 respectively, are notches 58 and 59 defining receptacles for spring switch arms 62 and 63 respectively, each switch arm being attached at its other end to a suitable frame member. As seen, the ends of switch arms 62 and 63 are configured to provide a surface engageable by notches 58 and 59 respectively.

For releasing a ball from a pocket 41 at each station a through l, there is provided a pair of air cylinders 81 and 82 at each station. Armatures 79 and 80 of air cylinders 81 and 82 are pivotally connected to cams 46 and 47 which support pocket halves 42 and 43. Air cylinders 81 and 82 are of the slow bleed type so that upon discontinuation of charged air the cylinders begin to quickly empty. Solenoid valves such as valves SV-C and SV-C' control the charging of air to air cylinders 82 and 81 respectively via air pressure lines indicated by reference numeral 83. Valves SV may be controlled by a ball sequencing system to be described for ejecting balls in a preselected sequence. Air cylinders 81 and 82 are pivotally mounted such as by hinge members 84 to a base support 87. Upon actuation of air cylinders 81 or 82, armature 79 or 80 is pushed upward pivoting pocket half 42 or 43 about pivot 48 or 49 to release or eject the ball from position B-2 to the right to position B-4 on track 73 or to the left to position B-3 on track 72 respectively. Fingers 42a or 43a of pocket halves 42 and 43 support the ball for proper ejection. As air cylinders 81 and 82 are energized to pivot pocket segments 42 and 43 outwardly for ejecting the bowling ball, hinges 84 permit pivoting of cylinders 81 or 82 to accommodate the arcuate sideways motion of plungers 79 and 80 required in the illustrated embodiment for pivoting the pockets. Tracks 72 and 73 are inclined or sloped down-

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wardly toward ball pickup or removal stations BR and BR'. Stops 88 are provided to stop a ball rolling the inclined tracks under force of gravity at stations BR or BR'. The ball may be picked up by the bowler at station BR or BR' for bowling. Each time a ball is removed from station BR or BR', the corresponding switch BP or BP' is tripped by passage of the ball to momentarily close. Assuming the ball is being ejected from station c for use in the left hand lane, roller 55 is urged against compression spring 53, leaves notch 57 and travels on the periphery of disc 47 until the roller 55 re-engages notch 59. In the meantime, switch arm 63 is forced out of notch 59 and is left on the peripheral surface of disc 47 causing closure of the contacts of switch SW-C which, as will be seen, combines with other elements to redirect the ball, after it is bowled, via branch track 16 and common track 18 onto segmented track 28 and back to ball storage station c, solenoid SOL-C having been activated. As the ball is lowered on pocket bottom 44, the ball engages fingers 42a or 43a of the previously pivoted pocket half and returns the pocket half to its pocket forming position. Also, as switch arm 63 leaves notch 59 and rides on the peripheral surface of disc 47, the contacts of switch ST-C are changed so that the center contact breaks its circuit with the upper contact and makes with the lower contact.

In the operation of the ball storage and ejection system, the system is controlled, as will be more particularly described below, to eject balls in a predetermined order from a preselected side of the rack. Each bowler closes both of the SP identity switches corresponding to the storage station in which his ball is stored. A sequencing control next actuates the solenoid valve SV for the appropriate station of the first bowler to bowl for ejecting the bowler's ball toward the lane on which he is scheduled to bowl. Pivoting of the pocket half during ejection signals a memory system via closure of an SW switch to control return of the ball from the lane on which it is bowled to the same station from which it was removed and via reversal of an ST switch to stop the ejection of other balls to the same side of rack 12 for use on the same lane until the ejected ball has been returned to its station. The ejection of balls toward the other lane functions in the same manner. A ball out on one lane does not stop ejection of the next ball toward the other lane.

Referring now to FIGS. 8 through 10, there is illustrated a form of ball delay mechanism which may be used herein. As is shown, a pair of ball blocking assemblies indicated generally at 93 are used. Each ball blocking assembly is connected to the other by means of interconnecting link 94 which is pivotally attached to each assembly as indicated at 97. Each ball blocking assembly includes a roller 98 carried by an arm 99 pivotally mounted on a pin 100 which is in turn mounted to suitable framework (not shown). Secured to and carried by link 94 there is provided an abutment member 101.

Also provided is a locking and unlocking structure including a locking release arm 102 pivotally mounted at 103 by pin 104 and carrying roller 107. Also pivotally attached to arm 102 at 109 is link 108 which is universally attached at its other end at 110 to a rod 111 spring loaded to a frame member 112 by means of compression spring 113 bearing between frame member 112 and block member 114 urging block member 114 away from frame member 112.

In operation of the ball delay device of FIGS. 8-10, the first ball over either track 16 or 17 to engage its roller 98 pivots the roller 98 forward and the ball continues to pass. Pivoting of roller 98 and arm 99 about mounting 100 pulls link 94 to move block 101 away from a central position with respect to a blocking member 114 to a position laterally of blocking member 114 on the side of the blocking member from which the ball is travel-

ing. The ball passes onto track 18 and back to storage rack 12. Blocking member 114 is urged by spring 113 into the path of block 101 preventing shifting of rod 94 in the opposite direction. Thus, as a ball comes down the other track, arm 99 is held in an upright position carrying roller 98 into blocking position in the path of the next ball, thereby stopping its progress. As the first ball travels along track 18 toward storage rack 12, it engages roller 107 pivoting arm 102 forward pulling link 108, rod 111 and blocking member 114 against the urging of spring 113 and out of the path of block member 101, thereby permitting the second ball to depress arm 99 and shift link 94 until block 101 travels to the other side of blocking member 114 and the blocking and unblocking sequence is repeated. Of course, where there is no subsequent ball on the other side track, block 101 will be returned under the weight of link 94 to a central position.

Each of tracks 16 and 17 is sloped downward toward the junction with track 18 to provide gravity roll of balls over the tracks, with tracks 16 and 17 having sufficient slope to permit a ball to resume rolling after release by the blocking means by a ball on track 18. Thus, when the ball on track 18 trips arm 116 and a blocked ball on track 16 or 17, the ball on track 16 or 17 starts rolling down the track by gravity.

Sensor switches 130 and 130' are mounted beneath tracks 16 and 17, respectively, on the down track sides of blocking assemblies 73 (FIGS. 8 and 9) disposed with switch plates projecting between the track rails for operation of the switches by passage of balls thereover. The function of these switches will be more apparent hereinbelow.

In the system for returning a given bowling ball from a given storage station for use on either of the lanes to the same storage station in the storage rack from which it was ejected, there are provided ball release switch means SW-A through SW-L and SW-A' through SW-L' which are triggered responsive to ejection of the bowling ball from the storage rack at a given ball release position. In the illustrative embodiment, release switches are provided at each release position, i.e. two for each station. One release switch is tripped by ejection toward lane 10 and the other is tripped by ejection toward lane 11. The ball switch means indicates the ball release position, including the storage station from which the ball is ejected and the lane upon which the ball is to be bowled. The ball release switches are triggered, as discussed hereinabove, by ejection of the ball, e.g. by pivoting the ball pocket halves. Each ball release switch means is capable of energizing a separate ball release position circuit. Each of these separate circuits includes a memory means for remembering the ball release position and may include an indicator lamp for identifying the position. Means may also be provided for producing a readout signal for indicating the selected ball release position, for use, for example, in an automatic bowling scoring machine. After the ball has been bowled and while it is being returned to the rack, sensor means determine the lane from which the ball is returning and the memory means directs the return of the ball to the storage station from which it was ejected for bowling upon the determined lane. Upon return of the ball to its home position, the memory of its ejection is cancelled. The release switches SW function as bowler identification switches for the control system because they identify the bowler whose ball has been released. The same bowler alternates between lanes using the two ball release positions of the same storage station, e.g. a particular bowler may alternately use positions C and C' of station c.

Referring now to the drawings and especially to FIG. 11 for a more specific example of operation, the release of a bowling ball at a given release position, e.g., position C, closes bowler identity or release switch SW-C which actuates the bowler identity relay, e.g. RC, and turns on

the bowler identity lamp (illustrated in FIG. 11 immediately below the corresponding switch SW) for the bowler whose ball is kept in storage station c and who is now bowling on the left-hand lane 10. Initially the circuit to the bowler identity lamp and relay RC is completed through contact Z, e.g. RC-Z, and all of contacts Y to ground G. Contacts RC-Z and RC-Y then break and contact RC-X holds in the relay and lamp. The T contacts, e.g. RL-T are closed initially and remain closed while the relay is energized. However, the bowler identity switch actuates the bowler identity lamp and relay RC only if all of the other bowler identity relays for lane 10 are de-energized in that any contact Y opened by another relay being held in through its contact X will prohibit initial making of the circuit through the line of contact Y.

Energization of relay RC, for example, first makes contact RC-X and then breaks contacts RC-Y and RC-Z. Contact RC-X holds in relay RC to ground G through all contacts Y to the left while breaking contact RC-Y cuts off the remainder of the relays corresponding to lane 10 positions from ground G, preventing their initial energization. Relay RC controls and closes ball drop solenoid switch SS-C which readies solenoid SOL-C for control by preference relay 134. Relay RC also closes the corresponding readout switch T-C (see also FIG. 13) for position C for use by an automatic scoring machine.

The ball of the next subsequent bowler on a given lane may be released by the sequencing system at any time after the last ball of the previous bowler for a given frame has been returned. The subsequent bowler's identity switch then closes so his relay will energize after de-energization of the previous bowler's relay.

After a ball, e.g. ejected through position C', is bowled, it is picked up from the pit and deposited on track 16 whereupon the ball travels back toward ball rack 12. The ball, on track 16 as illustrated in FIG. 8, trips sensor or ball drop switch 130 by depressing the switch plate between the rails of track 16. Sensor switch 130 which is spring-loaded toward open position, is caught and held closed by pivotally mounted latch 131, spring biased toward latching engagement with switch member 130. Closure of switch 130 actuates coil 132 of preference relay 134, thereby closing contacts V and W and putting sensor switch reset solenoid 133 in circuit for control by ball drop cancel switch SR-C. The preference relay closes the circuit to the normally open ball drop solenoid control contacts SS-A through SS-L and since the ball drop solenoid control contacts SS-C have been closed by relay RC, ball drop solenoid SOL-C is actuated, readying station c for return of the ball thereto as discussed hereinabove. As the ball is lowered in its cradle, ball drop cancel switch SR-C is momentarily closed, thereby energizing solenoid 133 to withdraw latch 131 and permit spring loaded switch 130 to reopen releasing control of the preference relay 134.

If in the meantime, a ball has been released for bowling on the adjacent lane, e.g. from position I', switch SW-I' has been tripped energizing relay RI'. Assuming the ball on track 17 has been delayed, if necessary, in its route toward the ball rack by the delay means such as illustrated in FIGS. 9 and 11, release of the preference relay by switch SR-C permits the immediate control of the preference relay by coil 132' upon its energization by the delayed ball in closing switch 130' by passing thereover. The preference relay is spring urged to a middle position and balanced so that while the relay is shifted about its pivot point by one coil, the other coil, being of about equal strength, cannot put the relay back. Thus, as coil 132 is de-energized, coil 132' is now permitted to control the preference relay, thereby closing the circuit through contacts SS-I' (closed by relay RI') to actuate ball drop solenoid SOL-I so that as the second ball enters the storage rack and after return of the first ball to station c, the second ball, due to the action of ball drop

solenoid SOL-I, will be deposited in station *i*. The cancel switch SR-I is momentarily closed and preference relay 134 goes back to its spring centered position.

The T contacts of the bowler identity relays remain closed during the period that the respective bowler identity relay is closed. The T contacts provide a readout signal for use by automatic scoring devices for crediting the proper score to the bowler whose ball was bowled to produce the score. The readout signal is fed to a computer or other component of a scoring device via appropriate bundles of wire or cables as identified by reference numbers 135 and 135'. It is apparent that the readout signals from the various bowler identity relays for each lane will be fed to the scoring device in the same order as the balls are removed from the rack for bowling giving the scoring device fully adequate information regarding the identity of a bowler whose ball is out of the storage rack.

The T contacts are more particularly identified in FIG. 13 as T-A through T-L and T-A' through T-L', each of which is closed as a contact of the corresponding letter-suffixed relay R. The contacts are in electrical circuitry for closing a circuit to a solenoid or latching relay LR of the same letter suffix. The latching relays LR are in a computer system and serve to store the bowler identity signal. Assuming its corresponding contact T closed by its relay R, the circuit to the latching relay LR is momentarily completed by momentary closing of switch BP or BP' as the bowler's ball is picked up at the ball removal station BR or BR'. Relay LR closes and latches closed until the computer has assimilated the information, whereupon the computer releases or opens relay LR. In accordance with this form of the invention, the computer is signal responsive to an act of the bowler, i.e. removal of his ball for purposes of bowling.

Turning now to FIG. 12, a system is illustrated including means for selecting storage areas for delivery of balls in a predetermined progression, such as the means exemplified by switches SP-A through SP-L and SP-A' through SP-L'. There is at least one SP switch for each bowler and in the illustrated embodiment there are two such switches. The switches are manually operated by the bowler, one of each bowler's switches corresponding to one of each of the two adjacent lanes. In open play, each bowler would close the SP switch corresponding to his storage station in the ball rack for the lane he is to use. In team play, with lane rotation, the bowler would operate both SP switches corresponding to his storage station.

The system of FIG. 12 also provides control responsive to the selecting means for actuating delivery of balls in accordance with the predetermined selection. The illustrated control means normally actuates a delivery means at each of the ball storage stations, i.e. actuates one of solenoid valves SV-A through SV-L or SV-A' through SV-L', according to which lane the ball is to be delivered and station from which the ball is to be delivered. The control means actuates the delivery means twice in succession before proceeding to actuation of the next subsequent delivery means in accordance with the predetermined progression. The SV solenoid valves are connected so that current through the solenoid connects air under pressure to the head end of cylinder 81 or 82 causing it to extend its armature and tip the pocket segment to discharge a ball as desired. Unexcited, the solenoid valve disconnects the high pressure and the air cylinder bleeds. However, detent rollers 55 in notch 59 prevent return of its pocket half to pocket forming association with its cooperating pocket half until the ball is returned to the pocket. After the ball is returned to pocket bottom 44 from the overhead track system, the weight of the ball compresses spring 69 and as the ball is lowered, it engages pocket half 42 or 43 and fingers 42a or 43a to repivot the pocket half and reform the pocket 41, detent

rollers 55 and arm 63 returning to their positions in FIG. 4.

In FIG. 12, similar scanner circuits are provided for each of two adjacent bowling lanes. The scanner circuits include spring actuated stepper switches or scanners 120 and 121, each of which scans a plurality of electric circuits, one electric circuit for each ball storage station. The scanned electric circuits each include one of the manually operable bowler presence switches SP, a normally open electric contact portion of one of switches ST-A through ST-L or ST-A' through ST-L', one of release solenoid valves SV-A through SV-L or SV-A' through SV-L' and one of the ball operated switches ST-A through ST-L or ST-A' through ST-L'. The electrical contacts for each ball storage station are disposed in a sequential scannable array, each of the contacts defining two scanning stations. The stepper or scanner provides step-by-step and station-by-station sequential scanning of the array of contacts and energizes and de-energizes each circuit serially while in contact with the contacts provided for that circuit in the array.

The scanning action of scanners 120 and 121 is provided by actuating coil 122 or 123 respectively, interrupting contacts 137 and 138, homing contacts 139 and 140 and either of the two contacts per ball station circuit in the bank or array of contacts. The interrupting contacts 137 and 138 open and reclose upon each step by the scanning wiper. The homing contacts 139 and 140 are normally closed but open while the scanning wiper is in position ready to scan as shown in FIG. 12. Double-ended wipers are illustrated in the scanning mechanism to permit the scanner to repeat its sequence by unidirectional rotation without interruption. Thus, each scanner scans all of its contacts for each lane each 180° of wiper rotation. The circuitry is connected with the scanners such as to provide wiping of the left and right lane contacts for each ball storage position out of phase with each other approximately one-half of the angular disposition of the contacts, e.g. about 90° out of phase in FIG. 13. An Automatic Electric Company type 45 relay, with 24 contacts per bank is suitable for use as the scanner. Other similar scanners are available and will be apparent to those in the art, a variety of scanners being usable or modifiable for use in accordance herewith.

The bowler presence or SP switches have two positions. In FIG. 12 the SP switches are set to provide use of ball stations *a* through *e* and *g* through *k* by bowlers bowling and alternating between left and right lanes, SP switches SP-A and SP-A' through SP-E and SP-E' and switches SP-G and SP-G' through SP-K and SP-K' are set to indicate use of stations *g* through *k* by bowlers in the right hand lane. The remainder of the SP switches SP-F, SP-F', SP-L and SP-L' are in the position indicating no-bowler presence at the lane and ball storage stations *f* and *l* corresponding to the SP switches. When the SP switches are in the bowler present or closed position, they function to cause the stepping switch 120 or 121 to complete a contact with the respective SV solenoid valve for ejection of a bowling ball to the corresponding ball delivery means or track 72 or 73 as illustrated in FIG. 4. In the no-bowler present or open position, the SP switches cause the stepper or scanner to self-step past unused player electric circuits without operating the SV solenoid valves or air cylinders 81 or 82.

The switches ST-A through ST-L and ST-A' through ST-L' are SPDT switches operated by release of a ball from a ball storage station and return of a ball to the ball storage station. All switches are shown in the position with a ball in place in the respective ball station of the ball rack. Upon ejection of a ball, an ST switch is tripped and signals the stepper, via actuator coil 122 or 123, to proceed to the next contact in normal progression. Return of a ball to the ball storage station resets the switch in the position shown and, if the scanner wiper is still on a contact of the circuit of the particular ST

switch, the SV solenoid valve of that circuit is reactuated to again immediately eject the ball for second ball bowling. Thus, the first stepper or scanner contact of each ball station electric circuit is provided to eject the first ball for bowling and the second contact to sequentially thereafter re-eject the ball for second ball bowling.

A strike advance device in the form of switches 124 and 125 is provided in the circuitry and arranged or disposed so as to produce a momentary interruption in an otherwise closed circuit to the actuator coil 122 or 123 each time a strike is made. The signal for operating switches 124 and 125 is received as the strike signal from the pin deck and detector circuitry of a pinsetter. As illustrated, the strike advance devices 124 and 125 are each hexagonal cams which are advanced 60° by strike signal solenoid coil to operate contacts on a cam follower. The strike advance device causes the scanner to advance to the first of the next pair of contacts, i.e. to advance one additional step, effectively bypassing the second ball for the ball positions, the contacts of which the wiper is energizing when the strike occurs. Thus, the ejection of the second ball in such case is omitted.

"Play-reset" switches 126 and 127 are 3PDT switches which restore the stepper switch to starting condition before each game. The switches 126 and 127 are shown in "play" position energizing the circuitry for normal operation as discussed hereinbelow. With the switches in their other positions or "reset" positions, coils 122 and/or 123 are actuated to cause the scanner to advance step-by-step until contacts 139 and 140, which are normally closed, open upon arrival of the scanner in the first scanned position as shown in FIG. 12.

The system in FIG. 12 is shown in its condition immediately after throwing the reset switch from reset position to play position. One team of five bowlers has put its balls in ball storage stations *a* through *e* and the other team of five in storage stations *g* through *k* in any suitable manner. The corresponding presence switches are operated in both lanes and all balls are in their respective storage stations. As soon as contact is made by switches 126 and 127 in play positions, solenoid SV-A is energized, causing the air cylinder at station *a* to operate and the pocket segment to discharge the ball toward the left-hand lane through position A.

The discharge of the ball operates switch ST-A removing power from solenoid valve SV-A and applying the power to solenoid coil 122. Being spring operated, the stepper contact does not move until the ball returns to its ball storage station and trips switch ST-A back to the position shown. Such tripping of switch ST-A restores power to solenoid SV-A and coincidentally permits the stepper switch to advance its contacts one step by release of power therefrom. Return of the ball, after being bowled again for the second ball of a frame, to station *a* in like manner causes the stepper to advance from the second contact of the circuit of station *a* to the first contact of the circuit of station *b* where the ball ejection, etc. is repeated, power now being supplied to solenoid valve SV-B.

When the stepper switch encounters a channel or circuit for which the presence switch SP is not operated, a path is created to the mid-point of contacts 137 and 139 with the results that the stepper switch rapidly self-advances to the next actuated circuit, i.e., the next circuit where presence switch SP has been operated.

In the meantime, in the same manner described with reference to station *a*, stepper 121 has advanced to the first contact of station *g* and has triggered solenoid SV-G' for ejection of the ball from that station to the right-hand lane, i.e. through position G'. Subsequent operation is the same as for the circuit of ball storage station *a*.

If a strike is made, the strike advance 124 or 125 simulates a ball return so that the actual return of the strike ball to its storage station advances the stepper to the next storage station circuit.

In order to provide for 11th frame bowl-out, switches 141 and 142 are provided in the master circuits for the left and right lane. Switches 141 and 142 are normally closed switches but may be opened to release coil 122 or 123 as desired by manual operation. Opening of switch 141 or 142 will cause the same ball to be re-ejected from its storage station by interrupting the programmed sequence as long as desired. Such provision permits the bowler to bowl-out his 11th frame without the scanner system moving to the next ball station circuit. For this purpose, the bowler opens switch 141 or 142 normally prior to bowling his ball. To restore normal progression, the switch is reclosed at any time during the return of the bowler's last proper ball. Power for the above circuitry is supplied by source 143.

A computer 128 containing switches similar to switches 141 and 142 is shown connected in the system so that the switches may be automatically opened after the first ball of the 10th frame is ejected and automatically closed during return of the last ball of the bowl-out, enabling the illustrated system to automatically handle such bowl-out. Computer 128 also contains latch relays LR, described above.

It is apparent from the foregoing that I have provided a ball return system which includes an in-line ball storage means having a plurality of ball storage stations adapted to eject balls responsive to selection systems and a ball return system for returning a bowled ball responsive to a remembered signal and a ball sensor means, back to the same storage station from which it was removed for bowling purposes.

I claim:

1. A bowling ball handling apparatus for association with a bowling lane having a pit, said apparatus comprising bowling ball storage means located adjacent the bowler's end of the lane including a plurality of separate ball storage stations, ball return means including a ball return path for returning balls from the pit to the bowler's end of the lane, means normally maintaining said ball storage means separated from said ball return path, movably mounted means for directing balls from the path selectively to the separate storage stations, a ball receiving pocket at each of said separate storage stations adapted to receive a ball from said movably mounted means and hold the ball in the storage station, means for releasing a ball from said ball receiving pocket, ball delivery means adapted to deliver a ball released from said ball storage stations to a ball pickup station more accessible than said ball storage stations, means controlling said releasing means for selecting a ball storage station for release of a ball therefrom to said ball delivery means, electric circuit means adapted upon energization to control said ball directing means to return a ball to the ball station from which it was released, means responsive to the return travel of a ball on said ball return means for energizing the electric circuit to control the ball directing means.

2. In a bowling ball storage rack having a plurality of ball storage stations and a ball pickup area, the combination of means associated with each of said storage stations for releasing a ball therefrom to the pickup area, means for selecting a predetermined order of balls to be released from said storage stations and control means for actuating said releasing means responsive to said selecting means in accordance with the selected order.

3. A bowling ball handling apparatus associated with a pair of adjacent bowling lanes each having a pit, comprising a bowling ball storage means located adjacent the bowler's end of a pair of adjacent bowling lanes including a plurality of separate bowling ball storage stations from which bowling balls may be selected for bowling on either lane, ball return means including a common ball return track for delivering balls from the pits of adjacent lanes to the storage means, a ball receiving pocket at each of said separate storage stations adapted

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to receive a ball and hold the ball in the storage station, means for directing balls from said return means to said separate storage stations, means for selecting a ball storage station for release of a ball therefrom, means for ejecting a ball from said ball receiving pocket, ball delivery path means for each of said adjacent lanes adapted to receive a ball ejected from said ball storage stations for delivery to a ball pickup station more accessible than said ball storage stations, and means associated with said ball return means for delaying return of one of two coincident or immediately subsequent balls sufficient to permit directing of the other ball to its separate storage station without interference from said one ball.

4. A bowling ball handling apparatus associated with a pair of adjacent bowling lanes each having a pit, comprising a bowling ball storage means located adjacent the bowler's end of a pair of adjacent bowling lanes including a linear plurality of separate bowling ball storage stations from which bowling balls may be selected for bowling on either lane, ball return means including a common ball return track for delivering balls from the pits of adjacent lanes to the storage means; movably mounted means for directing balls on the track selectively to the separate storage stations; a ball receiving pocket at each of said separate storage stations adapted to receive a ball from said movably mounted means and hold the ball in the storage station; each of said ball receiving pockets comprising: a plurality of movably mounted ball pocket segments adapted to move between a ball holding position and a ball releasing position, said pocket segments while in ball holding position forming a pocket disposed to receive a ball from said movably mounted means and hold the ball in the storage station, said pocket segments upon movement to ball releasing position releasing the ball from the storage station; means for selecting a ball storage station for release of a ball therefrom selectively to either side of the selected station; pneumatic cylinder means for pivoting either of said pocket halves to ball releasing position, control means for selectively actuating said pneumatic cylinder means to pivot one or the other of said pocket halves to ball releasing position to release a ball from one or the other side of the ball storage station responsive to said selection means; ball delivery track means adjacent each side of said linear plurality of ball storage stations disposed to receive balls ejected from any of said storage stations and deliver ejected balls to a ball pickup station adjacent the bowler's end of said rack; separate electric circuit means for each of said adjacent lanes adapted upon energization to control said ball return means to return a ball to any ball position readied by removal of a ball for use on the lane corresponding to the energized circuit; preference relay means responsive to the returning of a ball from either lane pit by said ball return means for selectively energizing the electric circuit corresponding to the lane from which the ball is returning; and means responsive to return of a ball to its storage station enabling said preference relay means to energize the electric circuit for the lane from which any subsequent ball is being returned.

5. A bowling ball handling apparatus associated with a pair of adjacent bowling lanes each having a pit, comprising a bowling ball storage means located adjacent the bowler's end of a pair of adjacent bowling lanes including a plurality of separate bowling ball storage stations from which bowling balls may be released for bowling on either lane, ball return means including a common ball return track for delivering balls from the pits of adjacent lanes to the storage means, a ball receiving pocket at each of said separate storage stations adapted to receive a ball and hold the ball in the storage station, means for selectively ejecting a ball from said ball receiving pocket toward either of said adjacent bowling lanes, ball delivery tracks adjacent said pockets and disposed to receive balls ejected from any of said storage stations and deliver ejected balls to a ball pickup station

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adjacent the bowler's end of said rack, and means for generating a signal responsive to removal of a ball from the pickup station identifying the pocket from which the ball has been ejected.

6. A bowling ball storage device which comprises a plurality of storage areas and a pickup area, means associated with each of said storage areas for delivering a ball therefrom to the pickup area, means for selecting more than one of said storage areas for delivering balls in a predetermined progression, and control means responsive to said selecting means for actuating said delivering means to deliver balls in accordance with said predetermined progression.

7. The device of claim 6 in which said control means includes means for normally actuating each of said delivering means twice in succession before proceeding to actuation of the next subsequent delivery means in accordance with said predetermined progression and signal responsive means for overriding the last mentioned actuating means.

8. The device of claim 6 wherein each of said ball delivering means is operably responsive to electrical energization, said selecting means comprises manually operable electric switch means operable between two positions, and said control means comprises an electric circuit for each ball storage station, selecting means and delivering means including: normally open electrical contact means in electrical series with the ball delivering means, the electrical contacts for each ball storage station being closable in a sequentially scannable array, each of said contact means defining two scanning station means for step-by-step and station-by-station sequentially scanning the array of contacts adapted to energize and de-energize each circuit seriatim, means responsive to said manually operable switch means in its first position for actuating said scanning means to move to the next sequential contact means for advancing said scanning means two stations, a ball operable switch in series with said manually operable switch means in its second position, said ball operable switch being movable to a first position responsive to delivery of a ball from the storage area by said delivery means and being movable to a second position responsive to return of the ball to the storage area, means responsive to movement of said ball operable switch to its first position for advancing said scanning means one station and for de-energizing said delivering means and means responsive to movement of said ball operable switch to said second position for enabling energization of said delivering means.

9. The device of claim 8 including override means for selectively advancing the scanning means one station.

10. A bowling ball storage device which comprises a plurality of storage areas, means for delivering balls selectively to each of said storage areas, means associated with each of said storage areas for releasing a ball therefrom, means for selecting more than one of said storage areas for releasing balls in a predetermined order, ball pickup station means, means responsive to said selecting means for controlling said releasing means to release balls to said pickup station means in accordance with said predetermined order and means for overriding said control means for selecting a storage area out of turn in said predetermined order.

11. A bowling ball storage device for use at the bowler's end of a pair of adjacent bowling lanes which comprises a plurality of storage areas, separate ball receiving stations for each of the adjacent lanes, means associated with each of said storage areas for selectively delivering a ball therefrom to either ball receiving station, means for selecting more than one of said storage areas for delivering balls to one or both of said ball receiving stations in a predetermined order, control means responsive to said selecting means for sequentially controlling said delivering means to deliver a first ball in accordance with said predetermined order and means

responsive to delivery of the first ball by said delivering means for actuating said control means to control the delivering means for delivery of the next ball to be delivered in accordance with the predetermined order.

12. The device of claim 11 wherein said selecting means includes manually operable switches for each storage area operable between a position signalling said control means that the respective storage area is included in the predetermined order and a position signalling said control means that the respective storage area is excluded from the predetermined order.

13. A ball handling device for use in association with a bowling lane and ball return system for return of balls from the lane pit, comprising means defining a plurality of ball storage stations, selectively operable means for delivering a ball from each station, means defining a ball pickup station for receiving a ball delivered from any of said storage stations, and means responsive to removal of a ball from said pickup station for generating a read-out signal identifying the storage station from which the removed ball had been delivered.

14. The device of claim 13 including operable means for directing balls from said ball return system to each of said storage stations, means controlling said operable means for directing the removed ball for return to the storage station from which it had been delivered, and means responsive to delivery of the ball from its storage station for indicating to said controlling means the identity of the storage station from which the ball had been delivered.

15. In a bowling ball storage rack having a linear array of ball storage stations, the combination of a pair of ball pocket halves at a ball storage station, means mounting said pair of ball pocket halves for pivotal movement between an interengaging ball holding position for holding a ball and separate ball releasing positions toward opposite sides of the ball storage station for releasing the ball from the pocket, pneumatic cylinder means for pivoting either of said pocket halves to ball releasing position for releasing the ball from the pocket, and control means for selectively actuating said pneumatic cylinder means to pivot one or the other of said pocket halves to ball releasing position to release the ball from one or the other side of the ball storage station.

16. A bowling ball storage rack having a linear array of ball storage stations, at each station: the combination of a separate pair of ball pocket halves, means mounting each pair of pocket halves for individual pivotal movement between a central ball holding position for holding a ball and a lateral ball releasing position for releasing the ball, said mounting means providing pivotal movement of each pocket half of the pair to the lateral releasing position on opposite sides of said ball storage station, each pair of pocket halves while in ball holding position forming a cradle disposed to receive a ball and support the ball in the storage station, and motor means for moving the pocket halves from holding to releasing positions.

17. In a bowling ball storage rack for servicing adjacent bowling lanes and having a plurality of ball storage stations, the combination of means associated with each of said storage stations for releasing a ball therefrom toward either lane, open and manually accessible ball pickup station means, and a separate ball delivery path means on each lane side of said storage rack adapted to receive a ball released from said storage stations and deliver the received ball to the pick-up station means.

18. A ball storage rack for storing a plurality of bowling balls having a plurality of separate storage stations, a ball holder at each station for holding a ball at the station, separate and individually operable drive means at each station for moving the associated ball holder to eject a ball from the holder, control means for selectively

energizing the drive means, and means adjacent each of the holders for receiving a ball therefrom for pickup by a bowler.

19. A ball handling device for use in association with a bowling lane and ball return system for return of balls from the lane pit, comprising means defining a plurality of ball storage stations, separate means for ejecting a ball from each storage station, means for selectively actuating said ejection means, and means defining a ball pick-up area adjacent each of the stations for receiving balls delivered from each of said storage stations.

20. A ball handling device for use in association with a pair of adjacent bowling lanes and a ball return system for returning balls from both lane pits, comprising means defining an array of ball storage stations, selectively operable means for delivering a ball from each station to either side of said array, ball pick-up station means for receiving a ball delivered from any of said storage stations, and means responsive to removal of a ball from said pick-up station means for generating a read-out signal identifying the bowling lane toward which the delivered ball had been removed.

21. In a bowling ball storage rack for servicing two adjacent bowling lanes, a ball return track, a linear array of ball storage stations disposed beneath said track, each said storage station including ball pocket means, there being one pocket means for each ball used in a game, means for selectively directing balls from the track to respective pocket means, relatively accessible pickup areas at opposite sides of the ball pocket means, means mounting said pocket means for movement between a first position within the linear array and equidistant from said lanes, and second alternate positions on either side of said array to discharge balls to the pickup areas, means responsive to the movement of a ball from a pocket to a pickup area for causing the directing means to direct the ball, upon its return along said track, to its respective pocket means, and means for moving said pocket means to locate the ball in a predetermined pickup area.

22. A ball handling device for use in association with a bowling lane and ball return system for return of balls from the lane pit, comprising means defining a plurality of ball storage stations, separate means for ejecting a ball from each storage station, means for selectively actuating said ejection means, a stationary ball pickup station more accessible than the storage stations, and means defining a ball receiving area adjacent each of the stations for receiving balls delivered from each of said storage stations and delivering same to the pickup station.

23. A combination as defined in claim 22 including movably mounted means selectively operable for directing balls from the ball return system to the different ball storage stations.

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