TWO-PLAYER PINBALL MACHINE

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ABSTRACT

A two-player pinball machine intended for simultaneous play by a player at each end and in which the play field has means for tilting first in one direction and then in the other to place the players alternately in offensive and defensive roles, triggered by passage of the ball into the offensive player's out-hole. Scoring targets are provided on the play field with the prime goal being the goal at the opposite out-hole. Sets of flippers, controlled from the respectively opposite ends of the machine, are provided for the offensive player to drive the ball to the scoring targets and for concurrent use by the defensive player to thwart the offensive player, particularly by driving the ball through the out-hole of the latter, to achieve tilting of the play field so as to take over the offensive role. A single ball, which need not leave the surface of the play table, suffices for both players. A control arrangement is provided for the targets in which a portion of the targets are activated in a commutated sequence and in which the status of commutation is preserved, and the sequence is reversed, incident to reversal of the tilt of the table. A tilting mechanism is used which is disengageable for easy access to the underside of the table for servicing purposes. The accumulated score of each player is indicated by a single set of drums viewable through oppositely facing panels extending bridgingly over the center of the machine.

22 Claims, 25 Drawing Figures
FIG. 13b.

FROM FIG. 13a.

A PLAYER GOAL
(AT B END)

B PLAYER GOAL
(AT A END)

200 205

A player
B player

1000 SCORING LINE

1000 SCORING LINE

1000 SCORING LINE

TO 1000 RUNOUT

TO 1000 RUNOUT

TO 1000 RUNOUT

TO 10 E RUNOUT

TO 10 E RUNOUT

TO 10 E RUNOUT

TO 10 E RUNOUT

TO 10 E RUNOUT

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Fig. 14

Fig. 15

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TWO-PLAYER PINBALL MACHINE

Pinball machines intended for amusement purposes have generally been "single player" machines in which each person takes a turn and in which the only uniting interest is the relative final score. Machines intended for use by two players are known, as indicated by the Di Motta U.S. Pat. No. 3,452,987, but in the arrangement shown in that patent the players simply take turns playing on a play field which closely resembles a conventional play field, and the opposite party is relegated to a passive role in which he is powerless to strike or otherwise affect the play of the ball.

It is an object of the invention to provide a pinball machine which permits active competitive play of the ball by two players playing on a play field which tilts alternately in the direction of one of the players or the other thereby to establish offensive and defensive roles and in which both of the players concurrently operate sets of flippers acting upon a single ball. It is another object of the invention to provide a pin ball machine in which the play field is tilted in its opposite directions upon passage of the ball into the out-hole, either by action of gravity or as a result of driving of the ball into the out-hole by the defensive player. Thus it is an object to provide a game in which the offensive and defensive roles of the players continually switch back and forth and in which the defensive player, by skilful flipper manipulation can take over and maintain an offensive position for accumulation of score.

It is a related object to provide a pinball machine in which out-holes are provided at each end of the play field, with both out-hole positions being active during the play of the game, the near out-hole being utilized to trigger the tilting of the table and the remote out-hole being used as a high-scoring target, and with the functions being reversed automatically when the play field is tilted.

It is another object of the invention to provide a two-player pinball machine in which certain of the targets are selectively activated and in which the status of activation is preserved during the tilting movement of the table so that a newly offensive player is presented with an array of scoring targets which depends upon the achievement, during his turn, of the formerly offensive player. More specifically it is an object of the present invention to provide, in a two-player pinball machine, a series of scoring targets which are active in a commutated sequence for achievement of a high score at the end of the commutation cycle and in which the status of commutation is preserved and the sequence of commutation is reversed incident to reversing the tilt of the table so that the newly offensive player is presented with scoring opportunities which are inversely related to the achievement of the former offensive player.

It is an object of the invention to provide a two-player pinball machine in which the scoring possibilities on the play field are not the same in each player's offensive turn but are constantly varied.

It is still another object of the present invention to provide a two-player pinball machine in which the ball, after passing into the out-hole, is restored to play by the resultant reverse tilting of the table so that there is no necessity for the manually-operated spring plungers usually employed to put a ball into play. Thus it is an object of the invention to provide a two-player pinball machine in which the usual construction of the out-hole is replaced by a receptacle which is on substantially the same level as the play field and from which the ball is free to roll back onto the play field when the direction of tilt is reversed. However, for restoring the ball to the play field as promptly as possible, a power operated ejector is preferably used, synchronized with the tilting movement.

It is yet another object of the present invention to provide a two-player pinball machine which is easily serviced and in which elements in the frame, and which are secured to the underside of the play field, are rendered easily accessible at either end of the machine. It is a more specific object to provide a two player pinball machine having novel means for tilting the table about a horizontal transverse axis but in which the table itself may be separated from the tilting means and propped at either end at a relatively steep angle to permit access, for service purposes, at each end of the frame.

It is an object of the invention in one of its aspects to provide means for continuously displaying the score of both players to the players at the opposite ends of the machine. More specifically it is an object to provide a score displaying arrangement which includes panels spaced back to back bridgingly mounted on the machine and with a single set of stepped drums for each player displaying the same score in oppositely facing directions.

It is an object of the invention in one of its aspects to provide a two-player machine having novel provision for single-player operation.

Other objects and advantages of the invention will become apparent upon reading the attached detailed description and upon reference to the drawings in which:

FIG. 1 is a perspective view of a two-player pinball machine constructed in accordance with the present invention;
FIG. 2 is a plan view of the play field shown in FIG. 1;
FIG. 3 is a plan view showing the tilting means and with the play table indicated by the dot-dash outline;
FIG. 4 is a fragmentary elevation showing the table tilting linkage and driving motor;
FIG. 4a is a fragmentary perspective showing the coupling between the motor and pitman;
FIG. 5 is a fragmentary vertical section looking along the line 5—5 in FIG. 3;
FIG. 6 is an elevational view, with the frame in vertical section, showing the two ways in which the play table may be elevated for access to the mechanism;
FIG. 7 is a fragmentary perspective showing a typical flipper and actuating solenoid;
FIG. 8 is an elevation of "pop" bumper looking along the line 8—8 in FIG. 2;
FIG. 9 is a fragmentary plan view showing a typical power actuated bumper;
FIG. 9a is a fragmentary section looking along the line 9a—9a in FIG. 9;
FIG. 9b is a fragmentary section looking along the line 9b—9b in FIG. 9;
FIG. 10 is a section taken through one of the roll-over switches and looking along the line 10—10 in FIG. 2;
FIG. 11 is a fragmentary vertical section taken through the out-hole region at one end of the machine looking along line 11—11 in FIG. 2;
FIG. 12 is a perspective view of the ball which operates the goal switch;
FIGS. 13a, 13b, and 13c taken together comprise a schematic diagram of the electrical circuit employed in the present invention;
FIG. 14 is a fragmentary vertical section through a roll-over button taken along line 14—14 in FIG. 2;
FIG. 15 is a diagram, partly in perspective, showing the electromechanical arrangement employed for activating the roll-over buttons and for scoring and illuminating the same;
FIG. 16 is a fragmentary elevation of the bridge at the center of the machine used for displaying the score with panel removed;
FIG. 17 is a fragmentary horizontal section looking along the line 17—17 in FIG. 16;
FIG. 18 is a perspective view of one of the drums employed in the scoring device;
FIG. 19 is a fragmentary section taken through one of the drum assemblies looking along the line 19—19 in FIG. 17;
FIG. 20 is a diagram showing a modification permitting play by a single player when a second player is not available.

GENERAL ORGANIZATION

Turning now to the drawings, there is disclosed in FIGS. 1 and 2 a pinball machine 20 constructed in accordance with the invention having a box-like frame or housing with ends 21, 22 and sides 23, 24. Mounted within the housing is a play field, or table, 30 upon which the game is played which is recessed into the frame and which has corresponding ends 31, 32 and sides 33, 34. The frame is supported at convenient playing height upon legs 35.
In arching position over the central portion of the frame is a bridge 40 having vertical supporting members 41, 42 and score display panels 43, 44, to which more detailed reference will be made at a later point.

In accordance with the present invention the table is not only tilt-able alternately in opposite directions for play by two players but separate out-holes are provided at the ends and separate sets of flippers are provided which are concurrently operated by the "offensive" player at one end to achieve a score and by the "defensive" player at the other end to thwart the offensive player and to drive the ball into the out-hole of the offensive player thereby to reverse the tilt of the table and interchange the offensive and defensive roles of the players.

Further in accordance with the invention, a single ball is used and the out-hole receptacles are so constructed that the ball remains on the play field table at all times, being restored to the center of the play field incident to tilting of the table in the reverse direction. Thus, as shown in FIGS. 1 and 2, where the player positions have been indicated at A and B respectively, separate out-holes, goals, and flippers are provided for each of the players as indicated by use of the subscripts a and b, respectively. At the first end of the machine there is a raised plateau 54a defining a receptacle or out-hole 51a which is substantially at the level of the play field. Left of the center-line is a left-hand set of flippers 52a, 53a operated by a flipper control button 54a. To the right of the center-line is a right-hand set of flippers 55a, 56a controlled by a right-hand button 57a.

The primary goal of the player at the "A" end of the machine is to manipulate the flippers so as to drive the ball into a goal 58a at the opposite end of the machine. Entry of the ball into the goal is, as will be discussed, a high-scoring achievement.

Similarly at the opposite or "B" end of the machine a plateau 50b defines an out-hole receptacle 51b. To the left of the center-line, as viewed from "B" end, are flippers 52b, 53b under the control of a left-hand control button 54b. To the right of the center-line are a set of flippers 55b, 56b under the control of a right-hand button 57b. The goal for the player at the "B" end is indicated at 58b.

Flanking the flippers 52a, 53a are bumper assemblies 61a, 62a (See also FIG. 9) of generally parallelogram shape. Corresponding bumper assemblies 61b, 62b are provided adjacent the flippers 52b, 53b at the opposite end. In addition to the goals 58a, 58b, other scoring targets provided on the play field include "pop" bumpers 71-74 (FIG. 8) which are per se known in the art as well as "island" bumpers 81-84 which are arranged along both of the lateral edges of the machine. The bumpers 81 and 84 are spaced from the edge to provide channels for roll-over switches 85, 86 (FIG. 10). Additional roll-over switches 87, 88 flank the bumper assemblies 61a, 62a and 61b, 62b respectively.

With regard to scoring elements thus far described, the aim of the offensive player, in whose favor the play field is tilted, is to manipulate the flippers under his control so as to propel a ball through the goal at the opposite end or into contact with the bumpers and roll-over switches to accumulate a maximum score prior to the ball's passing into the out-hole at the near end. The purpose of the defensive player is to operate his own flippers concurrently, either to thwart scoring by the offensive player or to drive the ball into the offensive player's out-hole to cause the play field to tilt in the opposite direction, thereby ending the "turn" of the latter player. Arranged along the center-line of the machine are a series of roll-over buttons 91, 96 (FIG. 14) which have a high score potential and which will be discussed at a later point. Prior to a discussion of the nature of the electrical circuitry required to bring about the mode of play, reference may be made to the mounting of the play field table for alternate tilting toward the respective ends of the machine.

**TABLE MOUNTING**

Thus turning to FIGS. 3-6 a cross-shaft 100 extends transversely between the sides 23, 24 of the frame. Centered along the lateral edges of the table are small L-shaped brackets 101, 102 having downturned portions which engage the ends of the shaft for rocking support. For positively rocking the table in one direction or the other a teeter-totter member 105 is provided mounted on the shaft at 106 and having pads 107, 108 which engage the underside of the table at regions spaced in opposite directions from the shaft. For oscillating the member 105 a gear type motor 110 (FIG. 4a) is provided having a shaft 111 which carries a crank 112 which is pivoted at 113 to a slide 114 on a link or pitman 115, the slide being clamping at a predetermined position by a clamping screw 116. The link 115 has a pivot connection 117, at its upper end, to the end of the member 105. For causing the crank 112 to come to rest in either its straight up or straight down position, a sensing cam 120 is secured to the shaft 111 with cooperating detector or limit switches 121, 122. The circuit for energizing the motor will be discussed in due course.

In accordance with one of the mechanical aspects of the present invention the table 30 is secured to the shaft 100, upon which it rocks, by means of a disengageable connection, and means are provided at the ends of the table so that when it is disengaged from the shaft it may be tilted upwardly about each of its ends at a steep angle for access to the elements on the underside of the table and other components which are mounted within the frame. Thus the brackets 101, 102 on the table and which were previously mentioned, are simply notched on the underside and are held down in firm engagement with the shaft by means of rockable hooks which engage respective locking pins, or stubs, mounted upon the brackets. Thus referring to FIGS. 4 and 5, a hook lever 131 is provided adjacent the bracket 102 having a hook 132 which may be rocked into and out of engagement with a pin 133 riveted to the bracket. A spring 134 at the lower end of the lever 131 maintains the hook normally engaged so that the table is firmly seated upon the teeter-totter member 105. A corresponding hook structure is utilized at the opposite end of the shaft 100. For simultaneously releasing the hooks at both ends of the shaft, a V-shaped linkage or yoke 135 is provided which is pinned to the lower ends of the levers and pinned, at the junction 136, to a manual throw-over lever 137 which is anchored to a supporting bracket 138. A closure member 139 uncovers an opening at one end of the frame which provides access to the throw-over or locking lever 137. Further security is provided by a glass top (not shown).

Thus when the locking lever 137 is moved to its vertical position and the cover 139 is locked in place, the machine is secure and the table cannot be raised. However when service is necessary the glass top is removed, the closure 139 is opened, and the lever 137 is thrown to its horizontal position. This rocks the hooks out of engagement, permitting the table to be lifted at one end while pivoting about the other. For achieving the pivoting movement at the ends of the table obstruction or shoulder is provided inside each end of the frame. Such obstruction is in the form of a transversely extending member 141 having a hook-shaped cross-section which is engaged by an inverted hook-shaped member 142 on the table.

A similar hook-shaped member 143 is provided at the opposite end engaged by an inverted hooked member 144. Engagement of the hooks provides support continuously along the "lower" edge of the table thereby standing the table against vibration during play. In order to prop the table up for service, a prop 145 is provided which is swingable about the shaft 100 and which engages supports 146 or 147 secured to the underside of the table, depending upon which way the table is raised.

By adjustment of the slide 114 on the link 115 and by adjusting the location of the hooks at each end of the board the desired angle of the table during play, preferably 3 1/2°, the throw of the crank is then adjusted to minimize impact at the hooks.
SCORING TARGETS AND OUT-HOLE CONSTRUCTION

Returning attention to the play field it will be understood that many of the mechanisms and scoring targets are similar to those employed in a conventional single-ended or single-player machine. For example the mechanism for operating the flippers 52a, 53a from the switch 54a is per se the same as that previously used, employing a spring-return solenoid which is mechanically coupled to the flipper as described in FIG. 7.

Similarly a typical "pop" bumper 71, shown in elevation in FIG. 8, includes a contact ring 71a, controlling contact 71b, and an impinging ring 71c which is, upon closure of the contact, downwardly impelled by a solenoid 71d having a set of normally closed contacts 71e. The remaining bumpers 72-74 will be understood to be of the same construction and to be equipped with the same switch contacts and solenoid bearing corresponding reference numerals where applicable.

For the purpose of insuring a complete power stroke when the contact ring 71a on bumper 71 is contacted by the ball, an interlocked relay RC having contacts RC1, RC2, and RC3, is interposed in the circuit as shown in FIG. 13a. Contacts RC1 are normally open contacts which are included in a relay sealing circuit. Contacts RC2 and RC3 are energizing contacts connected in series with the solenoids 71d, 72d of the "pop" bumpers 71, 72. For breaking the sealing circuit at the end of the power stroke normally closed contacts 71e, 72e are connected in series with contacts RC1.

It will be apparent, then, that when the ring 71a is encountered by the ball, closure of contacts 71a causes closure of relay RC which is then firmly seated by closure of the sealing contacts RC1. This produces simultaneous energization of the solenoids 71d, 72d causing the impinging ring 71c (FIG. 8) to be drawn sharply downward thereby causing the ball to be impelled away from the bumper. The contacts 71e are so arranged as to be broken toward the end of the power stroke of the solenoid 71d, and when the contacts 71e open, breaking the sealing circuit, the relay RC drops out, thereby de-energizing the solenoid. A similar operating sequence occurs when the "pop" bumper 72 is engaged by the ball. It will be noted that the electrically associated "pop" bumpers are diagonally arranged on the playfield thereby to insure response upon ricocheting of the ball between two powered bumpers.

Other ones of the bumpers on the playfield are powered in a similar fashion. For example taking the bumper 61a adjacent the flipper 52a, shown in FIG. 9, it includes a resilient cord 151 of rubber or the like behind which is a switch blade 152 connected to a switch 153 (FIG. 9a). The switch controls a solenoid 154 (see FIG. 9b) which actuates an impelling lever 155 behind the cord 151. Thus when the ball strikes the cord closing the switch, the solenoid is energized to produce a powered rebound. A similar construction is employed at 62a and at 61b, 62b, and for the bumper islands 81-84 inclusive.

As to the construction of the roll-over switches 85-88, reference is made to FIG. 10 where a typical switch is seen to be made up of a roll-over member 156 biased upwardly by blade 157 and depressible by a ball to close contacts 158.

In order to understand the construction of the out-hole receptacle and goal switch reference is made to FIGS. 11 and 12. While the term "out-hole" has been used to denote the receptacle into which the ball is received following play on the field, it is one of the features of the present invention that the surface of the out-hole receptacle is substantially at the same level as the playfield. Formed in the surface within the out-hole receptacle is a shallow tapering groove 161b, which guides the ball into contact with the projecting tip of an out-hole switch 160b. Such switch senses the arrival of the ball regarding whether the ball comes down the center of the playfield or down one of the side alley ways indicated at 156c.

While it is one of the features of the construction that the ball is discharged with the assistance of gravity when the table tilts in the opposite direction, it is preferred to assist gravity, and speed up the game, by forcibly ejecting the ball from the out-hole position. This is accomplished by a solenoid 163b having a bell crank 164b which includes a vertical portion 165b, the latter projecting upwardly through an opening 166b in the table behind the switch 160b. As will be discussed, the solenoid 163b is energized at approximately the same time that the table is being tilted in the opposite direction so that the ball is on the playfield during the tilting movement. The groove 161 and ejecting assembly are preferably rotated through a small angle on the order of 5° so that the ball is ejected into the center line of the table but along line 167b at such an angle that it will pass into range of the flippers.

The goal 58a, shown in FIGS. 11 and 12, is positioned just ahead of the out-hole and has a goal switch 170a connected by a spring 171a to a pendulously mounted arm 172a. Mounted on one side of the arm 172a is a switch operator in the form of a bell 175a having trunions 173a. Thus when the playfield is tilted in favor of player A (to the left as viewed in FIGS. 1 and 2) the skillful striking of the ball by one of the "A" flippers will cause the ball to be directed toward the goal 58a at the defensive player's position. As the ball rolls between the defensive flippers 52b, 55b, it rocks the ball 175a upward, as shown, so that it engages the arm 172a, tensioning the spring 171a to make contact at switch 170a which, as will be seen, is recorded as a high-scoring event. Since the ball operator A to the arm 172a in only one direction, the ball may "brush" by the ball when moving out of the out-hole without hindrance. Structure corresponding to that shown in FIGS. 11 and 12 is provided at the opposite end of the playfield for controlling an out-hole switch 160a and a goal switch 170b.

In the above paragraphs mention has been made of the various components on the playfield. As in the case of a conventional pinball machine, scoring results from the making of contact at the various scoring targets which award score in proportion to the amount of skill involved. In a practical machine of present design the "pop" bumpers have a score of 10, as do the bumper assemblies 61a-62b at the ends of the field, representative scores being encircled in FIG. 2. A score of 10 is also achieved by the roll-over switch 85 along the sides of the playfield. The bumper switches in the islands 81-84, upon each striking, provide a score of 1.

The goal switches at each end of the table may provide a score of 500 or a score of 1,000. While a score of 500 is preferred for a practical machine, the attached circuitry and description have, for the sake of simplicity, assumed a score of 1,000, since such score may be registered by a single step of advancement of the third order drum in the scoring or tallying mechanism. The roll-over buttons 91-96 also have a high-scoring potential but discussion of this will be reserved to a later point. In the discussion which follows it will be understood that all of the switches on the playfield scoring a count of "one" are connected in parallel and are designated in the diagram, FIG. 13b, for convenience, as the "units" switch US. It will further be assumed that all of the switches achieving a count of 10 are connected in parallel and thus appear in the circuit diagram as the "tens" switch TS. The target switches providing a count of 100 (where used) have been indicated in the diagram as the "hundreds" switch HS. The switches providing a count of 1,000 include the goal switches 170a, 170b which energize a "thousands" scoring line 200. The operation of the specific means for tallying the score in response to actuation of the switches may be reserved until a later point.

SIMPLIFIED CIRCUIT DIAGRAM

The invention may be understood by reference to the simplified circuit diagram shown in connected FIGS. 13a, 13b, and 13c. It is convenient to supply the circuit from the 115 volt commercial AC source via lines 201, 202. A transformer 203 steps the control voltage down to approximately 24 volts AC. For the supplying of main buses 205, 206. A second transformer 207 (FIG. 13c) serves to step the voltage down to 6 volts AC for lamp busses 208, 209.
Turning to FIG. 13c, a ratcheted "player unit" assembly is used for triggering the tilting of the table and performing the switching functions which are required to reverse the offensive and defensive roles of the players. Such assembly includes a player unit ratchet wheel 210 having positions defined by teeth 211–217 and an output shaft 218. For the purpose of advancing the player unit ratchet wheel 210 a solenoid 220 is used having a ratchet or pawl 221 and a return spring 222. The parts are so arranged that when the solenoid is pulsed the ratchet "takes a tooth", at the same time elongating the spring 222 and, at the end of the stroke, opening an associated normally closed contact 221. When the solenoid is de-energized, contraction of the spring advances the wheel 210 one tooth distance. The seven teeth define three turns for each player plus an "off" position.

Coupled to shaft 218 of the ratchet wheel 210 is a player unit cam 230 having positions 231–237 and a cam follower 238. The cam 230 has three lobes or plateaus 231, 233, 235 with valleys 232, 234, 236 between them. The cam follower 238, among other things, controls motor switch motors 239a and 239b. Also coupled to the shaft is a player unit disk 240 having a notch 241 and a follower 242. The ratchet wheel, player unit cam 230, and the player unit disk 240 are all shown in the seventh or "game-over" position. When a player is stepped forwardly one step stroke of the solenoid, it will be apparent to one skilled in the art that the ratchet teeth may be multiplied by any suitable multiple so that a series of small ratchet teeth are traversed for each cam step by vibration of the ratchet, with means for stopping the action at the end of each series.

The player unit disk 240 serves to control a "game-over" switch 245 which is in series with a "game-over" relay RQ having normally closed contacts RQ1 which feed current to a switched bus 246 and normally closed contacts RQ2 which are in series with the play table motor 110. Operation of the circuit is initiated by a start push button PB which may, for convenience and simplicity, be mechanically coupled to contacts RQ1.

Responsive to closure of the active one of the out-hole switches 160a and 160b, is a "changeover" relay RQ having sealing contacts RQ1, contacts RQ2 in series with the ball return or ejector solenoids 163e, 163b, and contacts RQ3 arranged in series with the player unit solenoid 220. A transfer switch 260 (FIG. 13b) having contacts 261, 262, and 263 which is connected to the cam follower 238 on the player unit cam 230, serves to alternately energize busses 246a and 246b during operation of the machine by players A and B respectively.

In the "initial" conditions shown in the circuit (FIG. 13c), the status of the significant elements are as follows: Voltage exists on the lines 201, 202. The player unit ratchet wheel is in its "seventh" or "game-over" position in which the player unit cam 230 and player unit disk 240 are positioned as shown. Under such conditions the switch 245 controlled by the latter is closed so that the "game-over" relay RQ is energized. The contacts RQ1 and RQ2 which are normally closed, are, therefore, both in the open condition, but contacts RQ3 (FIG. 13a) are closed so that the "game-over" lights are turned on. It is assumed that player B having been the last to play, the table is tilted toward player B and that the ball occupies the out-hole position at the "B" end of the machine, thereby closing out-hole contacts 160b.

Operation of the machine is initiated by putting a coin into the machine and pressing the push button PB associated with the contact RQ1. This completes a circuit from the bus 206 to the switched bus 246, energizing the latter. Since, at the beginning of the game, the ball occupies the "B" out-hole position closing contacts 160b, voltage on bus 246 is applied to the changeover relay RQ. This closes contacts RQ1, RQ2 and RQ3.

Closure of contacts RQ1 serves, temporarily, to seal in the relay RQ. Closure of contacts RQ2 energizes the ball ejecting solenoids 163e, 163b so that solenoid 163b ejects the ball onto the play field. This opens the out-hole contacts 160b, but this does not make any difference since the sealing contacts RQ1 maintain the relay closed.

Closure of contacts RQ3 applies voltage to the solenoid 220 so that the ratchet 221 "takes a tooth". Upon completion of the solenoid stroke the contacts PU1 open, breaking the sealing circuit to relay RQ, permitting the relay to drop out and thereby permitting the contacts RQ3 thereon to open, cutting off further flow of current to the player unit solenoid. De-energization of the solenoid permits the spring 222 to contract to apply an advancing, or power, stroke to the ratchet wheel 221 thereby advancing the shaft 218 through one step. This rotates the player unit disk 240 so that the follower 242 rides up out of the notch 241 to open the switch 245, thereby to de-energize the relay RQ which permits the relay armature to move into a position in which the normally closed contacts RQ1 and RQ2 are closed. The push button may then be released and contacts RQ1 will remain closed, with the contacts RQ2 serving to set up a circuit to the play table motor 110.

Rotation of the ratchet wheel shaft 218 through one step also rotates the player unit cam 230 causing the cam follower 238 to ride upwardly onto the first plateau 231. This causes motor switch 239b to open and switch 239a to close, completing the circuit 110 through the limit switch 113. The cam follower 238 also throws the transfer switch 260 to energize line 246a which causes score to accrue to player A and which selectively energizes player A's goal and out-hole switches.

As the motor rotates, and the table begins to tilt, the ball out on the play field, previously ejected by solenoid 163b along the angled path 167b, may be manipulated by operation of the flippers — even before the table completes its movement.

At the completion of the tilting movement, the crank 112 has been moved from straight up to straight down position and the cam 120 associated therewith has been moved to the point of drop off of the limit switch 121 thereby de-energizing the drive motor 110. At the completion of the drive stroke the transversely extending hook members 141, 142 (FIG. 6) at player A's end of the table come together along their entire length to brace and steady the table for play until the next reversal of the direction of tilt.

During the course of play, the main aim of the offensive player is to drive the ball, by manipulation of the flipper buttons 54a, 57c to the goal at the opposite end of the machine. Where A is the first offensive player his aim, then, is to drive the ball through goal 58c at the "B" end of the machine to close contacts 170a (FIG. 13b) thereby to apply a pulse of voltage to the 1000's scoring line 209 to cause the 1,000 drum to advance one unit. The scoring circuitry will be discussed in detail in a following paragraph. The aim of player A is, further, to engage the ball with the scoring targets including the bumpers, pop bumpers and roller over contacts, during his turn, so as to accumulate a score which is as high as possible. As will be noted in FIG. 13b, the solenoids which operate the scoring drums for players A and B are connected respectively to the voltage supply lines 246a and 246b. During player A's turn as offensive player, the transfer switch 260 energizes only the line 246a so that only A's scoring drums respond to closure of the scoring switches, for example, US and TS operated by the scoring targets. Similarly, since only A's goal switch 58c and A's out-hole switch 163b are connected to an energized line (246a), only these switches, and not B's corresponding switches, are capable of responding to the ball.

During the time that player A is the offensive player, player B may concurrently operate the "B" flippers by manipulating the buttons 54b and 57b for two separate purposes. One purpose is to thwart player A's manipulation of the ball, either to prevent A's making a goal or to prevent, insofar as possible, the ball from striking a scoring target. For example, when the ball is in the region of the goal it can often be driven away from the goal position by the flippers which are spaced closely.
on opposite sides of the goal entryway. Any scoring contact with a target which may be made by player B simply adds to A's score. The second and even more important maneuver is for B, by manipulation of his flipper, to drive the ball down through the center of the table and into player A's out-hole. This closes out-hole contacts 160a to reverse the roles of the players so that B becomes the offensive player and A is relegated to defensive position. The out-hole contacts 160a will also be closed in the event that player A, by reason of lack of skill, allows the ball to gravitate into his out-hole while either along the center line of the table or via the side alleyways 162. In either event, closure of the contacts 160a brings about the following sequence of events:

Referring to the schematic diagram, closure of contacts 160a at player A's out-hole applies voltage to the change over relay RO which seals itself in by reason of closure of contacts RO1. Closure of contacts RO2 impels the ejection solenoids so that the solenoid 163a ejects the ball back out onto the play field. Meanwhile closure of contacts RO3 applies voltage to the player unit solenoid 220 causing the ratchet 221 to "take a tooth. " At the end of the ratchet stroke the contacts PU1 open, thereby de-energizing the solenoid 220 and allowing the spring 222 to contract to apply a power stroke to the ratchet wheel.

Advancement of ratchet wheel causes the cam follower 238 on the player unit cam 230 to drop off of the plateau 231 into the valley 232 which reverses the setting of the switches 239a, 239b, causing contact to be made at switch 239b, thereby to complete its circuit through the (then closed) limit switch 122 to the motor 110 to cause the table to be tilted in the direction of player B.

At the same time, dropping of cam follower 238 causes the transfer switch 260 to switch to its opposite condition, thereby opening contacts 261 to de-energize the line 246c and closing contacts 262 to energize the alternate supply line 246b. This energizes player B's goal and out-hole switches and goal light and causes any subsequent scoring at a target to be tallied on player B's scoring drums. Thus if player B, now offensive, is able to drive the ball through the goal 58b at A's end of the playfield, a pulse of voltage is applied to the 1,000's relay RP, via line 200, adding the sum of 1,000 to B's score. Conversely, if player A, acting defensively, drives the ball into player B's out-hole, closure of the contacts 160b energizes the relay RO. This closes contacts RO2 to impulse the ball return solenoids so that the ball is restored to the play field without delay and, at the same time, closes contacts RO3 to impulse the player unit solenoid 230 thereby to advance the ratchet wheel 210 and cam follower 238 to ascend the next plateau 233 on the player unit cam 230. This closes motor switch 239a which completes a circuit to the motor through limit switch 121 to cause the table to tilt back toward player A to reverse the roles of the players. Also, movement of the cam follower 238 reverses the condition of the transfer switch 260 so that line 246a is energized. This re-energizes player A's goal and out-hole switches and insures that closure of the contacts at the scoring targets results in registering of score on player A's scoring drums.

Subsequent triggerings of the changeover relay RO by the out-hole contacts produces successive advancement of the ratchet wheel 210 and successive steps of movement of the player unit cam 230 until each player has had a total of three turns as offensive player. When, at the completion of player B's third turn, the ball rolls into his out-hole to close out-hole switch contacts 160b, the final energization of the changeover relay RO produces a final step of movement of the player unit disk 240 so that the cam follower 242 thereon drops into the notch 241 to close the associated contacts 245, thereby energizing the "game-over" relay RO. This opens the normally closed contacts RO1, thus de-energizing the switched bus 246 which prevents any further score from being accrued by either of the two players. Moreover opening of contacts RO2 isolates the play table motor 110 so that no further tilting of the table may occur and the table occupies a final position in which it remains tilted toward player B's end of the machine. The ball gravitates into player B's out-hole where it remains, contacts RO3 turn on the "game over" lights LG, one at each end of the table.

For the purpose of enabling the players to keep track of the "turns" which they have had, "turn" lights are provided which are energized by a commuting switch which is coupled to the player unit shaft 218. Thus referring to FIG. 13a commuting switch 270 is employed having contacts connected in series with lamps LA1-LA3 at player A's end of the machine and lamps LB1-LB3 at player B's end of the machine, the lamps being connected to alternate switch contacts. In addition, a seventh or "off" position is provided so that all of the lamps are off between games. The contacts and "off" position are equally distributed about an arc of 360°. When a game is started, accompanied by a first step of movement of the player unit cam 230, lamp LA1 is turned on and the lamps are thereafter operated in sequence to signal the offensive turns of the players.

In order to highlight the goal for each of the players a goal light transfer switch 280 is provided connected to cam follower 238 of the cam 230 and having contacts 281, 282 which are respectively connected to goal lights GLA and GLB which illuminate flush lighted areas adjacent the goals at the ends of the machine. The highlighting of the target goal facilitates taking aim upon the goal under conditions of visibility.

It will be seen, then, that the player unit ratchet wheel 210 and the solenoid which drives it can be considered as a simple form of stepping motor for stepping the player unit cam for reciprocation of the player unit cam follower between alternate positions for alternate tilting of the table and for alternate, and corresponding, activation of the "A" and "B" lines, 246a and 246b which selectively activate the "A" and "B" goal switches, out-hole switches, and scoring devices.

**SEQUENTIAL ACTIVATION OF SCORING TARGETS**

In accordance with one of the aspects of the present invention a series of scoring targets are provided on the play field which are sequentially activated, and means are provided for preserving the status of the activated targets during the tilting movement of the table so that the newly offensive player is presented with an array of scoring targets which depends upon the achievement of the formerly offensive player. More specifically in accordance with the invention, a series of scoring targets are provided in the form of "roll-over" buttons arranged in a row, each button, upon contact with the ball, serving to activate the next button in the series to enable the player to achieve a higher score when the previously activated se ries is activated during the offensive turn of the player. Still further in accordance with the invention means are provided for maintaining the activated status of a button during the tilting of the table while reversing the direction of the sequence. Thus failure of one player to progress beyond a low point in the sequence presents an unusual scoring opportunity to the opposite player when his offensive turn comes upon tilting of the table.

Thus, referring to FIG. 2, the series of roll-over buttons, indicated at 91-96, are arranged longitudinally along the centerline of the table. Each button has an associated normally open contact, the line of which is being indicated at 301-306 respectively (see FIG. 13a). The buttons occupy a normal position in which they extend just slightly above the surface 30 of the play field, with the weight of the ball being effective to depress the button for the making of momentary contact. Conveniently each button may have a shank or plunger 307 (FIG. 14) a stop 308 at the end thereof, and a transparent or translucent support 309 of disk profile. If desired the button may be made of "star" shape with pointed portions of the last few degrees being extended inwardly, in register, between the points of the star.

For the purpose of automatic commutation of the buttons so that the striking of one button is effective to activate the next button in the series, a two-way stepping switch is pro-
vided as shown diagrammatically in FIG. 15 and in schematic form in FIG. 13a. The stepping switch indicated at 310 has a shaft 311 and a wiper 320 which cooperates with contacts 321-326 which are respectively connected in series with the roll-over button contacts 301-306. For the purpose of stepping the shaft “forwardly” during A’s turn as an offensive player, a ratchet wheel 330 is provided having a ratchet 331, a solenoid 332, and a spring 333. Associated with the solenoid is a pair of normally open contacts 334. For rotating the shaft 311 step by step in the “reverse” direction during player B’s turn, a ratchet wheel 340 is provided having a ratchet 341, a solenoid 342, and a spring 343. Coupled to the solenoid 342 is a pair of normally open contacts 344. For determining whether the “A” solenoid 332 or “B” solenoid 342 is operated a sequence reversing switch 350 is provided which is coupled to the cam follower 238 on the player unit cam 230 and which has alternately closed contacts 351, 352. Thus during player A’s turn the contacts 352 are open and the contacts 351 are closed so that only solenoid 332 may be actuated.

In operation, therefore, assuming that contact 321 is engaged by the wiper 320, the roll-over button 91 is the activated roll-over button. Thus when the ball encounters the roll-over button 91, closing the contacts 301 thereon, a circuit is made through the commutator contacts 321 and wiper 320 and to contacts 351 to the “A” solenoid 332 causing forward stepping of the shaft 311. When this occurs the wiper 320 is moved into engagement with the second contact 322 of the commutator so that the roll-over button 92 becomes the activated one. In this way one of the roll-over buttons after the other may be engaged by the ball during the turn of the player A until the roll-over button 96 becomes the activated one. As previously stated, when this final button of the series is activated and subsequently engaged by the ball, this is considered a high-scoring achievement and means are provided for adding a high score increment.

For the purpose of energizing the 1,000’s relay RP(FIG. 13b) when the sixth contact is achieved during player A’s turn, a commuting type scoring switch is provided having a wiper 360 coupled to the shaft 311 and having contacts 361-366, the contact 366 being connected to the scoring line 200 via normally open contacts 334 associated with the “A” solenoid 332.

The operation of the scoring switch will be clear upon considering what occurs when the commutator wiper 320 in engagement with the commutator contact 326, making the roll-over button 96 the activated one of the buttons. Under such circumstances the wiper 360 of the scoring switch is in engagement with the commutator scoring contact 366. However not all circumstances, and such circumstances applied to the scoring line 200 leading to the relay RP since contacts 334 are, at that time, open. However when the ball engages the roll-over button 96, closing contacts 306, a circuit is made via contact 326 through the wiper 320 and thence through contacts 351 of the switch 350 causing voltage to be applied to the “A” solenoid 332. Sucking in of the solenoid causes closure of contacts 334. This completes the circuit from the bus 246 through contacts 366 and wiper 360 so that voltage from the bus is applied to scoring line 200 causing energization of the relay RP so that player A is credited with an increment of score of 1,000. When the ball rolls clear of the roll-over button 96, the “A” solenoid 332 is de-energized causing the spring 333 to retract the ratchet 331 with a power stroke. This not only opens contacts 334 but serves to advance the shaft 311 and the wipers 320, 360 thereon, one step. This brings the wiper 320 into contact with the first commutation contact 321, thus again making the roll-over button 91 the active one. Contact between the wiper 360 and the contact 361 of the scoring switch is ineffective since, at that time, contacts 344, associated with the “B” solenoid 342, are open.

In accordance with one of the features of the present invention, means are provided for selectively illuminating the roll-over buttons in order to denote which of the buttons is currently activated. To accomplish this, each of the roll-over but-

tons has a light for illuminating it from the bottom and the lights are connected to the individual contacts of a light commutating switch powered from the ratchet shaft 311. Accordingly, referring to FIGS. 13a and 15, a commutating switch is provided having a wiper 370 and contacts 371-376 which are individually connected to the light contacts at ROLI-ROL6 respectively. Thus illumination of lamp ROL1 associated with the first roll-over button 91 indicates that contact exists between wiper 320 and the first contact 321 of the button commutating switch, making roll-over button 91 active. When the roll-over button 91 is struck by the ball, completing contact to the “A” solenoid 332, the ratchet wheel 330 is stepped causing advancement of the wiper 320 into contact with the second commutator contact 322, thereby activating the roll-over button 92, accomplished by advancement of the wiper 379 into engagement with the contact 372 to light lamp ROL2. This clearly indicates that it is the second roll-over button which is now active.

In the above discussion it has been assumed that it is player A’s offensive turn and that contacts 351 of the sequence-reversing switch 350 are closed, thereby to selectively activate the “A” solenoid 332. However when it becomes B’s offensive turn the sequence-reversing switch 350 is thrown into its opposite position so that wiper 238, closing contacts 352 so that the “B” solenoid 342 becomes active. Since the teeth of ratchet wheel 340 are faced in the opposite direction, actuation of the solenoid has the effect of rotating the shaft 311 in the counterclockwise or “subtract” direction. This causes the roll-over buttons to be activated in the reverse sequence. In other words, hen it is player B’s turn the sequence of the roll-over buttons is from player B’s position to the opposite end of the board, and roll-over button 91, at the end of the series, thus becomes the high-scoring button.

For scoring completion of the sequence by player B, the commutator contact 361 is connected to the 1,000’s scoring line 200 via the normally open contacts 344 associated with the “B” solenoid 342.

In understanding how the device works on behalf of player B, it will be assumed that player B has, in succession, hit roll-over buttons 96 through 92 so that the wiper 320 of the commutator switch occupies contact 321 and so that the wiper 370 of the light commutator switch occupies contact 371 thereby illuminating the roll-over button 91 to indicate that it is now active. When the roll-over button 91 is engaged by the ball, completing a circuit through contacts 321 and contacts 352 to the “B” solenoid 342, the solenoid “takes a tooth” on the wheel 340, closing the contacts 344. This completes a circuit through the wiper 360 and contact 361 on the scoring switch to apply a pulse of voltage to the scoring line 200 so that an increment of score of 1,000 is credited to player B’s account. As the ball clears the roll-over button 91, the solenoid 342 is de-energized permitting the spring 343, upon contraction, to rotate the shaft 311 one step in the counterclockwise direction while simultaneously opening the contacts 344 to remove voltage from the scoring line. Such “subtracting” movement of the wiper 320 and wiper 370 serves to activate the roll-over button 96 and the light ROL6 which illuminates it, thus putting player B back to the beginning of a roll-over button sequence.

It should be particularly noted that when an offensive player’s turn expires by reason of the fact that the ball passes into his out-hole, causing reversal of the tilt of the board, the activated roll-over button remains the same, but the sequence is automatically reversed. The activated button remains the same by reason of the fact that there is no movement of the shaft 311 incident to tilting of the board and thus the wipers of the commutator switches remain in position and the same button remains illuminated and lit. However the sequence is reversed by reason of the shifting of the sequence through switch 350 to its opposite condition by cam follower 238 between the turns of the players and as their offensive and defensive roles are reversed. Thus an inept player may present his opponent with a high-scoring opportunity thereby adding
to the excitement of the game. For example, let us suppose that as player A begins a first game with the roll-over button 91 activated and lit, he immediately permits the ball to roll into his out-hole. This causes the table to tilt in favor of player B, with the roll-over button 91 remaining activated and lit. Such button is the high-scoring button for player B and thus it is possible for player B to direct his attention to hitting the roll-over button 91 which will give him an incremental score of 1,000 without the necessity for traversing the series of buttons. The least one of the offensive player's score is achieved in the set of commutated roll-over buttons 91–96 is not cancelled when his turn is over, but the commuting progress or "level of commutation" of the player is preserved to form a challenge to the newly offensive player when it is his turn.

In a more elaborate circuit diagram than that as shown, means well within the skill of the art may be provided for automatically restoring the commuting shaft 311 to the reference position shown in FIG. 15 at the start of a game. In the relatively simplified version set forth herein there are two choices. The players can start a game with a roll-over button activated as a result of the play of the previous game. Alternatively, the terminal of one of the two solenoids 332, 342 which is not connected to the bus 305 may be brought out, via a pushbutton, to the constantly energized bus 206. Successively pressing the pushbutton will then be effective to rotate the shaft 311 around to the point where the first roll-over button is illuminated by lamp ROL.1 which indicates that the commutator switch contact is properly engaged by the commuting wiper. It is permissible since the roll-over lamps are on a separate and constantly energized circuit. It has been assumed for the sake of simplicity that the purpose of traversing the sequence of roll-over buttons is to achieve a score by engaging the final button in the series. However, if desired, means may be provided for producing a score whenever one of the activated buttons 92–95 is engaged by the ball regardless of its position in the series. For example it will be apparent to one skilled in the art that the scoring commutator switch may be so constructed that when the wiper 360 thereon strikes one of the contacts 362–365, monumental rather than sustained contact will be made. Thus upon connecting the contacts 362–365 to the scoring line which feeds the 100's relay RL, each time an activated button is struck by the ball, in other words, each time that the shaft 311 of the ratchet advances in one direction or the other to make contact with one of the contacts 362–365, an incremental score of 100 will be added to the score of the offensive player.

While it is preferred, for the sake of simplicity, to provide mechanical means for the making of only momentary contact as the wiper arm 360 is stepped over the contacts of a given inclusive, it will be understood that such momentary contact may also be achieved by any desired design of electrical momentary contact device MC included in the line which leads to the relay RL. Such a device may for example be responsive to the leading edge of the voltage wave, say, by using a derivative stage, to produce only a pulse voltage on the line of relay RL while being non-responsive to the succeeding steady state voltage condition.

Also for the sake of simplicity a simple type of commutating arrangement has been disclosed employing a wiper 360 which is capable of progressing beyond a single commutation cycle. Thus, employing the arrangement shown in FIG. 18, after the entire progression of roll-over buttons 91–96 has been completed, the button 91 is reactivated, and it is possible for player A to progress through the series again during his turn of play. However it will be apparent to one skilled in the art that such continuous cycling of the commutation switch is simply one of the options. In a practical case these three wipers 320, 360 and 370, rigidly secured together, may be provided with a stop to prevent clockwise rotation of the wipers beyond the "final" contact 366 during player A's turn. This would have the effect of limiting the player to a single cycle of commutation. To permit player A to have an additional increment of score upon re-engagement of the roll-over button 96, which remains illuminated, a slip clutch may be interposed between the ratchet drive shaft 311 and the wipers which it drives. Similarly, a stop may be used to prevent counter clockwise rotation of the wiper 360 beyond the position of the contact 361 for player B.

SCORING DRUM CIRCUITRY AND CONSTRUCTION

In the above discussion it has been assumed that making of contact at the scoring switches US, TS, HS, or applying voltage to the scoring line 200, combined with the selective energization of the voltage lines 246a, 246b, has been effective to produce tallying of the score on the scoring drums. Attention may next be directed to the drum drive and to an improvement in the scoring indication which results in the score for each of the players being readable from the opposite ends of the machine while using only a single set of drums for each of the players. In the discussion which follows reference will not only be made to FIG. 13b which shows the schematic circuit diagram of the scoring drum driving arrangement but also to the FIGS. 16–19 which show the scoring assembly and the structure of individual scoring units. Focussing attention first upon player A's "units" drum 400a, it is powered by a sole- noid 401a which drives a pawl or ratchet 402a having a return spring 403a. Coupled to the solenoid 401a are normally open contacts 404a and normally closed contacts 405a. On the drum 400a is a cam projection 406a which operates an output switch 407a. The "unites" drum of player B, indicated at 400b, has corresponding parts which have been given corresponding reference numerals with addition of subscript b. For controlling the "units" drums a relay RN is employed having normally open contacts RN1-RN4 inclusive connected as shown. A similar pattern of numerals has been employed for the "10' s" drums indicated at 410a, 410b respectively, the "100's" drums 420a, 420b and the "1,000's" drums 430a, 430b, the latter being under the control of relays RL, RM, and RP respectively.

In operation when a typical contact US on a scoring target closes for a count of one, the relay RN is energized and seals itself in for a short space of time via contacts RN4 and normally closed interlocking contacts 405a, 405b. Contacts RN1 and RN2 are fed from the supply lines 246a, 246b which are energized depending on whether player A or player B is in the offensive role. Assuming that it is player A who is offensive when the solenoid 401a is energized, this causes the ratchet 402a to take a tooth and is accompanied by opening of the normally closed contacts 405a. The latter breaks the holding circuit so that relay RN drops out, opening contacts RN1 and de-energizing the solenoid 401a. The relay RN is effective to cause the unit's drum 400a to advance one step.

Similarly, when the scoring contact TS closes for a score of 10, the relay RM is energized, momentarily sealing itself in via contacts RM4 and, by closure of contacts RM1, energizing the solenoid 411a, causing the solenoid to take a tooth and opening the interlocked contacts 415a which permits the relay RM to drop out. The resulting opening of contacts RM1 de-energizes the solenoid so that the spring associated therewith can advance the "10's" drum by one step. The same pattern then occurs in the case of the "100's" drums 420a, 420b and "1000's" drums 430a, 430b. In each instance momentary energization of the scoring contact is sufficient to cause energization of a relay which then acts to advance one of the associated drums one step, the particular drum depending upon whether it is player A or player B who is in offensive status, in other words, depending upon whether line 246a or 246b is energized.

Means are, as is conventional, provided for spilling over into the next higher order whenever a number in a given order exceeds 9, and incident to its turning over to the tenth, or "O," position. Let it be assumed, for example, that the unit's drum 400a is in the ninth position with the cam projection 406a about to engage the switch 407a. Under such circumstances energization of the relay RN, for addition of a unit to
the lowest order, causes energization of the solenoid 401a for the stepping of the drum 400a from the ninth to the tenth position. Simultaneously closure of the contact 407a by the projection 410a completes a circuit from the bus 246 through contacts RN3 of the relay through contacts 401c of the solenoid to the input side of the relay RM in the next higher, or 102, order. This results in closure of relay contacts RM1 to energize the solenoid 411a which takes a tooth and which then breaks the sealing contacts 415c to cause the relay RM to drop out. This opens contacts RM1 de-energizing the solenoid 411a so that the ring associated therewith may advance the "10"s" drum 410a one step.

In a similar fashion, when a 10's drum is filled, the reading thereon is restored to "0" and the drum of next higher, or 100's order, is advanced one step. To complete the pattern, when a 100's drum is filled, it causes the corresponding 1,000's drum to advance one step. Only four drums are provided since it is unlikely that a score greater than 9999 will be achieved by one of the players during a single game.

It will be apparent to one skilled in the art that prior to starting a game the score on both sets of drums should be reduced to zero. This can be accomplished, as is conventional, by providing a special set of run-out contacts for each of the solenoids to step the solenoids to zero repeatedly until the drums have been stepped around to a reference or zero position for automatic turn off. The present circuit diagram will not be complicated by a showing of this conventional feature. However it will be noted that "run-out" terminals have been brought out from each of the drum solenoids which might be connected by pushbutton or other repetitive contact maker to the supply bus 246 thereby permitting the drums to be restored to the zero reference position before each game.

In accordance with one of the aspects of the present invention, each station on the drum is provided with two sets of numerals from 0-9 with the sets differing in phase by approximately 180° and with an aperture on each side of each drum for exposing the appropriate numeral, and with all other numerals masked out so that the score is indicated with equal effectiveness through the oppositely facing panels 43, 44. Thus referring to a typical drum 420a shown in FIGS. 17 and 18, numerals of two different sets occupying a single station 440 on the drum are offset from one another by a difference of five units, so that corresponding numbers are physically offset by approximately 180°. The term "approximately" has been intentionally employed since corresponding numbers of the two sets may either be advanced one-half set or retarded one-half set with respect to one another resulting in a physical angle of displacement of 180°, either plus or minus 18. In other words, corresponding numerals are 90° apart measured about the drum in one direction and 198° apart when measured about the drum in the opposite direction. Thus corresponding numbers may be viewed simultaneously from opposite sides by employing masks 441, 442 which have apertures 443, 444, the center-lines of which are offset by an angle of 157°. As shown in FIG. 17 the numeral zero is viewable through both of the apertures 443, 444 from opposite ends of the table. The same is true with respect to the apertures on both of the panels provided for the remaining drums of each set. The panels 43, 44 may be of glass painted on the backside as indicated at 43a, 44a except for apertures which register with the apertures 443, 444 in the masks.

In short by using the present invention it has been possible to achieve double display from a single set of drums at a cost which is substantially no greater than in the case of a conventional pinball machine where only a single direction of display is required.

In machines constructed in accordance with a preferred form of the invention the passage of a ball through the offensive player's out-hole serves to trigger the changeover relay RO so that the play table is tilted in the opposite direction and so that suitable transfer switches are actuated for shifting the scoring means from one player to the other. It will be apparent, however, to one skilled in the art that passage of a ball through an out-hole is not the only possible criterion for reversing the tilt of the table and that other means might be employed, within the scope of the invention, to accomplish a similar result. For example a special target might be provided having contacts which would be effectively in parallel with the out-hole contacts 160a, 160b for triggering the changeover. It will also be apparent to one skilled in the art that time-controlled contacts may be provided for triggering the changeover after the lapse of a predetermined amount of time. Also, the present machine terminates a game automatically upon a complete revolution of the player unit cam 230 which acts as a counter for the turns which the players have had. It will be apparent that the game need not be terminated by the counting of turns and that other criteria may be employed without departing from the broader aspects of the invention; for example, a timer having contacts arranged effectively in parallel with the contacts 245 which control the "game-over" relay RO could be employed. The term "means responsive to the play of the ball" as used herein is intended to include time of play as a control criterion.

Moreover, it is one of the features of the present invention that a single ball is used and that the ball does not substantially leave the level of the play field, it will be apparent that the invention is not limited thereto and that, if desired, means could be provided for dropping a ball through the play field, as in the case of more conventional machines, with means for supplying additional balls as the players take their respective turns at offensive play. Thus the term "ball" refers to that which is in play, and is not limited to the use of a single ball.

The term "flippers" is intended as a general term to denote any ball engaging or propelling means furnished in separate sets and which may be concurrently operated under the control of the respective players for directing the ball about the play field. Such flippers may be located wherever desired on the field. It is one of the features of the present construction that flippers are so located as to straddle the out-hole position at each end that they perform both offensive and defensive functions for both of the players.

While it is one of the features of the present construction that all of the scoring targets are coupled to the scoring drums of the offensive player, it will be appreciated by one skilled in the art that certain versions of the present machine may be provided with auxiliary means for operating the transfer switch 260 in accordance with certain maneuvers of the players, for example, as a result of a playoff achievement on the part of the defensive player, so that an increment of score may be gained by the player in spite of the fact that he is in a defensive status. Thus, in addition to the regular out-hole switch, an additional switch may be in the out-hole position 245 which is turned on by the pilot lamp 246 which is turned on by the pilot lamp 246 which is turned on by the pilot lamp 246 which is turned on by the pilot lamp 246 which is turned on by the pilot lamp 246 which is turned on by the pilot lamp 246 which is turned on by the pilot lamp 246 which is turned on by the pilot lamp 246 which is turned on by the pilot lamp

The term "bridge" used herein is not limited to structure having a support at each end, and, if desired, the scoring panels may be supported cantilever-fashion on a single support.

The term "out-hole" refers to any receptacle or receiver into which the ball gravitates or into which it may be driven which has the effect of bringing the player's turn, or the play of the ball, to an end.

The circuit of FIGS. 13a-13c, forming an exemplary embodiment of a two-player game machine has been purposely
simplified in order to highlight the principles involved and the mode or sequence of play and to avoid submerging the invention in a mass of detailed circuitry. It will be understood, however, that in a practical case the circuit may be expected to depart from the specific circuit shown in Figs. 13a–13c, and to be much more complex than such circuit without, however, bringing about a mode of operation which is substantially different from that described. It is also possible to simplify the device still further, in certain aspects, for example, by providing only a single switch at each end to serve the functions of goal switch and out-hole switch, respectively, while utilizing the broader aspects of the present invention. For example, the switch 160b may be connected in the out-hole circuit during B's turn and switched into the goal circuit during A's turn thus dispensing with the switches 170a, 170b.

SINGLE PLAYER MODE

While it is the main purpose of the invention to provide a machine which enables competitive play by two players, it is one of the auxiliary features of the machine that it may be used by a single player when a second player is not available. This is accomplished by disabling or overpowering the cam follower 238 so that it operates only one position and therefore cannot effect transfer in the direction of tilt or transfer of the ball. This is done to avoid confusion of the roles of the players. The player unit ratchet wheel is, however, still effective to rotate the player unit disk 240 for operation of the "game-over" relay RQ after a predetermined number of cycles of the ball into the player's out-hole. Thus, referring to Fig. 20, a simple pivoted selector member 450 may be used, which is movable into a "1 player" position to raise the cam follower 238 into its position 238a and to maintain it in such position until the game has been completed.

Thus in the single player mode, the player occupies the A position and presses the start pushbutton PB. This energizes the switched bus 246, and since the ball initially occupies the "B" out-hole, contact is made through switch contact 160b to energize the relay RQ which temporarily seals itself in by contacts RQ1 and which applies voltage to the solenoid 163b via contacts RQ2 to eject the ball into the playfield. At the same time contacts RQ3 close so that the player unit solenoid 220 completes a stroke, opening the interlock contacts PUI to drop out the relay RQ, which by opening of contacts RQ3, de-energizes the solenoid, enabling the spring 222 to apply a power stroke to the ratchet wheel. This cam the follower 242 out of the notch in the disk 240 causing the relay RQ to be de-energized resulting in closure of the contacts RQ1 so that pressure on the pushbutton may be released.

De-energization of relay RQ also results in the closing of contacts RQ2 which complete a circuit to the motor 110 via contacts 239a and limit switch 121 to energize the motor 110 until the limit switch 121 opens with the table tilted in the direction of the player. The blocking up of the cam follower 238 in the position 238a for single player operation "permanently" switches the transfer switch 260 so that the contacts 261 thereof remain closed for constant application of voltage to the line 246a. Thus only the "A" goal and out-hole switches are activated and all score which is made on the board is credited to the account of the single player. During the game the primary aim of the player is to drive the ball into the goal 58a at the opposite or "B" end of the play field. When the ball has gravitated through the player's out-hole a total of six times, which is effective to complete a cycle of the ratchet wheel and the disk 240 which is connected to it, the cam follower 242 drops into the notch 241 on the disk resulting in closure of the switch 245 and energization of the "game-over" relay RQ which opens the contacts RQ1 to remove voltage from the switched bus 246 to terminate the game.

At that time the operator 450 may be restored to the "2 player" setting, lowering the cam follower 238 into contact with the cam 230 and thereby closing the motor control contacts 239a which completes a circuit to the motor 110 through limit switch 122. This rocks the table back into the "B" facing position where breaking of the contacts of the limit switch 122 de-energizes the motor. The ball rolls from the out-hole at the "A" end of the table to the out-hole at the "B" end in readiness for a new game.

We claim as our invention:

1. A two-player pinball machine in which players are alternately offensive and defensive comprising, in combination, an elongated frame having opposite ends, a play field mounted in the frame having tilting means for tilting alternately toward the opposite ends, a ball, means defining an out-hole at each end of the play field, each out-hole being open at all times during play, scoring targets distributed on the play field and having ball-actuated contacts, said scoring targets including the out-hole at the end of the play field remote from the offensive player, means controlled by the targets for tallying the score for the offensive player, first and second sets of right and left-hand flippers distributed on the play field, means including right and left-hand buttons at each end of the frame for operating respective sets of flippers for use by the offensive player to direct the ball to the scoring targets and with the buttons at the end of the frame remote from the offensive player being active for use concurrently by the defensive player to direct the ball into the offensive player's out-hole, and means responsive to the ball entering the offensive player's out-hole for actuating the tilting means for tilting the play field in the opposite direction.

2. The combination as claimed in claim 1 including means actuated incident to a predetermined number of tilting cycles for disabling further play.

3. A two-player pinball machine in which the players are alternately offensive and defensive comprising, in combination, an elongated frame having opposite ends, a play field mounted in the frame having tilting means for tilting alternately toward the opposite ends, a ball, means defining an out-hole at each end of the play field, scoring targets distributed on the play field and having ball actuated contacts, first and second sets of flippers distributed on the play field, means at each end of the frame for operating the respective sets of flippers for use by the offensive player to direct the ball to the scoring targets and concurrently by the defensive player to drive the ball into the offensive player's out-hole, means responsive to the ball's entering the offensive player's out-hole for actuating the tilting means for tilting the play field in the opposite direction, actuating devices for separately tallying the scores of the players, and switching means actuated incident to tilting the play field for connecting the contacts of the targets exclusively to the tallying device of the offensive player thereby giving the offensive player credit for targets struck by the defensive player during the offensive player's turn.

4. A two-player pinball machine in which the players are alternately offensive and defensive comprising, in combination, an elongated frame having opposite ends, a play field mounted in the frame having tilting means for tilting alternately toward the opposite ends, a ball, means defining offensive and defensive out-holes at the respective ends of the play field and having a goal switch, scoring targets distributed on the play field, means controlled by the scoring targets and the goal switch for tallying the score for the offensive player, offensive and defensive sets of flippers distributed on the play field, means at the respective ends of the frame for operating the flippers, means responsive to the operation of the goal switch for actuating the tilting means for tilting the play field in the opposite direction, means actuated incident to a predetermined number of tilting cycles for disabling further play, each goal switch being made up of two switch means operated by the ball, the first of which is coupled to the score tallying means and the second of which is coupled to the table tilting means.

5. A two-player pinball machine in which the players are alternately offensive and defensive, comprising in combination, an elongated frame having opposite ends, a play field mounted in the frame and having tilting means for tilting alternately toward the opposite ends, a ball, means defining an out-hole at
each end of the play field, each out-hole being open at all times during play, scoring targets distributed on the play field and having ball-actuated contacts, one of the scoring targets being for the offensive player's out-hole, means controlled by the scoring targets for tallying the score for the offensive player, first and second sets of right and left-hand flippers distributed on the play field, means including right and left-hand buttons at each end of the frame for operating respective sets of flippers for use by the offensive player to direct the ball to the scoring targets and with the buttons at the end of the frame opposite from the offensive player being active for use concurrently by the defensive player to drive the ball into the offensive player's out-hole, and means solely responsive to the play of the ball for actuating the tilting means so that the play field is tilted in the opposite direction.

6. A two-player pinball machine in which the players are alternately offensive and defensive comprising, in combination, an elongated frame having opposite ends, a play field mounted in the frame and having means for tilting alternately toward the opposite ends, a ball, scoring targets distributed on the play field and having ball-actuated contacts, means controlled by the contacts for tallying the score of the offensive player, commutated means for activating a series of scoring targets in a sequence in which the targets produce a successive increment of score, first and second sets of flippers distributed on the play field, means at each end of the frame for operating the respective sets of flippers, out-hole means at each end of the play field, means responsive to the ball's entering the offensive player's out-hole for triggering the tilting means for tilting the play field in the opposite direction, and means for preserving the status of the commutated means during the tilting movement so that the newly offensive player is presented with an array of scoring targets which depends upon the commutating progress of the formerly offensive player.

7. The combination as claimed in claim 6 in which engagement of the ball with the activated one of the series of targets serves to activate the next target of the series.

8. The combination as claimed in claim 6 in which the commutated scoring targets are in the form of a row down the central portion of the play field and with commutation starting from the end adjacent the offensive player so that the lower the level achieved by the first player in the sequence at the time of tilting the higher is the level in the sequence presented to the second player.

9. The combination as claimed in claim 6 in which the final target in the series has a high score value and in which switching means is provided for reversing the sequence incident to reversing the tilt of the table.

10. A two-player pinball machine in which the players are alternately offensive and defensive comprising, in combination, an elongated frame having opposite ends, a play field mounted in the frame and having means for tilting alternately toward its opposite ends, a ball, scoring targets distributed on the play field and having ball-actuated contacts, means for selectively activating a portion of the scoring targets for de-activation upon engagement by the ball, means controlled by the scoring targets for tallying the score of the offensive player, first and second sets of flippers distributed on the play field, means at each end of the frame for operating the respective sets of flippers, out-hole means at each end of the play field, means responsive to the ball's entering the offensive player's out-hole for triggering the tilting means for tilting the play field in the opposite direction, and means for preserving the activated status of the targets during the tilting movement so that the newly offensive player is presented with an array of scoring targets which depends upon the achievement of the formerly offensive player.

11. A two-player pinball machine in which the players are alternately offensive and defensive comprising, in combination, an elongated frame having opposite ends, a play field mounted in the frame and having means for tilting alternately toward the opposite ends, a ball, scoring targets distributed on the play field and having ball-actuated contacts, means controlled by the contacts for tallying the score of the offensive player, said scoring targets including a series of roll-over buttons with the final button denoting a high score, commutated means for activating the roll-over buttons in a sequence, illuminating means for actuating the roll-over buttons, first and second sets of flippers distributed on the play field, means at each end of the frame capable of concurrent operation of the respective sets of flippers, means actuated following play of the ball for triggering the tilting means for tilting the play field in the opposite direction, and means for preserving the activated status of the activated roll-over button and for reversing the commutation sequence incident to tilting movement of the play field so that the roll-over buttons present a scoring opportunity which depends inversely upon the level of commutation achieved by the formerly offensive player.

12. A two-player pinball machine in which the players are alternately offensive and defensive comprising, in combination, an elongated frame having opposite ends, a play field in the frame having means for tilting alternately toward the opposite ends, a ball, scoring targets distributed on the play field having ball-actuated contacts, means controlled by the scoring targets for tallying the score of the offensive player, first and second sets of flippers distributed on the play field, means at each end of the frame for operating the respective sets of flippers for use by the offensive player to direct the ball to the scoring targets and for use simultaneously by the defensive player to thwart the offensive player, an out-hole at each end of the play field, each out-hole being open at all times during play, means including a switch responsive to the ball's entering the offensive player's out-hole for triggering the tilting means for tilting the play field in the opposite direction, the switch means being of one-way construction so formed as to permit the ball to escape from the out-hole when the table is tilted in the opposite direction to restore the ball to the play field for the play of the opposite player.

13. The combination as claimed in claim 12 in which each of the out-holes has a ball-receiving receptacle and in which the receptacles are on substantially the same level as the play field so that the ball is free to roll out of the receptacle into the play field upon tilting of the play field in the opposite direction.

14. The combination as claimed in claim 12 in which means are provided for causing the ball leaving a receptacle to roll down a path which is offset from the out-hole at the opposite end thereby to restore the ball to play by the flippers on the play field.

15. A two-player pinball machine in which the players are alternately offensive and defensive comprising, in combination, an elongated frame having opposite ends, a play field in the frame having means for tilting alternately toward the opposite ends, a ball, scoring targets distributed on the play field having ball-actuated contacts, means controlled by the scoring targets for tallying the score of the offensive player, first and second sets of flippers distributed on the play field, means at each end of the frame for concurrent operation of the sets of flippers by the respective players, an out-hole at each end of the play field, a power-actuated ball ejector in each out-hole for ejecting the ball from the out-hole onto the play field, means responsive to the ball's entering the offensive player's out-hole for (a) triggering the tilting means for tilting the play field in the opposite direction and (b) actuating the ejector so that the ball is forcibly propelled out onto the play field at the time that tilting takes place.

16. A two-player pinball machine in which the players are alternately offensive and defensive but which is capable of use by a single player comprising, in combination, an elongated frame having opposite ends, a play field mounted in the frame having tilting means for tilting alternately toward the opposite ends, a ball, means defining an out-hole at each end of the play field, sets of flippers having means for concurrent operation by the respective players for engaging the ball, scoring targets distributed on the play field including high-scoring
targets at the respective out-holes and each having ball-actuated contacts, separate scoring devices for each of the players, a transfer switch for alternately controlling the scoring devices of the players, a player unit stepping device having means for stepping it forwardly by a step incident to passage of the ball through the offensive player's out-hole, said stepping device having a player unit cam and a cam follower movable by the cam alternately into first and second positions, means operated by the cam follower for actuating the tilting means and for simultaneously operating the transfer switch so that scoring accrues to the offensive player, and means for defeating the cam follower and for holding the same in a single position so that the table remains tilted in one direction and the transfer switch remains in one condition for operation of the game by a single player at one end of the machine.

17. The combination as claimed in claim 16 in which power-actuated ejectors are provided at each out-hole and which includes switching means for connecting the out-hole switches to the power ejectors and to the stepping device so that upon passage of the ball into the player's out-hole in the single player mode, the stepping device is stepped and the ejection device is energized for restoring the ball to the play field for continued play by the same player.

18. The combination as claimed in claim 17 in which a switch is provided operated incident to the completion of a cycle of movement of the player unit cam for terminating the game upon completion of a predetermined number of steps.

19. A two-player pinball machine in which the players are alternately offensive and defensive comprising, in combination, an elongated frame having opposite ends, a play field table mounted in the frame and having tilting means for tilting alternately toward the opposite ends, a ball, means defining out-holes at the ends of the play field, sets of flippers having means for concurrent operation by the respective players for engaging the ball, scoring targets distributed on the play field including high scoring targets at the respective out-holes and each having ball-actuated contacts, scoring devices for the players, means for coupling the contacts to the scoring device of the players, transfer means responsive to the passage of the ball through the offensive player's out-hole for reversing the tilt of the table and for causing score to accrue to the defensive player, manually settable means for effectively blocking the transfer means so that the table remains tilted toward one of the out-holes and so that all score accrues to the corresponding player, and means responsive to arrival of the ball at the said one of the out-holes for automatically ejecting the ball from the out-hole onto the play field for continued play by a single player.

20. The combination as claimed in claim 19 including counting means for counting the number of total passages of the ball through an out-hole and for disabling further play upon reaching a predetermined count.

21. A two-player pinball machine in which the players are alternately offensive and defensive comprising, in combination, an elongated frame having opposite ends, a play field table mounted in the frame having tilting means for tilting alternately toward the opposite ends so that in each tilted position the upper end is remote from, and the lower end is adjacent to, the offensive player, a ball, means defining an out-hole switch and a goal switch in alignment at each end of the table, each out-hole switch being arranged behind the associated goal switch, a ball, sets of flippers having means for concurrent operation by the respective players for engaging the ball, scoring targets on the field having target switches, separate scoring devices for each of the players, transfer switch means, activating the goal switch at the upper end and the out-hole switch at the lower end and for coupling the activated goal switch and target switches to the scoring device of the offensive player, means actuated by the engagement between the ball and the out-hole switch at the lower end for triggering operation of the tilting means and the transfer switch means, and means for counting the total engagements between the ball and the out-hole switches for disabling further play of the ball.

22. A two-player pinball machine in which players are alternately offensive and defensive comprising, in combination, an elongated frame having opposite ends, a play field mounted in the frame having tilting means for tilting alternately toward the opposite ends, a ball, means defining an out-hole at each end of the play field, each of the out-holes having a goal switch and an out-hole switch encountered in succession as the ball enters the out-hole, separate scoring devices for the players, scoring targets on the play field having switches, the goal switches and the target switches being coupled to the scoring devices, first and second sets of flippers distributed on the play field, means at the ends of the frame for concurrent operation of the respective sets of flippers (a) for use by the offensive player to direct the ball to the goal switch at the defensive player's end of the field and (b) for use by the defensive player to drive the ball into contact with the offensive player's out-hole switch, a stepping type motor having a player unit cam, means for advancing the motor one step upon engagement by the ball of an out-hole switch, first and second supply lines having means including a transfer switch for alternately furnishing voltage thereto, cam follower means responsive to the cam in successive steps of the motor for triggering the tilting means, means for connecting the goal switches, out-hole switches and scoring devices to the respective supply lines, and means actuated by the cam follower means for operating the transfer switch.