United States Patent [19]

McCulloch et al.

[11] **3,874,665**

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[54] **BALL PUTTING CUP AND METHOD OF EJECTING BALL FROM SAME**

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[73] Assignee: **McCulloch Corporation,** Los Angeles, Calif.

[22] Filed: **Sept. 8, 1972**

[21] Appl. No.: **287,433**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 186,289, Oct. 5, 1971, abandoned.

[52] **U.S. Cl.** ..... **273/34 A,** 273/179 A

[51] **Int. Cl.** **A63b 57/00**

[58] **Field of Search** ..... 273/179, 34, 127 A, 46; 335/231

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Primary Examiner—George J. Marlo
Attorney, Agent, or Firm—Burns, Doane, Swecker & Mathis

[57] **ABSTRACT**

Method and apparatus for automating the ejector operation of a golf cup and featuring the use of flexing diaphragm and/or impacting cup to impart ball impacting force to a gold ball.

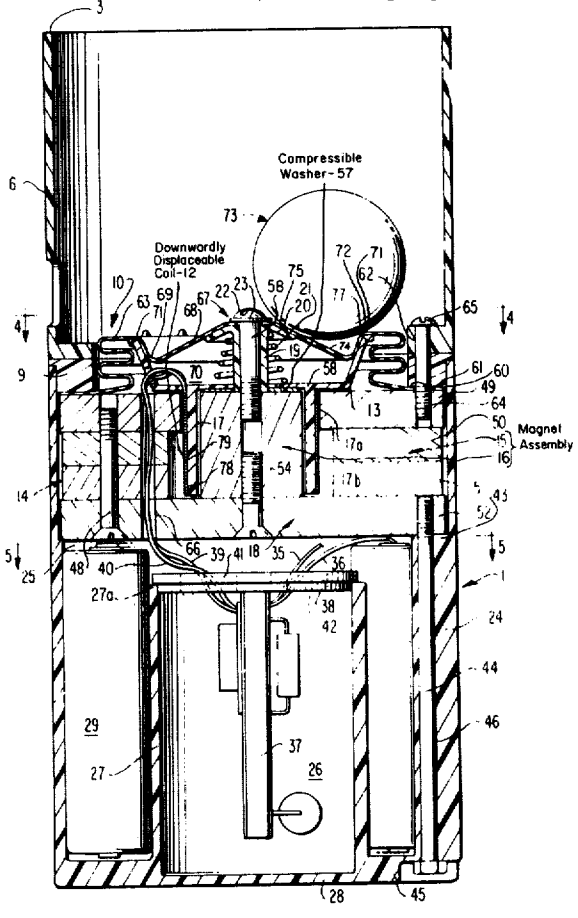
A telescoping coil and magnet system operate to trigger a control circuit, in response to the presence of a golf ball, and this control circuit in turn causes the coil and magnet means to interact and impart ball impacting force to the ball.

A pivoting impacting cup provides a multidirectional, pivotal movement, operable to permit impacting energy to be effectively developed and applied on impacting means.

Non-radial ball ejection is effected such that a random ejection pattern results.

The control circuit includes means to amplify a signal generated by relative movement between the coil and magnet means. This relative movement is induced by the golf ball engaging the diaphragm and moving the diaphragm and coil downwardly. The amplified signal serves to energize the coil by including the transmission of electrical energy back to the coil. The thus energized coil interacts with the magnet means, elevates, and this elevation causes abrupt elevation in turn of the diaphragm. This diaphragm movement imparts ball impacting force to the golf cup, effecting its randomly directed removal from the cup.

7 Claims, 11 Drawing Figures



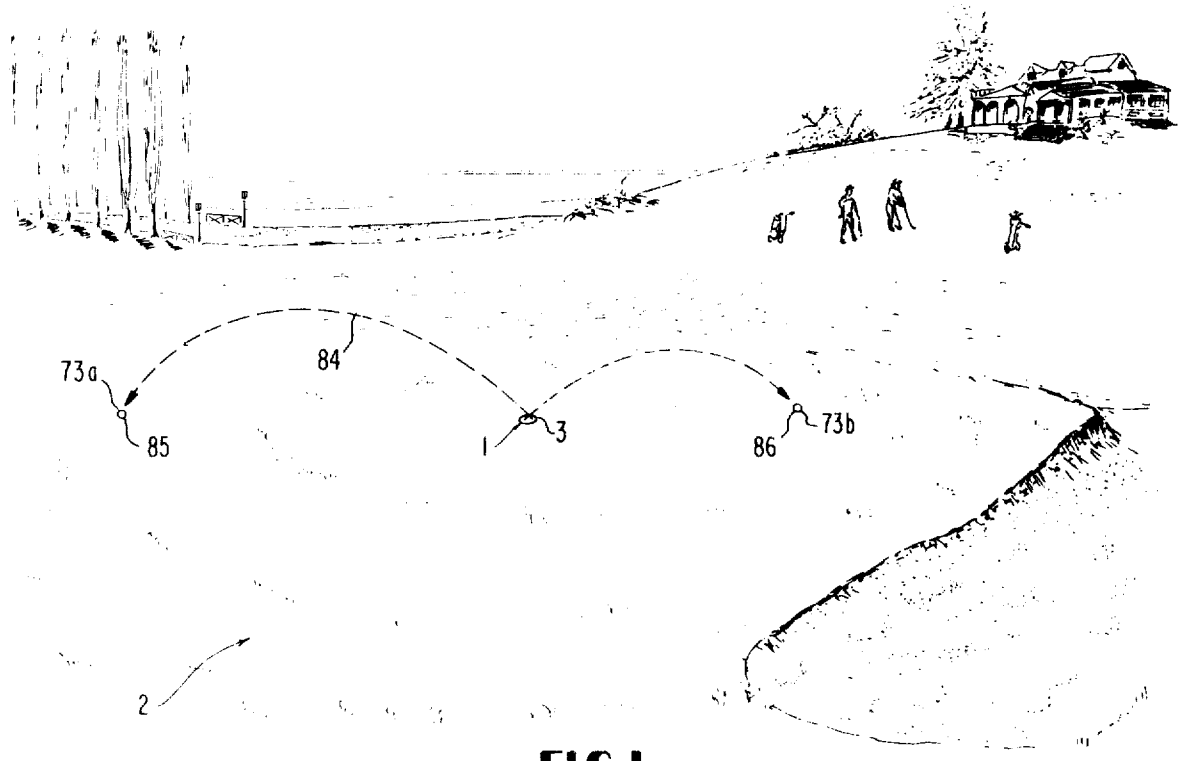


FIG 1

FIG 9a

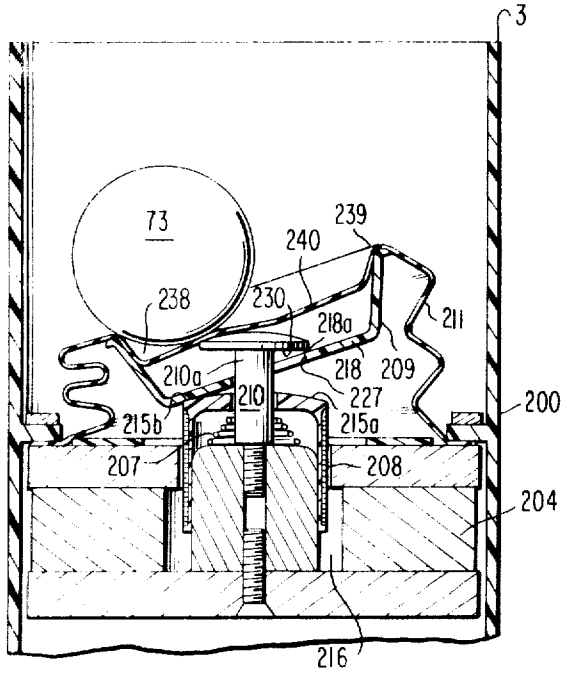
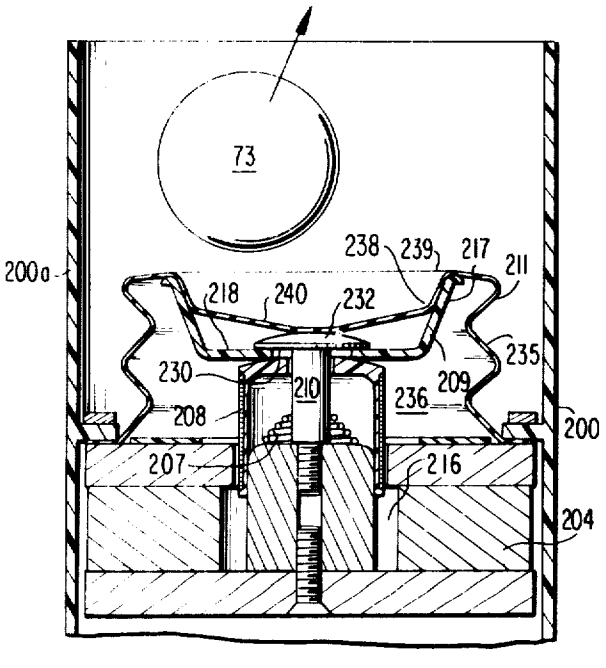
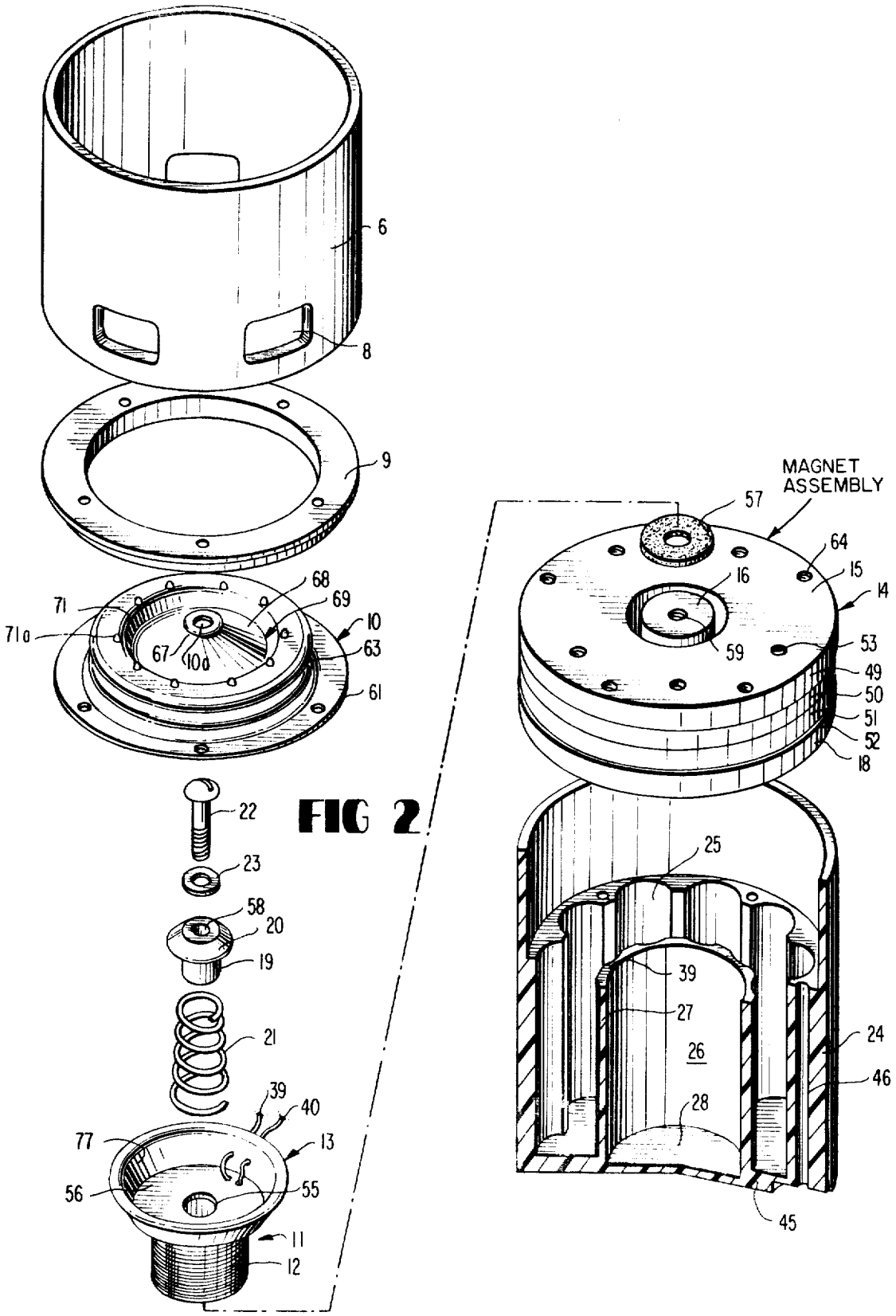


FIG 9b

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71a
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11
12
MAGNET ASSEMBLY
57
64
15
16
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18
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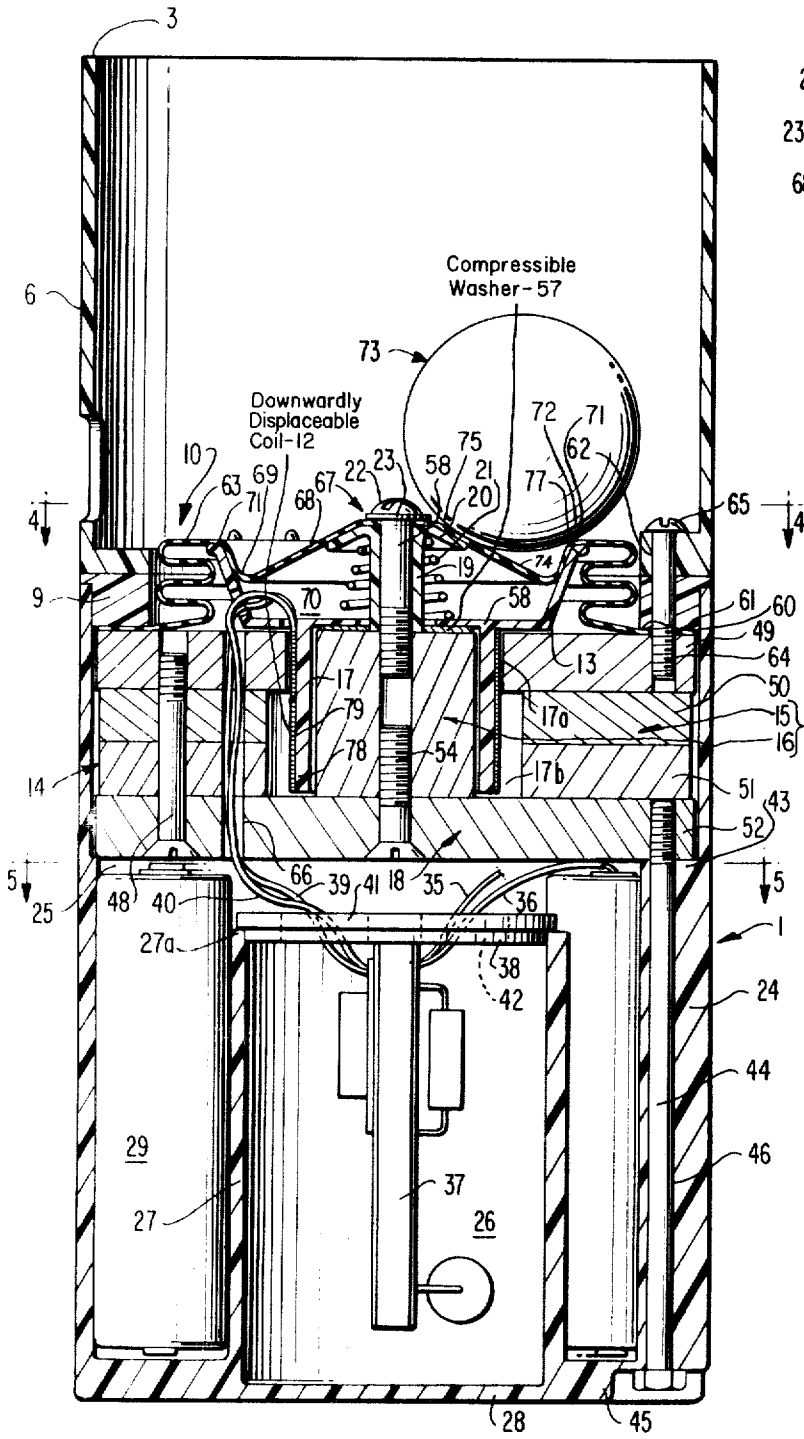
FIG 2

FIG. 3



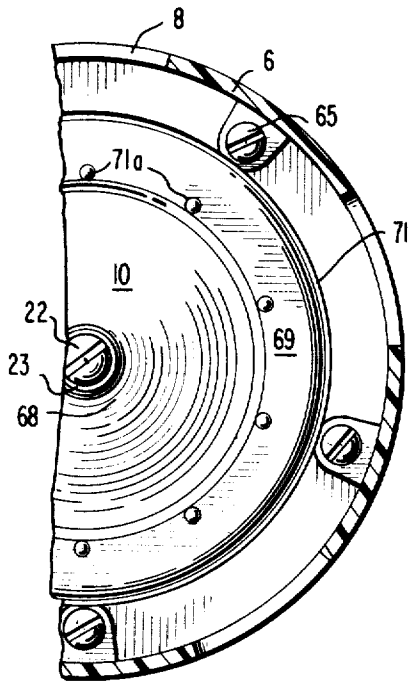


FIG. 4

FIG. 5

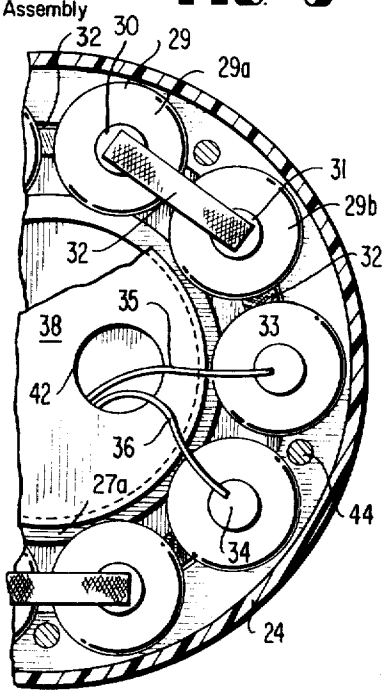
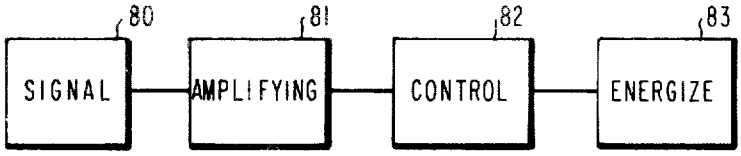


FIG. 6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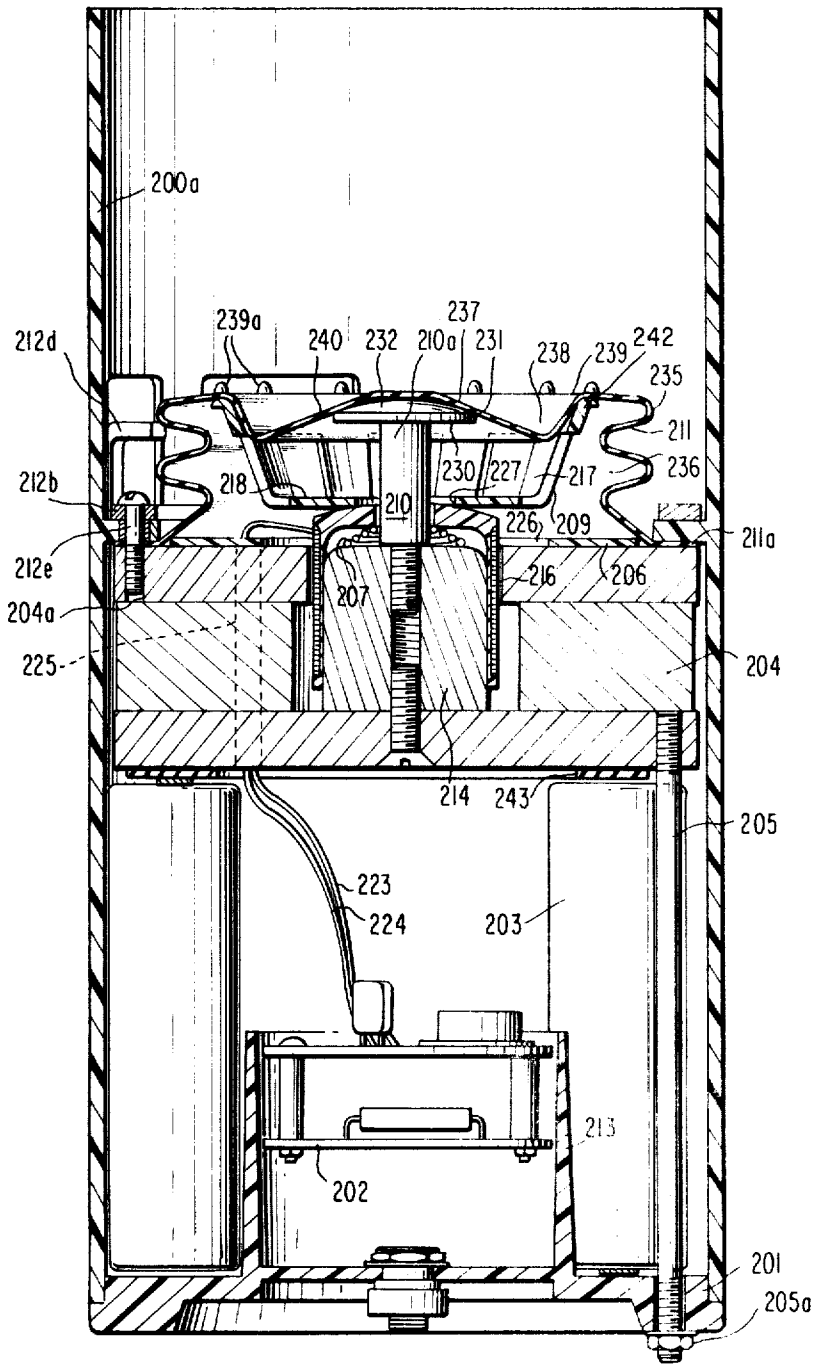
SIGNAL
AMPLIFYING
CONTROL
ENERGIZE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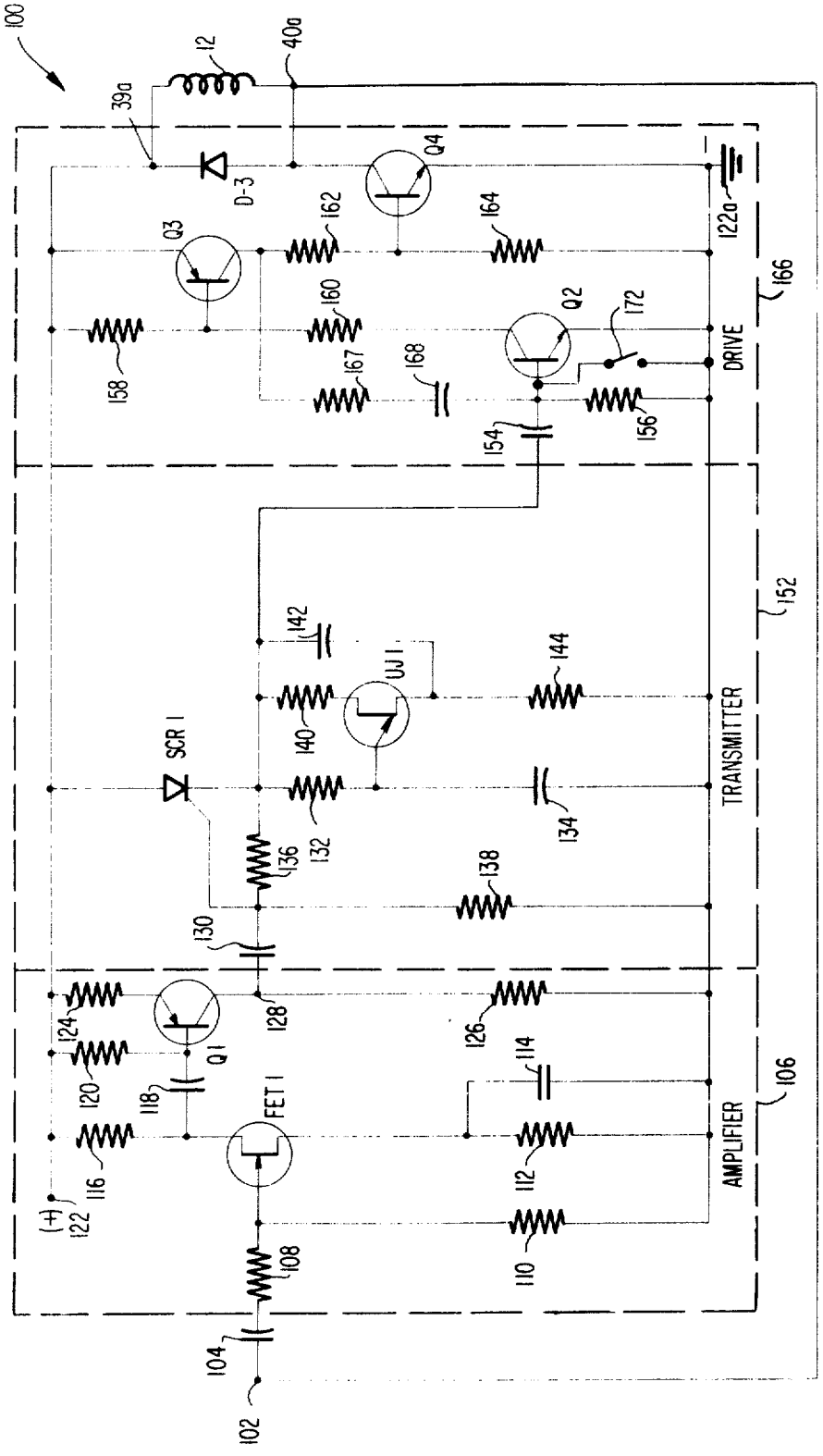
205a

FIG. 7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156
152
142
UJ1
144
SCR 1
140
TRANSMITTER
134
132
136
138
130
124
Q1
128
126
114
120
118
FET 1
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AMPLIFIER
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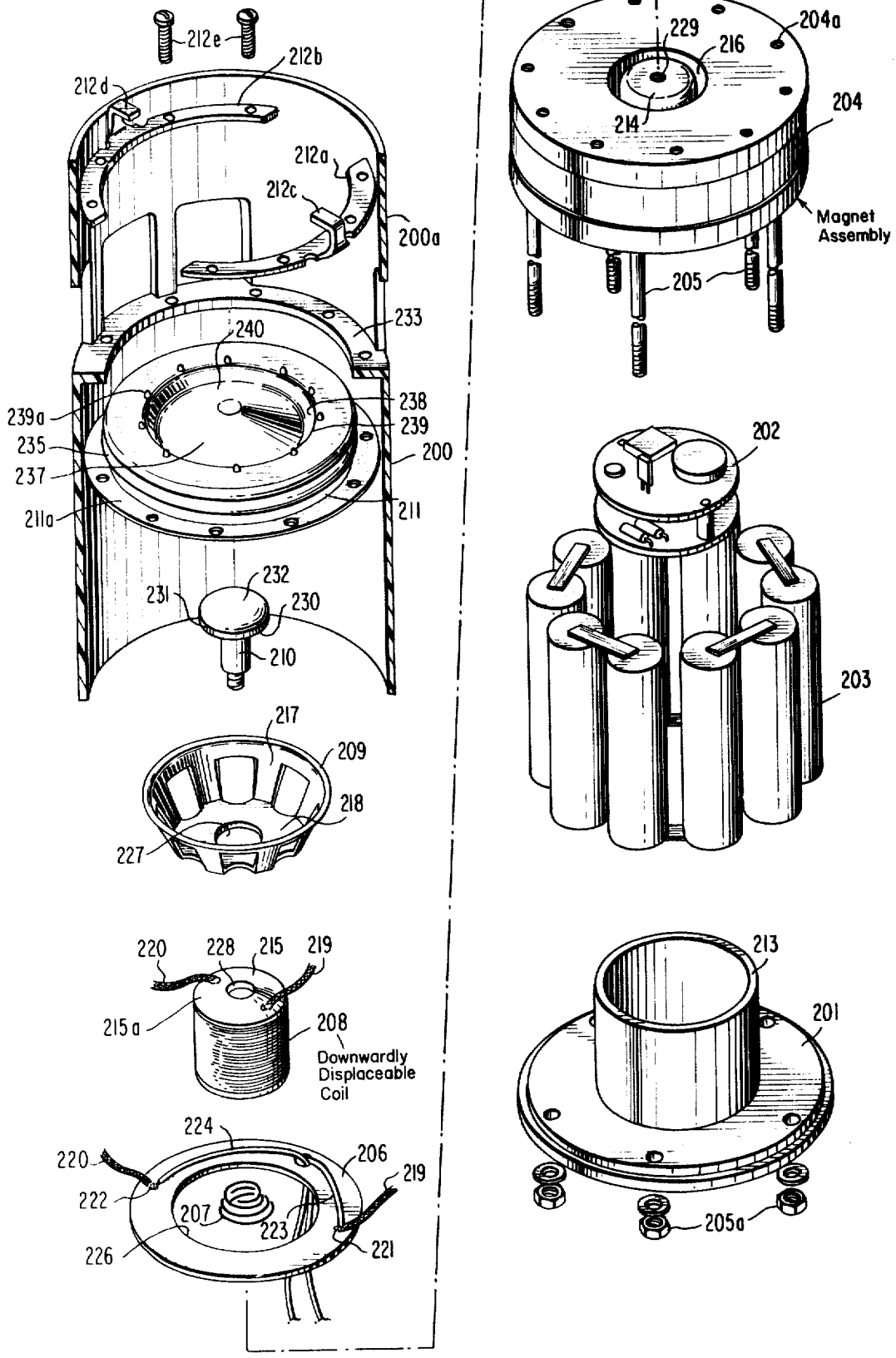
102

FIG 6a

FIG.8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230
210
217
209
218
227
220
228
215
219
215a
208
Downwardly Displaceable Coil
224
220
206
219
222
207
223
221
226
229
216
204a
214
204
Magnet Assembly
205
202
203
213
201
205a

BALL PUTTING CUP AND METHOD OF EJECTING BALL FROM SAME

RELATED APPLICATION

This application is a continuation-in-part of our U.S. Pat. application Ser. No. 186,289 filed Oct. 5, 1971 and entitled "Automated Golf Cup Concept, now abandoned."

GENERAL BACKGROUND, OBJECTS AND SUMMARY OF INVENTION

As golfing has increased in popularity, the sophistication entailed in maintaining golf courses has significantly increased.

With a view to minimizing the exertion required by players in retrieving golf balls from golf cups, and with a view to minimizing damage to turf on putting greens around golf cups, automated golf ball ejectors have been conceived.

Two such automated golf cup concepts are disclosed, one in a U.S. English et al Pat. No. 3,467,378, and another in U.S. Peeples Pat. Nos. 3,310,311 and 3,310,312.

The English et al and Peeples concepts commonly require the utilization of motor means and a mechanism for rotating a ball ejecting means so as to provide a random ejection pattern.

In the art there has persisted a need for an automated golf cup usable on a practice "green" or regular course, which would effect automated ejection of a golf ball while requiring minimum maintenance and while being characterized by a high degree of resistance to adverse environmental conditions and prolonged operating life.

A further need has persisted in the art for a golf ball ejecting mechanism or automated golf cup which is of a practicable and serviceable nature and effectively avoids reliance upon complex "throwing" mechanisms or precisely oriented radial ejection mechanisms, since such mechanisms as heretofore developed have been of only limited utility.

In particular, a need has persisted for the development of an automated golf cup which would effect the ejection of golf balls in a random pattern or manner, while avoiding the complexities of motor and rotation systems and reduce the number of moving parts to an absolute minimum.

Accordingly, it is a principal object of the invention to advance the automated golf cup art by providing an ejection mechanism which is operable to impact golf balls out of a golf cup in a random manner without requiring the use of complex motor means and/or mechanisms for rotating an ejection mechanism.

A further object of the invention is to provide an automated golf cup concept including an impacting mechanism which is effectively operable in conjunction with a diaphragm means yet which is operable in and of itself to provide effective golf ball ejecting action.

A further object of the invention is to provide a unique, articulated golf ball ejecting mechanism wherein an impacting member first undergoes a movement in one direction while impacting energy is being developed and then undergoes a golf ball impacting movement in another direction after sufficient energy has been stored in the mechanism for effective impacting operation.

A still further object of the invention is to provide an automated golf cup concept wherein reliance upon radially directed and/or throwing type ejection action is effectively avoided.

It is a further object of the invention to provide a flexible diaphragm means which functions as the base of the golf cup, as well as a golf ball impacting force transmitting means.

A related object of the invention is to provide such a diaphragm means which protects or shields control components of the golf cup located beneath the diaphragm means.

Another object of the invention is to provide a golf ball ejecting arrangement wherein simple interaction between a lightweight magnetic coil and a magnet system serves to both provide an indication of the presence of a golf ball in a golf cup and impart an impacting force to means such as the diaphragm means heretofore noted.

A further object of the invention is to provide a uniquely interrelated arrangement of batteries and control circuits and magnet means in an automated golf cup, such that the battery means and magnet effectively house the control circuit.

In accomplishing at least certain of the objectives heretofore noted, a method of ejecting a golf ball from a golf cup is presented where a diaphragm means is positioned so as to be operable to impact a golf ball out of a golf cup and function as the base of the golf cup rather than constitute an ejector which projects through the cup base into its interior. An energizing means is provided to effect this golf ball impacting movement of the diaphragm means. The energizing means is actuated in response to downward flexing movement of the diaphragm means.

Another independent method aspect of the invention operable to accomplish certain of the foregoing objectives entails a golf ball ejecting method where an electrical signal is generated in response to movement of the aforesaid diaphragm means caused by the presence of a golf ball in a golf cup.

In response to this generation of electrical signal, the diaphragm means is caused to flex upwardly and impact a golf ball generally non-radially out of a golf cup in a generally random manner.

Another method aspect of the invention pertains to a mode of operation which it is believed may be ascribed to the diaphragm means. In this aspect of the invention, the diaphragm means is operable to support a golf ball in a golf cup, with the diaphragm means being disposed in a generally retracted condition. As the golf ball impacting force is directed upwardly against the diaphragm means, the diaphragm means is extended upwardly. The imparting of this impacting force, concurrent with this extending action of the diaphragm means, is believed to be operable to impact a golf ball generally nonradially, in a random manner, out of a golf cup.

A further method aspect of the invention pertains to another aspect of a mode of operation which may be ascribed to a resilient diaphragm means. As an impacting force is applied to the underside of such a resilient diaphragm means, the diaphragm means is extended upwardly and flexes at least to some degree.

A further independently significant aspect of the invention pertains to the use of a lightweight coil means which is telescopingly received by a magnet means and which is operable to impart impacting force to the

aforesaid diaphragm means or other golf ball impacting means.

Downward movement of the diaphragm means or impacting means is operable to induce relative movement between the coil means and the magnet means so as to generate a signal indicative of the presence of the golf ball in a golf cup. In response to this signal, and interaction between the coil means and magnet means, an impact force is developed which is directed upwardly against the diaphragm means or impacting means.

A further method aspect of the invention involves the articulation of an impacting means so as to permit movement in one direction while energy is being stored, and movement in another direction for impacting purposes.

Various combinations of apparatus means are presented through this invention which interact to effect the individual and overall method aspects of the invention heretofore noted. At least in certain instances this interaction is believed to be synergistic in nature. Such various apparatus combinations constitute individually significant facets of the invention.

Another independently significant apparatus facet of the invention relates to the manner in which a battery pack and magnet function to provide housing for a control circuit.

Another independently significant apparatus aspect of the invention relates to the use of a control circuit which is operable to amplify a ball presence detecting signal and direct an energizing flow of electricity to a coil means for the purpose of generating a ball impacting force.

By way of clarification of the invention, but without limitation as to its scope, the summarized aspects of the invention will be reviewed in relation to certain presently preferred embodiments.

DRAWINGS

In describing the invention, reference will be made to presently preferred embodiments shown in the appended drawings.

In the Drawings:

FIG. **1** provides a perspective view of a practice putting green, illustrating the manner in which the golf cup ejecting mechanism of the present invention is operable to effect a generally random golf ball ejecting pattern;

FIG. **2** provides an "exploded" perspective view of components of one preferred embodiment of a golf cup which may be employed in the FIG. **1** installation;

FIG. **3** provides a further enlarged, transversely sectioned, elevational view of the first preferred embodiment, showing the components of FIG. **2** in their assembled relationship;

FIG. **4** provides a transverse sectional view of the FIG. **3** assembly, as viewed along section line **4—4** of FIG. **3**, looking downwardly on a ball impacting diaphragm means;

FIG. **5** provides a transverse sectional view of the FIG. **3** assembly, as viewed along section line **5—5** of FIG. **3**, looking downwardly on an annular battery pack arrangement;

FIG. **6** provides a schematic illustration of a control circuit which may be employed to effect actuation of an automated golf cup fabricated in accordance with the present invention;

FIG. **6***a* provides an illustration of a circuit which may be employed to implement the functions of the circuit schematically depicted in FIG. **6**;

FIG. **7** provides a transversely sectioned, elevational view of a second preferred embodiment of the invention;

FIG. **8** illustrates components of the FIG. **7** assembly in a perspective and longitudinally "exploded" format; and

FIGS. **9***a* and **9***b* provide a schematic, sequential illustration of the manner in which a coil and generally frustroconical impacting cup are disposed in a separable or relatively movable relation as a ball is impacted by a diaphragm means in response to electrical energization of the coil means.

DETAILED DESCRIPTION OF PRESENTLY PREFERRED EMBODIMENTS

The context in which the present invention is practiced is generally illustrated in FIG. **1**.

As there shown, a golf cup **1** is positioned on a practice putting green **2**. The upper rim **3** of the golf cup **1** is generally recessed about threequarters to one inch below ground level of the green **2**.

Cup **1** includes a cylindrical, ball receiving, upper portion **6**, as shown in FIG. **2**.

With the generaal context of the invention having been described, attention will now be devoted to a first preferred embodiment of the golf ball ejecting mechanism itself.

FIRST PREFERRED EMBODIMENT

Structural details of a first presently preferred embodiment of the invention are illustrated in FIGS. **2–4**.

As shown in FIG. **2**, the principal components of the first embodiment of the golf cup, include first means comprising a generally cylindrical body defining the golf ball receiving cup means or housing **6**.

Cup means **6** may be provided with a plurality of circumferentially spaced, radially outwardly directed drainage holes **8** adjacent its lower edge.

The first embodiment also includes second means comprising a generally annular, diaphragm retaining rim **9** and a diaphragm **10**.

Diaphragm **10** may be fabricated of elastomeric material so as to be somewhat resilient. However, it is contemplated that the diaphragm **10** will preferably comprise resilient material such as rubber, neoprene, or other elastomeric means within which reinforcing fabric is embedded so as to provide a structure of improved strength. Such reinforcing, when used, may be confined to a portion of the diaphragm, such as its top, transverse wall means.

The first embodiment additionally includes third means comprising a coil assembly **11** comprising a generally cylindrical coil **12** disposed beneath an upwardly diverging, frustoconical impacting cup or member **13**. The coil **12** may be fixedly connected with the cup **13** or may comprise a separate component disposed beneath the cup **13** and movable relative thereto.

The components shown in FIG. **2** additionally include a magnet assembly **14** comprising an annular outer pole **15** and an axial pole **16**. Poles **16** and **15** are separated on the upper side of the magnet assembly by an annular cavity **17**. Cavity **17** is operable to telescopingly receive coil **12**. The lower portion of the magnet assembly includes a base means **18** which serves to in-

terconnect the central pole means **16** and annular pole means **15** in a magnetically permeable manner.

As shown in FIG. **3**, cavity **17** may have an upper narrow zone **17***a* and a lower, wider gap zone **17***b*. This arrangement serves to intensify the magnetic lines of flux intersecting the turns of coil **12** and extending between center pole **16** and outer, annular pole **15**, by tending to intensify the density of flux lines in and extending across upper gap portion **17***a*.

Components for interconnecting the coil **12** and impacting cup **13** with the magnetic pole **16** comprise a generally cylindrical, spring retainer **19** including a frustoconical, downwardly diverging spring retaining lip **20**. A downwardly diverging, generally frustoconically configured coil spring **21** is also provided, along with a mounting screw **22** and mounting washer **23**.

A battery pack receiving base **24** is included in the FIG. **2** assemblage. Base **24** may be provided with a series of circumferentially spaced, battery receiving recesses **25**. Recesses **25** are disposed outwardly of a central cavity **26**. Cavity **26** is encircled by an imperforate, generally cylindrical wall **27** and includes a closed imperforate base **28**.

The manner in which the aforesaid components are assembled is generally depicted in FIG. **3**.

As there shown, each of the cavities **25** is occupied by a battery **29** which may comprise an alkaline, rechargeable battery of the nickle cadmium type. The batteries may be arranged in the circumferential pattern generally shown in FIG. **5**, with adjacent batteries being disposed in relatively inverted relationship. In other words, the battery **29***a* shown in FIG. **5** may be disposed with its positive pole **30** facing upwardly while the adjacent battery **29***b* may be disposed with its negative pole **31** facing upwardly. The poles **30** and **31** of adjacent batteries may be interconnected by a metallic bridege strip **32**.

A series of bridge strips are employed, as shown in FIG. **5**, so as to provide electrically conductive interconnection between positive and negative poles of all but two adjacent batteries so that the batteries **29** encircling cavity **26** are connected in series relationship and thus define an annular battery pack.

As is also shown in FIG. **5**, one of the two unconnected batteries is provided with a positive connecting terminal **33** and the other of these batteries is provided with a negative terminal **34**. Flexible electrical connections or leads **35** and **36** extend from these positive and negative poles or terminals **33** and **34**, respectively, to a fourth or control means, i.e., a solid state control circuit panel **37**.

Solid state control panel **37** may be supported in cavity **26** by a generally circular mounting plate **38** which rests upon upper rim **27***a* of wall **27** as generally shown in FIG. **3**.

With the circuit panel **37** disposed as shown in FIG. **3** within the cavity **26**, conventional, electrically, nonconductive, fluid plastic "potting" material may be injected into the cavity and allowed to solidify in the cavity so as to provide a totally waterproof and environment-proof circuit installation. Various resins, including epoxy resins, may be employed for this purpose.

In this connection it will be understood that another pair of leads or flexible electrical connections **39** and **40** would extend from the control panel **37** upwardly through the mounting plate **38** to the leads extending from the coil **12**.

Thus, as shown in FIG. **3**, leads **39** and **40** may pass from circuit panel **37** upwardly through a mounting plate opening **41**, while the leads **35** and **36** may pass through an opening **42** in the mounting plate **38**.

Magnet assembly **14** is telescopingly received within an upper portion of housing **24** and rests upon a housing ledge **43**.

The magnet assembly **14** may be secured to the ledge **43** by a series of threaded fasteners **44** which pass upwardly from the base **45** of housing **24** through threaded fastener receiving openings **46**.

As illustrated in FIG. **3**, the threaded upper ends of fasteners **44** are threadably received within threaded sockets **47** formed in the underplate **18** of the magnet assembly.

FIG. **3** also illustrates the manner in which other threaded fasteners **48** may serve to interconnect superposed plate members **49**, **50**, **51** and **52** of the magnet assembly. Fastening means **48** may comprise a series of circumferentially spaced fasteners extending through apertures in the plates to engage threaded sockets **53** in upper plate **49**, as generally shown in FIG. **2**.

Central pole **16** may be secured to base plate **52** (which provides magnetically permeable connection **18**) by another, centrally located threaded fastener **54**.

Before or after the magnet assembly **14** is installed, as heretofore described, the coil **12** may be telescopingly inserted into the recess **17** as shown in FIG. **3**. The mounting collar **19** may then be positioned on top of pole **16** so as to extend through a central aperture **55** in the base of impacting cup **13**. The mounting collar **19** may be thus positioned with the coil spring **21** disposed beneath and retained by the collar **20**.

In this manner, the lower, larger diametered portion of the spring **21** will engage the base **56** of the impacting member **13** so as to resiliently and yieldably urge the impacting member downwardly to its rest position shown in FIG. **3**.

In this rest position, a longitudinally and compressible washer or collar **57** formed of resilient plastic or elastomeric foam material (or other spring means) may be interposed axially between wall **56** and the upper end of the magnet **16**. This resilient support, or other spring means, will serve to support coil **12** in a somewhat elevated position in recess **17** and permit resiliently yieldable downward movement of the cup **13** and coil **12** from the rest position shown in FIG. **3** in response to the weight of a golf ball dropping in cup **6** onto the diaphragm **10** and cup **13**.

The retainer member **19** and spring **21** may be secured in the position shown in FIG. **3** by installing the threaded fastener **22** so that it extends downwardly through a central aperture **10***a* of diaphragm **10** and a central aperture **58** of the member **19** and is threadably received within a threaded central passage **59** of the magnetic pole **16**. The washer **23** may be interposed between the head of the fastener **22** and the top of diaphragm **10** as shown in FIG. **3**.

In completing the assembly of the golf cup components, as aforesaid, the diaphragm **10** will be positioned on top of the magnet **14** and on top of the components **22**, **20**, **21** and **13**. With these components located in housing **24** as shown in FIG. **3**, the mounting rim **9**, having a generally L-shaped cross-section, may be telescopingly inserted into the upper end of housing **24** so as to cause a lower annular rim **60** to abuttingly engage the rim or outer radial lip **61** of the diaphragm **10** and

urge this lip, in sandwiched relation against the upper magnet plate **49.**

The ball receiving cup **6** may then be positioned above the rim **9** such that a series of circumferentially spaced and longitudinally extending threaded fastener receiving openings **62** of this cup are aligned with threaded fastener receiving openings **63** in rim **9** and with threaded openings **64** in magnet plate **49.** The insertion of threaded fasteners **65** through these openings will serve to interconnect the components **6, 9** and **49** and thereby effectively secure the diaphragm means **10** in position as the base of the cup **6** and structually integrate the overall assembly.

With the assembly thus integrated, the leads **39** and **40** may extend from the turns of the coil **12,** through the base and side wall of cup **13,** and downwardly through an aperture means **66** extending longitudinally through magnet assembly **4.** These leads **39** and **40** will extend from beneath magnet means **14** through base plate aperture **41** to appropriate electrical connections with the control panel **37.** The leads **39** and **40** will be sufficiently flexible and slack above magnet **14** as to permit generally free vertical up and down movement of coil **12** relative to magnet **14.**

At this juncture it is appropriate to consider certain structural details of the flexible diaphragm **10,** bearing in mind that the diaphragm **10** functions as a sealed flexible base for the golf ball receiving cup **6** as well as an upwardly flexing, golf ball impacting member.

Diaphragm **10** includes the aforesaid rim or radial lip **61.** A bellows portion **67** of the diaphragm **10** extends upwardly from the rim **61.** A generally convex or generally conical wall portion **68** extends across the top of bellows portion **67.**

During upward movement of cup **13,** the bellows wall **67,** due to its lateral flexibility, will function to relieve any vacuum which might tend to form in the cavity **70** beneath the diaphragm.

A generally annular, ball receiving recess **69** is defined by top transverse wall means **68** and encircles the cavity **70** which is encircled and thus defined in part by the bellows means **67.** The recess **69** has a generally concave, upwardly opening, cross section.

An outer rim **71** of recess **69** is operable to engage a first under portion **72** of a golf ball **73** as generally shown in FIG. **3.** The upwardly converging wall portion **74** of wall means **68** is operable to engage a second under portion **75** of the golf ball.

A series of upwardly projecting, circumferentially spaced protuberances may be carried by rim **71,** generally as illustrated in FIG. **3.** These "bumps" perform a ball arresting function, i.e., arrest rolling movement of the ball around recess **69.**

As shown in FIG. **3,** under portions **72** and **75** are generally spaced. Diaphragm portion **76** underlying the golf ball and extending between these contact points is in a generally slack, i.e., retracted, condition. However, it will here be recognized that such a retracted condition could result with the diaphragm generally cradling or conformingly engaging the under side of the golf ball **73.**

In this connection, it will be understood that a golf ball **73** entering the cup portion **6** will tend to locate itself in a random manner at some circumferential location on the recess **69,** for the reason that the recess provides the only stable golf ball supporting structure within the interior of the golf cup. This results, of course, from the fact that the recess provides at least two stabilizing support means **71** and **74** while the remaining structure within the cup fails to provide such a stable, multiple support arrangement.

All this notwithstanding, the invention contemplates ball impacting operation even when the ball **73** does not locate itself in this manner.

As is shown in FIG. **3,** frustoconical rim **77** of cup means, or impacting means **13** engages diaphragm **10** generally immediately beneath and contiguous with the rim **71** of the recess means **69** so as to be able to impart force directly upwardly against an off-center, outer side of golf ball **73.** In this connection, it will be understood that while cup **13** is lightweight in nature, it is fabricated so as to be generally rigid, so as to be operable to effectively transmit impacting force from coil **12** to diaphragm **10.**

As will here be noted, the circumferential arrangement of the batteries **29** provides, in essence, a battery defined barrier or wall encircling the cavity **26** within which the control panel **37** is received. The top of this cavity, in essence, is closed by the magnet means **14.** Thus, the magnet means and the battery pack cooperate to substantially house and protect the control means **37.**

At this juncture it is also significant to note certain variations which may be effected in relation to the coil **12** and impacting member **13.**

Coil **12** and impacting cup **13** are lightweight components, preferably weighing not in excess of a few ounces.

Cup **13** may be bonded, connected with, or integrated with a core (possibly plastic) **78** of coil **12.** This core **78,** which may be cylindrical in nature supports on its outer periphery a coil winding **79.**

As shown in FIG. **3,** the winding of the coil **79** may have a generally rectangular cross-section, elongated generally radially of the cup axis. This arrangement is desirable in that it would provide a relatively great area of wire intersecting the magnetic field of magnet means **14.**

By fabricating the coil of anodized aluminum wire, the need for insulation may be avoided.

While such an edge wound coil arrangement is desirable, the invention may also be effectively practiced with a coil akin to a conventional speaker coil, where the winding comprises insulated copper wire having a conventional circular cross-section.

While the invention may be practiced with the integrated coil core **78** and cup **13** as shown in FIG. **3,** it is believed that improvements in ball impacting performance, resulting in golf balls being thrown a further distance from the cup **1,** may result by fabricating the coil **12** as a component structurally separate from the cup **13.** In this arrangement, the cup **13** would merely rest upon or be supported above the upper edge of the coil **12,** generally in the manner subsequently described in connection with the second embodiment of the invention.

With the principal components of the golf cup **1** having been described, along with their mode of assembly, it is now appropriate to consider the manner in which the golf cup operates on an automated basis to impact golf balls outwardly therefrom.

MODE OF OPERATION OF FIRST PREFERRED EMBODIMENT

When a golf ball comes to rest in recess **69** of diaphragm **10** as shown in FIG. **3**, the downwardly directed force imposed by the golf ball on the diaphragm will cause the cup **10** to tend to move downwardly and thereby induce downward movement of the coil **12** in the magnetic field of magnet means **14**. This downward movement will be yieldably resisted by the supporting resilient means **57** underlying the wall **56**. (Wall **56** may be considered as the upper wall of the coil **12** as well as the base of the frustoconical impacting means **13**.)

This downward movement of coil **12** relative to the magnet means **14** will generate an electrical signal which will be transmitted from coil windings through leads **39** and **40** to circuit **37**. FIG. **6** schematically depicts this signal generating function in schematic circuit block **80**.

This electrical signal will be electrically amplified by circuit means **37** in a circuit sequence generally depicted in block **80** of FIG. **6**.

Circuit **37** will cause a pulse or flow of electrical energy to be directed back through leads **39** and **40** to coil winding **79**.

The aforesaid transmission of electrical energy through leads **39** and **40** to coil winding **79**, will cause electrical interaction between coil **12** and magnet **14**, resulting in abrupt upward movement of the coil **12**. This abrupt upward movement is generally depicted in block **83** of the schematic circuit of FIG. **6**.

The termination of upward movement of coil **12** may be determined by either the progressive resistance to diaphragm distension caused by the diaphragm **10** itself and/or the spring **21** or the engagement of impact cup wall **56** with the collar or retaining lip **20**. At, or near, the end of this movement, the energization of coil **12** will terminate and spring **21**, possibly in combination with diaphragm **10**, will restore the cup **13** and coil **12** to the rest position of FIG. **3**.

This upward movement of coil **12** will cause upward movement of the impacting means **13**. The abrupt movement of the impacting means **13** would then be transmitted to the underside of the diaphragm **10**.

The imposition of upwardly directed force to the under side of the diaphragm **10** will cause longitudinal elongation of the bellows means **63** and upward extension and flexing of the bellows means, and in certain instances could induce distension, stretching or tensioning of the wall means **68**.

This distending of the wall means **68**, even thus may tend to remove at least some of the slack in area **76** as the diaphragm **10** is moving upwardly. Such slack removal may vary as a factor dependent upon diaphragm flexibility, etc. However, where, as in the present case, the center wall means **68** remains engaged with center support means **22** as cup **13** is raised, diaphragm flexing in top wall **68** will occur. In any event, slack removal in bellows portion **63**, tending to offset any vacuum or reduction in pressure in cavity **70** as cup **13** is raised, will facilitate ball impacting action.

While the precise phenomena attributable to the interacting of these events is not fully understood, observation of performance of the cup **1** shows that the operation of the diaphragm will produce a unique, random ejection pattern.

Thus, as schematically shown in FIG. **1**, one golf ball **73** a impacted by diaphragm **10**, would follow a trajectory **84**, moving from the recess **69** on the right side of the cup shown in FIG. **1** across and upwardly out of the cup and passing through the left side of the cup to come to rest at position **85**.

Another golf ball **73***b*, shown in FIG. **1**, might be impacted from the left side of the cup in recess **69**, pass upwardly out of the cup through the right side of the cup, and come to rest at position **86**.

As shown in FIG. **1**, positions **86** and **85** may well be located at varying radial distances from the cup **1**, as well as being located at different circumferential locations in relation to the cup **1**.

This random mode of ejection is significant in that it causes players to retrieve ejected balls at widely varying locations of the green and at distances spaced substantially outwardly from the cup. This retrieval phenomena reduces or minimizes wear of the green at any particular location, and particularly wear in the vicinity immediately adjacent to the cup **1**.

With the basic mode of operation of the golf cup **1** having been described with reference to schematic circuits depicted in FIG. **6**, it is now appropriate to consider an electrical circuit which may control functions depicted in FIG. **6** and be integrated in the control panel **37**.

CONTROL CIRCUIT

FIG. **6***a* depicts an exemplary control circuit **100** which may be enployed in control panel **37**.

Leads **35** and **36** are connected to circuit **100** at positive and negative junctures **122** and **122***a*, respectively, while leads **39** and **40** are connected to other control circuit junctures **39***a* and **40***a*.

With reference now to the schematic circuit diagram of FIG. **6***a*, the coil **12** of the extreme right side of the figure functions as a sensing element. The coil **12** may be loosely suspended in a magnet field of about 8,000 to 10,000 gausses developed by magnet means **14**. The displacement of coil **12** in response to the weight of a golf ball entering the cup **6** may generate an e.m.f. across the terminals of the winding **79** to coil **12** of approximately 15 millivolts.

This signal which indicates that a golf ball is present in the cup is applied by way of the terminal **102** and a coupling capacitor **104** to a two-stage amplifier circuit indicated generally at **106**. The coupling capacitor **104** is connected in series with a surge limiting resistor **108** to the gate electrode of an N-channel junction-field effect transistor FET-**1**. The gate electrode of the transistor FET-**1** is electrically connected with negative battery terminal **122***a* through a resistor **110**, the source electrode of the transistor FET-**1** is grounded through a resistor **112** and a capacitor **114** connected in parallel, and the drain electrode of the transistor FET-**1** is connected through a resistor **116** to a source of positive d.c. potential which may, for example, comprise a **24** volt battery pack consisting of a plurality such as **10** "sub C" nickel cadmium cells **29**.

The output signal from the transistor FET-**1** is fed from the collector electrode thereof through a coupling capacitor **118** to the base electrode of a PNP transistor Q**1**. The base electrode of the transistor Q**1** is connected through a resistor **120** to the source of positive potential **122**, the emitter electrode of the transistor Q**1** is connected through a resistor **124** to the source of

positive potential **122**, and the collector electrode of the transistor Q1 is grounded, through a resistor **126**, to negative connection **122***a*.

The output signal from the two-stage amplifier **106** is taken from a terminal **128** at the collector electrode of the transistor Q1 and is applied through a capacitor **130** to the gate electrode of a silicon controlled rectifier SCR-1 in a transmitter circuit indicated at **152**. The anode of the rectifier SCR-1 is directly connected to the source of positive potential **122** and the cathode electrode thereof is connected through a series connected resistor **132** and a capacitor **134** to negative potential **122***a*. The cathode of the SCR-1 is also connected by a resistor **136** to the gate electrode thereof, and the capacitor **130**-resistor **136** junction is connected to ground potential through a resistor **138**.

The cathode of the silicon controlled rectifier SCR-1 is connected through a resistor **140** to the second base electrode of a unifunction transistor UJ-1 and through a capacitor **142** to the first base electrode thereof. The first base electrode of the transistor UJ-1 is connected with negative terminal **122***a* through a resistor **144** and the emitter electrode thereof is connected to the resistor **132**-capacitor **134** junction in the cathode circuit of the rectifier SCR-1.

The junction of SCR-1 and the resistor **140** serves as the output terminal of a transmitter circuit **152** and is connected with a drive circuit **166** through a capacitor **154** to the base electrode of a negative potential grounded emitter NPN transistor Q2. The base electrode of the transistor Q2 is grounded to potential **122***a* through a resistor **156** and the collector electrode thereof is connected to the source of positive potential **122** through a voltage divider network comprising resistors **158** and **160**. The resistor **160**-resistor **158** junction is directly connected to the base electrode of a PNP transistor Q3 whose emitter electrode is directly connected to the source of positive potential **122**. The collector electrode of the transistor Q3 is connected to negative potential **122***a* through a voltage divider network comprising resistors **162** and **164** and is also connected through a feedback path comprising a series connected resistor **167** and a capacitor **168** to the base electrode of the transistor Q2. The resistor **162**-resistor **164** junction is directly connected to the base electrode of a grounded emitter NPN transistor Q4. The collector electrode of the transistor Q4 is connected to the source of positive potential **122** through a PN junction diode D-3 which is connected across the coil **12**.

In operation and with continued reference to FIG. **6***a*, the downward physical displacement of the coil **12**, responsive to the weight of the golf ball dropping on diaphragm **10** as it enters the cup **6**, generates a small electrical signal which is coupled from the terminal **102** through the capacitor **104** to the two-stage amplifier circuit **106**. The field effect transistor FET-1 is connected as a class A amplifier and provides a voltage gain on the order of 1,000. The use of a field effect transistor is desirable both from the standpoint of a low drain current on the order of approximately 185 microamps and also for the low noise characteristics thereof at these low current values. This extends the life of the battery pack without misfires due to noise.

The amplified output signal from the transistor FET-1 is coupled through the capacitor **120** to the base electrode of the transistor Q1 which is connected as a class C inverting amplifier. The output signal from the amplifier **106** is taken from the collector electrode of the transistor Q1 and is applied to the transmitter circuit **152** to initiate the pulse or current flow which will eject the golf ball from the cup.

The conduction of the silicon controlled rectifier SCR-1 is triggered by this amplified signal from the coil **12**. The transmission circuit **152** consists basically of an instantaneous signal transmitter and one relaxation oscillator. In the transmitter, the triggers of SCR-1 will immediately send a signal pulse through capacitor **154** to the drive circuit generally indicated at **166**.

With reference to the relaxation oscillator of the circuit **152**, conduction of the rectifier SCR-1 also applied the source of positive potential **118** across the resistor **132** and capacitor **134**. The values of these elements are conveniently selected to fire or trigger the unifunction transistor UJ-1 about 1.2 seconds after the golf ball drops in the cup and physically displaces the coil **12** downwardly, in order to reactivate the cup for further operation. The capacitor **142** and resistor **144** act as a filter to prevent the initiation of conduction of the unijunction transistor UJ-1 when the golf ball is ejected by holding the voltage from the uppermost base electrode constant. The positive pulse developed on the lowermost base electrode of the unijunction transistor UJ-1 is coupled to the cathode of the SCR-1 through the capacitor **142** to provide a reverse bias which extinguishes the conduction of the SCR-1 after coil **12** has come to rest. As earlier explained, the diode D-1 provides a fast discharge path for the capacitor **148**, when the conduction of the SCR-1 is extinguished, through the resistor **140**, the base resistance of transistor UJ-1, and the resistor **144**, to negative terminal **122***a*.

The delay between the coil coming to rest and cup reactivation tends to prevent damage which might otherwise result from recycled impacting of a ball in cup **6**. But for this activation delay after impacting has occurred, a child or player could drop a ball into the cup **6**, cover the cup **6** with a foot and induce potentially damaging "endless" recycling of the coil, cup, and diaphragm.

The drive circuit **166** receives the output pulse of the timing circuit **152** as an input pulse of the base electrode of transistor Q2 which conducts to effect the saturation of the transistor Q3. The conduction of the transistor Q3 holds the transistor Q2 in conduction until the coil **12** moves to its upper limit by the signal fed back through from the collector electrode of the transistor Q3 through the resistor **167** and capacitor **168**.

The conduction of the transistor Q3 effects the conduction of the transistor Q4 which connects the positive d.c. potential from the source **118** through the coil **12** to ground. The resulting current flowing through the coil winding **79** reacts with the magnetic field in which the coil **12** is suspended to effect a rapid upward movement of the coil **12**. This upward movement of the coil **12** effects the ejection of the golf ball as has been previously described.

The reactance of the coil winding **79** is desirably matched to the impedance of the source of positive potential **122** and the source potential accordingly drops significantly, when the coil **12** reaches the upper limit of its travel, due to the increased impedance load. This reduction in the potential seen at the collector electrode transistor Q2 drives the transistor Q2 into cut-off extinguishing the drive pulse.

Thus, the coil **12** serves at least two important functions in the circuit of FIG. **6***a*. It serves first as a sensing element to develop a signal when the golf ball drops into the cup. Secondly, the coil **12** functions as the linear actuator for ejecting the golf ball from the cup.

To facilitate the deactivation of circuit **100** when cup **1** is being transported, a mercury switch **172** may be incorporated in the circuit, possibly as shown in FIG. **6***a*. When the cup **1** is upright, switch **172** is closed and circuit **100** is active. When the cup is removed from a green to be charged, its inversion will open switch **172** and deactivate the circuit **100**.

It now becomes appropriate to consider structural operating characteristics of a second presently preferred embodiment illustrated in FIGS. **7, 8,** and **9**.

SECOND PRESENTLY PREFERRED EMBODIMENT

FIGS. **7, 8,** and **9** illustrate structural details of a second or alternate, presently preferred embodiment of the automated golf cup mechanism **1**.

In this connection, it will be understood that circuit means corresponding generally to that described in connection with FIG. **6**, may be employed for the purpose of actuating the components of this second embodiment.

A circuit similar to that shown in FIG. **6a** may be employed for this purpose.

As will also be understood, the general mode of operation of the second embodiment corresponds to the mode of golf cup operation described in connection with the first embodiment heretofore.

As shown in the "exploded" format view of FIG. **8**, the components of the second preferred embodiment may comprise a unitized (or multicomponent) housing **200**, a battery pack base **201**, a control circuit panel means **202**, and a generally annular battery pack assembly **203**.

Battery pack assembly **203** may be taped together, with the battery electrodes being interconnected in the manner previously described in connection with the arrangement shown in FIG. **5**.

The components shown in FIG. **8** additionally include a magnet assembly **204**, substantially identical to magnet assembly **14** and provided with a plurality of downwardly extending and circumferentially spaced, threaded fastening means **205**.

A centrally apertured terminal board **206** is provided along with a coil biasing spring **207** and a coil **208**.

A generally frustoconical impacting cup **209** is included in the assembly of components, along with a generally radially flanged, threaded retaining member **210**.

A diaphragm **211** is included, along with diaphragm retaining ring means **212**.

As will be apparent by reference to FIG. **7**, the control panel **202** is inserted into an upwardly open receptacle or housing **213** carried by base plate **201**. The battery assembly **203** is telescoped over the housing **213**.

The magnet is positioned so as to overlie the assembled components **203, 201,** and **202**, with the threaded fastener **205** being threadably secured by threaded nut **205***a* to the base plate **201**.

Prior to effecting this assembly, the circuit panel means **202** may be "potted" by fluid plastic means injected into, and allowed to harden within, the housing **213**.

Of course, prior to such "potting" electrical connections would be made between the battery means **203** and the circuit means **202**, as well as between the circuit means **202** and the terminal board **206**.

Terminal board **206** merely provides a convenient connection juncture between the leads of the coil **208** and the control panel **202**.

Before or after this assembly is completed, the spring **207** may be positioned between the top or center pole **214** of the magnet assembly **204** and the underside of a generally horizontally extending and centrally apertured top wall **215** of the core of coil assembly **208**.

The positioning of the spring in this manner would support the coil **208** in a slightly elevated position in an annular recess **216** of magnet **204**.

In this slightly elevated recess, the coil **208** would be operable to move downwardly in response to the presence of a golf ball in the cup, dropping into the diaphragm **211**.

The impacting means **209** comprise a generally frustoconical, albeit apertured, and upwardly diverging wall **217** and a generally horizontally extending, centrally apertured wall **218**.

As shown in FIG. **7**, impacting means **209** would be supported on the top of coil **208**, and may rest directly on top of transversely extending core top wall **215**. The annular periphery **215***a* of wall **215** may be somewhat rounded, as shown generally in FIGS. **7** and **8**.

Leads **219** and **220** may extend from coil **208** outwardly between walls **215** and **218** to two terminals **221** and **222** on terminal board **206**. Other leads **223** and **224** would extend from these terminals **221** and **222** downwardly through a magnet passage **225** to electrical connection means of control panel means **202**.

In the assembly depicted in FIG. **7**, coil **208** is operable to move upwardly through a central opening **226** in the terminal panel **206**.

The threaded retaining member **210** passes through a central aperture **227** in impacting member base plate **218**, and through a central aperture **228** in the top wall **215** of the core of coil **208**, to threadably engage a threaded socket **229** in center pole **214** of magnet **204**.

The under side **230** of flange **231** of retaining member **210** is operable to engage an upwardly moving base wall **218** of impacting member **209**, and thus limit upward movement of this member.

The top surface **232** of retainer **210** may be three-dimensionally rounded so as to provide support for the center of the under side of the diaphragm means **211**, as generally depicted in FIG. **7**.

With the components **210, 209, 208** and **207** connected with the other components **206, 204, 203, 202,** and **201**, housing **200** may be lowered over this completed assemblage. The diaphragm **211** will then be positioned in abutting relation with, and disposed beneath, a housing flange **233**.

As shown in FIGS. **7** and **8**, gasket **211** may be secured by retaining means comprising two arcuate rings **212***a* and **212***b*.

These rings, when superposed on top of rim **233**, will each partially circumscribe the diaphragm rim **211***a* and provide fastener receiving openings alignable with the fastener receiving openings in the diaphragm rim **211***a*, the superposed housing rim **233**, and the top of magnet means **204**.

The diaphragm rim **211***a* may be effectively sandwiched between the securing rim or ledge means **233**

and the top of magnet **204** by the use of threaded fastening means **212***e*, the rings **212***a* and **212***b*, as depicted generally in FIGS. **7** and **8.** As there shown, the fastener means **212***e* pass through aligned openings in rim means **212***a* and **212***b*, housing rim **233**, and diaphragm rim **211**, to be threadably received within threaded sockets **204***a* in magnet means **204.**

Each of the retaining rings **212***a* and **212***b* may be provided with a generally inverted L-shaped, radially inwardly projecting, hook-like structure.

Thus, the two hook-like structures **212***c* and **212***d* carried by the retaining means **212***a* and **212***b*, repectively, provide means within the golf cup interior engageable with a golf cup lifting tool.

This tool may comprise a handle, including means operable to engage and exert a lifting force on the hook means **212***c* and **212***d*.

This arrangement enables an operator to effectively lift a golf cup axially out of its socket on the green without damaging housing or operating components of the golf cup itself.

As shown in FIG. **7**, diaphragm **211** may include, in addition to rim **211***a*, a generally longitudinally extending bellows portion **235** encircling a cavity **236.**

A transverse wall means **237** provides a generally annular recess **238** having a generally concave, upwardly opening cross section. Wall means **237** may be internally reinforced with fabric means, etc., such that its stiffness will exceed that of bellows means **235.**

Recess **238** extends between a generally rim-like portion **239** of the diaphragm means and a generally upwardly converging, interiorly located wall means portion **240.** A series of protuberances **239***a*, akin to elements **271***a*, may be carried by rim means **239.**

A golf ball resting on concave recess **238** may generally conformingly engage the recess or the recess **238** may "sag" slightly beneath the golf ball as described in connection with the first embodiment. However, it is desirable that upper edge **242** be beneath diaphragm recess rim **239.**

Desirably, the recess **238** will provide stabilized concave support operable to support a golf ball in virtually any circumferential location about the recess **238.**

While the diaphragm may be fabricated of fiber or fabric reinforced elastomeric means, upward movement of the diaphragm caused by upward movement of the coil **208** and impacting cup **209** will serve to somewhat flex the diaphragm. Here, again, it is believed that this action may to some extent, not perfectly understood, cooperate with the impacting force directed against the diaphram by the cup **209** to provide a unique, effective random-type, golf ball ejecting action.

As will be appreciated, the arrangement shown in FIG. **7**, is such that a downwardly biasing retaining spring is not employed in connection with the impacting means **209.**

The overall mode of operation of the mechanism shown in FIG. **7** corresponds in general to that described with the first embodiment.

Thus, the presence of a golf ball dropping onto recess **238** will move the cup **209** and coil **208** downwardly so as to develop an electrical control signal indicative of the presence of a golf ball. This control signal, of course, is generated by the interaction between the windings of the coil **208** and the magnetic field generated by magnet means **204.**

The thus generated control signal will be amplified by control circuit means **202** and in response to the amplified signal, a return flow of electricity will be transmitted from the battery pack **203**, back to the windings of the coil **208.** This upward abrupt movement will cause the cup **209** to move upwardly such that the upper rim **242** of cup **209** of the rim will engage the under side of the diaphragm generally adjacent the diaphragm rim area **239** and distend the diaphragm means upwardly.

This distension will impart an impacting force to the diaphragm, with the rim **242** imparting an impacting force through the diaphragm directly to the golf ball overlying the rim portion **239.**

Here, again, it is contemplated that the golf ball would be impacted out of the recess **238** from one side of the cup so as to cross the cup and exit from the upper part of the cup on a generally opposite side. Desirably, the ball will be ejected back toward the location from which the ball was putted into the cup.

The independently movable characteristics of the impacting cup **209** and the coil **208** are believed to provide an intensified and improved impacting action. Empirical experience thus far gathered indicates that the separable nature of these components produces an impacting action operable to impact or hit a ball further, away from the cup than the distance which would ordinarily be obtained by a mechanism where these components were unitized.

The reason for this improved impacting action is not fully understood. However, it is possible, as schematically depicted in FIGS. **9***a* and **9***b* that the improved impacting action may result from the ability of the cup **209** to pivot as the coil **208** elevates.

As shown in FIG. **9***a*, during the first part (possibly about half) of the upward movement of coil **208** through magnet gap **216**, the edge of cup **209** below golf ball **73** will be weighted due to the presence of the ball, and it is believed that the cup **209** will tend to pivot counterclockwise, generally about coil top location **215***b*. Location **215***b* will tend to be located on rounded coil core top edge **215***a*, in general alignment with a plane extending radially of ball **73** and the central longitudinal axis of magnet **204** and coil **208.**

With the components disposed as shown in FIG. **9**a, such an initial pivotal movement will be in generally counterclockwise direction, possibly about left edge location **215***b*, and may continue until wall **218** engages retaining wall **230**, generally as illustrated.

At this point, it will be recognized that some or all of the aforesaid tilting or pivotal movement may take place when ball **73** comes to rest on recess **238.** In this event, the initial movement of cup **209** may be primarily of an elevating nature and serve to bring the tilted cup into engagement with the under side **230** of retainer **210.**

During the last portion (possibly about the last half) of the elevating movement of coil **208**, impact member **209** is believed to undergo a generally oppositely directed pivotal movement, the termination of which is schematically depicted in FIG. **9***b*. During this movement, a point of engagement **218***a* between wall **218** and the outer corner of retaining wall **230** may function as a pivot, wiht cup **209** undergoing upward, clockwise pivotal movement operable to impel ball **73** upward, from the left toward the right side of the ball receiving, upper cup portion **200**a of housing **200.**

Significantly, this latter phase of a multiple and reversely directed pivotal action would take place with coil **208** impacting member **209** through a relatively long pivot arm extending generally between engagement locations **215***b* and **218***a*. The length of this lever arm would exceed the radius of coil **208** and such a lever arm would be displaced from the coil **208.**

This latter ball impacting phase of a reverse pivotal movement of cup **209** would take place after coil **208** had acquired substantial stored energy and had started effective upward movement, and overcome the initial resistance to movement or system inertia.

As will be appreciated, this reverse pivotal movement would be facilitated by clearance between the edges of aperture **227** and the shank **210***a* of retainer **210** and by the rounded top coil corner **215***a*. This rounded corner would permit "rolling" pivotal contact between the under side of wall **218** and the top of coil **208.**

It should also be noted, at this juncture, that it is believed that the center of diaphragm **21** will generally remain in superposed, contiguous engagement with, or at least close proximity to, the rounded top **232** of retainer **210** during the aforesaid reverse pivotal action.

The latter, clockwise, ball impacting movement phase, described in relation to FIg. **9***b*, would probably terminate when wall **218** pivoted into a generally horizontal plane shown in this FIGURE, into generally flush engagement with horizontal wall **230** of retainer **210.** At this point, movement of coil **208** would cease, and the FIG. **6** and **6***a* circuit would deactivate coil **208** and permit the coil **208** and cup **209** to restore to the neutral position of FIG. **7.**

It is also believed that the elimination of the downward biasing spring acting on the impacting cup **209** will contribute to more effective "long distance" ball impacting action, as will the removal of electrical leads from the cup **209.**

Removal of the cup from its socket on the green may be facilitated by vent means. Such vent means may comprise external recesses, extending longitudinally of the exterior of casing **200.** Alternatively, or in addition to such a venting arrangement, vent tubes may extend between ledge **233** and base **201,** internally of housing **200,** and provide venting communication between the base of the unit and the ball receiving area.

While various structural and operational embodiments of the overall invention have been described, it may be of clarifying interest to here review certain more salient advantages of the invention and its overall scope.

IMPROVED ENVIRONMENTAL PROTECTION

In order to effectively protect either of the aforesaid embodiments from environmental conditions, and particularly moisture, several protective measures may be taken.

For example, it is contemplated that prior to the "potting" of the circuit panel within its housing through the use of materials such as epoxy resins, the battery pack, including terminals and at least parts of projecting leads, may be dipped in epoxy resin and the epoxy resin allowed to harden to form a moisture proof coating around the battery pack.

Various dipping and spraying techniques could be employed with partial or complete assemblies of either disclosed embodiment so as to virtually encapsulate and waterproof all electrical components of the system including the power source, circuit panel, leads, etc.

In order to positively electrically isolate battery terminals from the base of the magnet assembly, so as to avoid possible short circuiting problems, an insulating gasket may be interposed longitudinally between the magnet assembly and the upper end of the battery pack.

A representative insulating gasket **243,** having a generally annular, planar configuration overlaying the upper end of the battery pack, is shown in FIG. **7.**

SUMMARY OF MAJOR ADVANTAGES AND SCOPE OF INVENTION

Most significantly, the present invention provides an automated golf cup concept of a practical and serviceable nature wherein complex throwing mechanisms are eliminated and reliance upon precision radial ejection is avoided.

When used on a practice putting green, the automated golf cup of this invention provides an ejecting mechanism which is continuously operable to cope with a plurality of players. In this instance, the cup may be located remote from, or out of access of, all players, with the ejecting mechanism serving to return balls back to an annularly arranged series of putting stations spaced outwardly of the cup.

The use of the diaphragm and the impacting cup arrangement provides a unique integration of a cup base, sealing mechanism and an impacting structure and affords a particularly effective random-type, ball ejecting or impacting action.

Significantly, this ball ejecting action is effected without relying upon precise, radially directed ejection or a "throwing" force as contemplated in prior patents such as English et al U.S. Pat. No. 3,467,378.

The use of the interacting coil means and magnet provides, in essence, a single movable actuating member which transmits force through the impacting cup and cooperates with the diaphragm means to effect random ejection. All this is accomplished without placing reliance on complex motor means or repositioning elements heretofore considered necessary by such patentees as English et al and Peeples (U.S. Pat. Nos. 3,310,311 and 3,310,312).

The use of the lightweight, speaker-type coil as the ejector mechanism affords a low-cost, highly effective mechanism operable to develop a ball presence indicating signal and also deliver ball impacting force to an ejecting mechanism such as a diaphragm.

The overall assembly provides a unique protection for relatively delicate control components. Such protection is achieved by housing the control panel or elements with the magnet and battery means and sealing these components in the base of the golf cup by the diaphragm means itself.

The overall characteristics of the unit are such that the golf cup is particularly immune or resistant to breakdowns caused by adverse environmental conditions and is thus characterized by a uniquely prolonged operating life.

The overall simplicity of the system contributes to acceptable low fabrication and installation costs and ensures minimal maintenance efforts and costs.

The golf ball impacting action of the present invention is believed to achieve its effectiveness through a variety of interacting phenomena, not all of which may

be necessarily completely understood. However, it is believed that a most significant phenomena may reside in the alternately directed pivotal action described in connection with impacting cup **209** of the second embodiment.

In a sense, it is believed that the first pivotal movement of the cup **209** depicted in FIG. **9***b* may be viewed as a "cocking" movement which takes place as energy is developed in the ejecting or driving mechanism comprising the upwardly moving coil **208.**

After the energy has been effectively accumulated, the reverse pivotal movement of the cup **209** depicted in FIG. **9***b* takes place and imparts effective impacting force to a golf ball supported by the cup or by a diaphragm overlaying the cup.

While the aforesaid diaphragm phenomena are believed to be significant, the impacting action of the cup alone, in the context of the invention as claimed, even in the absence of a diaphragm, would probably yield desirable, random ejection action.

As is described in parent application Ser. No. 186,289, this ejector mechanism of this invention may be employed in a golf cup operable to receive well known flag pins, such as those described in the prior art, U.S. Pat. Nos. 1,568,320 (Coldwell) and 1,548,289 (Sparks). In addition the transmitter **152** may be provided with conventional circuitory, described in the aforesaid parent application, to delay the ejecting action, thereby employing the prior art ejection concept featured, for example, in U.S. Pat. No. 3,105,683 (Kimbrell). However, such auxiliary concepts are independent of the invention aspects presented herein which relate to the ejector mechanism.

In describing the present invention, reference has been made to certain variations which are exemplary of certain of the types of changes which may be made in practicing aspects of the ejector concept.

Those skilled in the automated golf cup art and familiar with this disclosure, may well recognize other additions, deletions, substitutions, modifications, or alterations, or changes which would fall within the scope of the ejector invention as defined in the appended claims.

What is claimed is:

1. A golf cup comprising:

first means including a housing operable to be positioned at least partially below ground level, and open upwardly, and receive a downwardly moving golf ball;

second means including a diaphragm operable to impact a golf ball out of said housing;

said diaphragm defining base of said housing and being operable to undergo downward and upward flexing movement;

said diaphragm including a recess operable to receive and support a golf ball at random locations therein;

third means operable to effect golf ball impacting, upward flexing movement of said diaphragm; and

fourth means operable to actuate said third means in response to downward flexing movement of said diaphragm;

said upward flexing of said diaphragm being operable to impact said golf ball upwardly out of said housing, generally transversely across said diaphragm.

2. An apparatus as described in claim **1** wherein said diaphragm comprises:

a bellows encircling a cavity and operable to resiliently extend longitudinally upwardly of said housing; and

a flexible wall extending across an upper portion of said bellows and defining a generally annular, ball receiving recess, comprising said recess of said diaphragm, and generally encircling said cavity;

said annular, ball receiving recess having

a generally concave cross section,

an outer, generally annular rim operable to engage an under portion of a golf ball, and

an upwardly converging wall operable to engage an under portion of said golf ball.

3. An apparatus as described in claim **2** wherein said third means comprises:

an impacting cup operable to engage the underside of said rim of said diaphragm and effect upward movement thereof;

said upward movement of said rim being operable to longitudinally extend said bellows and cause said annular, ball receiving recess to impact a golf ball supported thereby and cause said golf ball to be impacted generally upwardly out of said housing.

4. An apparatus as described in claim **3**:

wherein said impacting cup comprises a generally frusto-conical, impacting wall diverging upwardly of a longitudinal axis of said housing; and

wherein said third means further includes

a lightweight, electromagnetic coil disposed beneath said frustoconical impacting wall,

said frustoconical impacting wall being movable upwardly, at least in part, away from said lightweight coil, and

a magnet defining an annular passage, within which annular passage said lightweight coil is telescopingly received;

said magnet and lightweight coil being operable to actuate said fourth means by generating an electrical signal in response to downward movement of said diaphragm, said frustoconical impacting wall, and said coil caused by engagement of a golf ball with said diaphragm;

said fourth means being operable to generate a flow of electricity through said coil in response to actuation of said fourth means, with said flow of electricity being operable, in cooperation with a magnetic field generated by said magnet, to induce upward, ball impacting movement of said lightweight coil;

said upward, ball impacting movement of said lightweight coil being operable to induce upward movement of said frustoconical impacting wall, with said upward movement of said frustoconical impacting wall in turn inducing upward movement of said diaphragm; and

said upward movement of said diaphragm being operable to impact a golf ball received therein generally across, and upwardly out of, said housing in a random manner;

said frustoconical impacting wall, during said upward movement, being movable relative to, and away from said coil; and

said fourth means including battery means operable to supply said flow of electricity.

5. An apparatus as described in claim **1**:

wherein said third means includes

a coil movable downwardly in response to downward movement of said diaphragm caused by en-

gagement of a golf ball therewith and movable upwardly to effect golf ball impacting movement of said diaphragm;

said downward movement of said movable coil being operable to develop an electrical signal; and

wherein said fourth means includes

an amplifier operable to amplify said electrical signal; and

means operable to deliver electrical energy to said movable coil, with said electrical energy being operable to induce said upward movement of said coil.

6. An apparatus as described in claim **1** wherein said third means comprises:

a coil operable, when electrically energized, to impart a generally upwardly directed impacting force to said diaphragm; and

a magnet telescopingly receiving said coil and operable, in cooperation with said electrical energization of said coil, to develop said impacting force.

7. A method of operating a golf ball ejecting cup which includes:

a golf ball receiving cup positioned at least partially below ground level, opening upwardly, and having a base defined by a diaphragm;

said diaphragm having a recess operable to support a golf ball at random locations therein; and

a magnet mounted in said cup and a coil movable downwardly and upwardly in said cup relative to said magnet, said coil being movable downwardly relative to said magnet in response to downward movement of said diaphragm and movable upwardly relative to said magnet so as to induce upward flexing movement of said diaphragm;

said method comprising:

causing a golf ball to drop into said cup and be supported on said recess of said diaphragm;

generating an electric signal in response to downward movement of said coil relative to said magnet caused by downward movement of said diaphragm as caused by the presence of said golf ball in said cup on said diaphragm; and

in response to generation of said electrical signal, flexing said diaphragm upwardly and impacting said golf ball with said diaphragm generally upwardly out of said cup means in a generally random manner from one of said random locations, directed generally across said diaphragm.

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