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Pisor et al.

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(54) **PROJECTILE LAUNCHER**

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F41B 7/08 (2006.01)
F42B 6/00 (2006.01)

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CPC . ***F41B 4/00*** (2013.01); *F42B 6/00* (2013.01)

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USPC 124/1, 6, 46, 51.1, 78, 81; 446/473
See application file for complete search history.

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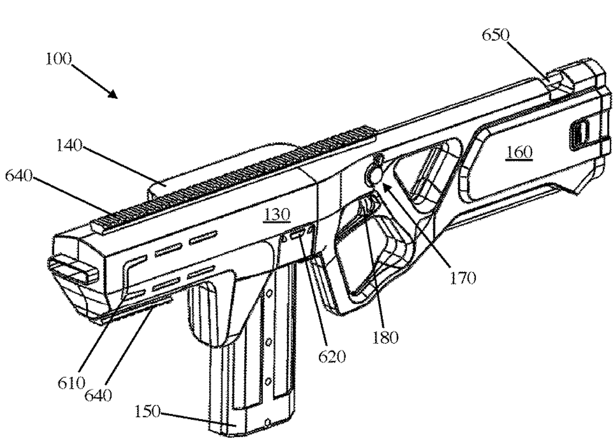
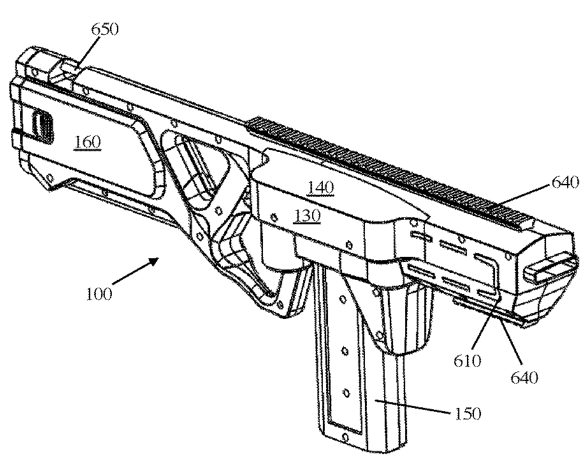
(57) **ABSTRACT**

A projectile launcher comprises a motor driven flywheel having a rotational axis and a roughened circumferential edge surface, and a flywheel housing having a passageway therethrough. The passageway comprises an entry opening at a first end that is configured to receive at least one disc projectile, and a release opening at a second end.

20 Claims, 16 Drawing Sheets





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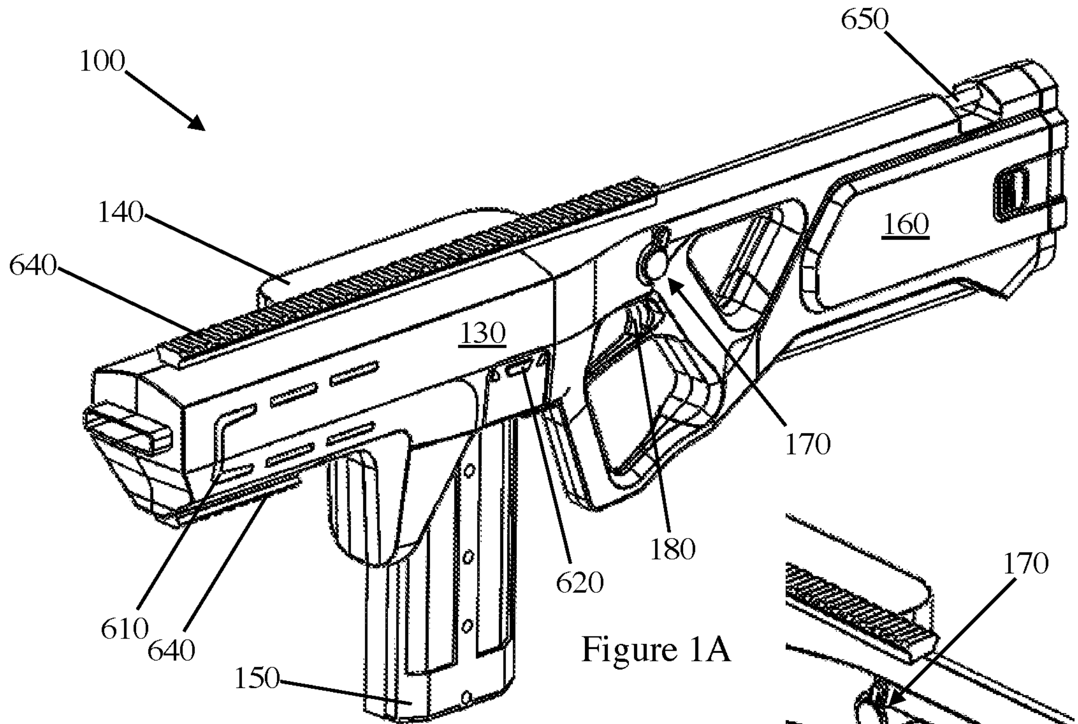


Figure 1A

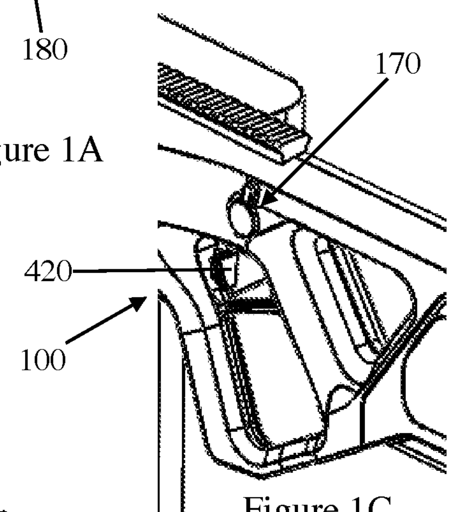


Figure 1C

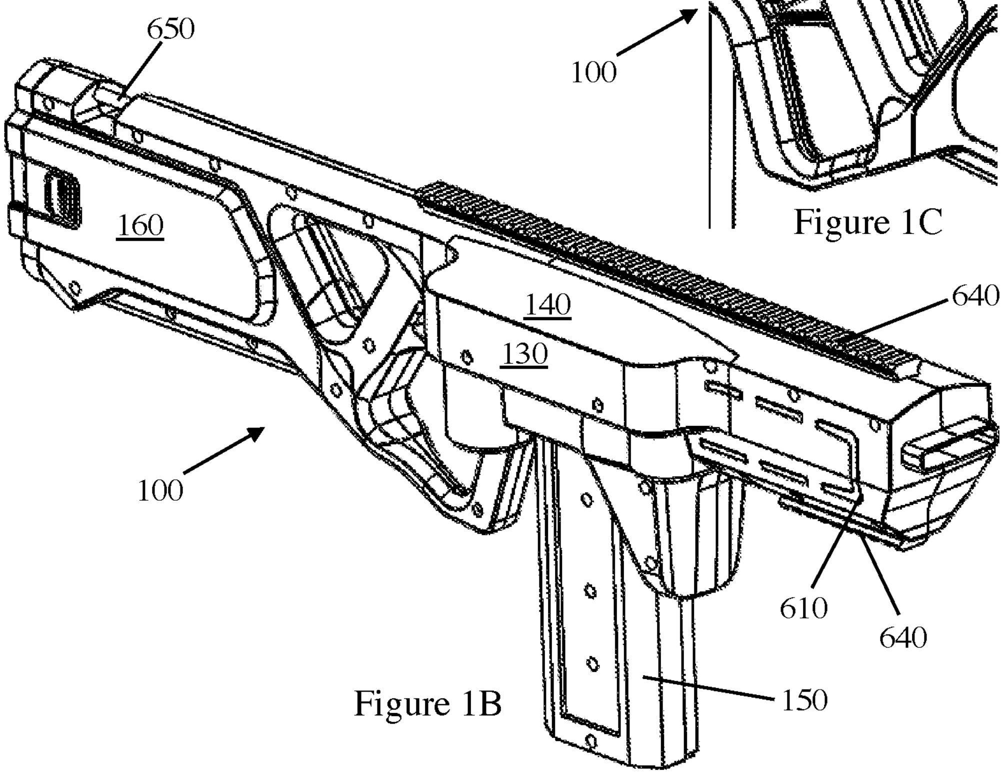


Figure 1B

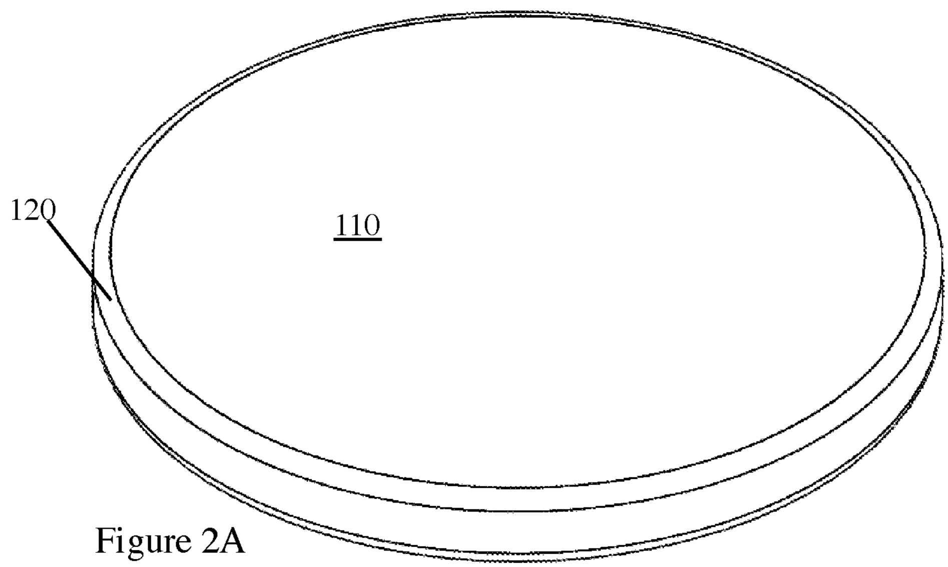


Figure 2A

Figure 2B

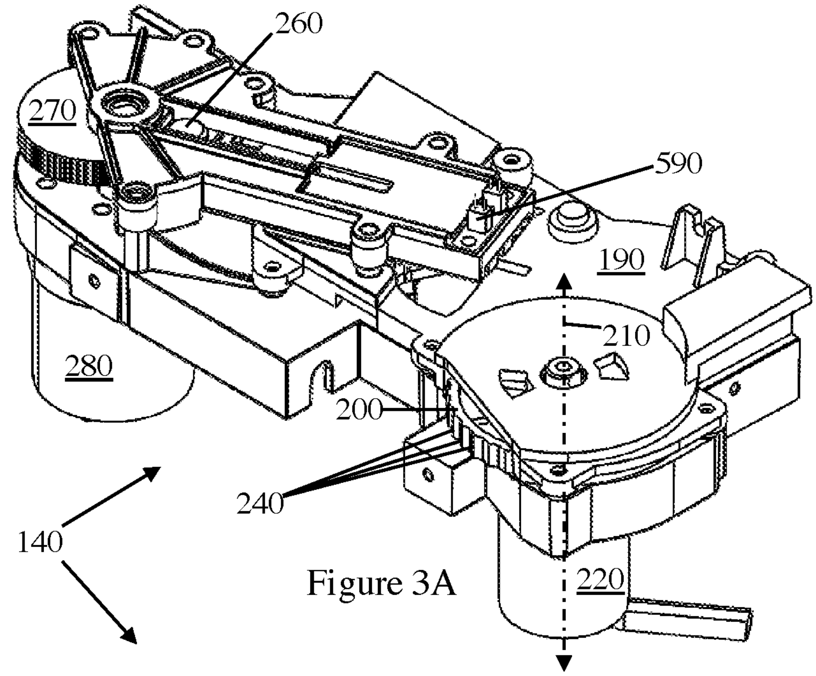


Figure 3A

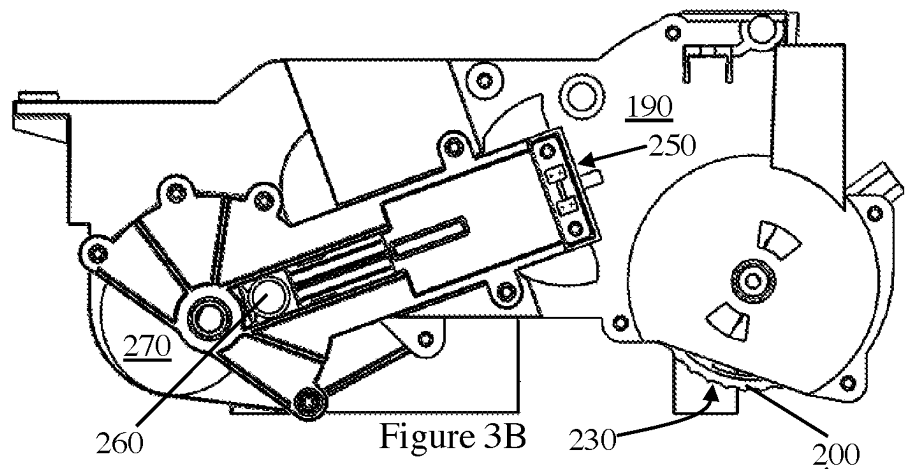


Figure 3B

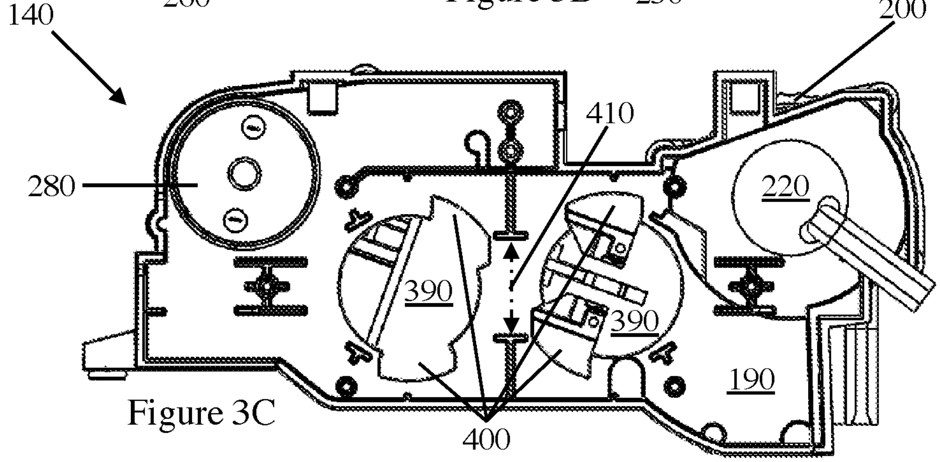
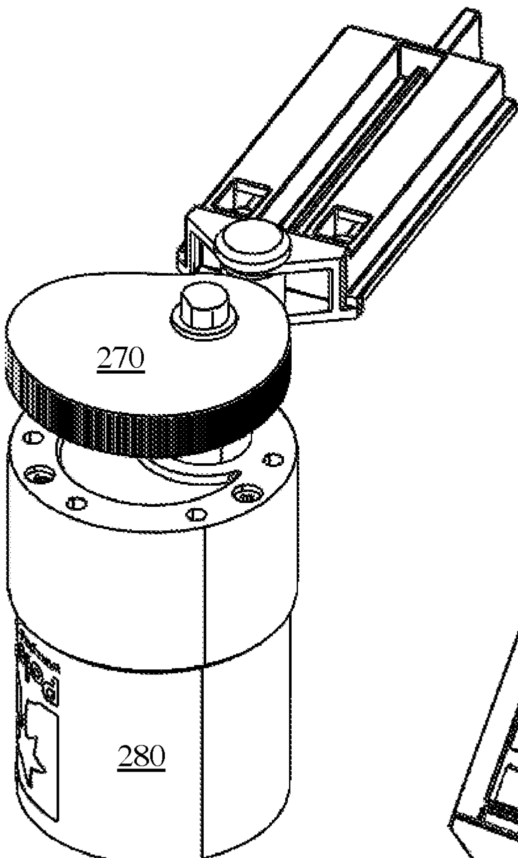


Figure 3C



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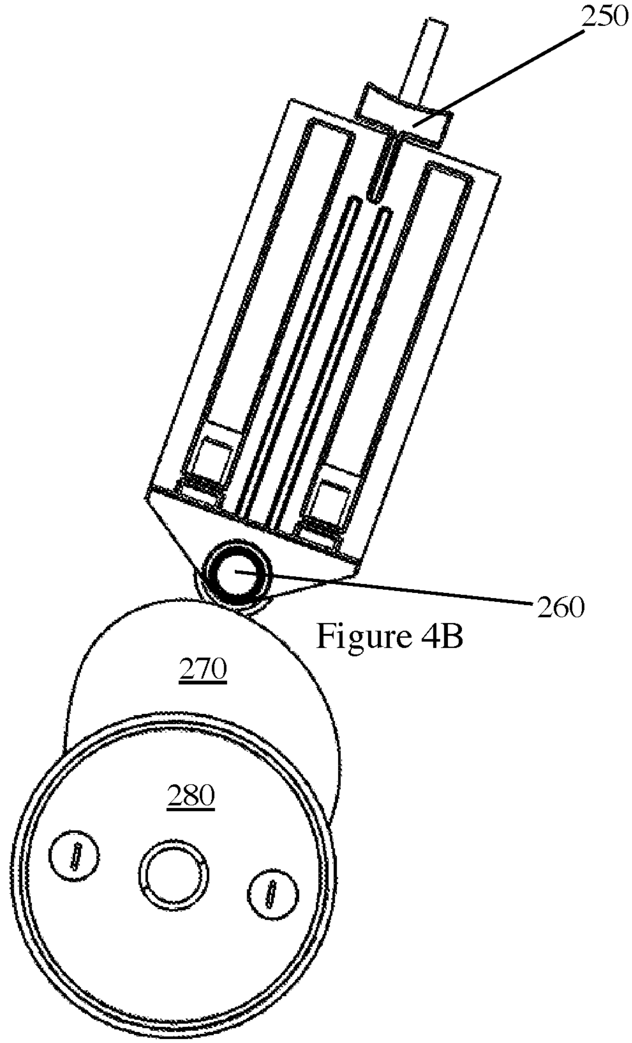

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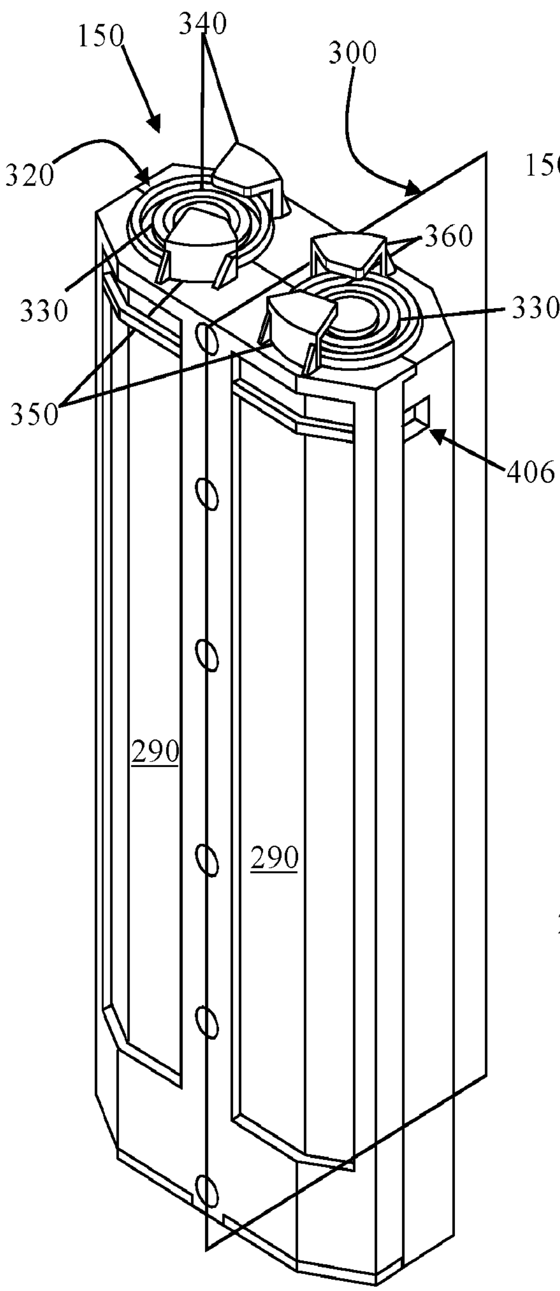

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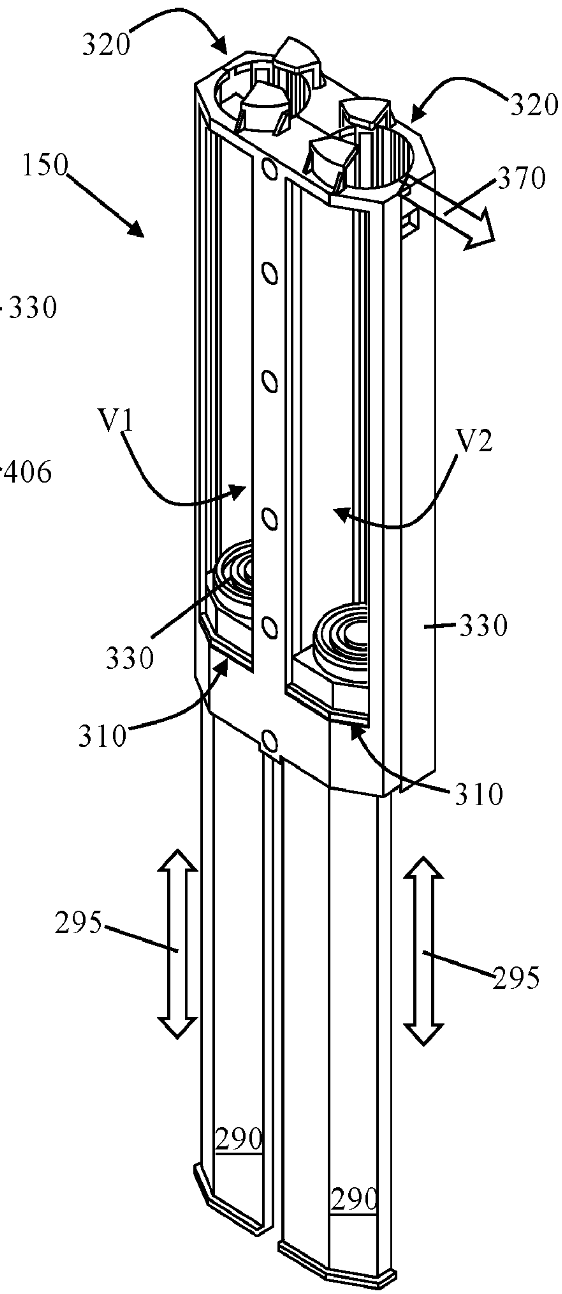

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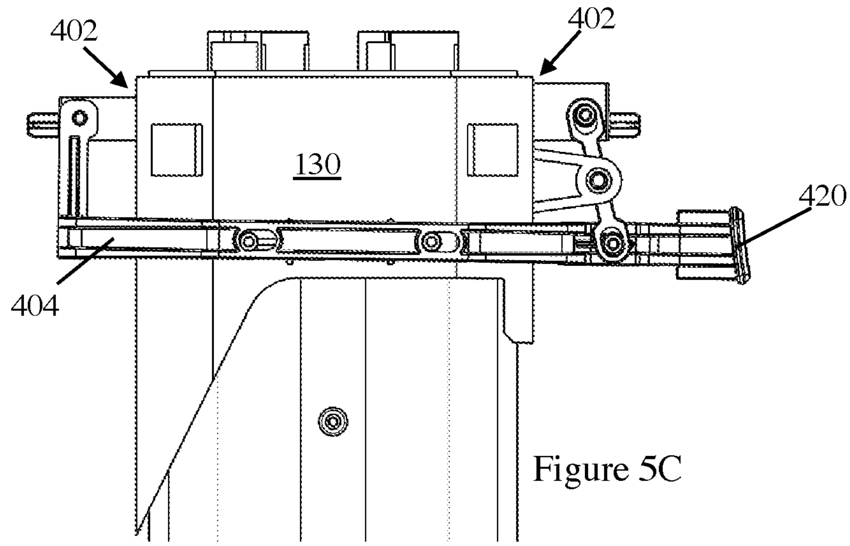

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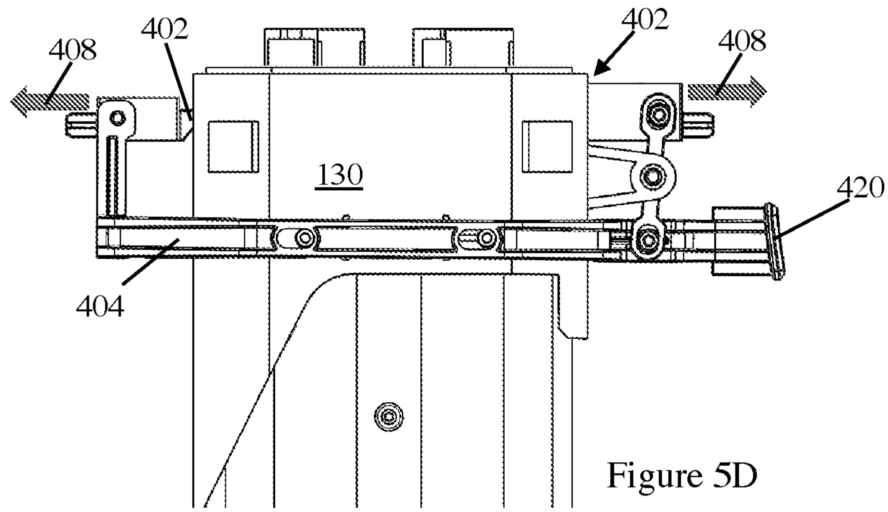

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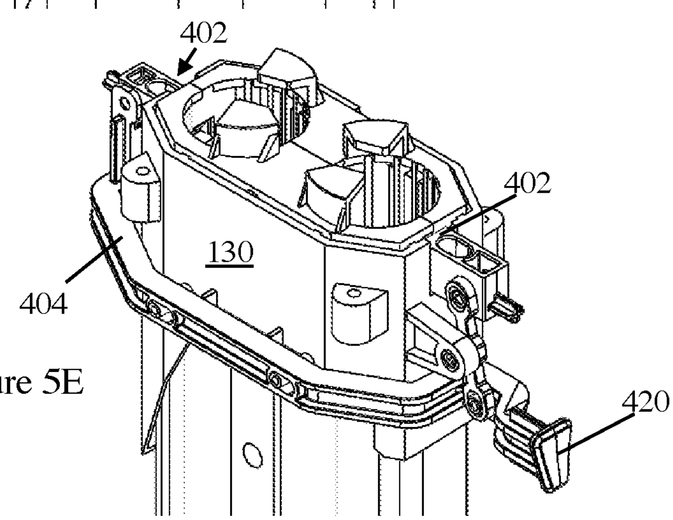

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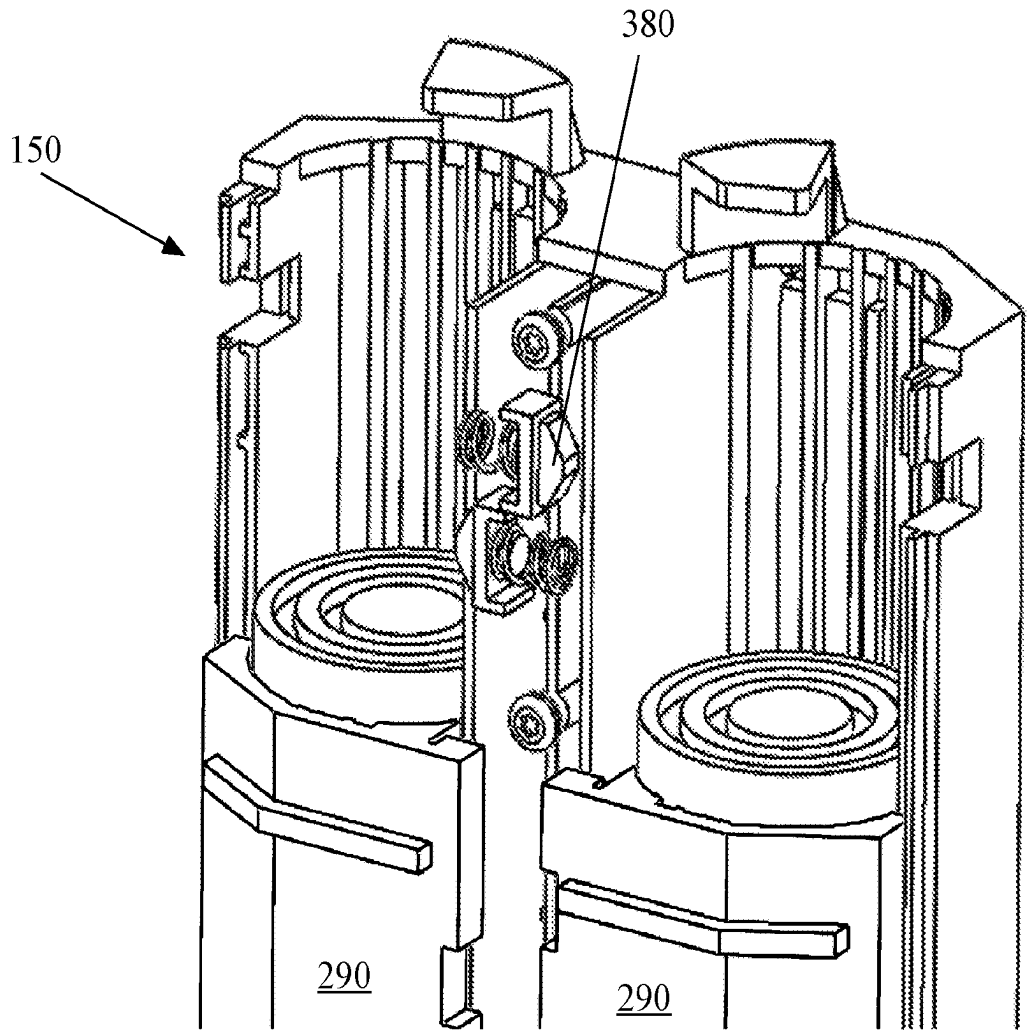
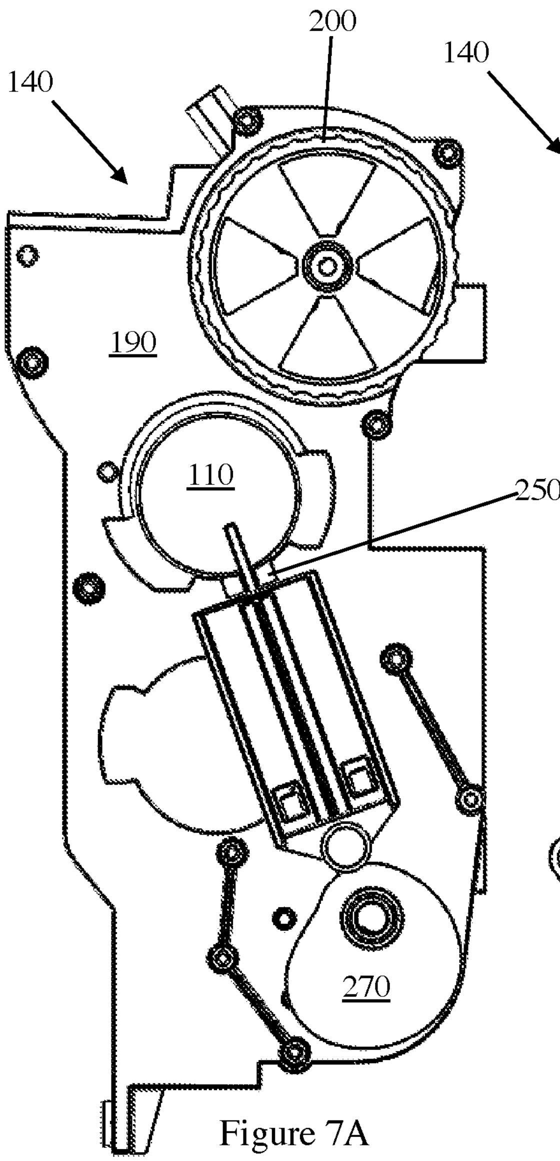


Figure 6



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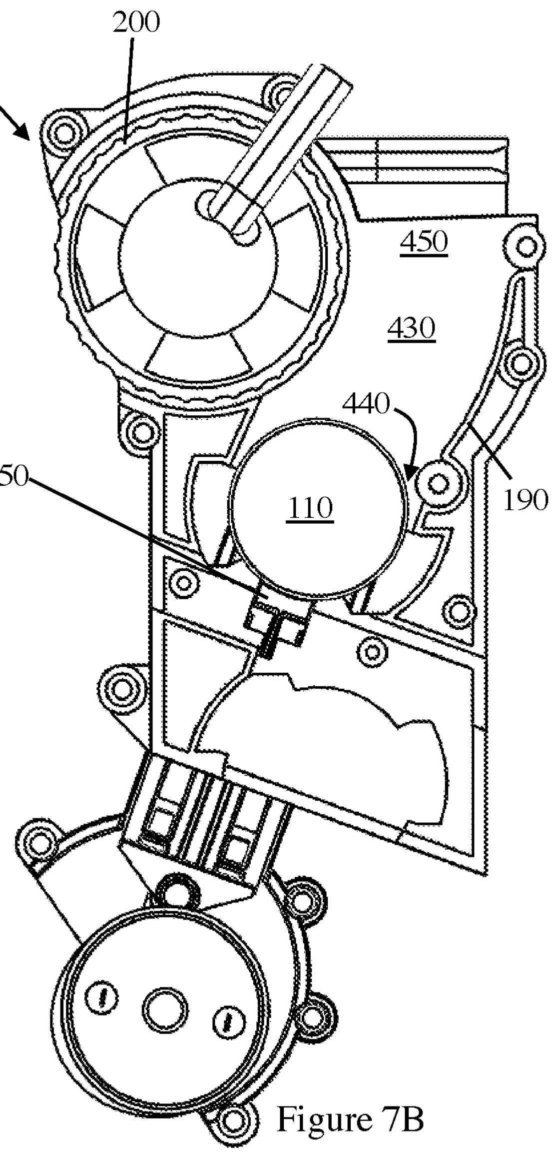
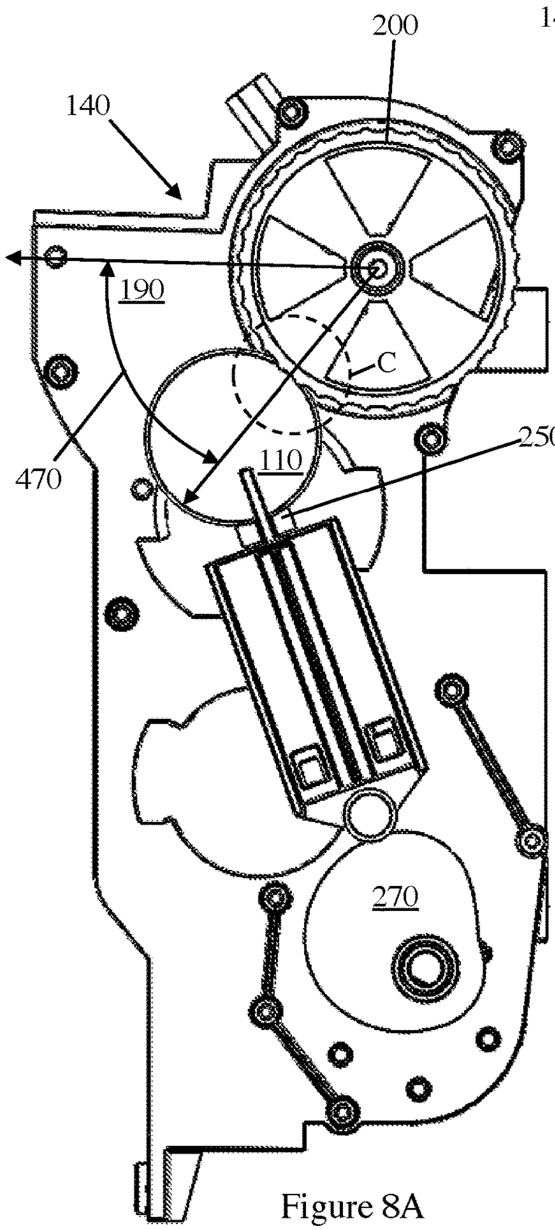


Figure 7B



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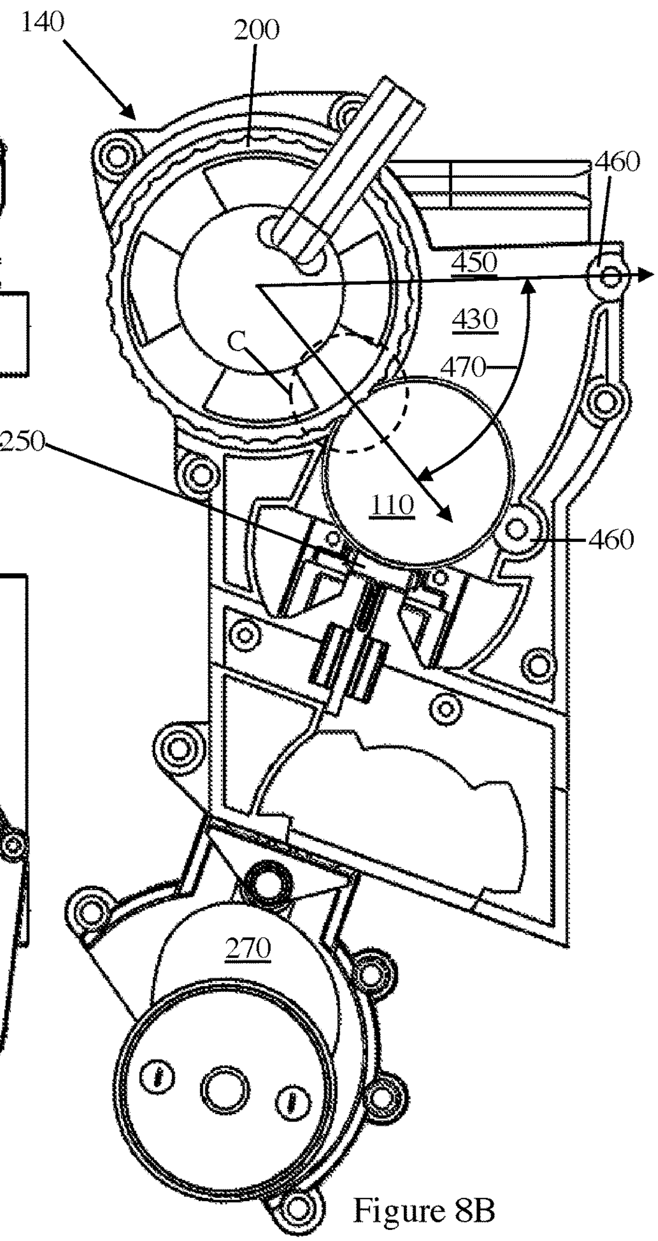

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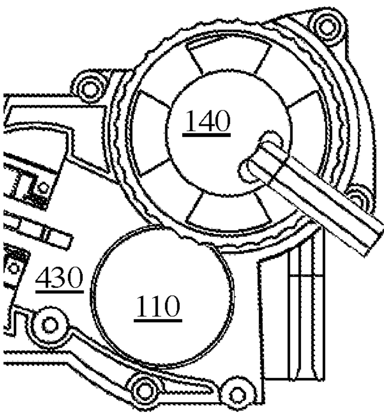

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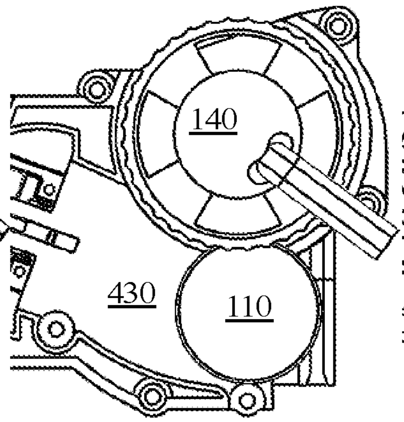

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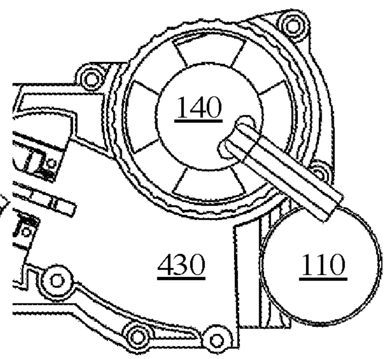

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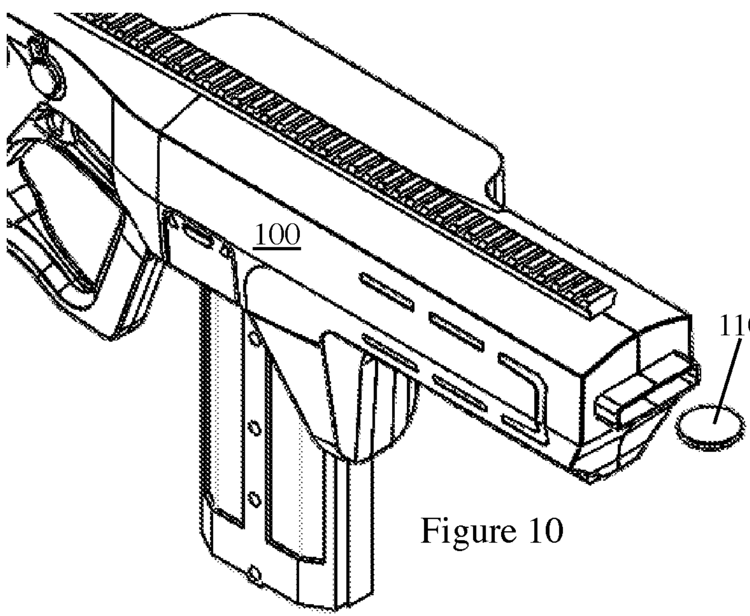

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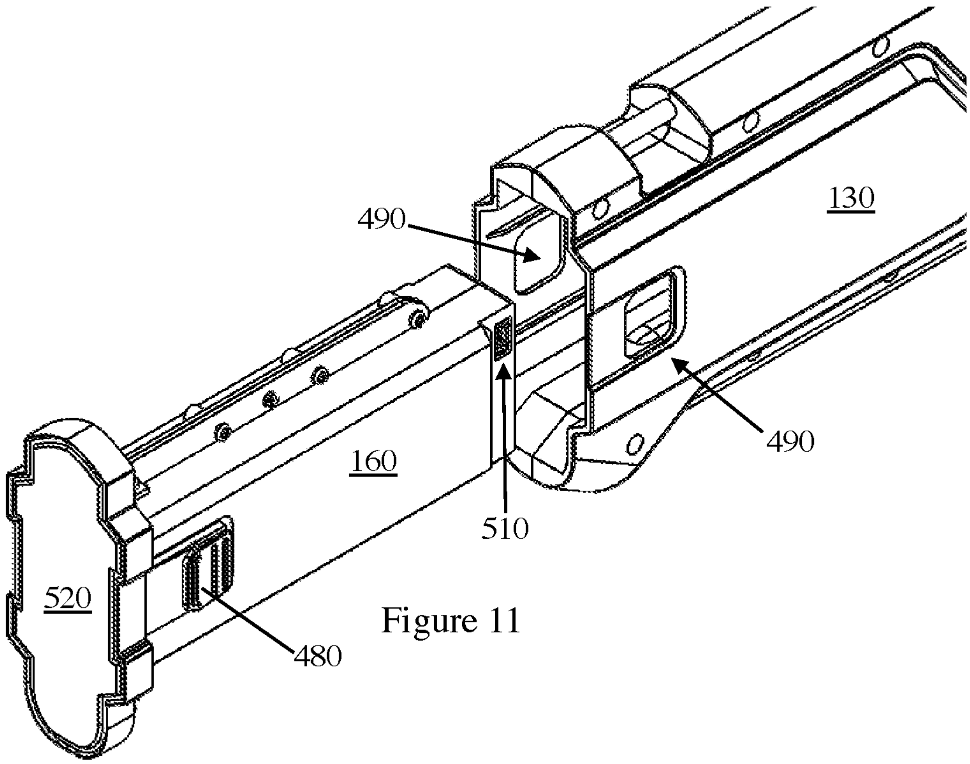
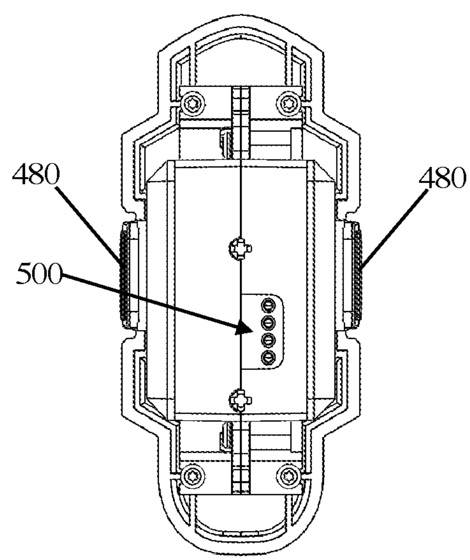


Figure 11



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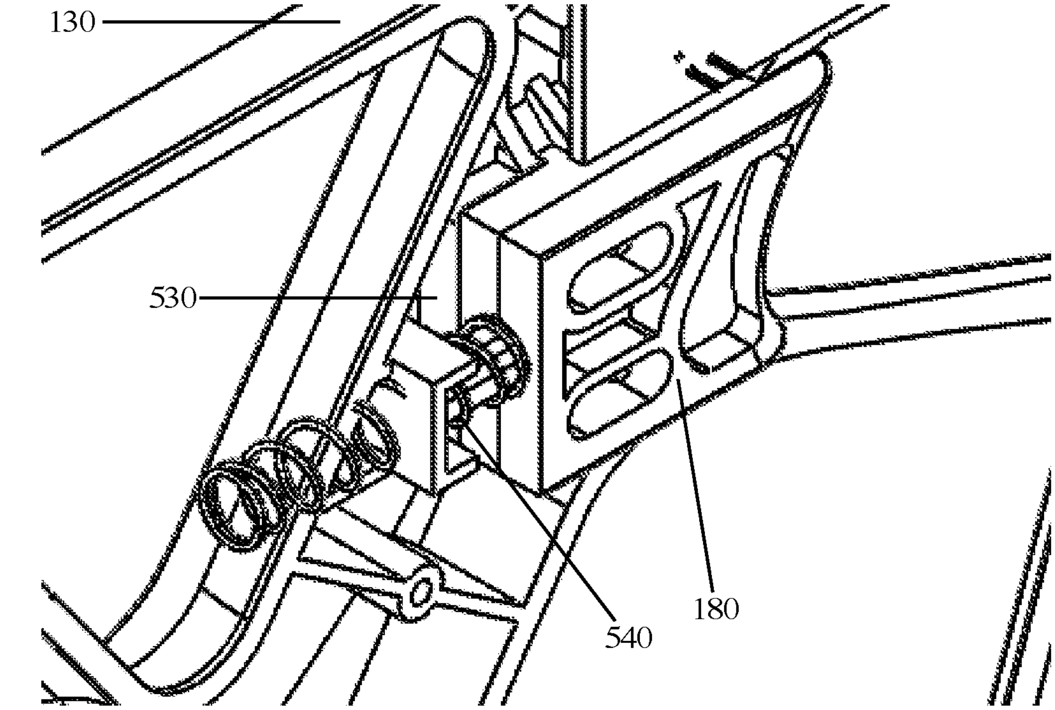

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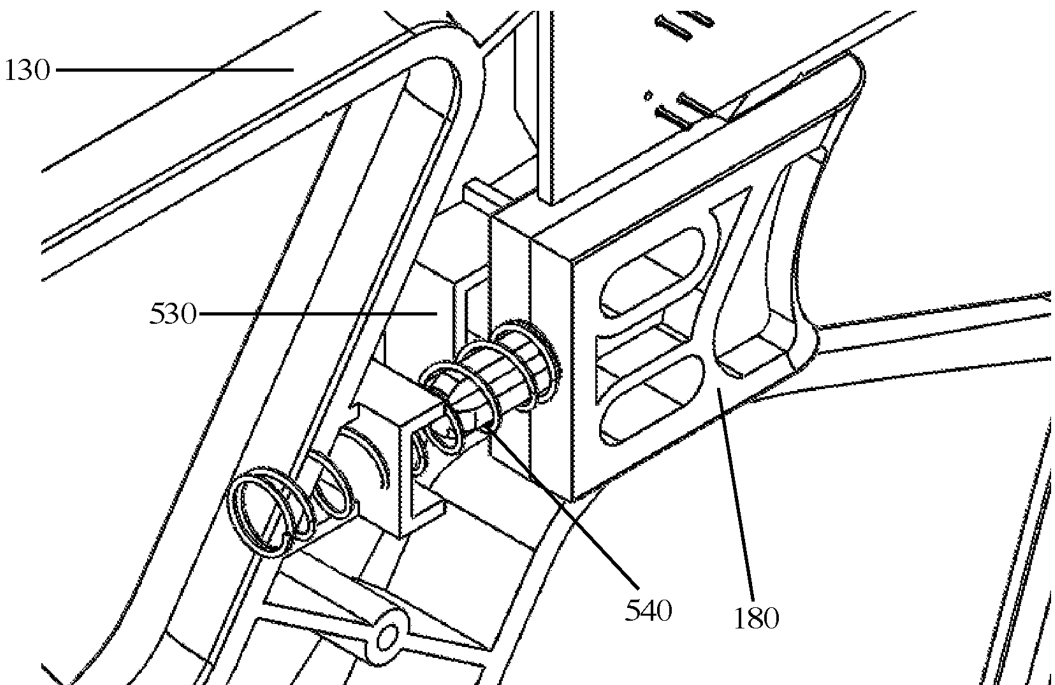


Figure 13B

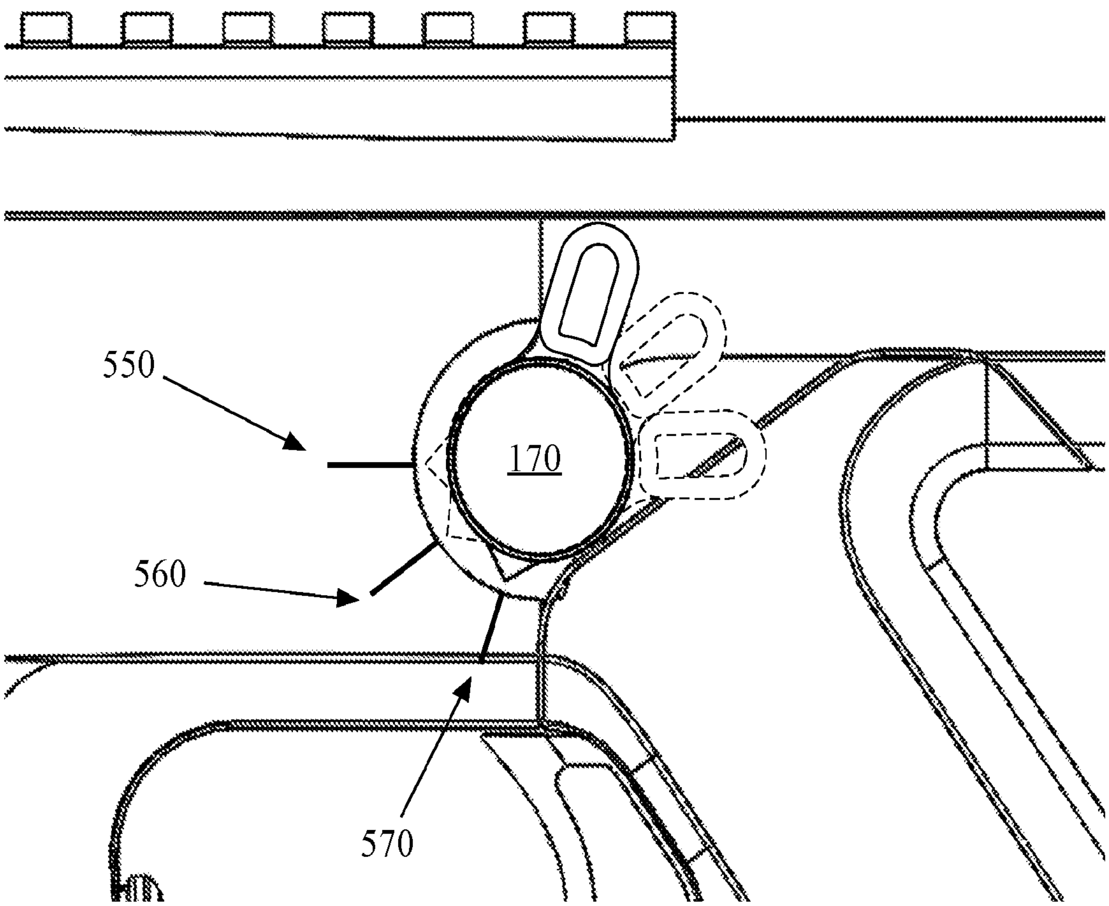


Figure 14

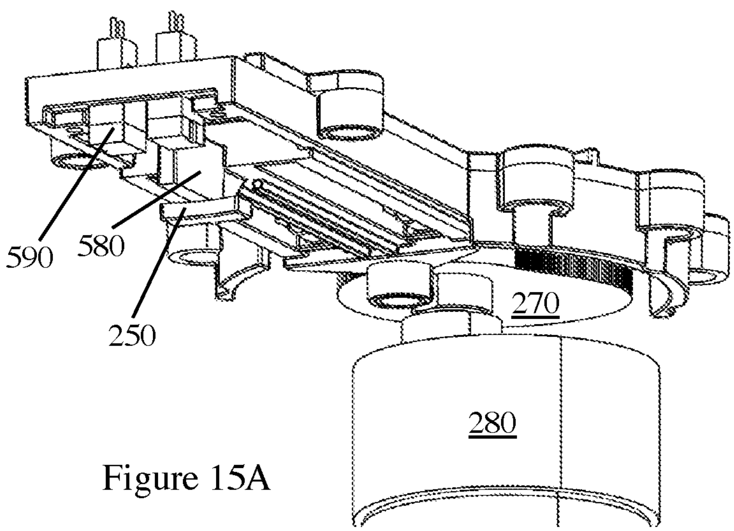
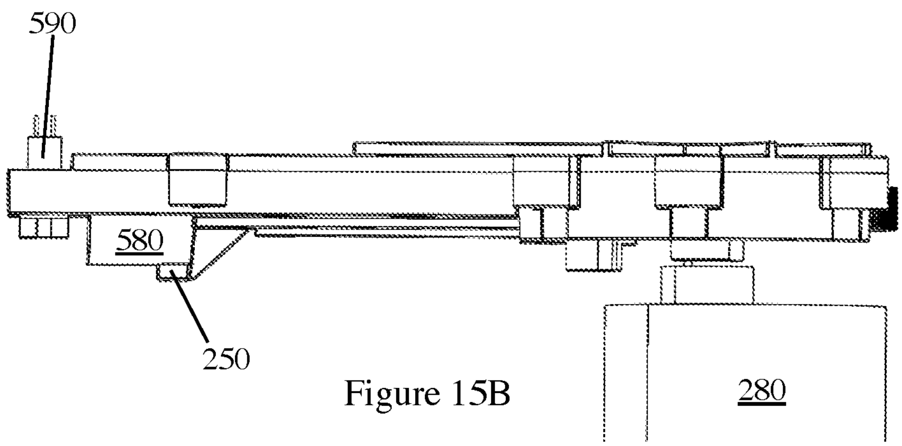


Figure 15A



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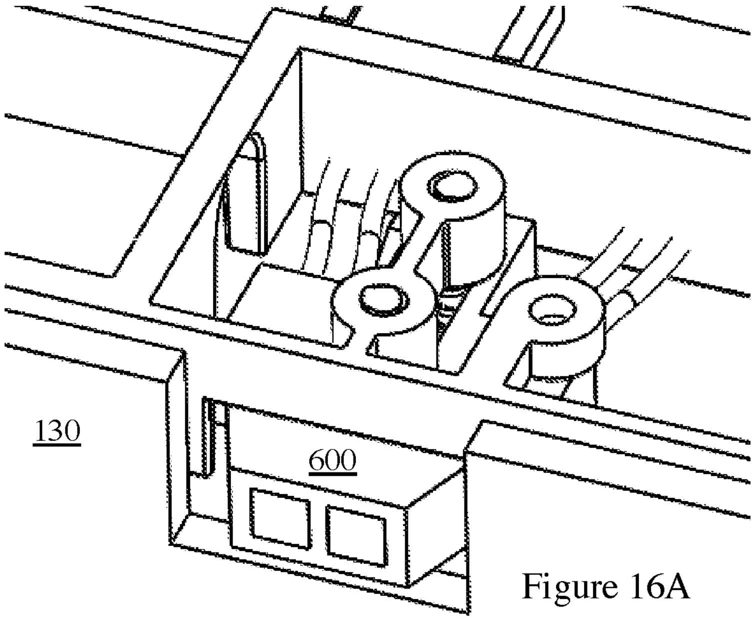

Figure 16A

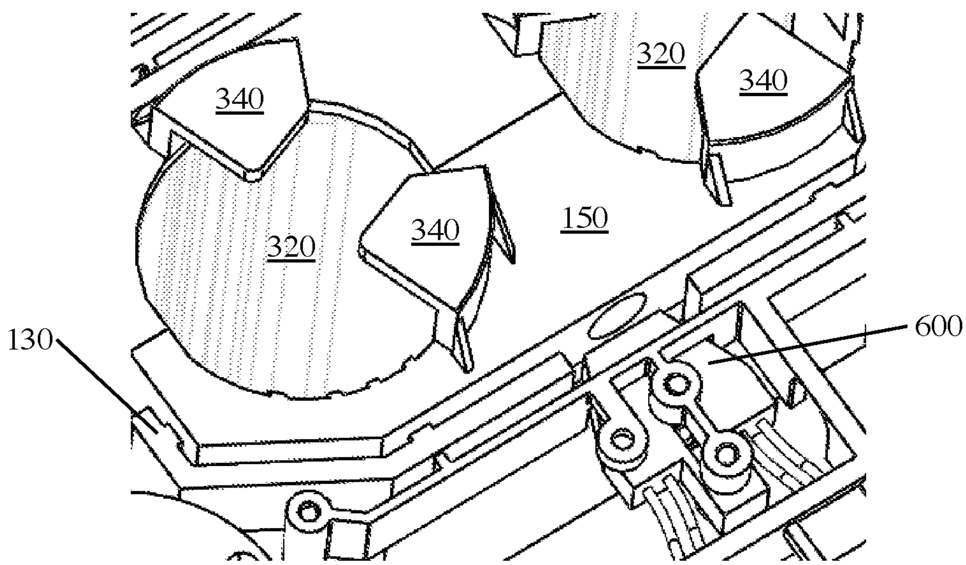

Figure 16B

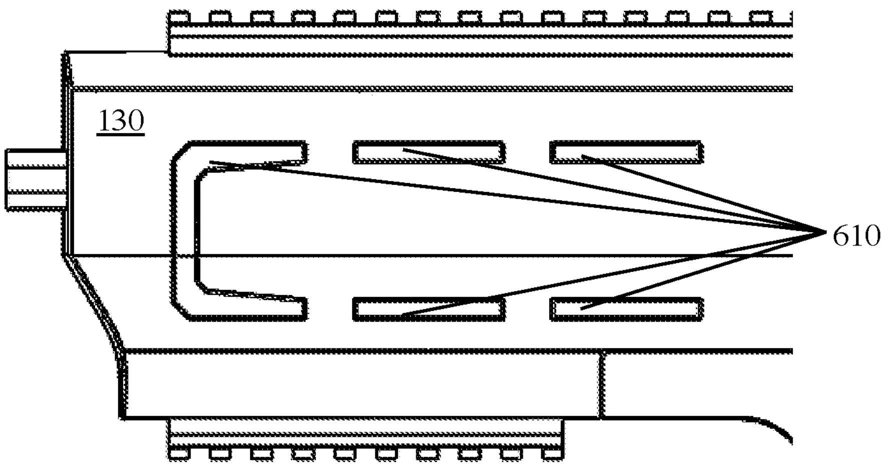

Figure 17A

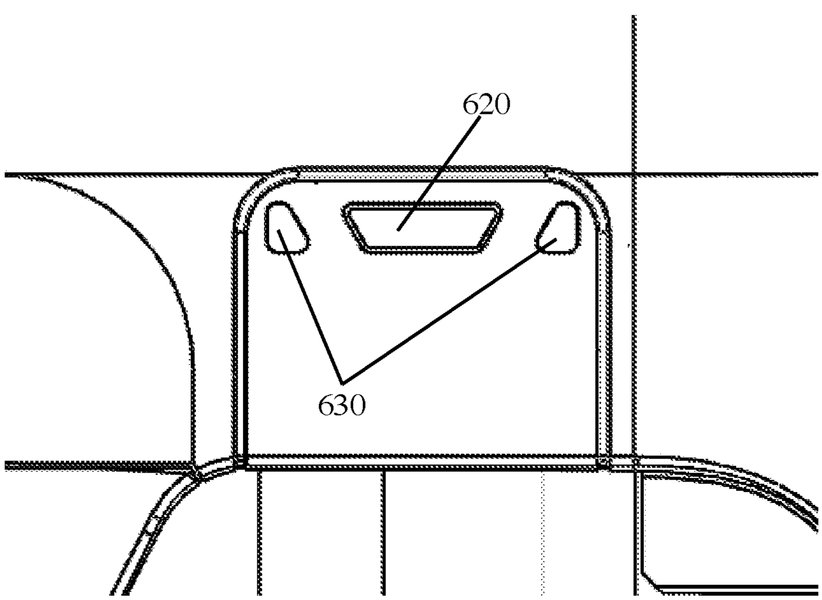

Figure 17B

PROJECTILE LAUNCHER

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims priority to U.S. Provisional Application Ser. No. 63/130,947, filed on Dec. 28, 2020, which is incorporated by reference herein in its entirety.

FIELD OF THE INVENTION

The present invention relates to a projectile launcher. More specifically, the present invention relates to a toy projectile launcher that launches disc projectiles.

BACKGROUND

Toy projectile launchers are known in the art. However, existing toy projectile launchers lack particularly good accuracy or precision when fired at a target. Existing toy projectile launchers also lack a high rate of fire or a selector switch that allows a user to select between a single shot at a time or an automatic firing mode. A need exists for an entirely new toy projectile launcher including features never before included in such a projectile launcher, wherein the new features provide for a higher level of accuracy and precision and a high fire rate, as well as quick and easy bulk reloading, an increased ammunition capacity, and other features as are described more fully hereinbelow, all of which are directed toward an enhanced user experience.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1**A is a left side perspective view of an exemplary embodiment of a projectile launcher;

FIG. **1**B is a right side perspective view of the exemplary embodiment of the projectile launcher;

FIG. **1**C is a close-up left side perspective view of the projectile launcher of FIG. **1**A showing an exemplary location for a magazine release button;

FIG. **2**A is a top side perspective view of an exemplary embodiment of a disc projectile;

FIG. **2**B is a side elevational view of the exemplary embodiment of the disc projectile;

FIG. **3**A is a perspective view of an exemplary embodiment of a firing mechanism that is part of the projectile launcher of FIG. **1**A;

FIG. **3**B is a top plan view of the firing mechanism of FIG. **3**A;

FIG. **3**C is a bottom plan view of the firing mechanism of FIG. **3**A;

FIG. **4**A is an isolated perspective view of a cam and pusher assembly that is part of the firing mechanism of FIG. **3**A;

FIG. **4**B is an isolated bottom plan view of the cam and pusher assembly of FIG. **4**A;

FIG. **5**A is a perspective view of an exemplary magazine for use with the projectile launcher of FIG. **1**A, wherein the magazine is shown in a first configuration with loading doors closed;

FIG. **5**B is a perspective view of the magazine of FIG. **5**A shown in a second configuration with the loading doors open;

FIG. **5**C is a side view of a mechanism for releasably holding the magazine when inserted into the launcher housing where the mechanism is shown in a first state;

FIG. **5**D is a side view of the mechanism for releasably holding the magazine when inserted into the launcher housing where the mechanism is shown in a second state;

FIG. **5**E is a perspective view of the mechanism for releasably holding the magazine when inserted into the launcher housing where the mechanism is shown in the first state shown in FIG. **5**C;

FIG. **6** is a close-up perspective view of the magazine of FIG. **5**A showing detent features for the sliding doors of the magazine;

FIG. **7**A is a bottom plan view of the firing mechanism of FIG. **3**A shown at a first instance of time in a firing sequence;

FIG. **7**B is a top plan view of the firing mechanism of FIG. **3**A shown at the first instance of time in the firing sequence;

FIG. **8**A is a bottom plan view of the firing mechanism of FIG. **3**A shown at a second instance of time in the firing sequence when the disc projectile first contacts the flywheel;

FIG. **8**B is a top plan view of the firing mechanism of FIG. **3**A shown at the second instance of time in the firing sequence;

FIG. **9**A is a top plan view of a portion of the firing mechanism of FIG. **3**A shown at a third instance of time in the firing sequence;

FIG. **9**B is a top plan view of a portion of the firing mechanism of FIG. **3**A shown at a fourth instance of time in the firing sequence;

FIG. **9**C is a top plan view of a portion of the firing mechanism of FIG. **3**A shown at a fifth instance of time in the firing sequence;

FIG. **10** is a perspective view of a disc projectile having just exited the projectile launcher;

FIG. **11** is a perspective view of the one or more batteries or battery pack removed from a back end of the launcher housing; and

FIG. **12** is a front view of the one or more batteries or battery pack showing electrical contacts;

FIG. **13**A is a close-up partial cutaway view of the launcher housing showing a trigger in a pressed position;

FIG. **13**B is a close-up partial cutaway view of the launcher housing showing the trigger in a released position;

FIG. **14** is a close-up side view of the launcher showing three positions for the firing mode switch;

FIG. **15**A is a perspective view of the cam and pusher assembly illustrating an optical sensor on the pusher portion;

FIG. **15**B is a side view of the cam and pusher assembly of FIG. **15**A;

FIG. **16**A is a perspective view on a portion of the housing that receives the magazine illustrating the magazine presence sensor;

FIG. **16**B is a top perspective view on the portion of the housing of FIG. **16**A illustrating the magazine presence sensor with a magazine inserted;

FIG. **17**A illustrates several illuminating light panels disposed on a side of the launcher housing; and

FIG. **17**B illustrates a light selector button and additional illuminating light panels also disposed on a side of the launcher housing.

Other aspects and advantages of the present invention will become apparent upon consideration of the following detailed description, wherein similar structures have similar reference numerals.

DETAILED DESCRIPTION

The following detailed embodiments presented herein are for illustrative purposes. That is, these detailed embodiments are intended to be exemplary of the present invention for the purposes of providing and aiding a person skilled in the pertinent art to readily understand how to make and use of the present invention.

Referring to FIGS. **1**A and **1**B, an exemplary embodiment of a toy projectile launcher **100** is illustrated in perspective views from the left and right sides, respectively. In one embodiment the launcher **100** is made from a plastic material as is known in the art. In other embodiments the launcher can be made at least in part from other or additional materials including metals or natural materials such as wood or other plant or fiber products. The toy launcher **100** or any portion of it disclosed herein can be made in any color as desired for aesthetics or identification of the launcher as part of a group of launchers or users thereof. In one embodiment the launcher has, for example without limitation, an overall length of about 28.3 inches, a width of about 4.25 inches, a height without a magazine **150** installed of about 6.88 inches, and a height with the magazine **150** installed of about 10.93 inches. In other embodiments the launcher can have other dimensions as desired or as otherwise known in the art. In one embodiment the launcher **100** weighs about 4.8 lbs.; however, in other embodiments the launcher **100** can weigh more or less than about 4.8 lbs.

In one embodiment, the launcher **100** launches disc projectiles made of high density foam. For example, referring to FIGS. **2**A and **2**B, a disc projectile **110** is illustrated in a top perspective view and a side view, respectively. The disc projectile **110** is generally round with a finite thickness and rounded circumferential corner surfaces **120**. In one embodiment the disc projectile **110** is made from a material, for example a high density foam material as is known in the art, for example, having Shore 00 hardness 60 or Shore A 50 hardness. Such an exemplary hardness facilitates better transfer of rotational and translational energy to the disc projectile **110** during the firing process as is more fully described hereinbelow.

Without being held to any theory, the disc shape and the use of a high density foam in the disc projectile **110** are both contributing factors to a high level of accuracy and precision in hitting a target. There are no aerodynamic features on the disc projectile **110** other than top and bottom flat surfaces and the rounded circumferential corner surfaces **120**. Therefore, the manufacturing process for the disc projectile **110** can be simplified. In one embodiment, for example without limitation, the disc projectiles **110** are manufactured by a stamping process. In another embodiment, for example without limitation, the disc projectiles **110** are manufactured by a three dimensional printing process. Other embodiment can use one or more other processes for manufacturing the disc projectiles **110** as are known in the art.

The disc projectile **110** is sufficiently soft so as to be flexible upon impact, thereby dispersing impact forces and making the disc projectiles **110** safer for the user. In one embodiment the disc projectile has a diameter of about 1.25 inches and a thickness as desired, for example without limitation, as proportionally illustrated in FIG. **2**B. In other embodiments, the disc projectile **110** can have a different diameter and/or thickness to accommodate a different dimension or dimensions on the launcher or a component thereof, to change or adjust the ammunition capacity of the launcher or a component thereof, as may be beneficial or desired, or for other reasons as are known in the art.

Referring back to FIGS. **1**A and **1**B, the launcher **100** comprises a housing **130** that houses or otherwise supports a firing mechanism **140** (shown externally in FIGS. **1**A and **1**B), a magazine **150**, one or more batteries or battery pack **160**, a firing mode switch **170**, a trigger **180**, and other features, all of which are described more fully individually hereinbelow. An exemplary firing mechanism **140** is illustrated in perspective view in FIG. **3**A, in a top view in FIG. **3**B, and in a bottom view in FIG. **3**C.

Referring now to FIGS. **3**A-**3**C, in one embodiment a flywheel housing **190** houses a flywheel **200** having a rotational axis **210** and driven by a first electric motor **220**. In one embodiment, for example without limitation, the flywheel **200** is driven by a brushless in runner motor as is known in the art. Other embodiments utilize different types of electric motors as are known in the art. The flywheel **200** in one embodiment has a roughened circumferential edge surface **230** (see FIG. **3**B), and in another embodiment the roughened circumferential edge surface **230** comprises a series of ridges **240** oriented along the rotational axis **210** (see FIG. **3**A). The roughened circumferential edge surface **230** and/or ridges **240** serve to provide an enhanced frictional engagement or instantaneous attachment when coming in contact with the disc projectile **110** as is further explained hereinbelow.

The flywheel **200** in one embodiment is mounted to rotate on a bearing or bearing assembly (not illustrated) as is known in the art. Loads on the flywheel **200** are thus transferred to the bearing or bearing assembly, which enhances smooth rotation especially at high rotation speeds of the flywheel **200**, and further vastly increases the life cycle expectancy for the flywheel **200**, both factors contributing to the robustness and reliability of the operation of the flywheel **200**. In one embodiment the first electric motor **220** drives the flywheel at a rotational speed of 24,000 revolutions per minute (rpm). In other embodiments the first electric motor **220** drives the flywheel **200** at a different rotational speed. Further, control circuitry (not shown) operationally disposed between the trigger **180** and the first motor **220** is designed to provide power from the one or more batteries or battery pack **160** to the first electric motor **220** to ramp up the flywheel **200** to full speed in about 0.2 seconds. From the standpoint of a user, such a small ramp up time is experienced to be essentially instantaneous.

The role of the flywheel **200** in operation of the launcher **100** is more fully described hereinbelow after a description of some of the other components of the flywheel housing **190**. In one embodiment the flywheel **200** is made from a metal, for example without limitation aluminum. Making the flywheel **200** out of a metal like aluminum provides a hard material that it resistant to wear or other degradation, that can compress the foam of the disc projectiles **110**, and that is also lightweight and can be spun up very quickly by the first electric motor **220**.

Returning to FIGS. **3**A-**3**C, the flywheel housing **190** further houses a pusher and cam assembly that includes a pusher **250** including a spring-loaded follower **260** that maintains contact with a non-circular rotating cam **270**. The non-circular rotating cam **270** is rotationally driven by a second electric motor **280** (see FIGS. **3**A and **3**C). The spring-loaded follower **260**, which is typically a roller in contact with an edge of the non-circular rotating cam **270**, responds to rotation of the non-circular rotating cam **270** by reciprocating away from and back toward the axis of rotation of the cam **270**. The follower **260** is mounted to the pusher **250** with a spring (not illustrated but known in the art) therebetween, thus as the follower reciprocates back and forth it moves the pusher in the same back and forth pattern while force from the spring biases the follower **260** to remain in contact with the cam **270** at all states of rotation of the cam **270**.

Referring now to FIGS. **4**A and **4**B, FIG. **4**A illustrates an isolated perspective view of the cam and pusher assembly showing the geometrical relationships of the pusher **250**, the spring-loaded follower **260**, and the non-circular rotating cam **270** that is driven by the second electric motor **280**. FIG. **4**B illustrates a bottom plan view of the cam and pusher assembly wherein the end of the pusher **250** that contacts the projectile discs **110** is shown to include a slightly concave surface to accommodate the convex surface of the edge of each projectile disc **110**.

In one embodiment the second electric motor **280** is a gear motor as is known in the art. In other embodiments the second electric motor **280** can be chosen from other types of motors as are known in the art. In one embodiment, for example without limitation, the cam **270** is made of metal. As is explained more fully hereinbelow, to increase the firing rate of the launcher **100**, the second electric motor **280** must spin at a high rate. The cam **270** can withstand greater heat and greater forces if it is made of metal rather than being made from, for example, plastic or some other material. Further, a cam **270** made from metal will not deteriorate as fast as a cam **270** made from plastic or some other material would.

In one embodiment the rotating cam **270** is mounted to rotate on a bearing or bearing assembly (not illustrated) as is known in the art. Loads on the cam **270** are thus transferred to the bearing or bearing assembly, which enhances the smooth rotation of the rotating cam **270**, and further vastly increases the life cycle expectancy for the rotating cam **270**, both factors contributing to the robustness and reliability of the operation of the rotating cam **270**.

Before discussing the operation of the launcher **100** there is one more component to be described in relation to the path of the projectile discs **110** through the firing mechanism **140**. Referring to FIGS. **5**A and **5**B, the magazine **150** is illustrated in FIG. **5**A isolated away from the launcher **100** and in a closed configuration. In FIG. **5**B, the magazine **150** is further illustrated with a pair of sliding doors **290** both in an open configuration. The sliding doors **290** slide relative to the magazine **150** in the directions shown by arrows **295** between the closed configuration in FIG. **5**A and the open configuration in FIG. **5**B.

In the open configuration, the magazine **150** is seen to comprise two parallel internal volumes V**1** and V**2** each spaced equally from an imaginary plane **300** disposed therebetween. Each internal volume V**1**, V**2** is configured to accommodate a stack of disc projectiles **110**. Each internal volume V**1**, V**2** is further configured to include a closed end **310** and an open end **320**. A spring loaded plunger **330** is oriented within each internal volume V**1**, V**2** to provide a biasing force on the stack disc projectiles **110** from the closed end **310** toward the open end **320**. The plungers **330** are visible at the closed ends **310** of the internal volumes V**1**, V**2** in FIG. **5**B and are also visible as extending through the open ends **320** of the internal volumes V**1**, V**2** in FIG. **5**A wherein the magazine **150** is empty of disc projectiles **110**.

Still referring to FIGS. **5**A and **5**B, the open end **320** of each internal volume V**1**, V**2** comprises a pair of retaining tabs **340** each having a first portion **350** that extends away from the open end **320** and a second portion **360** that extends over the open end **320** so that a disc projectile **110** biased toward the open end **320** is restrained against the biasing force of the plunger **330** by the second portion **360** of the pair of retaining tabs **340**, but can be pushed laterally off the stack of disc projectiles **110**, for example in the direction of arrow **370**. The biasing force of the plunger **330** presses the stack of disc projectiles **110** upwardly, thereby pinning them against the second portions **360** of the retaining tabs **340**. During operation, whenever a disc projectile **110** is removed from the top of the stack, the plunger **330** forces the stack of disc projectiles **110** upwardly, thereby presenting another disc projectile **110** to the top of the stack until the entire stack of disc projectiles **110** is depleted. In one embodiment, the magazine **150** can hold 110 discs, 55 discs in each internal volume V**1**, V**2**.

Referring briefly to FIG. **6**, each of the sliding doors **290** includes detent features **380** to hold the door **290** in the fully closed position during operation of the launcher **100** and in the fully open position, for example, during filling of the magazine **150**. For example, the detent feature **380** in one embodiment includes a surface having ramped top and bottom sides backed by a spring wherein the surface is biased by the spring into a notch in the door **290**. Additionally, each sliding door **290** engages with and pulls along the spring loaded plunger **330** when slid from the open end **320** toward the closed end **310**, for example, the sliding doors **290** each have a shoulder portion that catches on a cooperating shoulder portion of the plunger **330** as the door **290** is slid open so as to move the plunger **330** away from the open end **320** with the door **290**. So when the sliding doors **290** are held in their fully open positions by detent features **380**, the plungers **330** are at their bottom-most positions allowing easy access to the internal volumes V**1**, V**2**.

The magazine **150** is loaded with the projectile discs **110** primarily through the two sliding doors **290**. So while it is also possible to load the disc projectiles **110** one at a time by depressing the plunger **330** or the top most projectile disc **110** at the open end **320** of an internal volume V**1** or V**2**, and sliding a single disc projectile **110** under retaining tabs **340**, it is easier and faster to load an entire stack of disc projectiles **110** simultaneously through one of the sliding doors **290** in a fully open configuration.

Referring again to FIGS. **5**A and **5**B, a top surface of the magazine **150** on a first side of the imaginary plane **300** has a structure that is identical to the top surface on a second side of the imaginary plane **300** but rotated 180 degrees relative thereto. Because of the 180 degree relationship of the top surfaces of the magazine **150** and the symmetry of the internal volumes V**1**, V**2** relative to the plane **300**, the magazine **150** can be removably inserted into the housing **130** in two orientations separated by 180 degrees of rotation relative to the housing **130**. This capability allows the magazine **150** having the two internal volumes V**1**, V**2** to double the available number of disc projectiles **110** deliverable to the launcher **100** without a reload operation of the magazine **150**.

Returning briefly to FIG. **3**C, which shows a bottom plan view of the firing mechanism **140**, two generally circular holes **390** can be seen between the first and second electric motors **220** and **280**. Each of the holes appears to have a pair of extensions **400** and the pairs of extensions **400** are arranged to be 180 degrees out of phase with each other across a centerline **410** disposed therebetween. Each of the extensions **400** accommodates a retaining tab **340** when the magazine is removably inserted into the flywheel housing **190**.

Referring to FIGS. **5**C-**5**E, the magazine **150** inserts into and is removably attached to the housing **130** via one or more magazine retention detents **402** that can be retracted by forcible insertion of the magazine **150** to allow the magazine **150** to be inserted and attached. However, once so attached the magazine **150** cannot be likewise forcibly removed simply by pulling on it in normal operation without breaking a portion of the magazine **150** or the housing **130**. The one or more magazine retention detents **402** can only be retracted with the magazine **150** installed by depression of a magazine release button **420** (see also FIG. **1**C), which is operationally connected to the one or more magazine retention detents, for example without limitation, by a mechanical linkage **404** as is known in the art.

For example, as illustrated in FIG. **5**D, each of the one or more magazine retention detents **402** is mounted on the mechanical linkage **404**, which is a spring loaded mechanism that is biased so that the one or more magazine retention detents **402** are forced toward one another. Each of the one or more magazine retention detents **402** has a ramped lower surface and a flat top surface and when the magazine release button **420** is not depressed the one or more magazine retention detents extend outwardly from the internal sides of the housing **130** wherein the magazine **150** gets inserted. Inserting the magazine **150** into the housing **130** first pushes the ramped lower surfaces outwardly allowing the magazine **150** to be pushed into the housing **130** until the one or more magazine retention detents **402** snap back toward each other into holes **406** disposed through sides of the magazine **150** (see FIG. **5**A). FIGS. **5**C and **5**E show the magazine **150** so inserted and held in place with the magazine release button **420** not depressed. When the magazine release button **420** is depressed as shown in FIG. **5**D, the connecting linkage **404** pushes the one or more magazine retention detents **402** away from one another as indicated by arrows **408**, which removes them from the holes **406** and releases the magazine **150** to be pulled out from the housing **130**.

Referring now to FIGS. **7**A and **7**B, operation of the launcher **100** is described in detail following the path of a single disc projectile **110** through a firing sequence starting from an open end **320** of one of the internal volumes V**1** or V**2** of the magazine **150**. FIG. **7**A illustrates a top view of the firing mechanism with a disc projectile **110** disposed at the open end **320** of one of the internal volumes V**1**, V**2** of the magazine **150**. FIG. **7**B illustrates a bottom view of the same time reference in the firing sequence looking through the magazine **150** (as if made transparent for this view). At this point in time the cam **270** is at a rotated position whereby the pusher **250** does not extend over the open end **320** and so has not yet pushed the disc projectile **110** laterally. FIG. **7**B also shows that the flywheel housing **190** includes a passageway **430** disposed therethrough, wherein the passageway **430** comprises an entry opening **440** at a first end that is configured to receive the disc projectile **110**, and a release opening **450** at a second end.

Referring now to FIGS. **8**A and **8**B, at a subsequent time in the firing sequence, the cam **270** has now rotated to a position whereby the pusher **250** has translated away from the rotational axis of the cam **270**. The pusher **250** thus translates to push the top-most disc projectile **110** off the stack of disc projectiles **110** disposed within one of the internal volumes V**1**, V**2** of the magazine **150** and into the firing mechanism **140**. In fact, the pusher **250** pushes the disc projectile **110** into the entry opening **440** (see FIG. **7**B) of the passageway **430**. The flywheel housing **190** and the passageway **430** disposed therethrough are configured so that the flywheel **200** makes contact with the disc projectile **110** (as shown within the dashed circle labeled C in FIGS. **8**A and **8**B) when the disc projectile **110** is pushed into the entry opening **440** of the passageway **430**.

It is to be noted that the disc projectile **110** is made from a material that is softer than the material of the flywheel **200**. The disc projectile **110** in FIGS. **8**A and **8**B can be seen to be slightly compressed between the flywheel **200** and an idler bearing **460** at the entry opening **440** (see FIG. **8**B). The idler bearings **460** at the entry opening **440** and at the release opening **450** of the passageway **430** allow for a consistent point of entry, point of first contact with the flywheel **200**, and point of release, and further allow the disc projectile **110** to be imparted rotation from the flywheel **200** as it exits the passageway **430**. Consistency in the point of release and in rotation of the disc projectile **110** is critical for accuracy and precision to the target. Upon making first contact with the flywheel **200**, the disc projectile **110** is pulled by the flywheel **200** rapidly toward the release point **450**. In embodiments of the flywheel **200** having a roughened circumferential edge surface **230** and/or ridges **240** disposed on the edge surface the roughened surface **230** and/or ridges **240** facilitate a better grip on the disc projectile **110**.

As can be seen in FIG. **8**B, the passageway **430** of the flywheel housing **190** is curved with the entry opening **440** configured to receive a disc projectile **110** at a first end, and a release opening **450** at a second end. In one embodiment, the passageway **430** has a curved geometry wherein when the disc projectile **110** is pushed into the entry opening **440** and makes first contact with the flywheel **200**, the first contact occurs at an angle **470** of about 45 degrees from the release opening **450** as measured around the rotational axis **210** of the flywheel **200**. Without being held to any particular theory, a curved path spanning a longer arc of contact between the flywheel **200** and the disc projectile **110** following 45 degrees of rotation of the flywheel **200** allows for a longer time of contact between the disc projectile **110** and the flywheel **200** as compared to a straight path spanning only a tangential point of contact that occurs, for example, just near the release opening **450**. More energy is transferred from the spinning flywheel **200** to the disc projectile **110** by a longer contact time, which results in the disc projectile **110** being accelerated to a faster speed. A curved path spanning a 45-degree arc of contact allows for the longer contact time while still maintaining a small overall profile for the firing mechanism **140**.

Referring to FIGS. **9**A-**9**C, the progress of the disc projectile **110** through the passageway **430** is illustrated for three later times in the firing sequence. FIG. **10** illustrates an external view of the disc projectile **110** having just exited the launcher **100**. In one embodiment of the launcher **100**, a prototype of the launcher **100** as described herein launches the disc projectiles **110** at an exit velocity of about 105 feet per second (fps). The disc projectiles **110** so launched are accurate to within about a 12 inch diameter circle of precision from a distance of about 35 feet.

Power for the first and second electric motors **220**, **280**, as well as other internal circuitry, indicators, lights, and sensors not yet described is provided by one or more batteries and/or a battery pack **160**. Referring to FIG. **11**, the exemplary one or more batteries or battery pack **160** is illustrated removed from the housing **130**. When installed within the housing **130**, an outer surface **520** of the one or more batteries or battery pack **160** defines the back end of the launcher **100**.

The one or more batteries or battery pack **160** is removable from the launcher **100** via two press tabs **480**, one on each side. The press tabs **480** in one embodiment are flexible tabs that have a default position that extends out further than when flexibly depressed. In another embodiment the press tabs **480** are any sort of tab that is backed by an outward biasing force provided by a leaf spring or other source of outward bias as is known in the art. When the one or more batteries or battery pack **160** is installed within the housing **130**, the press tabs **480** are accommodated by the holes **490** thereby holding the one or more batteries or battery pack **160** securely in place within the housing **130**. The one or more batteries or battery pack **160** is removed from the housing **130** by pressing on the press tabs **480** to depress them sufficiently through the holes **490** to allow the one or more batteries or battery pack **160** to be slid out from the housing.

An internal facing surface of the one or more batteries or battery pack **160** includes contacts **500** as illustrated in FIG. **12**. Upon installation of the one or more batteries or battery pack **160** into the housing **130** the contacts **500** provide electrical communication between the one or more batteries or battery pack **160** and the internal circuitry of the launcher **100** yet to be described. In one embodiment the contacts **500** can be accommodated into holes within the housing **130** or in another embodiment the contacts **500** can be spring-loaded pins, whereas in other embodiments the contacts **500** can have any structure for electrical contacts as is known in the art. The one or more batteries or battery pack **160** in one embodiment is a high-grade rechargeable Lithium-Ion polymer (LIPO) battery.

In one embodiment, the one or more batteries or battery pack **160** in one embodiment can discharge at a constant rate of 40c and a burst rate of 50c. The one or more batteries or battery pack **160** can be charged via a charge port **510**, that in one embodiment is a USB port, but that in other embodiments can be any sort of charging port as is known in the art. In one embodiment, the one or more batteries or battery pack **160** provides a voltage of about 11.1 volts and has a power rating of about 6400 mAh.

Referring now to FIGS. **13**A and **13**B, internal components associated with the trigger **180** are shown with a portion of the housing **130** effectively removed or rendered transparent. The trigger **180** is biased forward into a non-firing position by a simple biasing element **540**, for example without limitation, a simple mechanical spring **540**. The trigger **180** has no other mechanical linkages or controlling connections with any other components within the housing **130**—it simply slides relative to the housing **130** against the force of the biasing element **540**. A trigger switch **530**, for example an optical sensor **530**, detects whether the trigger **180** is in the pressed position shown in FIG. **13**A or in the released position shown in FIG. **13**B. The optical sensor **530** in one embodiment operates based on a reflected signal level that indicates the presence of the trigger **180** as a point of reflection. In other embodiments the optical sensor **530** is disposed on both sides of the trigger **180** and operates based on a transmitted or blocked signal. In other embodiments the optical sensor **530** can be any other sort of optical sensor as is known in the art. Upon detection of the trigger **180** in the pressed position the optical sensor **530** effectively closes a switch by communicating the pressed position of the trigger **180** to the internal circuitry of the launcher **100**, thus the optical sensor **530** is referred to interchangeably as the trigger switch **530**.

Referring to FIG. **14**, an input to the firing sequence as defined above is the firing mode switch **170**, shown in closeup view in three different positions. The firing mode switch **170** communicates with the internal circuitry of the launcher **100** and is operationally connected to the trigger switch **530** and to the pusher **250** to provide a firing mode selection that is used with the trigger **180** position to determine whether and what sort of firing sequence is initiated.

When the firing mode switch **170** is in a first position **550**, the launcher **100** is in the powered-off mode so that no power is applied to either of the first or second electric motors **220**, **280** regardless of the position of the trigger **180**. So when the firing mode switch **170** is disposed in the powered-off position (first position **550**), depression of the trigger switch has no effect on the pusher **250**. When the firing mode switch **170** is in a second position **560**, the launcher is in a single fire mode so that depression of the trigger **180** one time as sensed by the optical sensor **530** described hereinabove and signaled to the internal circuitry results in the internal circuitry initiating a single firing sequence including a single reciprocating cycle of the pusher **250**, also as described hereinabove. In this single fire mode as denoted by switch position **560**, holding the trigger in the pressed position has no additional effect beyond the initiation of a single firing sequence initiated by initial depression of the trigger **180**.

Still referring to FIG. **14**, when the firing mode switch **170** is in a third position **570**, the launcher is in a multiple or automatic fire mode so that depression of the trigger **180** as sensed by the optical sensor **530** described hereinabove and signaled to the internal circuitry results in the internal circuitry initiating repeated firing sequences causing the pusher **250** to actuate in repeated reciprocating cycles as long as the depression of the trigger **180** is sensed by the optical sensor **530**. In one embodiment, the launcher **100** in automatic fire mode can fire disc projectiles **110** at a rate of about 6.5 per second.

Referring now to FIGS. **15**A and **15**B, the pusher **250** includes a flange **580**. The pusher **250** is further equipped with an optical sensor **590** (also see FIG. **3**A). When the pusher **250** is in a forward position, meaning extended over one of the internal volumes V**1**, V**2** of the magazine **150**, the flange **540** breaks the plane of the optical sensor **590**. However, when the pusher **250** is not in a forward position, meaning not extended over one of the internal volumes V**1**, V**2** of the magazine **150**, in a configuration as illustrated in FIGS. **15**A and **15**B, the plane of the optical sensor **590** is not broken by the flange **580**. The optical sensor **590** communicates this information to the internal circuitry of the launcher **100**, indicating to the internal circuitry that the cam **270** is in the home position which is defined as the position where the pusher **250** is clear of the retaining tabs **340**. This is important because whenever the flywheel **200** is turned off either at the end of a firing sequence or after an error, the cam **270** will always rotate to the home position so that the pusher **250** is clear of the retaining tabs **340**. The internal circuitry of the launcher **100** and/or the optical sensor **590** also counts the number of times that the pusher **250** has extended into the forward position. This information is useful for determining that the single fire mode firing sequence has occurred following depression of the trigger **180**.

Referring to FIGS. **16**A and **16**B, a magazine presence sensor **600** is illustrated. FIG. **16**A illustrates an internal wall of the housing **130** where a top end of the magazine **150** would be disposed when the magazine **150** is inserted into the housing **130** as described hereinabove. FIG. **16**B illustrates a view looking toward the top of the magazine **150** when so inserted. The magazine presence sensor **600** in one embodiment is an optical sensor that operates by detecting a reflected signal, for example without limitation, a time of flight (TOF) sensor. In this application the reflected signal is detected when a magazine **150** is present but no signal is detected when a magazine **150** is not present. The optical sensor **600** communicates this information to the internal circuitry of the launcher **100**, indicating to the internal circuitry whether the magazine **150** is inserted into the housing **130**. If the magazine **150** is not detected to be inserted the internal circuitry prevents power from being supplied to either of the first or second electric motors **220**,

280. This operation prevents a user from getting entangled with any internal moving parts by accidentally pressing the trigger 180 with the magazine 150 not inserted.

In addition to the above described features of the launcher 100, the internal circuitry in one embodiment can comprise one or more printed circuit boards or other electrically connected collection of components including, for example without limitation, one or more integrated circuits, programmable integrated circuits, processors, volatile or non-volatile memories for firmware and/or software, communication ports, and any other electronic components as are known to be of use in controlling a mechanical sequence of events executed by electrically connected mechanical components as known in the art. When power is applied to the internal circuitry in one embodiment, the firmware or software stored in the one or more memories is executed by the one or more processors and controls the operation of the first and second motors 220, 280 with input from at least one or more of the sensors (530, 590, 600) and the firing mode switch 170, all described hereinabove. In one embodiment the internal circuitry is housed within the housing 130, for example without limitation, just forward of the firing mode switch 170. In other embodiments the internal circuitry is disposed elsewhere within the housing 130 or is distributed to multiple locations within the housing 130. In all embodiments the components of the electric circuitry are in electrical communication with the one or more sensors (530, 590, 600) as well as the firing mode switch 170 and any other electrical components that are included in or on the launcher 100, for example, as are further described hereinbelow.

In one embodiment, the internal circuitry described hereinabove is further in electrical communication (power and data) with a Bluetooth transceiver that allows for communication of data to or from the electrical circuitry to or from an external source. In particular, the firmware that controls operation of the launcher 100 can be accessed and upgraded or modified from an external source via the Bluetooth communication port. Therefore a launcher that is manufactured with an earlier version of the firmware can later be upgraded with a newer version of the firmware, for example without limitation, to provide for performance enhancements in terms of greater speeds of operation or enhanced modes of operation. It is also envisioned that the external source that the Bluetooth transceiver feature interfaces with can be a smart phone or tablet application, which can include for example without limitation, an application for team or individual competition involving the launcher 100.

Another feature of the launcher 100 that is related to the concept of a team competition can be seen in FIGS. 17A and 17B. Referring to FIG. 17A, the launcher 100 includes one or more illuminating color panels or light pipes 610 distributed, for example, along sides of the housing 130 (see also FIGS. 1A and 1B). Referring to FIG. 17B, a light selector button 620 is included on a part of the housing 130, for example on a left side of the housing 130 just above the magazine 150 as shown in FIG. 1A. Additional light pipes 630 are disposed near the button 620. In one embodiment pressing the light selector button 620 cycles the light pipes 610, 630 through a series of colors allowing a user to customize their launcher 100 to have a particular color, for example, to set up a team competition where all the members of the same team have the same color illuminated. In other embodiments the illuminating light panels 610, 630 illuminate as different colors or can otherwise flash or light in a pattern or sequence. In one embodiment, where the internal circuitry is in communication with a smartphone or tablet application, the illuminating light panels can indicate a communication of data to or from the application. In one embodiment the illuminating light panels are light pipes that are supplied by light from light emitting diodes (LEDs), and in another embodiment the LEDs are digitally addressable (neopixel) LEDs that are programmable. For example, the digitally addressable LEDs could be programmed via the Bluetooth transceiver via an application on a smartphone or tablet or via other communicative software as is known in the art.

Referring again to FIGS. 1A and 1B, the launcher 100 further includes some additional physical features on the housing 130. For example, in one embodiment the launcher 100 is equipped with two sections of picatinny rails 640, an approximately 14.75-inch section across the top of the housing 130 and an approximately 3.75-inch, tactical section under the barrel. Other embodiments can have different lengths and/or different arrangements of the picatinny rails 640. The picatinny rails 640 allow a user to add several attachments to customize the launcher, for example without limitation, a scope (not shown), or a swivel swing mount (not shown). The launcher 100 is further equipped with a bar or sling mount 650 disposed on the housing 130, for example, above the one or more batteries or battery pack 160, where the sling mount 650 provides a tether or looping point for a sling to be mounted to the launcher 100.

INDUSTRIAL APPLICABILITY

A projectile launcher includes a reversible bulk-loadable magazine that can deliver solid foam disc projectiles to the launcher. The launcher operates in single fire and automatic fire modes and can fire the foam projectiles at over 100 fps and at a firing rate of over 6 projectiles per second. The launcher includes a safety lockout that restricts power to internal components when the magazine is not inserted. The launcher can further be programmed via a Bluetooth transceiver and has external lighting features that are customizable. The launcher can be made in industry for the benefit of consumers and shooting competitors.

Numerous modifications to the present invention will be apparent to those skilled in the art in view of the foregoing description. It is not desired to limit the invention to the exact construction and operation shown and described, and accordingly, all suitable modifications and equivalents may be resorted to, falling within the scope of the invention. Accordingly, this description is to be construed as illustrative only of the principles of the invention and is presented for the purpose of enabling those skilled in the art to make and use the invention and to teach the best mode of carrying out same. The exclusive rights to all modifications which come within the scope of the appended claims are reserved. All patents, patent publications and applications, and other references cited herein are incorporated by reference herein in their entirety.

We claim:

1. A projectile launcher, comprising:

a motor driven flywheel having a rotational axis and a roughened circumferential edge surface, wherein the motor driven flywheel is driven at a rotational speed of approximately 24,000 revolutions per minute; and

a flywheel housing having a passageway therethrough, the passageway comprising an entry opening at a first end that is configured to receive at least one disc projectile, and a release opening at a second end; and

idler bearings positioned at the entry opening and at the release opening, the idler bearings configured to provide consistent point of release and rotation of each of the at least one disc projectile wherein the launcher is configured to fire projectiles at a rate of approximately 6.5 projectiles per second in automatic firing mode.

2. The projectile launcher of claim **1**, wherein the roughened circumferential edge surface comprises a series of ridges oriented along the rotational axis.

3. The projectile launcher of claim **1**, further comprising a motor driven rotating cam, wherein the motor driven rotating cam and the motor driven flywheel are both mounted on bearings.

4. The projectile launcher of claim **3**, wherein the motor driven rotating cam is made from a first metal, and wherein the motor driven flywheel is made from a second metal.

5. The projectile launcher of claim **1**, further comprising:

the at least one disc projectile, wherein the disc projectile is made from a material that is softer than the motor driven flywheel; and wherein

the flywheel housing is configured so that the motor driven flywheel makes contact with the at least one disc projectile when pushed into the entry opening.

6. The projectile launcher of claim **5**, wherein the disc projectile is made from a material having Shore 00 hardness 60 and rounded circumferential corner surfaces.

7. The projectile launcher of claim **5**, further comprising:

a magazine configured to provide a biasing force on the at least one disc projectile; and

a pusher configured to push the at least one disc projectile out of the magazine and into the entry opening of the flywheel housing.

8. The projectile launcher of claim **7**, wherein the magazine comprises two parallel internal volumes each spaced equally from a plane disposed therebetween, each internal volume including a closed end and an open end, wherein each internal volume is configured to accommodate a stack of the at least one disc projectiles, and wherein each internal volume further includes a spring loaded plunger oriented to provide the biasing force on the stack of the at least one disc projectiles from the closed end toward the open end.

9. The projectile launcher of claim **8**, wherein each of the two parallel internal volumes further comprises a sliding door, wherein each sliding door has a closed position and an open position wherein the sliding door is slid away from the open end, and wherein each sliding door engages with and pulls along the spring loaded plunger when slid from the closed position toward the open position.

10. The projectile launcher of claim **8**, wherein the open end of each internal volume comprises a pair of retaining tabs each having a first portion that extends away from the open end and a second portion that extends over the open end so that a single one of the at least one disc projectiles is restrained against the biasing force of the spring loaded plunger by the second portion of the pair of retaining tabs, but can be pushed off the stack of the at least one disc projectiles.

11. The projectile launcher of claim **8**, wherein a top surface of the magazine on a first side of the plane has a structure that is identical to the top surface on a second side of the plane but rotated 180 degrees relative thereto.

12. A projectile launcher, comprising:

a motor driven flywheel having a rotational axis and a circumferential edge surface, wherein the motor driven flywheel is driven at a rotational speed of approximately 24,000 revolutions per minute;

a flywheel housing having a curved passageway therethrough, the curved passageway comprising an entry opening at a first end that is configured to receive at least one disc projectile, and a release opening at a second end, wherein the curved passageway spans a 45-degree arc of contact between the entry opening and release opening to provide extended contact time between the motor driven flywheel and the at least one disc projectile, resulting in increased acceleration; and

idler bearings positioned at the entry opening and at the release opening, the idler bearings configured to provide consistent point of release and rotation of each of the at least one disc projectile wherein the launcher is configured to fire projectiles at a rate of approximately 6.5 projectiles per second in automatic firing mode.

13. The projectile launcher of claim **12**, further comprising:

the at least one disc projectile;

a magazine configured to provide a biasing force on the at least one disc projectile; and

a pusher actuated in a reciprocating cycle by a motor driven rotating cam, the pusher configured to push the at least one disc projectile out of the magazine and into the entry opening of the flywheel housing on a stroke of the reciprocating cycle; wherein

the at least one disc projectile when pushed into the entry opening makes first contact with the motor driven flywheel at an angle of about 45 degrees from the release opening as measured around the rotational axis of the motor driven flywheel.

14. The projectile launcher of claim **13**, further comprising:

a trigger;

a trigger switch that closes when the trigger is depressed; and

a firing mode switch operationally connected to the trigger switch and to the pusher; wherein

the firing mode switch is disposed in one of three positions selected from a group consisting of an off position, a single fire position, and a multiple fire position; and wherein

when the firing mode switch is disposed in the off position, depressing the trigger has no effect on the pusher;

when the firing mode switch is disposed in the single fire position, depressing the trigger causes the pusher to actuate a single reciprocating cycle; and

when the firing mode switch is disposed in the multiple fire position, depressing the trigger causes the pusher to actuate in the reciprocating cycle for as long as the trigger remains depressed.

15. The projectile launcher of claim **13**, further comprising at least one optical safety switch operationally connected with a motor mechanically configured to drive at least one of the motor driven flywheel or the motor driven rotating cam, wherein when triggered the at least one optical safety switch operates to cut power to the motor.

16. The projectile launcher of claim **15**, wherein the magazine is removably attached to the flywheel housing, and the at least one optical safety switch comprises an optical sensor configured to detect whether the magazine is attached to the flywheel housing.

17. A projectile launcher, comprising:

a firing mechanism comprising:

a motor driven flywheel having a rotational axis and a circumferential edge surface, wherein the motor driven flywheel is mounted on bearings to enhance smooth rotation and increase lifecycle expectancy, and wherein the motor driven flywheel is driven at a rotational speed of approximately 24,000 revolutions per minute; and

a pusher actuated in a reciprocating cycle by a motor driven rotating cam, wherein the motor driven rotating cam is mounted on bearings to enhance smooth rotation and increase lifecycle expectancy, and wherein the motor driven rotating cam is made of metal to withstand greater heat and forces at high rotation rates; and

a magazine configured to provide a biasing force on at least one stack of one or more disc projectiles; wherein

the pusher is configured to push a top disc projectile off the at least one stack of one or more disc projectiles on a forward stroke of the reciprocating cycle, and the motor driven flywheel is configured to engage the top disc projectile to impart acceleration thereto; and wherein the launcher is configured to fire projectiles at a rate of approximately 6.5 projectiles per second in automatic fire mode.

18. The projectile launcher of claim **17**, further comprising a housing disposed around the firing mechanism, wherein the magazine is removably inserted into the housing.

19. The projectile launcher of claim **18**, wherein the housing further comprises one or more illuminating colored panels.

20. The projectile launcher of claim **18**, wherein the magazine further comprises two parallel internal volumes each spaced equally from a plane disposed therebetween, each internal volume configured to accommodate one stack of the at least one stack of one or more disc projectiles, so that the magazine can be removably inserted into the housing in two orientations separated by 180 degrees of rotation relative to the housing.

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