

Coin-Operated Pinball Machines

AN HISTORICAL AND TECHNOLOGICAL SURVEY



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By Herbert B. Jones

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Political cartoon, published in 1863, depicts Abraham Lincoln, the sixteenth President of the United States, playing a bagatelle game, generally considered the basic inspiration for pinball.

The Pinball Game

THE ORIGIN OF PINBALL is lost in antiquity. The earliest known reference to a similar amusement device is found in Chapter XIV of *Pickwick Papers*, published by Charles Dickens in 1836. The narrator describes the Peacock Tavern at which members of the Pickwick Club stopped and “beguiled their time chiefly with such amusements as the Peacock afforded, which were limited to a bagatelle-board on the first floor.” The game probably resembled the board illustrated at the top of the page, which is generally regarded as the ancestor of pinball¹.

Early in 1929, John J. Sloan, an advertising solicitor for *Billboard*—a magazine then catering to the carnival and circus trade, street vendors and operators of slot-machines, and other early coin-operated equipment—observed an adaptation of bagatelle in the basement of his apartment building. The device had been built by the janitor for the amusement of his friends.

Although the unknown, unsung inventor of modern pinball utilized the traditional scoring objective of bagatelle—holes or cups in a plane surface with the score-value of each hole prominently displayed—he introduced three historic innovations: (1) the plane surface was slightly slanted, balls² being propelled upward to the rear of the surface, then rolling toward the front of the surface; (2) the scoring holes were partially surrounded by hedges of brass nails or pins, increasing the degree of skill required to shoot balls into holes; (3) the balls were shot, not by means of a cue, but by a spring-loaded plunger,

identical in basic principle to the ball-shooter used in pinball games today. The basement bagatelle was not coin-operated.

Intent on developing a new source of advertising revenue, Sloan described his subterranean discovery to several of his carnival equipment accounts; and one company—In and Outdoors Games, Inc.—built and marketed several coin-operated bagatelle or pinball games.

Probably because the games were too large for the average location and too expensive—approximately (U.S.) \$100—for an economy already drifting into economic depression, the In and Outdoors Games contribution to Coin-Operated Amusement was not successful and soon vanished from the amusement scene—but not before other entrepreneurs shrewdly appraised the enormous potential of coin-operated bagatelle.

First Pinball Boom

“On a gloomy day in October of depression-clouded 1931,” writes a veteran coin-machine historian, “a young businessman, Raymond T. Moloney, after

1. Municipal ordinances governing pinball in the United States often refer to the game as “bagatelle.”

2. The ball in the basement bagatelle, as in early commercial pinball, was the spherical glass toy usually called a “marble” in the United States. Indeed, for several years, pinball was variously identified as “marble game”—in reference to the projectile used in play—or as “pin game”—in reference to the hole-guarding pins.

hours of stubborn argument, persuaded his senior partners in a small Chicago printing shop to join him in a bold venture.

"As a result of their decision, a simple but fascinating, color-splashed pinball game was introduced to America late in 1931. By the time 1932 dawned, under darker depression clouds than ever, the rainbow-bright game, BALLYHOO¹, was a national sensation. 50,000 BALLYHOO games were sold in a period of 7 months."

New Locations Develop

"The lexicon of locations," the historian continues, "did not include taverns in 1932². But in barber shops, tobacco stores, restaurants, drug stores, coffee shops, gasoline stations, railroad depots, bus terminals, roadside stands and—in the words of BALLYHOO advertisements—"wherever people congregate," BALLYHOO brightened the somber scene, giving Americans a penny's worth of escape from worry, a nickel's worth³ of cheer in a grim world."

New Operators Appear

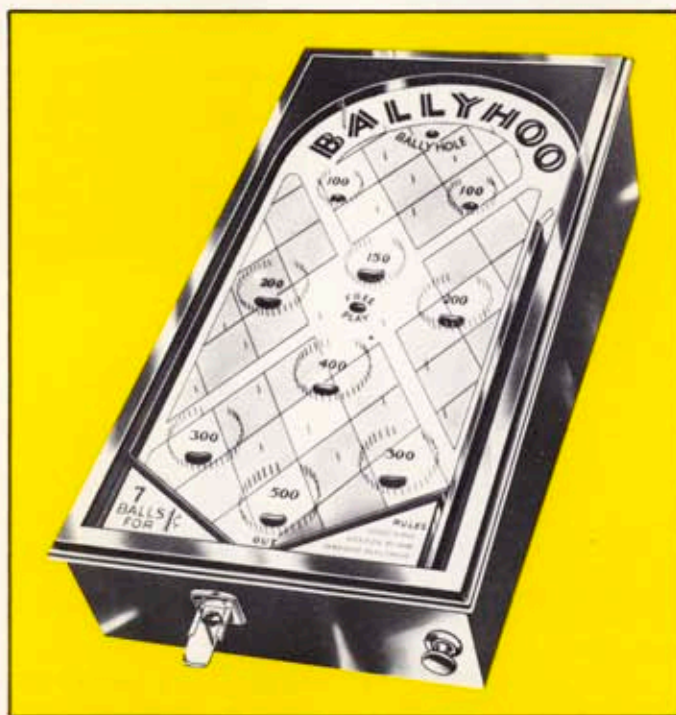
Slot-machine operators, whose advent is chronicled on page 3, constituted the first immediate market for BALLYHOO. But they were soon joined by throngs of

other men and women: unemployed workmen, who risked their small savings to buy BALLYHOO and embark on new careers of self-employment; bankrupt businessmen; doctors and dentists without regularly paying patients; lawyers without clients; anyone who could scrape together (U.S.) \$16.00—the list price of BALLYHOO—or (U.S.) \$160.00 to be a 10-game tycoon. Indeed, the slot-machine boom of 1907 was a mild and minor economic event compared to the pinball boom of a quarter of a century later.

1. The name, BALLYHOO, was adopted because of the popularity of "Ballyhoo," an American satirical journal of the era. And, for the purpose of manufacturing and marketing BALLYHOO, Moloney and his partners incorporated Bally Manufacturing Company, predecessor of Bally Manufacturing Corporation, cited in note 1, page 6.

2. A tavern in the United States is a retail establishment licensed to serve alcoholic beverages. The Amendment to the Constitution of The United States which prohibited "intoxicating liquors"—in effect from January, 1920—was not repealed until December, 1933.

3. BALLYHOO was offered in two models, the sole differences being in the coin mechanisms and the number of balls available for play. One model provided 7 balls for (U.S.) 1 cent—commonly called a penny. The second model permitted a player to shoot 10 balls for (U.S.) 5 cents—commonly called a nickel.



BALLYHOO, pioneer pinball game of 1931, was only 18 in. wide, 24 in. long, 8 in. deep.

Evolution of Pinball

THREE ECONOMIC FACTORS largely account for the immediate and amazing success of BALLYHOO in 1932: (1) the presence in the United States¹ of thousands of men and women who, struck down by economic depression, were attracted to the novel amusement device as a means to earn a livelihood; (2) the extremely low price of BALLYHOO, which permitted the new influx of operators to engage in the business of Coin-Operated Amusement with a modest investment; (3) a populace which, unable to afford expensive entertainment, welcomed the incredible amusement bargain afforded by BALLYHOO.

Equally vital to the meteoric rise of BALLYHOO were three characteristics of the game: (1) the toy-like simplicity of BALLYHOO play appealed to a generation disenchanted with the gaudy sophistication of the preceding decade, which ended in economic disaster; (2) the elementary mechanics involved in the design and structure of BALLYHOO demanded no specialized skill on the part of operators, and in the expanded fraternity of Coin-Operated Amusement a kindergarten teacher, whose salary had been suspended by a school board in financial distress, was on equal terms with a watchmaker, who had lost his job; (3) the small size of BALLYHOO, not only opened innumerable doors of small but busy locations² to the game, but also dispensed with the necessity of transport equipment, for an operator could easily carry two BALLYHOO games—one under each arm.

As economic conditions improved throughout the world, some coin-machine operators of the class of 1932 returned to their former occupations. Most, however, remained in Coin-Operated Amusement, their newly established careers strengthened by the fact that pinball quickly attained the position of one of America's—later the world's—favorite and perennial modes of entertainment.

Manufacturers responded to the large immediate market—the operators—and the larger ultimate market—the players—by rapid and ingenious improvement of pinball—a development so vast and varied, through the years, that only the salient advances may be traced in a general survey of Coin-Operated Amusement.

1. The economic depression which commenced in 1929 affected, not only the United States, but the entire world—with a world wide influence on the popularization of pinball. Although BALLYHOO was sold only in the United States and Canada, by the end of 1932 pinball games were exported from Chicago—center of the industry—to Europe, Africa and near east areas of Asia.

2. The majority of BALLYHOO games were placed directly on tobacco counters, pharmacy counters, restaurant counters and similar crowded but convenient spaces in retail establishments. However, a metal stand was available for use with BALLYHOO at (U.S.) \$2.50 extra.

The evolution of pinball proceeded along two major lines: (1) technology of construction; (2) principles of play. The two forward trends in pinball design must, for convenience, be separately considered.



Although a typical single-player flipper-type pinball game, illustrated, is designed for play by one player, two or more players may play competitively, each player shooting a complete game before yielding to the next player.

Introduction of Electricity

The first notable progress in pinball was the graduation from the status of counter-top¹ accessory to the position of an independent item of furniture with legs integral to the machine, permitting the gradual enlargement in size to the present dimensions of 23 in. wide, 53 in. long.

Of greater importance than size was the adaptation of electricity to pinball purposes, which occurred in 1933². The first source of electrical energy for powered pinball was the dry cell voltaic battery, but within two years the games were connected to the electrical outlets of locations, a transformer being installed in each machine to reduce the high "house" voltage to the lower voltages used in the operation and illumination of pinball.

As in the case of slot-machines, since 1963, electrical circuitry in pinball, since 1933, encouraged a profusion of epochal improvements in pinball technology.

The simplest electrical device in pinball is the switch, which—in response to the pressure of the ball in play—closes or opens, thus closing or opening portions of the total electrical circuitry for various purpose related to play action and scoring. Although widely used in the typical pinball game, the ordinary switch is the least important circuit link employed in pinball. By 1936 three elaborations of the switch appeared in pinball games: (1) the relay³, (2) the stepping switch⁴, (3) the cam-controlled switch⁵.

Probably the most significant electrical apparatus in pinball is the solenoid⁶, first used on the playfield of FLEET—a popular game of 1934—and destined to be a major motive force in pinball.

1. Coin-operated counter-top amusement devices, not related to pinball, preceded pinball and continued in use after pinball moved from the counter-top. However, counter-top machines largely vanished from the amusement scene by the middle of the current century.

2. Electrical energy was first used in pinball to operate the payout mechanism of ROCKET, which delivered awards automatically in coins.

Automatic payout pinball games continued in limited use from 1933 to 1950.

3. A relay consists of 4 essential components: (1) a switch or a series of switches in a stack, all secured by a common fastener (or several such switch stacks); (2) a switch-actuator, fabricated of electrically non-conductive material with slots which engage the movable blade of each switch; (3) an electromagnet; (4) an armature, which is a hinged, spring-loaded, movable iron flap, attached to the electromagnet but normally not touching the central iron core of the electromagnet.

When an electrical current is caused to flow through the copper wire coil of the electromagnet, the core is magnetized, i.e., acquires the magnetic property of attracting iron. The iron armature is magnetically pulled to the magnetized core, the force of magnetism overcoming the restraining force of the spring attached to the armature. Being engaged with the switch-actuator, the magnetically moved armature moves the actuator; and the movement of the actuator causes the engaged movable switch blades to flex, thus closing or opening the switches in accordance with the predetermined function of the relay.

The displacement of the switch blades continues until the electrical current ceases to flow through the coil, demagnetizing the core, permitting the spring load to pull the armature up from the core, reversing the movement of the switch-actuator and, thus, returning the movable switch blades to normal position.

The purpose of a relay is twofold: (1) to maintain the relay switches in the desired closed or open position for a predetermined period of time; (2) to permit a single electrical impulse—through the coil of the electromagnet—to operate a multiplicity of switches. Thus, in a typical pinball game the out-hole relay—energized by a ball entering the out-hole and closing a single switch—includes 6 different relay switches, which close or open several sub-circuits, effecting the various phenomena desired by the entrance of a ball into the out-hole.

Several specialized types of relays are used in pinball, e.g., the interlocking relay and the trip relay. However, description of the basic relay should suffice to suggest the vital role of the relay, three dozen of which may be employed in a pinball game.

4. A stepping switch consists of two basic components, the first of which, the contact plate, is fabricated of electrically non-conductive material. The conductive element of the contact plate is either a series of brass rivets, affixed in the perimeter of the plate, or a "printed" circuit, which is a copper pattern adhering to the contact plate, after the undesired portions of an overall copper coat—applied to the plate by electrolysis—has been acid etched off of the plate.

Soldered to the rivets—or to the outer termini of the "printed" circuit—are electrically conductive wires, forming potential partial circuits to various apparatus of the game.

The second basic component of a stepping switch is the wiper assembly, comprised of several copper blades, affixed to a common rotatable axis, separated by discs of electrically non-conductive material, and extending outwardly from the axis in a "spider" pattern.

Soldered to the inner termini of the blades are wires which form the second section of the potential circuits described in respect to the contact plate.

When the wiper assembly rotates, the wiper blades glide across the rivets—or the surface of the "printed" circuit—causing the several potential circuits to be complete and effective circuits, momentarily and successively or in steps, as the term "stepping switch" implies.

The motive force which causes the wiper assembly to rotate is the solenoid, described in note 6, below.

5. A cam-controlled switch is a switch which closes briefly, then opens again—or opens briefly, then closes again—in response to the pressure of a generally circular but irregularly contoured cam, rotating tangentially to the lower blade of the switch.

Cam-controlled switches are mounted in a parallel bank of switches—or, usually, stacks of several switches—each switch or switch stack being controlled by a separate cam, all of which are affixed to a common motor-rotated axis. As many as a dozen differently contoured cams may be employed in a bank of cam-controlled switches.

6. The solenoid is based on the same fundamental principle of physics which is the basis of the electromagnet, described in note 3, at left, i.e., the establishment of a magnetic field of force within a coil of wire, when an electrical current is caused to flow through the coil.

The modern solenoid consists of two essential components: (1) a coil of wire wound to produce the hollow cylinder for which the solenoid is named, i.e., from the Greek word—"solen"—for pipe; (2) a plunger, a spring-loaded iron rod, which is inserted in the coil with only sufficient clearance to permit the plunger freely to move, as a piston, within the coil.

When an electrical current is caused to flow through the coil, a magnetic field is produced within the cylindrical cavity of the coil, i.e., the coil acts as a magnet. The iron plunger is magnetically—almost violently—pulled into the cavity. When the current ceases, demagnetizing the coil, the spring load on the plunger immediately returns the plunger to normal position.

Depending on the design of a particular solenoid, the magnetic movement of the plunger may pull any apparatus to which the outer end of the plunger is linked, push any object which the plunger contacts or merely strike a surface, as a bell or a chime.

The tremendous importance of the solenoid to pinball design is demonstrated in the chapter on Principles of Pinball Play.

Development of Coin Mechanism

The coin mechanism used in BALLYHOO and other early pinball games was an extremely primitive device—simply a narrow, horizontally disposed, sliding metal plate with which the player pushed a coin into the cabinet, the coin depressing a latch to release balls for play. Although frequently modified to reduce the muscular effort required to deposit a coin—and to minimize the hazard of “counterfeit” coins called slugs—the old coin-slide continued to protrude from the front of pinball games until production of pinball was suspended in 1942, as a wartime measure. When pinball manufacture was resumed in 1946, the first convenient drop-type coin chute appeared.

Continuously improved through the years, the present drop chute is a sophisticated and sensitive apparatus, quickly accepting the proper coin, while rejecting improper coins. Bally Manufacturing Corporation, cited in note 1, page 6, presently ships pinball game with coin chutes designed, respectively, to accept 50 different coins of 25 different nations, from the 5 and 10 cents coins of Australia to the 5, 10 and 20 ngwee coins of Zambia—and to reject slugs and coins foreign to each nation.

During the past decade, pinball games have usually been manufactured with 3 separate coin chutes, each accepting a different denomination of coin. The purpose of triple chutes is threefold: (1) to accommodate the various coins in a player's possession; (2) to permit operators to establish a play price for which no single coin exists; (3) to encourage repeated play by discounting the price per game, when a player engages to play several successive games.

For example, in Austria the basic play price of a single game is 2S (2 schillings). But no 2S coin is minted, the common denominations being 1S, 5S and 10S. The first coin chute on a pinball destined for delivery to Austria is, therefore, designed to accept the 1S coin and is captioned (in the German language) to direct the player to deposit two 1S coins for one play. The second chute accepts the 5S coin, which entitles the player to play 3 games. The third chute accepts the 10S coin, for which the player can play 6 games. The price per game is, thus, discounted, when either 5S or 10S is deposited.

Multiple-Player Pinball

An incidental purpose of a coin-chute capable of crediting several successive games is to permit two or more players, playing in competition, to share the expense of play. Indeed, since 1960, departing from the traditional single-player pinball game, manufacturers have produced games designed to encourage competitive play. While single-player games continue regularly to appear on the market, manufacturers also periodically produce 2-player¹ and 4-player¹ games.



A typical 2-player pinball game may be played by a single player or, competitively, by two players, shooting alternately until the allotted number of balls per player have been shot.

1. A 2-player game may be played by a single player or by 2 players. A 4-player game may be played by a single player or by 2, 3 or 4 players.

When two or more players competitively play a multiple-player game, each player shoots a ball in turn, until the allotted number of balls per player have been shot; and the score of each player is separately registered on a separate totalizer. During play, the score of each player may advance dramatically beyond the score or scores of the other player or players—or decline relatively to an opponent's score—thus intensifying the competitive spirit and the pleasure of play.

Duration of Play

Reference in the preceding paragraph to “the allotted number of balls” requires a brief historical survey of the quantity of balls at the disposal of a pinball player.

As pinball games, following BALLYHOO, increased in complexity and cost, the pricing of 7 balls for (U.S.) 1 cent was abandoned; and for several years the common pricing was 10 balls¹ for (U.S.) 5 cents. In 1933, when glass marbles were replaced by polished steel ball bearings, the number of balls per game was reduced to 5. Today, the standard pinball game is adjustable to either 5-ball or 3-ball play; and—in an era of monetary inflation—3-ball play is increasingly favored by operators to reduce the duration of play and, thus, increase hourly earnings.

Illumination and Scoring

Three familiar characteristics of modern pinball, being closely related, evolved in unison: (1) illumination, (2) automatic scoring, (3) the back cabinet, which in current pinball technology is the primary device to attract players to a game.

Illumination and automatic scoring appeared simultaneously in SKYSCRAPER, a 10-ball game of 1933. The facade of a “skyscraper” office building lay prone on the surface of the playfield. As balls were shot into numbered holes, corresponding numbers painted on the “windows” of the “skyscraper” were lighted to indicate the advancing score. The total sum was, as in earlier pinball, determined by addition in the player's head.

In 1935 a low back cabinet was added to pinball; and both illumination and scoring were concentrated in the back cabinet.

The first truly automatic score-indicator was a metal disc, located in the back cabinet and perforated with small holes grouped in the configuration of numerals. As the balls in play hit various scoring objectives, the disc rotated; and the light of a lamp behind the disc shone through the holes to project the advancing score on a white translucent area of the back cabinet frontal glass. Obviously, the device was limited by size to the projection of comparatively low totals.

As the desire for very high scores intensified in the ego of players—and the advertising value of the

frontal glass was increasingly recognized—the back cabinet was gradually enlarged; and the glass was chiefly ornamented with several series of illuminable numbered panels—1 through 9; 10 through 90; 100 through 900; 1000 through 9,000; 10,000 through 90,000. If, for example 80,000, 7,000, 600, 50 and 4 remained lit at the end of the game, the final score was 87,654. The player was obliged to revert to the early method of mentally summarizing the score; and the flashy but sprawly numeral panels foreclosed the possibility of the 2-player and 4-player games previously described—a development necessarily postponed until the invention in 1958 of the revolving drum counter currently used in pinball.

The Drum Score Counter

The drum score counter is similar in principle to the odometer which registers miles or kilometers in an automobile, consisting of 4 parallel, vertically disposed plastic wheels or drums on a common axis. The digits 1 through 9, plus a zero, are painted on the circumferential surface of each drum. Usually, a stationary “dummy” segment of a drum, marked only with a zero, is added. As the drums rotate successively, in response to the player's skill in shooting balls, any score—from 10 to 99,990—may be registered as rapidly as the ball action commands. When a coin is deposited to start a succeeding game, the drums automatically reset to 00,000. The motive force which advances the visible score by revolving the drums is the solenoid described in note 6, page 23. Reset to zero position is by simple spring action.

The Replay Mechanism

Although the drum score counter is in a high category of pinball progress, probably the top rank in pinball technology must be accorded to the Replay Mechanism.

From the earliest era of pinball, manufacturers and operators sought a means to recognize extraordinary skill with modest awards. No satisfactory solution² to the problem of “patting the player on the back” was found until the invention in 1941 of the Replay Mechanism, which permits a player who attains a specified score³ to continue to play without deposit of coins.

Each Replay is a right to play, free of charge, a complete game of 3 or 5 balls, depending on the price.

1. A specialized type of pinball—the one-ball game—was popular from 1935 to 1950, but, being obsolete today, is not considered in a general survey of Coin-Operated Amusement.

2. Early efforts to reward skilled players involved merchandise prizes or actual coins, as described in note 2, page 23.

3. A player may also be entitled to one replay if the last 2 digits of his final score match the 2 digits which light on the backglass at the end of the game.

ing of a particular machine, as previously described. The number of Replays to which a player may become entitled, while playing pinball, is displayed through the glass of the back cabinet by means of a Replay Counter, similar in operation to a single drum of the score counter. Replays credited on the Counter are obtained by the player simply by pressing a Replay Button, the Counter resetting to zero, credit by credit, as the Replays are played.

Although the standard Replay Counter is capable of crediting up to 25 Replays, a player is seldom sufficiently skilled to "win" in excess of 3 or 4 Replays in a single game. Indeed, score cards posted on pin-

ball games usually provide for only a maximum of 4 Replays per game.

Although not permitted in some jurisdictions of the United States¹, the Replay Mechanism is in general use throughout the world and is, undoubtedly, a major factor in the continued popularity of pinball—second only to the innovative principles of play, which remain to be discussed.

1. Some jurisdictions permit only Add-A-Ball play in which, during the course of a game, a player receives additional balls in reward for attaining specified scores. Most pinball games are convertible to either Replay or Add-A-Ball play.

A typical 4-player flipper-type pinball game, illustrated on the opposite page, may be played by one player or by two, three or four players in competition, each paying the price of a complete game and each shooting a ball in turn until the allotted number of balls per player are shot. A detailed view of the playfield appears on page 32.



Principles of Pinball Play

A MASSIVE BOOK would be required to describe the innumeral scoring objectives which, through the years, have been incorporated into pinball, ranging from the pin-guarded hole to a ray of light which, when momentarily blocked by the passage of a ball, influenced a photoelectric cell¹ to add to the player's score²; and details of obsoleted pinball targets could interest only an antiquarian. However, a review of present-day scoring apparatus—with occasional reference to antecedent devices—is useful to an understanding of the continued popularity of pinball.

Rollovers and Buttons

The simplest pinball scoring device is a switch-actuator, which protrudes slightly above the surface of the playfield and, when depressed by the passage of a ball, closes or opens a switch beneath the playfield. One type of surface switch-actuator, the Rollover, is formed of wire; a second type, the Button, is cast of plastic. Both styles must be carefully designed to respond to the pressure of a rapidly moving ball, without obstructing the free movement of the ball.

Buttons and Rollovers are widely used in pinball technique; and, although simple in operation, are usually extremely important to the play of a particular game. Often, in addition to adding to his score by hitting a Button or Rollover, a player may qualify other targets as scoring objectives, increase the score-value of designated targets, or activate apparatus such as the Kickback Kicker, described on page 30, or the Free Ball Gate, described on page 31.

Bumpers and Targets

As related on page 23, the solenoid, described in note 6, page 23, was first used in FLEET, manufactured in 1934. Balls were prevented by metal rails from direct entrance into several high-scoring holes on the FLEET playfield; and, in order to place a ball in a guarded hole, the player first shot the ball into the mouth of a miniature cannon aimed at a guarded hole. Entering the cannon, the ball closed a switch, energizing a solenoid, the plunger of which forcibly propelled the ball into the desired high-scoring hole.

Two years after the appearance of FLEET, Bally Manufacturing Corporation introduced a game appropriately named BUMPER, the playfield being studded with a dozen coiled wire springs called bumpers. Each bumper was suspended from an upright post centered within the coil of the bumper. When a ball struck any point in the perimeter of a bumper, the spring structure swerved inwardly toward the post, closing an electrical switch to advance the player's score by the indicated value of the hit bumper.

The spring bumper continued as a favored scoring objective, until production of pinball was suspended in 1942. When manufacture was resumed in 1946, the bumper principle was wedded to the solenoid to produce a scoring apparatus which is never absent from the playfield of modern pinball—the Thumper Bumper.

The design of the Thumper Bumper may be conveniently described by enumeration of essential components, which, incidentally, reflects the general principles of other solenoid-operated devices:

- (1) Stationary components, i.e.,
 - (A) The Body, a hollow plastic cup which serves
 - (a) To attach the Thumper Bumper assembly to the playfield,
 - (b) To position the Skirt relatively to the entire Thumper Bumper assembly,
 - (c) To position the Flange & Stud assembly relatively to the entire Thumper Bumper assembly,
 - (d) To provide a base for a detachable Cap and a housing for a lamp by which the Cap may be illuminated;
 - (B) The Cap, a decorative inverted "saucer" fabricated of translucent plastic, attached to the Body by means of screws, and usually marked with the score-value of the Thumper Bumper;
 - (C) The Case, a plastic member directly below and mating with the Body by means of press-fit studs, serving
 - (a) To position the entire Thumper Bumper relatively to the playfield,
 - (b) To provide a retainer for a spring, which returns the Skirt to normal position, after being depressed by the impact of a ball;
- (2) Movable components, i.e.,
 - (A) The Skirt, a thin plastic ring positioned concentrically with the entire Thumper Bumper assembly, the upper surface being tapered, upwardly and inwardly from the outer circumference, while the lower surface is flat and normally parallel with and slightly elevated above the playfield, a slender plastic "tail" extending from the center of the flat surface downwardly through the Case and the hole in the playfield in which the Case is seated;

1. The electrical characteristics of a photoelectric cell are modified by the action of light.

2. The only photoelectric pinball game manufactured, lacking the kinetic impact of a ball against a tangible target, was a notable failure.

(B) The Flange & Stud assembly, consisting of,

(a) The Flange, a cupped metal ring, positioned concentrically with the entire Thumper Bumper, flared upwardly and outwardly from the inner to the outer circumference, with the upper edge being normally parallel with and slightly below the lower surface of the Cap,

(b) Two elongated metal studs or rods, attached to the Flange and extending downwardly through holes in the Skirt and holes in the playfield to link with the motive component;

(3) The motive component, i.e., a solenoid, generally as described in note 6, page 23.

A ball shot against any point on the perimeter of a Thumper Bumper rolls up the tapered surface of the Skirt, depressing the Skirt sufficiently to cause the "tail" of the Skirt to close a switch directly below the Thumper Bumper. The closed switch completes a sub-circuit which (a) registers points gained by hitting the Thumper Bumper, (b) energizes the solenoid coil. The solenoid plunger is drawn forcibly downward by the magnetic pull of the energized coil. The plunger being attached by means of Studs to the Flange of the Flange & Stud Assembly, the Flange is pulled violently downward, the flared rim of the Flange striking the ball and forcibly propelling the ball outward from the Thumper Bumper. A hit against a Thumper Bumper, therefore, not only adds to the score, but also intensifies ball action—the "thumper-bumped" ball usually slamming against other scoring objectives.

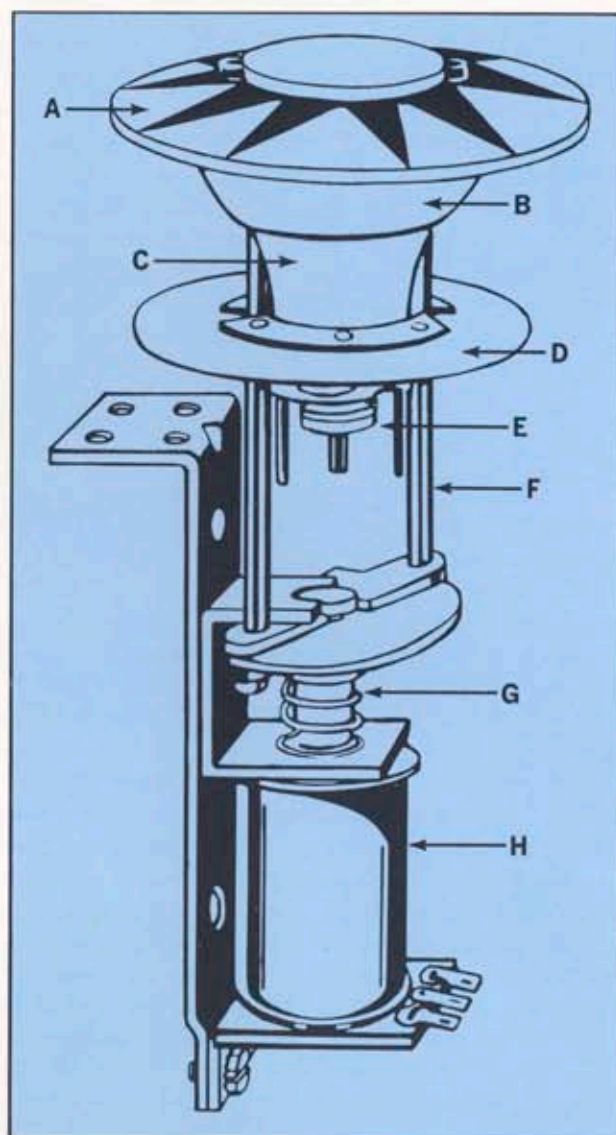
When the ball is propelled away from the Thumper Bumper, the Skirt is returned to normal position by the spring housed in the Case. As the solenoid plunger nears the end of the downward stroke, a projection attached to the plunger opens a second switch, demagnetizing the coil. A spring load on the plunger returns the plunger—and, thus, the Flange & Coil Assembly—to normal position.

Another type of bumper is the Mushroom Bumper, so called because of resemblance to a mushroom or toadstool. The Mushroom Bumper consists essentially of (a) the Post, attached to the playfield, and (b) a spring-loaded Cap & Plunger, the Plunger section being loosely inserted in the hollow cavity of the Post and pressing against the movable blade of a switch, normally maintaining the switch in the open position. When a ball contacts a Mushroom Bumper, pressure of the ball against the lower surface of the Cap elevates the Cap & Plunger, releasing the restraint on the movable switch blade. The switch is momentarily closed effecting the predetermined result of a hit against the Bumper. As the ball rebounds from the Bumper—with the assist of an elastic rubber ring stretched around the Post—the

spring load returns the Cap & Plunger to normal position, causing the switch to return to the normal open position.

Related to bumpers in function is the Target, which is essentially a vertically disposed switch, projecting above the surface of the playfield, with a colored disc attached to the movable blade. When a ball strikes a Target, the movable blade is flexed, momentarily closing the switch to effect the scoring or other purpose of the Target.

Although neither the Target nor the Mushroom Bumper induce the dramatic action which a Thumper Bumper imparts to a ball, both possess the merit of providing important skill objectives in considerably less space than required by a Thumper Bumper. The number of Targets and Mushroom Bumpers on a playfield, therefore, usually exceeds the number of Thumper Bumpers.



Generalized view of Thumper Bumper, showing components: A, Cap; B, Flange of Flange & Stud Assembly; C, Body; D, Skirt; E, Case; F, Stud of Flange & Stud Assembly; G, spring-loaded Plunger of the Solenoid; H, Coil of Solenoid.

As in the case of Rollovers and Buttons, Thumper Bumpers, Mushroom Bumpers and Targets may perform functions other than addition to the total score, often acting, when hit, as "keys" which open previously closed avenues to advantageous skill objectives.

The score value of the Thumper Bumper, Mushroom Bumper or Target may increase—or the auxiliary function may become effective—during play either on a random "mystery" basis, effected by the internal mechanism, or as a result of the player's skill in hitting designated "key" objectives. The alteration in potency is signalled by illumination of the translucent Thumper Bumper Cap or of a translucent plastic disc set flush with the surface of the playfield and adjacent to the related Target or Mushroom Bumper.

Kickers

The pinball apparatus which excels all other scoring objectives in imparting energetic action to the ball is the Kicker, 3 principal styles of which are common on pinball playfields. All are activated by the solenoid, described in note 6, page 23.

(A) The Slingshot Kicker¹ is never absent from a pinball playfield. Usually located at the lower end of the field, the purpose of a Slingshot Kicker—in addition to scoring points—is to propel the ball back up toward the upper end of the playfield, prolonging play, as the violently kicked ball strikes scoring objectives which may have been missed during the original zig-zag course of the ball, from top to bottom of the playfield.

(B) Another type of Kicker designed to volley the ball back toward the top of the playfield for a "repeat performance" is the Kickback Kicker, which is frequently but not invariably used in pinball. Located in the left out-alley, the Kickback Kicker serves a double purpose: (1) to rescue the ball from sinking in the out-hole, (2) to return the ball to continued scoring action. However, the Kickback Kicker is active only when a playfield disc, adjacent to the Kicker, is illuminated, either on a "mystery" random basis or when the prescribed "key" target is hit, depending on the design of a particular game.

(C) An important Kicker included in all² pinball games is the Ball Ejector, a solenoid-activated kicking device located at the bottom of a shallow hole in the playfield, commonly called a kickout hole, although a fanciful title, related to the theme of a particular game, is often applied to the hole.

A ball shot into a kickout hole closes a switch, registering the score value of the hole—or effecting auxiliary functions assigned to the hole—and energizing the solenoid to kick the ball out of the hole. Ejection of a ball from a kickout hole may occur immediately or may be delayed³ until a later ball hits a designated kickout trigger hole. In either case

the ball is shot from the hole with considerable force, usually resulting in extraordinary scoring action.

Bonus Scores

When pinball manufacture was resumed in 1946, after wartime suspension, a new style of scoring technique—the Bonus—was introduced. The Bonus is a tentative score, which increasingly accumulates in the course of play but is not added to the player's final score until he succeeds in hitting a "Collect Bonus" scoring objective⁴.

The original Bonus arrangement, which continues in use today, is known as the Advancing Bonus—usually with a thematic title. The advance of the Bonus is usually in increments of 1,000—from, for example, 1,000 to 10,000—indicated by successive illumination of numbered plastic discs in the surface of the playfield and is in response to the player's success in hitting an "Advance Bonus" target.

The highest lit Bonus score remains lit until a "Collect Bonus" target is hit, when the Bonus value is transferred to the score counter described on page 25, while the Bonus indicator resets to the lowest Bonus value. If a player fails to "collect" the Bonus, the indicator may reset to 1,000 as each ball enters the out-hole. Usually, however, the highest lit Bonus remains lit—or increases to a higher value—until

1. Contact of a ball with a Slingshot Kicker is against the outer radial surface of an elastic rubber ring, which is stretched tautly between two posts, providing a "target" 5 in. long. Centrally located between the posts and within the encircling rubber ring is a solenoid-operated kicker arm, which projects above the surface of the playfield between two vertically disposed switches, the movable blade of each switch touching the inner radial surface of the rubber ring.

When a ball strikes any point along the expanse of the rubber ring, the pressure of the ring against the movable switch blades momentarily closes electrical circuits which (a) register the score-value of the Slingshot Kicker, (b) energizes the ball-kicking solenoid.

Similar to the Slingshot Kicker in design and scoring function is the Rebound, the rubber ring "target" area of which may vary from 2 in. to 5 in. in length, depending on the position of a particular Rebound. The Rebound utilizes only one switch, centrally located between the posts; and the solenoid kicker is not used, the ball merely bouncing off the elastic rubber ring. Rebounds are chiefly stationed along the sides of the playfield to provide scoring capability to otherwise "dead" surfaces.

2. When kickout holes are not included in the play scheme of a game, the Ball Ejector is, nevertheless, the apparatus which delivers balls from the internal mechanisms to the ball-shooter.

3. In some games 2 balls may be captive in 2 separate kickout holes. When a third ball is shot to hit targets which eject balls from both kickout holes, 3 balls may be simultaneously on the playfield, resulting in a frenzy of scoring action, as the balls collide and carom to hit scoring objectives.

4. Some games incorporate a specialized style of Bonus known as the Spell-Name Bonus in which the highest lit tentative Bonus score is "collected" when the player succeeds—by hitting scoring objectives identified by letters of the alphabet—in lighting all the letters which compose the name of the game, the completely illuminated name appearing either on the backglass or on translucent plastic discs set in the surface of the playfield.

"collected" or until the end of the game, offering the player—or his opponent in a multiple player game—an opportunity to "collect" the Bonus with any ball shot. Some pinball games are so designed that the top accrued but tentative Bonus remains effective, from game to game, providing an inducement to continued play.

Early in 1971 Bally Manufacturing Corporation introduced a new type of Bonus, conveniently described as the Catch-a-Flash Bonus but usually identified by a name related to the decor of a particular game. When a "Start Bonus" target is hit, numbered illuminable plastic discs in the playfield light in rapid succession—1000, 2000, 3000, 4000, 5000—repeating the cycle from 1000 to 5000 until a "Collect Bonus" target is hit, when the player scores the Bonus value which is lit at the moment the "Collect" target is hit.

Free Balls, Extra Balls

An extremely popular pinball attraction, the Free Ball Gate, was introduced in 1963. Although varying in construction, all Free Ball Gates are designed to open a passage to the ball-shooter, when an "Open Gate" target is hit. A ball shot through an open Gate is, thus, returned to the player as a Free Ball. Usually, the Gate, not only opens an avenue to the ball-shooter but also closes an adjacent entry to the out-hole, channeling the ball from oblivion to further scoring action on the playfield.

Related to the Free Ball is the Extra Ball¹, which is not recovered from the playfield but is delivered directly from the internal mechanism to the ball shooter, when a ball in play hits the appropriate "Extra Ball" target.

The Flipper

From the earliest days of pinball, players habitually and with considerable gusto practiced the art of nudging—popularly described in a word of unknown etymology as "gunching"—an effort to manipulate ball action by pushing, wobbling, bumping or shaking the entire cabinet sufficiently to deflect the course of the ball without activating the "tilt" signal, which promptly penalizes² the player. Each "gunch" is usually accompanied by gyrations of the player's body and a psychokinetic grunt of command. The true pinball aficionado is remarkably adept at nudging and considers "brinkmanship"—with the "tilt" as adversary—as a skill factor equal in importance to the nicety with which he handles the ball shooter.

Because the nudge is a universal ritual of pinball play, Bally Manufacturing Corporation in 1947 introduced NUDGY, a pinball game with a built-in automated nudger. Merely by pressing a button on the side of the cabinet, a player could cause the entire playfield to jerk toward the rear of the cabinet, affecting the ball in play similarly to the action of a

manually "gunched" game. The experiment was not a success, players being convinced that their finesse in old-fashioned nudging excels the insensitive force of a solenoid.

However, two years after the fiasco of NUDGY, games appeared with a powerful automatic but localized "nudging" device. The new invention, called the Flipper, was an immediate and tremendous success and is used in all popular pinball games today. Indeed, the Flipper is such a mandatory characteristic of pinball that in France pinball games are commonly called *Les Flippers*.

The Flipper is a slightly tapered, rubber-clad plastic arm 3 in. long, disposed parallel to and slightly above the surface of the playfield. The wider extremity of the Flipper is secured to the upper end of a rotatable vertical post, the lower end of which is linked to a solenoid-operated lever apparatus. When the solenoid is energized, the abrupt rotation of the post causes the Flipper to swing in the manner of a bat with sufficient force to propel a Flipper-flipped ball the entire length of the playfield.

Invariably, in modern pinball design, a pair of Flippers guard the central exit to the out-hole³, with a 2 in. gap between the Flippers. Each Flipper is activated by the pressure of the player's finger on a Flipper button. The right Flipper button is visible on the right side of the cabinet of the game illustrated on page 27, the left button is positioned in a corresponding location on the left side of the cabinet.

As a ball nears the central out-hole exit, a player may, by pressing a Flipper button—or both buttons—flip or bat the ball back up the playfield, for two purposes: (1) rescue of the ball from the out-hole; (2) accumulation of additional score-points, as the reprieved ball busily hits scoring objectives.

Random propulsion of the ball, however, is not necessarily the most productive Flipper strategy. Although the casual player may merely jab the buttons impulsively, the practiced pinball scholar manipulates Flippers with deft delicacy. A typical display of Flipper finagling is described by Tom Buckley in his wise and witty essay, *Mother Is A Pinball Machine*⁴:

1. The Extra Ball feature is important in pinball design, not only as an attraction to players, but also because the Extra Ball circuitry facilitates conversion of a game from Replay scoring to Add-A-Ball scoring, described in note 1, page 26.

2. Formerly a "tilt" invalidated a player's total score. Now, however, when a game is nudged with sufficient violence to light the "tilt" signal, all scoring objectives are deactivated, and the "guilty" ball, i.e., the ball in play at the moment the "tilt" occurs, is prevented from further scoring. As the next ball is shot, the "tilt" signal disappears and scoring objectives are reactivated.

3. Occasionally, a game is designed with a third Flipper in the upper area of the playfield, activated by one of the standard Flipper buttons and flipping the ball toward a specially desirable scoring objective.

4. Published in the August, 1966 edition of *ESQUIRE*.

"He could press the button now, sending the ball back up the board, but without direction. Instead he waits for a fraction of a moment. Then he pivots the flipper slowly¹, trapping the ball in the acute angle that the ball makes with the rail alongside it. All concentration, he eases his fingers off the button. The ball rolls downward a half inch along the flipper. Now! Dead on the mark, the [flipped] ball hits the ultimate target . . ."

Mother Is A Pinball Machine prophesied that in the near future "... the technique of flipper play will be radically altered." The reference is to the Movable Flipper, the prototype of which Buckley examined, while visiting the Bally Manufacturing Corporation factory, and which, indeed, was introduced to the pinball public in October 1966. The technical term, Movable Flipper, is not precisely descriptive, for all Flippers are, as previously described, movable. The added significance of the word "movable" in Movable Flipper² is that, when a "Close Flippers" target is hit, both Flippers—and all attached operative paraphernalia—move inwardly, completely closing the gap between the Flippers, as shown at the bottom of the playfield illustrated at right³.

Although the Flippers may be activated, as usual, to bat balls back up the playfield, while the "Flipper gap" is closed⁴, a ball cannot possibly escape through the central out-hole exit and remains a busy captive on the playfield—until accidentally hitting an "Open Flippers" target, restoring the Flippers to normal positions with a 2 in. aperture between the two opposed ends of the Flipper arms.

As the present survey is on press, pinball designers and engineers in secluded research departments are developing new playfield actions and new scoring objectives, which will be the "sensations" of tomorrow. One may safely assume, however, that the basic devices reviewed will continue in use as familiar and favored characteristics of modern pinball.



1. Excepting the word "slowly," Buckley's description is accurate. The speed of Flipper movement is not variable. But a Flipper arm can be held in the position of extreme forward swing, forming the "acute angle" mentioned; and an adroit player can perform the maneuver which Buckley describes.

2. Advertising copywriters avoid the semantic difficulty by referring to a pair of Movable Flippers as the Flipper-Zipper, the allusion being, of course, to the zipper used to close gaps in garments.

3. Although Flippers are used in all modern pinball games, Movable Flippers are used only periodically to add a "deluxe" aspect.

4. In some games the "Flipper gap" is closed by a solenoid-operated device called a Playmore Post, the top of which is normally flush with the surface of the playfield in the open area between the Flippers. When an "Up Post" target is hit, the Post rises and blocks the "Flipper gap" as effectively as closed Movable Flippers.

Bird's-eye view of playfield of **FIREBALL**, which is completely illustrated on page 27, shows several old and new play principles. At the bottom of the panel, Moveable Flippers, described at left, appear in closed position, preventing ball from exiting through central out-hole. Toward the top of the playfield, at extreme left and right, a ball is visible in each of two kickout holes—temporarily held captive as, described on page 30. Directly to right of the left captive ball, is another ball, which demonstrates a very new technique. The ball—called a Messenger Ball—is permanently captive in a closed channel and moves only when hit by a ball in play, score-power of the Messenger Ball depending on distance the ball travels up the channel. If Messenger Ball travels to top of the channel, the Free Ball Gate, described on page 31, opens. Black circle illustrates another new technique. Flush with the surface of the playfield, the disc continuously spins, twirling balls into a frenzy of scoring action.

Psychology of Pinball

FRENZIED BALL ACTION appears at first glance to be the basic ingredient, the *sine qua non*, of pinball. However, the pinball designer, while striving to animate his innovations with exciting and surprising action, is primarily guided by three psychological principles not related to the mere hustle and bustle of the ball.

Balance

If triumph in pinball, i.e., achievement of high scores and, perhaps, Replays, is extremely difficult to attain, a player who is aware of his usual competence may be discouraged by his inability to cope with a particular game and forego the game after repeated defeats. The casual, careless player will promptly abandon a "tough" game. Conversely, if success is a routine event for players of a game, all players will quickly be bored by the flaccid opposition. The pinball designer must, therefore, strike a balance between "too easy" and "too hard," between the challenge demanded by the dexterous, alert player and the less talented player's biological need to "make a winning sometime"—in the words of the sentimental song, *I'm Always Chasing Rainbows*.

The ways in which balance may be built into pinball are innumerable, usually involving "tricky" shots which are accomplished, not by skill alone, but by skill and "the breaks"—the gentle, mysterious assistance of Fortuna, who impartially smiles—or frowns—in turn on the champion and the duffer.

Verge of Success

Balance between success and failure in pinball play is not necessarily related to a player's final score. Equally important is the player's performance during play. The total score may not register Replays, but, if a player ends a game on the verge of success, his relative satisfaction usually prompts him to further play. Indeed, the slender margin of his defeat convinces him that the next game played will crown him with laurel. The phenomenon of confidence induced by slight failure is known in the pinball industry as "came-close-try-again" appeal—a quality which the

economic laws of pinball earning power compel all designers to incorporate in every game.

Terminal Suspense

Related to the "verge of success" principle are two types of pinball suspense, colloquially called "last inch suspense" and "last ball suspense." Both terms refer to the pleasurable anxiety experienced by a player who knows that his mediocre score may suddenly be elevated to a high or, at least, acceptable score—either by the scoring action of a ball within the "last inch" or two of the out-hole or by the activity of the "last ball" available for play.

Both modes of suspense must be present in an effectively designed pinball game; both may be generated in a variety of ways. A typical manner in which "last inch" suspense may be enjoyably relieved is assignment of a score-value of 1,000 to the left and right out-alleys, the 1,000 points gained, as a ball retires from play, often boosting a player's score from hopeless to encouraging status. An example of "last ball" suspense is a player's hope that the final ball of a game may hit a "Collect Bonus" target, as described on page 30, adding the tentative Bonus—which might be as high as 10,000—to the total score.

Progressing to the general psychology—one is tempted to use the word "philosophy"—of pinball, several propositions have been advanced. George W. Jenkins, retired sales manager of Bally Manufacturing Corporation, insisted that pinball offers vicarious adventure in a world in which the perils of the frontier are largely tamed. Another theory is that pinball offers a harmless method to discharge aggressive psychic hostility—a battle with a foe which "fights back" fiercely but without personal animosity. Mastery of pinball may, indeed, serve as an antidote for the vexations and frustrations which assail men and women.

McLuhan's dictum on games in general, is, of course, particularly applicable to pinball. However, the common sense explanation of the continued world wide popularity of pinball, through nearly half a century, may be that pinball is a simple, low-priced, easily comprehended and readily available form of Coin-Operated Amusement.

