United States Patent [19]

Scott

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[54] **SPRING TYPE PROJECTING DEVICE**

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[52] **U.S. Cl.** ..... **124/16,** 273/26 D, 124/50, 124/30 R, 273/29 A

[51] **Int. Cl.** **F41b 7/00**

[58] **Field of Search** ..... 124/16, 17, 36, 30 A, 124/41, 50; 273/26 D, 29 A

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[57] **ABSTRACT**

Apparatus is disclosed for propelling game balls or like objects sequentially in a desired trajectory. A rotating elongated leaf spring, being bent over its entire length by the combined action of a trip lever and a fulcrum, is used to propel the objects. The trip lever, when engaged by the elongated leaf spring, pivots to separate the object to be propelled from the flow of objects from a magazine and to retain the elongated leaf spring in a stressed and cocked condition. The apparatus prevents overloading of the leaf spring and also prevents extended vibration of the leaf spring by the use of leaf springs and snubbing spring.

7 Claims, 8 Drawing Figures

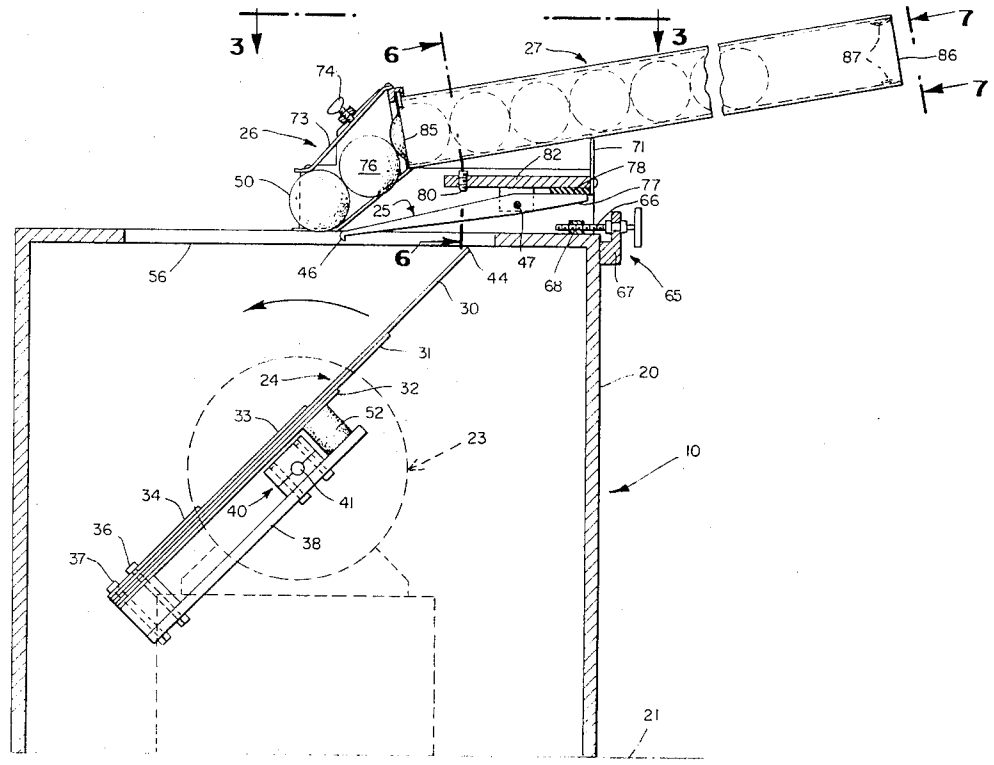
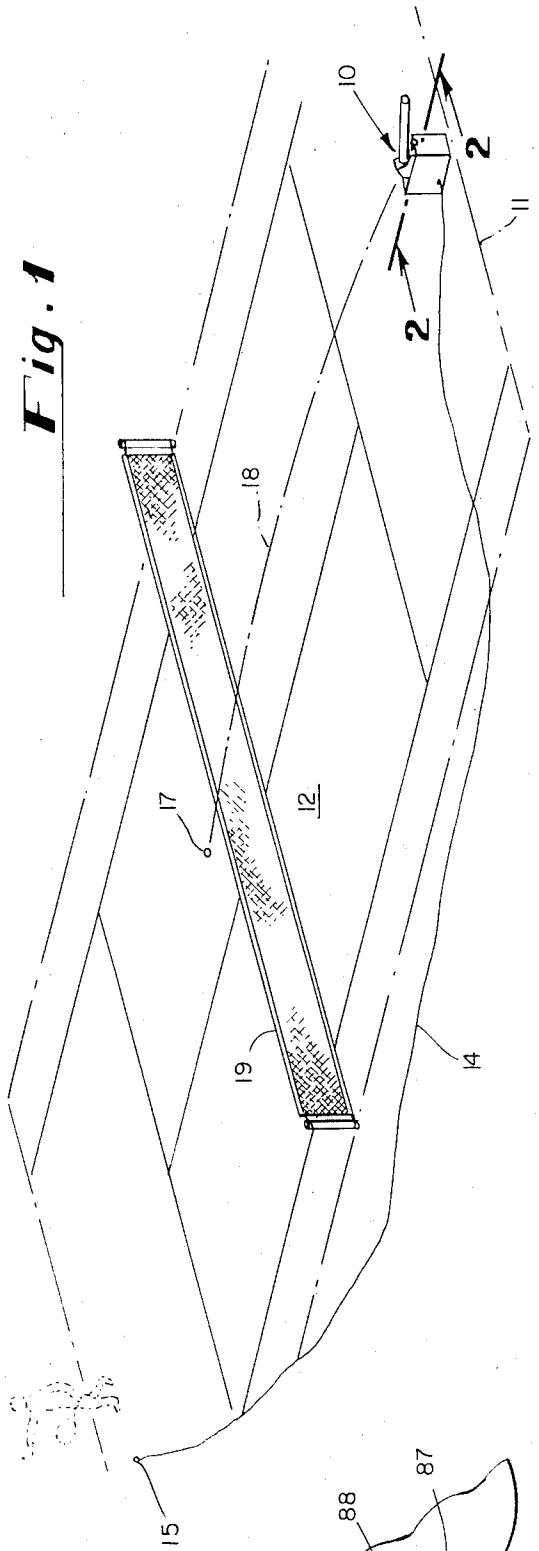


Fig. 1



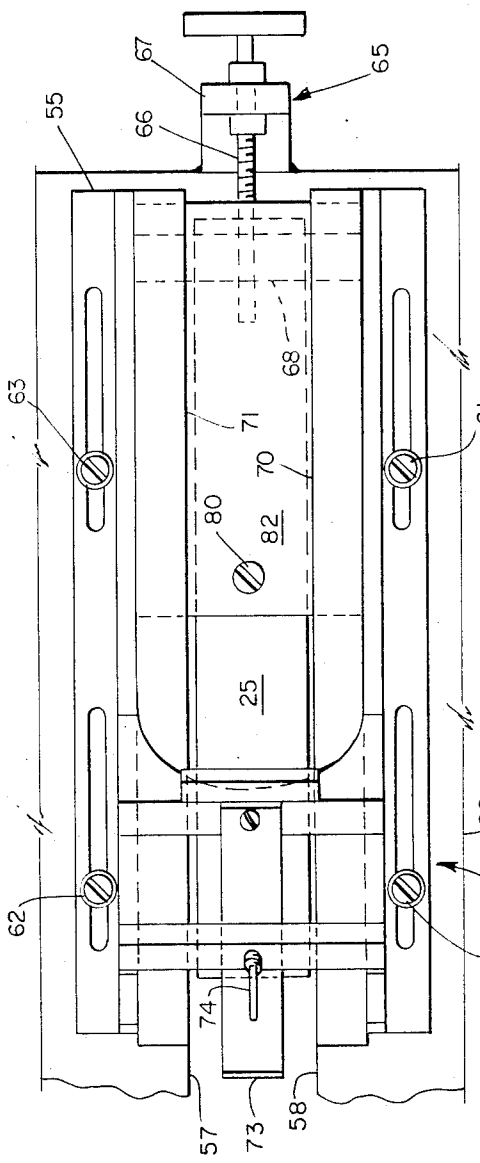


Fig. 3

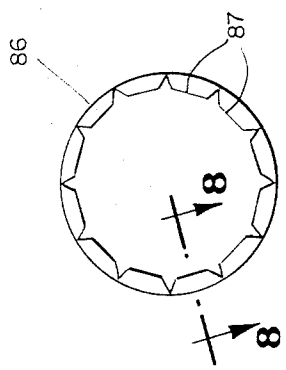


Fig. 7

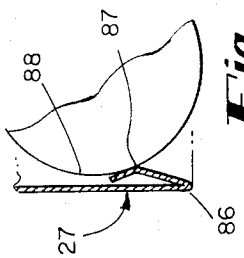


Fig. 8

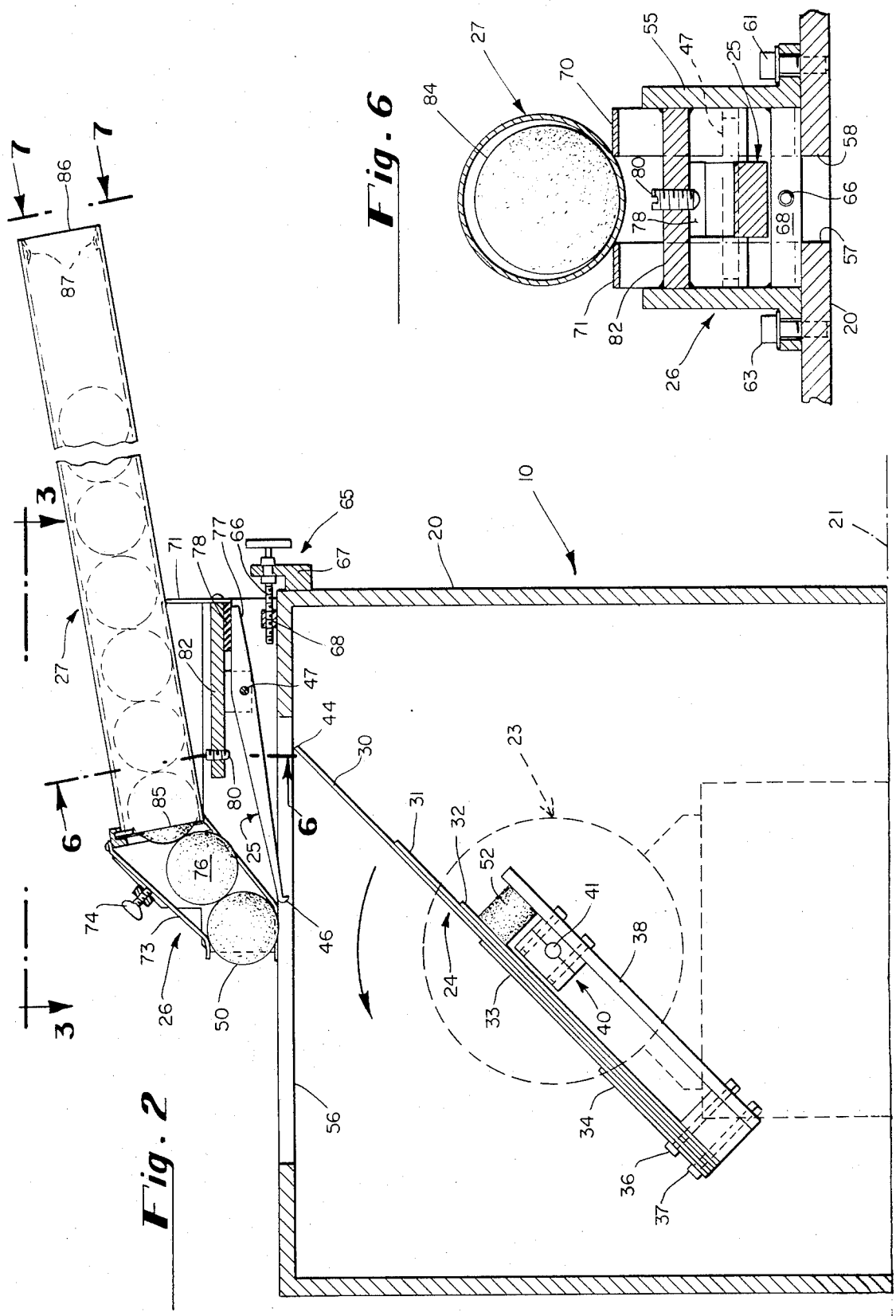
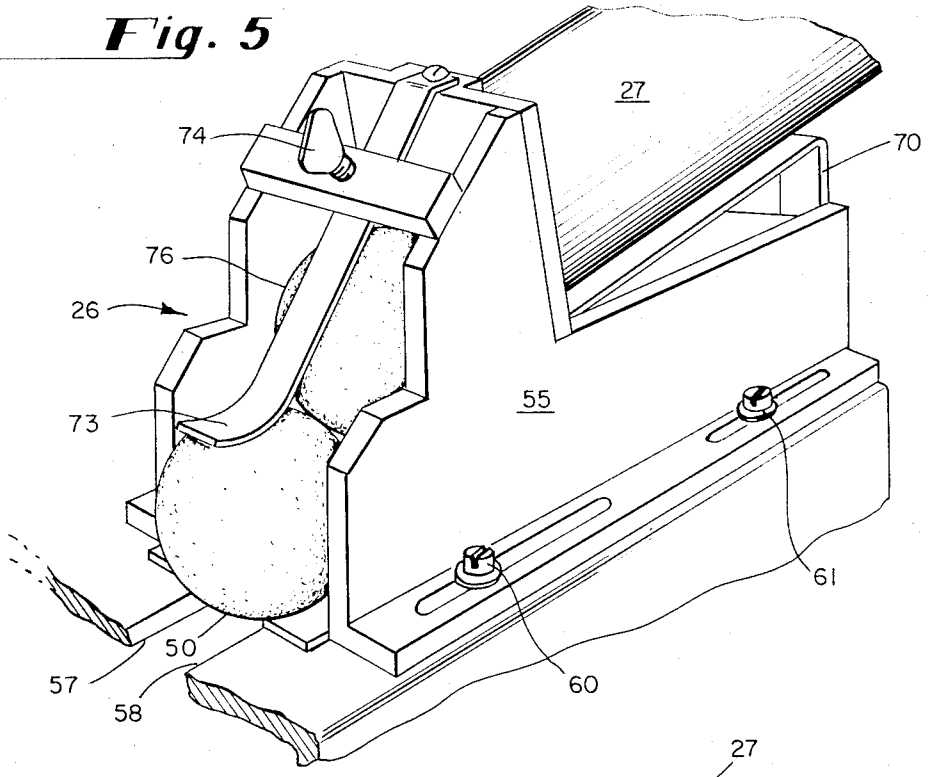

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Fig. 2

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Fig. 6

Fig. 5


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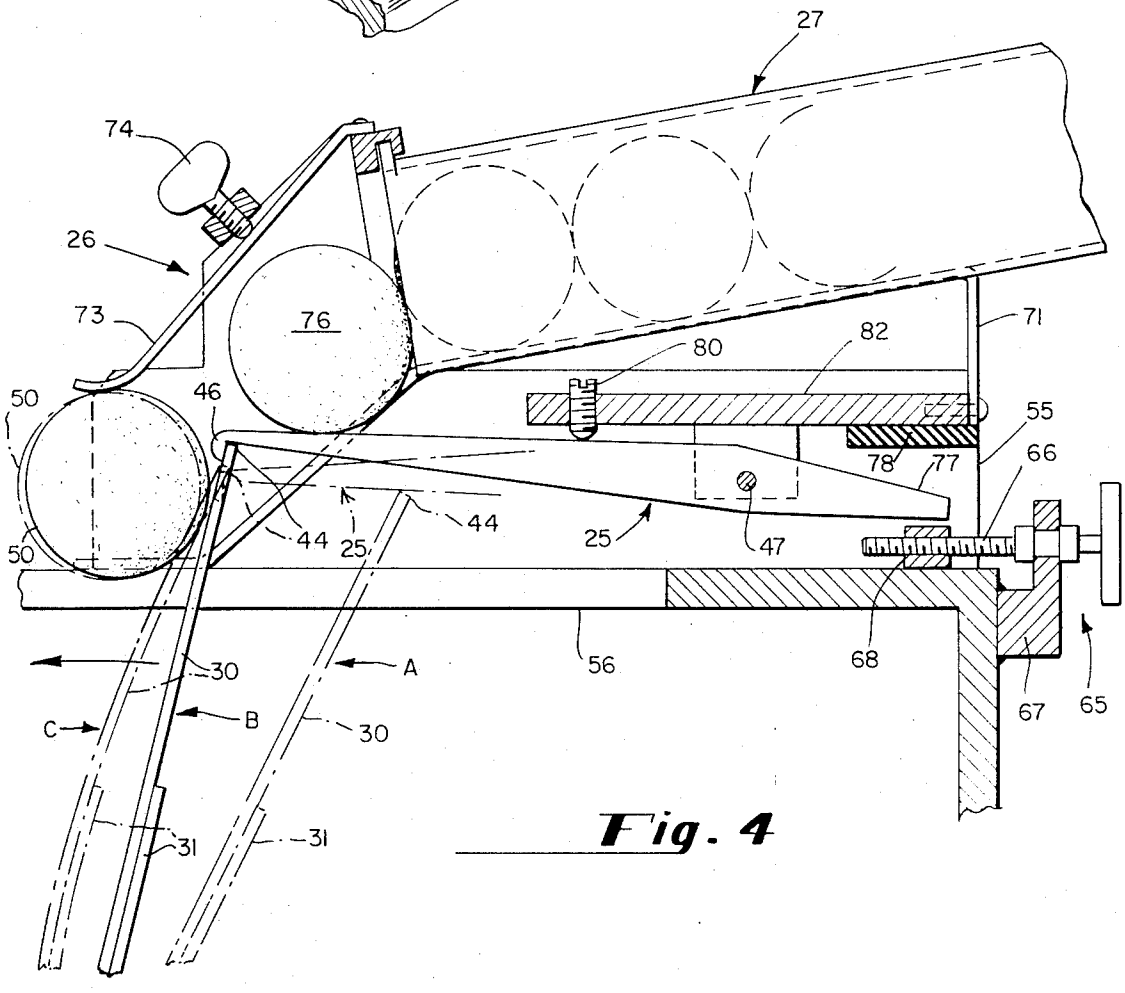

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Fig. 4

SPRING TYPE PROJECTING DEVICE

FIELD OF THE INVENTION

The present invention relates to ball throwing apparatus and, more particularly, to apparatus which, without required operator attention, will successively propel objects such as game balls in a desired trajectory at timed intervals.

BACKGROUND OF THE INVENTION

Once the elementary rudiments of a game such as tennis, baseball and the like have been learned, improvement of techniques and perfection of fundamental swings are usually mastered only by intensive practice. In recent years various mechanical devices have been constructed to serve as a substitute for professional players in such practice sessions. The mechanical devices, i.e., ball throwing apparatus, are intended to provide the precisely duplicated situations necessary in games such as tennis and baseball for the perfection of swings, reactions and timing. Such devices are thus designed to permit a beginner to practice at times a professional player is not available. The devices are also designed to permit a critical study of a beginner's form to be made by a professional player without having to concentrate on his own game skill with the beginner.

Baseball pitching machines were among the first ball throwing machines to be constructed. In general, the baseball type pitching machines which have been developed consist of a relatively large baseball hopper and a "throwing" or "pitching" arm such as that set forth in U.S. Letters Patent No. 3,136,308. In such machines baseballs are permitted to gravitate seriatim through an opening at the bottom of the hopper onto a track for delivery to a station where each baseball is picked up successively by a throwing arm which is acceleratedly driven through a predetermined arc by a power mechanism so that baseballs are thrown in spaced relationship to each other. The throwing or pitching arm of such machines is designed to simulate an actual throw of a human by duplicating the overhand circular action of an individual's pitching arm. While such pitching machines have been produced on a commercial basis, a number of significant and troublesome problems have developed with the use of such machines. Typically, such pitching apparatus, involving several gears and at least one coil spring, tend to be quite complicated mechanically. Among other difficulties there has been an inability to quickly and easily preset such machines for changes in velocity and trajectory. Moreover, specially made C-springs or heavy duty automative springs typically used for such machines are costly, are subject to high breakage rate when utilized to impart the required amount of kinetic energy, and are not capable of accurate preadjustment. Another major problem associated with the construction of such machines is the mechanism for delivering baseballs from storage to the ball pickup station. If a baseball bridges cross the opening of a storage hopper it becomes necessary to agitate the balls in order to clear the opening for free movement. Any repeated clogging substantially defeats the utility of the apparatus. Of necessity, such baseball pitching machines also require that a baseball be picked up, carried up and forward by the pitching arm and then precisely released at high speed. Under these circumstances the trajectory of the projected ball becomes dependent upon a large number of variables, any of which can and will cause error in the trajectory of the projected ball.

Another commercial ball throwing machine, designed mainly for tennis, requires the use of two motors. One of the motors is used to position the balls and the other motor is used to compress air for driving a tennis ball through a cannon-like barrel. Since these cannon-like pitching devices depend on air pressure for the ejection of tennis balls one of the difficulties with such devices is the fact that only new tennis balls can be used. The reason for this is that a friction fit is required between the tennis balls and the cannon-like barrel because air escapes between the tennis balls and the cannon-like barrel when the tennis balls become worn. Consequently, worn tennis balls either cannot be fired or if used they take irregular, uncontrolled trajectories. Since pitching or ball throwing devices are used primarily for practice, any requirement that only new balls must be used is a distinct drawback.

Another problem which has plagued ball throwing devices from the very beginning has been the problem of vibration. Vibration occurs in such devices with the sudden release of energy necessary to send a game ball or like object on a desired trajectory. Unless a ball throwing device is firmly anchored to some surface, vibration will often alter the trajectory of balls propelled from the device each time a ball is "fired." For outdoor baseball practice, automatic pitching devices can be anchored to the ground without too much difficulty. However, for indoor practice or practice on most tennis courts, whether indoor or outdoor, it has been much more difficult to anchor ball throwing devices effectively while maintaining desired portability in such devices.

Heretofore, spring type devices such as that set forth in U.S. Letters Patent No. 1,777,976 have been suggested for use in ball throwing equipment in which a spring strikes the ball and sends the ball on trajectory. Experience has shown, however, that after a few thousand game balls have been struck by a spring the repeated deflection tends to cause the spring to take a permanent set. This necessitates that the equipment be disassembled and a new spring be inserted. It has also meant that heretofore spring arms could not effectively be used to propel harder game balls, such as baseballs, since a permanent set in the spring arm would occur so frequently as to make the use of such a ball throwing device totally impractical. In addition, unless the deflection of the spring was very slight the spring would tend to vibrate like a tuning fork each time a ball was struck. Another problem with spring type ball throwing equipment has been the inability of such equipment to so position individual balls such that when the spring is released, the spring immediately strikes a ball squarely and strikes only one ball at a time.

SUMMARY OF THE INVENTION

An object of the present invention is to provide portable apparatus for mechanically propelling balls, such as game balls used for tennis, baseball and other similar games, in successive manner along a predetermined trajectory at a desired velocity.

Another object of the present invention is to provide an improved ball throwing device which can be easily adjusted so as to successively propel balls or like objects with repetitious accuracy at timed intervals.

Still another object of the present invention is to provide relatively uncomplicated ball throwing apparatus which is reliable and durable and which can be constructed at a relatively low cost.

A further object of the present invention is to provide ball throwing apparatus which will operate with new or used balls as well as objects of different sizes and different weights.

Yet another object of the present invention is to provide ball throwing apparatus having a spring arrangement for propelling game balls or like objects which apparatus is so constructed as to resist permanent set of the spring and materially reduce any vibration following impact with the objects to be propelled.

In accordance with the present invention an elongated leaf spring is deflected over its entire length by the combined action of a trip lever which temporarily engages an end of the leaf spring and a fulcrum located near the center of the leaf spring. The trip lever acts to simultaneously position a ball for firing, separate and remove other balls from the ball to be fired, and momentarily retain the leaf spring immediately behind the ball to be fired. When the trip lever is released the leaf spring immediately and directly strikes the ball positioned for firing and then returns to an undeflected position; the vibration of the leaf spring being dampened by a retarding or snubbing spring.

BRIEF DESCRIPTION OF THE DRAWINGS

Other and further objects, advantages and features of the invention will be apparent to those skilled in the art from the following detailed description thereof, taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a perspective view of a tennis court, showing the apparatus of this invention in one application of use;

FIG. 2 is a side view, partially in cross section, taken along lines 2—2 of FIG. 1 of the ball throwing apparatus of the present invention and this figure particularly illustrates the relationship between the elongated leaf spring, the fulcrum and the trip lever;

FIG. 3 is a top view taken along lines 3—3 in FIG. 2, the ball canister shown in FIG. 2 being removed for this figure;

FIG. 4 is a side view, partially in cross section, which illustrates the action of the elongated leaf spring and trip lever at three successive stages in the operation of the apparatus of the present invention;

FIG. 5 is a perspective view of the feed mechanism portion of the apparatus as shown in FIG. 4 and this figure illustrates some of the adjustment which is possible with the apparatus of the present invention;

FIG. 6 is a sectional view taken along lines 6—6 in FIG. 2 and this figure illustrates the position of the balls in a storage canister relative to a portion of the feed mechanism illustrated in FIGS. 4 and 5;

FIG. 7 is an end view of the canister used for storage of balls and is taken along lines 7—7 in FIG. 2; and

FIG. 8 is a cross sectional view taken along lines 8—8 in FIG. 7 which illustrates a compression fit existing between one outer edge of the storage canister and balls held by the canister.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The apparatus forming the subject matter of the present invention is characterized by an elongated leaf spring which is designed to be deflected or bent over its entire length before striking an object such as a tennis ball or baseball, thereby propelling the ball according to a regulated trajectory and speed. The apparatus is also characterized by a trip lever feeding system which successively presents a ball to the action of the spring in such a manner that only one ball at a time is propelled by the apparatus. These characteristics can be illustrated by reference to the accompanying drawings which, for convenience, illustrate a ball throwing machine for tennis. It is to be understood, however, that the very same ball throwing apparatus of the present invention can be used for propelling baseballs and other like objects and unlike some ball pitching equipment the apparatus is not limited in application to only one sport.

Turning now to FIG. 1 of the drawings, the serving mechanism **10** of this invention is shown in mid position along the base line **11** of tennis court **12.** The serving mechanism **10** can, of course, be positioned at any desired point. As shown, it is in line with the marker which separates the service courts. A control cable **14** extends from serving mechanism **10** to the opposite end of court **12,** where it lies on the ground, exposing a treadle or other appropriate switch mechanism **15** for foot actuation by player. Serving mechanism **10** can also be actuated by a switch located on its housing.

The trajectory of a tennis ball **17** is suggested by broken line **18,** although, as will be explained later, the serving mechanism is capable of adjustment so as to impart considerable variation to the trajectory of tennis balls which are served. By suitable adjustment, the trajectory **18** can be so regulated as to cause ball **17** to cross net **19** at a substantial height above the top line of that net or cross only a few inches above the top line of the net.

The serving mechanism **10** is illustrated in greater detail in FIG. **2.** In this figure housing **20** of the serving mechanism is shown resting on surface **21.** The main parts of the apparatus are the motor or driving mechanism **23** (shown by a dashed line), the elongated leaf spring mechanism **24,** the trip lever mechanism **25,** the feed mechanism **26,** and the storage mechanism **27.**

Elongated leaf spring **24** is a cantilevered beam which is capable of being deflected when loaded. Leaf spring **24** comprises main leaf **30** and several auxiliary leaves **31 – 34** of varying lengths which improve the deflection characteristics and load carrying ability of main leaf **30.** Main leaf **30** and auxiliary leaves **31 – 34** are firmly fixed by suitable means, such as bolts **36** and **37,** to member **38** which is attached by means **40** to an extension **41** of the motor or driving mechanism **23.** Motor or driving mechanism **23** thus causes leaf spring **24** to rotate counterclockwise as shown in FIG. **2.**

As leaf spring **24** is rotated, end **44** of main leaf **30** moves as illustrated in FIG. **4.** Proceeding in a counterclockwise direction end **44** strikes trip lever **25** as shown by dashed illustration A in FIG. 4 and causes trip lever **25** to rotate about axis **47** as end **44** of main leaf **30** proceeds forward. When main leaf **30** reaches the point shown by illustration B in FIG. 4, end **44** becomes engaged with end **46** of trip lever **25** and is retained by end **46** until the movement of leaf spring **24** is such that the leaf spring becomes deflected as shown by dashed illustration C in FIG. 4. In the position shown by illustration C, end **44** becomes disengaged with end **46** of

the trip lever 25 and the energy stored in leaf spring 24 as the leaf spring was deflected is then released as the leaf spring returns to its original shape. As will be described more fully below, this released energy is used to propel ball 50 on a desired trajectory.

It will be seen from FIGS. 2 and 4 that main leaf 30 and auxiliary leaves 31 – 34 are so formed that they strengthen each other while allowing free play for the natural spring of each leaf to act. The leaves thereby absorb a large portion of the vibration and jolt caused upon (a) disengagement of end 44 of leaf spring 24 and end 46 of trip lever 25 and (b) contact of end 44 with ball 50. It will also be observed that as leaf spring 24 becomes deflected attachment means 40 serves as a fulcrum for the deflection of leaf spring 24 over its entire length. Simultaneously with the deflection of leaf spring 24 retarding or snubbing spring 52 (shown in FIG. 2), made from a suitable material such as rubber, is compressed until leaf spring 24 contacts attachment means 40, which acts as the fulcrum. When leaf spring 24 reaches the position shown in illustration C (FIG. 4), leaf spring 24 begins its return to its original position. Without the action of retaining or snubbing spring 52, leaf spring 24 would vibrate like a tuning fork repeatedly striking attachment means 40 until the action of the auxiliary leaves 31 – 34 caused the vibration to subside to an acceptable level. Retaining or snubbing spring 52 immediately causes the vibration of leaf spring 24 to cease.

Feed mechanism 26 is illustrated in FIGS. 2 through 6 and comprises frame 55 which is attached to housing 20 of serving mechanism 10 in such a manner that the frame straddles slot 56 formed by side walls 57 and 58 of housing 20. Slot 56 thus permits end 44 of leaf spring 24 to pass up and through feed mechanism 26 and contact a ball upon disengagement of leaf spring 24 from trip lever 25. Frame 55 is firmly attached to housing 20 by suitable attachment means, such as bolts 60 – 63, which permit the entire frame to move relative to the housing upon making suitable adjustment of the attachment means. Frame 55 is preferably also attached to housing 20 by attachment means 65, comprising a threaded adjustment screw 66 which is permanently attached to L-shaped extension 67 of housing 20 and is in threaded engagement with member 68 of frame 55.

Feed mechanism 26 supports storage mechanism 27 by suitable means such as members 70 and 71 of frame 55, at such an angle (e.g., about 10 degrees) that game balls inside the storage mechanism 27 will sequentially gravitate into the desired position in the feed mechanism each time a ball is propelled by leaf spring mechanism 24. As a ball gravitates toward the lower end of frame 55 it is retained in feed mechanism 26 by suitable means such as spring 73 which can be adjusted to any desired height by means of adjustment screw 74 such that the curved end of spring 73 exerts very slight pressure on a ball to be fired. Thus, spring 73 can be adjusted to accommodate balls of different sizes and the spring exerts enough tension to retain a ball in place until it is (1) properly positioned by means of trip lever 25 in a manner described below and (2) then propelled by means of leaf spring 24.

The dual function of trip lever 25 will now be described. Trip lever 25 not only retains leaf spring 24 in a position immediately behind ball 50 and causes energy to be stored in the spring 24 as the spring is deflected, but trip lever 25 also acts to position the balls which are to be fired. It will be seen from FIG. 4 that as leaf spring 24 causes trip lever 25 to rise and pivot around axis 47 curved end 46 of trip lever 25 urges ball 50 into its exact position for firing and proceeds, almost simultaneously, to raise the ball immediately behind ball 50, namely, ball 76, up and away from ball 50. Thus, when main leaf 30 of leaf spring 24 reaches the position shown in illustration B of FIG. 4, ball 50 has been correctly positioned just ahead of main leaf 30 and ball 76 has been moved out of the way. Upon disengagement of end 44 of leaf spring 24 from end 46 of trip lever 25 only ball 50 is struck and it is hit squarely and immediately by main leaf 30 as shown in illustration C of FIG. 4. Accordingly, only one ball at a time is positioned for firing and there is no possibility of any jamming or other interference caused by other balls held by frame 55. Since about 85 percent of the force of a loaded leaf spring is dissipated in the first ten degrees of its movement after release, the positioning of the loaded leaf spring with relationship to the ball to be fired is quite important.

As seen in FIG. 2, in its normal position end 77 of trip lever 25 rests against pad 78 of a suitable resilient material, such as rubber or plastic, which cushions the return of trip lever 25 following the disengagement of the lever from leaf spring 24. The amount of deflection of leaf spring 24 can be easily adjusted by means of set screw 80 located in member 82 of frame 55. Set screw 80 adjusts the height to which trip lever 25 can be pushed by leaf spring 24 and consequently provides an easy and quickly adjustable means of regulating the amount of energy stored as leaf spring 24 is deflected about its fulcrum. The very considerable potential energy stored in the leaf spring becomes suddenly transformed into kinetic energy when the leaf spring disengages from the trip lever and strikes the ball.

The storage mechanism 27 can be in any desired form. A canister type of storage mechanism is illustrated in the drawings. As seen in FIG. 6, the diameter of storage mechanism 27 is slightly greater than the diameter of ball 84 which is contained inside. End 85 of storage mechanism 27 also has a diameter just slightly larger than the balls contained therein. However, as seen in FIGS. 7 and 8, opposite end 87 of storage mechanism 27 is folded back such that a compression fit exists between wall 87 and ball 88. The existence of this compression fit permits balls to be picked up off a playing surface by simply forcing the canister of storage mechanism 27 down over a ball. Once inside the canister, wall 87 prevents the balls from rolling out end 86. Thus, a number of balls can be loaded into a canister type storage mechanism 27 without ever having to stoop over and drop the balls into the canister.

In one specific embodiment, a one-fourth horsepower motor reduced to 12 rpm was employed to rotate an elongated leaf spring having a main leaf about 2 feet long and about ⅛ inch thick against tennis balls which gravitated into the feed mechanism from a storage canister having a capacity of 20 tennis balls. Upon disengagement of the leaf spring and trip lever after about a 5° deflection, a tennis ball was propelled every five seconds. By suitable adjustment, the ball throwing apparatus was adjusted for projecting high lobs, flat drives, drop shots, cross court shots, fast balls, slow balls, and other various combinations encountered during an actual game. The ease with which the apparatus could be adjusted constitutes one of the real advan-

tages over mechanical devices previously proposed. As previously explained, attachment means **65** effectively locks the carriage of frame **55** in place. When this carriage is moved forward, an easy or fairly soft throw is possible whereas if the carriage is moved back, a harder throw is permitted since there is longer contact between leaf spring **24** and ball **50.** The force with which the ball is propelled can also be regulated by simple adjustment of set screw **80** which regulates the deflection. Moreover, simple adjustment of screw **74** on feed mechanism **26** permitted baseballs to be propelled without further adjustment after the apparatus had been used to propel tennis balls.

The apparatus of the present invention duplicates as closely as possible the trajectory, speed and other characteristics imparted to a tennis ball by an experienced tennis player. Thus, the ball is struck by the apparatus suddenly and forcefully as though it had been hit by a tennis racket. This fact differentiates the apparatus of the present invention from machines which have concentrated on pitching the ball rather than on striking it. Due to the absence of the same degree of compressibility of a baseball compared to a tennis ball, the fact that a ball is struck has not rendered the apparatus unsuitable for use in propelling baseballs.

From the foregoing, it will be seen that this invention is well adapted to obtain all of the ends and objects hereinabove set forth, together with other advantages which are obvious and which are inherent to the system. The apparatus of the present invention has the advantages of convenience, simplicity, relative inexpensiveness, positiveness, effectiveness, durability, accuracy and directness of action. The invention substantially overcomes the problem of vibration which has been a significant problem with almost every type of ball-throwing device conceived to date. The apparatus is portable and is essentially free of all maintenance problems.

It will be understood that while the leaf spring is preferably made from tempered pieces of steel the material for the spring can be any mechanical element which stores energy when displaced or deflected and might even be made from such elastic materials as plastic and rubber.

It will be understood that the number of auxiliary leaves in the leaf spring is not critical although the leaf spring preferably has at least one leaf on each side of the main leaf. Due to the fact that the leaf spring is deflected over its entire length uniformly, the presence of the auxiliary leaves, and the presence of the retarding spring or snubbing spring, the leaf spring is not overloaded. It has been observed experimentally that the leaf spring of the apparatus in accordance with the present invention will not take a permanent set even after propelling as many as twenty thousand balls over a desired trajectory.

Reference has been made to movement of the leaf spring in a counter-clockwise direction. Obviously by simple rearrangement of the components, the apparatus could be designed for operation of the leaf spring in a clockwise direction. The means used to propel the leaf spring is preferably an electric motor. However, other suitable means, including a gasoline engine, could be used.

The retarding spring or snubbing spring could be made of metal. However, it has been found that a hard rubber or deformable plastic material is preferable to a metal spring. Without the retarding or snubbing spring, the leaf spring would be ruined by the tuning fork effect. As previously explained, the retarding or snubbing spring prevents any whipping action from occurring.

While it has been indicated that the device in accordance with the present invention can be operated either by handswitch or with remote control cable, it will be understood that other means of activating the apparatus can be used. For example, at some additional cost, the apparatus can be equipped with radio remote control such that the apparatus can be started and stopped without requiring any electrical extension cord or direct contact with the apparatus.

It will be understood that other storage type hoppers can be substituted for the canister type feed mechanism which is specifically illustrated. The canister type feed mechanism offers the advantage of uniform unclogged feed wherein one ball at a time is permitted to gravitate to the discharge point. The illustrated type of canister storage mechanism also offers the advantage of simplified ball pickup. As previously explained, balls can be picked up off the ground using the canister type feed mechanism simply by sequentially pressing an end of the canister over the balls thereby eliminating the necessity for stooping to pick up each individual ball. The only possible limitation of the canister type feed mechanism is the capacity of each canister. While one end wall of the illustrated canister is folded in such a way as to provide a desired compression fit for ball pick up purposes it will be understood that other means of obtaining the desired compression fit, such as the use of a metal or plastic ring inserted into one end of the canister, could be used.

Obviously, many other modifications and variations of the invention as hereinbefore set forth may be made without departing from the spirit and scope thereof.

What is claimed is:

1. Apparatus for propelling game balls sequentially in a desired trajectory, said apparatus comprising:

a feed mechanism for supplying game balls;

an elongated leaf spring for propelling game balls supplied by the feed mechanism;

a retarding spring positioned adjacent the elongated leaf spring,

driving means for rotating the elongated leaf spring; and

lever means for causing the elongated leaf spring to bend during rotation thereof to momentarily retain the elongated leaf spring immediately behind a game ball, to be projected and to interrupt the flow of balls from the ball feed mechanism, said elongated leaf spring being a cantilevered beam which is bent by the lever means over its entire length around a fulcrum and wherein said retarding spring is so positioned relative to said beam as to be compressed during the deflection of the cantilevered beam.

2. Apparatus of claim **1** in which the retarding spring functions to eliminate vibration of the elongated leaf spring upon its release from contact with the lever means.

3. Apparatus of claim **1** which further comprises storage means for storing game balls and said storage means being so positioned as to cause game balls to sequentially pass into the feed mechanism.

4. Apparatus of claim 3 wherein the storage means is a canister type device which is constructed at one end to have a compression fit with game balls contained by said storage means.

5. Apparatus of claim 1 wherein the feed mechanism contains means for permitting reception of different size game balls.

6. Apparatus for propelling game balls sequentially in a desired trajectory, said apparatus comprising:

a feed mechanism for supplying game balls;

an elongated leaf spring for propelling game balls supplied by the feed mechanism;

driving means for rotating the elongated leaf spring, said driving means being connected indirectly to the elongated leaf spring at a position offset from the axis of the driving means;

lever means for causing the elongated leaf spring to bend during rotation thereof to momentarily retain the elongated leaf spring immediately behind a game ball to be projected and to interrupt the flow of balls from the ball feed mechanism, and

a retarding spring which is so positioned relative to said beam as to be compressed during bending of the elongated leaf spring for eliminating vibration of the elongated leaf spring.

7. Apparatus of claim 6 in which the lever means is adjustable to vary the amount of bending of the elongated leaf spring.

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