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 [31] **16311/67**

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[54] **DEVICE FOR PROJECTING PROJECTILES AT CYCLICALLY VARYING AZIMUTH AND ALTITUDES**
 17 Claims, 11 Drawing Figs.

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124/31, 124/41, 273/26 D, 124/29 A, 124/50
 [51] Int. Cl. **F41b 15/00**
 [50] Field of Search..... **124/6, 7, 8,**
9, 29, 32, 41; 273/26 D, 29 A; 318/164

ABSTRACT: Balls are thrown from a rotating spiral-shaped guideway by the action of the centrifugal force through an outlet which is opened for the passage of an ejected ball. The speed of rotation, the elevation angle, the azimuth angle, and the frequency of the ejections are cyclically varied by rotary cams driven from an electric motor.

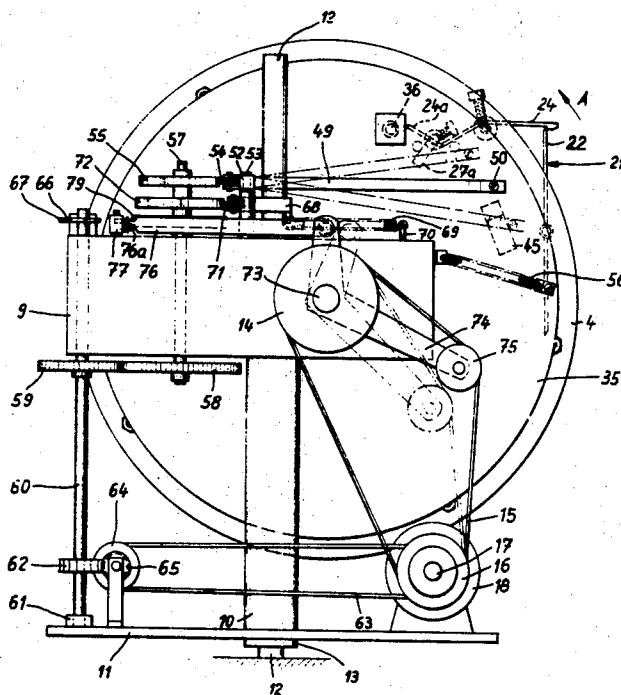
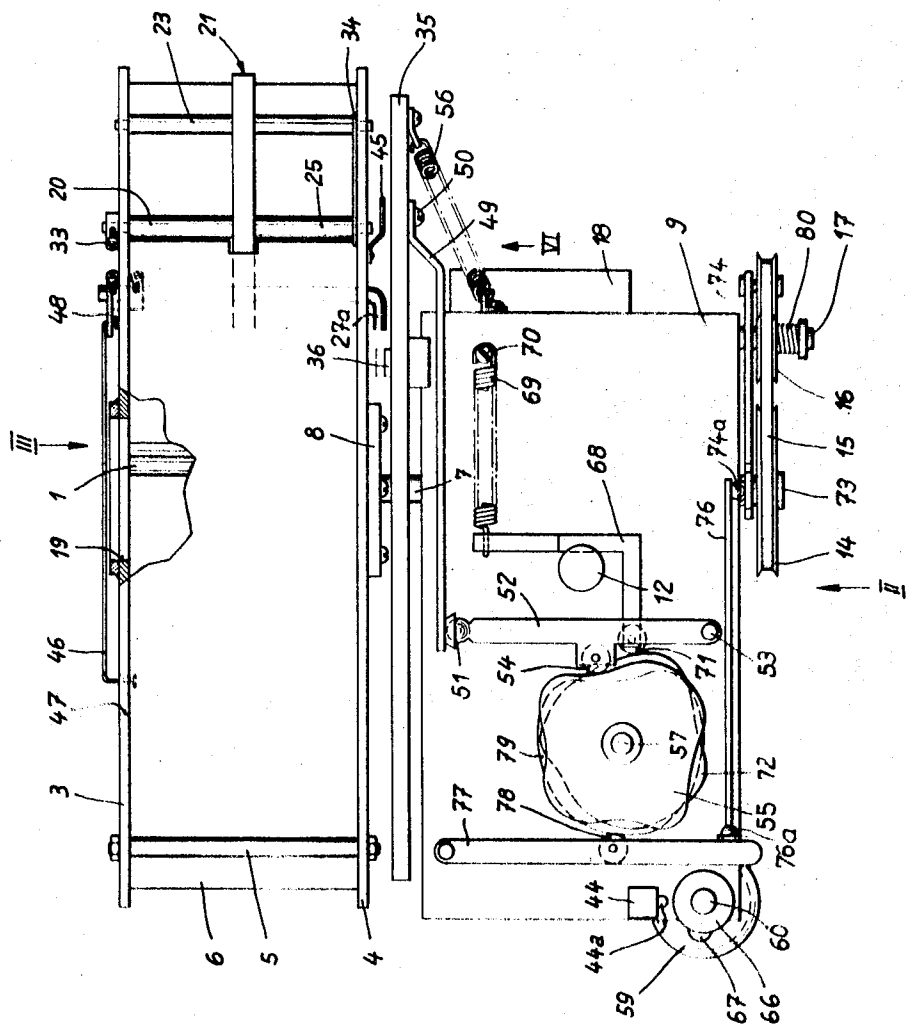


FIG. 1



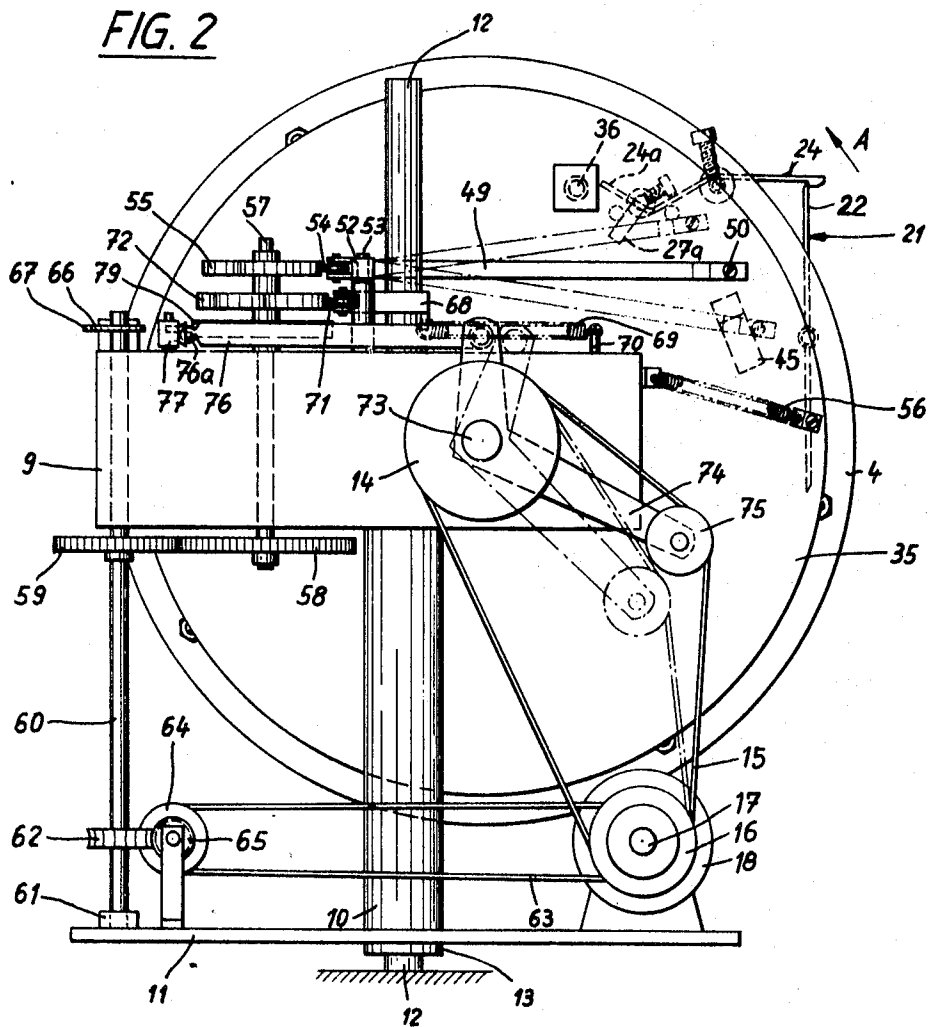
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FIG. 2



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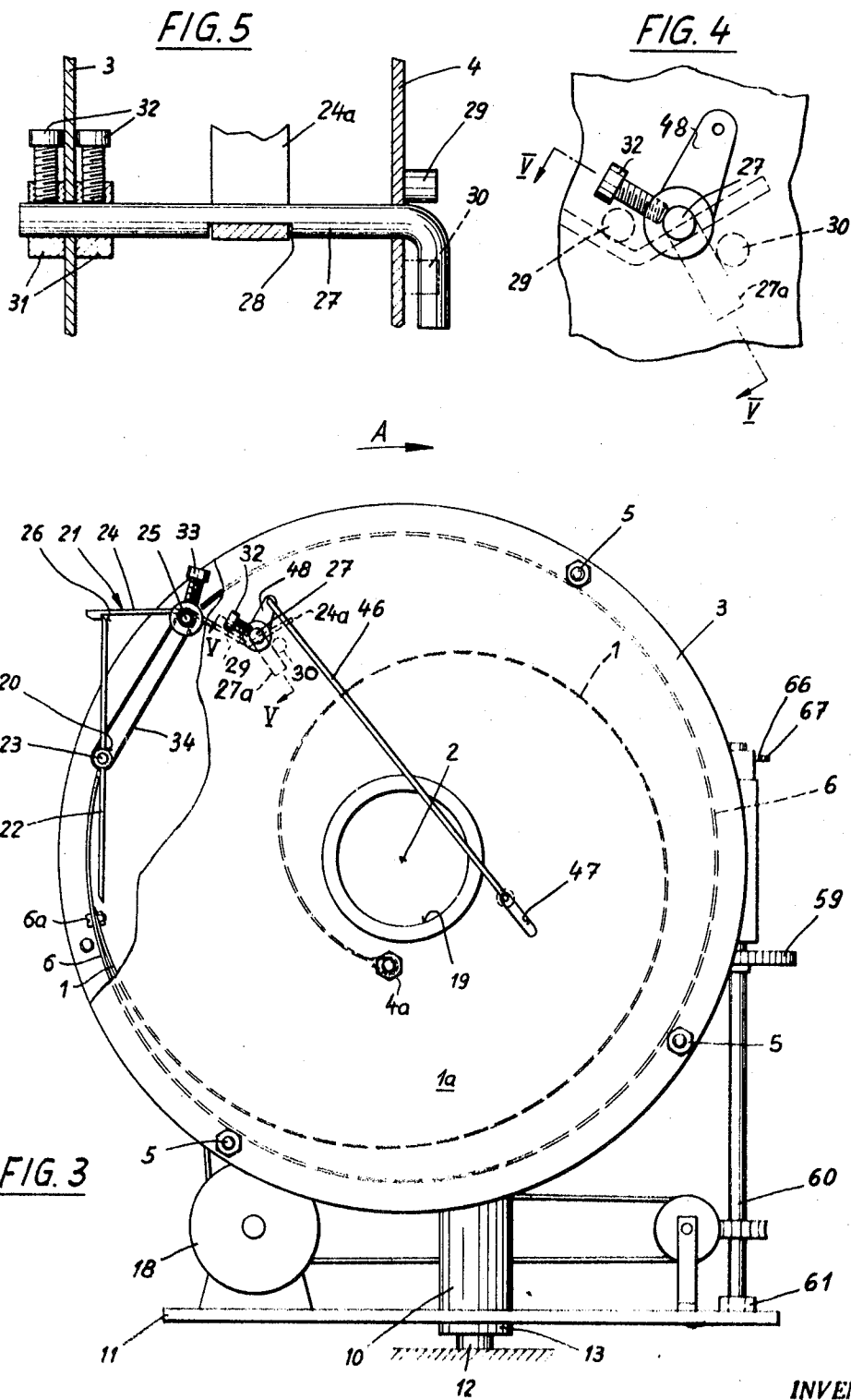


FIG. 6

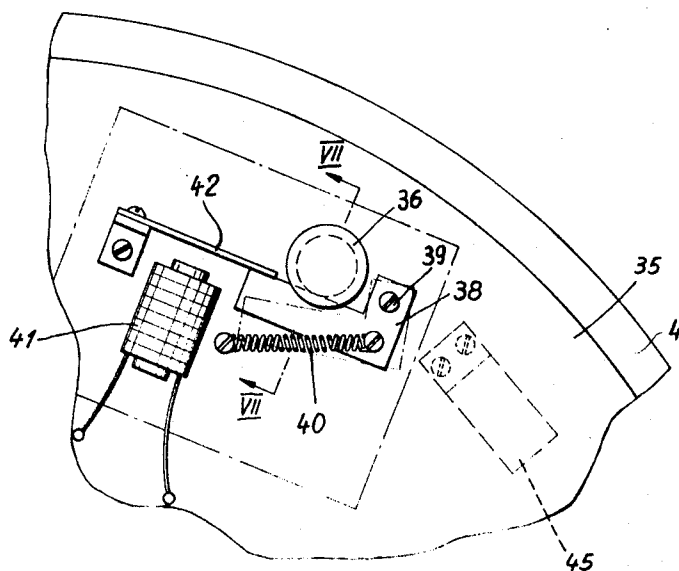


FIG. 7

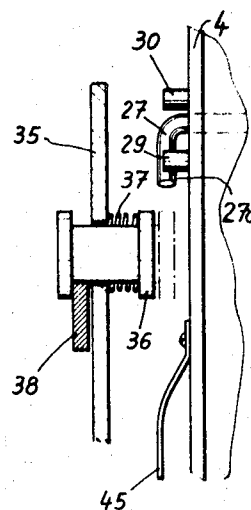


FIG. 11

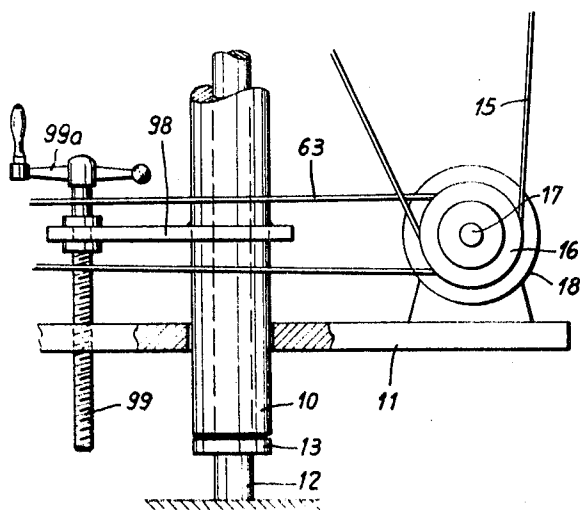
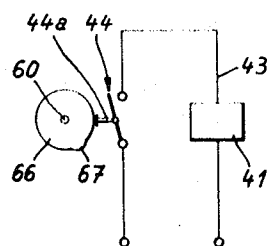


FIG. 8



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FIG. 9

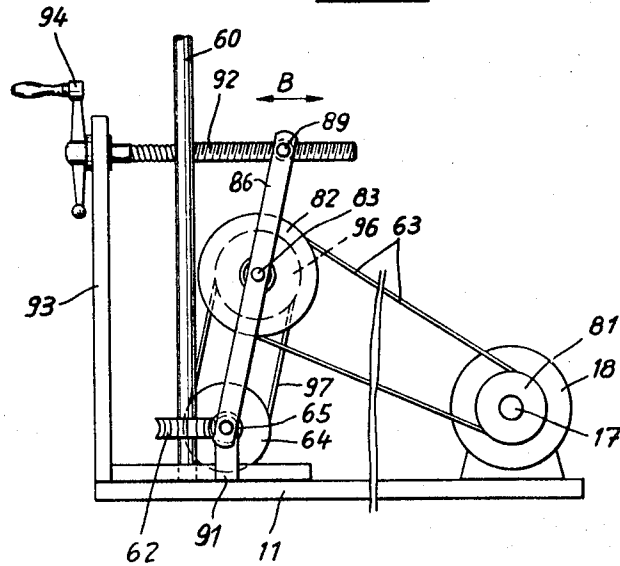
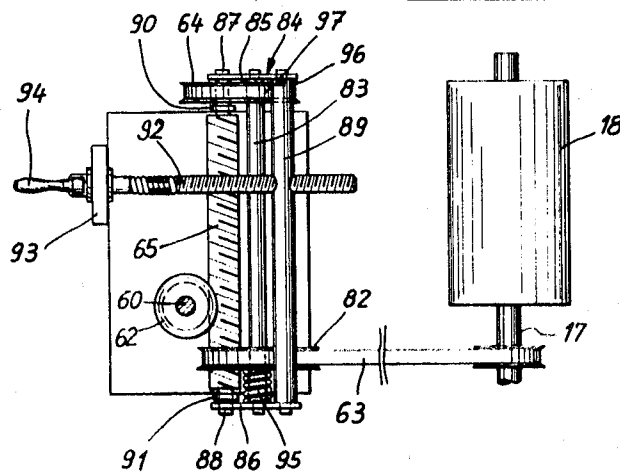


FIG. 10



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DEVICE FOR PROJECTING PROJECTILES AT CYCLICALLY VARYING AZIMUTH AND ALTITUDES

BACKGROUND OF THE INVENTION

Training apparatus for throwing balls, or clay pigeons, is known by which the thrown objects are ejected by the release of a tensioned spring. The apparatus of the prior art is incapable for obtaining a great variation of the trajectory of the ejected object, and is suitable for simulating the conditions of a tennis game, or of other complicated games.

SUMMARY OF THE INVENTION

It is one object of the invention to provide a training apparatus for throwing objects, such as balls, along a great number of different trajectories.

Another object of the invention is to provide a training apparatus by which objects are thrown along different cyclically varying trajectories.

Another object of the invention is to provide a training apparatus which can be set to throw balls along little changing trajectories for beginners, and along very varied trajectories for advanced players.

Another object of the invention is to provide an apparatus for throwing balls along cyclically varying trajectories which can be further gradually changed by a manual adjustment of the apparatus.

The apparatus comprises rotary throwing means having an axis of rotation, and forming a spiral-shaped guideway having an inner end portion in the region of the axis provided with an inlet, and an outer end portion provided with an outlet so that an object, such as a ball, inserted through the inlet into the guideway is accelerated in the same and driven to the outlet by the action of the centrifugal force. Closure means normally close the outlet, and are operated by actuating means to open the outlet so that the object or ball is ejected through the open outlet.

First control means, preferably including a first rotary cam, are provided for varying the rotary speed of the throwing means and thereby the initial speed of the ball.

Second control means are provided for opening the closure means in different angular position of the throwing means whereby the elevation angle of the trajectory, and the distance which the balls are thrown are varied. Preferably, second rotary cam effects cyclical variations of the elevation angles.

Third control means are provided for turning the throwing means about a vertical axis to different azimuth angles, and preferably a third rotary cam effects a cyclical variation of the azimuth angles.

Fourth control means are provided for operating the actuating means to open the closure means at predetermined intervals so that the frequency of the succession of thrown balls can be varied. Preferably, a fourth rotary driven cam effects a cyclical variation of the frequency of the throws. Each of the control cams is preferably exchangeable so that the pattern of the cyclically varied throws can be further modified.

Preferably, a transmission between the drive motor and the cams can be manually varied for obtaining a gradual variation of the cyclically modified throws.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a plan view illustrating an embodiment of the invention;

FIG. 2 is a side view of the apparatus taken in the direction of the arrow II in FIG. 1;

FIG. 3 is a side view of the apparatus taken in the direction of the arrow III in FIG. 1;

FIG. 4 is a fragmentary side view illustrating a detail of FIG. 3 on an enlarged scale;

FIG. 5 is a fragmentary sectional view taken on lines V—V in FIGS. 3 and 4;

FIG. 6 is a fragmentary elevation taken in the direction of arrow VI in FIG. 1 and illustrating a detail of FIG. 2 on an enlarged scale;

FIG. 7 is a fragmentary sectional view taken on line VII—VII in FIG. 6;

FIG. 8 is a schematic diagram illustrating an electric circuit for operating the control means shown in FIGS. 6 and 7;

FIG. 9 is a fragmentary side elevation illustrating a modification of transmission means shown in FIG. 2;

FIG. 10 is a fragmentary plan view illustrating the apparatus of FIG. 9; and

FIG. 11 is a fragmentary side elevation of an auxiliary device for continuously varying the rotary speed of the throwing means shown in FIGS. 1 to 3.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The embodiment illustrated in the drawing is particularly suited for throwing tennis balls to a practicing player, but it will be understood that the device could be easily adapted for throwing different types of balls, or other objects, such as clay pigeons.

As best seen in FIGS. 1 and 3, a throwing means includes a circular wall 6 having an outlet 20, a pair of lateral walls 3 and 4 abutting the lateral edges of the circular wall 6, and being fixedly connected with each other by bolts 5, and a spiral-shaped wall 1 whose lateral edges abut the end walls 3 and 4. The inner end of the spiral-shaped guide wall 1 is secured by a bolt 4a to the lateral walls 3 and 4, and the outer end is secured to the circular wall 6 by a bolt 6a. The inner end portion of the spiral-shaped wall 1 has a smaller radius of curvature than the outer end portion thereof, which extends almost in tangential direction. Spiral-shaped wall 1 forms a spiral-shaped guideway into whose inner portion an inlet 19 in lateral wall 3 opens, while its outer end is located in the region of the outlet 20 which is laterally bounded by lateral walls 3 and 4, and circumferentially bounded by axially extending edges 6b of circular wall 6.

The throwing means 1, 2 to 6 is rotated about an axis 2 by a drive shaft 7 secured by a flange 8 to the lateral wall 4. Shaft 7 is mounted for rotation in a support 9 and has an end portion 73 projecting from the same and carrying a pulley 14. Support 9 is fixedly mounted on a tubular support 10 which is secured to a baseplate 11 provided with an opening registering with tubular support 10. A vertical supporting shaft 12 has a flange 13 on which baseplate 11 rests, and passes through the opening in the baseplate 11, and through tubular support 10 so that support means 9, 10, 11, together with shaft 7, and the throwing means 1 to 6 carried by the same, can be turned about a vertical axis defined by support shaft 12.

Pulley 14 on the free end of shaft 7 is connected by a V-belt 15 with a motor pulley 16 which is connected with a motor 18 for rotation. Consequently, motor 18 rotates the throwing means 1 to 6 about axis 2 by means of shaft 7 and transmission 14, 15, 16 which is variable since pulley 16 has two parts, one of which can be axially displaced against the action of a spring 80 on motor shaft 17 whereby the transmission ratio is varied. The adjustment of the transmission ratio will be described hereinafter in greater detail.

When the throwing means 1 to 6 is rotated in the direction of the arrow A, and a tennis ball is inserted through the circular inlet 19 which is concentric with the axis 2, the ball is driven by the action of the centrifugal force in guideway 1a along the spiral-shaped wall 1 to the outlet 20 which is normally closed by closure means 21. Closure means 21 include a double-armed lever 22 secured to a pin 23 which is turnable in bearing openings in lateral walls 3 and 4. A latch 24 has a

shoulder 26 arresting one arm of lever 22 in the closed position of the closure means 21 illustrated in FIG. 3. Latch 24 is secured to a pin 25 mounted on sidewalls 3, 4 for turning movement, and has an end portion 24a projecting inward through opening 20. As shown in FIGS. 4 and 5, the free end portion 24a is bent and normally engages a recess 28 in a trigger rod 27 which is mounted for turning movement in lateral walls 3 and 4, and has a transverse actuating portion 27a located outside of wall 4, as also shown in FIG. 1. Trigger rod 27 is turnable between two position in which portion 27a abuts stops 29 and 30, and is prevented from axial movement by a pair of holding rings 31 secured by screws 32 and located on opposite sides of lateral wall 3. Screws 32 are urged by the centrifugal force to turn trigger rod 27 to a position in which actuating portion 27a abuts stop 30. In this illustrated position, latch portion 24a is located in recess 28.

When trigger rod 27 is turned to a position abutting the other stop 29, the circular portion of trigger rod 27 engages latch portion 24a instead of recess 28 so that latch 24 is turned in clockwise direction, as viewed in FIG. 3, to a position releasing double-armed lever 22.

A screw 33 (see FIGS. 1 and 3) is threaded into a bore of pin 25 which is secured to, and supports latch 24, and due to the mass of screw 33, the centrifugal force urges latch 24 to move in counterclockwise direction to the illustrated position arresting closure lever 22.

A ball inserted through inlet 19 is accelerated and outwardly driven to outlet 20, but can pass through the same only when trigger rod 27 is turned to displace latch 24 in clockwise direction so that closure lever 22 can be turned in counterclockwise direction by the ball passing through the outlet. Due to the action of the centrifugal force acting on screw 33, latch 24 is turned back into its normal position, and its end portion 24a engages again recess 28 of trigger rod 27 when the same has been returned to the position abutting stop 30 by the centrifugal force acting on screws 32.

The free closure lever 22 is urged by the centrifugal force to turn to a substantially radial position so that the next following ball engages the inner arm of closure lever 22 and turns the same until its end is engaged by shoulder 26. Pins 23 and 25 have pulley portions over which an endless string or cord 24 passes so that the turning movement of closure lever 22 due to the pressure of the driven ball, is transmitted to pin 25, turning latch 24 into the position engaging closure lever 22, aiding the centrifugal action of screw 33.

As explained above, in order to release a ball from the throwing means, it is necessary to turn trigger rod 27 from the illustrated position abutting stop 30 to a position abutting stop 29. This is accomplished by actuating means including a carrier plate 35 which has a central bore through which shaft 7 passes. The means by which the angular position of carrier 35 is determined will be described hereinafter, but carrier 35 can only perform a very limited angular movement, and may be considered stationary as compared with the rotary movement of throwing means 1 to 6.

As best seen in FIGS. 6 and 7, an actuator 36 passes through an opening in carrier plate 35 and has two end flanges. A spring 37 urges actuator 36 from the position illustrated in solid lines to the position illustrated in chain lines in FIG. 7, located in the circular path of actuator portion 27a, as shown in FIG. 2 of trigger rod 27. A stop member 38 is mounted on carrier plate 35 on a pivot screw 39 and is urged by a spring 40 to the position illustrated in FIGS. 6 and 7 in which stop member 38 holds actuator 36 in the illustrated inoperative position. Stop member 38 is secured to a leaf spring 42 mounted on carrier plate 35 and forming the armature of an electromagnet 41. As shown in FIG. 8, electromagnet 41 is connected into a circuit 43 including a switch 44 operated by a cam 66 on a shaft 60 and having a cam lug 67 for operating switch 44, as best seen in FIG. 1. Switch 44 is closed at a selected frequency by cam 66, 67, and every time electromagnet 41 is energized, stop member 38 is moved from its illustrated holding position to a position releasing actuator 36

which is urged by spring 37 to move axially into the circular path of movement of actuating portion 27a. During rotation of throwing means 1 to 6, actuating portion 27a abuts actuator 36 in its operative position, and is turned to the position abutting stop 29 so that latch 24 is released from the recess 28 of trigger rod 27 and turns a small angular distance clockwise, as viewed in FIG. 3 so that shoulder 26 releases the outer end of lever 22 which is turned by the centrifugal force to a substantially radial position whereby the closure means 21 is opened, permitting the ball to pass through the outlet opening 20. Actuator 36 is just passed by stop 29. Further turning of throwing means 1-6 with lateral wall 4 brings a leaf spring 45 on lateral wall 4 into contact with actuator 36 (see FIG. 2) which is axially pushed from its operative position back into its inoperative position against the action of spring 37, whereupon electromagnet 41 is deenergized by switch 44 and spring 42 moves stop member 38 into the illustrated blocking position in which actuator 36 is held inoperative and located outside of the path of movement of actuator portion 27a with wall 4.

If actuator 36 would not be returned to the inoperative position, closure means 21 would be again opened after each following revolution and permit the throwing of a ball, which may cause a undesirably high frequency of the throws.

The elevation angle of the trajectory of the thrown ball depends on the angular position of opening 20 when closure means 21 is opened. The distance of a throw depends on the elevation angle and is greatest for an elevation angle of about 45°. Therefore, the distance of each throw depends on the moment in which the closure means 21 is opened by actuator 36. By adjusting the angular position of actuator 36 in relation to the horizontal axis of rotation defined by shaft 7 the elevation angle of the outlet 20 at the moment of opening, and therefore the elevation angle of the vector representing the initial speed of the ball can be varied so that, for the same rotary speed of the throwing means and initial speed of the ejected ball, the throws are of different height and length. If actuator 36 remains in the same position, and support 9 is not turned with throwing means 1 to 6 about shaft 12, all trajectories have the same length and height, and are located in the same vertical plane so that a practicing player will hardly have to change his position for returning the balls. However, the time intervals between successive throws are determined by the rotary speed of cam 66.

As shown in FIGS. 1 and 2, a vertical shaft 60 passes through support 9 and carries cam 66 which cooperates with switch 44 by its lug 67. A worm gear 62 is secured to shaft 60 and meshes with a worm 65 connected with a pulley 64 and driven by a belt 63 from the divided pulley 16 on motor shaft 17. As noted above, pulley 16 is also used for driving shaft 7 with throwing means 1 to 6 by means of a belt 15.

Control means are provided for varying the angle of elevation of successive throws. As best seen in FIGS. 1 and 2, a link 49 is secured by a pivot screw 50 to carrier plate 35. The free end of link 49 is connected by a universal joint with a cam follower lever 52 mounted on support 9 for turning movement about a pivot 53 and carrying a cam follower roller 54 cooperating with a cam 55 driven by a cam shaft 57. Shaft 60, which carries the switch cam 67 also carries a fixed gear 59 meshing with the gear 58 on cam shaft 57 so that cam 55 is driven from motor 18. The peripheral cam track of cam 55 has several irregular lobes cooperating with cam follower roller 54 to oscillate the cam follower means 52, 49 and thereby carrier plate 45 with actuator 36 about shaft 7. A pretensioned spring 56 connects carrier plate 35 with support 70 and biases carrier plate 35 and cam follower means 49, 52, 54 normally into engagement with cam 55, but permitting limited angular movement of carrier plate 35 about shaft 7 under the control of the lobes of cam 55 while spring 56 is tensioned. During rotation of cam 55, carrier plate 35 freely oscillates with actuator 36 about shaft 7 so that the angular position of actuator 36 is cyclically varied, and actuator portion 27a is engaged in different angular positions of the throwing means 1 to 6 so that

closure 21 is opened when outlet 20 is in different angular positions corresponding to different angles of elevation of the trajectory of the thrown ball.

Cam 57 can be exchanged for another cam having differently arranged cam lobes whereby the elevation angles are changed in a different cycle resulting in different sequence of throws having different lengths. The interval between the throws, in other words the frequency of the throws, is controlled by cam 66, and depends on the number of lobes 67 on the same since electromagnet 41 is controlled by switch 44 to operate stop member 38 to release actuator 36 to move into the path of movement of actuator portion 27a which effects opening of the closure means 21. Between each throw, the throwing means 1 to 6 may perform several revolutions with closure 21 closed.

By the above described control means, the apparatus is operated to make throws of different lengths under the control of cam 55, and if desired, different frequencies under the control of cam 66, 67, in the same vertical plane.

Control means are provided for varying the horizontal angular direction of the throws, in other words the azimuth angle of the trajectories. As explained above, support 9 by which shaft 7 and throwing means 1 to 6 are carried, is turnable about the vertical shaft 12. As shown in FIGS. 1 and 2, a stationary cam follower means 68 carrying a cam follower roller 71 is fixedly secured to the fixed shaft 12 and has a free portion connected by a spring 69 to a screw 70 threaded into support 9. Spring 69 is pretensioned and angularly displaces support 9 with tubular support member 10 and baseplate 11 about support shaft 12 so that cam shaft 57, which is mounted on support 9, see FIG. 2, and a fixed cam 72 thereon, are normally in a position in which the peripheral cam track of cam 72 engages cam follower roller 71. Cam 72 has irregular cam lobes and is driven with cam shaft 57 from motor 18, as described above, and each lobe causes angular displacement of support 9, and of shaft 7 with throwing means 1 to 6 about fixed shaft 12.

Depending on the shape of the cam lobes of cam 72, support 9, and also throwing means 1 to 6, cyclically oscillate about the vertical axis of shaft 12 so that the balls are ejected in different directions at different azimuth angles. By selecting the lobes of cams 55 and 72, it is possible to throw successive balls into different corners of the tennis court, and for advanced players, successive balls may be thrown into a far corner on one side of the court and to a spot adjacent the net on the other side of the court.

The above-described control means obtain variations of the throws, but it has been assumed that the initial speed of each thrown ball is the same. Control means are provided to vary the speed at which the ball is ejected from the outlet 20 of throwing means 1 to 6. The end portion 73 of shaft 7 supports between pulley 14 and support 4, an angular lever 74, as best seen in FIGS. 1 and 2. One arm of angular lever 74 carries a pulley 75 about which a portion of the endless belt 15 passes by which the divided motor pulley 16 is connected with the drive pulley 14 on shaft 7. The other arm of angular lever 74 is connected by a joint 74a with a link 76 connected by a universal joint 76a with the end of a cam follower lever 77 which carries a follower roller 78 cooperating with the peripheral track of a cam 79 mounted on cam shaft 57.

As explained above, the outer half of the divided pulley 16 is mounted on motor shaft 17 for axial movement against the action of a spring 80. During rotation of cam 79, cam follower means 77, 76, 74 displace pulley 75, see FIG. 2, so that the loop of belt 15 is tensioned, and one-half of the divided V-pulley 16 is axially displaced whereby the effective radius of pulley 16 acting on belt 15 is reduced, and the transmission ratio of the transmission 14, 15, 16 varied. Since the variation of the effective radius of pulley 16, and the corresponding variation of the transmission ratio between motor shaft 18 and shaft 7 of the throwing means 1 to 6 are cyclically changed by the lobes of cam 79, the rotary speed of throwing means 1 to 6 is continuously and cyclically varied, so that the initial speed of successive thrown balls varies. A throw at an increased initial

speed can be combined with a small elevation angle of outlet 20 when the same is opened, so that a flat and long throw is effected. As cams 72 and 75, cam 79 can be exchange for another cam having differently arranged and shaped cam lobes.

An auxiliary device, which can be combined with the above-described apparatus, is illustrated in FIGS. 9 and 10. As described above, control means are provided, including cam 72 for cyclically varying the azimuth angle of the throwing means 1 to 6, cam 55 for cyclically varying the elevation angles of the throws, cam 79 for varying the rotary speed of the throwing means, and cam 66 for varying the frequency of successive throws. The auxiliary device illustrated in FIGS. 9 and 10 permits a simultaneous, continuous, and gradual variations of the cyclical variations obtained by the cams 66, 55, 72, and 79 of the control means.

As shown in FIG. 2, belt 63 directly connects the divided V-pulley 16 with pulley 64, but in the modified construction of FIGS. 9 and 10, a pulley 81 on motor shaft 17 is connected by a belt 63 with a divided V-pulley 82. One half of pulley 82 is fixed to a shaft 83 which is mounted for rotation in a frame 84 having two lateral legs 85 and 86 whose lower ends are turnably mounted on journals 86 and 87 at the ends of a worm spindle 65. The upper ends of legs 85 and 86 are connected by a rod 89 which has journals at the ends mounted in legs 85 and 86. Journals 87 and 88 of worm spindle 65 are mounted in bearings 90 and 91 which are fixed on the baseplate 11. A threaded spindle 92 is mounted in a thrust bearing on a bracket 93 on baseplate 11, and can be turned by handle 94. The thread of the spindle 92 meshes with a threaded bore traversing connecting rod 89 of frame 84. When handle 94 is rotated, frame 84 is turned about journals 87, 88 since connecting rod 89 is moved in the directions of the arrows B. When pulley 82 is moved away from pulley 18, the greater tension applied by belt 63 to the divided pulley 82 forces the axially movable half of the same against the action of the spring 95 away from the other half of pulley 82 so that the effective radius of pulley 82 is reduced, and the transmission ratio between the shaft 17 of motor 18 and shaft 83 is varied. Shaft 83 carries another V-pulley 96 connected by belt 97 to pulley 64 which is secured to worm spindle 65 so that the same is rotated at a speed depending on the adjusted transmission ratio, and drives through worm gear 62 and shaft 60, control cams 67, 55, 72, 79 at gradually and selectively varied rotary speeds.

The combination of the modification of FIGS. 9 and 10 with the apparatus illustrated in FIGS. 1 to 3 permits a gradual, continuous, and selective variation of the factors which influence the trajectories of the thrown balls within certain limits. However, for a motor 18 having a predetermined rotary speed, there is no possibility of varying the average initial speed of the thrown balls, and the average distance which the balls are thrown.

The modification illustrated in FIG. 11 serves the purpose to provide control means for varying the rotary speed of throwing means 1 to 6 within a wide range. While in the construction shown in FIG. 2, baseplate 11 is secured to tubular support member 10 and rests on a flange 13 of shaft 12, in the embodiment of FIG. 11, baseplate 11' is axially movable along the tubular support member 10 which directly rests on flange 13 of shaft 12 and carries support 9, as described with reference to FIG. 2. Tubular support member 10 carries a fixed arm 98 with a thrust bearing in which a spindle 99 is mounted for rotation. Spindle 99 passes through a bore in baseplate 11', and by operation of handle 99a, baseplate 11' with motor 18 and pulley 16 can be raised toward support 9, or lowered away from the same. Since pulley 16 is a divided V-pulley, as explained with reference to FIG. 1, the axially movable half of pulley 16 is moved away from the other half which is fixed to shaft 17 when baseplate 11 with motor 18 and pulley 16 is downwardly moved away from support 9, not shown in FIG. 11. The tension of pulley 15 urges the movable pulley half away from the other pulley half so that the effective radius

of pulley 16 is reduced, and the transmission ratio to pulley 14, see FIGS. 1 and 2 is varied and the rotary speed of throwing means 1 to 6 is reduced. Due to the axial displacement of baseplate 11, it is necessary to construct shaft 60, not shown in FIG. 11, as a telescopic shaft consisting of two axially slidable shaft portions connected for rotation with each other, for example two hollow prismatic shafts.

By the variable transmission 16, 17, 14 between motor 18 and drive shaft 7 which carries pulley 14, the rotary speed of the throwing means 1 to 6, and also the initial speed of the thrown balls can be varied within wide limits.

It is possible to manually insert balls into the inlet opening 19, but it is preferred to provide a magazine, not shown, in which balls are stored and supplied through a chute or hopper, not shown, to the inlet 19 in lateral wall 3. In order to prevent the entry of more than one ball into the interior of the throwing means 1 to 6, a blocking rod 46 has a normal position crossing inlet 19 and blocking the same, see FIGS. 1 and 3. The end of blocking rod 46 has a transverse portion guided in a slot 47 in lateral wall 3, so that blocking rod 46 is longitudinally and angularly movable in slot 47. The other end of blocking rod 46 is connected to an arm 48 secured to trigger rod 27, as shown in FIG. 3 and FIG. 4. When actuating portion 27a of trigger rod 27 engages actuator 36 and is turned by the same to a position effecting opening of the closure means 21, lever 48 turns to a position in which blocking rod 46 is shifted and angularly displaced to a position spaced from inlet 19 so that the next following ball in the chute of the magazine, which was resting on blocking rod 46, can enter the inner portion of guideway 1a through inlet 19.

The invention has been described mainly with reference to an apparatus for throwing tennis balls to a practicing player. The apparatus can also be used to simulate passes in a football game, and pitches in a baseball game, using different balls. Goalkeepers for ice hockey and land hockey can be trained by the apparatus throwing pucks and hockey balls, respectively, and it will be understood that other objects, such as clay pigeons, can be thrown for target-shooting practice.

Each of the control means described above, or two or more together may also find a useful application in other types of training apparatus for throwing objects, different from the embodiments described above.

While the invention has been illustrated and described as embodied in a training apparatus for throwing tennis balls at different speeds, azimuth and elevation angles, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

What is claimed as new and desired to be secured by Letters Patent is set forth in the appended claims.

1. Training apparatus for throwing objects, comprising, in combination, rotary throwing means having an axis, and including wall means forming a spiral-shaped guideway having an inner end portion in the region of said axis, and an outer end portion, said throwing means having an inlet into said inner end portion and an outlet from said outer end portion of said guideway; drive means for rotating said throwing means about said axis so that an object inserted through said inlet into said guideway is accelerated and driven to said outlet by the centrifugal force; closure means having a normal closing position for closing said outlet, and an open position; actuating means for moving said closure means to said open position for passage of said object through said outlet; blocking means having an inoperative position, and a blocking position blocking said inlet so that no object can be inserted through the same into said throwing means; and means connecting said closure means with said blocking means so that said inlet is blocked when said closure means is moved to said closed position and opened when said closure means is opened.

2. Apparatus as claimed in claim 1 comprising first control means for varying the rotary speed at which said throwing means is rotated by said drive means about said axis whereby the initial speed of the object is varied.

3. Apparatus as claimed in claim 2 wherein said drive means include a motor and a variable transmission connecting said motor with said throwing means; and wherein said first control means include first rotary cam means driven from said motor, said first cam follower means operatively connected with said variable transmission means for cyclically varying the transmission ratio of the same.

4. Apparatus as claimed in claim 1 wherein said axis is horizontal; and comprising control means for operating said actuating means in different angular positions of said throwing means in which a radial plane through said outlet defines different acute elevation angles with a horizontal axial plane whereby the distance which the objects are thrown is varied.

5. Apparatus as claimed in claim 4 wherein said actuating means include an actuator, comprising a carrier member mounted for angular adjustment about said axis and supporting said actuator located in the path of movement of said closure means for opening the same; and wherein said control means include a rotary cam means driven by said drive means, and a cam follower means operatively connected with said carrier member for cyclically varying the angular position of the same and of said actuator in relation to said axis.

6. Apparatus as claimed in claim 1 wherein said axis is horizontal; comprising support means for supporting said throwing means for angular movement about a vertical axis; and control means for turning said throwing means different azimuth angles about said vertical axis to different angular positions.

7. Apparatus as claimed in claim 6 wherein said control means include a rotary cam means driven by said drive means and cam follower means operatively connected with throwing means for turning the same cyclically varied azimuth angles about said vertical axis.

8. Apparatus as claimed in claim 1 comprising manually operated control means for continuously varying the rotary speed at which said throwing means is rotated by said drive means about said axis whereby the initial speed of said object is gradually and selectively varied under control of an operator.

9. Apparatus as claimed in claim 1 wherein said actuating means include a rotary member rotated by said drive mean, and means connecting said rotary member with said actuating means to effect cyclical movement of said closure means to said open position by said actuating means.

10. Apparatus as claimed in claim 1 comprising first control means for varying the rotary speed of said throwing means; second control means for operating said actuating means in different angular positions of said throwing means; third control means for turning said throwing means about an axis transverse to said axis, fourth control means for operating said actuating means to open said closure means at predetermined intervals; and wherein said drive means drive all said rotary control means in synchronism.

11. Apparatus as claimed in claim 10 wherein said drive means include a motor and a variable transmission for driving said cams in synchronism; and comprising manually operated means connected with said variable transmission means for varying the transmission ratio of the same whereby said cams cyclically operate at a continuously variable speed determined by operation of said manually operated means.

12. Apparatus as claimed in claim 10 including driven shaft means, and mounting means for mounting said cams on said shaft means.

13. Apparatus as claimed in claim 1 wherein said wall means of said rotary throwing means include a circular wall formed with said outlet, a pair of lateral walls at the axial ends of said circular wall, a spiral-shaped wall located within said circular wall and having lateral edges abutting said lateral walls, an inner end portion having a small radius of curvature, and an outer end portion having a great radius of curvature and ending adjacent said outlet in said circular wall, said guideway being formed by said spiral-shaped wall between said lateral walls; means for securing said spiral-shaped wall to

said circular wall and said lateral walls; wherein one of said lateral walls is formed with said inlet, and wherein said inlet is partly surrounded by said inner end portion of said spiral-shaped wall.

14. Apparatus as claimed in claim 1 wherein said closure means include a double-armed lever mounted at one end of said outlet for pivotal movement and having a normal closing position in which one arm thereof is located at said outlet and the other arm thereof projects into said guideway, and an open position extending radially to said axis, and latch means for holding said double-armed lever in said normal closing position; and wherein said actuating means include an actuator located in the path of movement of said latch means for releasing the same and opening said closure means in an angular position of said throwing means in relation to said axis determined by the angular position of said actuator.

15. Apparatus as claimed in claim 1 wherein said wall means includes a spiral-shaped wall having a central inner end and an outer end, and being wound from said outer end to said inner end in one direction; and wherein said drive means rotate said throwing means and said spiral-shaped wall in a direction opposite to said one direction.

16. Training apparatus for throwing objects, comprising, in combination, rotary throwing means having a horizontal axis, and including spiral-shaped wall means forming a spiral-shaped guideway about said horizontal axis and having an inner end portion in the region of said axis and an outer end portion, said throwing means having an inlet into said inner end portion and an outlet from said outer end portion of said guideway; drive means for rotating said throwing means about said horizontal axis so that an object inserted through said inlet into said guideway is accelerated and driven through said outlet by the centrifugal force; closure means including a closure lever having a normal closing position for closing said outlet, and an open position; actuating means operative to permit said closure means to release said closure lever so that

said closure lever may be rotated under the force of a thrown object to an open position for passage of said object through said outlet; and control means for cyclically operating said actuating means to open said closure means in different angular positions of said spiral-shaped wall means in which said outer end portion of the same defines different angles with a horizontal axial plane whereby the elevation angle of the trajectory of the object and distances which the objects are thrown are varied.

17. Training apparatus for throwing objects, comprising, in combination, rotary throwing means having an axis, and including wall means forming a spiral-shaped guideway having an inner end portion in the region of said axis and an outer end portion, said throwing means having an inlet into said inner end portion and an outlet from said outer end portion of said guideway; drive means for rotating said throwing means about said axis so that an object inserted through said inlet into said guideway is accelerated and driven to said outlet by the centrifugal force; closure means having a normal closing position for closing said outlet, and an open position; actuating means including an actuating portion mounted on said throwing means and operative to permit said closure means to move to said open position for passage of said object through said outlet, said actuating means further including an actuator, a carrier member supporting said actuator for movement of said actuator between an inoperative position and an operative position, said actuator in said operative position being located in the path of movement of said actuating portion for opening said outlet; and control means including electromagnetic means and a stop member operable by the same for permitting said actuator to move to said operative position, a switch for energizing said electromagnetic means, and rotary cam means driven by said drive means for cyclically closing and opening said switch whereby said closure means are cyclically moved at predetermined time intervals to said open position.

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