United States Patent [19]

McCulloch et al.

[11] **3,897,059**

[45] **July 29, 1975**

[54] **GOLF BALL PUTTING CUP**

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[22] Filed: **Nov. 16, 1973**

[21] Appl. No.: **416,448**

Related U.S. Application Data

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

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

[51] **Int. Cl.** **A63b 69/36;** A63b 57/00

[58] **Field of Search** 273/34, 179, 127

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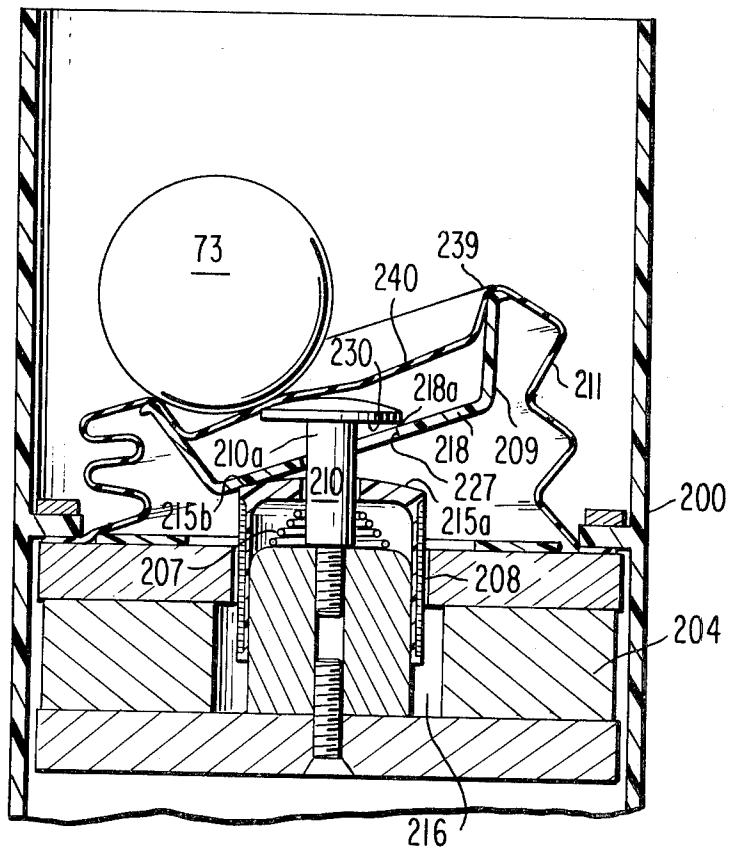
Primary Examiner—George J. Marlo

Attorney, Agent, or Firm—Burns, Doane, Swecker & Mathis

[57] **ABSTRACT**

A golf cup which effects an automatic ejection of a golf ball putted therein, wherein a tiltable, cup-like impacting means is operable to laterally restrain a golf ball and randomly locate the golf ball and thereafter undergo upward tilting movement operable to impart laterally and upwardly directed ball ejecting force to the golf ball.

3 Claims, 12 Drawing Figures



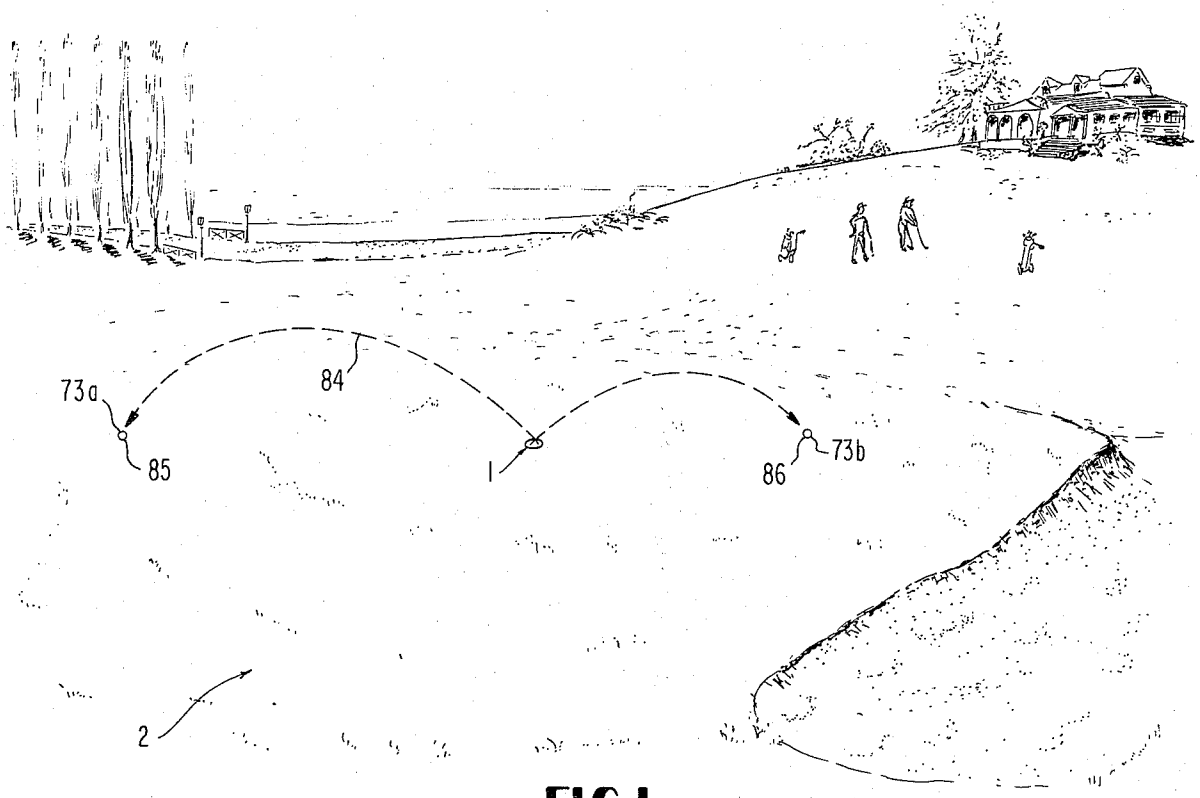


FIG. 1

FIG. 9a

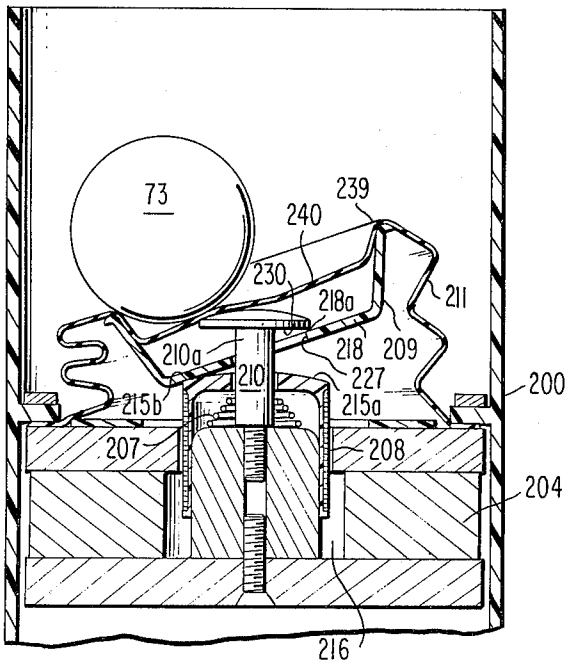


FIG. 9b

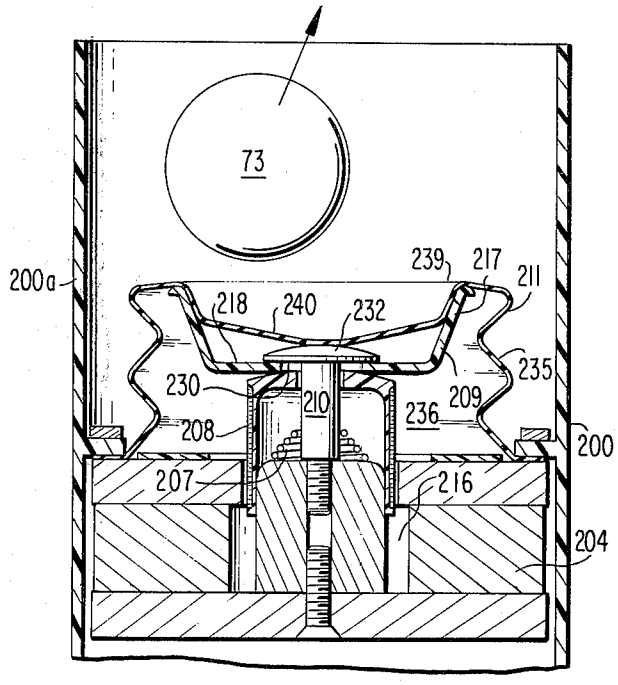
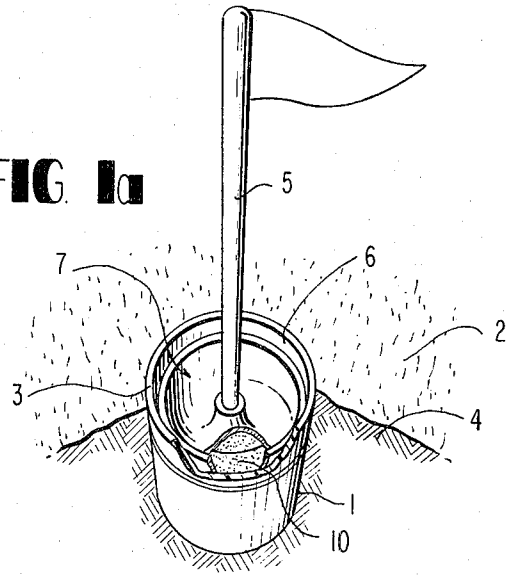


FIG. 1a


5
7
6
2
3
4
1
10

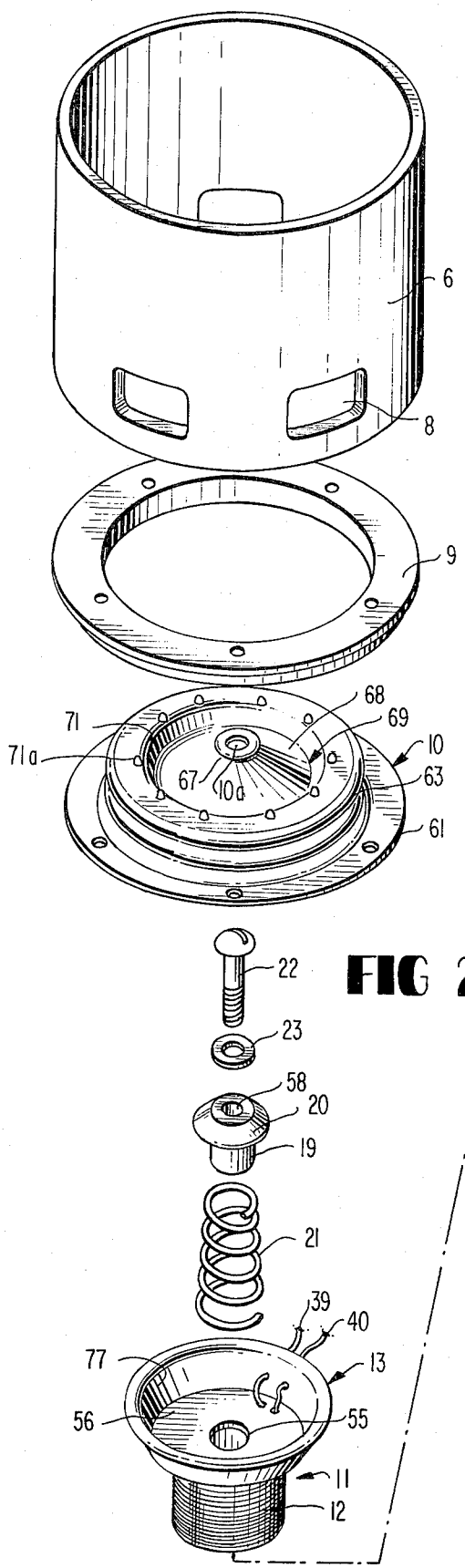

6
8
9
71
71a
68
69
10
67
10a
63
61
22
23
58
20
19
21
39
40
77
13
56
55
11
12

FIG 2

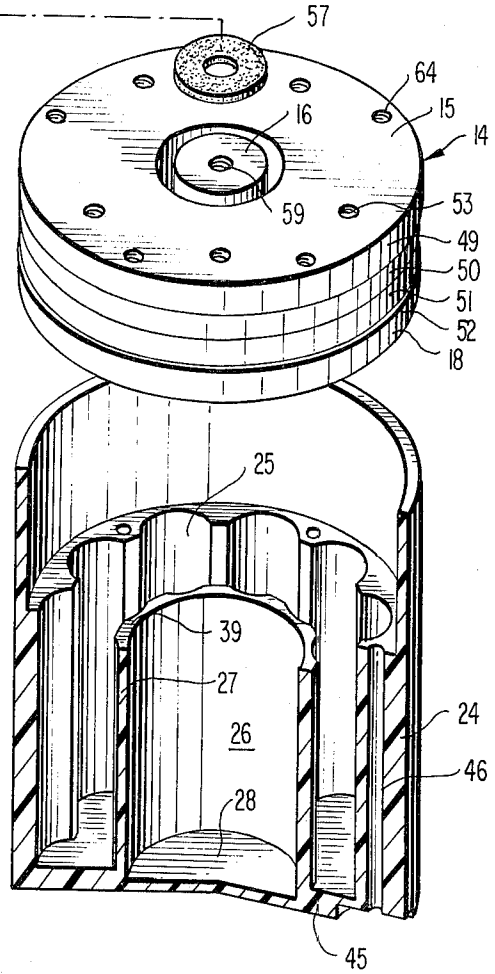
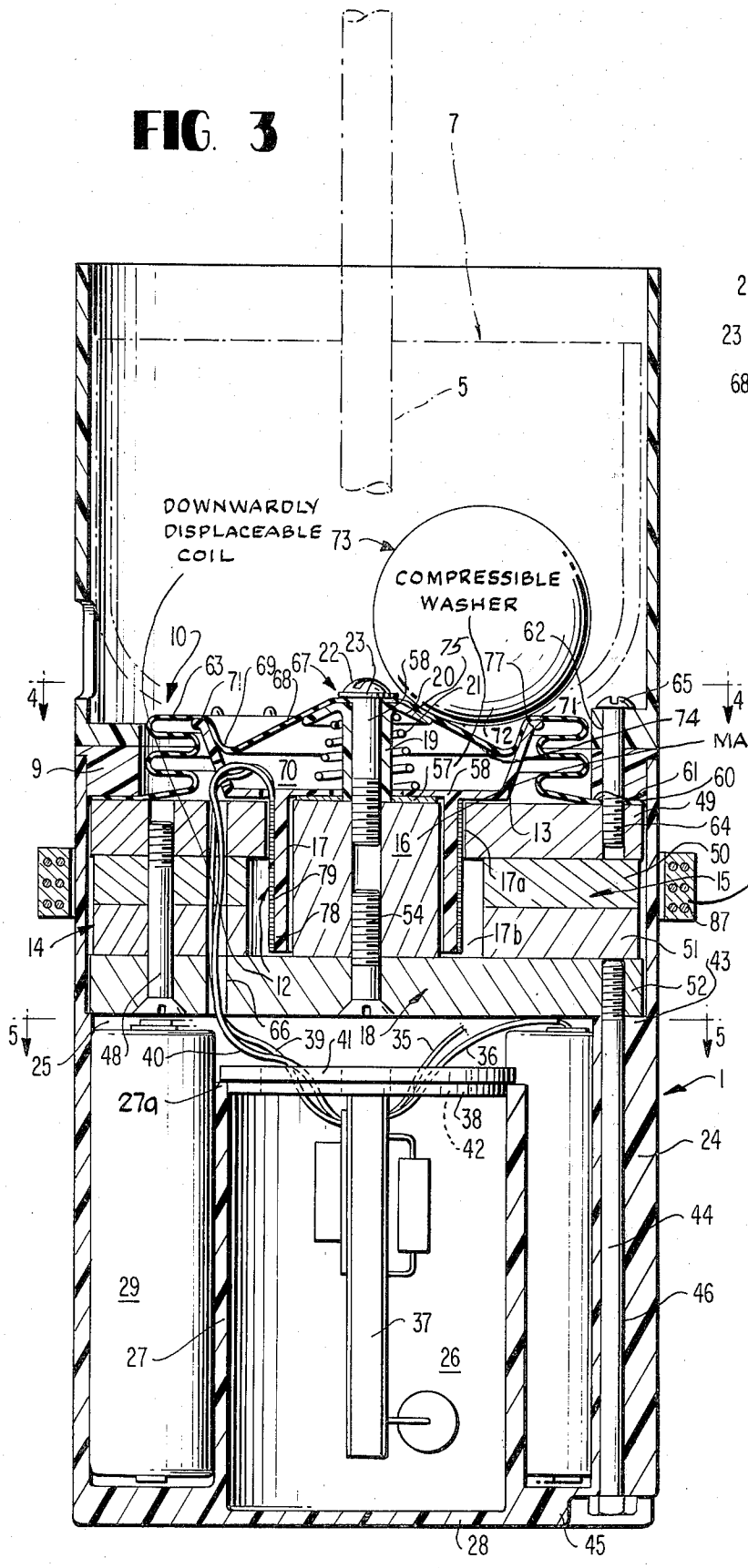

57
64
15
16
14
59
53
49
50
51
52
18
25
39
27
26
24
46
28
45

FIG. 3



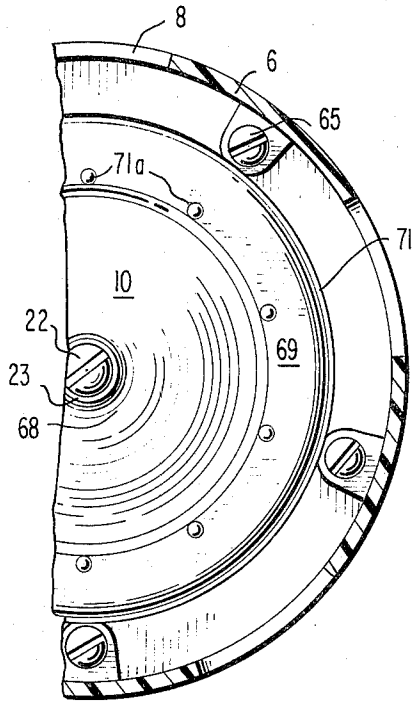


FIG. 4

FIG. 5

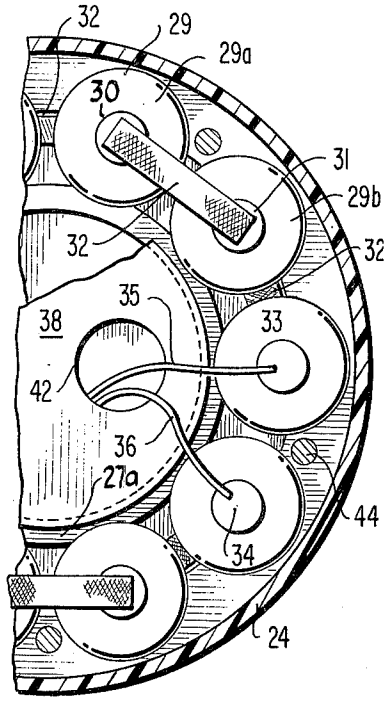
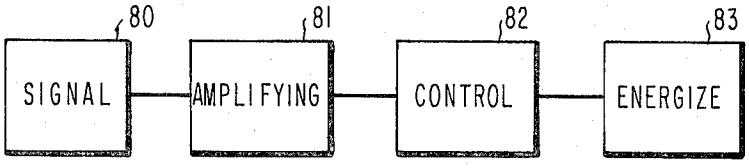


FIG. 6



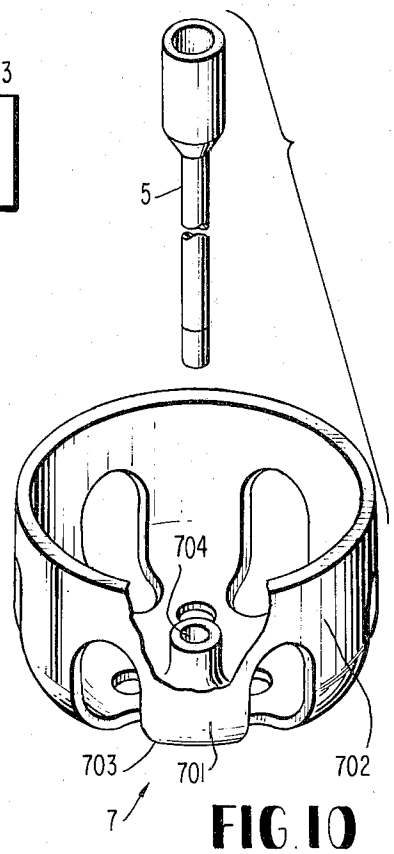


FIG. 10

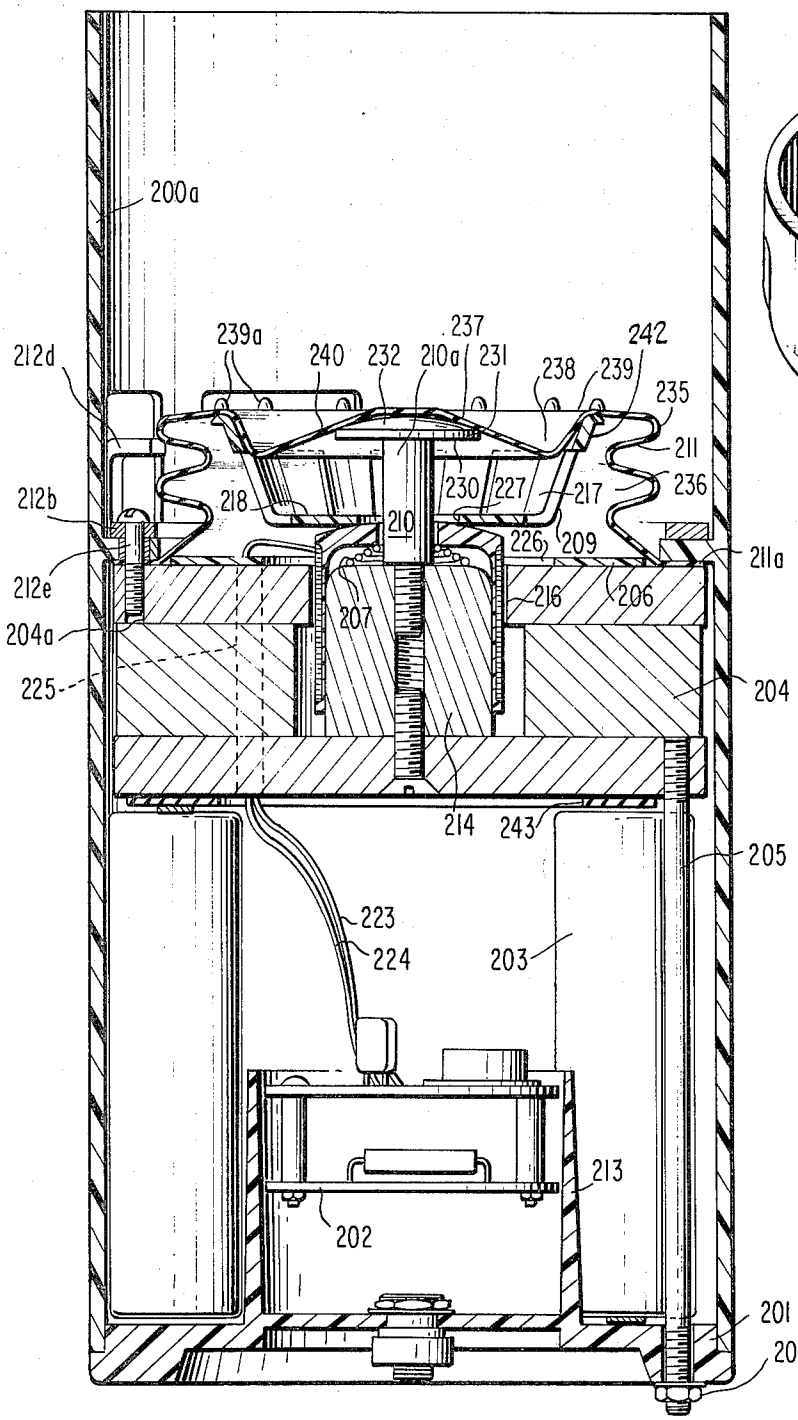


FIG. 7

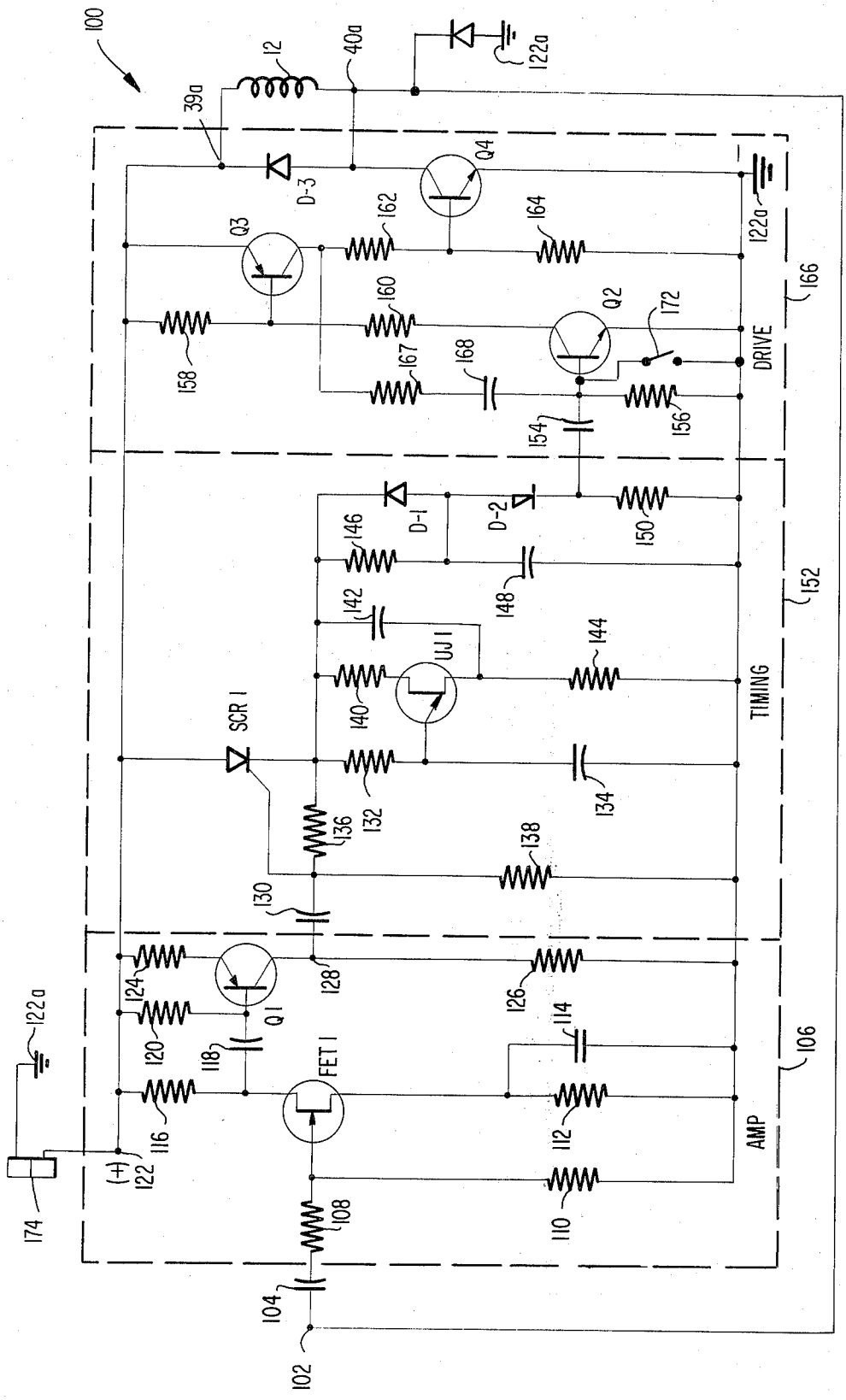
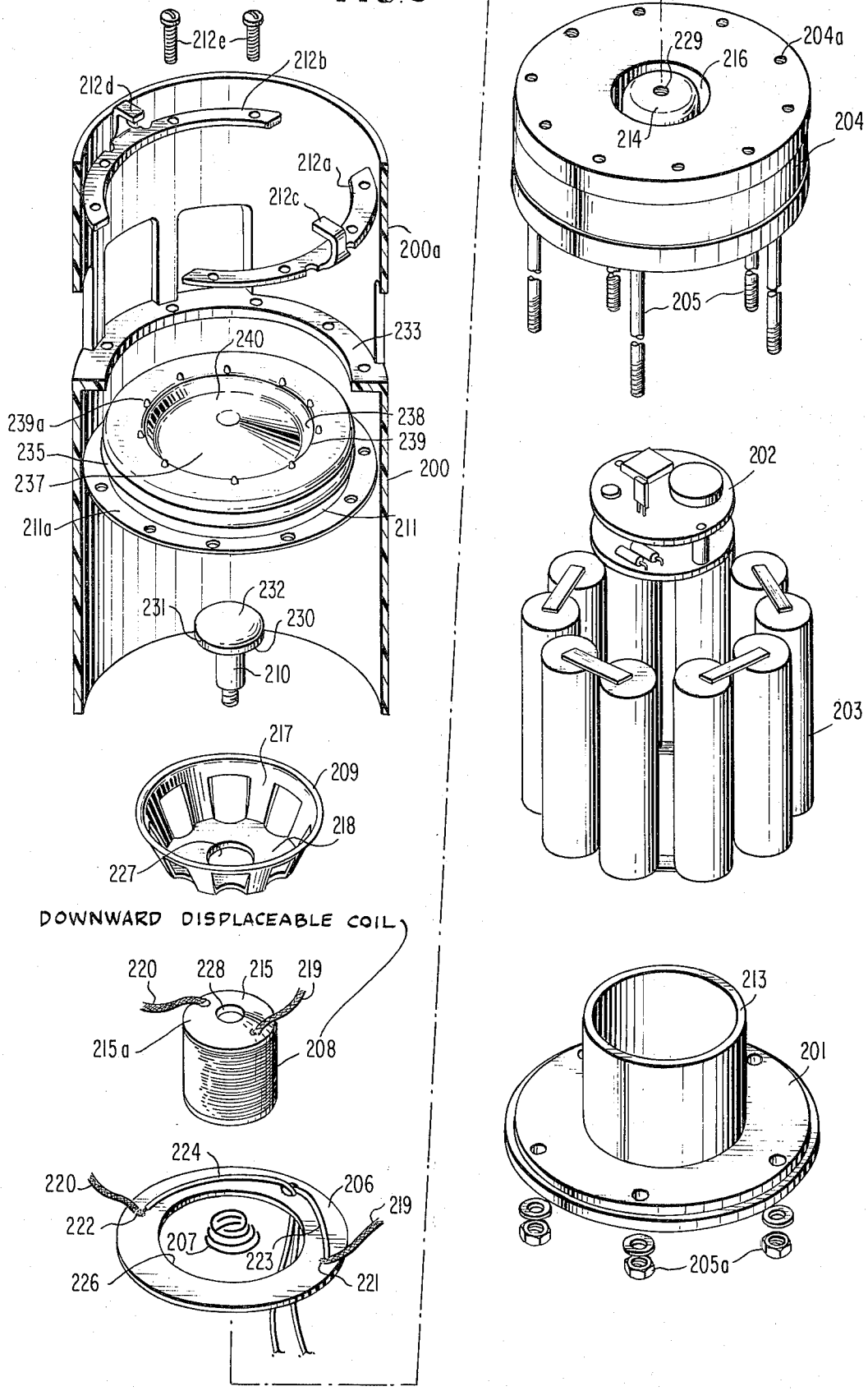

100
12
40a
122a
39a
D-3
Q4
Q3
162
164
160
Q2
172
158
167
168
DRIVE
166
154
156
D-1
D-2
146
150
148
142
152
UJ 1
144
140
TIMING
SCR 1
132
134
136
138
130
124
126
128
Q1
114
120
118
FET 1
106
116
112
AMP
(+)
122
108
110
174
104
102

FIG. 6a

FIG. 8


212e
212b
212d
212a
212c
200a
233
240
239a
238
239
235
237
200
211a
211
232
231
230
210
217
209
218
227
DOWNWARD DISPLACEABLE COIL
220
228
215
219
215a
208
224
220
206
219
222
207
223
226
221
229
216
204a
214
204
205
202
203
213
201
205a

GOLF BALL PUTTING CUP

This is a continuation, of application Ser. No. 186, 289, filed Oct. 5, 1971, 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 United States English et al Pat. No. 3,467,378, and another in United States Pat. Nos. 3,310,311 and 3,310,312.

The English et al and Peeples concepts require the utilization of motor means and a mechanism for rotating a ball ejecting means so as to provide a random ejection pattern. The English et al mechanism is further complicated by integration of a flag pin carried, disabling mechanism with an ejector mechanism and by reliance upon a delay in actuation which is dependent upon "bouncing" or "rimming" action of a golf ball.

The complexity of the English et al and Peeples concepts has significantly limited their practical utility and acceptability in the art.

Thus, in the art there has persisted a need for an automated golf cup 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.

A further need has existed for an automated golf cup concept where the ejecting mechanism is neither structurally nor functionally dependent upon or integrated with irrelevant and/or unnecessarily complicating criteria.

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.

Yet another object of the invention is to provide an automated golf cup concept where the complexities engendered by reliance upon integration of an ejection mechanism disabling device with the ejecting mechanism itself is altogether avoided.

Another object of the invention is to provide such an automated golf cup concept wherein complexities attendant upon delaying the operation of an ejection mechanism in accordance with bounce characteristics of a golf ball or rimming action of a golf ball may be avoided.

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

A further related object of the invention is to provide a diaphragm means which, when subjected to impacted force, is subjected to an increase in tension, with slack being removed, so as to provide effective and unique impacting action.

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.

Another object of the invention is to provide an automated golf cup including a battery source of power and a charging mechanism which enables batteries in the golf cup to be recharged by merely placing the golf cup in an induction field.

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. 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 electric 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 im-

pact a golf ball generally nonradially 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 slack or nontensioned condition. As the golf ball impacting force is directed upwardly against the diaphragm means, slack is at least partially removed from the diaphragm means beneath the golf ball. The imparting of this impacting force concurrent with the at least partial removal of slack from 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 distended and tensioned 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 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.

Another aspect of the invention pertains to the manner in which a golf cup, including a coil means and battery source of power, is placed in an inductive field for the purpose of recharging the battery source of the golf cup.

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 a 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 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. **1***a* provides an enlarged view of the golf cup portion of the FIG. **1** installation, illustrating a conventional flag pin in position and supported by the golf cup;

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;

FIGS. **9***a* and **9***b* provide a schematic, sequential illustration of the manner in which a coil and generally frustoconical 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; and

FIG. **10** illustrates a telescoping socket arrangement which may be employed to secure a flag pin in the golf cup of the present invention in operationally and structurally disconnected relationship with the golf ball ejection mechanism itself.

DETAILED DESCRIPTION OF PRESENTLY PREFERRED EMBODIMENTS

The context in which the present invention is practiced is generally illustrated in FIGS. **1** and **1***a*.

As there shown, a golf cup **1** is positioned on a putting green **2**. The upper rim **3** of the golf cup **1** is generally recessed about three-quarters to one inch below ground level **4** of the green **2**.

As shown in FIG. **1***a*, while golfers are driving toward the green, a flag bearing pin **5** would ordinarily be telescopingly received by a cylindrical, ball receiving, upper portion **6** of the golf cup **1**.

Support of the flag bearing pin **5** may be facilitated by an upwardly opening can-like, semi-ellipsoid, semi-spheroid, or cylinder-like structure **7.** Mounting structure **7** is connected to the lower end of the pin **5** and telescopingly engages the inner side wall of the ball receiving cup portion **6.**

As shown in FIG. **10,** the pin **5** in a presently contemplated arrangement may be telescopingly or socketingly supported by a perforate can-like structure **701.**

This structure **701** may comprise a perforate, generally cylindrical side wall **702** and a rounded edge, perforate wall **703,** and a pin receiving socket **704.**

The pin **5,** when assembled with socket **704,** may be readily supported in the cup **6** by merely telescopingly inserting the wall means **702** into telescoping cooperation with the interior of the ball receiving cup **6.**

Thus, this flag pin supporting arrangement corresponds substantially to prior art arrangements akin to those described in such U.S. Pat. Nos. as Jacoby U.S. Pat. No. 2,684,245.

This telescoping arrangement, operable to support a flag pin, is generally conventional in nature and antedates the automated golf cup art.

This pin supporting arrangement is thus devoid of operational integration or structural integration with the golf ball ejecting mechanism itself which comprises the present invention.

With the general 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 interconnect 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 nickel 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 bridge 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, the 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 telecopingly 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 structurally 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 71*a* may be carried by rim 71, generally as illustrated in FIG. 3. These bumps perform a ball arresting function in a manner to be subsequently described.

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., nonplanar or tensioned, condition. However, it will here be recognized that such a slack 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 with the pin 5 and supporting can 7 (shown in phantom in FIG. 3) removed, a golf ball 73 entering the cup portion 6 will tend to come to rest 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 come to rest 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 esscence, 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 would 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 **81** of FIG. **6**.

Circuit **37** may incorporate a timing circuit which will cause a pulse or flow of electrical energy to be directed back through leads **39** and **40** to coil winding **79** only after a delay. This delayed transmission of an electrical flow of electricity to coil **12** is depicted by block **82** of FIG. **6**.

The delay contemplated may be on the order of one or more seconds. Significantly, this time delay is quite short. It may desirably be sufficient to allow a ball to come to rest in recess **69**, on the side of the cup opposite from that where the putted ball enters. When the ball comes to rest in this manner, it may tend to be ejected back toward the putting player.

All in all, the limited delay contemplated in the present instance is related to optimum, impact functioning aspects of the apparatus and not to difficult to predict bounce or rimming characteristics of a golf ball.

In marked contrast, the prior art as exemplified by the previously noted U.S. English et al Pat. No. 3,467,378 teaches that an ejection mechanism should be delayed for a time sufficient to ensure that a golf ball exiting a cup did not bounce from or rim cut of the cup but was ejected by the ejection means.

This delay concept is illusory in that the English et al ejection mechanism could well be actuated by a bouncing ball and operate after a delay period and after a ball had started to bounce clear of or rim out of a cup.

This invention thus recognizes that adequate golf ball ejecting operation may be effected without trying to predict and rely on delay factors which are dependent upon bouncing or rimming tendencies of a golf ball. Instead, the structural nature of the actuating components of the invention is such that the generation of an actuating signal will, as a rule, occur only when a ball is effectively confined by the cup and could leave the cup only in response to operation of the ejecting mechanism.

The series of upwardly projecting protuberance **71a** on top of rim **71** are engageable with the under side of a ball **73** rolling around recess **69** and will act as arresting means tending to bring the ball to rest in this short delay time (i.e., a second or so or less).

After the short time delay, 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 upward 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 distension, stretching or tensioning of the wall means 68.

This distending of the wall means 68 will tend to remove at least some of the slack 76 and tension, or at least tend to partially stretch, the wall means 68 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 of wall means 68 remains engaged with center support means 22 as cup 13 is reused, diaphragm flexing and/or slack removal in top wall 68 probably 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 ejected 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 on 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 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 employed 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* amd 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 is loosely suspended in a magnetic 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 generates an e.m.f. across the terminals of the winding 79 of 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 twostage 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 Q1. The base electrode of the transistor Q1 is connected through a resistor 120 to the source of positive potential 122, the emitter electrode of the transistor Q1 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 122a.

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 timing circuit indicated as 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 to 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 unijunction transistor UJ-1 and through a capacitor 142 to the first base electrode thereof. This 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 cathode of the SCR-1 is also connected with terminal 122*a* through a series connected resistor 146 and a capacitor 148. The cathode

of the rectifier SCR-1 is also grounded to negative terminal 122*a* through a series connected PN junction diode D-1, a PNPN four-layered diode D-2 and a resistor 150.

The junction of the diode D-2 and the resistor 150 serves as the output terminal of a timing circuit 152 and is connected 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 166 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 118 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 164 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 timing circuit 152 to initiate the timing cycle begun by the pressure of the golf ball in the cup.

The conduction of the silicon controlled rectifier SCR-1 is triggered by this amplified signal from the coil 12. The timing circuit 152 consists basically of two relaxation oscillators. In the first of these, the forward breakover voltage of the four-layered diode D-2 is selected at approximately 9 to 11 volts and the values of the resistor 146 and the capacitor 148 are conveniently selected to provide a time constant such that this voltage level is reached approximately 1.0 seconds after the conduction of the SCR-1 is initiated. Upon the conduction of the diode D-2, the charge accumulation on the capacitor 148 is discharged through the diode D-2 and the resistor 150 and the pulse thus developed across the resistor 150 is applied through the capacitor 154 to the drive circuit generally indicated at 166.

With reference to the second relaxation oscillator of the timing circuit 152, conduction of the rectifier SCR-1 also applies 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 unijunction 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, 0.2 seconds 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 short 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 or possibly the flag pin mount 7, 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 on 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 three important functions in the circuit of FIG. 6a. It serves first as a sensing element to develop a signal when the golf ball drops into the cup. Secondly, after a predetermined time delay, the coil 12 functions as the linear actuator for ejecting the golf ball from the cup. The third function is that of a secondary winding of a transformer by which the battery pack which comprises the source 122–122*a* may be recharged.

The nature of the circuit shown in FIG. 6a is such as to permit an inductively induced flow of electricity in coil winding 79 to be transmitted through junctions 122

and 122*a* and charge the series connected battery means 29.

The structure, mode of operation and circuitry of one embodiment of the golf cup means 1 having been described, it is here appropriate to consider the manner in which the battery means 29 may be inductively recharged without requiring disassembly of the components of the golf cup itself.

GOLF CUP BATTERY RECHARGING

Based upon experience or empirical factors, the operator of a golf course, on a regularly scheduled basis, may remove each automated golf cup 1 on a golf course for recharging operations. This servicing could be effected by simply lifting each cup 1 from its recess in a green 2 and transporting the cup to a service location.

At this location, the cup 1 may be positioned such that a charging coil 87 encircles the exterior of the cup 1 in the vicinity of the coil 12.

With charging coil 87 thus inductively coupled to coil 12, the inductive relation between coils 12 and 87 will, via transformer action, cause a flow of charging electricity to be generated in the coil 12. This flow of electricity will be transmitted through the circuit shown in FIG. 6*a*, to the battery terminals 122 and 122*a* so as to provide a charging flow of electricity to the battery pack or cells of interconnected batteries 29. Flow to terminal 122*a* may take place through silicon isolation diode 170.

The timing and intensity of the charging flow may be empirically determined so as to ensure that the inductive charging of the golf cup battery pack does not induce overcharging.

It is also contemplated that, in certain instances, inductive charging of the golf cup units 1 may be effected in the field by providing a charging coil 87 operable in the field to effect inductive charging of the battery means 29.

To facilitate the deactivation of circuit 100 when cup 1 is being transported to a charging station and while it is being charged, 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.

So as not to place sole reliance upon induction charging, the circuit 100 may include a jack or plug connection 174, shown in FIG. 6*a*, operable to be connected to a charging apparatus. The jack or plug 174 may be located in base wall 28 and accessible from the exterior of cup 1, when it is removed from a green and inverted for charging purposes. When a charging apparatus is connected to jack 174, charging current will be transmitted directly to the battery pack. Desirably, the charging apparatus may comprise a McCulloch Rapid Charger (Registered Trademark) battery charger, operating on principles described in patents and patent applications including U.S. Burkett et al Pat. No. 3,517,293.

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, will 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 nuts 205a 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 junction 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 of 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 onto 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 rounded 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,* and 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,* respectively, 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** of cup **209** 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** may serve to somewhat distend or tension the diaphragm and remove slack from the bellows **235** and possibly the top wall **237.** Here, again, it is believed that this action may to some extent, not perfectly understood, cooperate with the impacting force directed against the diaphragm 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 in connection 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 the 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 at a suitable time (probably after a slight delay), a return flow of electricity will be transmitted from the battery pack **203,** back to the windings of the coil **208.** This flow of electricity will induce an upward abrupt movement of the coil **208.** This upward abrupt movement will cause the cup **209** to move upwardly such that the upper rim **242** 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.**

During this impacting action some slack in concave area **238** may be removed. Such a removal of slack, to the extent it effectively occurs, may tend to provide an "Eskimo-blanket toss" or "snap" action which may contribute to the efficiency of the ball impacting action and the obtaining of a random, non-radial, ejecting action. The removal of slack from bellows **235** so as to relieve any pressure reduction in cavity **236** will further enhance the impacting action.

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 throw a ball further away from the cup than the throwing distance which would ordinarily be obtained by a mechanism where these components were unitized.

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

As shown in FIG. *9a*, 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. *9a*, such an initial pivotal movement will be in a 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. *9b*. 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, with 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 **211** 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. *9b*, 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 *6a* 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.**

The assembly shown in FIG. **7** includes the aforesaid plug **174** mounted in the base **201** of housing **200–201** of the second embodiment golf cup. With this golf cup removed from its socket or hole in a green, it may be readily inverted and connected with the plug of a charging circuit as previously noted.

Alternatively, the cup could be inverted and inductively charged in the manner previously noted. In either event, the automatic opening of mercury switch **172** would prevent the damaging of, or inadvertent operation of, the ejecting mechanism during the charging operation and/or the transportation of the inverted cup to a charging location.

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 more 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 overlying the upper end of the battery pack, is shown generally 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.

Furthermore, the prior art concept, anticipating a delay in the operating of an ejection mechanism dependent upon cup rimming or bouncing characteristics of a golf ball, has been found to be unnecessary.

In addition, it has been discovered that conventional flag pin supporting arrangements — totally divorced from the structure and mode of operation from the golf ball ejecting mechanism — may be employed such that flag pin supporting structures antedating the automated golf cup art, as exemplified by the English et al patent, may be utilized.

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 use of the coil as the impacting device in a golf ball ejecting mechanism provides a uniquely convenient vehicle for effecting inductive charging of a battery pack which serves to actuate the golf cup ejecting mechanism.

The overall assembly provides 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 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 overlying the cup.

The removal of slack from the diaphragm and the distending of the diaphragm may also significantly contribute to effective impacting action.

In this connection, the removal of slack may be advantageous in that it may entail either the removal of slack from the upper portion of the diaphragm or the removal of slack from the bellows portion so as to offset any pressure reduction beneath the diaphragm which might impede diaphragm movement.

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.

In describing the 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 invention.

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 invention as defined in the appended claims.

What is claimed is:

1. A golf cup apparatus comprising:

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

generally concave, upwardly opening, ball impacting means positioned generally interiorly of said housing and including

base means extending generally transversely of a vertical axis of said golf cup, and

rim means extending upwardly from said base means and operable to exert laterally directed, ball restraining force on a golf ball disposed above said ball impacting means in force receiving cooperation therewith;

pivot means pivotally supporting said ball impacting means for random tilting movement relative to said golf cup axis; and

impact force applying means operable to transmit ball impacting force to said base means operable to tilt said ball impacting means about said pivot means, with said ball impacting force being operable to be transmitted through said ball impacting means to a golf ball which is laterally restrained by said rim means and disposed in force receiving cooperation with said ball impacting means;

said generally concave, ball impacting means being operable to

tilt downwardly on one side thereof in response to the weight of a golf ball acting thereon, with said rim means exerting a restraining force on said golf ball, causing it to be supported on said one side, and with said downward tilting being random in nature in accordance with the location on said ball impacting means where the weight of said golf ball is applied, and

tilt upwardly on said one side, in response to said transmission of said impacting force thereto, and impart golf ball ejecting force to said golf ball during said upward tilting directed upwardly and transversely of said golf cup means.

2. An apparatus as described in claim **1** and further comprising:

diaphragm means operable to support a golf ball in said golf cup means, said diaphragm means being supported by, and located above, said generally concave, ball impacting means;

said diaphragm means including

upwardly opening, generally annular, ball receiving recess means supported by said rim means and operable to support a golf ball at random locations therein, with said laterally directed, ball restraining force being transmitted through said diaphragm means to a golf ball supported in said recess means.

3. An apparatus as described in claim **2** wherein:

said generally concave, ball impacting means comprises a generally frusto conical cup,

with said base means defining the base of said cup and having a central opening, and with said rim means defining the lateral periphery of said cup;

said pivot means comprises

retainer means anchored in said housing and passing upwardly through said central opening of said cup in generally laterally spaced relation with the periphery of said central opening; and

said impact force applying means comprises

electrical coil means telescopingly associated with said retainer means and having an upper, annular end operable to randomly impart force to the underside of said base means by engaging the underside of a downwardly tilted portion of said base means, and

electro-magnet means operable to induce upward movement of said electrical coil means capable of imparting said force to the underside of said base means.

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