March 19, 1968 W. H. THOMPSON ET AL 3,373,612

MECHANICAL GOLFER

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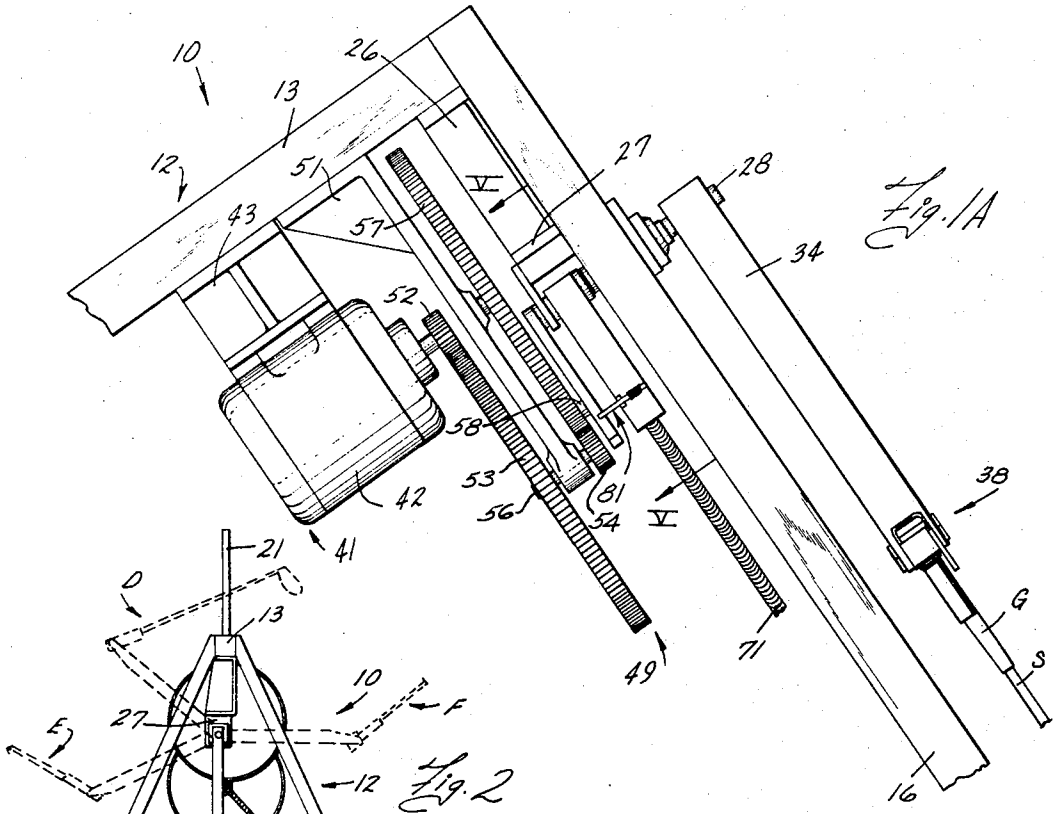


Fig. 1A

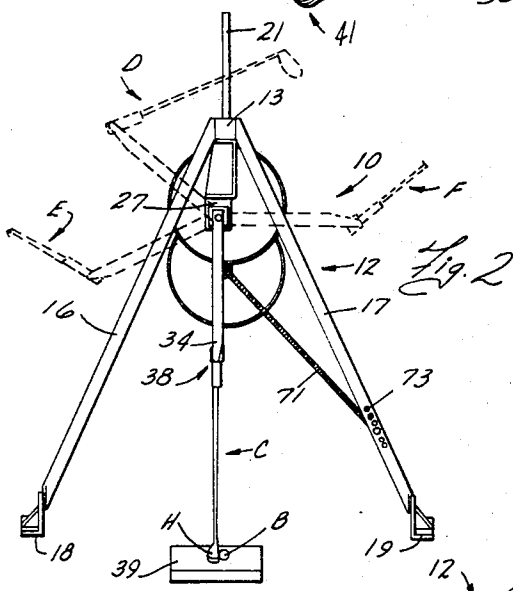


Fig. 2

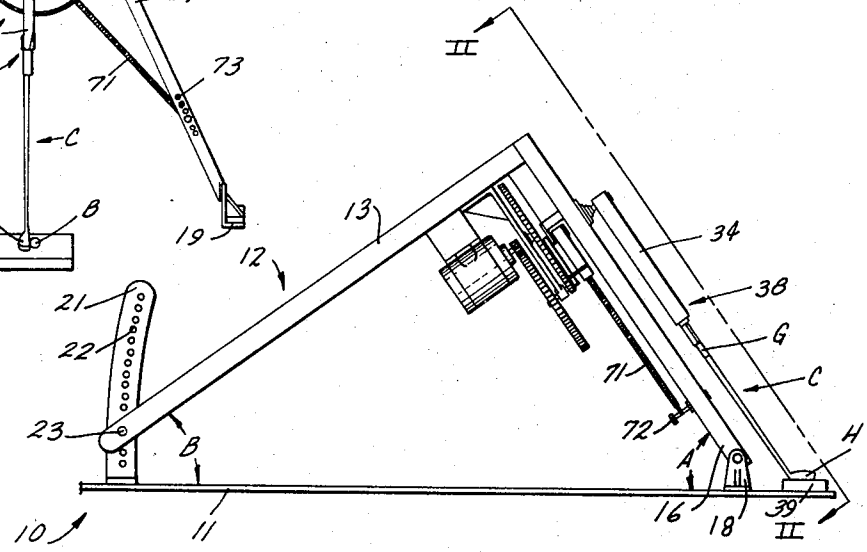


Fig. 1

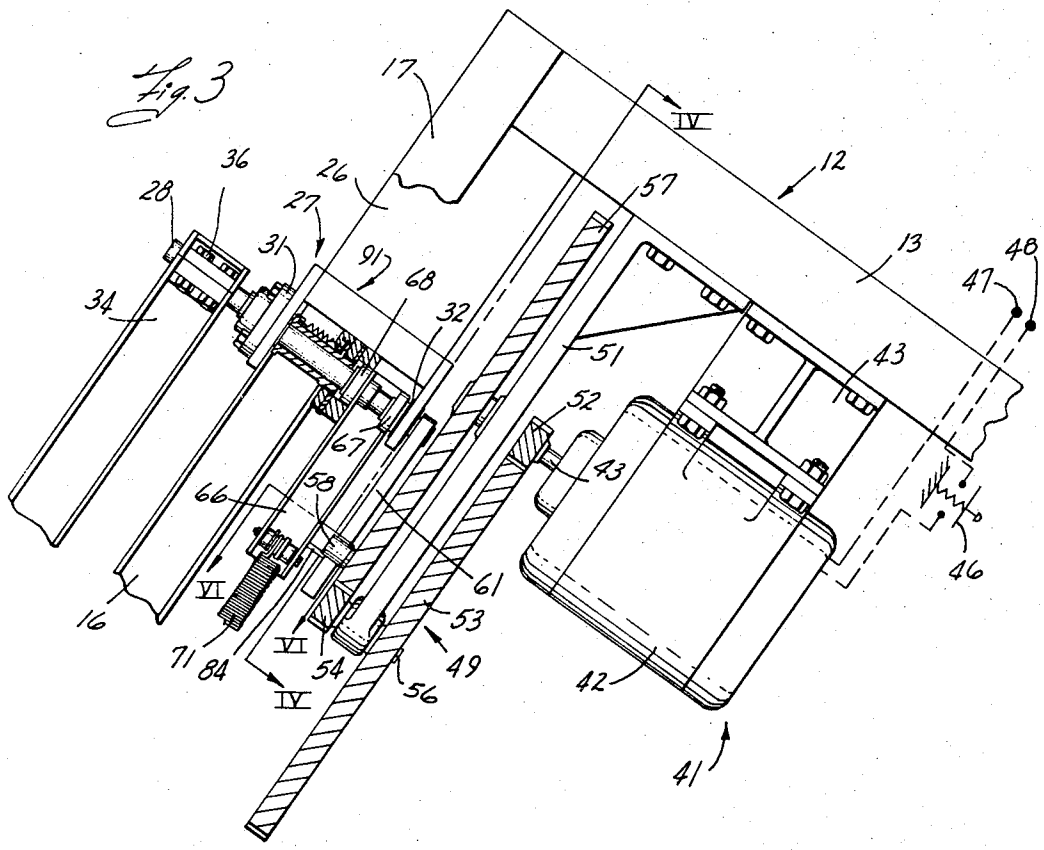
INVENTORS
WILLIAM H. THOMPSON
WILLIAM J. GLASSON
BY
Woodhams, Blanchard and Flynn
ATTORNEYS

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MECHANICAL GOLFER

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Fig. 3



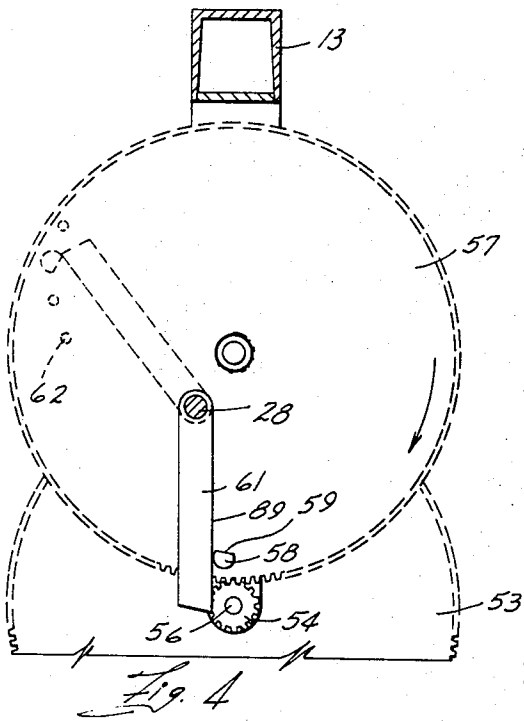


Fig. 4

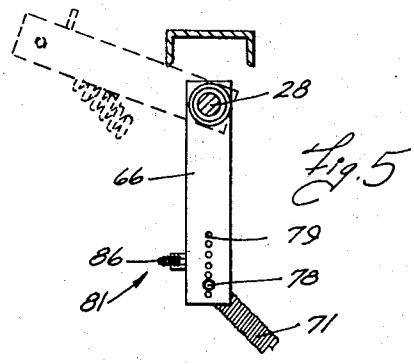


Fig. 5

INVENTORS
WILLIAM H. THOMPSON
WILLIAM J. GLASSON
BY
Woodhams, Blanchard and Flynn
ATTORNEYS

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Fig. 6

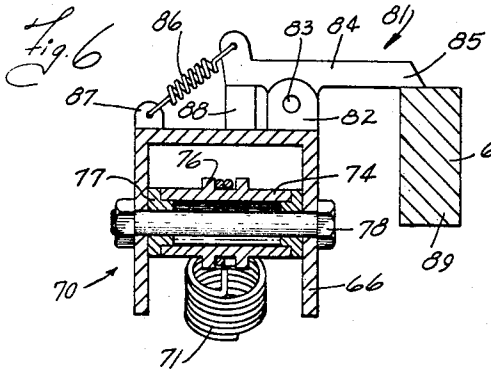


Fig. 7

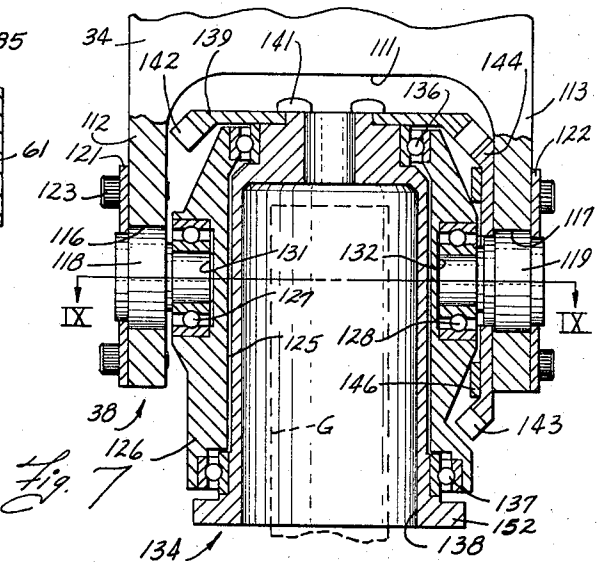


Fig. 8

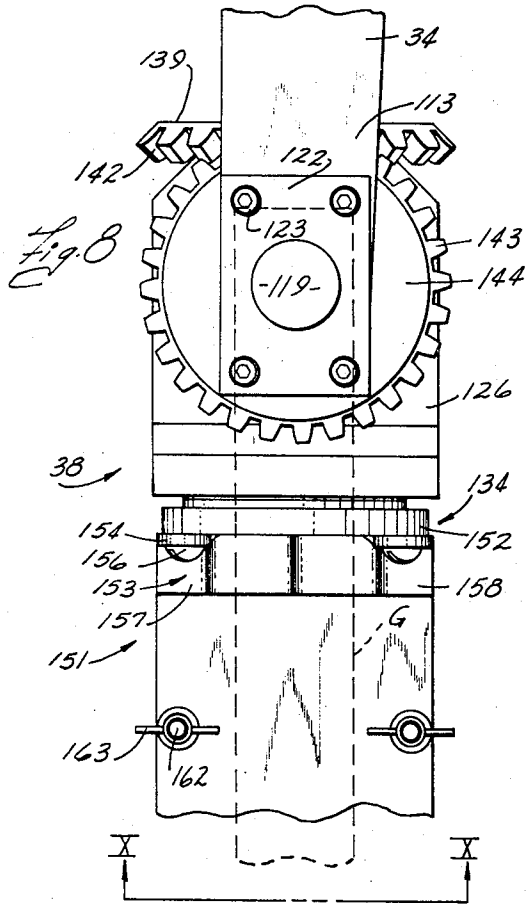


Fig. 9

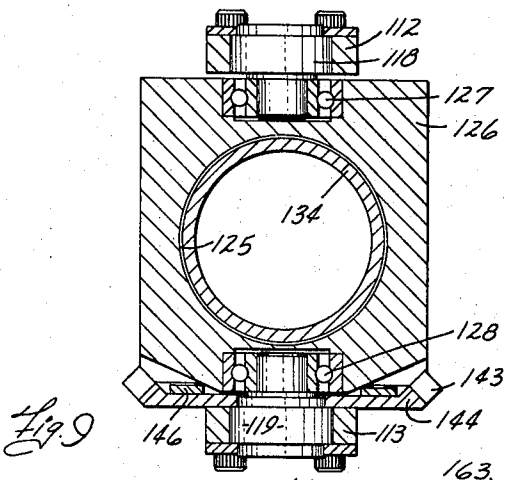
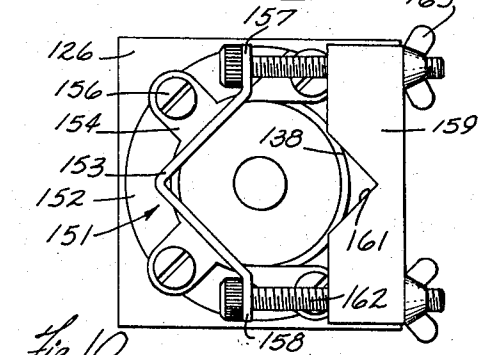


Fig. 10



INVENTORS
WILLIAM H. THOMPSON
WILLIAM J. GLASSON
BY
Woodhams, Blanchard & Flynn
ATTORNEYS

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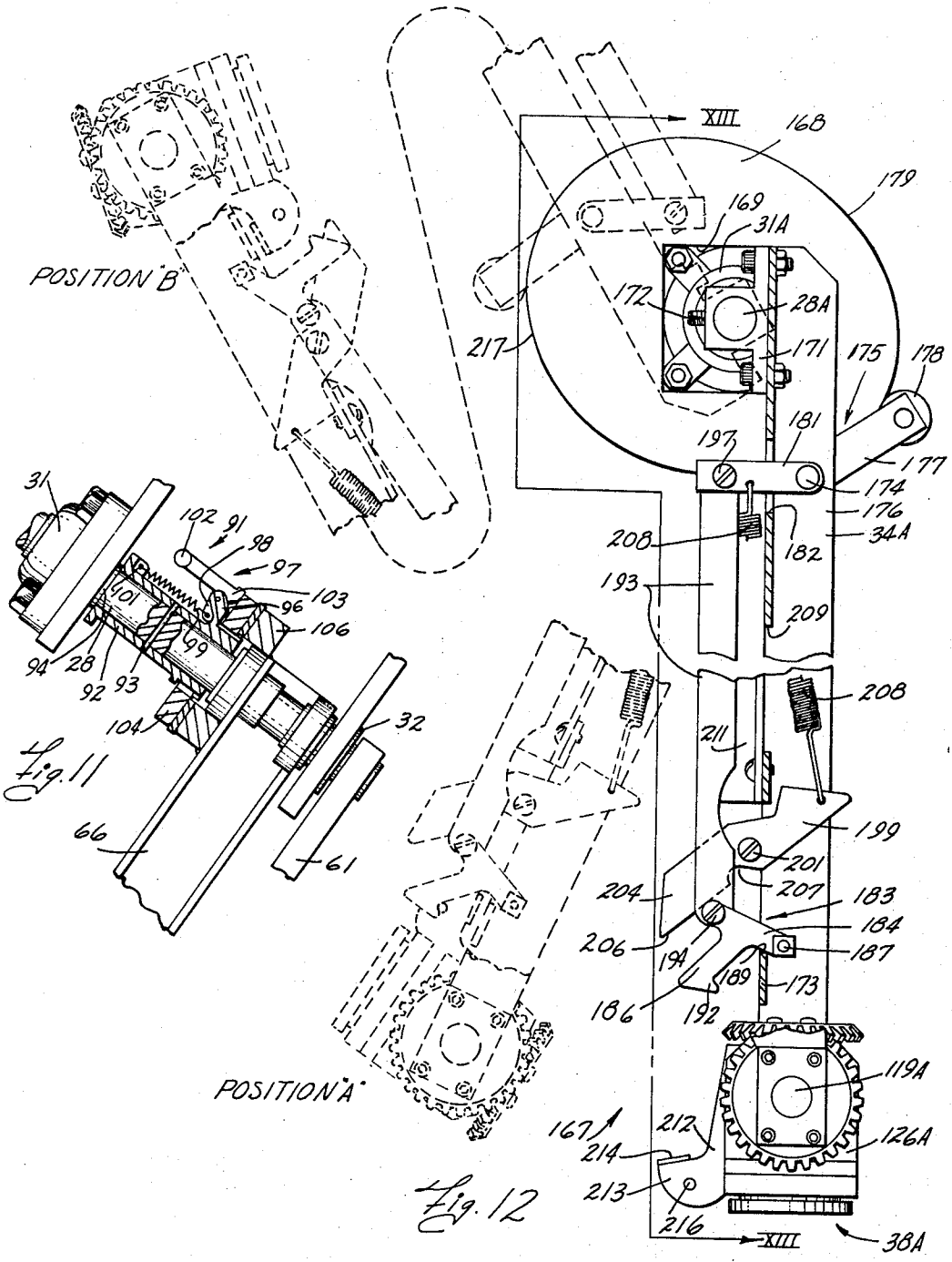


Fig. 11

Fig. 12

INVENTORS
WILLIAM H. THOMPSON
WILLIAM J. GLASSON
BY
Woodhams Blanchard and Flynn
ATTORNEYS

March 19, 1968 W. H. THOMPSON ET AL 3,373,612

MECHANICAL GOLFER

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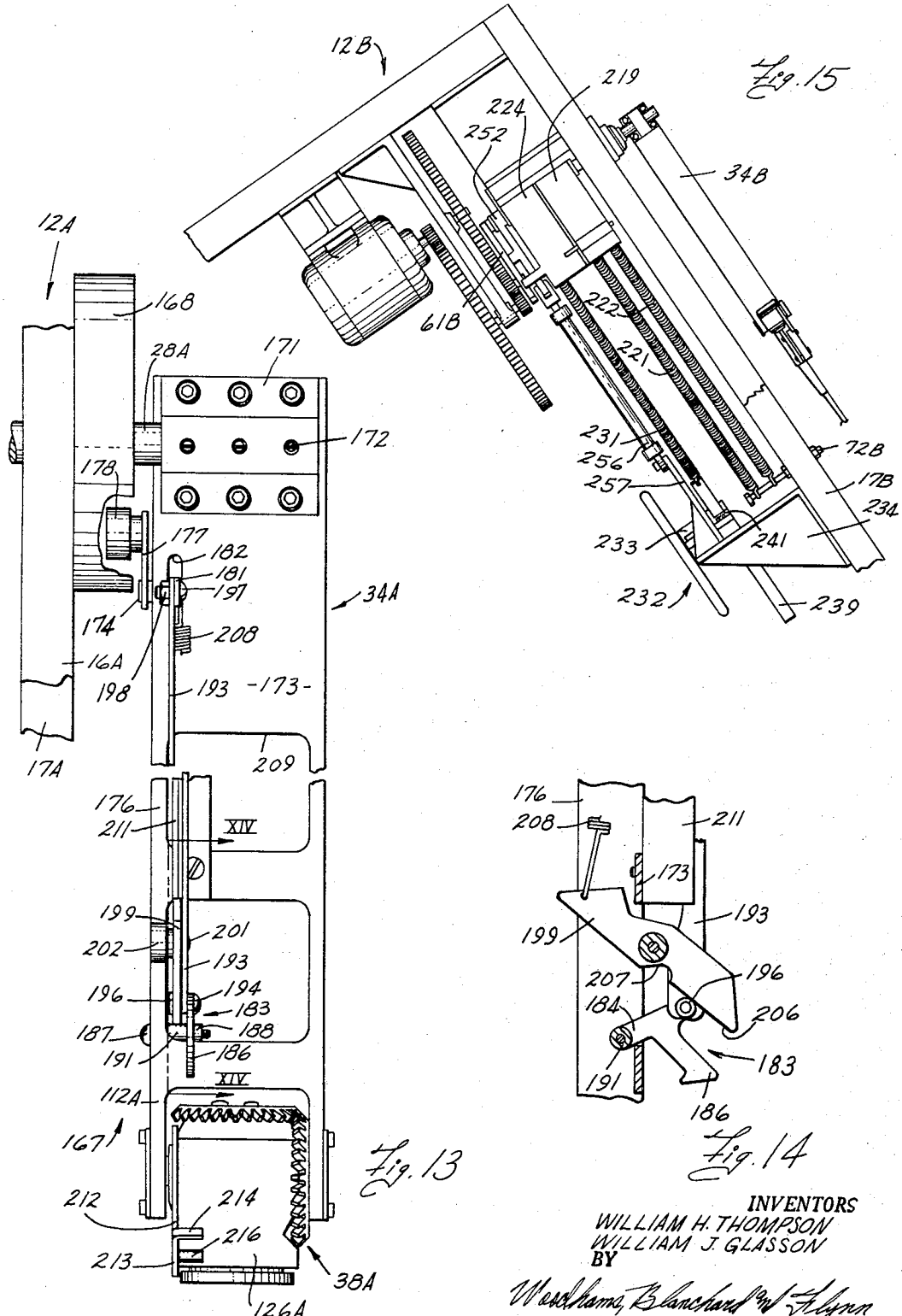


Fig. 15

Fig. 13

Fig. 14

INVENTORS
WILLIAM H. THOMPSON
WILLIAM J. GLASSON
BY
Woodhams, Blanchard and Flynn
ATTORNEYS

March 19, 1968 W. H. THOMPSON ET AL 3,373,612

MECHANICAL GOLFER

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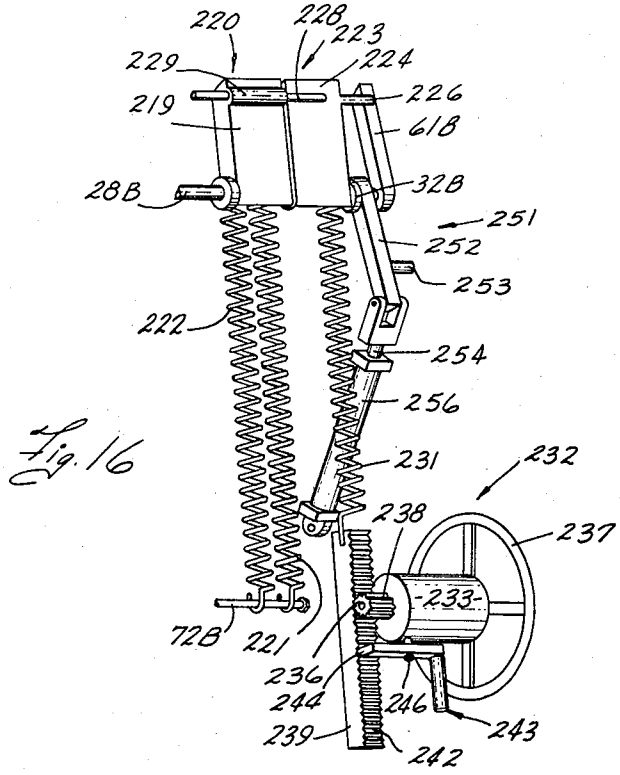


Fig. 16

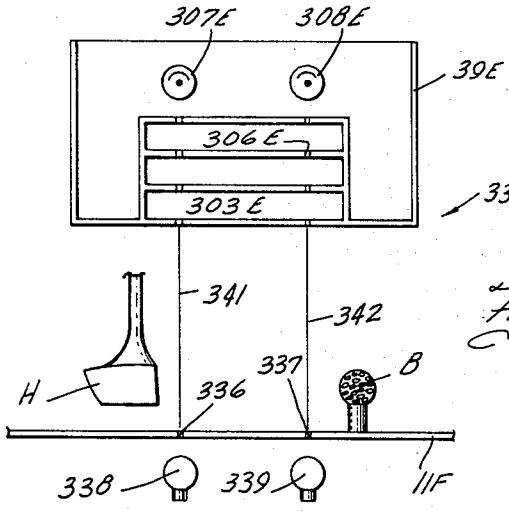


Fig. 22

INVENTORS
WILLIAM H. THOMPSON
WILLIAM J. GLASSON
BY
Woodhams, Blanchard and Flynn
ATTORNEYS

March 19, 1968 W. H. THOMPSON ET AL 3,373,612

MECHANICAL GOLFER

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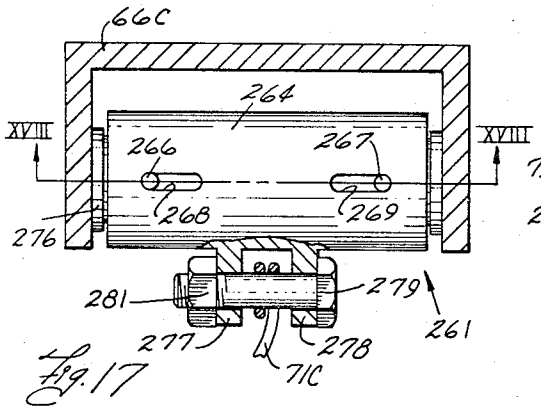


Fig. 17

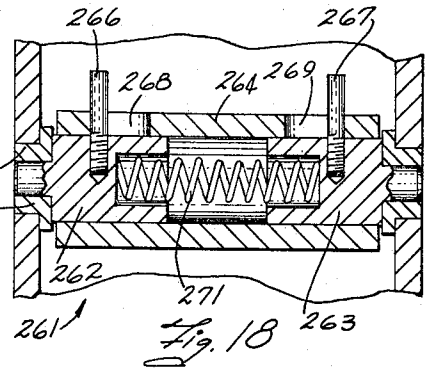


Fig. 18

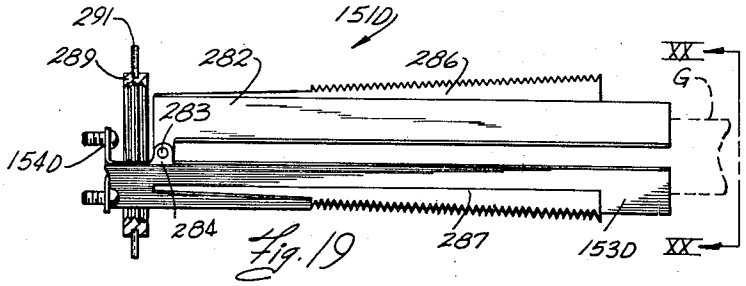


Fig. 19

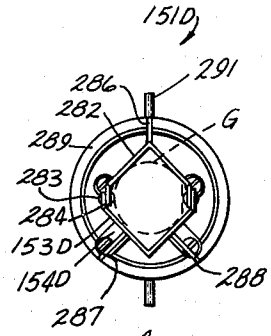


Fig. 20

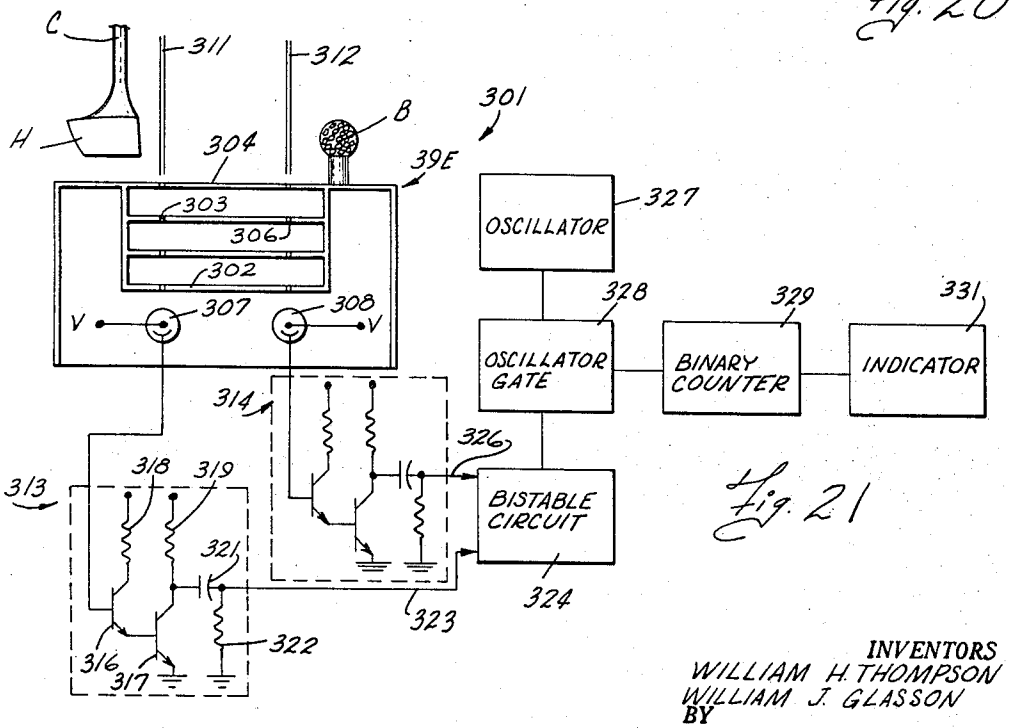


Fig. 21

INVENTORS
WILLIAM H. THOMPSON
WILLIAM J. GLASSON
BY

Woodhams, Blanchard & Flynn
ATTORNEYS

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3,373,612

MECHANICAL GOLFER

William H. Thompson, Escondido, and William J. Glasson, Solana Beach, Calif., assignors to Goldcraft Incorporated, Escondido, Calif., a corporation of California

Filed Dec. 27, 1965, Ser. No. 516,347
26 Claims. (Cl. 73—379)

ABSTRACT OF THE DISCLOSURE

A mechanical golfer having a club arm rotatably mounted upon a frame, the club arm having wrist means hinged freely on the free end of the club arm for pivotal movement with respect thereto within the radial plane. Grip means are provided on the wrist means for rolling movement about the axis of the club handle. Motor means move the club arm and the club in correspondence to the golfer's backswing and automatically release the arm at the end of such backswing. Potential energy storing means then drive the club arm and the club downwardly through the foreswing with the club arm being braked so as to decelerate same during the followthrough portion of the swing.

This invention relates to a machine for hitting a golf ball with a golf club and more particularly relates to a machine of the afore-mentioned type capable of closely simulating the club swing of a competent golfer.

The present invention was developed to fill a need for a golf club swinging machine capable of producing a club swing closely similar to that of a competent golfer for use in testing golf clubs and balls and for assisting in determining the particular clubs best suited to the individual golfer.

Although a variety of golf club swinging devices are known, none is believed completely satisfactory for the above-mentioned purpose. For example, one known type of device intended primarily as an aid in teaching golf through demonstrating the preferred positions of substantially all the major skeletal parts of the human body from head to foot during the full cycle of ball address, backswing and so forth. Such devices are, understandably, relatively complex and expensive since they closely simulate the human skeleton in structure and movement and provide a pseudo-muscle system for driving the parts of the skeleton. Further, such devices generally cannot generate club head velocities and ball impact forces at a level of magnitude comparable to the performance of an average golfer and thus are generally not suitable for club and ball testing. Moreover, such devices cannot normally withstand, without undue wear and tear, the shocks and stresses imposed thereon by normal club acceleration and ball impact forces.

Other known devices provide only a substantially simplified club swing corresponding to only the relatively gross movements of a few major body parts or joints. More particularly, such prior devices have generally omitted some of the more subtle and yet important movements applied by the human golfer to the golf club, particularly movements of the wrist area, which contribute in large measure to the dynamics of a competently swung golf club. It would be expected, therefore, that such prior devices might give a distorted picture of the performance of a particular club or ball or club and ball combination used therewith and lead to error in prediction of the suitability of such equipment for the average golfer and and beyond that for a particular individual.

Accordingly, an object of this invention is to provide a mechanical golfing machine arranged for swinging a golf club and hitting a golf ball therewith in which the swing of the golf club closely simulates the club swing of a competent golfer.

A further object is to provide an apparatus, as aforesaid, capable of hitting a golf ball in a repeatable manner to any desired distance substantially up to the capability of the longest hitter in golf and capable of relatively highly precise targeting of the ball.

A further object is to provide an apparatus, as aforesaid, capable of duplicating the major golf club dynamics imposed by a competent golfer on a golf club during backswing, foreswing and followthrough.

A further object is to provide an apparatus, as aforesaid, capable of adjustment to simulate common faults in swing and to predictably demonstate the effects thereof upon ball path and which in this manner may be used in golf instruction or to assist in correcting the faults of individual golfers.

A further object is to provide an apparatus, as aforesaid, capable of use in testing and comparing existing and experimental clubs, e.g., for shaft and head quality, which is arranged for providing a variety of data including data comparing club head speed, ball impact point, club loft angle and ball path, which may be used as an aid in custom golf club building and in the improvement of commercial lines of golf clubs and which may be used in testing golf balls and particular combinations of ball and club.

A further object is to provide an apparatus, as aforesaid, which is adjustable for correctly positioning and swinging a wide variety of different types of clubs with respect to both form and speed and which is adaptable to all common types of woods and irons.

A further object is to provide an apparatus, as aforesaid, which can be used to determine the proper clubs for an individual based on analysis of his swing and on performance results of a variety of club swings by the mechanical golfing device when set for a swing similar to that of the golfer.

A further object is to provide an apparatus, as aforesaid, which is capable of being readily and relatively inexpensively manufactured, which requires only readily available materials or parts and which is well adapted either to large or small scale production.

A further object is to provide an apparatus, as aforesaid, which is capable of hitting a series of golf balls in rapid succession, which is simple to use and to adjust and which is relatively compact and easy to transport.

A further object is to provide an apparatus, as aforesaid, which is sturdy enough to withstand the shock and strain of repeated high speed club-ball impacts, which is capable of a long operating life under disadvantageous conditions with a minimum of maintenance and which is readily maintainable with only common tools and little or no instruction.

Other objects and purposes of this invention will be apparent to persons acquainted with apparatus of this general type upon reading the following specification and inspecting the accompanying drawings.

In the drawings:

FIGURE 1 is a side elevational view of a machine embodying the invention.

FIGURE 1A is an enlarged fragment of FIGURE 1.

FIGURE 2 is a view showing the front of the machine as taken along the line II–II of FIGURE 1.

FIGURE 3 is an enlarged, partially broken fragment of the machine embodying the invention taken from the opposite side thereof as FIGURE 1.

FIGURE 4 is a sectional view substantially as taken along the line IV—IV of FIGURE 3.

FIGURE 5 is a sectional view generally taken on the line V—V of FIGURE 1A.

FIGURE 6 is an enlarged sectional view generally taken on the line VI—VI of FIGURE 3.

FIGURE 7 is an enlarged, partially broken fragment of FIGURE 1A.

FIGURE 8 is a fragmentary view taken from the right side of FIGURE 7.

FIGURE 9 is a sectional view substantially taken on the line IX—IX of FIGURE 7 and rotated in a clockwise direction through 90°.

FIGURE 10 is a sectional view substantially as taken on the line X—X of FIGURE 8 and rotated in a clockwise direction through 90°.

FIGURE 11 is an enlarged fragment of FIGURE 3.

FIGURE 12 is an enlarged partially broken fragment of FIGURE 2 and discloses a modification thereof.

FIGURE 13 is a partially broken fragmentary sectional view substantially taken on the line XIII—XIII of FIGURE 12.

FIGURE 14 is a fragmentary sectional view substantially as taken on the line XIV—XIV of FIGURE 13.

FIGURE 15 is a fragmentary side elevational view corresponding to FIGURE 1A and disclosing a further modification.

FIGURE 16 is a fragmentary oblique view of the modified apparatus of FIGURE 15.

FIGURE 17 is an enlarged fragment of FIGURE 6 showing a further modification.

FIGURE 18 is a partially broken sectional view taken substantailly on the line XVIII—XVIII of FIGURE 17.

FIGURE 19 is a side elevational view partially in central section of a modified club handle gripping device.

FIGURE 20 is a sectional view substantially as taken on the line XX—XX of FIGURE 19.

FIGURE 21 is a diagrammatic view of a club head speed indicating device disclosed broadly in FIGURES 1 and 2 above.

FIGURE 22 discloses a modification of the apparatus of FIGURE 21.

Certain terminology will be used in the following description for convenience in reference only and will not be limiting. The words "upwardly," "downwardly," "rightwardly" and "leftwardly" will designate directions in the drawings to which reference is made. The word "front" will refer to the rightward end of the apparatus seen in FIGURE 1. The words "inwardly" and "outwardly" will refer to directions toward and away from, respectively, the geometric center of the device and designated parts thereof. Said terminology will include the words above specifically mentioned, derivatives thereof and words of similar import.

General description

In general, the objects and purposes of the invention are met by providing an apparatus for swinging a golf club through a sequence of backswing, foreswing and followthrough in a manner of simulating the swing of a competent golfer which includes a frame and a main shaft rotatably mounted on the frame. A club arm is fixed to and extends radially from the end of the mainshaft for rotation therewith within a radial plane. Wrist means are hinged freely on the free end of the arm for pivotal movement with respect thereto within the radial plane. Means for releasably gripping the handle of a golf club are rotatably fixed to the wrist means for rolling movement with respect thereto generally about the axis of the club handle. Interacting means on the free arm end and gripping means control the roll position of the gripping means on the wrist means as a function of the hinged position of the wrist means on the end of the arm. Thus as the club pivots within the radial plane upon the hinge connection of the wrist means to the free end of the arm, it is rotated about the axis of its handle to stimulate the wrist hinging and rolling action imposed on a golf club by a competent golfer during the swing.

Motor means are provided to move the club arm and club in correspondence to a golfer's backswing and automatically release the arm at the end of such backswing. Potential energy storing means, energized during the backswing, drive the arm and hence the club downwardly through the foreswing after release thereof by said motor means. The club, which preferably has been manually cocked to an angled position with respect to the arm corresponding to the normal cocked position of the club at the top of the swing of a competent golfer, freely responds to centrifugal force and thereby is swung to and through a position in alignment with the club arm in the area of the ball to stimulate the wrist snap of a competent golfer. Suitable brake means are preferably included to gradually decelerate the club head during the followthrough portion of the swing.

Detailed description

Apparatus **10** comprising a preferred embodiment of the invention is disclosed in FIGURES 1–11. The apparatus **10** includes a generally horizontal base **11** (FIGURES 1–3) upon which is mounted a frame **12**. Frame **12** comprises a sloped central beam **13**. The forward end of the beam **13** is elevated and carried by a downwardly diverging pair of legs **16** and **17** preferably defining a plane at right angles to the beam **12** and, hence, sloped at an angle A with respect to the base **11**. The lower ends of the legs **16** and **17** are supported just above the base **11** on brackets **18** and **19** for pivotal movement about a common axis in the plane thereof. An upstanding arcuate member **21** is supported on the base **11** adjacent the lower, rearward end of the beam **13**. The rear end of the beam **13** is adjustably fixed to the arcuate member **21** so that raising or lowering the rearward end of the beam **13** along the arcuate member **21** alters the angle A above mentioned and the angle B which the central beam **13** makes with the base **11**. In the particular embodiment shown, the arcuate member **21** is provided with a plurality of spaced holes **22** arranged along an arc centered on the pivot axis of the legs **16** and **17**, the beam **13** being secured to the arcuate member **21** at any desired location upon a suitable pin **23** extending through one of the holes **22**.

A mounting block **26** (FIGURE 1A) is fixed to and extends generally downwardly from the forward end of the central beam **13** along the plane of the legs **16** and **17**. Fixed to the block **26** is an inverted, U-shaped yoke **27** comprising a downwardly opening channel-shaped bight and a pair of legs which parallel the plane of the legs **16** and **17** and are spaced longitudinally of the central beam **13**. A main shaft **28** parallels the central beam **13** and extends through and is rotatably supported by bearings **31** and **32** carried by the lower ends of respective legs of the yoke **28**. In the particular embodiment shown, the main shaft **28** is mounted slightly to the left of the central plane of the frame **12** as seen in FIGURE 2.

The front end of the haft **28** extends beyond the bearing **31** and, hence, beyond the plane of the legs **16** and **17**. A radially extending club arm **34** is fixed at its upper end, here by screws **36** (FIGURE 3), to the front end of the shaft **28** for rotation therewith and circumferential adjustment thereon. A wrist device **38**, described hereinafter in detail, is secured to the lower end of the club arm **34** and releasably grips the hand grip G of a golf club C of any desired kind. The club arm **34** and the shaft S of the gold club C are arranged to move in a common plane perpendicular to the axis of the shaft **28**. A platform **39** is supported on the base **11** in front of the legs **16** and **17** and just below the path of swing of the head H of the golf club C for supporting a ball B in such a position that it will be struck by the club head H as the club C is swung by the arm **34**. The apparatus **10** is intended to swing the club arm **34** and therewith the club C in a clockwise direction as seen in FIGURE 2 to simulate the backswing of the normal golf stroke, then to urge the club arm and club downwardly in a counterclockwise direction toward

the ball B to simulate the foreswing portion of a golf stroke and then, after the ball is struck by the head H of the club C, to allow the club arm **34** and club C to travel through the followthrough portion of a normal golf club swing.

The apparatus **10** includes a drive system generally indicated at **41** (FIGURES 1–4). The drive system **41** comprises a motor **42** pendently supported beneath the central beam **13** on a mount **43** and having a shaft **44** which parallels and lies beneath the central beam **13**. The motor **42** is preferably an electric motor supplied with electrical current through a normally open, manually actuable switch **46** from suitable current supply terminals **47** and **48** which preferably constitute a conventional 110 volt A.C. output. The shaft **43** of the motor **42** drives a speed reducing gear train generally indicated at **49**. The gear train is mounted on a bracket **51** which parallels the plane of the legs **16** and **17** and is placed between the motor **42** and mounting block **26**. The gear train **49** includes a drive pinion **52** fixed to the motor shaft **43** which drives an enlarged countershaft input gear **53**. The countershaft input gear **53** and a countershaft output gear **54** of reduced diameter are disposed on opposite sides of the bracket **51** and are fixed for rotation on a countershaft **56** rotatably mounted with respect to the lower end of said bracket **51**. An externally toothed drive disk **57** of relatively large diameter meshes with the countershaft output gear **54** and is rotatably supported in a plane parallel to that of the legs **16** and **17** on the bracket **51**. The rotational axis of the disk **57** is spaced above and to the right (FIGURE 2) of the axis of the main shaft **28**. The drive disk **57** is rotated by the motor **42** in a clockwise direction as seen in FIGURES 2 and 4. The drive disk **57** has a drive pin **58** fixed to and extending generally forwardly from the front face thereof near the periphery thereof. In the particular embodiment shown, the drive pin **58** is of generally circular cross section except for a flat **59** which, as seen in FIGURE 4, faces somewhat to the right of the center of the disk **57**.

A drive arm **61** is rigidly affixed to the rearward end of the shaft **28** behind the bearing **32** and extends radially and generally downwardly therefrom preferably in substantial parallelism with the club arm **34**. The drive arm **61** is located near the forward face of the drive disk **57** and in the path of the drive pin **58** during the lower, leftward (FIGURE 4) portion of its rotation. More particularly, the drive arm **61**, when near its downwardly extending position indicated in the solid lines of FIGURE 4, will be engaged by the revolving drive pin **58** and will be pivoted thereby for rotating the shaft **28** in a clockwise direction. Due to the eccentric location of the axes of the drive disk **57** and main shaft **28**, the revolving drive pin **58** gradually moves radially outwardly from the shaft **28** along the drive arm **61** until it reaches the end of such drive arm, such position being indicated at broken lines in FIGURE 4. Eventually, the end of the drive arm **61** slides off the edge of the rounded portion of the revolving drive pin and may then drop freely past the flat **59**. In the particular embodiment shown, the arm **61** is lifted to a position about 50° above the horizontal by the pin **58** prior to its release. However, if contemplated that further openings, indicated in broken lines at **62**, may be furnished in the disk **57** for releasably receiving the drive pin **58** in alternative fixed location therein to vary the angle of inclination of the drive arm **61** when released by the pin **58**.

As shown in FIGURE 3, a spring arm **66** is supported on and for rotation with respect to the main shaft **28** intermediate the main shaft bearings **31** and **32** by suitable bearings **67** and **68**. The spring arm **66** is in the particular embodiment shown substantially the same length as the drive arm **61** and is located closely adjacent the rearward bearings **32** and, hence, relatively close to the drive arm **61**. A spring **71**, here an elongated helical tension spring, is connected between anchor means **70** (FIGURE 6) on the spring arm **66** and the frame for urging the spring arm **66** downwardly into and, if desired, somewhat past its depending solid line position of FIGURE 5 from its elevated broken line position of FIGURE 5. In the particular embodiment shown, the lower end of the spring **71** preferably adjustably connects to the rightward leg **17** as seen in FIGURE 2 at a point near to but spaced from the bracket **19**. The lower end of the spring **71** is here secured to the leg **17** by a bolt **72** alternatively positionable in any one of several holes **73** extending through and spaced along the leg **17**. The upper end of the spring **71** is coiled around a generally cylindrical core **74** of the anchor means **70** at the center thereof and is snugly disposed between an axially spaced pair of radial flanges **76**. The core **74** is equipped with bushings **77** which mount the core **74** snugly but rotatably upon a bolt **78** which extends transversely through the spring arm **66**. The bolt **78** is alternatively insertable through a plurality of holes **79** (FIGURE 5) spaced along the length of the spring arm **66** to allow varying of the length of the lever arm upon which such spring works. By varying the locations of the spring ends with respect to the holes **73** and **79**, the force exerted on the arm **66** by the spring **71** can be varied for any desired position of the spring arm, any fatigue in the spring can be compensated for and the spring arm position versus spring tension characteristic can be altered.

Thus, the adjustment of the spring ends in the holes **73** and **79** together with the adjustment of the pin **59** and holes **62** and angular adjustment of the club arm **34** of the shaft **28** together with the possibility of readily replacing the spring **71** by a stronger or weaker one, allows considerable variation in the top point of the backswing, the instantaneous torque exerted on the club arm at any point in its swing by the spring and the point at which the spring ceases to exert further accelerating torque on the club arm.

An overrunning one-way latch **81** (FIGURES 1A, 3, 5 and 6) on the spring arm **66** allows the drive arm **61** to move the spring arm **66** therewith through the backswing substantially to their respective broken line positions of FIGURES 4 and 5 for tensioning the spring **71**. The latch **81** further allows the spring arm **66**, upon release of the drive arm **61** by the pin **59**, to accelerate the drive arm **61** and club arm **34** through the foreswing, that is, from the broken line positions through the solid line positions of FIGURES 2, 4 and 5. Still further, the latch allows the drive arm **61** to move freely past the spring into the followthrough portion of the stroke as the spring arm swings past the spring **71** and is retarded thereby.

In the particular embodiment shown in FIGURE 6, the latch **81** comprises a bracket **82** on the side of the spring arm **66** away from the spring **71** near the lower end thereof, such bracket **82** generally being U-shaped and supporting a pin **83**. A latch arm **84** is mounted intermediate its ends pivotally of the bracket **82** by the pin **83**. The rearward end **85** of the latch arm **84** extends into the path of the drive arm **61**. The forward end of the latch arm **84** is connected by a tension spring **86** to a boss **87** fixed to the face of the spring arm **66** forwardly of the bracket **82**, such spring **86** extending at an angle forwardly and toward the spring **71** to urge the latch arm **84** in a counterclockwise (FIGURE 6) direction. An abutment **88** is disposed between the boss **87** and bracket **82** for limiting counterclockwise movement of the latch arm **84** to a position generally parallel to the adjacent face of the spring arm. As seen in FIGURE 6, the latch arm **84** positively prevents movement of the spring arm **66** past the drive arm **61** in one direction (downward in the drawing) so that the drive arm **61** carries the spring arm **66** through the backswing and the spring arm carries the drive arm **61** through the foreswing. Should the drive arm move away from the latch arm **84** through a full circle, the face **89** of the drive arm will eventually strike the rearwardly extending end **85** of the latch arm on the other side thereof and pivotally displace the latch arm against the tensioning spring **86** to move therepast.

A brake **91** (FIGURE 11) is preferably provided for decelerating the club arm **34** during followthrough. The brake **91** preferably does not act during the foreswing and backswing portions of the operation. In the particular embodiment shown in FIGURES 3 and 11, the brake **9** comprises a generally cylindrical shell **92** snugly surrounding the shaft **28** and secured thereto for rotation therewith by any convenient means, here comprising a pin **93**. The shell **92** is bounded at its forward end by a shoulder **94** on the shaft **28** adjacent the forward leg of the yoke **27**. An integral bracket **96** extends generally radially from the shell **92** intermediate the ends thereof. A generally T-shaped actuator **97** has a leg **98** extending substantially radially inwardly toward the shaft **28** and pivotally supported on the bracket **96**. A tension spring **99** extends axially along the shaft between the inner end of the leg **98** and a boss **101** on the sleeve **92** adjacent the forward end thereof. Thus, the spring **99** urges the actuator **97** in a clockwise direction as seen in FIGURE 11. The T-shaped actuator **97** has a crosshead at the outer end of the leg **98** which extends generally parallel to the axis of the shaft **28**, the forward end **102** of such crosshead being weighted, if desired, so that rotation of the shaft tends to pivot the actuator **97** more strongly in a clockwise direction as the speed of rotation increases due to centrifugal force. The rearward end **103** is relatively short and is rounded on its lower face for bearing against a brake disk **104** splined to the rearward end of the sleeve **92**. An annular brake ring **106** is affixed, here by welding, to the forward face of the spring arm **66** coaxially of the shaft **28** and brake disk **104**. A frition ring **107** is interposed between the brake ring **106** and brake disk **104** and is preferably affixed to the former.

The brake **91** frictionally engages the spring arm **66** to the main shaft **28** and, hence, to the club arm **34** and drive arm **61**. Thus, during the backswing and foreswing, the brake **91** is not subjected to torques since the spring arm **66** is connected to the drive arm **61** and hence to the shaft **28** through the latch **81**. On the other hand, when the drive arm **61** overruns the latch **81** during followthrough due to the slowing of the spring arm **66**, relative movement between the spring arm **66** and shaft **28** necessarily takes place and the brake **91** is called upon to decelerate the shaft **28**. If the centrifugal weight **102** is included in the brake, the braking force thereof will be greater at higher main shaft speeds and will lessen the lower main shaft means. Thus, during followthrough, the club arm **34** is frictionally retarded with respect to the spring arm **66** by the brake **91** and the spring arm **66** is in turn resiliently urged against moving with the club arm **34** through followthrough by the spring **71**. In this manner, the club arm **34** is slowed and is preferably stopped before it reaches a top dead centered position, the spring **71** and the weight of the club arm and the club tending thereafter to cause the club arm **34** to return in a clockwise direction to a position near its downwardmost position shown in FIGURE 2.

Turning now to the wrist device generally indicated at **38** in FIGURE 1A and disclosed in more detail in FIGURES 7–10, same is mounted at the lower end of the club arm **34**. The lower end of the club arm **34** is notched as indicated at **111** (FIGURE 7) to define parallel rearward and forward webs **112** and **113** between which the wrist device is disposed. The webs **112** and **113** have centered, coaxial openings **116** and **117**, respectively, therethrough. Coaxial stub shafts **118** and **119** are snugly disposed in the openings **116** and **117**, respectively, and extend inwardly into notch **111** a short ditsance. The stub shafts **118** and **119** are restrained from outward axial movement with respect to the arm **34** by retainer plates **121** and **122** secured to the outer surfaces of the webs **112** and **113**, respectively, by screws **123**. An elongated generally rectangular shell **126** is disposed between the webs **112** and **113** and has a central opening **125** extending longitudinally therethrough. The shell **126** carries intermediate its ends a

coaxial pair of ball bearings **127** and **128** aligned diametrically of the central opening **125** and snugly disposed in outwardly opening recesses **131** and **132** in the periphery of the shell **126**. The inner ends of the stub shafts **118** and **119** are snugly received within the respective bearings **127** and **128** for pivotally supporting the shell **126** for rotation about the axis thereof and, hence, within the plane of motion of the arm **34**. Pivotal movement of the shell **126** with respect to the club arm **34** simulates the hinging action of a golfer's wrist and in this sense the bearings **127** and **128** and stub shafts **118** and **119** comprise the hinge portion of the wrist means **38**.

A generally cup-shaped member **134** (FIGURE 7) is supported for rotation about the longitudinal axis thereof within the shell **126** on bearings **136** and **137** disposed adjacent the ends of the shell **126**. The cup-shaped member **134** has a relatively deep, cylindrical and downwardly opening central recess **138** into which the grip G of a club C may be loosely and coaxially received. Thus, the cup-shaped member **134** is supported for rolling motion about the axis of the club shaft and in the plane of the swing of the club arm **34**.

A bevel gear **139** is coaxially affixed to the upper end of the cup-shaped member **134** by any convenient means here comprising screws **141**. The teeth **142** of the bevel gear **139** mesh with corresponding teeth **143** of a further bevel gear **144** which is arranged coaxially of the stub shaft **119** between the web **113** and the bearing **128**. The further gear **144** is fixed to the inner face of the web **113**, in the particular embodiment shown, by the screws **123** securing the plate **122** to the web **113** which extend through the beveled gear **144** to threadedly engage a retaining ring **146** coaxially disposed on the inner face of the beveled gear **144**. The bevel gears **139** and **144** interconnect the rolling cup-shaped member **134** and the lower end of the club arm **34** so that the rolling motion of the cup **134** is a function of the hinging motion of the shell **126** with respect to the club arm **34**. More particularly, the bevel gears **139** and **144** are, in the particular embodiment shown, of equal diameter and, therefore, rotation of the shell **126** through a given angle with respect to the arm **34** will produce a rotation through the same angle of the cup-shaped member **134** with respect to the shell **126**.

A gripping member **151** is secured to the open lower end of the cup-shaped member **134**. In the particular embodiment shown in FIGURES 7–10, the lower end of the cup-shaped member **134** is provided with an integral radial flange **152**. The gripping member **151** (FIGURES 8 and 10) comprises an elongated rigid metal sheet generally of V-shaped cross section indicated at **153**. The sheet **153** is provided with transverse flanges **154** at its upper end. The flanges **154** are secured to the lower radial face of the flange **152** by screws **156** so that the sheet **153** extends axially away from the open end of the cup-shaped member **134**. The V-section sheet **153** has oppositely and outwardly extending coplanar flanges running axially therealong as indicated at **157** and **158**.

A cover block **159** (FIGURE 10) extends axially along the V-shaped sheet **153**. The cover block **159** is provided with a V-shaped, longitudinal groove **161** opposite the center of the V-shaped sheet **153**. Screws **162** are disposed at spaced locations along the flanges **157** and **158** and extend therethrough and through the cover block **159** adjacent edges thereof. Wing nuts **163** are threaded on the ends of the screws **162**. Thus, the grip G of a golf club C may be inserted between the center of the V-shaped sheet **153** and the V-shaped groove **161** in the block **159** with the upper end thereof lying, as above mentioned, within the recess **138** of the cup-shaped member **134**. The wing nuts **163** may then be tightened to bring the cover block **159** evenly and firmly against the grip G of the club in a manner to fix the club C to the wrist device **38**.

Operation

Although the operation of the apparatus **10** has been disclosed to some extent hereinabove, same will be briefly reviewed hereinbelow to insure a complete understanding of the invention.

The apparatus **10** can be adjusted for providing the proper angle between the club shaft S and the base **11** by positioning the pin **23** and the rear end of beam **13** at a different one of the holes **22** in the member **21**. Also, clubs of different shaft lengths are readily accepted by altering the longitudinal position of the end of the club grip within the recess **138** of the cup-shaped member **134**.

With a club C firmly affixed, as above described, the gripping member **51** and a ball B in place as disclosed in FIGURE 2 upon the platform **39** in line with the path of the club head H, operation of the apparatus **10** may be initiated by closing the switch **46** to energize the motor **42**.

The motor shaft **43** rotates the driving disk **57** through the gear train **49** to revolve the drive pin **58** in a clockwise direction as seen in FIGURE 4. The drive pin **58** engages the face **89** of the drive arm **61** and causes a corresponding clockwise rotation thereof and of the shaft **28** and club arm **34** affixed thereto through the backswing portion of the club stroke. As the drive arm **61** moves through the backstroke, it engages the rearward end **85** of the lever arm **84** of the latch **81** and so carries along the spring arm **66**, thus stretching the spring **71**. During the backswing, the club C is preferably manually hinged in a clockwise direction, as seen in FIGURE 2, on the stub shafts **118** and **119** past a vertical position to simulate the cocking of the wrist of the golfer during the backswing. If desired, the shell **126** may be rested against the edge of the notch **111** on any convenient stop, not shown. Such hinging of the club C with respect to the club arm **34** results in a rolling of the club C about the axis of its shaft S on the bearings **136** and **137** due to interaction of the bevel gears **139** and **144**. Thus, the wrist device **38** is cocked with respect to both hinged motion and rolling motion of the club. The top of the backswing is normally at least near the broken line position D in FIGURE 2.

As the drive disk **57** continues to rotate, the drive arm **61** eventually reaches the top of the backswing and is released by the drive pin **58**. The stretched spring **71** thereupon strongly accelerates the spring arm **66** and, because of the latch **81**, the drive arm **61** and club arm **34** downwardly in a counterclockwise direction through the foreswing. As the club arm **34** begins the foreswing, the club head C is accelerated angularly therewith and is pulled radially outwardly with respect to the axis of the main shaft **28** by centrifugal force as indicated at position E of FIGURE 2, thus hinging on the stub shafts **118** and **119** and moving toward a position of axial alignment with the club arm **34** as the club arm **34** sweeps downwardly toward its depending, solid line position of FIGURE 2. As the hinging continues, the club C is rolled about its shaft S by the gears **139** and **141** so as to bring the face of the head H into the proper relationship with the ball B as such ball is approached and struck. The acceleration of the club arm **34** by the contracting spring **71** diminishes as the club arm **34** approaches alignment with the ball B.

As the movement of the club arm **34** continues, the club shaft S advances to a position of axial alignment therewith and then swings therepast as would generally be the case when a competent golfer uncocks his wrists at ball impact. As the club head swings past the axially aligned position, its effective radius of the path of movement decreases, that is, the distance between the axis of main shaft **28** and the club head decreases. Assuming the club arm **34** is not decelerating, the velocity of the club head will increase as its effective orbit radius begins to decrease. Therefore, the club head velocity is generally at its greatest near where it passes a position of axial alignment with the club arm and it is preferable that the ball B be struck by the club head when the latter is at or near maximum velocity. Thus, the club shaft will normally be at or somewhat slightly past a position of angular axial alignment with the club arm **34** as the club head strikes the ball B as shown in solid lines in FIGURE 2.

The foreswing of the apparatus **10**, including the point of ball impact, closely parallels the swing that would be given the club by a competent golfer, in the free hinging movement, the rolling movement interlinked with the hinging movement, the maximization of angular club head velocity and its exceeding of angular club arm velocity substantially at ball impact and the straightening of the angle between the club arm and shafts just prior to ball impact. Further, the apparatus **10** has been observed to hit regulation golf balls with a conventional driver to distances of the magnitude 200 yards and has been observed to consistently place balls so hit within a 30 foot diameter area of ground.

It will be noted that as the arm **34** moves through the followthrough stroke that the club head continues to hinge and advance with respect to the club arm, the wrist device **38** simultaneously rolling the club shaft to closely simulate the followthrough stroke of a competent golfer.

After the ball B is struck by the club C and the arm **34** swings in a counterclockwise direction as seen in FIGURE 2 into the followthrough portion of the stroke, the spring arm **66** and spring **71** soon become axially aligned. Acceleration of the club arm by the spring then stops and the spring **71** begins to decelerate the arm **66** as inertia carries it past such axially aligned position. As the spring arm **66** decelerates, the drive arm **61** moves away from the rear end **85** of the latch arm **84**, i.e., overruns the latch **81**, due to the inertia thereof and of the club arm **34** and club C. The resulting relative rotation between the rotating shaft **28** and the decelerating spring arm **66** is frictionally resisted by the brake **91**. Should the centrifugal weight **102** be included, the braking force will be higher for greater rotational rates of the main shaft **28**. When the club arm **34** reaches its normal topmost position during followthrough, preferably near or somewhat beyond position F of FIGURE 2, the spring **71** and brake **91** act to stop the club arm **34**.

Alternatively, however, the braking force of the brake **91** may be reduced as by removal or replacement of spring **99** with a spring of lesser force so that the club arm **34** continues around through a full circle or more. In such case, the drive arm **61** may continue its counterclockwise rotation past the spring arm **66**, the arm **84** of the latch **81** resiliently pivoting on the pin **83** to allow the drive arm to pass and the spring **86** returning the latch **81** to its rest position of FIGURE 6 thereafter. After the apparatus **10** has come to rest, the apparatus **10** may be reset for a new stroke. To reset the apparatus **10** for a further stroke, the club arm **34** is preferably manually moved to a position near its downwardmost position of FIGURE 2, if it has not returned there by itself, preferably in a clockwise direction, the friction brake **91** preferably having sufficient slippage to allow relative movement between the shaft **28** and spring arm **66** within only moderate tensioning of the spring **71**. Thereafter, the ball B may be replaced and a further cycle may be initiated as above described.

Modifications

FIGURES 12–14 disclose automatically engaging and disengaging catch **167** actuable to retain the wrist device in a cocked position and for releasing the wrist device to allow uncocking thereof. Parts of the apparatus of FIGURES 12–14 corresponding to parts of the apparatus **10** will carry the same reference numerals thereas with the suffix "A" added thereto.

An oval planar cam **168** is affixed to the front of the frame **12A** by any convenient means such as screws, not shown, and parallels the plane of the legs **16A** and **17A**

thereof. The cam **168** has an opening **169** therethrough in which the front main shaft bearing **31A** is disposed. The club arm **34A** differs from the club arm **34** of the apparatus **10** in being mounted eccentrically offset to the right (FIGURE 12) of the main shaft **28A**. More particularly, a mounting block **171** is bolted to the leftward side of the arm **34A** at the upper end thereof and snugly receives the main shaft **28** therethrough. Set screws **172** are tightenable to prevent relative rotation between the shaft **28A** and the club arm **34A**. In the particular embodiment shown, the arm **34A** comprises a channel member, the bight portion **173** of which faces leftwardly in FIGURE 12.

The catch **167** includes a bell crank **175** (FIGURE 12). The shaft **174** of the bell crank **175** extends through and is rotatably supported by the rearward flange **176** of the channel-like arm **34A**. The rearward end of the shaft **174** has rigidly affixed thereto a radially extending cam follower arm **177** which is seen in FIGURE 12 extends generally upwardly and rightwardly from the verticaly depending arm **34A** generally in front of the lower, rightward edge of the cam **168**. A roller **178** is rotatably mounted on the rearward face of the cam follower arm **177** at the free end thereof and bears on the periphery **179** of the cam **168**. A lever arm **181** is fixed to the shaft **174** in front of the flange **176** and extends leftwardly through an opening **182** in the bight **173**.

The catch **167** further includes a generally T-shaped lock member **183** (FIGURES 12, 13 and 14) which includes a crosshead **184** and a leg **186** extending generally downwardly therefrom and angling somewhat to the left as seen in FIGURE 12. The rightward end of the crosshead **184** is mounted by a screw **187** and nut **188** on the rear flange **176** of the club arm **34A** adjacent the lower end thereof and extends leftwardly through an opening **189** in the bight **173** so that the leg **186** and the leftward portion of the crosshead **184** are located to the left of the club arm **34A**. The lock member **183** is planar and parallels the rear flange **176**. A spacer **191** on the screw **187** spaces the lock member **183** forwardly of the flange **176**. The lower end of the leg **186** is provided with a generally rightwardly opening hook indicated at **192**.

The leftward end of the crosshead **184** is pivotally affixed to the lower end of a transfer bar **193** by a screw **194**. An internally threaded, elongated and cylindrical sleeve **196** (FIGURES 13 and 14) is threaded onto the rearward end of the screw **194** to retain the transfer bar **193** thereon and, further, for purposes described hereinafter. The transfer bar **193** extends generally upwardly and is sloped slightly to the rear as seen in FIGURES 13 and 14. The upper end of the transfer bar is pivotally connected to the free end of the lever arm **181** by a screw **197** and nut **198**.

A latch restraining lever **199** is pivotally mounted intermediate its ends by a screw **201** affixed to a boss **202** (FIGURE 13) extending leftwardly (FIGURE 12) from the club arm flange **176** and spaced a short distance above the generaly T-shaped lock member **183**. The latch restraining lever **199** extends from the screw **201** rightwardly (FIGURE 12) through the opening **189** into the arm **34A** along the flange **176**. The leftward end **204** of the latch restraining lever **199** extends past and above the leftward end of the crosshead **184** of the lock member **183**. The lower edge **206** of such leftward end **204** slideably bears upon the sleeve **196**. The latch restraining lever **199** slopes upwardly and toward the right. A generally rightwardly opening hook-shaped notch **207** is provided in the lower edge **206** adjacent the leftward edge of the club arm flange **176**.

A tension spring **208** (FIGURE 12) is connected between the rightward end of the latch restraining lever **199** and the lever arm **181** intermediate the ends thereof, such spring extending through the bight **173** at an opening **209** therethrough. The spring **208** acts through the bell crank **175** to press the roller **178** snugly against the periphery **179** of the cam **168**. Simultaneously, the spring **208** exerts a counterclockwise torque on the latch restraining lever **99** so as to maintain the lower edge **206** there firmly against the sleeve **196** and thereby urge the T-member **183** downwardly.

An angle guard **211** is affixed to the bight **173** behind the transfer bar **193** and extends from a point above the latch restraining lever **199** to a point spaced below the arm **181** to protect the transfer bar **193**.

A generally planar insertion plate **212** is fixed by any convenient means such as screws, not shown, to the rearward side of the shell **126A** within the web **112A**. As seen in FIGURE 12, the insertion plate **212** extends leftwardly and downwardly from the hinge axis of the shell **126A** and has a generally leftwardly extending end portion **213**. A flange **214** is formed preferably integrally with the upper edge of the end portion **213** and it extends forwardly therefrom through the plane of the T-shaped lock member **183** located thereabove. The flange **214** is preferably sloped slightly upwardly and to the right as seen in FIGURE 12. A locking pin **216** extends forwardly from the end **213** and is spaced beneath the rightward edge of the flange **214**. The pin **216** also extends through the plane of the T-shaped lock member **183**.

The latch **167** allows the wrist device **38A** to be manually hinged to a cocked position, here approximately at right angles to the longitudinal extent of the club arm **34A**, as illustrated in broken lines at position A of FIGURE 12. The latch **167** holds the wrist device **38A** in such cocked position until the club arm **34A** has rotated through and has reached the top of its backswing at which point the latch **167** releases the wrist device **38A** to allow same to uncock during the foreswing as above described with respect to the apparatus **10**. More particularly, with the arm **34A** in its lowermost position shown in solid lines in FIGURE 12, manual pivoting of the wrist device **38A** in a clockwise direction about the axis of stub shaft **119A** eventually brings the leftward end of the flange **214** into sliding contact with the lower end of the leg **186** of the lock member **183**. Continued clockwise movement of the wrist member **38A** causes the leftward end of the flange **214** to move along and lift the lower end **186** to cause a clockwise pivotal movement of the lock member **183** about the axis of the screw **187**. Thereafter, the leftward end of the flange **214** passes the hook portion **192** and along the rightward edge of the leg **186** to a position adjacent the lowermost portion of the bight **173** of the club arm **34A** as shown in the broken line position A of FIGURE 12. During this movement of flange **214**, the locking pin **216** is brought past the lower end of the leg **186** and as the flange **214** moves into adjacency with the bight **173**, the pin **216** enters the mouth of the hook **192**. The pin **216** is caught by the hook **192** and positively prevents return of the wrist portion **38A** to its solid line position of FIGURE 12. The catch **167** is now locked and positively holds the wrist device **38A** in its cocked position. It should be noted that during the above-described clockwise movement of the locking member **183**, the sleeve **196** rides up the edge **206** but not far enough to enter the notch **207**. Thus, the locking member **183** is allowed to return substantially to its original rest position as the flange **214** approaches the upper end of the leg **186** so that the hook **192** can engage the locking pin **216**.

In the particular embodiment shown in FIGURE 12, the cam **168** engages the follower **178** with a somewhat decreasing radius as the arm is moved through the initial part of the backswing through the broken line position A. This allows the locking member **183** to bear positively to the right against the locking pin **216** thereby securely holding the wrist position **38** in its cocked position as a result of the force of the spring **208** exerted through the restraining lever **199** upon the locking member **183**. However, as the club arm **34A** approaches the end of the back-

swing, the club C extending at least somewhat to the right from the wrist device, the roller **178** encounters a portion **217** of increased radius on the cam **168**. This causes bell crank **175** to pivot in a clockwise direction to its broken line position B of FIGURE 12. The transfer bar **193** is thereby pulled toward the main shaft **28A** to effect a corresponding clockwise movement of the locking member **183** sufficient that the locking pin **216** will be released by the hook **192** thus unlocking the catch **167**. The flange **214** will normally rest against the lowermost bight portion **173** of the arm **34A** to limit further clockwise movement of the wrist device **38A**, the force of gravity on the wrist device and the club held thereby preventing uncocking of such wrist device at this point.

As the club arm **34A** more closely approaches the end of the backswing. the cam portion **217** rises further and through the bell crank **175** and transfer bar **193** causes further clockwise movement of the locking member **183** which moves the sleeve **196** upwardly along the edge **206** of the latch restraining lever **199** and into the notch **207** thereof. This engagement of the sleeve **196** and notch **207** prevents counterclockwise returning movement of the locking member **183** independent of any movement of the follower roller **178** on the cam during the foreswing. As a result, the locking member **183** is prevented from re-engaging the locking pin **216** and the catch **167** is unlocked.

At some point thereafter, the backstroke motion will end and the forestroke will begin. As the arm **34A** moves into its forestroke, the resulting centrifugal acceleration of the club head H causes the wrist device **38A** to begin counterclockwise uncocking movement with respect to the arm **34A** as described hereinabove with respect to the apparatus **10**.

To ready the catch **167** for another cycle of use, the sleeve **196** is released from the notch **207** by momentarily lifting the left-hand end **204** of the latch engaging member **199** whereupon the spring **208** through the transfer bar **193** returns the locking member **183** to its counterclockwisemost position shown in solid lines in FIGURE 12. Release of the latch restraining lever **199** allows the spring **208** to urge the edge **206** thereof against the sleeve **196** which firmly holds the locking member **183** in its counterclockwisemost or rest position shown for future engaging of the locking pin **216** as discussed hereinabove.

FIGURES 15 and 16 disclose a modified forestroke spring drive and followthrough braking arrangement. Parts of the modified apparatus of FIGURES 15 and 16 corresponding to the apparatus **10** of FIGURE 1 will be referred to by the same reference numerals thereas with the suffix "B" added thereto. The apparatus of FIGURES 15 and 16 includes a secondary spring system **220** comprising a parallel pair of tension springs **221** and **222** connected between the bolt **72B** fixed to the frame leg **17B** and a spring arm **219** rotatable on the main shaft **28B**.

As shown in FIGURE 16, a primary spring system generally indicated at **223** is provided between the secondary spring system **220** and the rear bearing **32B** of the shaft **28B**. The primary spring system **223** comprises a further spring arm **224** rotatable on the shaft **28B**. The spring arm **224** has a rigid finger **226** near the free end thereof which parallels the shaft **28B** for engaging the upper surface of the drive arm **61B** in a manner similar to the latch **81** of FIGURE 6. Thus, when the drive arm **61B** is moved through its backswing, the spring arm **224** must follow.

A bar **228** is axially slideable through a boss **229** on the upper face of the spring arm **56B** adjacent the free end thereof. The bar **228** is manually movable into the path of the spring arm **224** as shown in FIGURE 16 for causing the spring arm **219** to follow the spring arm **224** through the backswing. Alternatively, the bar may be retracted to allow the spring arm **219** to remain at rest while the spring arm **224** and drive arm **61B** move together through the backstroke.

The springs **221**, **222** and **231** are secured to the free ends of their respective spring arms **219** and **234** preferably in a manner similar to that in which the spring **71** is secured to the arm **66** of FIGURE 6.

The lower end of the spring **231** secured to a fine adjustment device **232** which is manually actuable to set within relatively close limits the tension of the spring **231** and, hence, the force imposed thereby upon the spring arm **224** and drive arm **61B**. In the particular embodiment shown, the fine adjustment device **232** comprises a bearing **233** which is in turn secured by a bracket **234** to the rear face of the leg **17B** adjacent the bolt **72B**. The bearing **233** carries a shaft **236** rotatable therewithin. A manually adjustable hand wheel **237** is secured to the rear end of the shaft **236** and a pinion gear **238** is affixed to the forward end of the shaft **236**. An elongated rack **239** is slideably mounted at the forward end of the bearing **233** for movement substantially along the axis of the spring **231** by any convenient means substantially indicated at **241** in FIGURE 15. The teeth **242** of the rack **239** are engaged by the pinion **238** so that rotation of the hand wheel **237** will cause, through the pinion **238**, a corresponding axial movement of the rack **239** and a consequent tensioning or loosening of the spring **231**. Thus, the fine adjustment mechanism **232** provides a way to precisely adjust the velocity characteristic of the club during the foreswing. A latch **243** is provided for locking the rack **239** in a preselected position so that the hand wheel **237** may be released without allowing movement of the rack in response to the tensioning of the spring **231**. More particularly, latch **243** comprises a single toothed bar **244** pivotally mounted on the underside of the bearing **233** as indicated at **246** for engaging opposed ones of the teeth of the rack.

In operation, the bar **228** would normally be moved to its leftwardmost position out of engagement with the spring arm **224** when a relatively low club head velocity is required, the fine adjustment mechanism **232** allowing a precise selection of such velocity. On the other hand, when higher club head velocities required, for example, for driving golf balls to a distance comparable to that of a competent golfer, the bar **229** may be moved rightwardly to engage the upper surface of the spring arm **224** thereby paralleling the springs **221** and **222** with the spring **231** to provide additional torque on the shaft **28B** during the forestroke.

The modified braking device **251** disclosed in FIGURES 15 and 16 would normally be used with the modified spring drive thereof instead of the friction brake **92** hereinabove described. More particularly, the modified brake **251** provides for positively stopping the followthrough stroke of the club well before a complete revolution occurs and thereby prevents the drive arm from striking the back of the rigid finger **226**. The brake **251** comprises a brake arm pivotally affixed at one end thereof to the shaft **28B** between the bearing **32B** and the drive arm **61B**. The brake arm **251** mounts a rearwardly extending pin **253** adjacent its free or lower end which overlaps the path of the drive arm **61B**. The brake arm **251** is normally disposed in a depending, somewhat rightwardly angled position as seen in FIGURE 16. The free end of the brake arm **251** is pivotally affixed to the piston rod **254** of a braking fluid cylinder **256** the lower end of which is pivotally secured as indicated at **257** in FIGURE 15 to the bracket **234**. The axis of the cylinder **256** extends upwardly and is angled somewhat rightwardly to its connection with the brake arm **252**. The drive arm **61B** strikes the pin **253** during the early part of the followthrough and drags the brake arm **252** along therewith, the brake arm motion being retarded by the cylinder **256**. As the followthrough stroke advances, the piston rod **254** will approach a right angle inclination with respect to the brake arm **252** thus bringing to a maximum the retarding torque exerted on the drive arm **61B** and shaft **28B** during followthrough by the cylinder **256**. The cylinder **256** is preferably of sufficient length as to allow a follow-

through stroke of length at least approaching that of any competent golfer. Followthrough movement preferably substantially abates before the piston rod **254** is fully extended. The cylinder **256** preferably allows the club arm **34B** to return to its normal depending rest position of FIGURE 15 and in fact may be spring biased to retract.

FIGURES 17 and 18 disclose modified anchor means **261** for securing the upper end of a spring **71C** to the spring arm **66C**. The anchor means **261** differs primarily from the spring anchoring core **74** of FIGURE 6 in that the anchor means **261** is more quickly releasable from the arm **66C** for rapid adjustment of its position in the holes **79C** along said arm. More particularly, the apparatus **261** comprises a pair of stub shafts **262** and **263** snugly but slideably disposed within a sleeve **264** which sleeve is disposable between the side walls of the spring arm **66C**. Radial pins **266** and **267** extend from the intermediate portion of the stub shafts **262** and **263**, respectively, through aligned axial slots **268** and **269** in the shell **264**. The stub shafts **262** and **263** are urged apart by a coaxial compression spring **271** to the extent allowed by the engagement of the pins **266** and **267** with the outer ends of the slots **268** and **269** and so that the outer reduced diameter ends thereof extend into opposite ones of the holes **79C** to securely pivotally mount the anchor means **261** in the spring arm **266C**. The holes **79C** are preferably bushed as indicated at **276**. Axially spaced lugs **277** and **278** depend from the shell **264** and are connected by a bolt **279** fixed in place by a nut **281**. The upper end of the spring **71C** is wrapped around the bolt **279**, thereby being secured to the anchor means **261**.

FIGURES 19–20 disclose a modified club gripping member **151D**. The gripping member **151D** comprises an elongated substantially V-shaped cross section sheet **153D** having mounting flanges **154D** at the leftward end thereof, the sheet **153D** and flanges **154D** corresponding generally to similarly numbered parts of FIGURE 8. A clamping member **282** is of generally V-shaped inverted cross section and extends along and substantially through the length of the sheet **153D**. The leftward end of the clamping member **282**, is pivotally connected as indicated at **283** to ears **284** extending upwardly from the side edges of the sheet **153D** adjacent the leftward end thereof. With the clamping member **282** pivoted away from the sheet **152D**, the grip G of a golf club C may be inserted axially thereinto as indicated in broken lines in FIGURES 19 and 20. A leftwardly tapered radial fin **286** extends from point near the rightward end of the clamping member **282** leftwardly to the end thereof along the apex thereof. Similar fins **287** and **288** are axially aligned with the fin **286** and fixed to the side faces of the sheet **153D** at spaced locations. The fins **286** through **288** are circumferentially threaded, except for a portion at the leftward end of each thereof, for receiving an internally threaded ring **289** in threaded engagement therewith. The ring **289** is provided with manually engageable radial pins **291**. Thus, to tighten the gripping member **151D** upon the grip G of the golf club, the ring **289** is moved rightwardly over the members **153D** and **282** until it contacts the threaded portions of fins **286** through **288**. The ring **289** is then manually rotated to thread same rightwardly along such fins, the taper of the fins causing the member **282** to pivot toward the sheet **152D** to tightly grip the grip G of the golf club C therebetween.

FIGURE 21 discloses a preferred embodiment of a club head speed measuring device generally indicated at **301** arranged for measuring the speed of the head H of the club C as it approaches the golf ball B. The device **301** includes a platform of the type described hereinabove with respect to FIGURE 1 and indicated here at **39E**. The platform **39E** houses a vertically spaced series of horizontal baffles **302**. A vertically aligned series of holes **303**, preferably slots elongated transversely of the club head path, extend downwardly from the top **304** of the platform **39E** through the lowest ones of the baffle **302**. The slots **303** are spaced from the ball B along the foreswing path of the club head H. A similar vertically aligned series of transverse slots **306** extends through the top **304** and baffles **302** at a location between the slots **303** and ball B. Suitable photoresponsive means, here photocells **307** and **308**, are disposed in the platform **39E** below the series of slots **303** and **306**, respectively. The light passing through the series of slots **303** and **306** and striking the photocells **307** and **308** may be provided by lamps, not shown, mounted above the club head H or may simply be available light in the area in which the apparatus is being used. In any event, the vertical alignment and spacing of the slots **303** and **306** results in effective columnization of the light striking the photocells. Thus, in effect, the only light striking the photocell **307** that in a vertical beam **311** in alignment with the slots **303** and the only light striking the photocell **308** will be that in a vertical beam **312** aligned with the slots **306**. Therefore, as the club head H approaches the ball B it will first break the light beam **311** striking the photocell **307** and thus reduce the level of light impinging thereupon and at a time thereafter determined by the average speed of the club head between the slots **303** and **306**, said club head will break the beam **312** and sharply drop the level of light falling upon the photocell **308**. D.C. anode potential is supplied to the photocells from a source V of a conventional type. The cathodes of the photocells **307** and **308** are connected to suitable transistor amplifiers generally indicated at **313** and **314**, respectively. The amplifiers are preferably identical and hence only one thereof, for example the amplifier **313**, will be described in detail. More particularly then, the cathode of the photocell **307** is connected to the base of a transistor **316**, the emitter of which is connected to the base of the further transistor **317**. The emitter of transistor **317** is grounded. Positive operating potential is supplied to the collectors of the transistors **316** and **317** through supply resistors **318** and **319** from any convenient source of positive potential, not shown. The amplifier output is taken from the collector of the second transistor **317** through a capacitor **321**, the output side of which is grounded through a dropping resistor **322**, and applied through a line **323** to one of the inputs of a bistable circuit **324**. The output line **326** of the amplifier **314** is connected to the other input of the bistable circuit **324**.

Thus, when the light striking the photocell **307** drops due to breaking of the beam **311** by the club head H, the current flow therethrough also drops. This diminishes the current flow through the transistors **316** and **317** and thus produces a rising potential on the collector of the transistor **317** which through the action of the capacitor **321** provides a positive pulse through the line **323** to the bistable circuit **324**. The positive pulse on the line **323** reverses the state of the bistable circuit **324**.

Similarly, passing the club head through a beam of light **312** produces a positive pulse in the output line **326** of the second amplifier **314** and returns the bistable circuit to its rest state.

The alternating output of an oscillator **327** of any convenient type having a known, constant frequency output, conveniently of single polarity pulses, is fed through a gate circuit **328** to a pulse counting device **329** of any convenient type here a binary counter. The oscillator gate is controlled by the output of bistable circuit and thus by the conductive state of the photocells **307** and **308**. Therefore, as the club head breaks the beam **311**, the bistable circuit **324** turns on the oscillator gate **328** to allow pulses from the oscillator **327** to be fed to the binary counter **329**. The oscillator gate maintains the oscillator in connection with the binary counter **329** until the club head H breaks the second beam of light **312** which causes the bistable circuit **324** to shut the gate **328** and thereby stops the flow of pulses to the binary counter **329**. The binary counter **329** feeds a suitable count indicator **331**

which may be a series of lights actuable to indicate the number of pulses applied to the binary counter. Thus, the display of the indicator is a direct function of the period during which the moving club head H is between the beams **311** and **312** and, hence, is a known inverse function of the average club head speed.

FIGURE 22 discloses a modified speed measuring device **334** generally similar to the device **301** except that a ball B and club head H are disposed above a plate which may for example be the base plate **11F** of the apparatus and the platform **39E** is spaced above the path of the club head H as it nears the ball B. The platform **39E** and the circuitry associated therewith are otherwise similar to that disclosed in FIGURE 21 above discussed and need no further dicussion here. The plate **11F** is furnished with a pair of slots **36** and **37** coaxially aligned with the slots **303E** and **306E**. Lamps **338** and **339** are disposed below the plate **11F** in alignment with the holes **336** and **337**, respectively, and are connected to a suitable source power, not shown, for furnishing beams of light **341** and **342**, respectively, through the slots **336**, **337** and **303E**, **306E** to the photocells **307E** and **308E**. As in the case of the apparatus of FIGURE 21, movement of the club head H toward the ball B successively breaks the beams **341** and **342** as a result of which the phototubes **307E** and **308E** respectively actuate suitable counting means as described above with respect to FIGURE 21.

Although particular preferred embodiments of the invention have been disclosed above for illustrative purposes, it will be understood that variations or modifications thereof which lie within the scope of the appended claims are fully contemplated.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. In an apparatus for swinging a golf club through a stroke, the combination comprising:

a frame;

a club arm mounted for pivotal movement with respect to said frame and means for swinging said club arm;

mounting means for movably mounting a golf club on said club arm for hinging movement substantially in the plane of arm rotation and for rolling movement generally about the axis of its handle as it is hinged.

2. In an apparatus for swinging a golf club through a golf stroke, the combination comprising:

a frame;

a club arm mounted for rotation with respect to said frame;

means for rotating said club arm at least through the foreswing of a golf stroke;

wrist means hinged freely on said arm for pivotal movement with respect thereto substantially within the plane of rotation of said club arm;

rolling means rotatably fixed to said wrist means and interconnected therewith for rolling movement with respect thereto as a function of the hinging motion of said wrist means on said club arm;

club gripping means on said rolling means carrying said golf club with the handle thereof generally aligned along an axis of said rolling movement;

whereby rotation of said club arm through said foreswing results in hinging motion of said club with respect to said club arm and rolling motion of said club about the axis of its handle as a function of said hinging motion.

3. The device defined in claim **2** including a main shaft rotatably mounted on said frame, said club arm being affixed to said main shaft for rotation therewith with respect to said frame; and

a drive arm fixed to said main shaft and motor means engageable with said drive arm for automatically moving said club arm to the top of the backswing and releasing same to allow said arm to be moved through the foreswing.

4. The device defined in claim **2** which said means for rotating said club arm through said foreswing comprises a main shaft rotatably supported on said frame and fixedly supporting said club arm with respect thereto;

a spring arm pivotally mounted upon said shaft and overrunning latch means for securing said spring arm for rotation with said shaft at least during the backswing and foreswing of the golf stroke and for allowing the shaft to overrun the spring arm rotatably during followthrough;

spring means disposed between said spring arm and said frame for resiliently resisting rotation of said spring arm through said backstroke and for urging said spring arm through said forestroke.

5. The device defined in claim **2** including brake means connected at least indirectly between said main shaft and said frame and means responsive to the position of the club arm with respect to said frame for actuating said brake means to slow the rotation of the club arm during followthrough.

6. The device defined in claim **2** in which said wrist means comprises an elongated hollow shell pivotally mounted on one end of said club arm for rotation about a hinge axis parallel to the axis of rotation of said arm and transverse to the longitudinal axis of said shell;

said rolling means comprises generally cup-shaped member disposed within said shell for rotation about the longitudinal axis of said shell;

including a first bevel gear fixed to said club arm and coaxial with the hinge axis of said shell and a second bevel gear fixed to one end of said cup-shaped member and in toothed engagement with said first bevel gear;

whereby pivotal movement of the shell with respect to the club arm causes said first bevel gear to rotate said second bevel gear and therewith said cup-shaped member about the longitudinal axis of said shell.

7. The device defined in claim **2** including catch members on said wrist means and said club arm actuable for maintaining said wrist means in a cocked position with respect to said arm;

cam means fixed with respect to said frame adjacent said club arm;

means responsive to the relative position of said cam means and club arm for disconnecting said catch means so as to allow free hinging movement of said wrist means with respect to said club arm.

8. The device defined in claim **2** including means fixed with respect to said frame adjacent the path of the head of the golf club for determining the average speed of the golf club head as it passes thereby.

9. In an apparatus for swinging a golf club through a sequence of backswing, foreswing and followthrough in a manner simulating the swing of a competent golfer, the combination comprising:

a frame;

motor means mounted on the frame;

a main shaft rotatably mounted on said frame, a drive arm fixed thereon and drive means releasably connecting said motor means to said drive arm for rotating same through a preselected backswing path and releasing same at the end of said backswing path;

a radial club arm fixed to the end of said main shaft for rotation therewith in a radial plane;

wrist means hinged freely on the free end of said arm for pivotal motion with respect thereto in said radial plane;

means for releasably gripping the handle of a golf club, said club gripping means being rotatably fixed to said wrist means for rolling movement with respect thereto about the axis of the club handle;

interacting means on said free arm end and gripping means for controlling the roll position of said gripping means on said wrist means as a function of the

hinged position of said wrist means on the end of said arm;

a spring arm rotatably supported on said main shaft;

an overrunning latch for engaging said spring arm to said drive arm during the backswing of said drive arm but allowing said drive arm to move away from said spring arm during followthrough;

spring means disposed between said spring arm and frame for input of potential energy thereto by said spring arm during said backswing and for urging said main shaft through the foreswing upon release of said drive arm by said drive means;

brake means having one portion fixed with respect to main shaft and a further portion at least indirectly connected to said frame actuable during follow-through to slow the motion of said club.

10. The device defined in claim **9** in which said drive means comprises a gear train connected at one end thereof to said motor means;

a disk rotatably supported on said frame and rotatably driven by said gear train and a pin mounted on said disk, said pin extending substantially parallel to said main shaft and axially overlapping said drive arm, the axis of said disk being parallel to the axis of said main shaft and displaced therefrom in a direction toward the path of the club head during the intermediate part of the backswing, the area mapped by said drive arm as it rotates about the axis of said main shaft overlapping only a portion of the orbit of said drive pin whereby said pin moves said drive arm through the backswing and releases same at the top of the backswing whereat said pin enters the portion of said orbit not overlapped by the area mapped in a revolution of said drive arm.

11. The device defined in claim **9** in which said frame includes a pair of legs between which said main shaft is disposed;

said spring means comprises a helical tension spring and including means for connecting one end thereof alternatively to a plurality of locations on one of said legs;

releasable means fixed to said spring arm adjacent one end thereof and alternatively positionable along the length thereof for pivotally engaging the remaining end of said spring thereto;

said overrunning latch comprising a latch arm pivotally mounted on said spring arm and extending into the path of said drive arm, means resiliently opposing pivotal motion of said latch arm in one direction and further means rigidly preventing pivotal motion of said latch arm in the opposite direction so that said drive arm will, through engagement with said latch means, pull said spring arm through the backswing and can pass the spring arm when moving in the opposite direction.

12. The device defined in claim **9** in which said spring means comprises a tension spring fixed to said spring arm; and

including a further spring arm pivotally mounted on said main shaft adjacent said first-mentioned spring arm, said first-mentioned spring arm being located between said further spring arm and said drive arm;

overrunning means for releasably engaging said first-mentioned spring arm to said further spring arm for allowing said drive arm to move both of said spring arms through said backstroke;

at least one further tension spring affixed to and between said further spring arm and said frame for exerting a torque on said further spring arm, said further spring generally paralleling said first-mentioned spring;

continuously adjustable rack and pinion means for securing said first-mentioned spring to said frame and manually actuable for continuously adjusting the tension of said first-mentioned spring.

13. The device defined in claim **9** in which said spring means comprises at least one tension spring fixed at one end thereof to said spring arm; and including

a rack slideably mounted with respect to said frame along the axis of said tension spring and having the remaining end of said tension spring secured thereto;

a manually rotatable pinion gear engaging said rack for varying the axial location thereof and thereby the tension of the spring; and

a manually actuable stop for preventing unintended axial motion of said rack.

14. The device defined in claim **9** in which said brake means comprises a brake arm rotatably fixed to said main shaft and located adjacent said drive arm, said brake arm including means extending into the path of said drive arm so that when said drive arm moves through the follow-through portion of the stroke said brake arm will be carried along therewith;

a fluid cylinder pivotally disposed between the free end of said brake arm and said frame for resiliently resisting motion of said brake arm at least in one direction corresponding to the direction of said drive arm during followthrough, the axis of said cylinder lying tangent to the path of the end of the brake arm at an intermediate point thereon.

15. The device defined in claim **9** in which said brake means comprises sleeve means fixed to said main shaft adjacent said spring arm;

pressure plate means circumferentially fixed with respect to said sleeve but axially slideable therealong adjacent said spring arm;

backing plate means fixed with respect to said spring arm and opposed to said pressure plate means;

friction means disposed between said pressure plate means and backing plate means;

pivotal means bearing on said pressure plate means and resilient means for urging said pivotal means against said pressure plate means to urge same against said frictional means and backing means in order to frictionally resist relative movement between said spring arm and said shaft.

16. The device defined in claim **15** in which said pivotable means includes an arm generally paralleling said main shaft and extending away from said pressure plate means and a weight disposed on the free end of said arm, said weight reacting to centrifugal force generated by rotation of said main shaft for assisting said resilient means and urging said pressure plate means toward said backing plate means.

17. The device defined in claim **9** in which the wrist end of said club arm comprises a generally U-shaped notch opening along the direction of pivotable movement of said club arm; and including

a coaxial pair of stub shafts mounted on the wrist end of said arm and extending into said notch; in which

said wrist means comprises an elongated shell loosely disposed in said notch and carrying a diametrally aligned pair of bearings intermediate the ends thereof, said shell being freely hinged on the inner ends of said stub shafts by said bearings; and in which

said gripping means includes an elongated, generally cup-shaped member loosely disposed within said shell and extending therethrough and further bearing means disposed at opposite ends of said shell for rotatably supporting said cup-shaped member for rotation about the longitudinal axis of said shell; and in which

said interacting means comprises a bevel gear coaxial with one of said stub shafts and affixed to said club arm on the inner wall of said notch and a further bevel gear affixed to the closed end of said cup-shaped member and engageable with the first mentioned beveled gear, said beveled gears being of substantially equal diameter so that pivotal movement of said shell about the axes of said stub shafts

through a given arc will result in rolling of the cup-shaped member within said shell through a substantially equal arc, said first-mentioned beveled gear being located on the forward side of said shell so that clockwise hinging of said shell as seen from the front of said apparatus results in clockwise rolling of said club as seen from the handle end thereof.

18. The device defined in claim 9 including interengageable catch means on said arm and wrist means manually actuable for fixing said wrist means in a cocked position with respect to said arm and means responsive to the position of said club arm for releasing said catch means.

19. The device defined in claim 18 in which said interengageable catch means on said arm and wrist means comprises a locking member pivotally connected to said club arm adjacent said wrist means and carrying a hook and an insertion plate fixed to said wrist means including transversely extending means, said locking member including surfaces slideably engageable with said transversely extending means for guiding said transversely extending means into retained engagement with said hook upon hinging of said wrist means to a cocked position with respect to said club arm and thereby locking said club arm in said cocked position; and

wherein said means for releasing said catch means includes a cam fixed to said frame and surrounding said main shaft adjacent said club arm, a bell crank pivotally mounted on said club arm adjacent said cam, follower means on one end of said bell crank for riding the periphery of said cam, linkage for connecting the other end of said bell crank to said locking member so that displacement of said follower means away from the center of said main shaft by said cam disengages said hook from said transversely extended means and unlocks said wrist means from its cocked position, a latch restraining lever pivotally mounted on said club arm above and adjacent said locking member, said latch restraining lever having an edge bearing upon said locking member at its connection to said linkage, a notch in said edge between such bearing point and the pivot point of said latch restraining lever and a tension spring connected between the end of said bell crank connected to said lock member and the free end of said lacth restraining member for simultaneously urging said follower means against said cam and said edge against said locking member, the rise of said cam being sufficient to urge the locking member along said edge of said latch restraining lever into said notch to prevent return of said hook into engagement with said transversely extended means.

20. The device defined in claim 9 in which said means for releasably gripping the handle of said golf club includes rolling member fixed rotatably to said wrist means, a first elongated member extending axially therefrom and a second elongated member substantially paralleling the first elongated member and pivotally affixed thereto adjacent said rolling member, said first and second elongated members defining a cavity of variable cross section therebetween into which the grip of a golf club may be inserted, said first and second elongated members each having at least one substantially radially extending fin running axially therealong, said fins being tapered toward the wrist means, at least the ends of each of said fins farthest from said wrist means being circumferentially threaded and a nut threadable along said fins for tightening said first and second elongated members against the grip of a golf club.

21. The device defined in claim 1 in which the mounting means includes first means for movably mounting a golf club on said club arm for hinging movement substantially in a plane of arm rotation and a second means located between said golf club and said club arm for rotating said golf club about the axis of its handle as it is hinged.

22. In an apparatus for swinging a golf club through a stroke, the combination comprising:

a frame;

a club arm mounted for pivotal movement with respect to said frame;

means for swinging said club arm;

support means for movably mounting a golf club on said club arm for rolling movement about the longitudinal axis of the golf club handle and for swinging movement in a plane substantially parallel to a plane as defined by the swinging movement of said club arm; and

means interconnecting said support means with said club arm for causing rolling movement of the golf club about the longitudinal axis of said handle whenever said club arm is swingably displaced.

23. In an apparatus for swinging a golf club through a stroke, the combination comprising:

a frame;

a club arm mounted for pivotal movement with respect to said frame;

a golf club mounted for pivotal movement on said club arm;

first drive means for rotating said club arm through the foreswing of a golf stroke;

second drive means for moving said club arm to the top of the backswing of said stroke; and

means for releasing said club arm from said second drive means for permitting said first drive means to rotate said club arm through said foreswing.

24. The device as defined in claim 23 wherein said golf club is mounted on said club arm for free hinging movement relative thereto.

25. In an apparatus for swinging a golf club through a stroke, the combination comprising:

a frame;

a club arm mounted for pivotal movement with respect to said frame;

means for rotating said club arm at least through the foreswing of a golf stroke;

a spring arm mounted for pivotal movement with respect to said frame;

overrunning latch means for securing said spring arm for rotation with said club arm at least during the backswing of the golf stroke and for allowing the club arm to rotatably overrun the spring arm during followthrough; and

spring means disposed between said spring arm and said frame for resiliently resisting rotation of said spring arm through said backstroke and for urging said spring arm through said foreswing.

26. The device defined in claim 25 including brake means interconnected between said frame and said club arm for slowing the rotation of said club arm during followthrough; and

means responsive to the position of the club arm with respect to said frame for actuating said brake means to slow the rotation of the club arm during follow-through.

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JAMES J. GILL, *Primary Examiner.*

RICHARD C. QUEISSER, *Examiner.*

J. D. SCHNEIDER, *Assistant Examiner.*