Jan. 23, 1968 W. D. CORNELL ET AL 3,364,751

GOLFING TARGET AND GOLF BALL SPIN DETECTING APPARATUS

Filed July 8, 1965 3 Sheets-Sheet 1

Fig. 1.

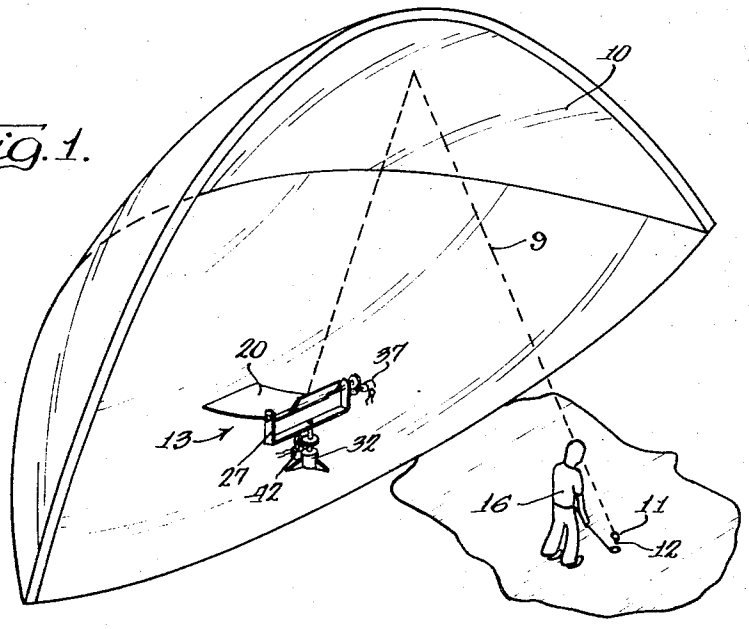
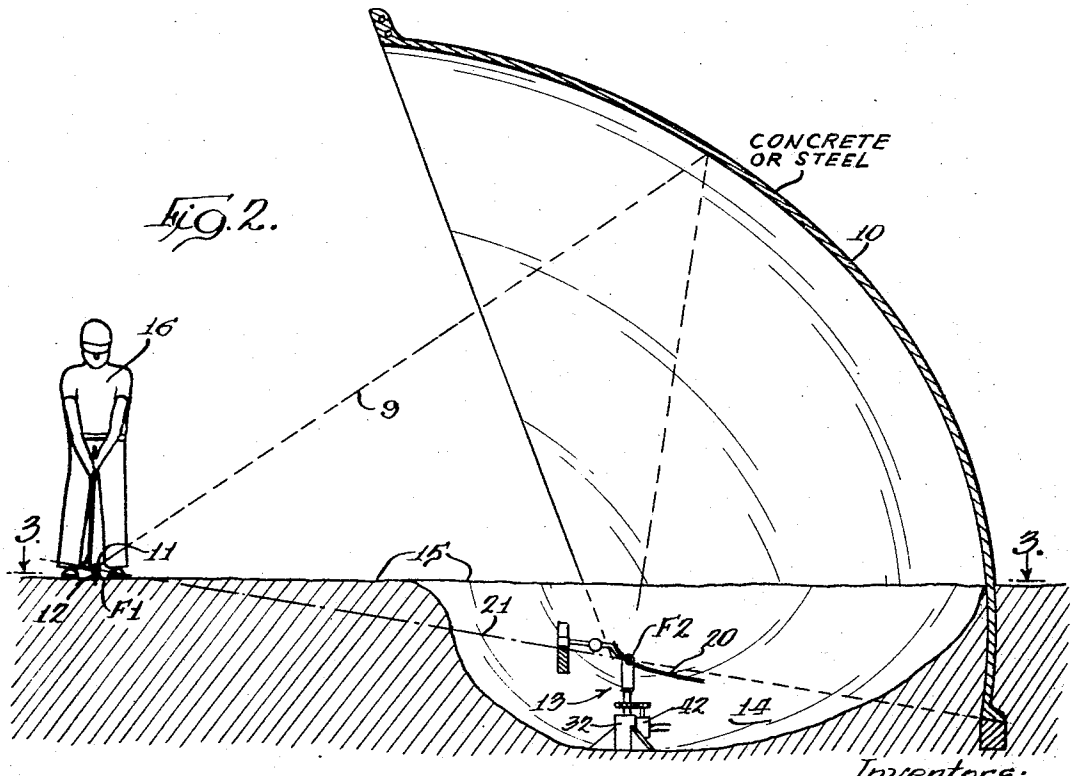


Fig. 2.



Inventors:
William D. Cornell
Donald F. Vecker
By Hofgren, Wegner, Allen, Stellman & McCord
Attorneys

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GOLFING TARGET AND GOLF BALL SPIN DETECTING APPARATUS

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Fig. 4.

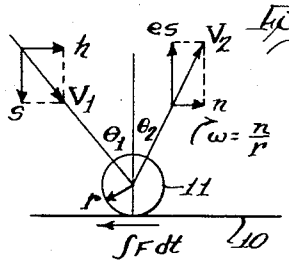

Fig. 3.

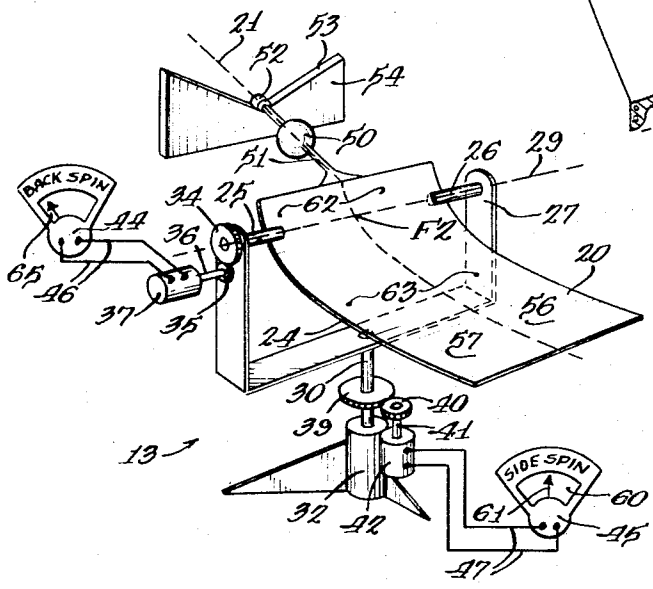

Fig. 5.

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Fig. 6.

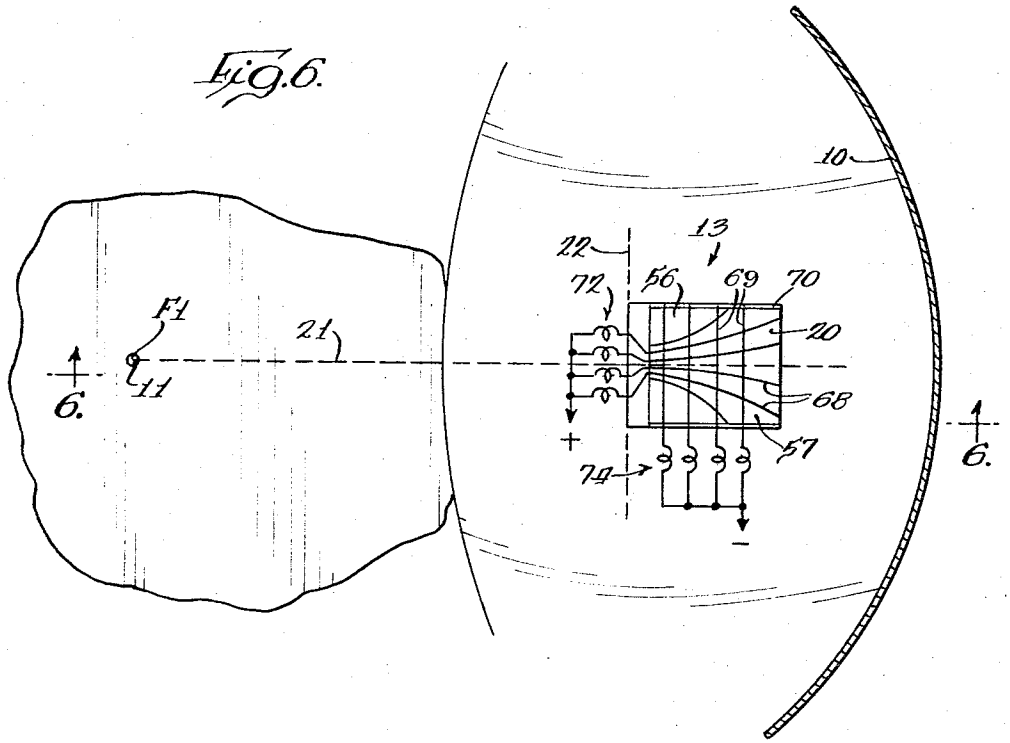
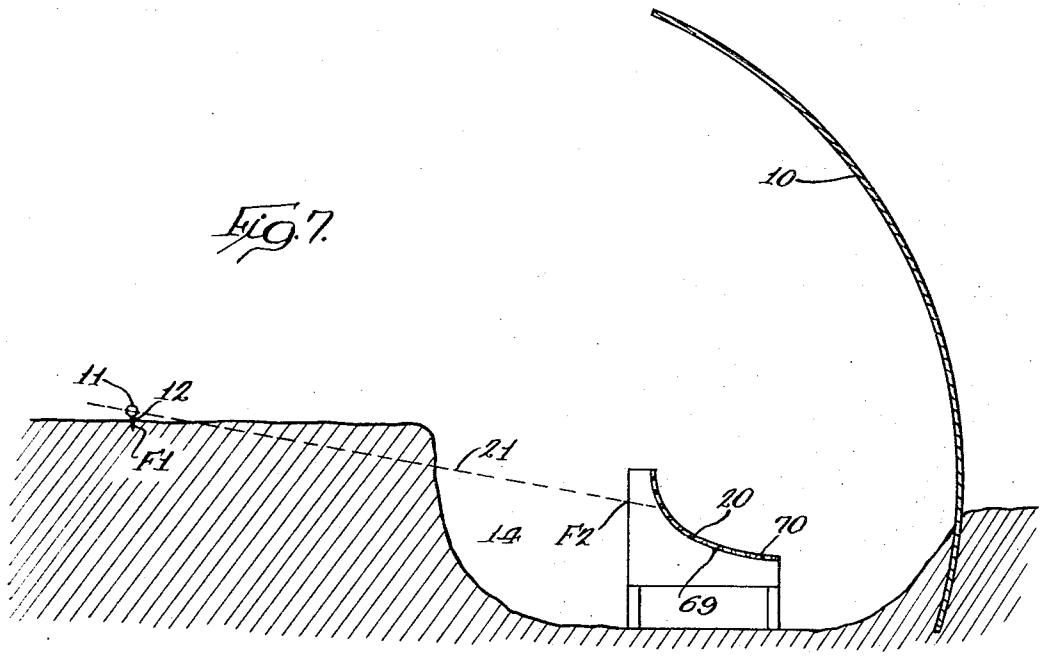


Fig. 7.



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3,364,751

GOLFING TARGET AND GOLF BALL SPIN DETECTING APPARATUS

William D. Corneil, Grand Haven, and Donald F. Uecker, Spring Lake, Mich., assignors to Brunswick Corporation, a corporation of Delaware

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14 Claims. (Cl. 73—432)

This invention relates to apparatus used in a game, and more particularly to apparatus for a golf game that may be played indoors.

In the present invention a novel shell and ball receiver are preferably used to detect the spin on a driven golf ball. Furthermore, the novel shape and construction of the target shell causes the driven golf ball to rebound, regardless of the point of contact of the ball with the shell, to a small area that is at a distance from the tee where the golf balls are driven. Thus the rebounding golf balls are removed from the immediate area where the players are located, producing a safe and realistic game.

It is therefore a principal object of this invention to provide new and improved game apparatus which may be used indoors.

Another object of this invention is to provide apparatus for an indoor golf game with means for automatically determining the total spin on a driven golf ball.

Yet another object of this invention is the provision of a novel shell for intercepting and rebounding golf balls downwardly towards a localized relatively small area or ball receiver that is safely removed from the vicinity of the players.

One feature of this invention is the provision of a novel shell in the shape of an ellipsoidal form, for rebounding golf balls, driven without spin from the tee, towards a common point of intersection. Golf balls driven with a spin rebound towards a localized small area surrounding the common point, and miss the common point by a distance that is proportional to the spin on the driven golf ball.

Another feature of this invention is the provision of a concave ellipsoidal shell, and a ball receiver that is substantially smaller than the shell, for determining the spin on a driven golf ball, located therebeneath, wherein a golf ball, driven from a tee elevated above the receiver, will strike the shell and rebound, regardless of the point of impact of the ball with the shell, into the receiver.

A further feature of this invention is the provision of golf game apparatus in which the spin on a driven ball is automatically computed and made available either to the player or to control a conventional golf image projector and computer.

Further features will be apparent in the following specification and the drawings in which:

FIG. 1 is an elevational view of the golf game apparatus, showing the shell and one embodiment of the ball receiver;

FIG. 2 is a sectional view taken generally through the midsection of FIG. 1;

FIG. 3 is a top sectional view taken along the line 3—3 in FIG. 2;

FIG. 4 is a vector diagram illustrating the various velocity and spin components on a golf ball striking the shell;

FIG. 5 is an enlarged elevational view of the ball receiver shown in FIGS. 1–3;

FIG. 6 is a top sectional view of the shell and another embodiment of the ball receiver with a schematic diagram of a circuit used therewith, the dimensions of the receiver being somewhat enlarged with respect to the dimensions of the shell in order to illustrate the receiver in more detail;

FIG. 7 is a sectional side view taken along the line 6—6 of FIG. 6.

While illustrative embodiments of the invention are shown in the drawings and will be described in detail herein, the invention is susceptible of embodiment in many different forms and it should be understood that the present disclosure is to be considered as an exemplification of the principles of the invention and is not intended to limit the invention to the embodiments illustrated. The scope of the invention will be pointed out in the appended claims.

The golf apparatus disclosed herein as illustrated in FIGURES 1–3, is generally comprised of a concave ellipsoidal shell **10** that is positioned to intercept the path **9** of a golf ball **11** driven from a tee **12** located a short distance in front of the shell. The path **9** of the driven golf ball is merely illustrative of one possible trajectory that the ball **11** may follow. The concave shell **10** is arranged with its bottom portion extending below the horizontal level of the tee and is tilted so that all golf balls driven from the tee **12** towards the shell **10** will impact the surface of the shell and rebound downwardly, regardless of where the balls impact the surface, and towards a small area located below the horizontal level of the tee and between the tee **12** and the shell **10**.

Located around this small area is a ball receiver **13** that intercepts the rebounding balls. As seen more clearly in FIG. 2, the receiver **13** is located in a pit **14** below the ground or floor line **15** on which a player **16** and the tee **12** are located. In the preferred embodiment of this invention, the receiver **13** includes means which determines the total spin on the driven golf ball. This spin could cause, for example, hook or slice if the ball was driven outdoors on a normal fairway.

The receiver **13** has a surface **20** which is slanted away from the direction of players **16** located near the tee **12**. Thus, golf balls rebounding from the shell **10** and striking the surface **20** of the ball receiver **13** are not directed back towards the players.

As seen in FIGS. 2 and 3, a golf ball driven without spin from the tee **12**, having a trajectory as indicated by the dotted line **9**, will rebound off the target **10** and strike a point F2 on the surface **20**. If the golf ball is driven with a spin, the rebounding ball will strike surface **20** outside point F2. The location of impact of the golf ball on surface **20** depends on the direction and magnitude of spin on the driven golf ball. The receiver **13** includes apparatus which detects a rebounding golf ball striking the surface **20**, and uses this information to determine the total spin on the driven golf ball.

The novel target shell **10** that produces the desired rebounding action is a portion of a surface of an ellipsoidal form. The shape of the ellipsoidal can be seen best in FIGS. 1–3. Such a surface may be generated by rotating an ellipse about an axis through its foci. The tee **12** is located at F1, one of the focus points of the ellipse. The receiver **13** is located at or near the second focus point F2 of the ellipse. An ellipse rotated about a longitudinal axis **21** extending through foci F1 and F2, as seen in FIGS. 2–3, will produce an ellipsoidal form, a portion of which is designated as the shell **10**.

The purpose of the ellipsoidal form is to cause all golf balls driven thereagainst to rebound, regardless of where the golf ball strikes the ellipsoidal surface, towards a small area remote from the location of the player. The novel shell **10** allows all golf balls driven without spin to rebound towards a common point of intersection, viz F2. Any balls driven with a spin will not rebound through point F2, but rather through a small area around point F2, thereby providing a unique rebounding target that allows relatively simple means to be used to determine the total spin on a driven golf ball.

In the above discussion, it has been assumed that golf balls reflect off an ellipsoidal surface like light rays. In optical terms, any ray of light emanating from one of the focus point of an ellipsoidal is reflected to the other. As will appear, this is only true for golf balls when the coefficient of restitution and the surface friction are of certain values.

Unlike a light ray reflecting off a surface, a golf ball impacting a massive shell produces an elastic collision in which the angle of incidence is usually not equal to the angle of reflection. A vector diagram showing the reflection of a golf ball off a massive surface is illustrated in FIG. 4. V_1 is the approach velocity having components that are normal *s* and tangent *h* to the surface **10**. The normal component $s=V_1 \cos \theta_1$ and the tangential component $h=V_1$ sine θ_1, where θ_1 equals the angle of incidence of a non-spinning golf ball **11**.

Surface **10** should develop sufficient friction during the impact so that the golf ball **11**, having a radius *r*, will pick up a spin *w* proportional to its tangential velocity *n* along the surface after impact, i.e.,

$$w=\frac{n}{r}$$

The normal velocity after impact will be equal to the coefficient of restitution *e* of the golf ball-shell, times the normal velocity *s*, that is, *es*. During impact, a tangential impulse of $\int F dt$ is applied to the ball, F being friction. The final rebounding velocity V_2 will be the sum of the components *es* and *n*, at an angle of reflection θ_2.

As is apparent from FIG. 4, the various components can have an infinite variety of values in an elastic collision. For the novel shell **10**, however, it is desired to have the angle of incidence equal the angle of reflection, i.e. $\theta_1=\theta_2$, to produce the desired rebounding action.

This desired result is accomplished by simultaneously equating momentum and angular momentum (or moment of momentum). For translation:

$$\int F dt=m(h-n) \quad (1)$$

while for rotation the formula can be expressed as:

$$r\int F dt=Iw=\tfrac{2}{5}mr^2\times\frac{n}{r} \quad (2)$$

I is defined as the moment of inertial of the ball. In the above formula, a golf ball has been assumed to be an elastic mass of homogeneous density, i.e., a sphere. For most purposes, this approximation is accurate enough for the calculations to follow. However, it will of course be realized that the following calculations could be made using a more rigorous mathematical treatment of the moment of inertia of a golf ball.

By rearranging and simplifying Formula 2, the following is obtained:

$$\int F dt=\tfrac{2}{5}mn \quad (3)$$

Equating Formulas 1 and 3:

$$m(h-n)=\tfrac{2}{5}mn;\ h=1.4n \text{ or } n\approx.72h \quad (4)$$

Formula 4 states that the tangential velocity after impact will be approximately .72 times the tangential velocity before impact.

If the normal velocity after impact *es* was approximately equal to .72 times the normal velocity before impact *s*, the ratios of the rebounding velocities would remain the same as before impact, therefore, the angle of incidence θ_1 would equal the angle of reflection θ_2. Since velocity after impact is *es*, if $e=.72$ for the golf ball-shell, the desired result will be obtained, and a golf ball will reflect off the shell in the same manner as light rays.

Any material can be used for the shell **10** in which the coefficient of restitution of the golf ball-shell impact is approximately .72. For present day range-quality golf balls, the shell material may be concrete or steel. Materials such as fiber glass or spun aluminum are, for example, not suitable for this application. It will of course be realized

that if the golf ball is modified in construction, any other materials can be used for the target shell **10**, following the teachings of this invention.

The novel target shell **10** can be used with a variety of ball receivers for intercepting the rebounding golf balls. In the preferred embodiment of the invention, the ball receiver includes means which determine the spin on a ball driven off the tee **12**.

In the preferred form of the shell, F2 is located below F1, as seen best in FIG. 2, producing an ellipsoidal form that is tilted slightly to the horizontal plane, i.e., the floor line **15**. This target shell **10** has the property that any ball **11** hit from the tee **12** towards the shell **10** will rebound off the shell, if the ball has no spin, to the focus point F2. If ball **11** has a spin, it will rebound off shell **10** to an area around the second focus point F2. Located at and around F2 is the ball receiver **13** having a surface **20** which will intercept the rebounding ball.

The illustrative embodiment of the ball receiver **13** shown in FIGS. 1–3 can be seen in more detail in FIG. 5. The surface **20** is formed in the shape of a tray **24**. Extending from and secured to tray **24** are shafts **25** and **26** which rotatably mount tray **24** in a U-shaped frame **27**. The shafts **25** and **26** coincide with the transverse axis **29** which extends through point F2 and is perpendicular to longitudinal axis **21**. Frame **27** is mounted on a vertical shaft **30** which is rotatably mounted in a base **32**. A driving gear **34** is secured to shaft **25** and meshes with a gear **35** which is secured to a shaft **36** of a D.C. generator **37**. A similar driving gear **39** is secured to the vertical shaft **30** and meshes with a gear **40** which is secured to the shaft **41** of D.C. generator **42**. The voltage outputs of D.C. generators **37** and **42** are respectively connected to D.C. voltmeters **44** and **45** by means of pairs of electrical conductors **46** and **47**. Voltmeters **44** and **45** may be located at a distance from the receiver **13**, and preferably are mounted near the tee **12** in view of player **16**.

At the rear of tray **24**, a sliding adjustable counterweight **50** is mounted on a rod **51** that is secured to the back of tray **24**. Rod **51** coincides with the longitudinal axis **21**. The end of the rod **51** is connected to a roller **52** which is movable over a cam surface **53** of member **54**.

As shown in FIG. 3, a ball **11** driven without spin from the tee will rebound off the ellipsoidal shell **10** and impact the receiver illustrated in FIG. 5 at point F2 on the tray **24**. Since point F2 represents the intersection of the longitudinal axis **21**, the transverse axis **29**, and vertical axis coincident with vertical shaft **30**, the tray **24** will not rotate.

If a ball having side spin is driven from the tee, it will rebound off the ellipsoidal shell and strike tray **24** on either side of the longitudinal axis **21**. The longitudinal axis **21** divides the surface **20** of tray **24** into a first area **56** and a second area **57**. The two areas are not physically distinguishable on the surface **20**, but rather are parts of a continuous surface. A golf ball impacting area **56** and **57** will produce a torque about the vertical axis that is coincident with vertical shaft **30**, causing shaft **30** to rotate in its base **32**. The angular velocity that the tray will acquire will be directly proportional to the spin which the golf ball had before reflection from the shell **10**. The rotating tray **24** will rotate the shaft **41** of the D.C. generator **42** through rotation of gears **39** and **40**. If the ball strikes area **56**, the shaft **30** will rotate in one direction, producing an output voltage of one polarity i.e., either positive or negative. Likewise, if the ball strikes the area **57**, the shaft **30** will rotate in the opposite direction, producing an output voltage of the opposite polarity. Therefore, the polarity of the D.C. output voltage will indicate the direction of the side spin, i.e., hook or slice, and the absolute magnitude of the D.C. output voltage will indicate the magnitude of the side spin.

This output voltage can be used to control conventional computers, which are known in the art, or can be fed to voltmeter **45**. The scale **60** of voltmeter **45** can be marked

to directly indicate the type and magnitude of side spin on the ball. The indicating needle 61 of voltmeter 45 rests at the center of scale 60 when no voltage is present. A voltage of positive polarity, e.g., indicating hook, will cause needle 61 to be deflected in one direction along scale 60. Similarly, a negative voltage, indicating slice, will cause needle 61 to deflect in opposite direction along scale 60. Scale 60 may be suitably marked on each side of the center position of needle 61 to indicate the type of side spin, and further marked to indicate the magnitude of the side spin.

The side spin indicated by voltmeter 45 will be completely accurate for all balls driven straight at the target 10 from tee 12, i.e., whose trajectory coincides with a vertical plane through longitudinal axis 21. Balls that are driven at an angle from the longitudinal axis 21, such as that shown in FIG. 3 by trajectory 9, will not rotate tray 24 about shaft 30 as far as it will be rotated when struck by a ball (with the same side spin) driven straight toward the target 10. The error will increase as the angle that the ball is driven from longitudinal axis 21 increases. The portion of shell 10 that is furthest from the receiver 13 will seldom be struck by a driven golf ball. The outer portions of the shell 10 are meant to intercept the occasional golf ball that is misdriven off tee 12 at an extreme angle. Accordingly, the reading indicated by scale 60 will be accurate enough for the vast majority of golf balls driven into target 10.

A ball driven with top or bottom spin will land on tray 24 in either a third area 62 or a fourth area 63, located on either side of transverse axis 29. A ball impacting area 63 will cause tray 24 to tilt about shafts 25 and 26, rotating shaft 36 of D.C. generator 37 through gears 34 and 35. This will produce an output voltage of one polarity whose magnitude will indicate the amount of back spin on the driven ball. After the tray 24 has been moved out of its equilibrium position by the impact of a rebounding golf ball in area 63, the weight of counterweight 50 acting through roller 52 on cam surface 53 causes the shaft 51 to return to its center position, thus returning the tray 24 to its equilibrium position. This construction does not allow tray 24 to tilt back when area 62 is struck by a rebounding ball with top spin. Since a ball is seldom driven with top spin the area 62 is included on tray 24 for safety purposes only, in order to intercept an occasional misdriven ball. As a result, voltmeter 44 responds only to the polarity of output voltage from D.C. generator 37 that corresponds to bottom spin. Similarly, scale 65 of voltmeter 44 is suitably marked to indicate the magnitude of back spin involved.

If it was desired to indicate the amount of top spin, an arrangement similar to that provided for side spin could of course be provided. To do so, member 54 would be removed, allowing tray 24 to tilt back about transverse axis 29. Furthermore, a voltmeter 44 similar to voltmeter 45 would be employed and suitably marked on its scale to indicate both top and back spin. Tray 24 could, in such an alternate construction, be returned to its equilibrium position by means of simple leaf springs in place of the roller 52 and cam surface 53.

The back spin indicated by voltmeter 44 will be in error when balls are driven from the tee with a large angle, similar to the error described in connection with side spin. However, for the great majority of driven balls, the voltmeter 44 will indicate the back spin with a sufficient degree of accuracy for practical purposes.

Most golf balls will be driven with both a side spin and a back spin into target 10. As a result, the ball will impact the tray receiver 24 in either the areas 56 or 57 that overlap area 63. As tray 24 tilts about transverse axis 29 and the vertical axis coinciding with vertical shaft 30, the two voltmeters 44 and 45 will together indicate the total spin on the driven ball.

The gimbaled tray detector described occupies a relative compact area that is under and just in front of the ellipsoidal shell 10, as seen in FIG. 2. This serves two important advantages. First, the receiver 13 for the rebounding balls is located in a protected area away from the area where the players and the tee are located. Because the ball receiver is located below the ground floor, the balls rebounding off target 10 will not be traveling toward the players. In the unlikely event that a ball misses the surface 20 of receiver 13, caused, for example, when a ball is driven at a large angle with an unusually large spin, it will fall in the pit 14 (which may have a layer of sand or other material therein), thus causing no safety problem for the players. The second major advantage is that the player does not see the mechanism used to determine the spin on his ball, but only the indicating meters 44 and 45, thus producing a more realistic game. In fact, a penetrable projection screen could be hung over the ellipsoidal shell 10, hiding its shape and the detection apparatus from view. A scene of the fairway being played could be projected upon the penetrable screen, and a ball image projector could be used to superimpose the image of a driven ball upon the screen. Such a penetrable screen is well known in the art and will not be described in detail herein.

In FIGS. 6 and 7 the shell 10 is shown with another embodiment of a ball receiver 13. The target shell 10 is somewhat smaller than the shell 10 illustrated in FIGS. 1–3, however, it is similar in every other aspect. The dimensions of the receiver are shown somewhat enlarged with respect to the dimensions of the shell 10 in order to illustrate the ball receiver 13 in more detail.

The receiver 13 illustrated has a surface 20 that consists of a matrix of electrical conductors. The longitudinal conductors 68 are mounted on the surface 20. The transverse conductors 69 are held in spaced nontouching relation with the conductors 68 by means of a frame 70. A dead rubber mat may be placed over the electrical matrix formed by the plurality of conductors 68 and 69. When a ball rebounds off the shell 10 and strikes the receiver 13, it will force one of the transverse conductors 69 into electrical contact with a conductor 68.

In order to simplify FIG. 6, only a few of the conductors 68 and 69 have been illustrated. In practice, the individual conductors will be spaced apart so that a rebounding golf ball will always force a transverse conductor 69 into electrical contact with a longitudinal conductor 68.

A plurality of relays 72, one for each longitudinal conductor 68, is connected between each conductor and a source of positive potential. Similarly, a plurality of relays 74, one for each conductor 69, are connected between each conductor and a source of negative potential. When a rebounding ball forces a transverse conductor 69 into electrical contact with a longitudinal conductor 68, an electrical path will be completed between the positive and negative source, and a current will flow through those conductors, causing the corresponding relays to be actuated.

These relays can control contacts, such as reed switches (not shown), which indicate the position that the rebounding ball strikes surface 20. This position can be calibrated with reference to longitudinal axis 21 and transverse axis 22, to correspond to a particular spin, in the same manner that the meters 44, 45, shown in FIG. 5, were calibrated. Apparatus for indicating where a missile strikes a matrix of electrical conductors in a target-like area are well known, and as such form no part of applicants' invention. Such apparatus can be controlled by the relays 72, 74 illustrated.

In the embodiment illustrated, the focus point F2 is not located on the surface 20, but at a short distance behind it. As a result, the balls driven from tee 12 without spin will not land at a single location but rather within a small annular area in front of F2. Similarly, balls driven with spin will usually land outside this small annular area. With the instant construction it is not possible to deter-

mine the spin on a rebounding ball as accurately as in the embodiment illustrated in FIGS. 1–5. However, the spin can be determined with only a slight error from that determined with the receiver shown in FIG. 5. The error depends upon the distance that the small annular area is located from F2. While it is preferred that the focus point F2 be located on surface 20, it is recognized that such a construction is not necessary if the error produced by the embodiment of FIGS. 6–7 is allowable.

The two receivers shown in the drawings are only illustrative of the many forms a practical ball receiver may take. Any device that indicates the location of impact of a rebounding ball with reference to the longitudinal and transverse axis heretofore described can be used as a spin detector.

For the purposes of this disclosure, a receiver is defined as any device having a surface which intercepts rebounding golf balls. The word between, as in focus point F2 being located between focus point F1 and the target, is defined to mean being located generally in the space between a plane containing F1 and a surface containing the target, and therefore includes locations not only along the straight line paths between F1 and all points on the target, but also all locations above, below, or to one side of those paths.

We claim:

1. A golf game apparatus having in combination: a tee for a golf ball; a target against which a ball strikes and rebounds when driven from said tee, having a surface which forms a portion of an ellipsoidal shell, said ellipsoidal shell having a first and a second focus point, said second focus point being located at a distance from said first focus point; said tee being located at or near said first focus point; a receiver for a ball rebounding from said target, having a surface adjacent said second focus point; the material of said shell being such that a golf ball driven from said tee towards said target will rebound from said target, regardless of the point of contact on said target, to said surface of said receiver.

2. The apparatus of claim 1 wherein said second focus point and said receiver are both located below a horizontal plane passing through said tee.

3. A golf game apparatus having, in combination: a tee for a golf ball; a target against which a ball strikes when hit from the tee, in the shape of a shell of an ellipsoidal form, the material of said target being such as to direct all golf balls hit from said tee to rebound from the shell, regardless of the point of contact of the ball with the shell, to within a small area below the shell if such balls are without spin and to locations outside said area if said balls are spinning; a ball receiver having a surface located at and around said area; and means to detect the location each spinning ball strikes said surface outside said area to thereby determine the direction of spin of each spinning ball.

4. A golf game apparatus having in combination: a tee for a golf ball; a target against which a golf ball strikes and rebounds when driven from said tee, having a surface which forms a portion of an ellipsoidal shell, said ellipsoidal shell having a first and a second focus point, said second focus point being at a distance from said first focus point and between said first focus point and said target; said tee being located at or near said first focus point; a receiver for a ball rebounding from said target, having a surface which is adjacent said second focus point, divided into a first and second area by a longitudinal axis defined by a line extending through said first and second focus points; the material of said target being such that a golf ball driven from said tee towards said target will rebound from said target, regardless of the point of contact of said ball with said target, to within a small area on said surface of said receiver if said ball is without spin, and to said first area if said ball has a side spin in one direction, and to said second area if said ball has side spin in the opposite direction; and means to detect the location of impact of said ball in one of said areas to determine thereby the side spin on said ball.

5. The apparatus of claim 4 wherein said surface of said receiver comprises a tray rotatable about a vertical axis through said second focus point; wherein a ball rebounding from said target will rotate said tray about said vertical axis when said ball strikes said first or second areas; and means to convert the rotation of said tray into electrical voltages indicative of the side spin on said ball.

6. The apparatus of claim 4 wherein said surface of said receiver comprises a matrix of electrical conductors which produce a signal when struck indicating the location of impact of a rebounding ball.

7. The apparatus of claim 4 wherein said receiver surface is additionally divided into a third and fourth area by an axis which is transverse to said longitudinal axis and passes through said second focus point; the material of said target being such that a golf ball driven from said tee towards said target will rebound from said target, regardless of the point of contact on said target, to within said third area if said ball has overspin, and to within said fourth area if said ball has underspin; and second means including said first mentioned means to determine the total spin on said ball.

8. A golf game apparatus having in combination: a tee for a golf ball; a target against which a golf ball strikes and rebounds when driven from said tee, having a surface which forms a portion of an ellipsoidal shell, said ellipsoidal shell having a first and a second focus point, said second focus point being at a distance from said first focus point and between said first focus point and said target; said tee being located at or near said first focus point; a receiver for a ball rebounding from said target, having a surface adjacent said second focus point, divided into a first and second area by a longitudinal axis defined by a line extending through said first and second focus points, said surface being further divided into a third and fourth area by a transverse axis defined by a line extending through said second focus point and transverse to said longitudinal axis; a pit, completely contained within a space located below a horizontal plane passing through said tee; said receiver being located in said pit; the material of said target being such that a golf ball driven from said tee towards said target will rebound from said target, regardless of the point of contact of said ball with said target, to within a small area on said surface of said receiver if said ball is without spin, and to said first or second area if said ball has a side spin, and to said third or fourth area if said ball has a top or bottom spin; and means for detecting the location of impact of a rebounding ball in said areas to determine the spin on the ball.

9. In a golf game, a target against which a driven golf ball strikes and rebounds, comprising: a shell, which is a portion of an ellipsoidal surface having a first and a second focus point, the material of said shell being such as to cause a golf ball driven without spin from said first focus point to rebound from said shell, regardless of the point of contact of the ball with the shell, towards said second focus point located between said first focus point and said surface.

10. In a golf game having a tee for driving golf balls therefrom, a target against which the driven golf balls strike and rebound, comprising: a shell having a concave surface defining a ball rebounding area, said shell being composed of a material having friction sufficient to cause a driven golf ball to rebound with a spin proportional to its tangential velocity along the shell after impact, said shell being so constructed and arranged that the ratio of rebound velocity to initial velocity is such that all golf balls rebound from said shell, regardless of the point of contact therewith, to converge toward an area significantly smaller than said rebounding area;

and detecting means for determining the rebound location of the ball within said smaller area and for providing a signal representative of the spin on said ball.

11. In a golf game having a tee for driving golf balls therefrom, a target against which the driven golf balls strike and rebound, comprising: a shell, which is a portion of an ellipsoidal surface having a first and a second focus point, said shell being composed of a material having friction sufficient to cause a driven golf ball to rebound with a spin proportional to its tangential velocity along the shell after impact, said shell being so constructed and arranged that the ratio of rebound velocity to initial velocity is such that all golf balls driven without spin from said first focus point rebound from said shell, regardless of the point of contact of the ball with the shell, towards a common point at said second focus point.

12. The target of claim 11 wherein said ratio is approximately .72.

13. The target of claim 12 wherein said material is concrete.

14. The target of claim 12 wherein said material is steel.

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ANTON O. OECHSLE, *Primary Examiner.*

G. J. MARLO, *Assistant Examiner.*