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**Buys**

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(54) **PNEUMATIC ARRANGEMENT OF A LESS-LETHAL DEVICE**

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***F41B 11/00*** (2013.01)
***F41B 11/62*** (2013.01)
(Continued)

(52) **U.S. Cl.**
CPC ............ ***F41B 11/62*** (2013.01); ***F41B 11/723*** (2013.01); ***F41B 11/73*** (2013.01)

(58) **Field of Classification Search**
CPC ......... F41B 11/55; F41B 11/62; F41B 11/723; F41B 11/721; F41B 11/50; F41B 11/73;
(Continued)

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*Primary Examiner* — Michael D David
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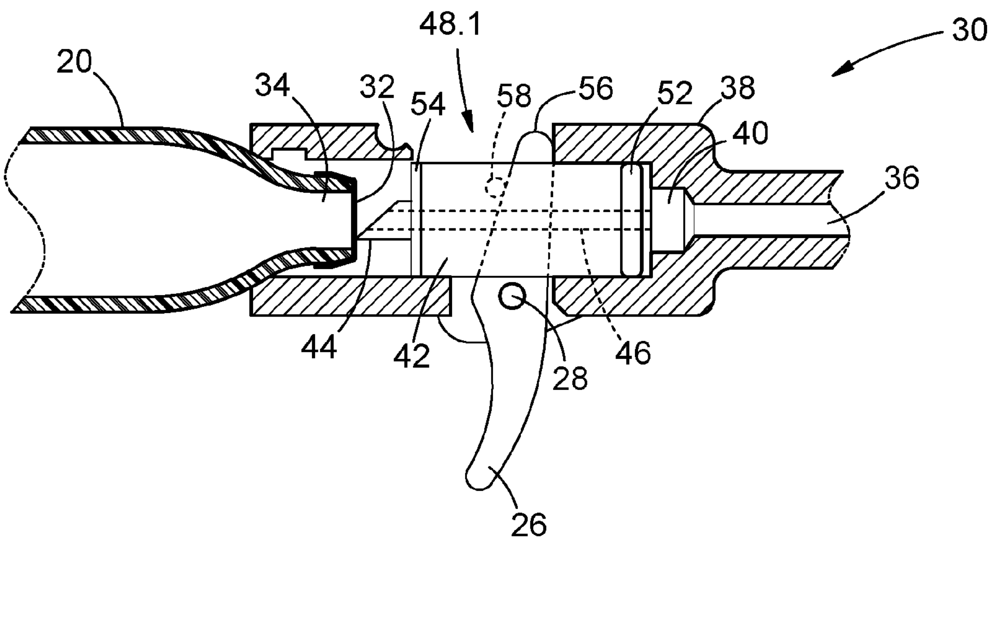
(57) **ABSTRACT**

A puncture mechanism that is configured to puncture a seal provided over a mouth of a canister of compressed gas received within a less-lethal device to propel a projectile from the less-lethal device when a trigger mechanism of the less-lethal device is actuated by a user. The puncture mechanism includes a displaceable body that has a piercing mechanism which is configured to pierce the seal provided over a mouth of the canister. The puncture mechanism further includes an actuation arrangement, which comprises a trigger mechanism, for displacing the displaceable body towards the canister whereby the piercing mechanism pierces a seal of the canister and compressed gas flows into a barrel of the less-lethal device to propel the projectile from the less-lethal device.

**13 Claims, 15 Drawing Sheets**



(51) **Int. Cl.**
***F41B 11/723*** (2013.01)
***F41B 11/73*** (2013.01)

(58) **Field of Classification Search**
CPC ...... F41A 9/69; F41A 9/70; F41A 9/68; F41A 9/65; F41A 9/71
USPC ........... 42/50, 49.01, 7, 49.02, 6; 124/73–77
See application file for complete search history.

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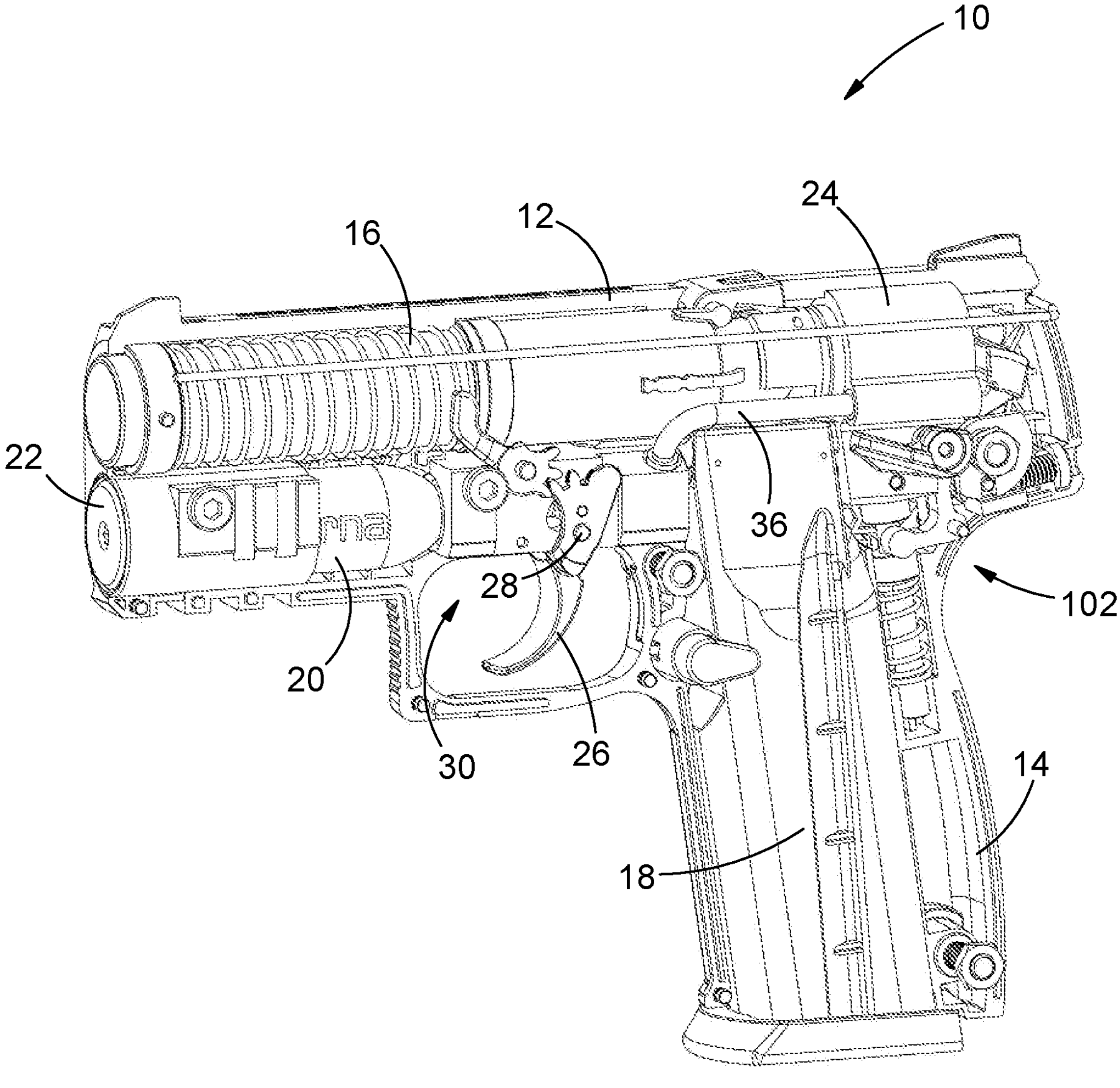



FIGURE 1

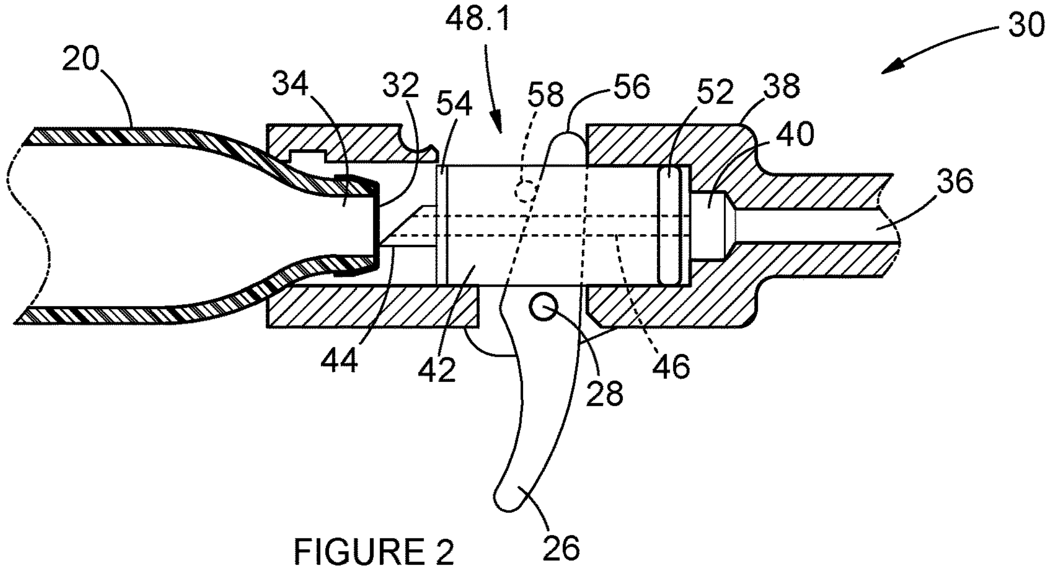
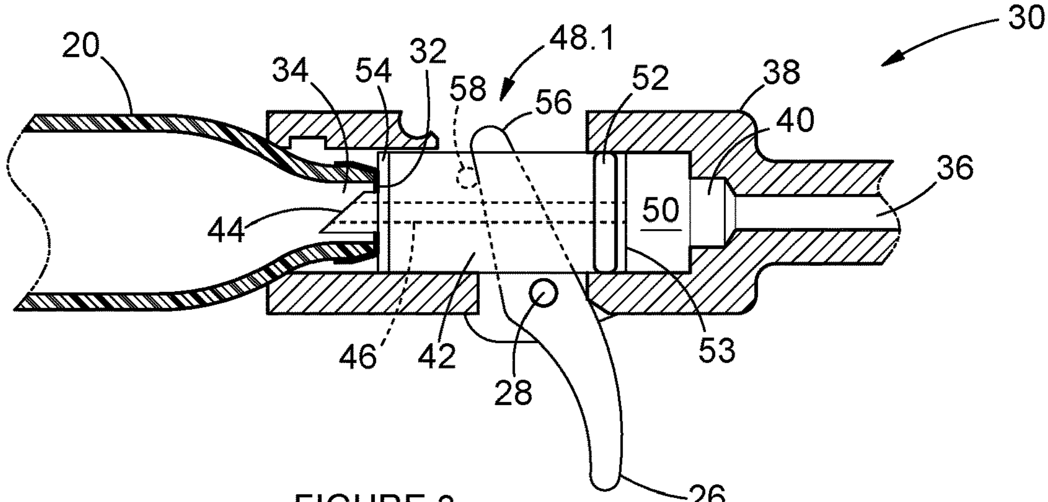



FIGURE 2

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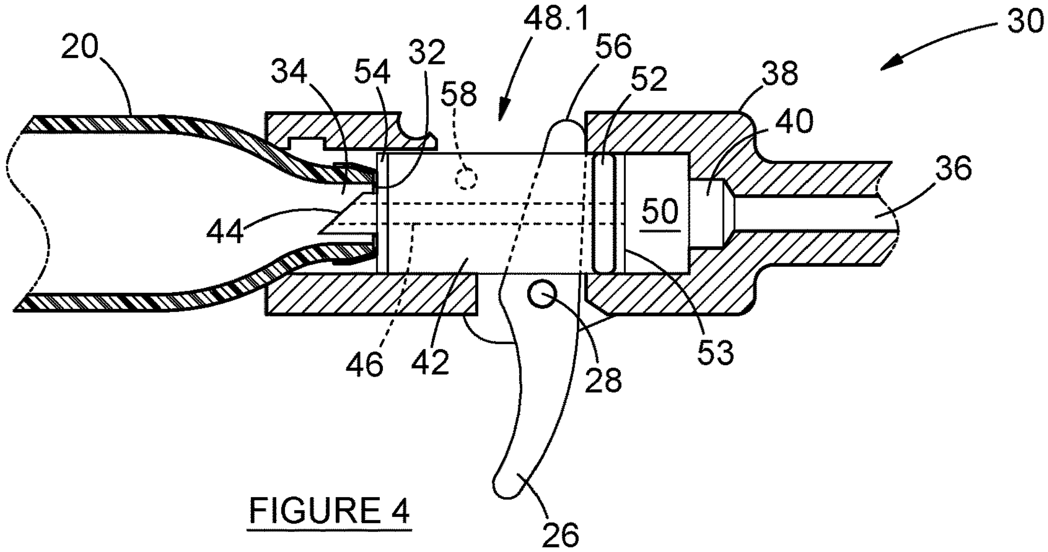


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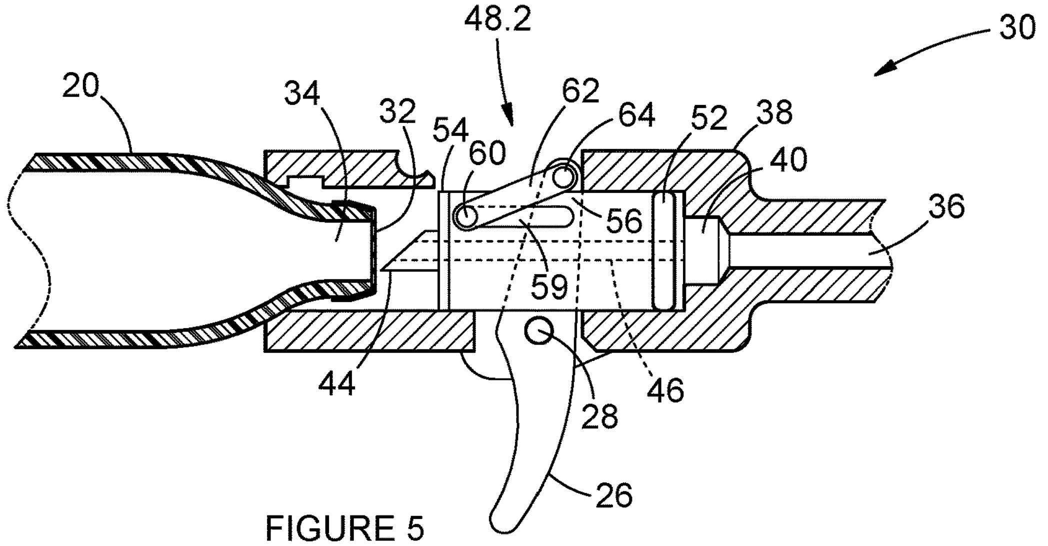


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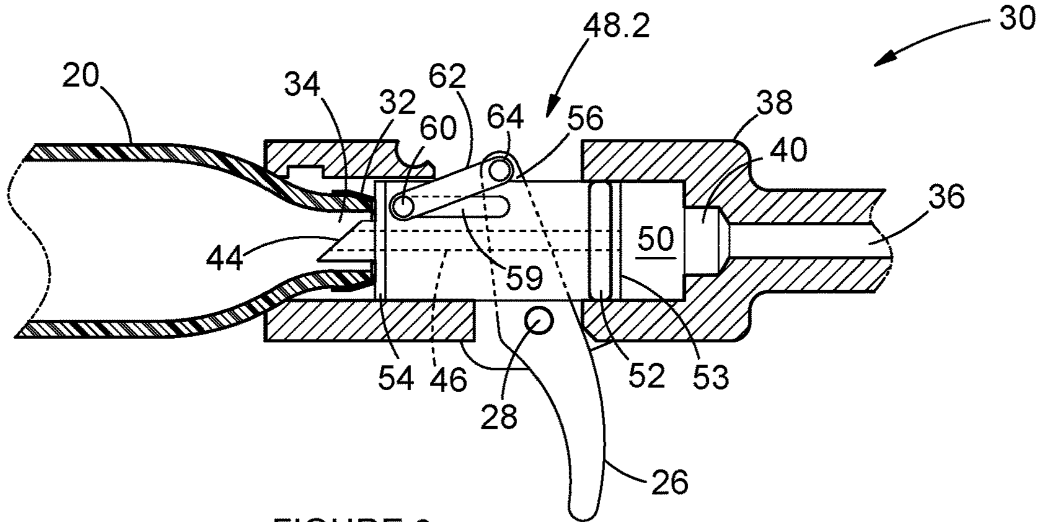


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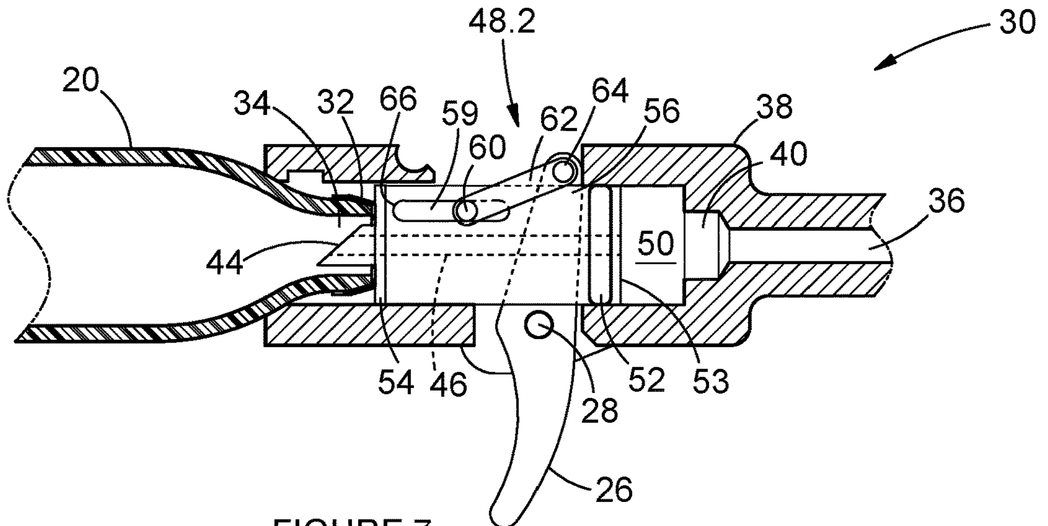


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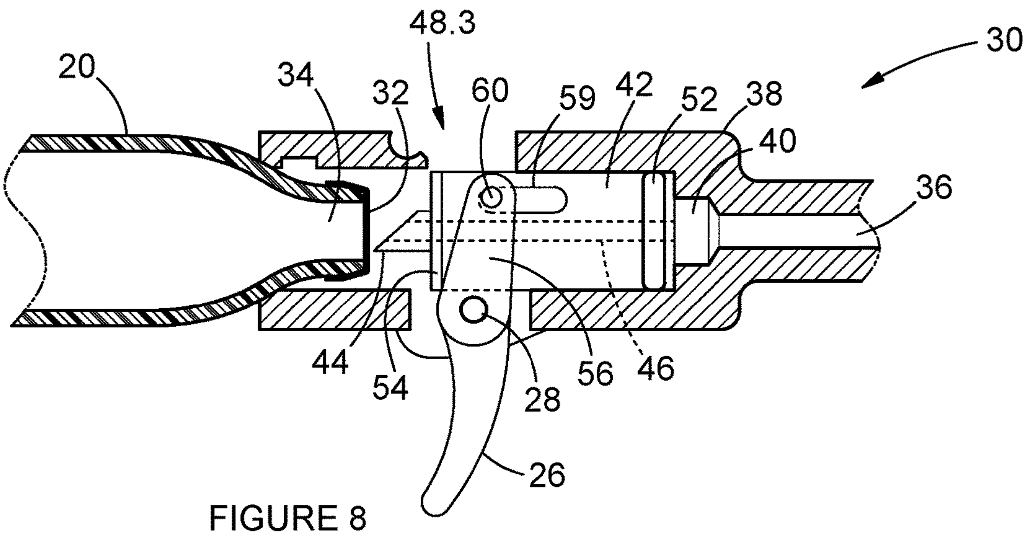


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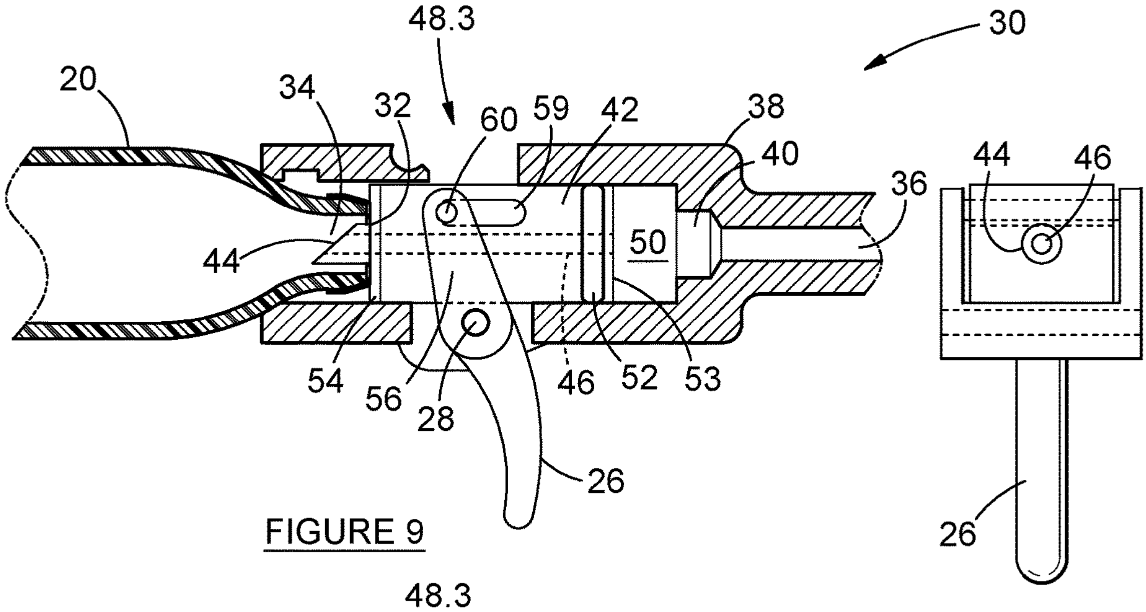


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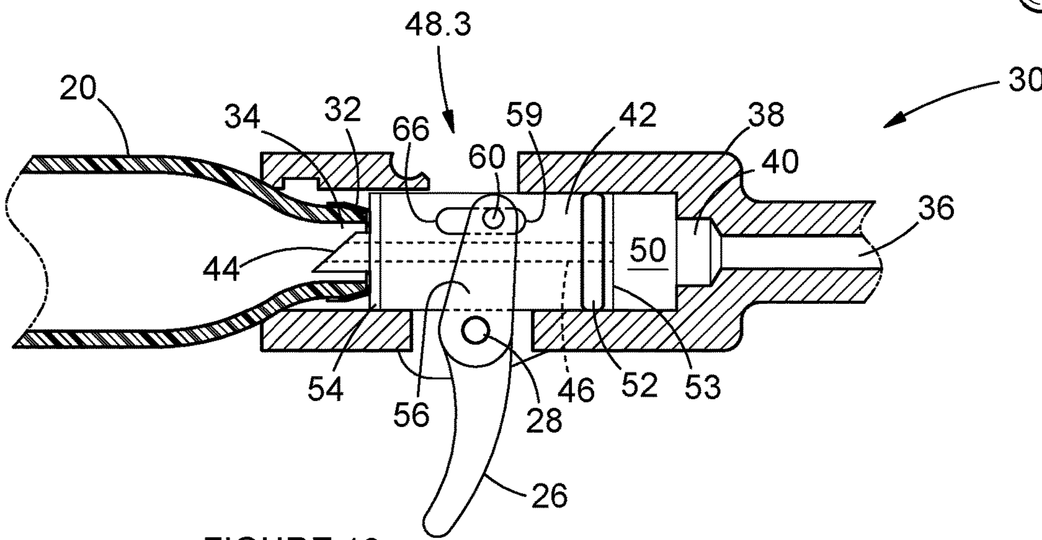


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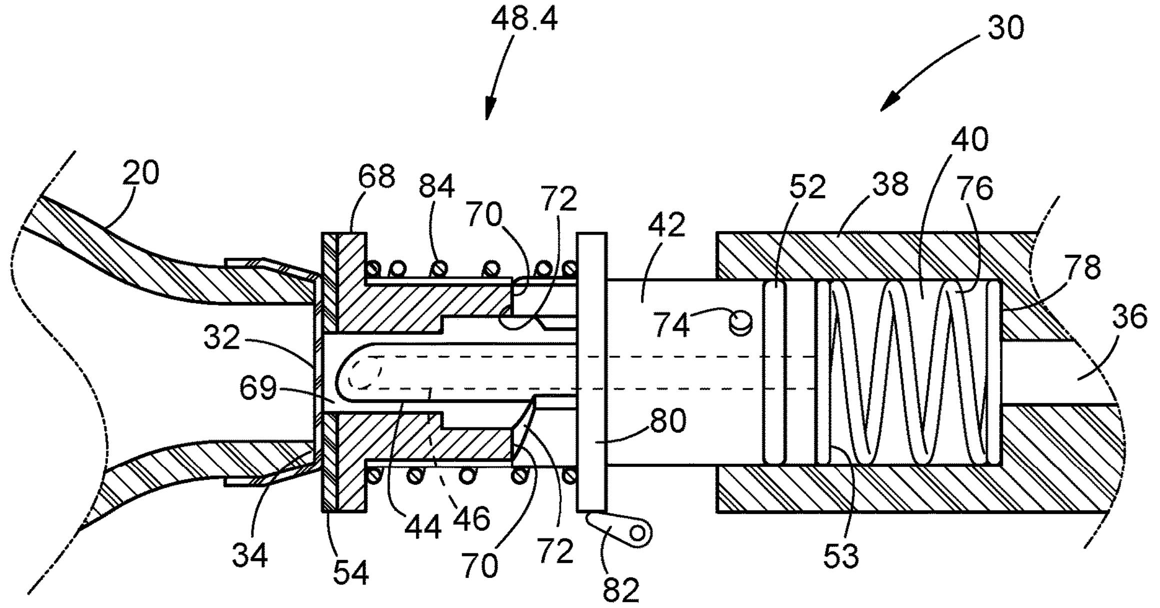


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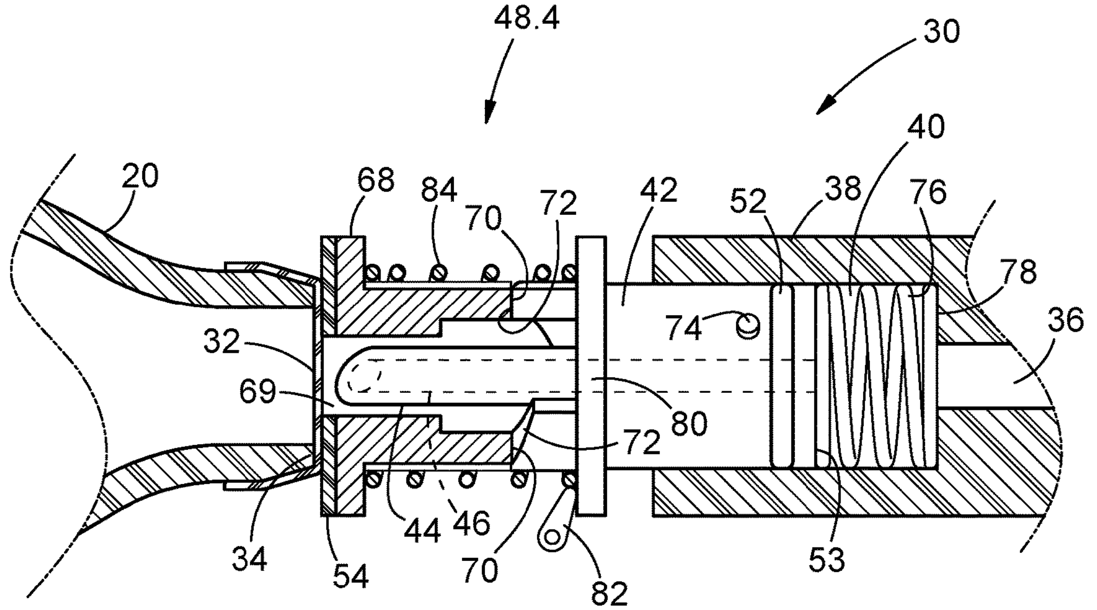


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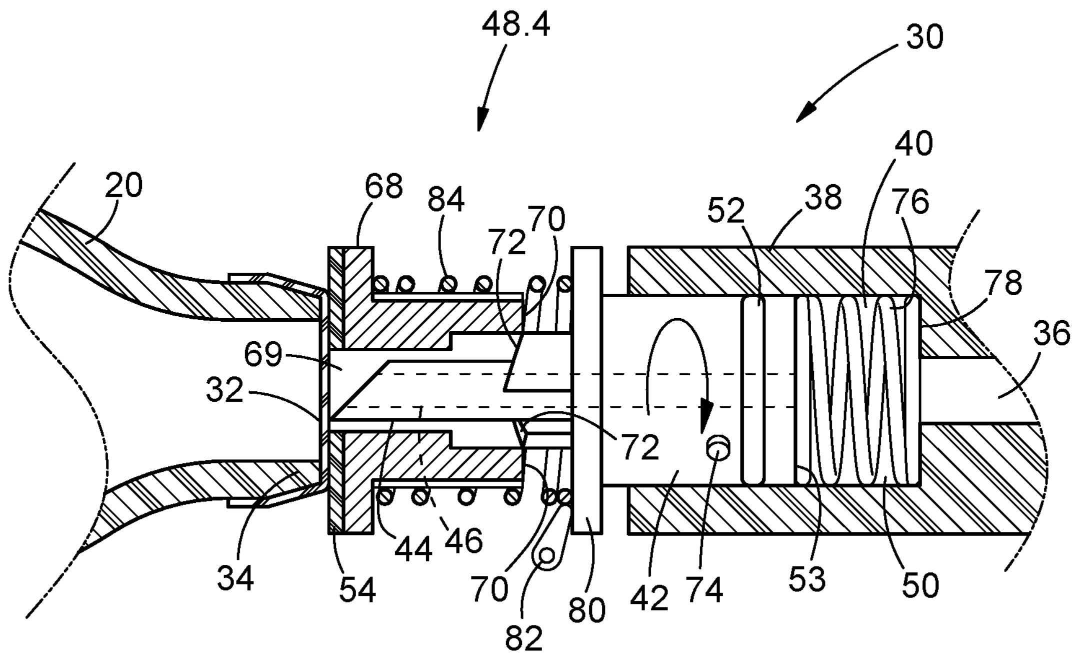


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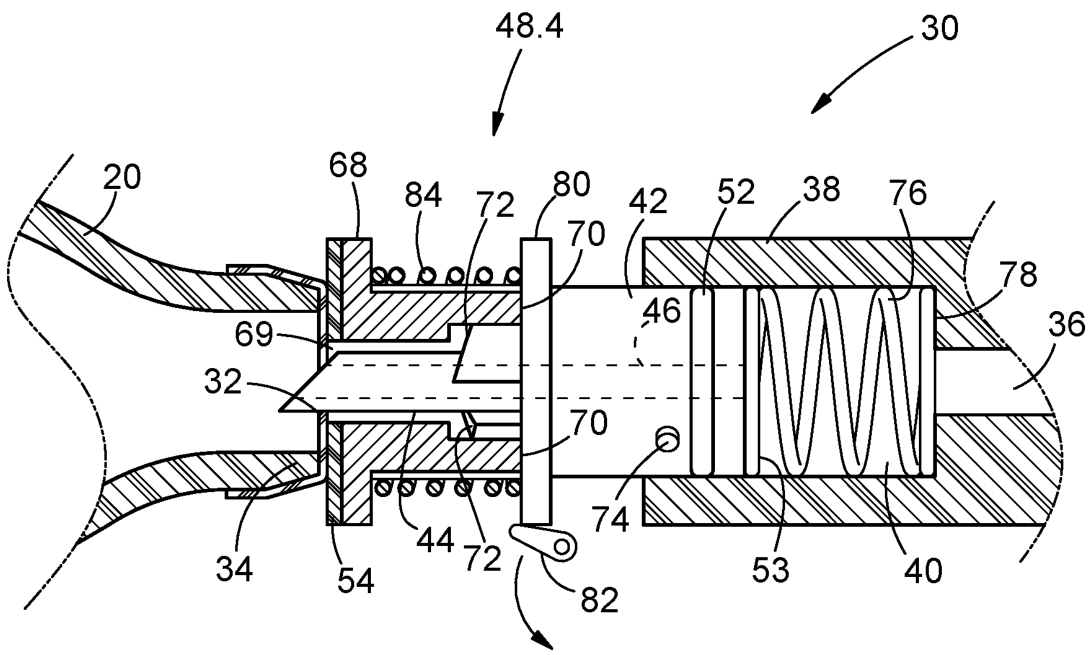


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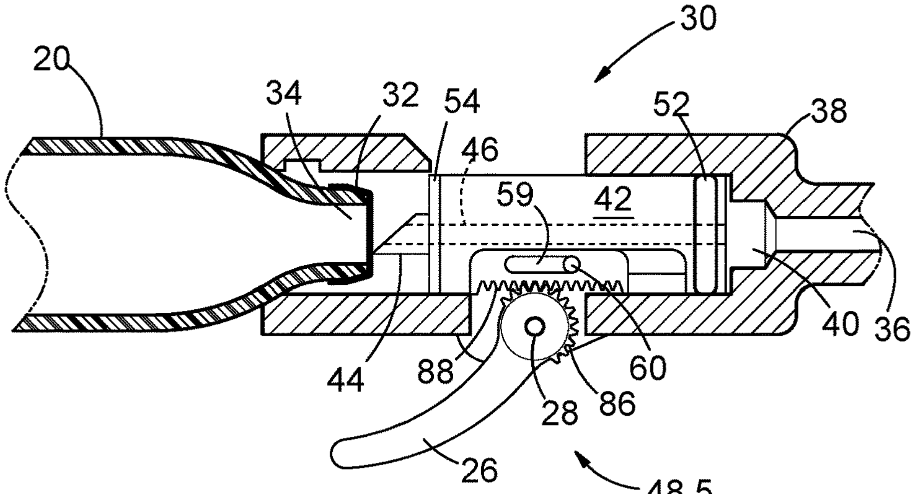


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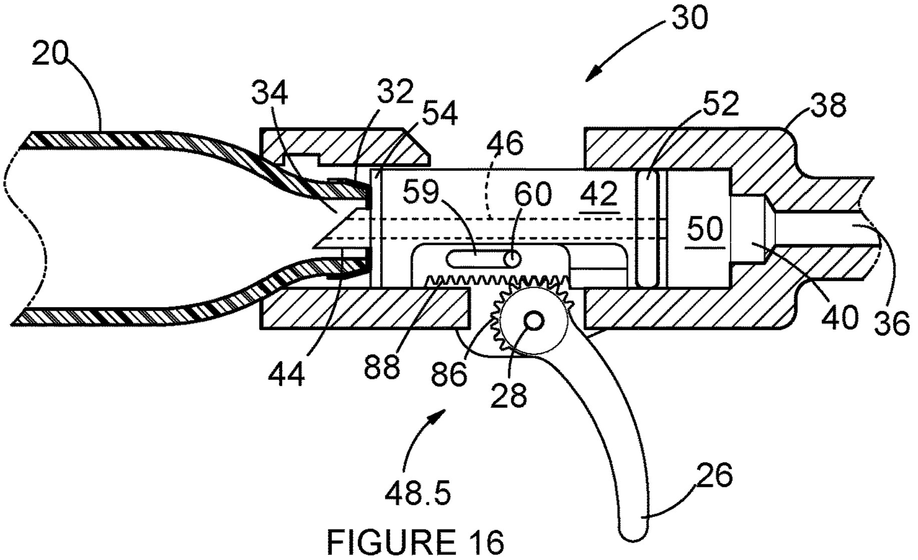


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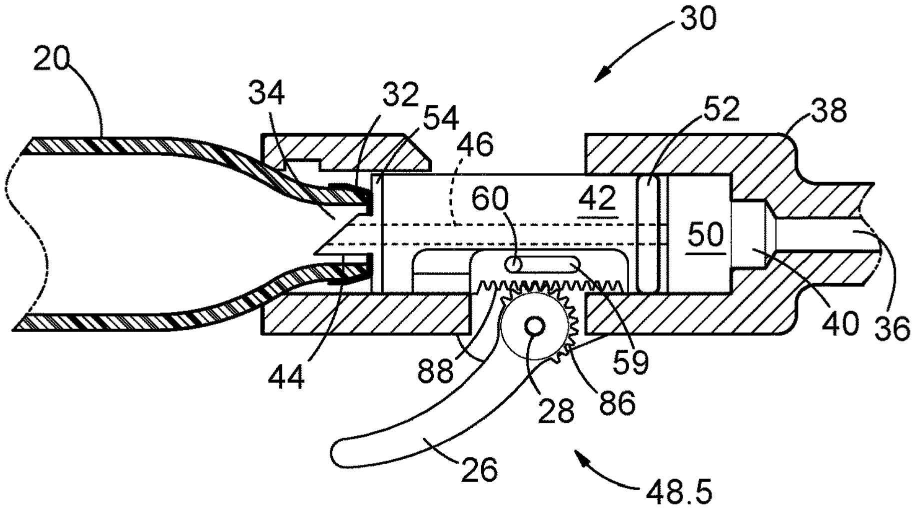


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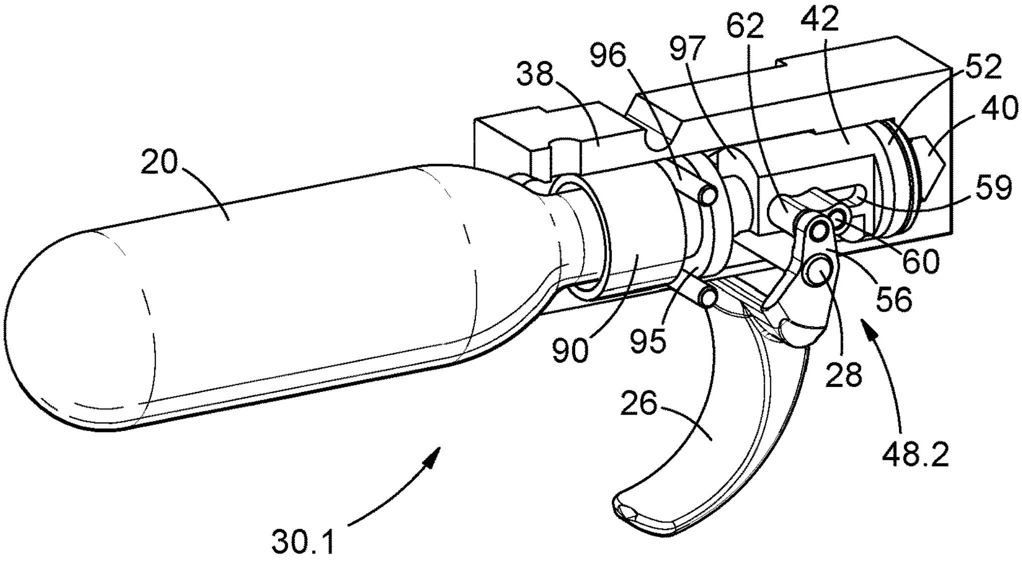


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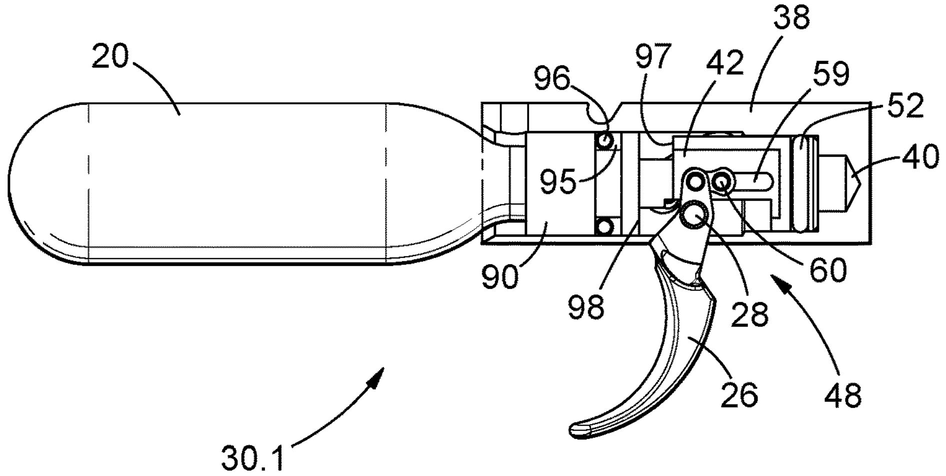


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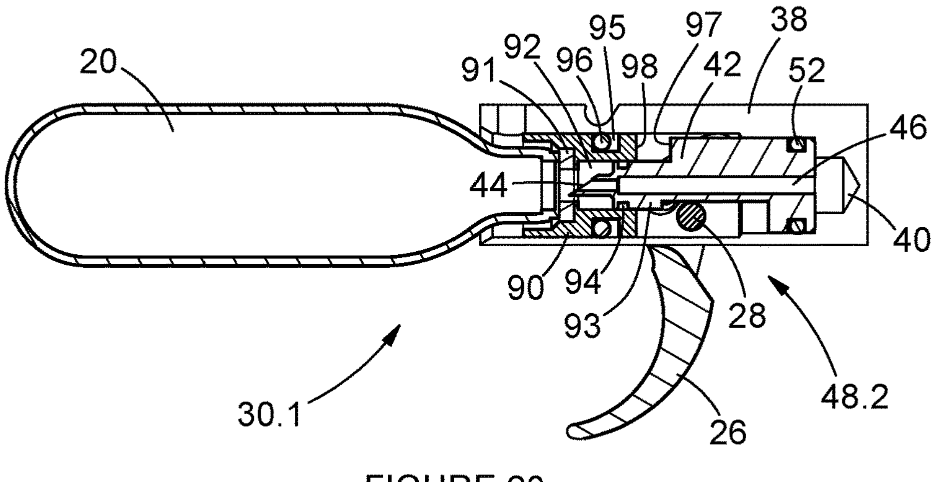


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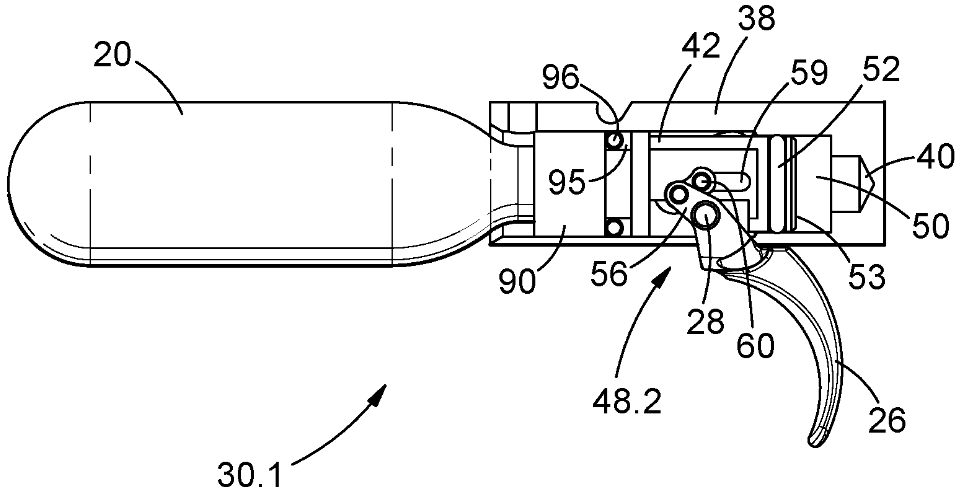


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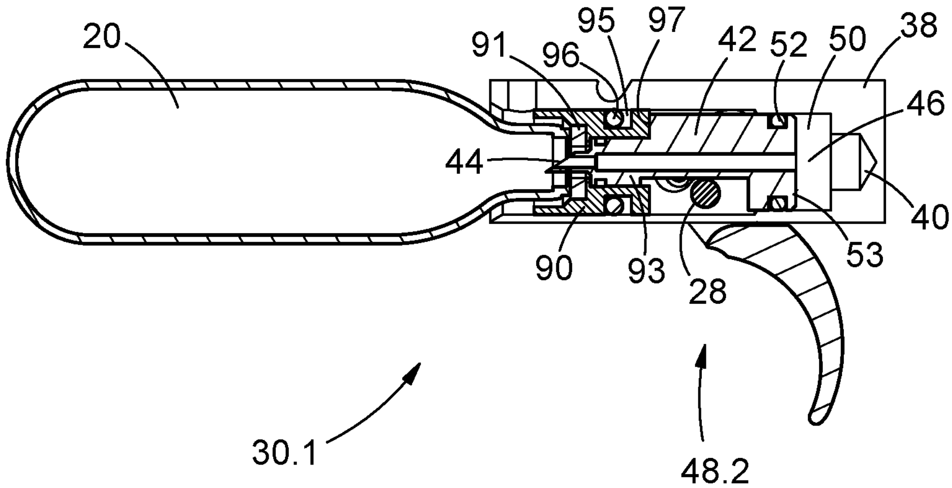


FIGURE 22

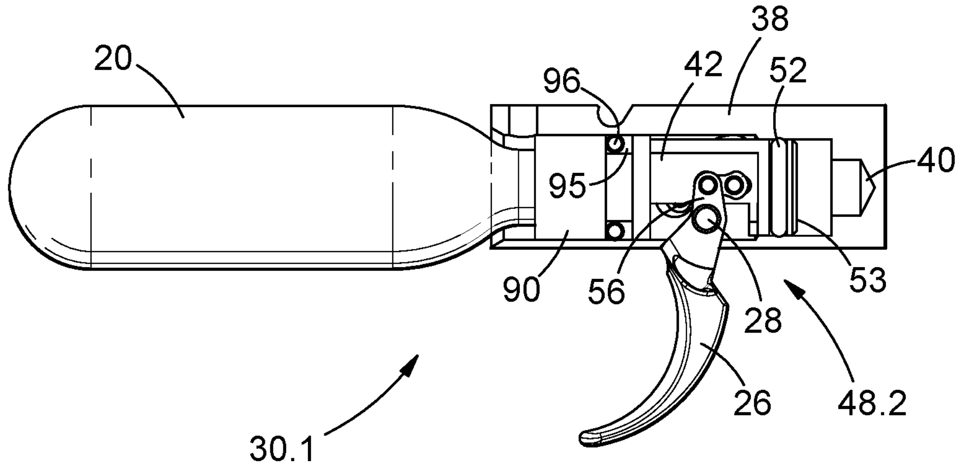


FIGURE 23

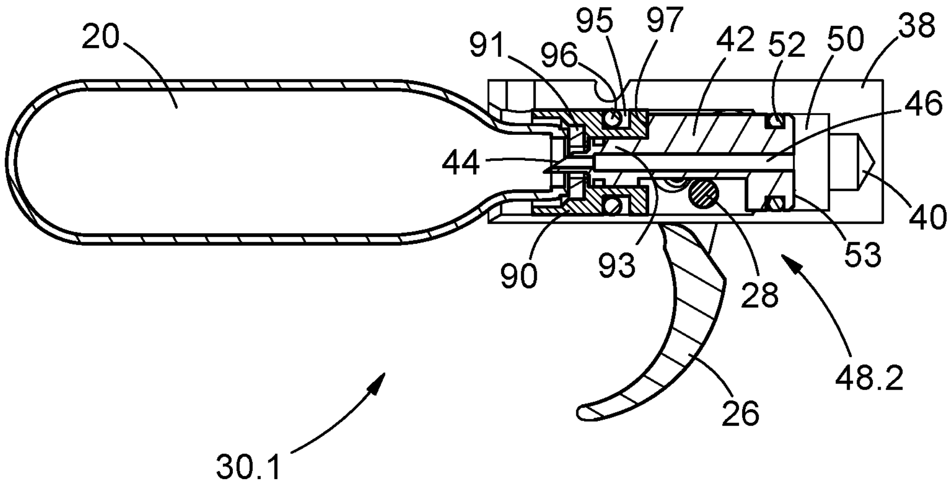


FIGURE 24

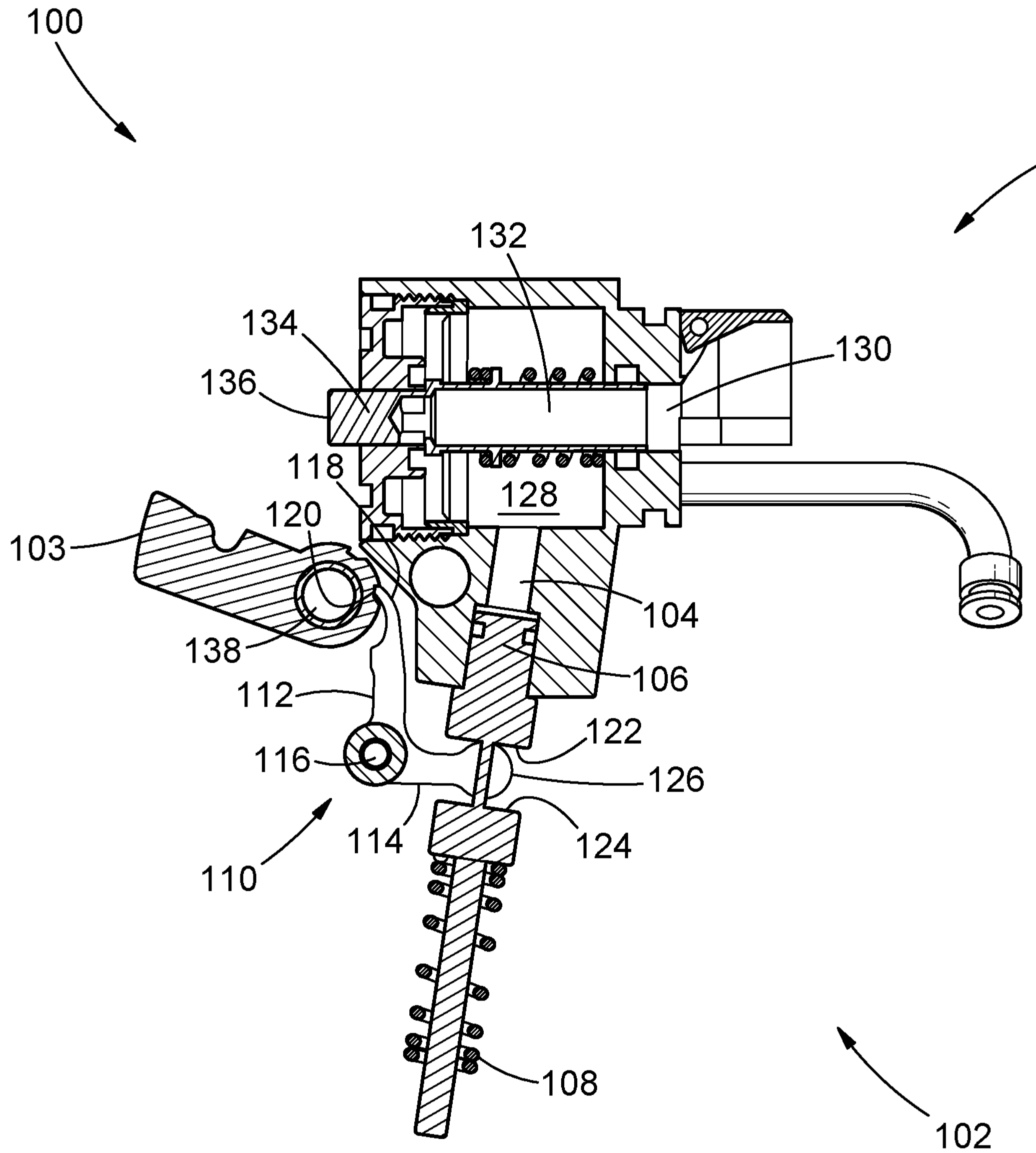
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FIGURE 25

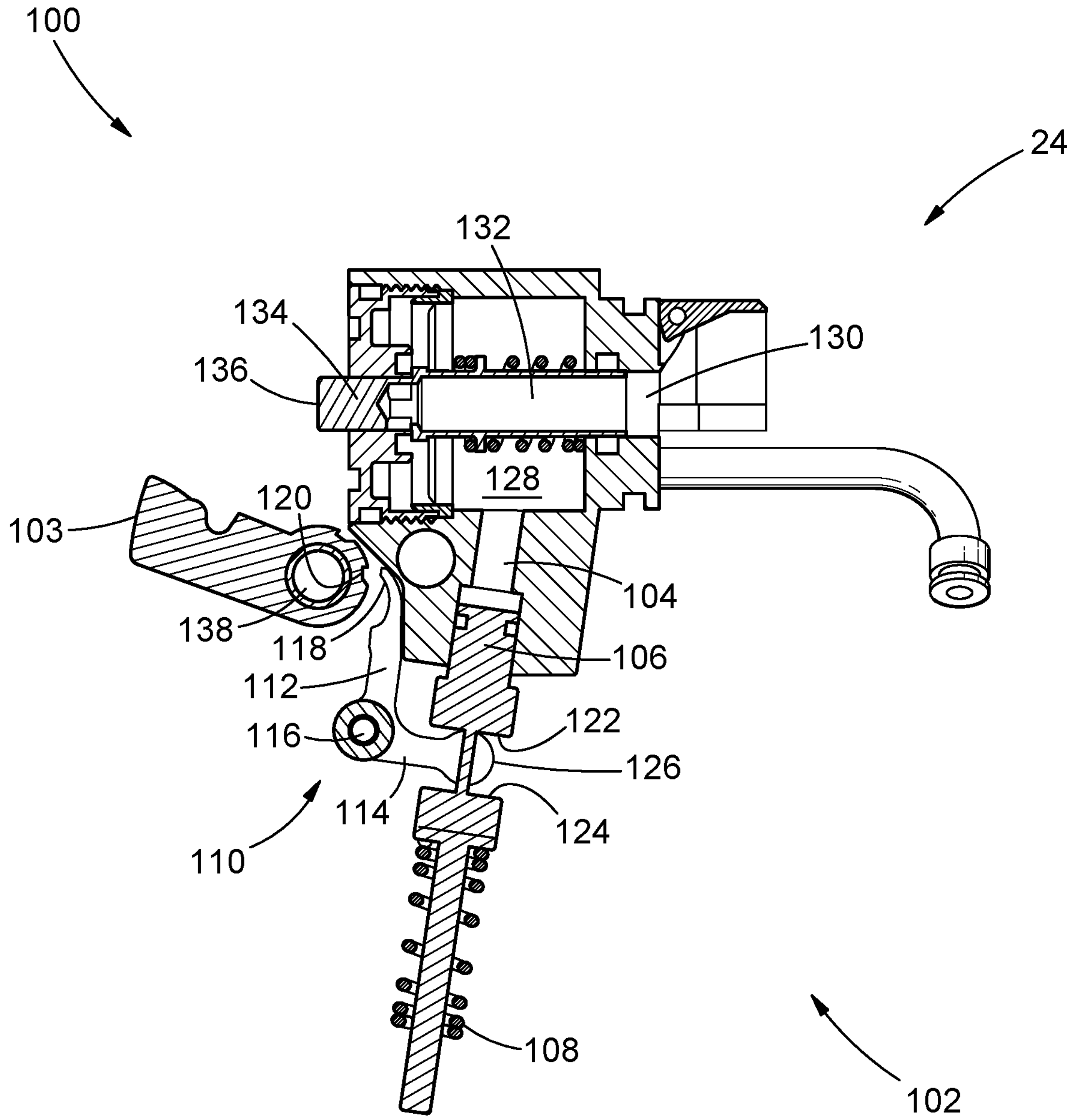
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FIGURE 26

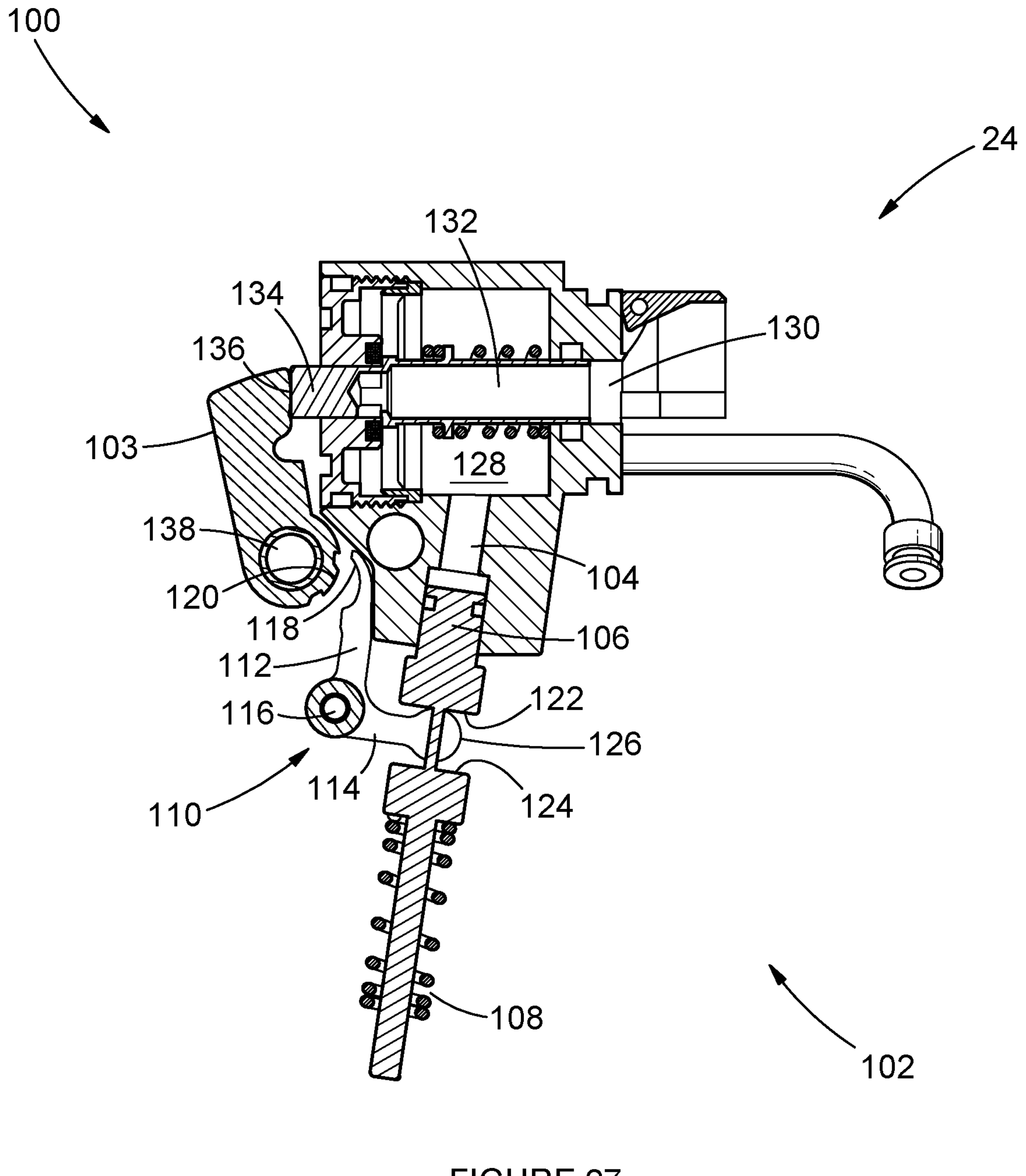
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FIGURE 27

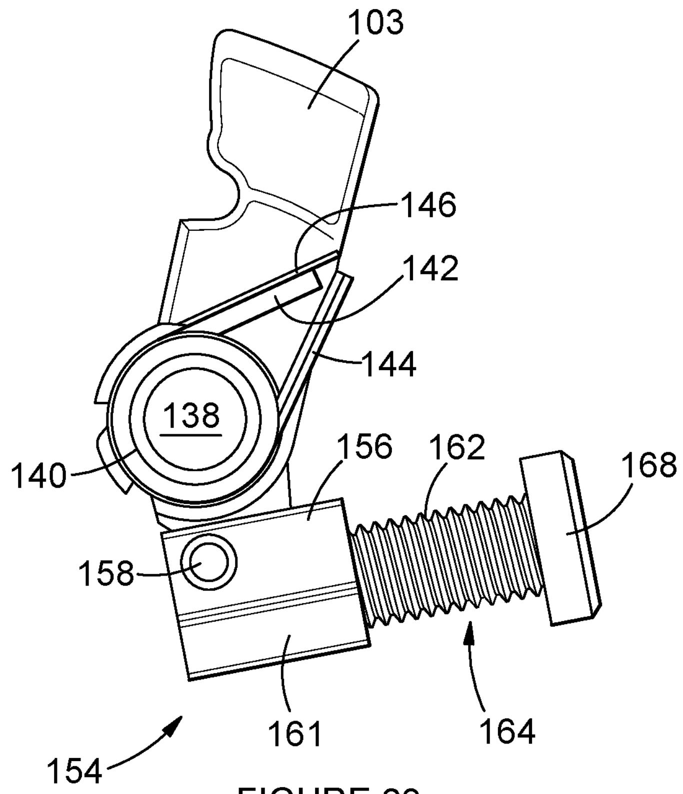


FIGURE 28

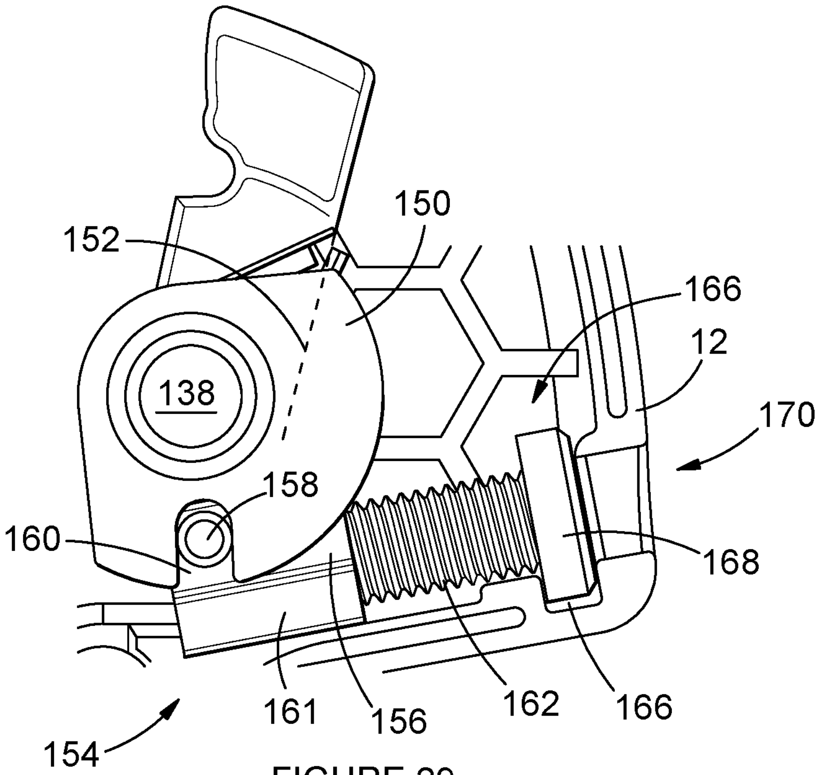


FIGURE 29

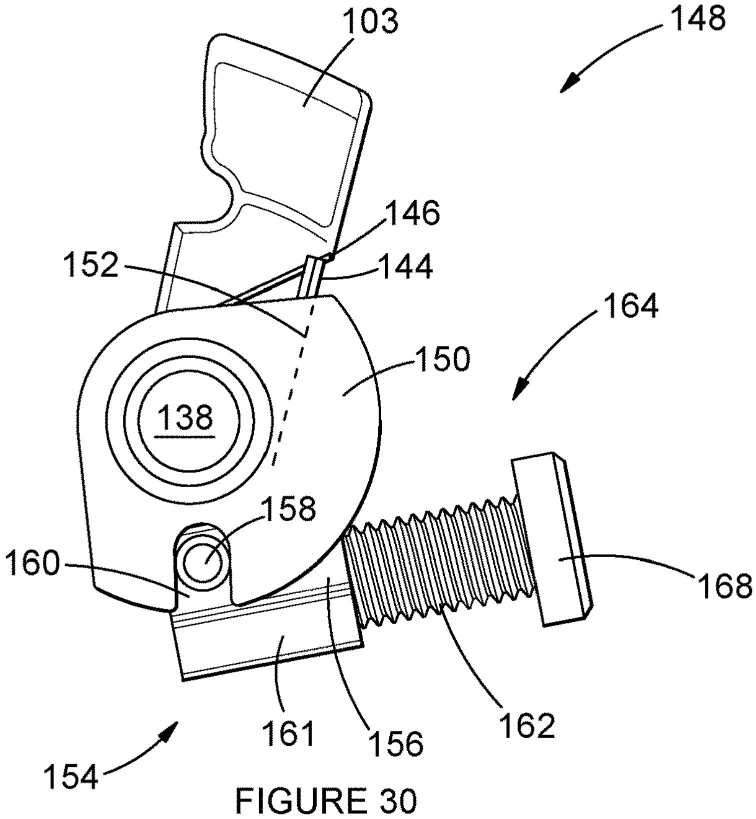


FIGURE 30

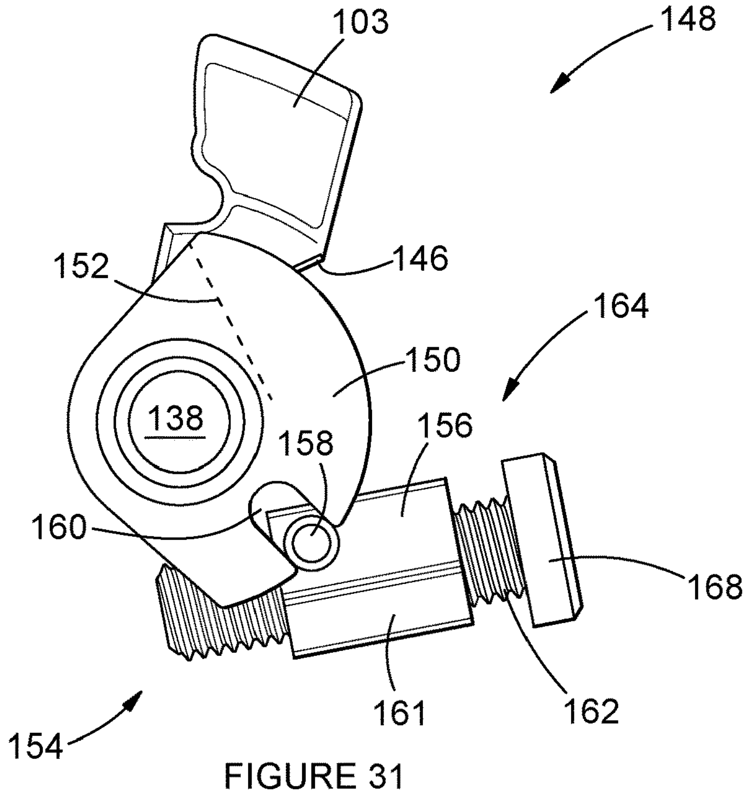


FIGURE 31

# PNEUMATIC ARRANGEMENT OF A LESS-LETHAL DEVICE

## INTRODUCTION AND BACKGROUND

This invention relates to a less-lethal device. More particularly, the invention relates to a pneumatic arrangement of a less-lethal device, which pneumatic arrangement comprises a puncture mechanism used for puncturing a sealed mouth of a canister of compressed gas, in use received within a body of the less-lethal device; a pressure sensitive activation assembly used to inhibit the device from propelling a projectile therefrom before a predetermined pressure is reached within a release valve of the device; a release valve assembly for venting compressed gas to a barrel to propel the projectile from the device; and a propelling assembly for adjusting the kinetic force with which a hammer impacts a release valve of the device. The invention also relates to a method of propelling a projectile from a less-lethal device.

The use of lethal force by law enforcement agencies or personnel, private security companies, or even private citizens as defensive or self-defensive measures is generally met with dissent. Internationally, legislative and regulatory requirements generally tend to dissuade the use of lethal force, and instead tends towards defensive regimes in the less-lethal sphere.

For example, currently in the USA, proposed legislative changes seek to require law enforcement personnel to employ less-lethal force to incapacitate an attacker, before resorting to lethal force.

In most cases, the effective range or accuracy of known or currently available less-lethal devices render these devices ineffective. Best known examples include tasers and lachrymatory substances such as mace (also known as pepper spray). Tasers are accurate and effective to a maximum of 15 feet. This falls within the currently permissible "shoot to kill" range of 21 feet. Consequently, the current less-lethal devices' inefficiency, inaccuracy and in-utility seem to render adherence to the proposed legislative provisions impractical. In some cases, the use of tasers are viewed as excessive use of force, and annually, as many as a thousand "wrongful deaths" are attributable to the use of tasers in a failed attempt to use less-lethal force by law enforcement agencies.

Also available are launchers (similar to paintball guns) shooting frangible projectiles filled with a lachrymatory substance. Even though these devices have increased ranges, they remain notoriously inaccurate, especially due to manufacturing imperfections and instability of the projectiles. These launchers are furthermore bulky and ergonomically unfriendly when carried on the person or when being handled.

One way to improve the accuracy of projectiles, is to impart spin to the projectile as it is launched. This is achieved by utilising launchers comprising rifled barrels. However, the use of rifled barrels usually falls within the purview of legislative provisions or bodies, such as the ATF (The Bureau of Alcohol, Tobacco, Firearms and Explosives).

A need exists for a less-lethal device, capable of temporarily incapacitating a person effectively at a range exceeding that of currently available less-lethal devices. A need furthermore exists for a compact and ergonomically friendly less-lethal projectile launcher that does not fall within the purview of legislative provisions or bodies, suitable for use by law enforcement agencies, correctional services, the military and civilians alike.



Known less-lethal devices, such as less-lethal pistols comprise a body with a grip portion, a barrel, a canister of compressed gas and a valve assembly arranged to vent gas to propel a projectile received within the barrel upon actuation by a firing mechanism (or trigger).

In a bid to reduce the overall size of the less-lethal device, the canister, which comprises a sealed mouth, is received within the body, and a puncture mechanism is provided for puncturing the sealed mouth, to allow compressed gas to flow towards the valve assembly.

Due to leakage of compressed gas, canisters ideally need to be punctured immediately before use. U.S. Pat. No. 8,430,086B2 describes a puncture mechanism comprising a pin which is displaceable towards the canister by a cam surface on the trigger. The piercing pin is actuated each time the trigger is pulled. A seal is created between a body of the canister and the body of the device. U.S. Pat. No. 8,726,895B2 describes a method of launching a projectile, wherein an initial trigger pull causes the piercing pin to puncture the canister, without causing a projectile to be launched, whereafter subsequent trigger pulls launches projectiles.

These devices and methods are impractical. Firstly, since the piercing pin is actuated each time the trigger is pulled, sensitivity in the trigger pull is lost. Also, specifically in emergency or self-defense situations, reaction times are paramount and the launching of the projectile by the first pull of the trigger is essential.

## OBJECT OF THE INVENTION

It is an object of the present invention to provide a pneumatic arrangement for a less-lethal device and a method of propelling a projectile from a less-lethal device, with which the applicant believes the aforementioned disadvantages may at least be alleviated or which may provide a useful alternative for the known pneumatic arrangements and methods.

## SUMMARY OF THE INVENTION

According to a first aspect of the invention there is provided a puncture mechanism for puncturing a seal provided over a mouth of a canister of compressed gas operatively received within a body of a less-lethal device, the puncture mechanism comprising:

- a housing defining an internal cavity;
- a displaceable body received within the internal cavity, having a piercing mechanism and an internal bore which extends from the piercing mechanism through the displaceable body; and
- an actuation arrangement for displacing the displaceable body from a first position operatively spaced from the canister, to a second position towards the canister,

wherein in use, the piercing mechanism pierces the seal when the displaceable body is displaced towards the second position, so that compressed gas flows from the canister through the internal bore.

The displaceable body may be received sealingly within the housing. When the displaceable body is in the second position, a chamber may be defined between an inner surface of the housing and a rear end of the displaceable body, which chamber may be provided in fluid flow communication with the internal bore.

The chamber may furthermore be provided in fluid flow communication with a valve assembly operatively provided to vent a predetermined volume of compressed gas thereby to propel a projectile from a barrel of the device.

The rear end of the displaceable body may be provided with a surface whereupon compressed gas within the chamber may act operatively thereby urging the displaceable body towards the second position.

The displaceable body may be provided with a peripheral seal received within a peripheral groove, the seal for sealing within the housing, thereby to inhibit compressed gas from operatively escaping between the housing and the displaceable body.

According to a first example of the first aspect of the invention, the actuation arrangement may comprise:

an extension member formed on a trigger mechanism of the less-lethal device; and

a contact surface formed on the displaceable body,

the arrangement being such that when the displaceable body is located in the first position and the trigger mechanism is actuated by a user, the extension member urges against the contact surface thereby to cause the displaceable body to be displaced to the second position, and so that when the trigger mechanism is released by the user, the extension member moves away from the contact surface, so that the displaceable body remains in the second position.

The contact surface may be in the form of a pin or a shoulder formed on the displaceable body. The displaceable member may comprise a slot extending lengthwise therealong, for the extension member to move in freely when the trigger mechanism is actuated and released while the displaceable body is in the second position.

According to a second example of the first aspect of the invention, the actuation arrangement may comprise:

an extension member of a trigger mechanism of the less-lethal device;

an actuation pin received within a slot extending in the displaceable body; and

a link member hingedly connected to the extension member and extending to the actuation pin,

the arrangement being such that when the displaceable body is located in the first position and the trigger mechanism is actuated by a user, the link member urges the actuation pin against a front end of the slot thereby to cause the displaceable body to be displaced to the second position, and so that when the trigger mechanism is released by the user, the actuation pin moves away from the front end, so that the displaceable body remains in the second position.

According to a third example of the first aspect of the invention, the actuation arrangement may comprise:

an extension member of a trigger mechanism of the less-lethal device; and

an actuation pin extending from the extension member into a slot extending in the displaceable body,

wherein a size of the slot exceeds a size of the actuation pin, and wherein the arrangement is such that when the displaceable body is located in the first position and the trigger mechanism is actuated by a user, the extension member urges the actuation pin against a front end of the slot thereby to cause the displaceable body to be displaced to the second position, and so that when the trigger mechanism is released by the user, the actuation pin moves away from the front end, so that the displaceable body remains in the second position.

According to a fourth example of the first aspect of the invention, the actuation arrangement may comprise:

at least one radially disposed cam surface formed on a cam body provided with an annular seal for sealing against the mouth of the canister, the cam body defining an axial bore;

at least one interacting cam surface formed on the displaceable body for interacting with the radially disposed cam surface of the cam body, wherein the piercing mechanism projects in the axial bore of the cam body;

a stop member formed on the displaceable body, receivable within an internal slot formed on the housing, so that when the stop member is received within the internal slot, the displaceable body is prevented from articulating relative to the housing;

a catch formation formed on the displaceable body for catching on a release mechanism; and

a biasing means for biasing the displaceable body towards the second position.

A second biasing means may be provided for biasing the cam body and the displaceable body away from each other.

A torsion member may be provided for pivoting the displaceable body to a predetermined orientation within the housing.

The release mechanism may be linked to a trigger mechanism of the less-lethal device, so that an initial actuation of the trigger mechanism may cause the release mechanism to release the catch formation, so that the displaceable body may be displaced to the second position by the first biasing means. The catch member may be in the form of a shoulder formed on the displaceable body.

According to a fifth example of the first aspect of the invention, the actuation arrangement may comprise:

a plurality of cogs formed on a trigger mechanism of the less-lethal device;

a rack arranged relative to the displaceable body, the rack comprising a slot which operatively receives a projection projecting from the displaceable body, wherein the rack is arranged to interact with the cogs; and

so that, the when the displaceable body is located in the first position and the trigger mechanism is actuated by a user, the plurality of cogs interact with the rack, thereby to urge the displaceable body to the second position, and wherein the projection is displaceable within the slot, so that the displaceable body remains in the second position when the trigger mechanism is released.

In each of the first to fifth examples, the displaceable body may comprise a sealing formation adapted for sealing against the mouth of the canister, whilst the housing may be provided with a receiving formation for operatively receiving the canister.

According an alternative example of the first aspect of the invention, the puncture mechanism may further comprise a sealing body, received within the housing, displaceable between a forward and a rearward position relative to the housing, the sealing body comprising an annular seal which operatively seals against the mouth of the canister. The sealing body may furthermore comprise an internal bore for receiving a leading portion of the displaceable body. The displaceable body may comprise a shoulder for urging the sealing body towards the canister, when the displaceable body is located in the second position. A seal may be provided between the leading portion of the displaceable body and the internal cavity for operatively preventing compressed gas from leaking between the displaceable body and the sealing body.

According to a second aspect of the invention there is provided a pressure sensitive activation assembly, comprising:

a chamber operatively receiving pressurised gas from a source;

a piston received within the chamber, which is displaceable between a first position and a second position within the chamber;

a biasing means arranged to bias the piston towards the first position;

a locking member displaceable between a first configuration, wherein the locking member interacts with a hammer of a release valve to inhibit the hammer from movement towards the release valve, and a second configuration, wherein the locking member does not interact with the hammer to allow the hammer to actuate the release valve,

wherein a predetermined pressure within the chamber causes the piston to overcome the bias of the biasing means thereby to move to the piston to the second position, and wherein the locking member is displaced from the first configuration to the second configuration when the piston is displaced from the first position to the second position.

The locking member may have a catch formation for interacting with a shoulder formed on the hammer, so that when the catch formation and the shoulder of the hammer interacts, the hammer is inhibited from pivoting towards the release valve.

The locking member may comprise first and second arms which are off-set at a predetermined angle, so that the locking member may be substantially L-shaped. The locking member may be fixed relative to the release valve via a hinge. The catch formation may be formed on an extremity of the first arm. The second arm may be arranged in sliding contact with a shoulder formed on the piston, so that when the piston is axially displaced from the first to the second positions, the locking member is pivoted about the hinge to thereby move the catch formation away from the shoulder. The piston may comprise a second shoulder for interacting with the second arm when the piston is displaced to the first position, to return the locking member to the first configuration.

The chamber may be in fluid flow communication with a holding chamber of the release valve.

The biasing means may be adjustable to adjust a minimum gas pressure that would cause the piston the overcome the bias.

According to a third aspect of the invention there is provided a release valve assembly for venting a predetermined volume of compressed gas thereby to propel a projectile from a barrel of a less-lethal device, the release valve assembly comprising:

a holding chamber for operatively containing gas at a predetermined pressure, the holding chamber comprising an outlet for gas into the barrel;

a valve pin displaceable between a closed position wherein the outlet is sealed, and an open position, wherein gas is allowed to escape from the holding chamber into the barrel, the valve pin being biased towards the closed position by a biasing means; and

a hammer arranged to strike a striking surface when actuated, the arrangement being such that the striking surface, when struck by the hammer, causes the valve pin to move to the open position.

The hammer may be fixed relative to the striking surface by a hinge, and may be displaceable between a cocked position and an un-cocked position. The hammer may be biased towards the un-cocked position by a biasing means. The hammer may comprise a cocking shoulder with a catch mechanism for holding the hammer in the cocked position. The biasing means may be a torsion spring, comprising a first and second arm. At rest, the first and second arms may be disposed at a free-angle relative to each other. The hammer may comprise a shoulder. In use, the first arm of the torsion spring may be arranged in contact with the shoulder of the hammer.

A kinetic force with which the striking surface is struck by the hammer may be adjusted, thereby to adjust the volume of gas escaping through the outlet, by means of a tension adjusting mechanism. The tension adjusting mechanism may comprise:

a follower body, defining a shoulder against which the second arm of the torsion spring urges in use; and

an adjusting mechanism for adjusting the follower body to cause the first and second arms of the torsion spring to be adjusted angularly relative to each other.

The follower body may be pivotably fixed relative to the body of the device. The adjusting mechanism may comprise an adjusting body slidably received within the body of the device, and displaceable between a first and second position. The adjusting body may comprise a protuberance in the form of a pin extending therefrom, in use received within a slot formed on the follower body, to constitute a linear cam arrangement between the follower body and the adjusting body, so that, when the adjusting body is displaced from the first to the second positions, the first and second arms of the torsion spring is adjusted relative to each other. The adjusting body may comprise a tapped hole. A shank of an adjustment screw may be received within the adjusting body, such that when the adjustment screw is rotated, the adjusting body is displaced between the first and second positions. A head of the adjustment screw may be prevented from being axially displaced relative to the body of the device. A portion of the body of the device proximate the head of the adjustment screw may define an aperture for operatively receiving a head of a screw-driver therethrough.

According to a fourth aspect of the invention there is provided a propelling assembly, comprising a release valve assembly according to the third aspect of the invention and the pressure sensitive activation assembly according to the second aspect of the invention.

According to a fifth aspect of the invention, there is provided a method of propelling a projectile from a barrel of a less-lethal device, comprising the steps of:

inserting a sealed canister of compressed gas into a receiving portion in a body of the less-lethal device;

providing a first trigger pull to a trigger mechanism to cause a displaceable body of a puncture mechanism to move from a first position relative to the canister, to a second position in which a piercing mechanism comprising a bore therethrough pierces a seal of the canister, so that compressed gas flows through the bore to a release valve; and

venting a predetermined volume of gas, via the release valve, responsive to the first trigger pull, to the barrel thereby to cause the projectile to be propelled from the barrel.

The method of propelling a projectile from a barrel of a less-lethal device may comprise the further steps of accumulating gas within a holding chamber of the release valve, until a predetermined pressure is reached; and causing a pressure sensitive activation assembly to activate a hammer, which causes the release valve to vent the predetermined volume of gas to the barrel.

## BRIEF DESCRIPTION OF THE ACCOMPANYING DRAWINGS

The invention will now further be described, by way of example only, with reference to the accompanying diagrams wherein:

FIG. **1** is a perspective view of an example less-lethal device according to the current invention, from which a body panel has been removed to render the inner components visible;

FIG. **2** is a puncture mechanism incorporating a first example embodiment of an actuation arrangement according to the invention, wherein a displaceable body is located in a first position;

FIG. **3** is the puncture mechanism of FIG. **2**, with the displaceable body in a second position, and wherein a trigger mechanism is actuated or pulled by a user;

FIG. **4** is the puncture mechanism of FIG. **3** after the trigger has been released;

FIG. **5** is a puncture mechanism incorporating a second example embodiment of an actuation arrangement according to the invention, wherein a displaceable body is located in a first position;

FIG. **6** is the puncture mechanism of FIG. **5**, with the displaceable body in a second position, and wherein a trigger mechanism is actuated or pulled by a user;

FIG. **7** is the puncture mechanism of FIG. **6** after the trigger has been released;

FIG. **8** is a puncture mechanism incorporating a third example embodiment of an actuation arrangement according to the invention, wherein a displaceable body is located in a first position;

FIG. **9** is the puncture mechanism of FIG. **8**, with the displaceable body in a second position, and wherein a trigger mechanism is actuated or pulled by a user;

FIG. **10** is the puncture mechanism of FIG. **9** after the trigger has been released;

FIG. **11** is a puncture mechanism according to the invention, further including a cam body interacting with the displaceable body;

FIG. **12** is the puncture mechanism of FIG. **11**, wherein the cam body and displaceable body is displaced by a canister of gas as it is installed into the less-lethal device;

FIG. **13** is the puncture mechanism of FIG. **11**, wherein the canister is in its final position, and before a trigger mechanism of the less-lethal device is actuated or pulled;

FIG. **14** is the puncture mechanism of FIG. **13**, after the trigger mechanism has been actuated or pulled by a user;

FIG. **15** is a puncture mechanism incorporating a fifth example embodiment of an actuation arrangement according to the invention, wherein a displaceable body is located in a first position;

FIG. **16** is the puncture mechanism of FIG. **15**, with the displaceable body in a second position, and wherein a trigger mechanism is actuated or pulled by a user;

FIG. **17** is the puncture mechanism of FIG. **15** after the trigger has been released;

FIG. **18** is a perspective view of an alternative, and preferred embodiment of a puncture mechanism, of which certain body panels have been removed to render internal components thereof visible, which puncture mechanism incorporates a sealing body;

FIG. **19** is a side view of the puncture mechanism of FIG. **18**;

FIG. **20** is a sectioned side view of the puncture mechanism of FIG. **18**;

FIG. **21** is a side view of the puncture mechanism of FIG. **19**, after the trigger mechanism has been pulled or actuated by the user;

FIG. **22** is a sectioned side view of the puncture mechanism of FIG. **21**;

FIG. **23** is a side view of the puncture mechanism of FIG. **18**, after the trigger mechanism has been released by a user;

FIG. **24** is a sectioned side view of the puncture mechanism of FIG. **23**;

FIG. **25** is a propelling assembly according to the invention, wherein a hammer is located in a cocked position, and wherein a locking member is in a first configuration;

FIG. **26** is the propelling assembly of FIG. **25** wherein the hammer is still located in a cocked position, but wherein the locking member is in a second configuration;

FIG. **27** is the propelling assembly of FIG. **25** wherein the hammer is located in an un-cocked position, and wherein the locking member is in the second configuration;

FIG. **28** is a side view of a tension adjusting mechanism, of which certain components have been omitted to render internal components visible;

FIG. **29** is a side view of the tension adjusting mechanism of FIG. **28** in situ, with an adjusting body in a forward position;

FIG. **30** is a side view of the tension adjusting mechanism of FIG. **28**, with an adjusting body in a forward position;

FIG. **31** is a side view of the tension adjusting mechanism of FIG. **28**, with the adjusting body in a rearward position.

## DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

A less-lethal device, in the form of a less-lethal pistol, is indicated by reference numeral **10** in FIG. **1**. The less-lethal device **10** typically comprises a body **12** having a grip portion **14** for handling the device **10** and a barrel **16** through which a projectile (not shown) is propelled in use. A magazine **18** is provided within the grip portion **14** and utilised to house a number of projectiles, and to load projectiles into a breech of the barrel **16**. A canister of compressed gas **20** is located within the body **12**, and typically, below the barrel **16**. The canister **20** is locked in position within the body **12**, by a locking cap **22**, typically provided with screw-in or a bayonet-type locking mechanism. A release valve **24** is provided to vent a predetermined volume of compressed gas into the barrel **16**, thereby to propel the projectile therefrom. The release valve **24** and canister **20** are therefore operatively arranged in fluid-flow communication. The release of gas by the release valve **24** is triggered by a trigger mechanism **26**, which hinges about a hinge point **28**.

A puncture mechanism **30** is provided to initially puncture or open a seal **32** provided over a mouth **34** of the canister **20** (typically shown in FIG. **3**). The canister **20** (also known as a cartridge) is of the known kind and is typically filled with compressed carbon dioxide ($CO_2$). A pressure tube **36** (shown in FIG. **1**) connects the canister **20**, via the puncture mechanism **30**, to the release valve **24**.

It will be understood that the less-lethal device **10** could take various forms other than that of a pistol, and may include such configurations as rifles and the like. In all instances the less-lethal device **10** utilises the release of compressed air to propel a projectile from a barrel. Throughout the remainder of this disclosure, reference will be made to a less-lethal device **10** of the pistol configuration.

The puncture mechanism **30** may take on various forms and configurations, as will be discussed in detail below. Generally, the puncture mechanism **30** comprises a housing **38** (or casing) defining an inner cavity **40**. A displaceable body **42** is received within the inner cavity **40**, in such a way that it is displaceable axially relative to the housing **38**. A piercing mechanism **44** is formed towards an operative front end of the displaceable body **42**. The piercing mechanism **44** typically takes the form of a needle or pin having a sharp point. A bore **46** runs from the piercing mechanism **44** through the displaceable body **42**. The bore **46** exits into the inner cavity **40**.

An actuation arrangement (generally indicated as **48**) is provided for operatively displacing the displaceable body **42** from a first position to a second position. When the displaceable body **42** is in the first position, it is spaced axially away from the canister **20** (when the canister is in situ), and the piecing mechanism **44** does not puncture or pierce the seal **32**. When the displaceable body **42** is in the second position, it is displaced towards the canister **20** (in situ) so that the piercing mechanism **44** pierces a portion of the seal **32** and at least partially enters through the mouth **34** of the canister **20**. The displaceable body **42** is shown in the first position in each of FIGS. **2**, **5**, **8**, **11**, **15** and **20** and in the second position in each of FIGS. **3**, **4**, **6**, **7**, **9**, **10**, **14**, **16**, **17**, **22** and **24**.

Therefore, when the actuation arrangement **48** causes the displaceable body **42** to be displaced to the second position, the piercing mechanism **44** pierces the seal **32**. Also, when the displaceable body **42** is in the second position, a chamber **50** is defined between the housing **38** and a rear end or surface **53** of the displaceable body **42** (the chamber **50** is therefore defined within the inner cavity **40**). The bore **46** therefore exits through the rear end or surface **53**, so that, when the displaceable body **42** is in the second position, the canister **20** is in fluid-flow communication with the chamber **50**, and therefore, compressed gas from the canister **20** flows in the bore **46**, through the displaceable body **42** and into the chamber **50**. The chamber **50** is provided in fluid flow communication with the release valve **24** via the pressure tube **36**.

The displaceable body **42** comprises a groove for receiving a peripheral seal **52** (which may take the form of an O-ring), which creates a fluid-tight seal between the displaceable body **42** and the inner cavity **40**, or at least, inhibits gas from escaping between the housing **38** and the displaceable body **42**. The rear surface **53** of the displaceable body **42**, which is received within the inner cavity **40**, acts as a piston or plunger, so that pressure within the chamber **50** acts on the rear surface **53** thereby exerting a resultant force on the displaceable body **42**, which urges the displaceable body **42** to the second position. In this way, the displaceable body **42** remains in the second position after initially being displaced from the first position to the second position, at least as long as the chamber **50** remains under a suitable amount of pressure.

In the examples of FIGS. **2** to **10** and **15** to **17**, a sealing formation **54** is provided to seal against the mouth **34** of the canister **20** when the displaceable body **42** is in the second position. Here, the sealing formation **54** is formed on the displaceable body **42**. As the pressure within the chamber **50** urges the displaceable body **42** towards the second position, the sealing formation **54** is pressed against the mouth **34**, thereby creating a tight seal. The locking cap **22** anchors the canister **20** in position and prevents it from being displaced by the force exerted on it by the displaceable body **42**. An operative front portion of the housing **38** is adapted to securely receive the canister **20**.

Upon the initial puncturing of the seal **32**, compressed gas fills the chamber **50** almost instantaneously and the release valve **24** is similarly almost instantaneously provided with compressed gas. As is described in more detail below, the initial pulling of the trigger mechanism **26** causes both the seal **32** to be punctured, the chamber **50** to become pressurised and the release valve **24** to vent a first predetermined volume of compressed gas thereby to propel a projectile from the barrel **16**.

Various different embodiments of the actuation arrangement **48** are shown in FIGS. **2** to **17**.

A first example actuation arrangement **48.1** is shown in FIGS. **2** to **4**. Here, the trigger mechanism **26** comprises an extension member **56** while a contact surface **58** is formed on the displaceable body **42**. The contact surface is typically in the form of a pin (as shown) or a shoulder (not shown).

Initially the canister **20** is loaded into position within the body **12**, and the displaceable body **42** is located in the first position (as is shown in FIG. **2**). The seal **32** covering the mouth **34** is therefore intact, and there is no flow of compressed gas through the bore **46**. The chamber **50** is therefore at atmospheric pressure. When the trigger mechanism **26** is actuated (or pulled) by a user of the less-lethal device **10**, the extension member **56** urges against the contact surface **58**. The extension member **56** makes sliding contact with the contact surface **58**. The urging of the extension member **56** against the contact surface **58** causes the displaceable body **42** to be displaced to the second position and in the process, the piercing mechanism **44** pierces or breaks the seal **32**, so that compressed gas flows into and through the bore **46**, and the chamber **50** is pressurised.

Since the extension member **56** and the contact surface **58** are provided in urging contact, the extension member **56** is free to move away from the contact surface **58** when the trigger mechanism **26** is released. Consequently, when the trigger mechanism **26** is released by the user, the displaceable body **42** remains in the second position.

Subsequent trigger mechanism **26** pulls by the user will not cause the displaceable body **42** to be displaced away from the second position. The volume of compressed gas within the canister **20** limits the number of projectiles that can be propelled from the barrel **16**. Once the canister **20** is spent, it is removed and replaced by a new sealed canister **20**. The above process is thus repeated.

A lengthwise slot (not shown) may be formed in the displaceable member **42** for the extension member **56** to move in freely when the trigger mechanism **26** is actuated and released while the displaceable body **42** is in the second position.

A second example actuation arrangement **48.2** is shown in FIGS. **5** to **7**. Again, the trigger mechanism **26** comprises the extension member **56**. The displaceable body **42** comprises a slot **59** that extends lengthwise in the displaceable body **42** (substantially parallel to the bore **46**). Typically, the slot **59** extends through the displaceable body **42**. An actuation pin **60** is received within and extends through the slot **59**. A link member **62**, which is hingedly connected to the extension member **56**, typically by a hinge **64**, links the actuation pin **60** and the extension member **56**. The actuation pin **60** is received loosely within the slot **59**, so that it is free to slide relative to the slot **59**.

The canister **20** is loaded into position as described above and the displaceable body **42** is located in the first position. When the trigger mechanism **26** is actuated, the link member **62** urges the actuation pin **60** against a front end **66** of the slot **59** thereby causing the displaceable body **42** to be displaced to the second position. Again, in the process, the piercing mechanism **44** pierces or breaks the seal **32** so that compressed gas flows into and through the bore **46**, thereby pressurising the chamber **50**.

Due to the length of the slot **59** and the fact that the actuation pin **60** is free to slide in the slot **59** and move away from the front end **66**, the displaceable body **42** remains in the second position when the trigger mechanism **26** is released.

A third example actuation arrangement **48.3** is shown in FIGS. **8** to **10**. Again, the trigger mechanism **26** comprises the extension member **56** and the displaceable body **42** comprises a slot **59** that extends lengthwise in the displaceable body **42** with an actuation pin **60** received within and extending through the slot **59**. However, now the actuation pin **60** extends from the extension member **56**, directly into the slot **59**. When the trigger mechanism **26** is actuated to hinge about the hinge point **28**, the actuation pin **60** describes a curve. The slot **59** is now larger, to accommodate the curve described by the actuation pin **60** when the trigger mechanism **26** is actuated.

The canister **20** is loaded into position as described above and the displaceable body **42** is located in the first position. When the trigger mechanism **26** is actuated, the actuation pin **60** again urges against the front end **66** of the slot **59** thereby causing the displaceable body **42** to be displaced to the second position. Again, in the process, the piercing mechanism **44** pierces or breaks the seal **32** so that compressed gas flows into and through the bore **46**, thereby pressurising the chamber **50**.

Due to the length of the slot **59** and the fact that the actuation pin **60** is free to slide in the slot **59** and move away from the front end **66**, the displaceable body **42** remains in the second position when the trigger mechanism **26** is released.

A fourth example actuation arrangement **48.4** is shown in FIGS. **11** to **14**. Here the puncture mechanism **30** comprises a second body, in the form of a cam body **68** which defines an axial bore **69** therethrough. The sealing formation **54** is provided on the cam body **68**, instead of on the displaceable body **42** as described previously. Therefore, in use, the mouth **34** of the canister **20** presses against the sealing formation **54** and therefore the cam body **68**. The piercing mechanism **44** projects in the axial bore **69**.

The cam body **68** comprises at least one, but typically as shown, two radially disposed cam surfaces **70**. The displaceable body **42** is furthermore provided with opposing and interacting cam surfaces **72** in use arranged to interact with the radially disposed cam surfaces **70**.

A stop member **74** is provided on the displaceable body **42**, whilst the housing **38** is provided with an internal slot (not shown) that extends substantially longitudinally within the housing **38**. The internal slot is provided for receiving the stop member **74**. The inner cavity **40**, as well as a portion of the displaceable body **42** received within the inner cavity **40**, is cylindrical, so that the displaceable body **42** may pivot or rotate relative to the housing **38**. However, when the stop member **74** is located within the internal slot, the displaceable body **42** is prevented or inhibited from rotating or pivoting within the housing **38**. A first biasing means **76** is provided within the inner cavity **40** and arranged to abut against a rear wall **78** of the chamber and the rear surface **53** of the displaceable body **42**.

The displaceable body **42** has a catch formation **80** in the form of a shoulder. A release mechanism **82** is provided for interacting with the catch formation **80**. The release mechanism **82** is linked to the trigger mechanism **26**.

In FIG. **11**, the mouth **34** of the canister **20** is pressed against the sealing formation **54**, but the canister **20** is not yet in its operational position. It therefore shows the canister **20** as it is being loaded into the less-lethal device **10**. In FIG. **12**, the canister **20** is advanced further into the body **12** of the less-lethal device **10**. The radial cam surfaces **70** are interacting with the interacting cam surfaces **72** of the displaceable body **42**, attempting to cause the displaceable body **42** to pivot or rotate relative to the housing **38**. However, the stop member **74** is located within the internal slot, and so the rotation of the displaceable body **42** is prevented or inhibited. Consequently, the cam body **68** and displaceable body **42** moves in unison, axially, against the bias of the first biasing means **76**. The displaceable body **42** therefore advances into the inner cavity **40**. No relative movement is present between the cam body **68** and the displaceable body **42**.



In FIG. **13**, the stop member **74** has exited the internal slot, and the rotation of the displaceable body **42** is no longer prevented. Consequently, because of the interaction between the various cam surfaces, the displaceable body **42** rotates as is indicated by the arrow, until the radially disposed cam surfaces **70** and interacting cam surfaces **72** are no longer in contact. The release mechanism **82** catches the catch formation **80**, and prevents the displaceable body **42** from being displaced to the second position under the bias of the first biasing means **76**. The displaceable body **42** is now in a "loaded" configuration, and the canister **20** is in its final position, and locked as such by the locking cap **22**.

Upon the next pulling of the trigger mechanism **26**, the release mechanism **82** will move out of the way of the catch formation **80**, as is shown in FIG. **14**, and the displaceable body **42** will be displaced towards the second position, under the bias of the biasing means **76** to puncture the seal **32**.

A second biasing means **84** is provided for biasing the cam body **68** and the displaceable body **42** away from each other so that when the canister **20** is spent and removed, the cam body **68** and displaceable body **42** may return to the configuration of FIG. **11**. Both the first and second biasing means (**76**, **84**) may be coil springs. Furthermore, a torsion member such as a torsion spring (not shown) may be provided for rotating the displaceable body **42** back to the configuration of FIG. **11**, after the second biasing means **84** has displaced the cam body **68** and displaceable body **42** away from each other.

Again, the first pulling of the trigger mechanism **26** will cause the seal **32** to be punctured whilst also causing the release valve **24** to vent the predetermined volume of pressurised gas to propel the projectile from the barrel **16**, as will be described in more detail below. It will be appreciated that the cam body **68** and the displaceable body **42** will remain in their respective positions of FIG. **14**, after the initial pulling of the trigger mechanism **26**, and as long as the canister **20** remains in situ.

A fifth example actuation arrangement **48.5** is shown in FIGS. **15** to **17**. The actuation arrangement **48.5** comprises a plurality of cogs formed on the trigger mechanism **26**, to resemble a pinion gear **86**. A rack **88** is arranged relative to the displaceable body **42**, and arranged to interact with the cogs of the pinion **86** when the displaceable body **42** is in the first position. The rack comprises a slot **59**. A projection, such as a pin **60**, is received within the slot **59**.

When the trigger mechanism **26** is pulled, the cogs interact with the rack **88**, so that an extremity of the slot **59** urges against the projection **60**, thereby to displace the displaceable body **42** to the second position. Since the pin **60** is free to move within to the slot **59**, the displaceable body **42** remains in the second position when the trigger mechanism **26** is released, even though the rack **88** is displaced relative to the displaceable body **42** (as is shown in FIG. **17**).

Another, and preferred example puncture mechanism **30.1**, is shown in FIGS. **18** to **24**.

The puncture mechanism **30.1** of FIGS. **18** to **24** is compatible with canisters **20** of different lengths, and differs from the puncture mechanisms **30** described above, in that the puncture mechanism **30.1** furthermore comprises a sealing body **90**, received within the housing **38**. Therefore, in the case of puncture mechanism **30.1**, the displaceable body **42** does not include a sealing formation **54**.

The sealing body **90** is displaceable between a forward position relative to the housing **38**, and a rearward position relative to the housing **38**. The sealing body **90** comprises an annular seal **91** which operatively seals against the mouth **34** of the canister **20**. As is discussed in more detail below, the displacement of the sealing body **90**, albeit limited in extent, improves sealing against the mouth **34** of the canister **20**.

An internal bore **92** (best shown in FIG. **20**) is formed within the sealing body **90**. A leading portion **93** of the displaceable body **42** (which is indicated in FIG. **22**) is received within the internal bore **92**. The displaceable body **42** is displaceable relative to both the housing **38** and the sealing body **90**. A seal **94** is provided between the leading portion **93** and the internal bore **92** for inhibiting compressed gas from escaping therebetween. The sealing body **90** comprises a peripheral slot **95** in which a stopper **96** (typically in the form of a dowel pin as shown) is received. The stopper **96** limits the axial displacement of the sealing body **90** relative to the housing **38**.

The displaceable body **42** comprises a shoulder **97**. When the displaceable body **42** is in the second position, the shoulder **97** urges against a rear surface **98** of the sealing body **90**, thereby improving the contact between the mouth **34** and the annular seal **91**. It will be remembered that, when the displaceable body **42** is in the second position, gas pressure within the chamber **50** exerts a force on the rear surface **53**. This force is therefore effectively translated to via the annular seal **91** to the mouth **34**.

The puncture mechanism **30.1** of FIGS. **18** to **24** comprises a similar actuation arrangement **48.2** as the second example actuation arrangement **48** shown in FIGS. **5** to **7**, with the exception that the link member **62** is pulled by the extension member **56**, and the slot **59** does not extend all the way through the displaceable body **42**. Therefore, two slots **59** are arranged on opposite sides of the displaceable body **42** with two pins **60** protruding into the slots **59** without extending through the displaceable body **42**. Again, the displaceable body **42** will remain in the second position, even when the trigger mechanism **26** is released, as the pins **60** are free to move within the slots **59**.

When the canister **20** is inserted into the body **12** of the device **10**, the mouth **34** contacts the annular seal **91** before the seal **32** is punctured. The sealing body **90** is urged by the canister **20** to the rearward position. When the trigger mechanism **26** is actuated, as described above, the piercing member or mechanism **44** pierces the seal **32** and the chamber **50** is pressurised. Since the sealing body **90** is displaceable to the forwards position, the force exerted by the annular seal **91** on the mouth **34** will be constant, irrespective of the size of the canister **20**. In this way a better seal is created with the mouth **34** of the canister **20**.

The locking cap **22** may furthermore comprises a spring (not shown), to ensure that canisters **20** of different lengths always make proper contact with the annular seal **91**.

It will be understood throughout this disclosure, where a first body comprises a slot and a second body comprises a pin or projection that interact with the slot, or that extends into the slot, the invention similarly extends to an arrangement where the first body comprises the pin or projection, and the second body comprises the slot, unless otherwise stated.

As was stated before, an initial pulling of the trigger mechanism **26** causes the canister **20** to be punctured and a first projectile to be propelled from the barrel **16**. This is made possible by a propelling assembly, which is generally designated by reference numeral **100** in FIGS. **25** to **27**. The propelling assembly **100** comprises the release valve **24** and a pressure sensitive/sensing/responsive activation assembly **102**.

The pressure sensitive activation assembly **102** (which in some respects corresponds with a conventional "sear" of a firearm), is used to inhibit a hammer (or cock) **103** associated with the release valve **24** from being activated before a predetermined pressure is reached within the release valve **24** (as is discussed more fully below). The pressure sensitive activation assembly **102** comprises a chamber **104** which receives pressurised gas in use, from the canister **20**, after being punctured as described above. A piston **106** is received within the chamber **104**, and is displaceable between a first position (as shown in FIG. **25**) and a second position (as shown in FIGS. **26** and **27**) within the chamber **104**.

A biasing means in the form of a spring **108** is used to bias the piston **106** towards the first position. The spring **108** has a spring constant or stiffness, which imparts a bias that requires a predetermined minimum force to be overcome. Therefore, a predetermined force needs to be exerted on the piston **106** to overcome the bias of the spring **108** and cause the piston **106** to be displaced to the second position. A predetermined pressure within the chamber **104** corresponds with the predetermined force required to cause the piston **106** to overcome the bias. This pressure is typically around 600 psi, but may vary or be changed based on user or operational requirements.

The pressure sensitive activation assembly **102** furthermore comprises a locking member **110** which is displaceable between a first configuration (shown in FIG. **25**) and a second configuration (shown in FIGS. **26** and **27**).

The locking member **110** comprises a first arm **112** and a second arm **114** which are disposed at a predetermined angle, such as a right angle, so that the locking member **110** is substantially L-shaped, as shown. The locking member **110** is fixed relative to the release valve **24** via a hinge **116**. The locking member **110** therefore pivots between the first and second configurations.

A catch formation **118** is formed on an extremity of the first arm **112** and is provided to interact with a shoulder **120** formed on the hammer **103**. When the locking member **110** is in the first configuration (and the hammer **103** is in a cocked position), the catch formation **118** and the shoulder **120** interacts and the hammer **103** is thereby inhibited from pivoting towards the release valve **24**. When the locking member **110** is however displaced to the second configuration, the catch formation **118** moves away from the shoulder **120**, so that the hammer **103** is free to pivot towards the release valve **24** and thereby actuate the release valve **24**.

The piston **106** comprises a first shoulder **122** and second shoulder **124**. The second arm **114** has a formation **126** which is arranged between the first and second shoulders (**122**, **124**) and in sliding contact with the first and second shoulders (**122**, **124**). Therefore, when the piston **106** is displaced from the first position to the second position, the locking member **110** is pivoted from the first configuration to the second configuration. Also, when the piston **106** is displaced from the second position back to the first position, the locking mechanism **110** is pivoted from the second configuration back to the first configuration.

The spring **108** is adjustable so that the minimum gas pressure that would cause the piston **106** to overcome the bias can be adjusted according to operational requirements.

The release valve **24** comprises a holding chamber **128** which is provided in fluid flow communication with the pressure tube **36**, and the chamber **104** of the pressure sensitive activation assembly **102**.

Therefore, once the canister **20** is punctured, as described above, compressed gas is received and contained within the holding chamber **128**. The holding chamber **128** comprises an outlet **130** into the barrel **16**.

The release valve **24** furthermore comprises a valve pin **132** which is displaceable between a closed position wherein the outlet **130** is sealed or closed, so that compressed gas within the holding chamber **128** is inhibited from escaping through the outlet **130**, and an open position, wherein compressed gas from within the holding chamber **128** is allowed to vent or escape through the outlet **130**. The valve pin **132** is biased towards the closed position by a biasing means.

A striker **134** having a striking surface **136** is arranged in contact with the valve pin **132**. It will be appreciated that the striker **134** and valve pin **132** may alternatively be integrally formed. The striker is arranged so that the hammer **103**, when actuated, strikes the striking surface **136**, thereby causing the valve pin **132** to be displaced to the open position.

The hammer **103** is fixed relative to the striking surface **136** by a hinge **138** and can pivot between a cocked position (shown in FIGS. **25** and **26**) and an un-cocked position (shown in FIG. **27**).

The hammer **103** comprises a cocking shoulder (not shown) with a trigger release mechanism (not shown) which interacts with the cocking shoulder for holding the hammer in the cocked position, against the bias of the torsional spring. When the trigger mechanism **26** is actuated, the trigger release mechanism moves away from the cocking shoulder, and the hammer **103** is allowed to strike the striking surface **136** under the influence of a torsion spring **140**.

The release valve **24** comprises various internal seals to prevent compressed gas from escaping from the holding chamber **128** between the striker **134** and an outside atmosphere, or between the valve pin **132** and the barrel **16**.

The torsion spring **140** (which is best shown in FIG. **28**) urges the hammer **103** to the un-cocked position. The torsion spring **140** is arranged about the hinge **138**. The torsion spring **140** comprises a first and second arm (**142**, **144**). At rest, the first and second arms (**142**, **144**) are disposed relative to each other at a "free angle", and no resultant force (or bias) is exerted between the first and second arms (**142**, **144**).

The hammer **103** comprises a shoulder **146**, against which the first arm **142** urges. Therefore, when the hammer **103** is moved towards the cocked position, the first arm **142** exerts a force on the shoulder **146**, thereby to urge the hammer towards the un-cocked position.

The kinetic force with which the striking surface **136** is struck by the hammer **103** is adjustable, thereby to adjust the volume of gas escaping through the outlet. A tension adjusting mechanism **148** is provided for this purpose. By striking the striking surface **136** with more kinetic energy, the valve pin **132** is kept in the open position for longer, and a larger volume of compressed gas is vented or released from the holding chamber **128** through the outlet **130**.



As is best illustrated in FIGS. **29** to **31**, the tension adjusting mechanism **148** comprises a follower body **150** which defines a shoulder **152** against which the second arm **144** of the torsion spring **140** urges in use. The tension adjusting mechanism **148** furthermore comprises an adjustor **154** which is used to adjust the follower body **150** by pivoting the follower body **150** about the hinge **138**. Pivoting of the follower body **150** causes the first and second arms (**142**, **144**) to pivot relative to each other, thereby adjusting the resultant force exerted between the first and second arms (**142**, **144**).

The follower body **150** is fitted to pivot about the hinge **138**. The adjustor **154** comprises an adjusting body **156** which can slide relative to the body **12** of the device **10**. Internal grooves (not shown) are provided within the body **12**, in which shoulders **161** of the adjusting body **156** slide, so that the adjusting body **156** may slide between a first (forwards) position (as is shown in FIGS. **28** to **30**) and a second (rearwards) position (as is shown in FIG. **31**). A protuberance, in the form of pin **158** extends from the adjusting body **156**. The pin **158** is received within a slot **160**, which is formed on the follower body **150**. The pin **158** and the slot **160** together constitutes a linear cam arrangement.

When the adjusting body **156** is displaced from the first to the second positions, the first and second arms (**142**, **144**) of the torsion spring **140** is adjusted relative to each other. The adjusting body **156** furthermore comprises a tapped hole (not shown). A shank **162** of an adjustment screw **164** is received within the tapped hole. When the adjustment screw **164** is rotated, screw threads of the shank **162** and the tapped hole interact so that the adjusting body **156** is displaced between the first to the second positions.

The body **12** comprises a slot **166** (best shown in FIG. **29**) in which a head **168** of the adjustment screw **164** is located, so that the head **168** is inhibited from being axially displaced relative to the body **12**. The body **12** also defines a hole **170** (also shown in FIG. **29**) proximate the head **168** of the adjustment screw **164**, for receiving the head of an adjustment tool, such as a screw driver therethrough.

Therefore, when the adjustment screw **164** is rotated, the adjusting body **156** is moved, so that the resultant force between the first and second arms (**142**, **144**) is adjusted.

In use, a canister **20** is inserted or installed into position within the body **12** of the less-lethal device **10** as described previously. A projectile (not shown) is advanced into a breech of the barrel **16**. Since the canister **20** is not yet punctured, the chamber **104** is at atmospheric pressure, or at least below the predetermined pressure, and the piston **106** is in the first position. Consequently, locking member **110** is in the first configuration so that the catch formation **118** interacts with the shoulder **120**. It will be appreciated that the hammer **103** will only be able to strike the striking surface **136** once the locking member **110** is displaced to the second configuration, and the trigger release mechanism moves away from the cocking shoulder. The hammer is cocked, which means that the trigger release mechanism interacts with the cocking shoulder.

Once the trigger mechanism **26** is actuated or pulled by a user, the canister **20** is punctured as previously described and compressed gas flows through the pressure tube **36** into the holding chamber **128**. Simultaneously, the trigger release mechanism moves away from the cocking shoulder. As soon as enough pressure builds up within the holding chamber **128**, and thus the predetermined pressure is reached within the chamber **104**, the locking member **110** is displaced to the second configuration, the catch formation **118** moves away from the shoulder **120**, and the hammer **103**, under the bias of the torsion spring **140** strikes the striking surface **136**, so that the valve pin **132** moves to the open position, allowing the predetermined volume of compressed gas to vent through the outlet **130** into the barrel **16**. The volume of compressed gas venting into the barrel **16** propels the projectile from the barrel **16**.

As long as the pressure provided from the canister **20** remains above the predetermined pressure, the locking member **110** will remain in the second configuration. When the trigger mechanism **26** is released, and after the projectile is propelled, the hammer is returned to the cocked position, and a subsequent projectile is received within the breech. A subsequent pulling of the trigger mechanism **26** will again cause to the trigger release mechanism to move away from the cocking shoulder, which will allow the hammer **103** to strike the striking surface **136** (since the locking member **110** is still in the second configuration), thereby causing the second projectile to be propelled from the barrel **16**.

Provided that enough projectiles are available in the magazine **18**, the above process may be repeated until the pressure of gas provided by the canister **20** drops below the predetermined pressure required to keep the locking member **110** in the second configuration, after which the canister **20** may be discarded. The above steps will be repeated when loading a new canister **20** into the device **10**.

Since the puncture mechanism **30** comprises the bore **46**, compressed gas can immediately after the seal **32** is punctured, flow from the canister **20** to the release valve **24**. This together with the use of the pressure sensitive activation assembly **102** enables the puncturing of the canister **20** and the propelling of a projectile with a single pull of the trigger mechanism **26**, which prevents undue delays during emergency situations. Also, since the displaceable body **42** remains in the second position when the trigger mechanism **26** is released after the initial pull, the sensitivity of the trigger mechanism **26** is not lost. Furthermore, the specific configuration of the propelling assembly **100** is compact and ensure that the device **10** is compact and ergonomically friendly. The pressure sensitive activation assembly **102** furthermore ensures that an adequate pressure is reached within the release valve **24** before the first projectile is propelled from the barrel **16**, to ensure that the projectile is propelled at an adequate velocity.

It will be appreciated by those skilled in the art that the invention is not limited to the precise details as described herein and that many variations are possible without departing from the scope and spirit of the invention.

The description above is presented in the cause of providing what is believed to be the most useful and readily understandable description of the principles and conceptual aspects of the invention. In this regard, no attempt is made to show structural details of the invention in more detail than necessary for a fundamental understanding of the invention. The words used should therefore be interpreted as words of description rather than words of limitation.

The invention claimed is:

**1**. A puncture mechanism for puncturing a seal provided over a mouth of a canister of compressed gas operatively received within a body of a less-lethal device, the puncture mechanism comprising:

a housing defining an internal cavity;

a displaceable body received within the internal cavity and sealingly within the housing, the displaceable body having a piercing mechanism and an internal bore which extends from the piercing mechanism through the displaceable body;

a chamber defined between an inner surface of the housing and a rear end of the displaceable body which is in fluid flow communication with the internal bore of the displaceable body; and

an actuation arrangement for displacing the displaceable body from a first position operatively spaced from a canister, to a second position towards the canister, the actuation arrangement comprising a trigger mechanism such that when the displaceable body is located in the first position and the trigger mechanism is operatively actuated the displaceable body is displaced towards the second position wherein the piercing mechanism pierces a seal of the canister and compressed gas flows from the canister through the internal bore towards the chamber, and when the trigger mechanism is released the actuation arrangement is released from the displaceable body and the displaceable body is kept in the second position due to compressed gas received within the chamber.

**2**. The puncture mechanism of claim **1**, wherein the chamber is in fluid flow communication with a valve assembly serving to operatively vent a predetermined volume of compressed gas to propel a projectile from a barrel of the less-lethal device, wherein the valve assembly comprises:

a holding chamber for operatively receiving and containing pressurized gas from the canister, the holding chamber comprising an outlet for releasing gas into a barrel to propel a projectile;

a valve pin displaceable between a closed position wherein the outlet of the holding chamber is sealed, and an open position, wherein compressed gas is allowed to escape from the holding chamber into the barrel;

a hammer displaceable between a cocked and an uncocked position and arranged to strike a striking surface to displace the valve pin to the open position when the trigger mechanism is actuated; and

a locking member displaceable between a first configuration, wherein the pressure inside the holding chamber is not at a predetermined pressure and the locking member interacts with the hammer to inhibit the hammer from strike the striking surface, and a second configuration wherein the locking member does not interact with the hammer allowing the hammer to strike the striking surface to displace the valve pin to the open position when the trigger mechanism is actuated.

**3**. The puncture mechanism of claim **2**, wherein the rear end of the displaceable body includes a surface whereupon compressed gas within the chamber acts to urge the displaceable body towards the second position.

**4**. The puncture mechanism of claim **3**, wherein the displaceable body includes a peripheral seal which is received within a peripheral groove, the peripheral seal serving to seal the housing to inhibit compressed gas from escaping between the housing and the displaceable body.

**5**. The puncture mechanism of claim **1**, wherein the actuation arrangement comprises:

an extension member of the trigger mechanism, the extension member freely movable in a slot in the displaceable body when the trigger mechanism is operatively actuated and released; and

a contact surface formed on the displaceable body,

the arrangement being such that when the displaceable body is located in the first position and the trigger mechanism is actuated by a user, the extension member urges against the contact surface thereby to cause the displaceable body to be displaced to the second position, and so that when the trigger mechanism is released by the user, the extension member moves away from the contact surface, so that the displaceable body remains in the second position.

**6**. The puncture mechanism of claim **1**, wherein the actuation arrangement comprises:

an extension member of the trigger mechanism;

an actuation pin received within a slot extending in the displaceable body; and

a link member hingedly connected to the extension member and extending to the actuation pin,

the arrangement being such that when the displaceable body is located in the first position and the trigger mechanism is actuated by a user, the link member urges the actuation pin against a front end of the slot thereby to cause the displaceable body to be displaced to the second position, and so that when the trigger mechanism is released by the user, the actuation pin moves away from the front end, so that the displaceable body remains in the second position.

**7**. The puncture mechanism of claim **1**, wherein the actuation arrangement comprises:

an extension member of the trigger mechanism; and

an actuation pin extending from the extension member into a slot extending in the displaceable body,

wherein a size of the slot exceeds a size of the actuation pin, and wherein the arrangement is such that when the displaceable body is located in the first position and the trigger mechanism is actuated by a user, the extension member urges the actuation pin against a front end of the slot thereby to cause the displaceable body to be displaced to the second position, and so that when the trigger mechanism is released by the user, the actuation pin moves away from the front end, so that the displaceable body remains in the second position.

**8**. The puncture mechanism of claim **1**, wherein the actuation arrangement comprises:

at least one radially disposed cam surface formed on a cam body provided with an annular seal for sealing against the mouth of the canister, the cam body defining an axial bore;

at least one interacting cam surface formed on the displaceable body for interacting with the radially disposed cam surface of the cam body, wherein the piercing mechanism projects in the axial bore of the cam body;

a stop member formed on the displaceable body, receivable within an internal slot formed on the housing, so that when the stop member is received within the internal slot, the displaceable body is prevented from articulating relative to the housing;

a catch formation formed on the displaceable body for catching on a release mechanism;

a biasing means for biasing the displaceable body towards the second position, and

a second biasing means for biasing the cam body and the displaceable body away from each other.

**9**. The puncture mechanism of claim **1**, wherein the actuation arrangement comprises:

a plurality of cogs formed on the trigger mechanism;

a rack arranged relative to the displaceable body, the rack comprising a slot which operatively receives a projection projecting from the displaceable body, wherein the rack is arranged to interact with the cogs; and

when the displaceable body is located in the first position and the trigger mechanism is actuated by a user, the plurality of cogs interact with the rack, thereby to urge the displaceable body to the second position, and wherein the projection is displaceable within a slot, so that the displaceable body remains in the second position when the trigger mechanism is released.

**10**. The puncture mechanism of claim **1**, wherein the housing includes a receiving formation for operatively receiving the canister with the displaceable body comprising a sealing formation adapted for sealing against the mouth of the canister.

**11**. The puncture mechanism of claim **1**, wherein the puncture mechanism further comprises a sealing body which is received within the housing, the sealing body comprising the internal bore for receiving a leading portion of the displaceable body and displaceable between a forward and a rearward position relative to the housing, the sealing body comprising an annular seal which operatively seals against a mouth of the canister.

**12**. The puncture mechanism of claim **11**, wherein a seal is provided between the leading portion of the displaceable body and the internal cavity for operatively preventing compressed gas from leaking between the displaceable body and the sealing body.

**13**. The puncture mechanism of claim **2**, wherein the trigger mechanism is configured to displace the valve pin of the valve assembly to an open position when the trigger is operatively actuated thereby allowing a predetermined volume of compressed gas to be released from the valve assembly to propel the projectile from a barrel of the less-lethal device.

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