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(54) **BALL THROWING MACHINE**

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(57) **ABSTRACT**

A ball throwing apparatus includes a ball magazine attached to a first end of a ball tube. A ball propelling or throwing assembly is attached to a second end of the ball tube. A retaining element, such as a spring finger, extends into the ball tube from a first side of the ball tube. A holder which may be pivotally mounted on the ball tube extends into the ball tube from a second side of the ball tube. An arm moves through an arm slot in the second side of the ball tube in a reciprocating motion, feeding balls one at a time from the ball magazine into the throwing assembly, in a uniform time sequence.

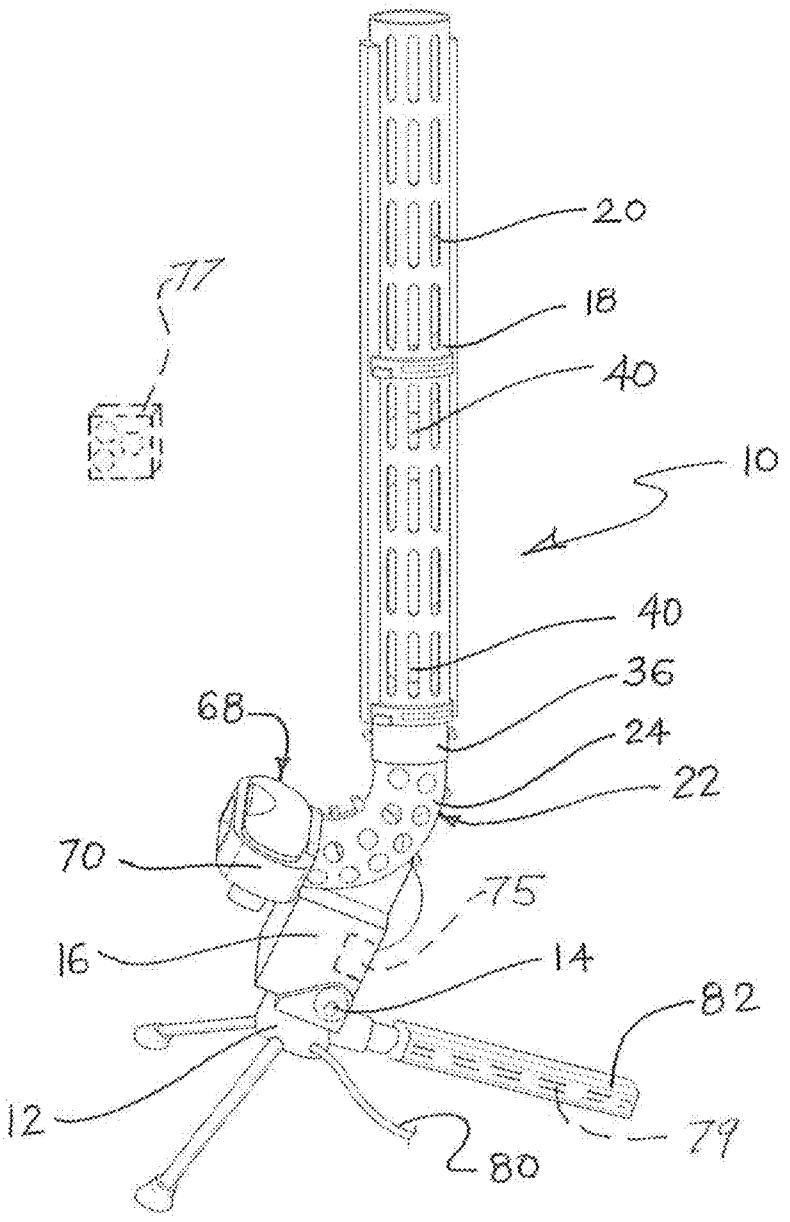
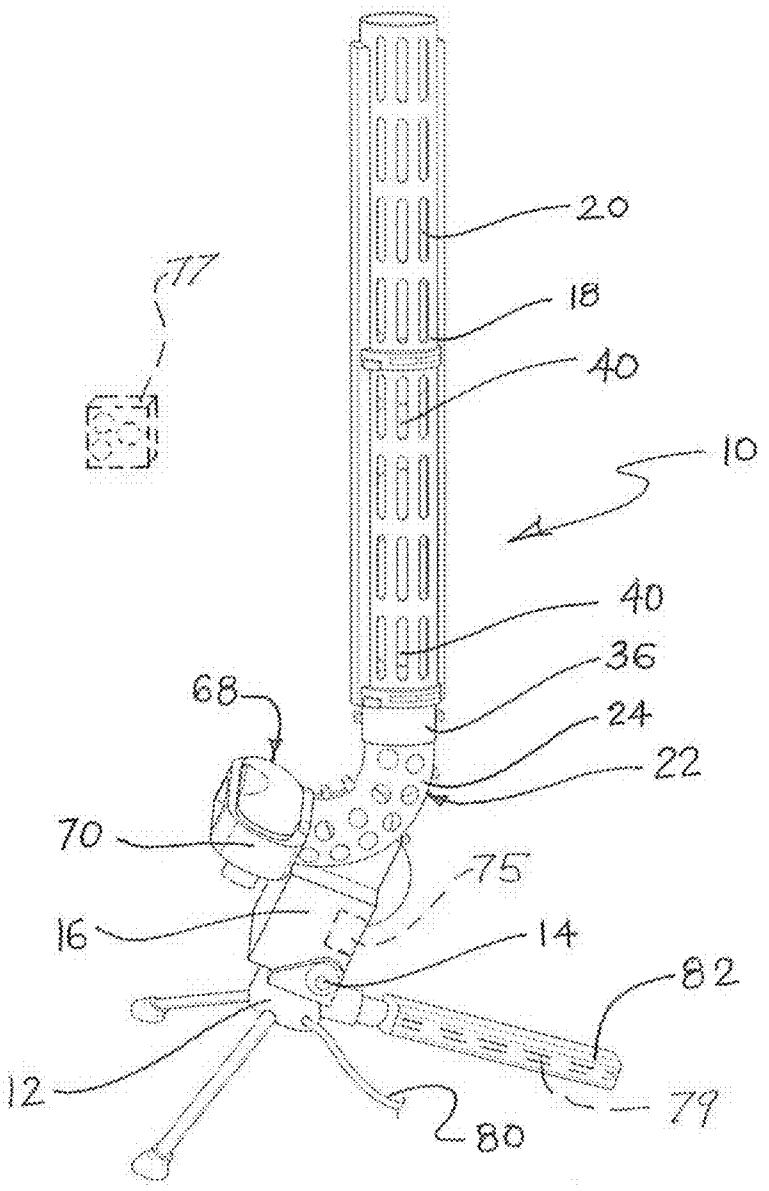


Fig. 1



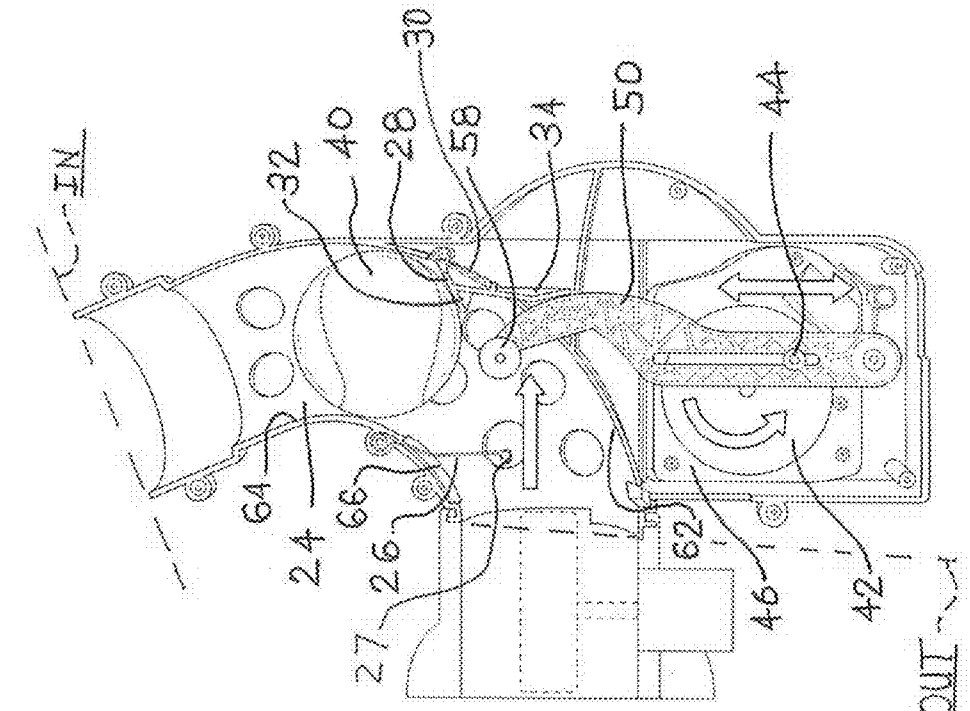
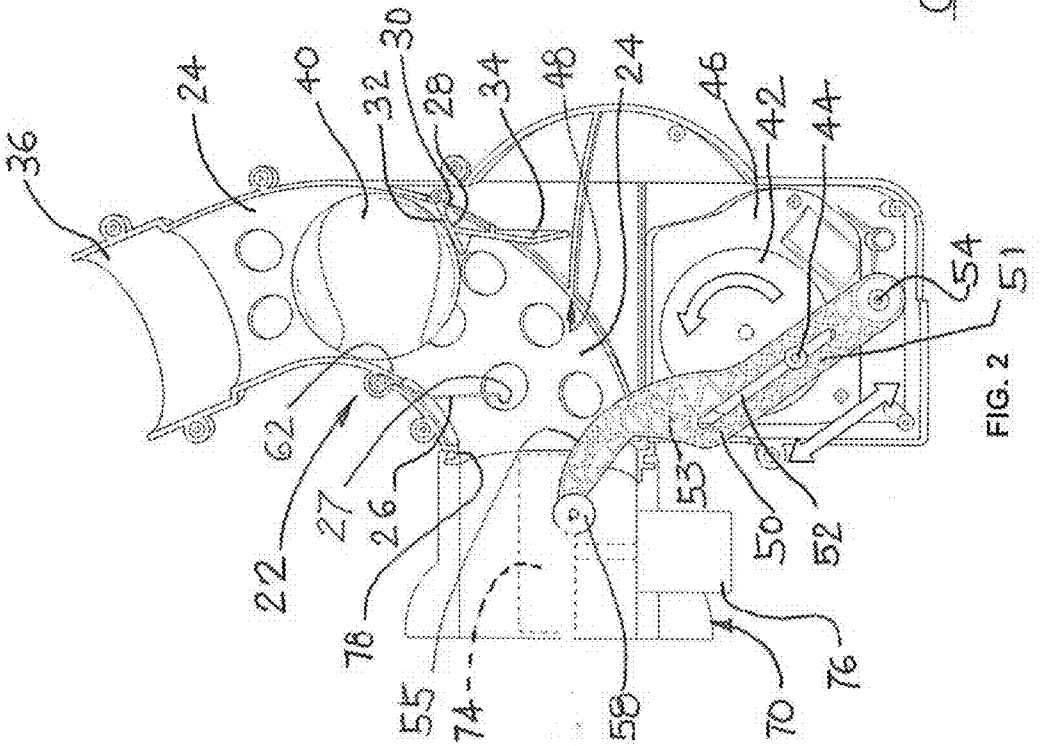

IN
OUT
30
40
28
58
34
50
44
32
64
66
24
26
27
62
46
42

FIG. 3


36
24
40
32
30
28
34
48
24
46
42
44
54
51
62
27
26
22
76
55
74
58
53
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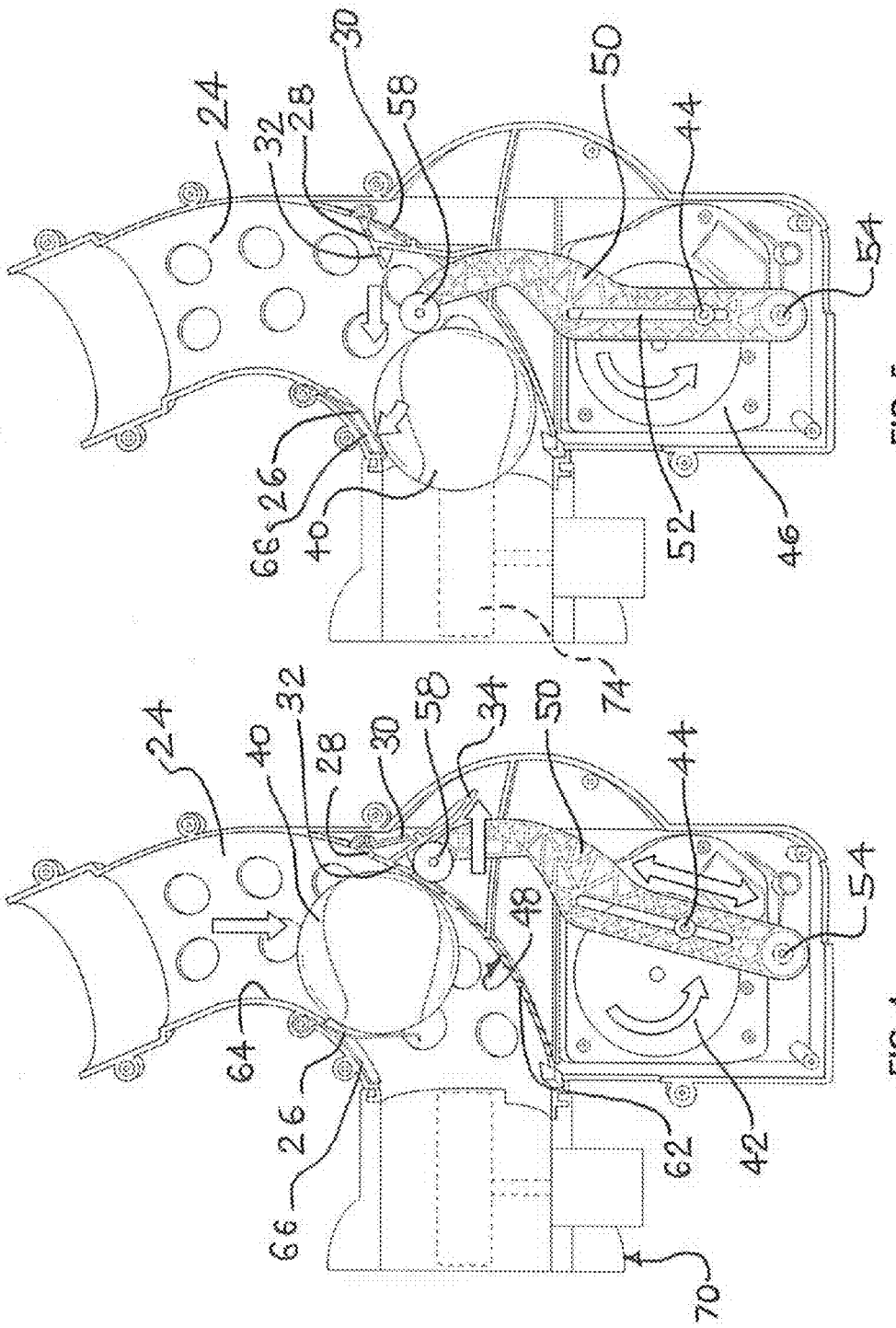
52
70
76

FIG. 2


24
32
28
30
58
50
44
54
66
26
40
52
46
74
FIG. 5
24
40
32
28
30
58
34
50
44
54
48
64
26
66
62
42
70
FIG. 4

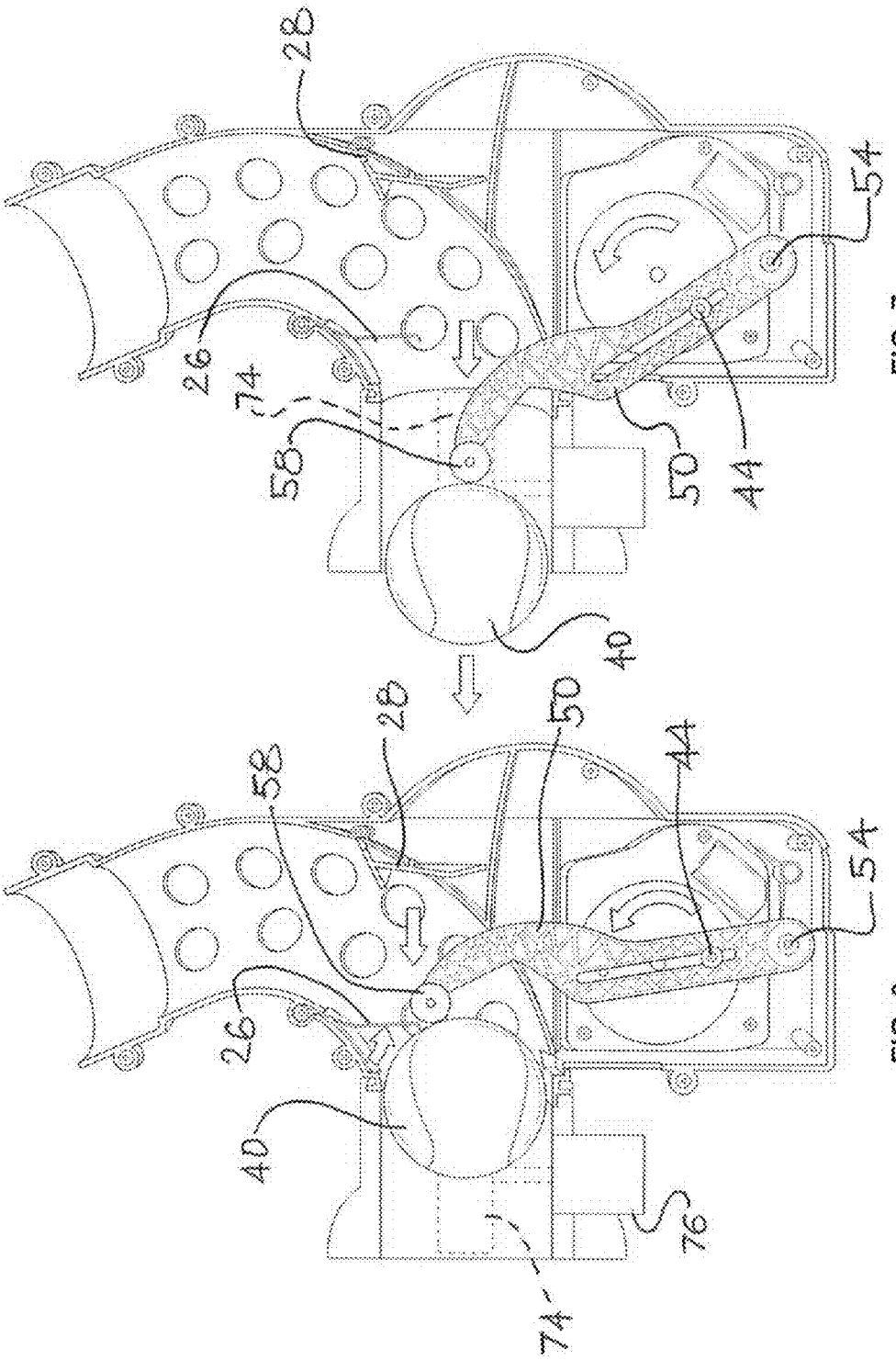


FIG. 7

FIG. 6

BALL THROWING MACHINE

FIELD OF THE INVENTION

[0001] The field of the invention is ball pitching or ball throwing machines. More specifically the invention relates to machines for automatically throwing balls, to assist players in practicing movements in various sports. In particular the invention relates to apparatus and methods for holding multiple balls and individually feeding balls into a ball throwing unit which throws the balls.

BACKGROUND OF THE INVENTION

[0002] Ball throwing machines are used in various sports, such as baseball and tennis. Typically these types of machines have a tray, track, or other component for holding several balls queued up for throwing. The balls are individually moved out of the holding space and dropped or pushed into a ball projecting device, such as a pair of opposing rotating pinch wheels. The balls are projected or thrown out by the machine typically at evenly spaced timed intervals.

[0003] While these types of machines have met with varying degrees of success in the past, challenges remain in designing a ball throwing machine that is lightweight, compact and easily portable. Challenges also remain in designing a ball throwing machine that is reliable, simple to set up and use, and inexpensive to manufacture. Accordingly, it is an object of the invention to provide an improved ball throwing machine is needed.

SUMMARY OF THE INVENTION

[0004] A new ball throwing machine includes a ball magazine for feeding balls into a ball tube. A flex element, such as a spring finger, extends into the ball tube. A holder, which may be pivotally mounted on the ball tube, is movable from a first position wherein the holder or part of the holder extends into the ball tube, to a second position wherein the holder is withdrawn. An arm moves through an arm slot in the ball tube in a reciprocating motion, with the arm moving the holder from the first to the second position. The holder may return to the first position via spring force. The flex element and the actuation of the arm feeds balls, one at a time, from the ball magazine into a throwing assembly which throws the balls.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] In the drawings, the same element number indicates the same element in each of the views.

[0006] FIG. **1** is a perspective view of a new ball throwing apparatus.

[0007] FIGS. **2-7** show the sequence of movement of components of the ball feeder assembly of the ball throwing apparatus of FIG. **1**.

[0008] FIG. **2** is section view of the ball feeder assembly of the ball throwing apparatus shown in FIG. **1** with ball feeder assembly in a first position and a ball in the load position.

[0009] FIG. **3** is section view of the ball feeder assembly in a second position.

[0010] FIG. **4** is a section view of the ball feeder assembly in a third position.

[0011] FIG. **5** is a section view of the ball feeder assembly in a fourth position.

[0012] FIG. **6** is a section view of the ball feeder assembly in a fifth position.

[0013] FIG. **7** a is section view of the ball feeder assembly now returned to the first position initially shown in FIG. **2** and with the ball moved into the projecting or throwing assembly shown in FIG. **1**.

DETAILED DESCRIPTION

[0014] Turning now in detail to the drawings, as shown in FIG. **1**, a ball throwing machine **10** may be described as having a ball magazine **18**, a ball feeder assembly **22** for dispensing balls at uniform time intervals, a throwing assembly **68** for throwing balls, and a base, such as a tripod **12**. The assemblies may optionally be designed so that they may be quickly and easily attached to together to provide the ball throwing machine **10** as shown in FIG. **1**, and then separated from each other for transport and storage.

[0015] Referring still to FIG. **1**, the ball throwing machine **10** has a ball feeder housing **16** which may be attached to a tripod **16** via a pivot joint **14**. A ball tube **24** is attached to or part of the ball feeder housing **16**. The ball magazine **18** is attached to a first generally up-facing end of the ball tube **24**. The ball magazine **18** may be formed via a magazine tube, or two or more magazine tubes attached together end to end, to provide the ball holding capacity desired. The inside diameter of the ball magazine **18** is slightly larger, for example 5-10 mm larger, than the diameter of balls to used with the throwing machine **10**. Slots or holes **20** may be provided in the magazine **18**, to allow the user to see how many balls are in the magazine. Alternatively, the magazine may be translucent. One of more legs of the tripod **12**, such as the rear leg **82**, may contain batteries and/or wireless control circuitry. The hinge **14** may include a clamping or friction device such as a lever, wing nut, etc., to hold the ball feeder housing at a desired angle on the tripod **12**. The throwing assembly **68** is attached to the ball feeder housing **16** and/or a second end of the ball tube **24**.

[0016] Referring now to FIG. **2**, a collar **36** may be provided at the first end of the ball tube **24**, for attaching the magazine **18** onto the ball tube **24**. The ball tube **24** is curved, with first or inlet end of the ball tube **24** generally oriented vertically, or within e.g., 30 degrees of vertical, and with the second or outlet end generally oriented horizontally. The plane of the opening of the first end of the ball tube, marked IN FIG. **3**, may be oriented at an angle of about 60 to 120 degrees relative to the plane of the opening of the second end of the ball tube, marked OUT in FIG. **3**. The position of the OUT plane relative to the ground, and the corresponding launch angle of the ball, may be adjusted by tilting the housing **16** about the hinge **14**, or by changing the position of the rear tripod leg. The upper or inner wall **64** of the ball tube **24** has a radius of curvature substantially larger than the radius of the ball **40**, to allow the ball to move through the ball tube without binding.

[0017] The lower or outer wall **62** of the ball tube may have a corresponding radius of curvature based on the diameter of the balls **40** used with the machine **10**. For example, for use with balls having a diameter of about 7 cm, such as a tennis ball, the inside diameter of the ball tube may be about 8 cm, the radius of curvature of the inner wall **64** may be 4 to 10 cm, and the radius of curvature of the outer wall **62** may be about 7 cm greater than the radius of curvature of the inner wall.

[0018] In FIG. **2**, an electric motor **46** within or on the ball feeder housing **16** rotates a drive wheel **42**. The motor may be powered by batteries contained in or on the tripod **12** or the ball feeder housing **16**, or in a separate battery box. Alterna-

tively, the motor **46** may be powered by a line cord **80** shown in FIG. **1**. Referring to FIG. **2**, the lower end of an arm **50** is pivotally attached to a fixed point, for example to a pivot attachment **54** in the ball feeder housing **16**.

[0019] A ball roller **58** may be attached to upper end of the arm **50**. A straight slot **52** is provided in the arm **50**. A pin **44** on the drive wheel **42** extends into and/or through the slot **52**. A cap or head on the pin **44** holds the pin **44** into the slot. A bearing or roller may be provided on the drive pin **44**, to reduce friction and wear between the drive pin and the slot. The upper end of arm **50** extends through an arm slot **48** in the outer wall **62** of the ball tube **24**. The arm slot may be just wide enough to provide clearance for the arm **50**.

[0020] The arm **50** may have a generally straight lower section **51** and an offset upper section **53**. The arm slot **52** may be straight and centered in the lower section **51** and also parallel to the lower section **51**. The offset upper section **53** advantageously has a curved back surface **55** that projects rearward. The ball roller **58** at the upper end of the upper section **53** may be substantially aligned over the arm slot **52**.

[0021] Referring still to FIG. **2**, a flex element, such as a leaf spring **26** or similar biasing element extends radially into the ball tube **24** from or through the inner tube wall **62**. As shown in FIG. **2**, the retainer spring may be attached to the outer surface of the inner wall **64** and extend through an opening in the inner wall **64**. A spacer **66** may be attached to, or formed on, the inside surface of the inner tube wall, adjacent to the retainer spring **26**. A holder **28** is positioned in the ball tube **24** generally across or opposite from the retainer spring **26**. The holder **28** may include a holder plate **32** attached at an angle to a holder leg **34**. The holder **28** is biased into the up position shown in FIG. **2** by a biasing element, such as a spring **30**. The holder is pivotally attached to the ball tube **24**, for example at a pivot point on the outside surface of the outer tube wall **62**. The leg **34** of the holder extends down through the arm slot in the outer tube wall **62**.

[0022] The throwing assembly **68** typically includes a throwing housing **70** which may be attached to a collar **78** on the second end of the ball tube **24**. A pair of spaced apart pinch wheels **74** are rotated by motors **76**. The pinch wheels are spaced apart by a dimension slightly less than the diameter of the balls **40**. As a ball **40** enters the throwing housing **70**, it is pinched slightly by the pinch wheels **74**, pulled in between the wheels, and then ejected or thrown out of the throw housing **70** with a throwing speed determined by the diameter and rotation speed of the pinch wheels **74**, as is well known in the art.

[0023] The motor or motors **76** used in the drive assembly **68** may also be powered via the line cord **80**, or by batteries. The motors **76** and **46** may optionally be remotely controlled via a wireless link via wireless circuitry on or in the throwing machine **10**. For example, The motor **46**, or motors **46** and **76**, may be connected to a receiver/controller **75** in the housing **16**. The regulator assembly **22**, or both the regulator assembly **22** and the pitching assembly **68**, may then be remotely controlled via a remote unit **77**. Control signals initiated by the user via the remote unit **77** are transmitted to the receiver/controller **75** by radio frequency, infrared light, or other known techniques. The remote unit **77**, if used, may include controls to turn on the motor **46**, or motors **46** and **76**, and also to adjust ball feed speed of the regulator assembly **22**, and the pitching speed of the pitching assembly **68**. One or more elevation angle actuators **79** connected to the receiver/controller **75** and positioned to tilt the housing **16** may also be provided, to allow the elevation angle to be remotely changed. Other forms of throwing assemblies may also be used in place of the pinch wheel type of throwing assembly. For example, a throwing assembly using a throwing arm, lever or paddle, or a pneumatic throwing apparatus may be used. In an alternative design, the receiver/controller may be voice activated. In this design, no remote unit **77** is needed. Rather, the receiver/controller is programmed, or otherwise designed to respond to voice commands, such as, ON, OFF, FAST, SLOW, UP, DOWN, etc.

[0024] In use, balls **40** are loaded into the magazine **18**. The first ball **40** to be loaded drops down through the magazine and moves into the load position as shown in FIG. **2**. The ball is held in the load position by the holder plate **32**, with the holder **28** biased into the up position shown in FIG. **2**. In the load position, the ball **40** is supported from below by the holder plate **32**, with the front surface of the ball resting against the inside surface of the upper wall **64** of the ball tube **24**.

[0025] The motor **46** is switched on, and the motor **46** rotates the drive wheel **42**. The motor **46** and a gear reduction unit may typically rotate the drive wheel at about 6-12 rpm. As shown in FIG. **3**, as the drive wheel **42** rotates counterclockwise, the arm moves rearward, with the curved back surface **55** of the arm **50** coming into contact with the holder leg **34**. Since the curved back surface **55** of the upper section **53** is offset rearward from the lower section **51** of the arm **50**, the arm **50** begins to pivot the holder **28** while the lower section **51** of the arm **50** is substantially vertical. Accordingly, the configuration of the arm effects the timing of the movement of the holder **28**, as well as providing curved surface that slides against the holder leg **34**, with a cam-like movement. The drive wheel may rotate clockwise or counterclockwise.

[0026] As shown in FIG. **4**, the rearward movement of the arm **50** pushes the holder leg **34** rearward, rotating the holder **28** counterclockwise into a down position. In the down position shown in FIG. **4**, the holder plate **32** is moved down or away from the centerline of the ball tube **24** sufficiently to allow the ball **40** to pass. The roller **30** may move into the corner formed between the holder plate **32** and the holder leg **34**, and the holder plate **32** may be near flush with the inside surface of the outer tube wall **62**, when the holder **28** is in the down position.

[0027] Via gravity, the ball **40** moves past the holder plate **32** and comes into contact with the leaf spring **26** or similar retaining element. The spring **26** holds the ball **40** in the ready position shown in FIG. **4**. The curvature of the ball tube **24** reduces the downward force acting on the ball **40** in the ready position from the queue of balls above it in the ball tube **24** and in the magazine **18**, since the majority of the weight of the queue of balls bears on the outer tube wall **62**, and not on the ball **40** in the ready position. Accordingly, it is not necessary for the retainer spring **26** to hold a ball in the ready position against the entire weight of the queue of balls behind the ready position.

[0028] As shown in FIG. **5**, as the drive wheel **42** continues to rotate, the arm **50** reverses direction in a gentle reciprocating motion and begins to pivot forwardly. The roller **58** moves forwardly in an arc and pushes on the back surface of the ball **40**. At the same time, the holder **28** moves back into the up position to hold back the balls in the queue. As the arm **50** continues moving forward, the arm pushes the ball **40** under the retainer spring **26** which flexes upwardly while continuing to exert force on the ball. As the arm completes its forward

stroke, the arm pushes the ball past the retainer spring and into the throw assembly **68**. The spring **26** flexes back outwardly to its original position as the ball passes by, tending to flick the ball forward. Hence, the forward movement of the arm **50** and the return movement of the spring **26** may combine to move the ball into the throw assembly **68**. The spring **26** may have an angles or flattened end **27**, as shown in FIGS. **2** and **3**, to assist in the flicking motion.

[0029] As shown in FIGS. **6** and **7**, as the ball enters the throw assembly **68** it is pinched between the rollers **74** and thrown rapidly forward out of the throw housing. The retainer spring **26** flexes back to its original position. As shown in FIG. **7**, the arm **50** is once again in the starting position shown in FIG. **2**. The ball feeder assembly **22** then repeats the sequence described above to throw the next ball **40** in the queue.

[0030] The speed of the motor **42** may be changed to increase or decrease the time interval between sequentially thrown balls. The motor speed may be changed using controls on the machine **10** or using a remote or wireless control. The speed of the motor **42** may also be varied to provide a degree of randomness between ball launches. The throwing assembly motors **76** may be similarly controlled to select different ball launch speeds.

[0031] Thus, a novel ball throwing machine and methods have been shown and described. The machine may be used for throwing baseballs, softballs, tennis balls, volleyballs, soccer balls, and similar types of balls. Various changes and substitutions may of course be made without departing from the spirit and scope of the invention. The invention, therefore, should not be limited except by the following claims and equivalents of them.

1. Apparatus comprising:
- a ball tube;
- a flex element extending into the ball tube from a first side of the ball tube;
- a holder extending into the ball tube from a second side of the ball tube, with the holder having a holder plate and a holder leg;
- a holder spring urging the holder into a first position;
- an arm moveable in the ball tube in a first direction to move the holder, and moveable in the ball tube in a second direction opposite from the first direction to move a ball out of the ball tube; and
- a motor linked to the arm and configured to move the arm in the first direction and in the second direction.

2. The apparatus of claim **1** with the holder pivotally mounted on the ball tube.

3. The apparatus of claim **1** with the holder leg joined to the holder plate at an angle ranging from 70 to 110 degrees.

4. The apparatus of claim **1** with the ball tube having an inlet and an outlet, and with the outlet oriented within 30 degrees of perpendicular to the inlet.

5. The apparatus of claim **1** further comprising a drive slot in the arm and a drive pin on a drive wheel attached to the motor, and with the drive pin extending into the drive slot, with the motor driving the arm in a reciprocating movement.

6. The apparatus of claim **1** with the arm having a substantially straight lower section and offset upper section, and with the motor linked to the lower section of the arm.

7. The apparatus of claim **6** wherein the motor oscillates the arm over an arc of 30 to 75 degrees.

8. The apparatus of claim **7** wherein the motor oscillates the arm between a forward position wherein the lower section of the arm is inclined forwardly 20 to 45 degrees from vertical, and a rearward position wherein the lower section of the arm is inclined rearward by 10 to 30 degrees from vertical.

9. The apparatus of claim **1** wherein the flex element comprises a spring finger and the holder positioned opposite from the spring finger, and with the holder and spring finger facing each other.

10. The apparatus of claim **9** with the arm and the holder leg movable through an arm slot in the second side of the ball tube.

11. The apparatus of claim **1** further comprising a magazine attached to a first end of the ball tube, and a throwing assembly attached to a second end of the ball tube.

12. The apparatus of claim **11** further comprising a tripod pivotally supporting the ball tube.

13. Ball throwing apparatus comprising:
- a curved ball tube;
- a ball magazine attached to a first end of the ball tube;
- a throwing assembly attached to a second end of the ball tube;
- a spring extending into the ball tube from a first side of the ball tube;
- a holder pivotally mounted on the ball tube and extending into the ball tube from a second side of the ball tube, with the holder having a holder plate and a holder leg joined to the holder plate, and the holder leg movable through an arm slot in the second side of the ball tube;
- a holder spring urging the holder into a first position; and
- an arm moveable through the arm slot in a reciprocating motion via a motor rotating a drive wheel having a drive pin moveable within a drive slot in the drive wheel, with the motor oscillating the arm over an arc of 30 to 75 degrees.

14. The apparatus of claim **13** with the ball tube supported on a tripod.

15. A method for throwing balls, comprising:
- loading a plurality of balls including a first ball and a second ball into a magazine; allowing the first ball to drop into a ball tube;
- holding the first ball in at a load position in the ball tube;
- moving an arm in a first direction through the ball tube to allow the first ball to drop down to a ready position;
- holding the ball in the ready position;
- pushing the ball out of the ready position via the arm by moving the arm in a second direction, opposite from the first direction; and
- holding the second ball at the load position.

16. The method of claim **15** further comprising pushing the first ball out of the ball tube by moving the arm in the second direction.

17. The method of claim **15** further comprising moving the arm in a uniform reciprocating motion.

18. The method of claim **15** further comprising using the arm to displace a holder from a first position wherein the holder projects into the ball tube and holds the first ball in the load position, to a second position wherein the holder does not project into the ball tube, to allow the first ball to move from the load position into the load position.

19. The method of claim **16** further comprising pushing the first ball out of the ball tube and into a ball throwing assembly connected to the ball tube.

20. The method of claim **17** further comprising rotating a drive wheel at a constant speed and moving the arm in a uniform reciprocating motion by linking the arm to the drive wheel.

* * * * *