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(54) **A MUZZLE BRAKE AND A MUZZLE BRAKE SYSTEM**

(57) A muzzle brake (100) for countering the recoil of a gun, the muzzle brake (100) comprising an elongated sheathing (101) extending in an axial direction (A); a cylindrical bore (105) in said sheathing (101) extending in the axial direction (A) between a proximate end opening (102) for entry of a projectile and a distal end opening (103) for exit of the projectile; at least two groups (110, 120, 130, 140, 150) of each at least one gas port, said

groups (110, 120, 130, 140, 150) being distributed in said axial direction (A), each gas port extending radially through the sheathing (101); and a baffle (160) associated with each group (110, 120, 130, 140, 150) of gas ports, each baffle (160) projecting outwardly from and extending around an outer circumference of the sheathing (101).

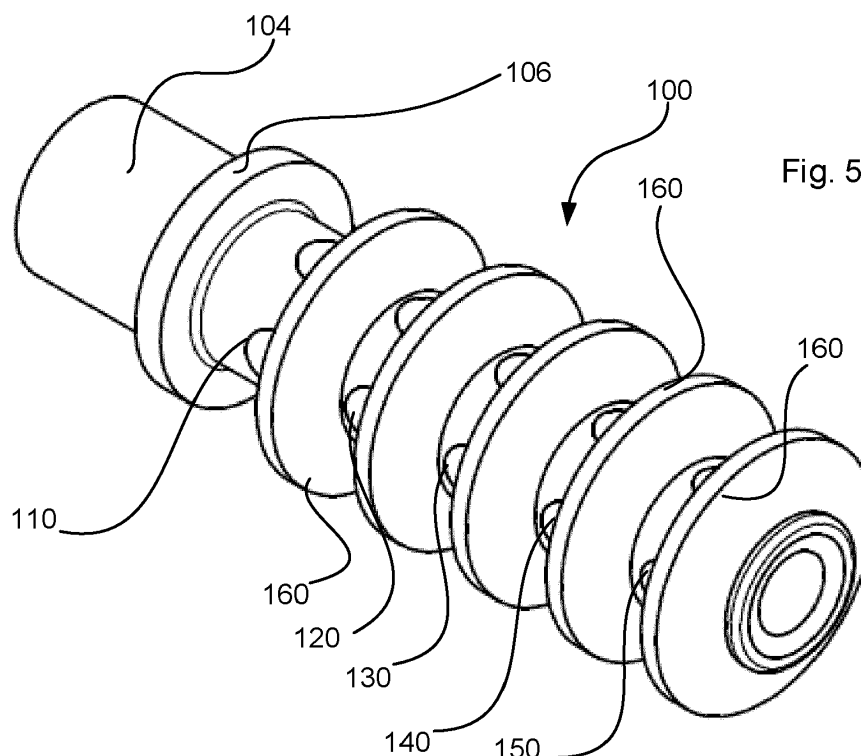


Fig. 5

Description

Field of the invention

[0001] The invention relates to a muzzle brake for countering the recoil of a gun and a muzzle brake system for countering the recoil and for diverting the concussion and sound of a gun. The invention further relates to a muzzle brake system for countering the recoil and for easy mounting of a muzzle brake and/or for diverting the concussion and sound of a gun.

Background of the invention

[0002] To reduce recoil, guns are often used in conjunction with either a muzzle brake or a suppressor. The use of suppressors is however, for security reasons, banned in many places around the world, making muzzle brakes the most viable option for reducing recoil.

[0003] Muzzle brakes function by redirecting the forwards expanding propellant gas of the ammunition outwards radially through gas ports in the muzzle brake whereby the recoil, which would have otherwise been generated by the gas exiting through the muzzle opening of the gun in a forward direction, is reduced.

[0004] To improve the effect of redirecting the expanding gas radially outwards, some muzzle brakes further comprise baffles. The baffles are arranged in front of the gas ports to provide an increased surface area for the propellant gas to push against, thereby exerting a forward force on the muzzle brake and thus on the gun to counteract the recoil felt by the shooter. To further increase this effect, some muzzle brakes comprise baffles which are angled backwards.

[0005] GB125141 A discloses a muzzle brake of the kind comprising a tube having a number of surfaces to which the gun gases gain access through suitable ports and are thereby deflected rearward by backwards angled baffles.

[0006] CA1235322 A1 discloses a muzzle brake, wherein the end of the gun barrel is provided with a long, narrow chamber which has the effect of containing the muzzle gases against radial expansion, causing them to emerge forwardly as a jet. The jet intensifies the concentration of the gases against the back of a reaction plate. The brake is open backed, so that the jet draws in atmospheric air. This promotes a vigorous explosion of the remaining unburnt propellant. The gases that travel rearward after the explosion exert only a small rearward (recoil worsening) force on the gun. A deflector deflects the gases away from the shooter.

[0007] While muzzle brakes are highly efficient at countering recoil, they do suffer from certain drawbacks, the most critical of which is that the sound and concussion from firing the gun is directed outwards and back at the shooter instead of going forward. This is particularly critical when shooting at a shooting range, where the shooter will fire several rounds and likely be in close proximity to

other shooters. Furthermore, as the gas ports redirect the expanding gas sideways, the expanding gas and the concussion it produces is likely to be an inconvenience to anyone being next to the shooter.

[0008] Some muzzle brake systems mitigate these drawbacks by supplying a blast shield, which provides a cylindrical element around the muzzle brake, thereby redirecting the propellant gas forwards once it has exited the gas ports to divert the sound and concussion forward. This however, may result in a turbulent flow of the gas making the flow of the gas within the blast shield unpredictable.

[0009] US 2017/0199002 A1 discloses A blast control device for a firearm is disclosed. The blast control device may include a muzzle brake comprising a first end, a second end, a top, a bottom, a bore, one or more baffles, one or more gas openings disposed between the one or more baffles, an alignment channel disposed on the top, one or more gas holes disposed on the top within the alignment channel, an alignment groove disposed at an end of the alignment channel, and a latch notch. The blast control device also may include a blast shield attachable around the muzzle brake. The blast shield may include an alignment protrusion, a latch assembly, a plurality of internal ribs, and one or more gas ports.

[0010] Furthermore, muzzle brakes are often customized, not only for a particular calibre of projectile, but also for the outer diameter of the gun barrel. This makes muzzle brakes highly limited as they will almost always only be used with a single gun of a particular muzzle threading. Providing a gun with an aftermarket muzzle brake is therefore very costly and often requires the assistance of a gun smith.

[0011] On this background it is an object of the invention to provide a muzzle brake, which in cooperation with a blast shield provides improved control of the gas expansion.

[0012] A further object of the invention is to provide a more versatile muzzle brake, which is easier to install and may be used with different guns of varying muzzle threading and of same or smaller calibre than the one which the muzzle brake is optimized for.

Summary of the invention

[0013] According to a first aspect of the invention, the objects laid out in the background section may be achieved by a muzzle brake for reducing the recoil of a gun, the muzzle brake comprising an elongated sheathing extending in an axial direction; a cylindrical bore in said sheathing extending in the axial direction between a proximate end opening for entry of a projectile and a distal end opening for exit of the projectile; at least two groups of each at least one gas port, said groups being distributed in said axial direction, each gas port extending radially through the sheathing; and a baffle associated with each group of gas ports, each baffle projecting outwardly from and extending around an outer circumfer-

ence of the sheathing.

[0014] By providing such a muzzle brake, the expanding gas which propels the projectile forward is allowed to flow radially outwards through the gas ports of each respective group and, after exiting the gas ports, exerting a force on the back surface of the baffle adjacent to the respective group of gas ports to counter the recoil.

[0015] In the context of this text, the terms front and back is to be understood with regards to the movement direction of the projectile, i.e. when the muzzle brake is mounted, and when the gun is fired. Thus, the term front is towards the distal end opening and the term back is towards the proximate end opening.

[0016] In the context of this text, the term gun is to be understood as a firearm, e.g. a pistol, a shotgun, or a rifle.

[0017] The axial direction is to be understood as the length direction of the muzzle brake, i.e. the axial direction is the movement direction of the projectile through the cylindrical bore when the muzzle brake is mounted, and when the gun is fired. The radial direction is to be understood as any direction perpendicular on the axial direction.

[0018] In a presently preferred embodiment, an opening area of at least one gas port in one said group closer to the proximate end opening is greater than an opening area of at least one gas port of another said group closer to the distal end opening. In some such embodiments, an opening area of all of the gas ports in one said group closer to the proximate end opening is greater than an opening area of all of the gas ports of another said group closer to the distal end opening. In some such embodiments the combined opening area of the gas ports in one said group closer to the proximate end opening is greater than the combined opening area of the gas ports of another said group closer to the distal end opening.

[0019] The opening area of each respective gas port is to be understood as the cross-sectional area taken along the radial direction in which said respective gas port extends. In embodiments wherein the gas ports are cylindrical, the opening area of a respective gas port is to be understood as the radius squared times pi of said respective gas ports.

[0020] This will allow more of the propellant gas to escape through the gas ports of the group closer to the proximate end opening, i.e. closer to the gun when the muzzle brake is mounted, than through the gas ports of the group(s) closer to the distal end opening. This is particularly advantageous when the muzzle brake is used with a blast shield, as the pressure of the gas within the blast shield will be greater towards the proximate end opening of the blast shield, thereby allowing the gas expelled from the rearwards group of gas ports to help push the gas expelled from the subsequent groups of gas ports forward.

[0021] In an embodiment of the invention, the baffles extend between 2 and 15 mm, preferably between 3,5 and 13,5 mm, more preferably between 5 and 12 mm, outwards from the exterior surface of the elongate ele-

ment.

[0022] In an embodiment of the invention, the elongate element comprises between three and six groups of gas ports, preferably between four and six groups of gas ports, more preferably five groups of gas ports.

[0023] In an embodiment of the invention, the gas ports are cylindrical passages extending between the cylindrical bore and an exterior of the sheathing.

[0024] In an embodiment of the invention, the sheathing is substantially cylindrical or conical. This is advantageous as it reduced the volume and weight of the muzzle brake.

[0025] In an embodiment of the invention, the opening area of the gas port(s) of each group is greater than the opening area of the gas port(s) of the neighbouring group towards the distal end. When the muzzle brake is used in combination with a blast shield, this may facilitate the forward flow of the gas through the blast shield as the amount of gas expelled from groups of gas ports will become gradually less towards the distal end opening.

[0026] In an embodiment of the invention the baffles are angled towards the proximate end. This has the advantage, that the gas expelled from the gas ports will be able to exert a greater force in a forward direction, i.e. with respect to the projectile direction, on the baffles, thus allowing the muzzle brake to counteract recoil more efficiently.

[0027] In some such embodiments, the baffles form an angle between 5 and 60 degrees, preferably between 10 and 50 degrees, more preferably between 15 and 40 degrees with respect to the radial direction.

[0028] In an embodiment of the invention, the edge facing the proximate end opening of the baffles are bevelled. This allows the gas to move past the edge of the baffles more easily, once the gas has exerted a force on the baffle. This is particularly advantageous when the muzzle brake is used in conjunction with a blast shield, as the gas will have to flow forward towards the distal end opening of the blast shield in order to exit the blast shield through. The bevelled edges may thus reduce a turbulent flow of gas within the blast shield.

[0029] In an embodiment of the invention, each group of gas ports comprises four gas ports. In such an embodiment, the gas ports of each respective group extends radially and perpendicularly with respect to the neighbouring gas ports of said respective group.

[0030] This provides a muzzle brake, wherein the gas ports are arranged so that the muzzle brake is four fold rotational symmetric, in regards of the arrangement of the gas ports, about the cylindrical bore. The advantage of this is that the radial force which is exerted on the muzzle brake when the propellant gasses are expelled from a gas port of a group cancel out with the force from the propellant gas expelled from opposite gas port of said group.

[0031] In an embodiment of the invention, the sheathing comprises an exterior thread at the proximate end opening. This allows the muzzle brake of the invention

to be mounted on a gun by means of an adaptor element, whereas muzzle brakes of the prior art are mounted directly on the barrel of the gun. With this configuration, the muzzle brake of the invention can be switched between different guns of identical or smaller calibre by using an adaptor element adapted to be attached onto the respective gun.

[0032] According to a second aspect of the invention, the objects laid out in the background section may be achieved by muzzle brake system for countering the recoil of a gun and for diverting the sound and concussion of the gun, said system comprising a muzzle brake according to the first aspect of the invention and at least one further element selected from a group consisting of:

- a blast shield with a distal end opening and a proximate end opening, said blast shield comprising a circumferential wall extending between the proximate and distal end openings and defining an inner cavity for housing the muzzle brake, said circumferential wall being dimensioned to extend around the muzzle brake so that a gap is formed between the circumferential wall and the baffles, wherein an interior surface of the circumferential wall has a conical shape which is wider towards the distal end opening; and
- an adapter element comprising a casing with a proximate end opening and a distal end opening,

a central passage extending between the proximate and the distal end openings,

a first interior thread in the central passage at the proximate end opening, said first interior thread being adapted to engage a thread on the barrel of the gun to attach the adaptor element to the muzzle of the gun,

a second interior thread in the central passage at the distal end opening, said second interior thread being adapted to attach the muzzle brake to the adaptor element, and

optionally, an exterior thread at the distal end opening, said exterior thread being adapted to attach the blast shield to the adaptor element.

[0033] By providing a muzzle brake system with an adaptor element, the muzzle brake and optionally the blast shield may be switched between various guns of calibres suited for the muzzle brake, unlike muzzle brakes of the prior art which are mounted directly onto the gun barrel and thus have to be adapted to that specific gun. The muzzle brake system is thus much more versatile and cost efficient.

[0034] By providing the muzzle brake system with a blast shield, the sound and concussion when firing the gun is diverted forward instead of in the backwards and sideways directions. Furthermore, by providing a blast shield with a conical inner surface, the propellant gas is allowed to escape the blast shield more easily through the distal end opening.

[0035] In an embodiment of the invention, and exterior

surface of the blast shield has an exterior surface which is substantially cylindrical or conical.

[0036] In an embodiment comprising an adaptor element, the muzzle brake comprises an external thread at its proximate end opening, said exterior thread of the muzzle brake being adapted to engage the second interior thread of the adaptor element to attach the muzzle brake to the adaptor element.

[0037] In some such embodiments, the muzzle brake comprises a radially projecting ring arranged on the exterior of the sheathing between the groups of gas ports and the exterior thread of the muzzle brake, and the central passage of the adaptor element comprises a circular expanded portion arranged between the distal end opening of the adaptor element and the second interior thread of the adaptor element, a diameter of said radially projecting ring being substantially the same as a diameter of said expanded portion.

[0038] The advantage of this embodiment is that the expanded portion provides support for the radially projecting ring so that the muzzle brake is supported when firing the gun.

[0039] In an embodiment comprising both a blast shield and an adaptor element, the blast shield comprises an internal thread at its proximate end, and the adaptor element comprises an exterior thread at its distal end opening, said interior thread of the blast shield element being adapted to engage the exterior thread of the adaptor element to attach the blast shield to the adaptor element.

[0040] In some such embodiments, the muzzle brake system further comprises a cap element adapted to cover the external thread of the adaptor element, when the blast shield is not attached to the adaptor element. The cap element may be mounted instead of the blast shield when sound reduction is not required, whereby the exterior thread of the adaptor element is protected from damage and from accumulating dirt during use of the gun.

[0041] In an embodiment of the invention, the diameter of the interior surface of the circumferential wall is at least 1,1, preferably at least 1,2, more preferably at least 1,3, times the diameter of the baffles. By providing an interior cavity with such dimensions compared to the diameter of the muzzle brake the expanding gases are provided with sufficient clearance to escape forwards out of the distal end opening of the blast shield after having passed the baffles.

Brief description of the drawings

[0042] The invention will be described in more detail below by means of nonlimiting examples of embodiments and with reference to the schematic drawings, in which:

Figs. 1a-c show a first embodiment of the muzzle brake of the invention from a side view, a front view, and a cross-sectional view, respectively;
Figs. 2a-c show a second embodiment of the muzzle

brake of the invention from a side view, a front view, and a cross-sectional view, respectively;
 Figs. 3a-c show a third embodiment of the muzzle brake of the invention from a side view, a front view, and a cross-sectional view, respectively;
 Figs. 4a-c show a fourth embodiment of the muzzle brake of the invention from a side view, a front view, and a cross-sectional view, respectively;
 Fig. 5 shows a muzzle brake of the invention from a perspective view;
 Fig. 6 shows a muzzle brake of the invention from a side view;
 Figs. 7a-c show a muzzle brake of the invention from a side view, a front view, and a side view, respectively;
 Figs. 8a-c show a muzzle brake of the invention from a side view, a front view, and a side view, respectively;
 Figs. 9a-c show a blast shield of the invention from a perspective view, a side view, and a front view, respectively;
 Fig. 10 shows a blast shield of the invention from a side view;
 Figs. 11a-c show an adaptor element of the invention from a perspective view, a side view, and a front view, respectively;
 Fig. 12 shows an adaptor element of the invention from a side view;
 Fig. 13 shows an adaptor element of the invention from a side view;
 Fig. 14 shows an adaptor element of the invention from a cross-sectional view;
 Figs. 15a-b show a cap element of the invention from a perspective view and a side view, respectively;
 Figs. 16a-b show a cap element of the invention from a side view and a front view, respectively;
 Figs. 17a-b show an assembled muzzle brake system of the invention from a side view and a cross-sectional view, respectively;
 Figs. 18 shows an assembled muzzle brake system of the invention from a cross-sectional view; and
 Figs. 19a-b show an assembled muzzle brake system of the invention from a perspective view and a side view, respectively.

Detailed description of the invention

[0043] In the following, embodiments of the invention will be described in further detail. Each specific variation of the features can be applied to other embodiments of the invention unless specifically stated otherwise. Note that for illustrative purposes the dimensions, especially thicknesses, of the different elements shown may be exaggerated.

[0044] Turning first to Figs. 1a-c a first embodiment of a muzzle brake 100 of the invention is shown from a side view, a front view, and a cross-sectional view. The muzzle brake 100 comprises an elongated sheathing 101 which

extends in an axial direction (A) between a proximate end opening 102 and a distal end opening 103. When mounted on a gun, the proximate end opening 102 will be connected to the muzzle of the gun and the projectiles will be discharged from the distal end opening 103. In the shown embodiment, the elongated sheathing 101 has a cylindrical outer shape, which is generally preferred as it reduces the volume and weight of the muzzle brake 100.

[0045] The muzzle brake 100 comprises a central cylindrical bore 105 which is adapted to be arranged in extension of the gun barrel to guide the projectiles fired from the gun. The central cylindrical bore 105 connects the proximate and distal end openings 102, 103 and has a diameter adapted to accommodate the calibre of projectile fired from the gun which the muzzle brake 100 is intended to be mounted on.

[0046] The muzzle brake 100 comprises multiple groups of gas ports 110, 120, 130, 140, 150 along its length, i.e. along the axial direction. The groups 110, 120, 130, 140, 150 of gas ports each comprise one or more cylindrical gas ports which bring the central bore 105 in fluid communication with the exterior of the muzzle brake 100 to redirect the expanding gases which propels the projectile outwards in radial directions, i.e. directions perpendicular to the axial direction, whereby the recoil is counteracted when firing the gun.

[0047] In the shown embodiment, the gas ports are cylindrical passages extending radially between the cylindrical bore 105 and the exterior of the elongated sheathing 101. As the gas ports are cylindrical, the openings area of each gas port equals the radius squared of said gas port times pi. The diameter of the gas ports of each respective group 110, 120, 130, 140, 150 is made gradually greater towards the proximate end opening 102, to ensure that a larger part of the expanding gas escapes via the gas ports closer to the proximate end opening 102. This is particularly advantageous when combined with a blast shield 200 of the invention as will be described below, as the expanding gases which leaves the gas ports closer to the gun will help drive the gas escaping through the subsequent gas ports forwards and out of the distal end opening 203 of the blast shield 200.

[0048] In the shown embodiment, the muzzle brake 100 comprises five groups 110, 120, 130, 140, 150 of gas ports, each comprising four gas ports. In this embodiment, the gas ports of each respective group 110, 120, 130, 140, 150 extend from a substantially same axial position along the length of the cylindrical bore 105 and radially outwards in different direction.

[0049] In the shown embodiment, each group of gas ports 110, 120, 130, 140, 150 comprise four gas ports extend perpendicularly with respect to the neighbouring gas ports of the respective group 110, 120, 130, 140, 150. This four-fold rotational symmetric arrangement allows the gasses to escape such that the forces resulting from the gas exiting a gas port is cancelled out by force

of the gas exiting the gas port on the opposite side of the sheathing 101, whereby the muzzle brake 100 will avoid pushing the gun to the sides, upwards, or downwards when firing.

[0050] The muzzle brake 10 further comprises a baffle 160 arranged in front of each group 110, 120, 130, 140, 150 of gas ports, in front being with respect to the movement direction of the projectile in the axial direction. The baffles 160 are formed by circular rings which extend around the entire circumference of the elongate member 101 and project substantially radially outwards. Each baffle 160 is arranged so that the gasses escaping the cylindrical bore 105 from gas ports of the group 110, 120, 130, 140, 150 behind the respective baffle 160 exerts a force towards the distal end opening 103 on the baffle 160, thereby counteracting the recoil which is produced when the projectile and part of the expanding gasses leaves the muzzle brake 100. As will be explained below, the baffles 160 may in some embodiments be angled backwards, i.e. towards the proximate end opening 102, to increase this effect.

[0051] Each of the baffles 160 has been provided with a bevelled back edge 161, i.e. the edge facing the proximate end opening 102. The bevelled edge 161 allows the expanding gasses to pass the baffle 160 more easily as it flows outwards along the back surface of the baffle 160. The bevelled edge 161 may be provided on any embodiment of the invention, and preferable forms an angle between 5 and 45 degrees with respect to the radial direction. Furthermore, the bevelled edge 161 preferably has a width of at least one fifth of the width of the baffle 160.

[0052] The muzzle brake 100 further comprises an exterior thread 104 at its proximate end 102. Whereas muzzle brakes of the prior art are often mounted on the gun barrel by means of an interior thread adapted to mate with an exterior thread on the gun barrel, the muzzle brake 100 of the invention is capable of being mounted on the gun by means of an adaptor element 300 (described below).

[0053] Remounting the muzzle brake 100 of the invention on other guns with the same or smaller calibre than the gun which the muzzle brake 100 is intended for, can therefore be done simply by using an adaptor element 300 adapted for the respective gun and attaching the muzzle brake 100 to that adaptor element 300. As the adaptor element 300 is substantially less costly than the muzzle brake 100, it is more cost-efficient to acquire a new adaptor element 300 and remounting the muzzle brake 100 than acquiring a new muzzle brake 100. This makes the muzzle brake 100 more versatile and possible to remount.

[0054] Turning now to Figs. 2a-c a second embodiment of a muzzle brake 100 of the invention is shown from a side view, a front view, and a cross-sectional view. The shown embodiment differs from that of Figs. 1a-c in that the baffles 160 are angled backwards, i.e. angled towards the proximate end opening 102, at an angle of 15

degrees with respect to the radial direction, i.e. an angle of 75 degrees with respect to the axial direction. Because the baffles 160 are angled backwards, the gasses flowing out of each respective group of gas ports 110, 120, 130, 140, 150 are able to exert a greater pressure on the back surface of the baffle 160 associated with said group 110, 120, 130, 140, 150. Hence, the counteraction of the recoil can be even greater, as the forward directed force exerted by the gasses on the muzzle brake 100, and thus the gun, is greater.

[0055] Similarly, Figs. 3a-c and Figs. 4a-c respectively show embodiments where the baffles 160 are angled backwards at an angle of 25 degrees with respect to the radial direction, i.e. an angle of 65 degrees with respect to the axial direction and are angled backwards at an angle of 40 degrees with respect to the radial direction, i.e. an angle of 50 degrees with respect to the axial direction. The angle of the baffles 160 may depend on the calibre of projectile to which the cylindrical bore 105 is intended to accommodate.

[0056] Fig. 5 shows a perspective view of a muzzle brake 100 according to the invention. The shown embodiment and the previously shown embodiments may all further comprise a radially projecting ring/rim 106 arranged between the gas ports and the exterior thread 104 of the muzzle brake 100. The radially projecting ring 106 serves two purposes, the first being the deflect the gasses deflected rearwards by the baffles 160 so the gasses do not hit the shooter, and the second being to support and stabilize the muzzle brake 100 when it is mounted in an adaptor element 300 as will be described below.

[0057] Fig. 6 shows the opening area of the gas ports of a particular embodiment of the muzzle brake 100. As can be seen from the indicated diameter, the diameter of the gas ports of each respective group 110, 120, 130, 140, 150 are made larger for each subsequent group 110, 120, 130, 140, 150 towards the proximate end opening 102. This ensures that more of the expanding gas flows out from the base of the muzzle brake 100, i.e. the group 110 closest to the proximate end opening 102, than from the subsequent groups 120, 130, 140, 150. This gradual reduction of the opening area towards the distal end opening 103 is particularly advantageous, when the muzzle brake 100 is combined with a blast shield 200 as will be described below.

[0058] Figs. 7a-c and Figs. 8a-c show the dimensions of two particular embodiments of the muzzle brake 100 of the invention. All measurements are given in mm.

[0059] Turning now to Figs. 9a-c, a blast shield 200 of the invention is shown from a perspective view, a side view, and a front view, respectively. The blast shield 200 is designed to shield the shooter of the gun from the sound and gasses which are deflected backwards when using the muzzle brake 100 of the invention. The blast shield 200 has a distal end opening 203 and a proximate end opening 202. The proximate end opening 202 is adapted to face the gun and to close around either the

barrel of the gun, the muzzle brake 100, or the adaptor 300 described below so that the gasses are prevented from escaping through the proximate end opening 202 and the backwards propagating sound and concussion are diverted forward. The distal end opening 203 is adapted to face away from the gun and the shooter and to allow the gasses to escape forwards after they have escaped the gas ports of the muzzle brake 100.

[0060] The blast shield 200 comprises a circumferential wall 201 which extends between the proximate and distal end openings 202, 203 to define an inner cavity 207 adapted for housing the muzzle brake 100. The dimensions of the inner cavity 207 is such that a gap is formed between the circumferential wall 201 and the baffles 106, when the blast shield 200 is arranged around the muzzle brake 100.

[0061] The blast shield 200 comprises an interior surface 205 of the circumferential wall 201 which has a conical shape. The conical shape is wider towards the distal end opening 203. The conical shape of the inner cavity 207 promotes the forward flow of the propellant gasses to facilitate the gas from escaping out of the blast shield 200 after the gas has exerted a force on the baffles 160. The conical shape works particularly well in combination with the gradually increasing opening area of the groups 110, 120, 130, 140, 150 of gas ports, as the gasses expelled from the most backwards group 110 helps drive the gas expelled from the subsequent group 120 and thereafter the groups 130, 140, 150 following, i.e. in the direction of flight of the projectile. Furthermore, the bevelled edges 161 of the baffles 160 facilitate the forward movement of the gasses after they have exerted the force on the backside surface of the baffles 160 by allowing the gas to flow around the baffles 160 more easily.

[0062] The blast shield 200 comprises an interior thread 204 which is adapted for engagement with a corresponding exterior thread 306 on an adaptor element 300 which will be described below. The blast shield 200 further comprises a locking bore 206 which is located near the proximate end opening 202 and extends radially. The locking bore 206 is adapted for engagement with a complimentary locking element (not shown) to keep the blast shield 200 from becoming unscrewed from the adaptor element 300. In the shown embodiment, the locking bore 206 is provided with a thread so that a screw providing the corresponding locking element can be screwed in until it abuts the exterior thread 306 of the adaptor element 300, thus preventing the blast shield 200 from becoming unscrewed.

[0063] Fig. 10 show the dimensions of a particular embodiment of the blast shield 200. All measurements in the figure are given in mm.

[0064] Turning now to Figs. 11a-c, an adaptor element 300 of the invention is shown from a perspective view, a side view, and a front view, respectively. The adaptor element 300 is adapted to mount the muzzle brake 100 and optionally also the blast shield 200 on the barrel of the gun. The adapter element 300 comprises a casing

301 which extends in an axial direction between a proximate end opening 302 and a distal end opening 303. The proximate end opening 302 is adapted to face the gun and the distal end opening is adapted to face away from the gun and face the muzzle brake 100.

[0065] The casing 301 defines a central passage 308 which extends between the proximate and distal end openings 302, 303, said central passage 308 having a minimum width which allows passage of the calibre shot by the gun which the muzzle brake 100 is designed to work with. The adaptor element 300 comprises a first interior thread 304 in the central passage 308 at the proximate end opening 302. The first interior thread 304 is adapted to engage a corresponding exterior thread on the muzzle of the gun to attach the adaptor element 300 on the gun.

[0066] The adaptor element 300 further comprises a second interior thread 305 in the central passage 308 at the distal end opening 303 of the adaptor element 300. The second interior thread 305 is adapted to engage the exterior thread 104 of the muzzle brake 100 to attach the muzzle brake 100 to the adaptor element 300 and thus also to the gun.

[0067] The adaptor element 300 further comprises an exterior thread 305 at the distal end opening 303 of the adaptor element 300. The exterior thread 306 is adapted to engage the interior thread 204 of the blast shield 200 to attach the blast shield 200 to the adaptor element 300 and thus also to the gun.

[0068] The adaptor element 300 further comprises a tool engagement portion 307 on the exterior of the casing 301. The tool engagement portion is provided by two opposite flat surfaces adapted to be engaged by pliers or similar, so that the adaptor element 300 can be easily screwed onto the gun.

[0069] The exterior surface of the casing 301 is preferably provided with markings 309 which indicate the thread measurement of the first interior thread 304, the second interior thread 305, and/or the exterior thread 306, and thus also the thread measurement of the exterior thread on the gun barrel, the exterior thread 104 of the muzzle brake 100, and/or the interior thread 204 of the blast shield 200, so that the shooter can easily identify which adaptor element 300 to use for a specific gun.

[0070] At the distal end opening 303, the central passage 308 comprises an expanded portion 310 with a greater diameter than the portion of the central passage 308 having the second interior thread 305. The expanded portion 310 is arranged between the distal end opening 303 and the second interior thread 305 and has a diameter substantially corresponding to that of the radially projecting ring 106 of the muzzle brake 100 so that the radially projecting ring 106 abuts the expanded portion 310 when the muzzle brake 100 is screwed into the adaptor element 300, whereby the expanded portion 310 can support and stabilize the muzzle brake 100 during use.

[0071] Due to the modular assembly of the muzzle brake system 400, the shooter need only one blast shield

200 which will fit almost any calibre of gun, with the exception of very large calibre guns, which might require additional blast shields 200. The shooter will also be able to use a single muzzle brake 100 for all of his guns which use the calibre to which that muzzle brake is intended for, whereas muzzle brakes of the prior art also had to be specifically chosen to fit the outer dimensions of the gun barrel. Thus the muzzle brake system 400 of the invention becomes more versatile and cost efficient, as the adaptor element 300 allows the more expensive parts to be moved between guns.

[0072] Figs. 13, 14, and 15 show particular embodiments of the adaptor element 300 of the invention with measurements indicated. All measurements are given in mm. Figs 13 and 14 are side-views while Fig. 15 is a cross-sectional view taken along the A-A line depicted in Fig. 11b.

[0073] Turning now to Figs. 15a-b, a cap element 500 of the invention is shown from a perspective and a side view, respectively. The cap element 500 is adapted to cover the exterior thread 306 of the adaptor element 300, when the blast shield 200 is not mounted. The cap element 500 comprise a hollow cylindrical element 501 which extend in an axial direction A between a proximate end opening 502 and a distal end opening 503. The proximate end opening 502 is adapted to face the adaptor element 300 and the gun and the distal end opening 503 is adapted to face away from the gun.

[0074] The cap element 500 comprises a threaded interior surface 506 which is adapted to engage the exterior thread 306 of the adaptor element 300 to attach the cap element 500 onto the adaptor element 300 when the blast shield 200 is not mounted on the adaptor element 300. This protects the exterior thread 306 of the adaptor element 300 from accumulating dirt and prevents damage to the exterior thread 306 which could occur if the exterior thread 306 was left exposed during use.

[0075] The cap element 500 further comprises an exterior handling surface 504 which is rough so that is the shooter can get a better grip on the handling surface 504 to screw/unscrew the cap element 500 on/from the exterior thread 306 of the adaptor element 300. In the shown embodiment, the handling surface 504 is provided with grooves extending in the axial direction to provide the rough surface. This gives the shooter a much better grip when rotating the cap element 500.

[0076] Similar to the blast shield 200, the cap element 500 may comprise a radially extending locking bore 505 adapted for retaining a corresponding locking element to prevent the cap element 500 from becoming unintentionally unscrewed. The locking bore 505 is preferably provided with a thread and the corresponding locking element by a screw.

[0077] Figs. 16a-b show a particular embodiment of the cap element 500 from a side and front view, respectively, with the dimensions indicated. All dimensions are given in mm.

[0078] Turning now to Figs. 17a-b, the assembled

muzzle brake system 400 of the invention is shown from a side view and a cross-sectional view, respectively. The two figures show how the muzzle brake 100 is attached to the adaptor element 300 by means of the mutual engagement of the exterior thread 104 of the muzzle brake 100 and the second interior thread 305 of the adaptor element 300. The two figures also show how the blast shield 200 is attached to the adaptor element 300 by means of the mutual engagement of the interior thread 204 of the blast shield 200 and the exterior thread 306 of the adaptor element 300. The muzzle brake 100 and the blast shield 200 can thus be mounted onto the muzzle of a gun by engaging the first interior thread 304 of the adaptor element 300 with an exterior thread on the gun barrel.

[0079] Fig. 18 shows a cross-sectional view taken along the A-A line indicated in Fig. 17a of the assembled muzzle brake system 400. In Fig. 18, the flow of gas following the shooting of the gun on which the muzzle brake system 400 is mounted is shown by the arrows going into the adaptor element 300 and subsequently entering the muzzle brake 100 through the proximate end opening 102 and exiting through the gas ports.

[0080] Due to the opening area of the gas ports of the group 110 closest to the proximate end opening 102 of the muzzle brake 100, more gas is able to flow out from this group 110 thereby building up a greater pressure at the base of the inner cavity 207 of the blast shield 200, i.e. the portion of the inner cavity 207 towards the proximate end opening 202 of the blast shield 200. This allows the gas which has escaped through the first group 110, counting from the proximate end opening 102, to push forward the gas which has escaped through the second group 120 and so forth.

[0081] The bevelled edges 161 of the baffles 160 further promotes this forwards motion of the gasses by making it easier for the gas to pass the edge of the baffle 160 once it has exerted a pressure on the baffle 160. This is further promoted by the concave shape of the inner cavity 207 of the blast shield 200.

[0082] Turning now to Figs. 19a-b, an alternative configuration of the muzzle brake system 600 of the invention is shown from a perspective and a side view, respectively. In this configuration, the muzzle brake system 600 is assembled with the cap element 500 instead of the blast shield 200. This configuration may be preferred in situations where sound reduction is considered less important so that the blast shield 200 can be omitted. Instead, the cap element 500 may be screwed onto the exterior thread 306 of the adaptor element 300 to protect the exterior thread 306 and prevent dirt from accumulating within the pitches of the exterior thread 306.

[0083] In general, the muzzle brake 100, the blast shield 200, the adaptor element 300, and the cap element 500 are preferably made from metal, alloys, or composite. The cap element may alternative be made from plastics as it does not have the same durability requirements as the remaining components.

List of reference numbers

[0084]

100 muzzle brake
101 sheathing
102 proximate end opening of the muzzle brake
103 distal end opening of the muzzle brake
104 exterior thread of the muzzle brake
105 cylindrical bore
106 radially projecting ring
110 group of gas ports
120 group of gas ports
130 group of gas ports
140 group of gas ports
150 group of gas ports
160 baffles
161 bevelled edges of the baffles
200 blast shield
201 circumferential wall of the blast shield
202 proximate end opening of the blast shield
203 distal end opening of the blast shield
204 interior thread of the blast shield
205 inner surface of the blast shield
206 locking bore
207 inner cavity of the blast shield
300 adaptor element
301 casing
302 proximate end opening of the adaptor element
303 distal end opening of the adaptor element
304 first interior thread of the adaptor element

305 second interior thread of the adaptor element
306 exterior thread of the adaptor element
5 307 tool engagement portion
308 central passage
309 markings indicating thread measurements
10 310 enlarged portion
400 muzzle brake system
15 500 cap element
501 hollow cylindrical element
502 proximate end opening of the cap element
20 503 distal end opening of the cap element
504 handling surface
25 505 locking bore of the cap element
506 interior thread of the cap element
600 muzzle brake system
30

Claims

1. A muzzle brake for countering the recoil of a gun, the muzzle brake comprising:
- an elongated sheathing extending in an axial direction;
a cylindrical bore in said sheathing extending in the axial direction between a proximate end opening for entry of a projectile and a distal end opening for exit of the projectile;
at least two groups of each at least one gas port, said groups being distributed in said axial direction, each gas port extending radially through the sheathing; and
a baffle associated with each group of gas ports, each baffle projecting outwardly from and extending around an outer circumference of the sheathing.
2. The muzzle brake of claim 1, wherein an opening area of at least one gas port in one said group closer to the proximate end opening is greater than an opening area of at least one gas port of another said group closer to the distal end opening.
3. The muzzle brake of any of the previous claims,

wherein the baffles are angled towards the proximate end.

4. The muzzle brake of any of the previous claims, wherein an edge, said edge facing the proximate end opening, of one or more of the baffles is bevelled. 5
5. The muzzle brake of any of the previous claims, wherein the opening area of the gas port(s) of each group is greater than the opening area of the gas port(s) of the neighbouring group towards the distal end. 10
6. The muzzle brake of any of the previous claims, wherein each group of gas ports comprises four gas ports. 15
7. The muzzle brake of claim 6, wherein the gas ports of each respective group extends radially and perpendicularly with respect to the neighbouring gas ports of said group. 20
8. The muzzle brake of any of the previous claims, wherein the sheathing comprises an exterior thread at the proximate end opening. 25
9. A muzzle brake system for countering the recoil and, optionally, for diverting the sound and concussion of a gun, said system comprising a muzzle brake according to any one of the previous claims and at least one further element selected from a group consisting of: 30
 - a blast shield with a distal end opening and a proximate end opening, said blast shield comprising a circumferential wall extending between the proximate and distal end openings and defining an inner cavity for housing the muzzle brake, said circumferential wall being dimensioned to extend around the muzzle brake so that a gap is formed between the circumferential wall and the baffles when the muzzle brake system is assembled, wherein an interior surface of the circumferential wall has a conical shape which is wider towards the distal end opening; and 40
 - an adapter element comprising 45

a casing with a proximate end opening and a distal end opening, 50

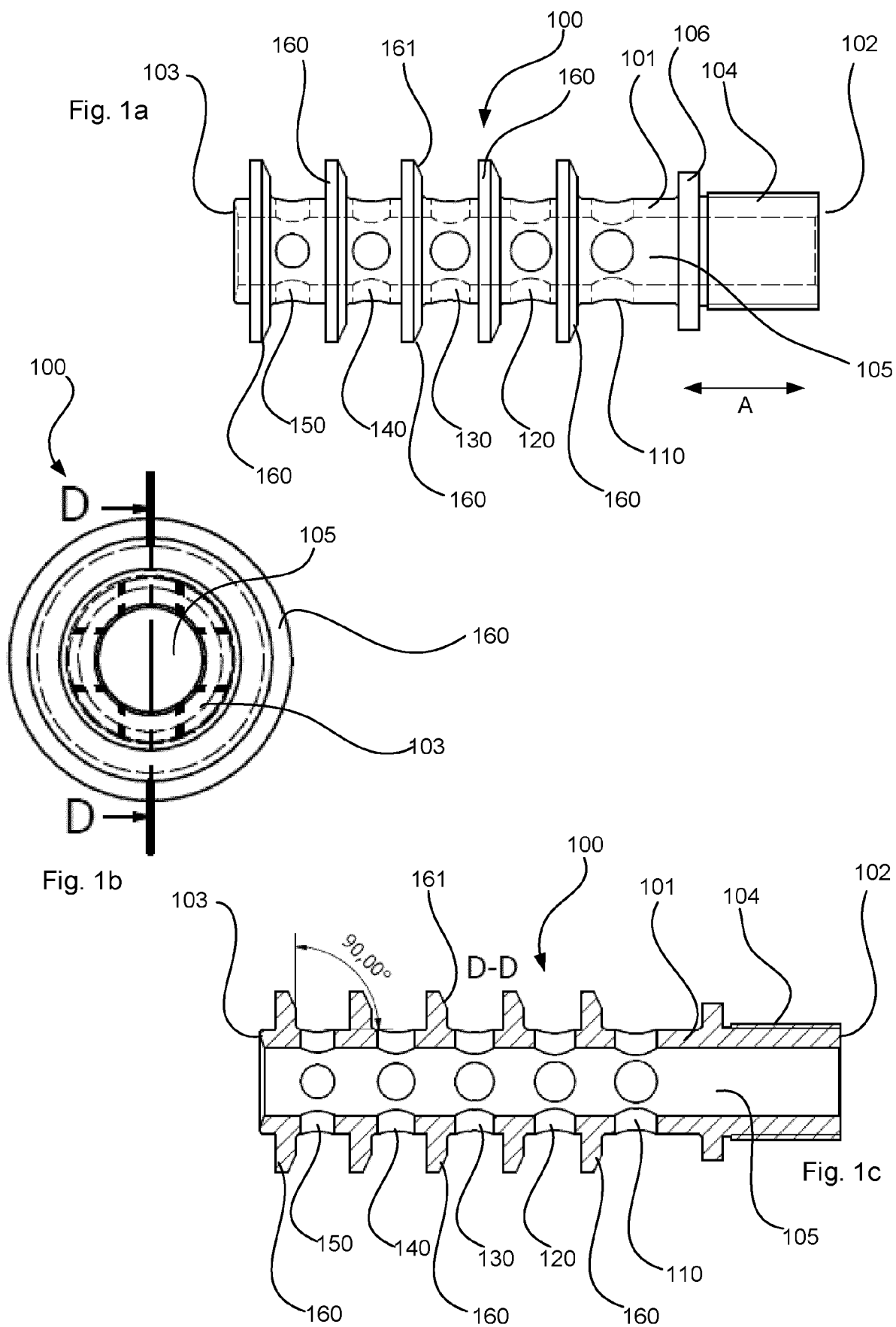
a central passage extending between the proximate and the distal end openings,

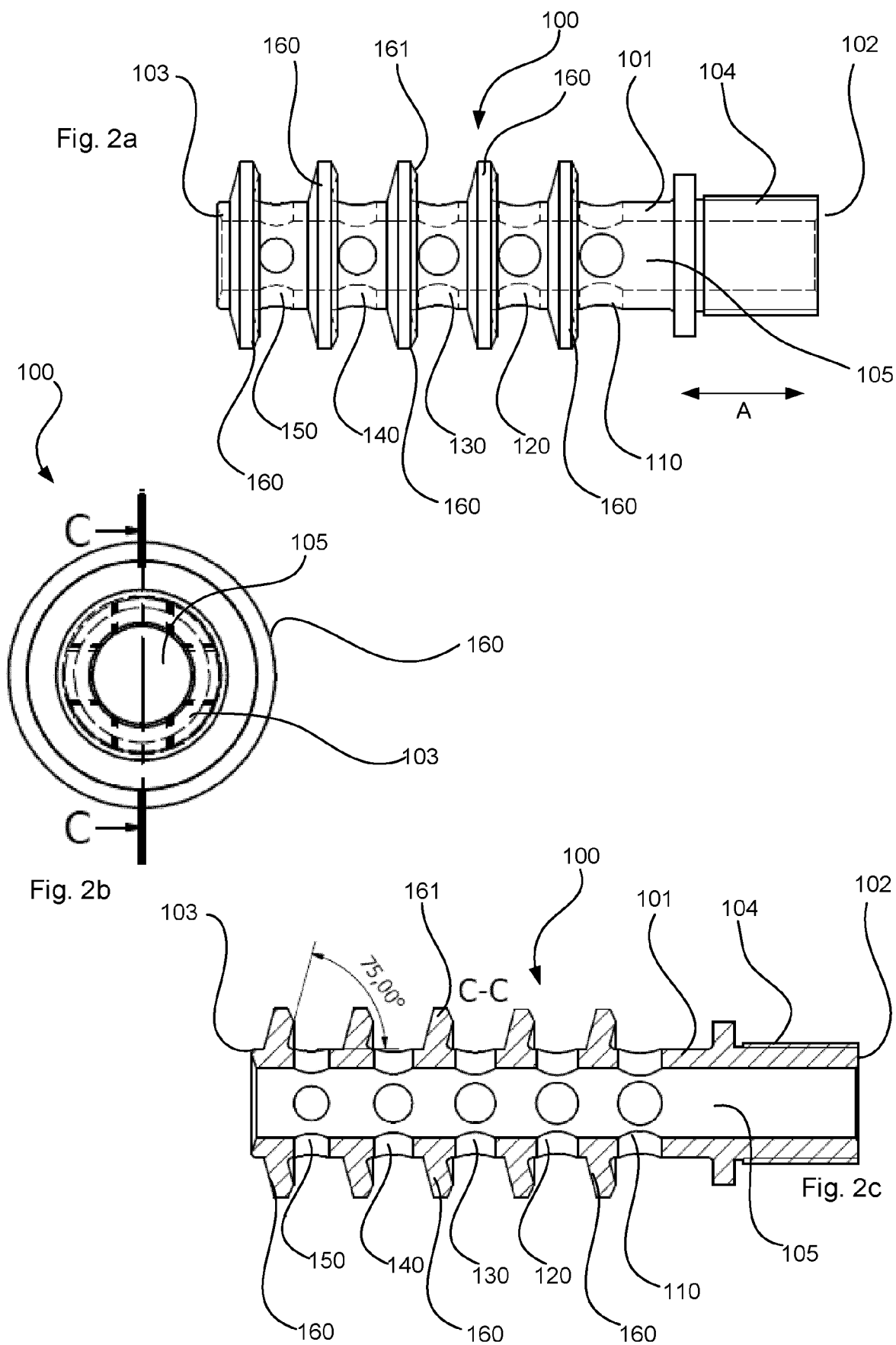
a first interior thread in the central passage at the proximate end opening, said first interior thread being adapted to engage a thread on the barrel of the gun to attach the adaptor element to the muzzle of the gun, 55

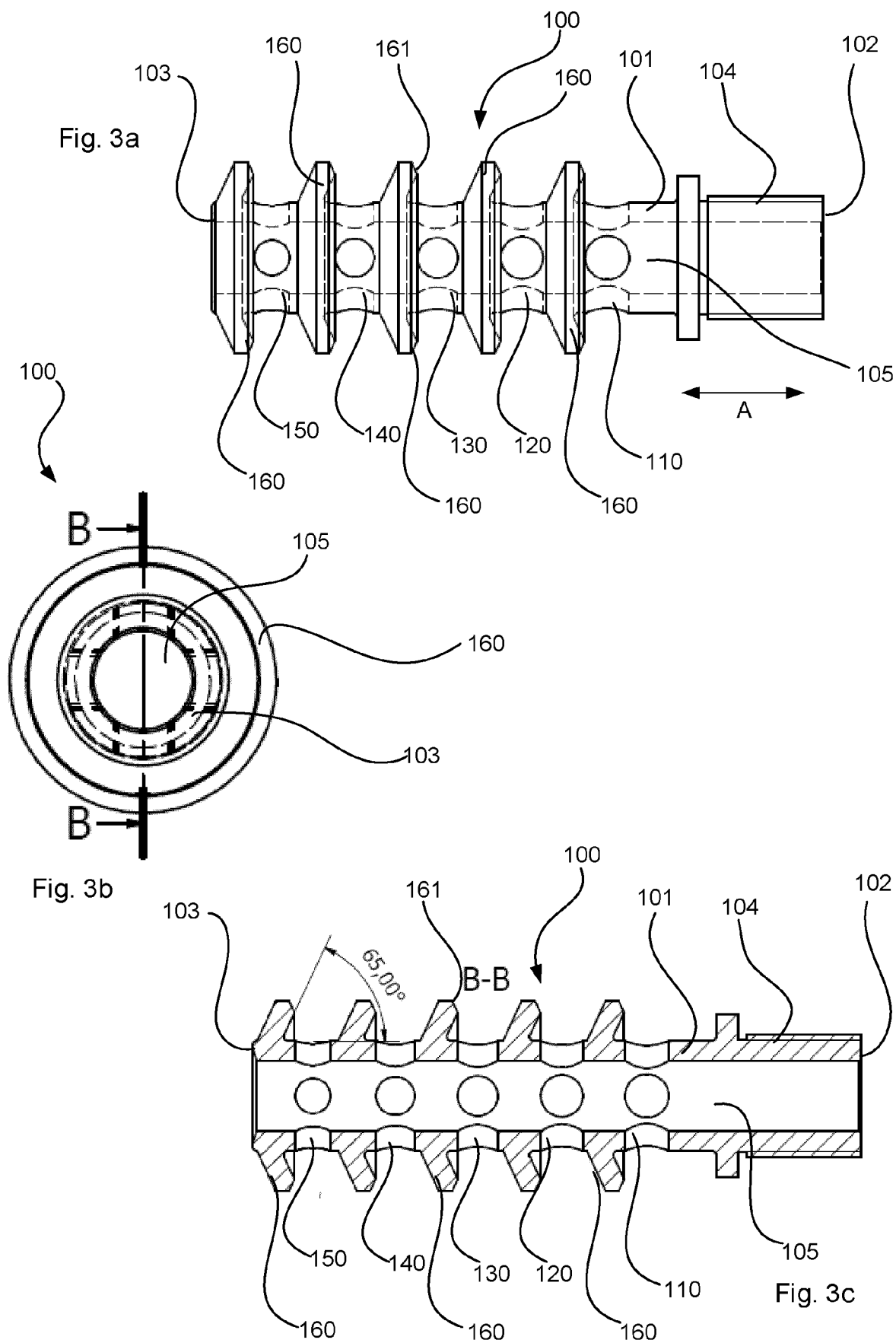
a second interior thread in the central passage at the distal end, said second interior thread being adapted to attach the muzzle brake to the adaptor element, and

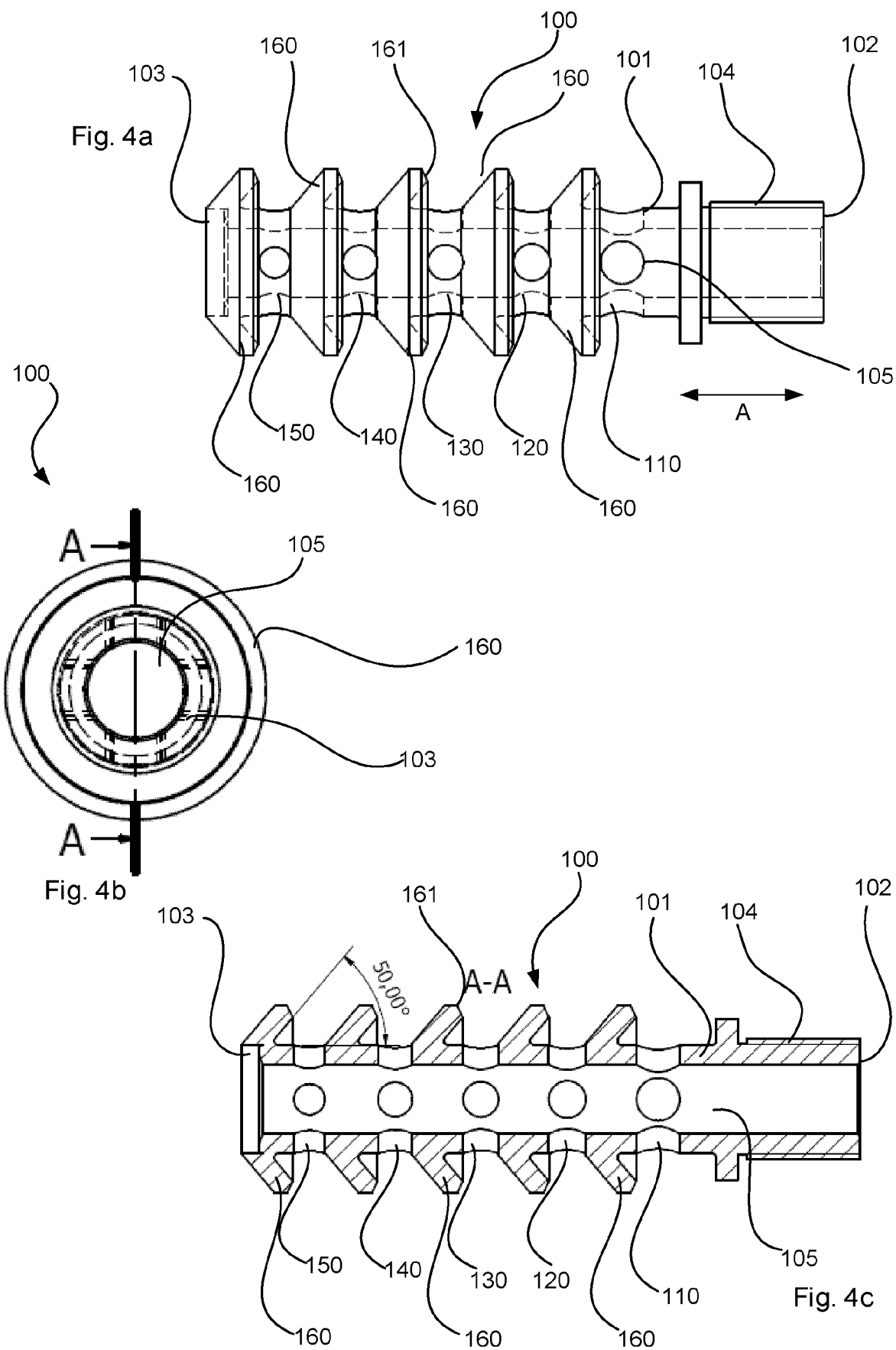
optionally, an exterior thread at the distal end, said exterior thread being adapted to attach the blast shield to the adaptor element.

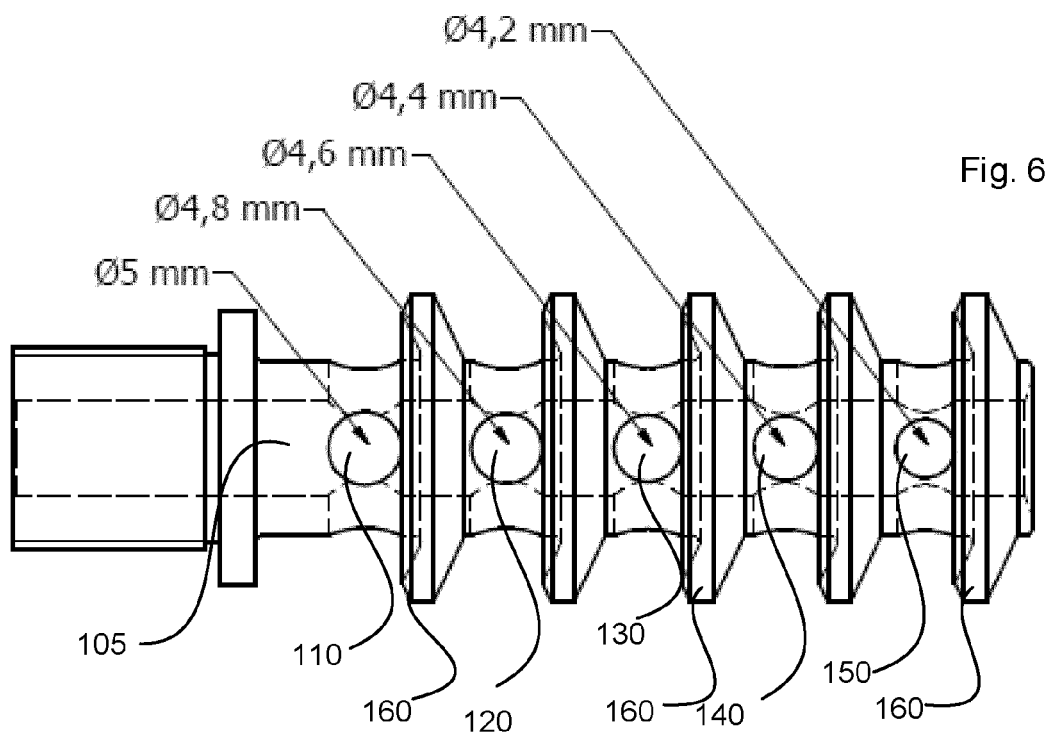
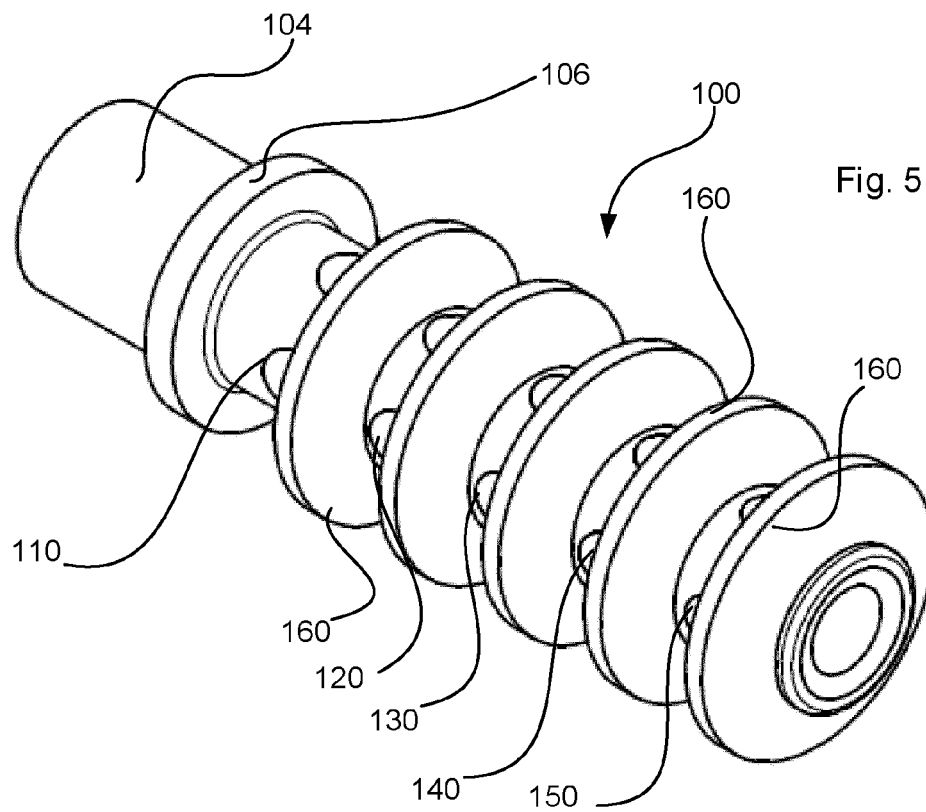
10. The muzzle brake system of claim 9, further comprising a cap adapted to cover the external thread of the adaptor element.

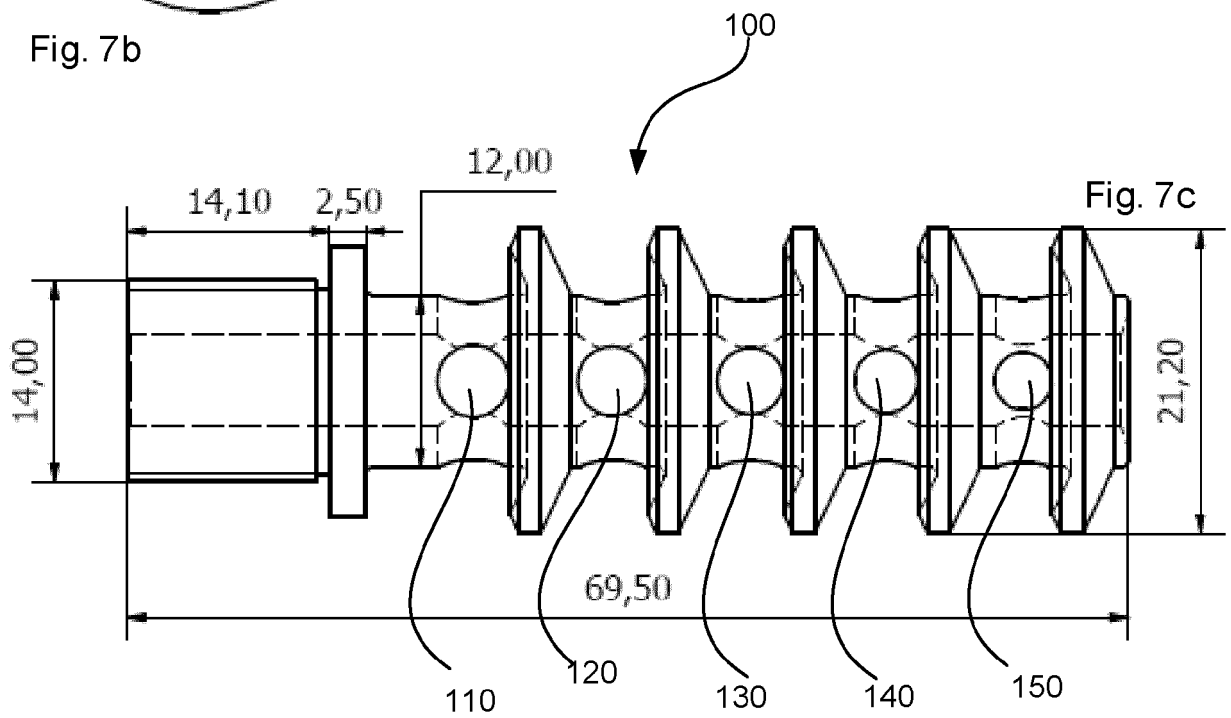
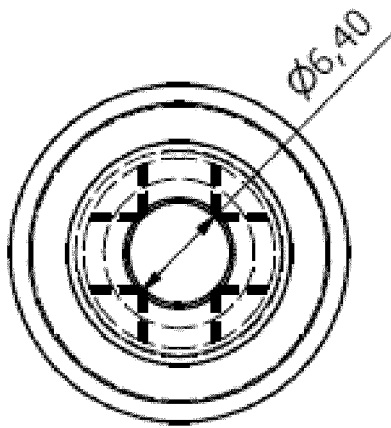
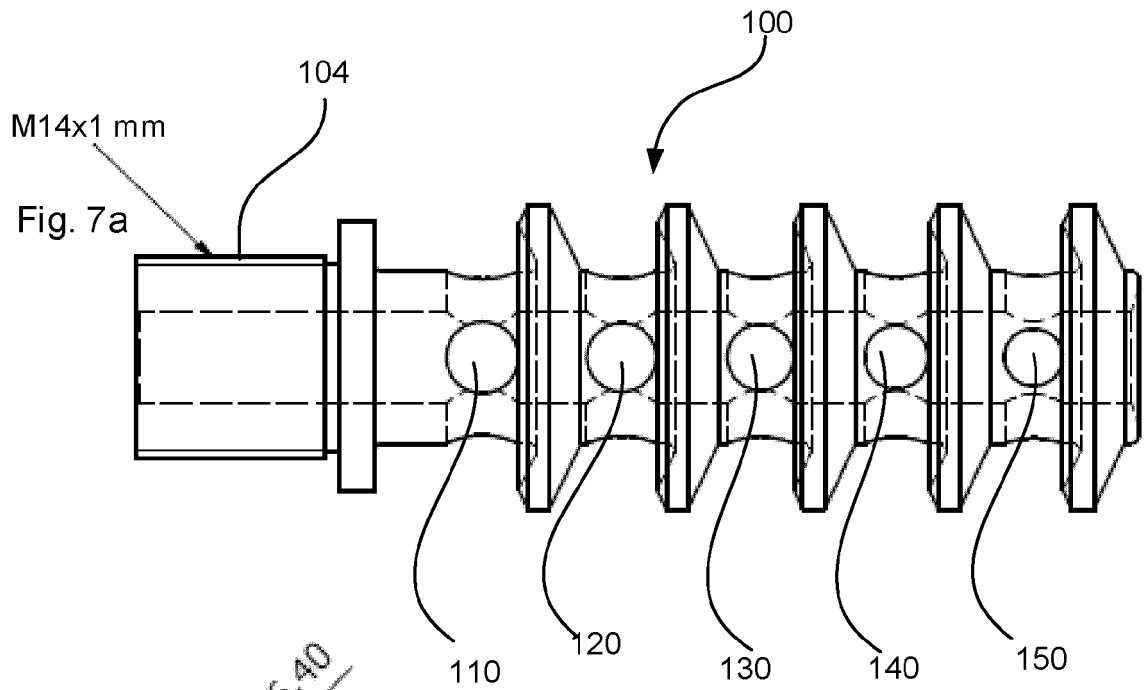












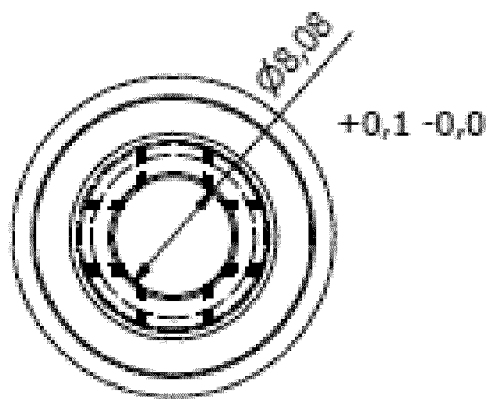
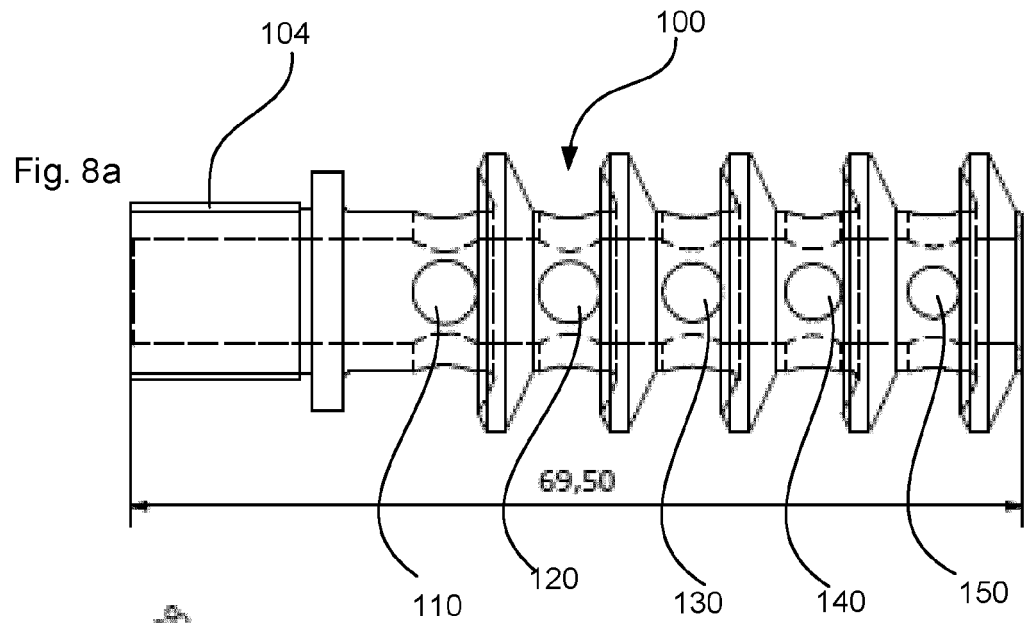


Fig. 8b

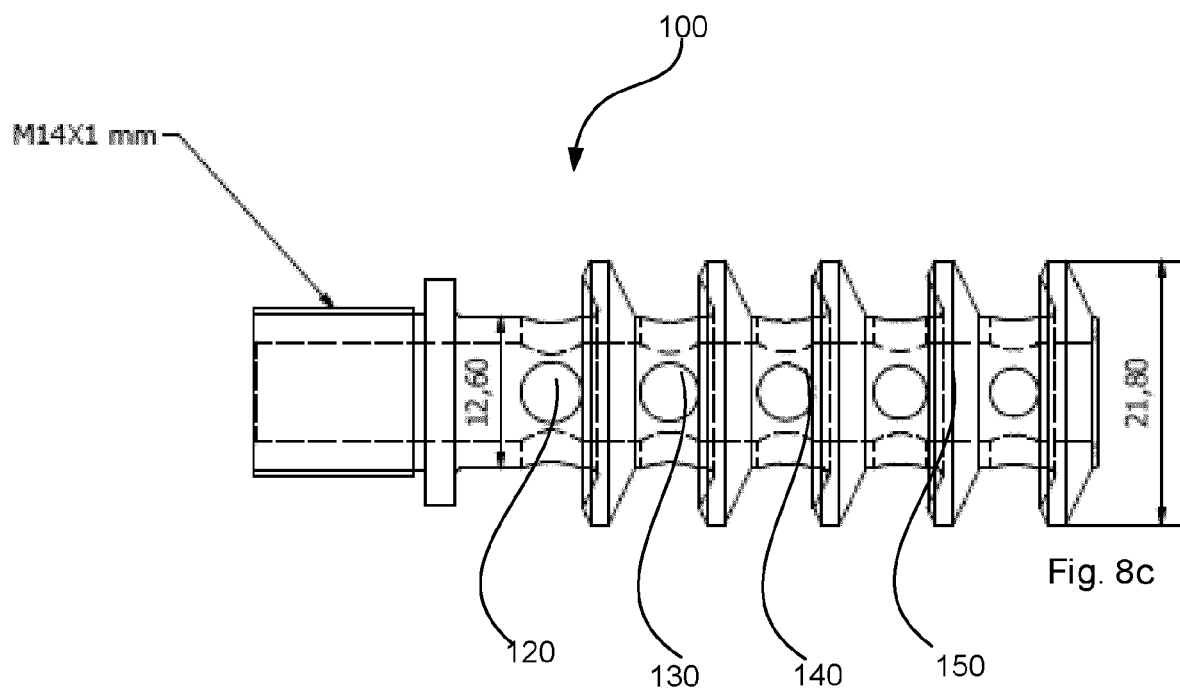


Fig. 8c

Fig. 9a

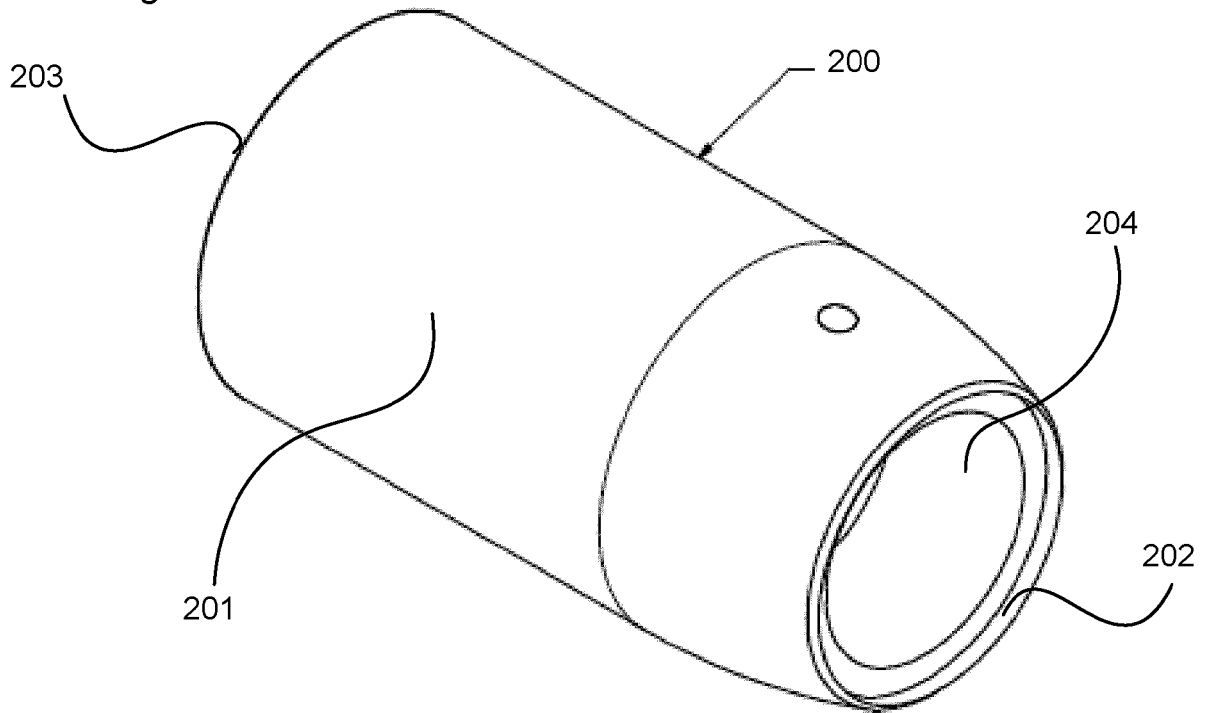
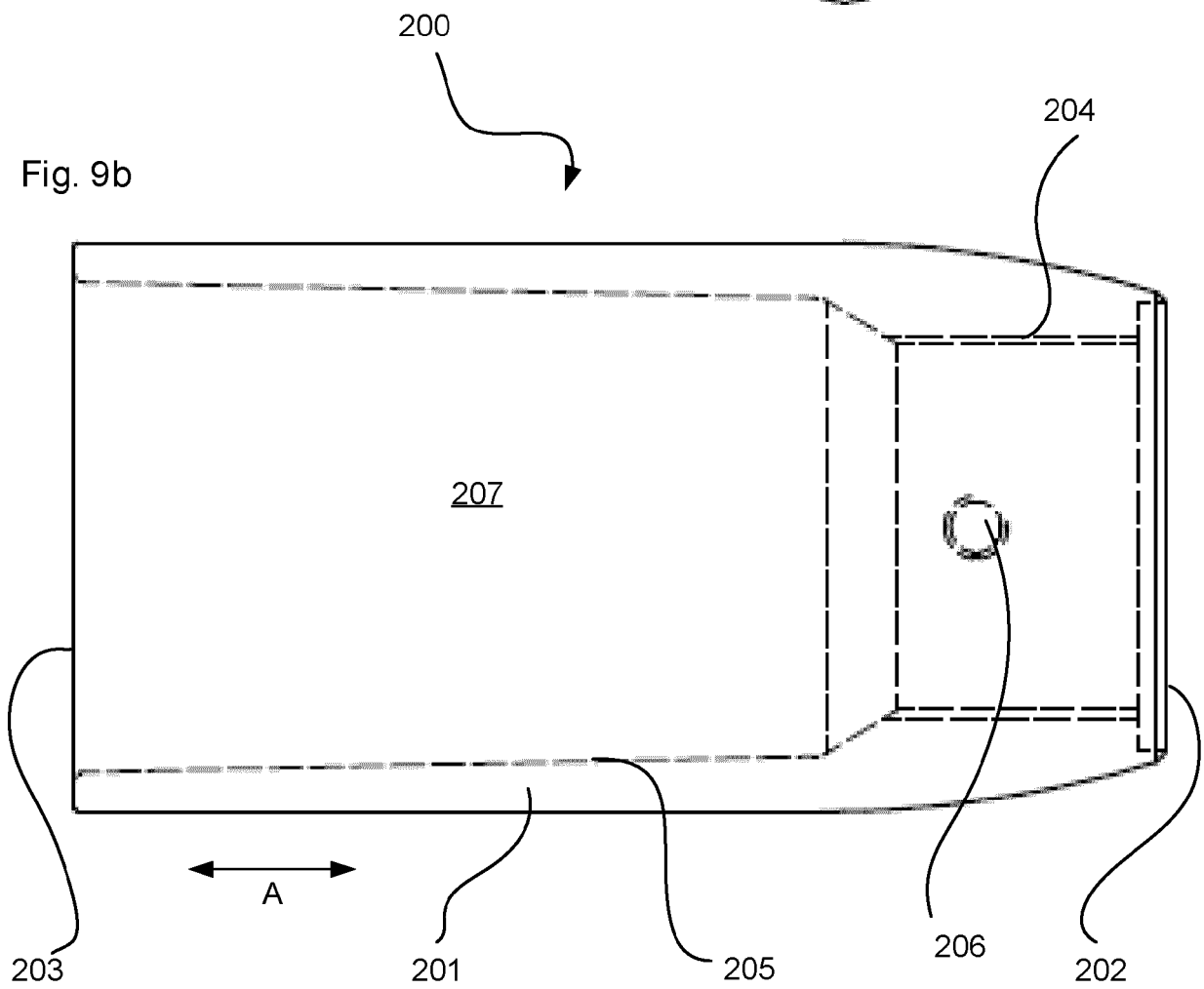
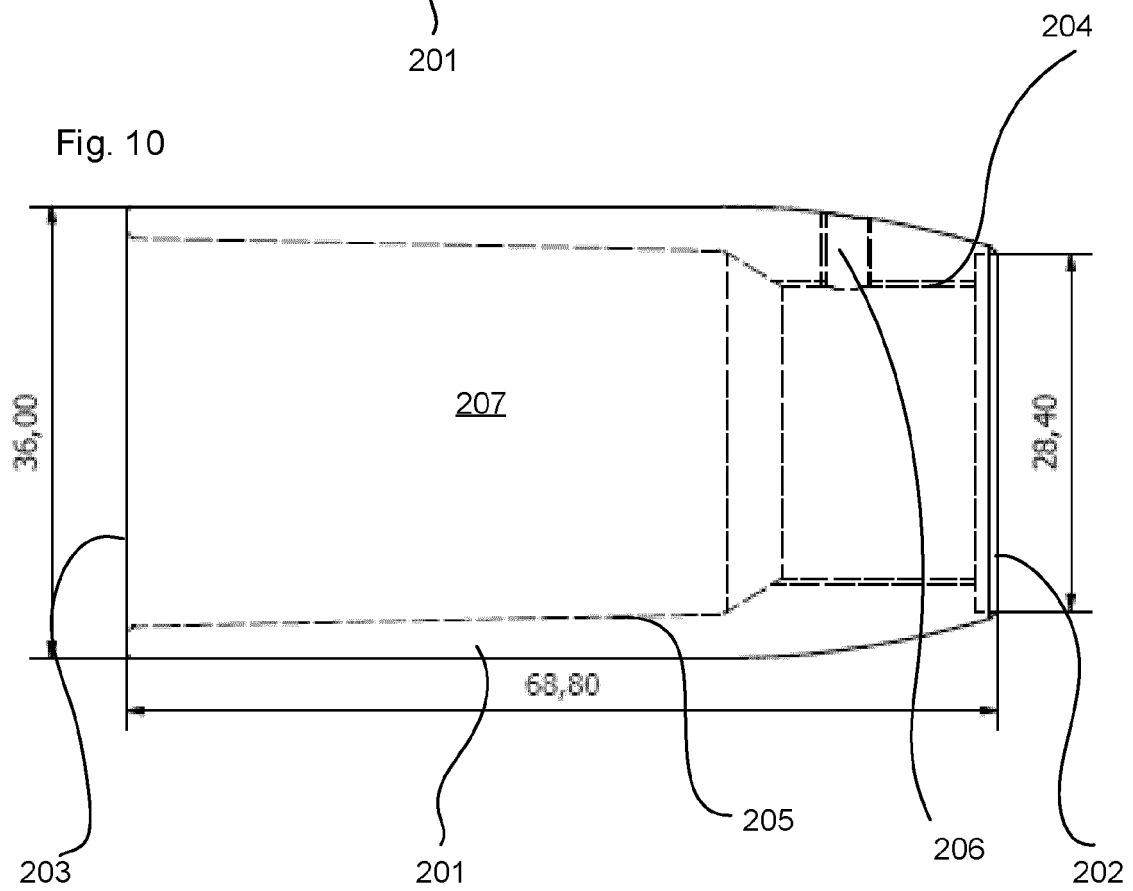
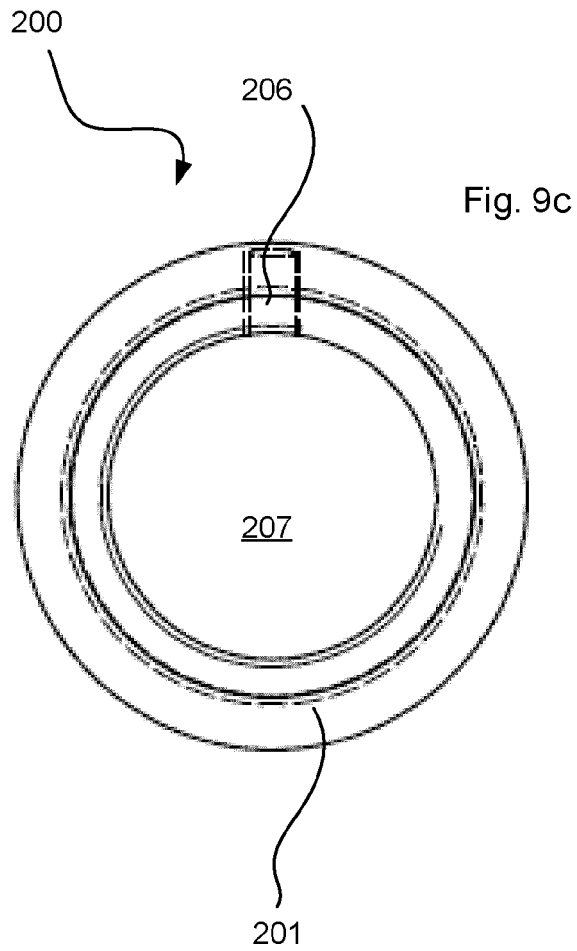
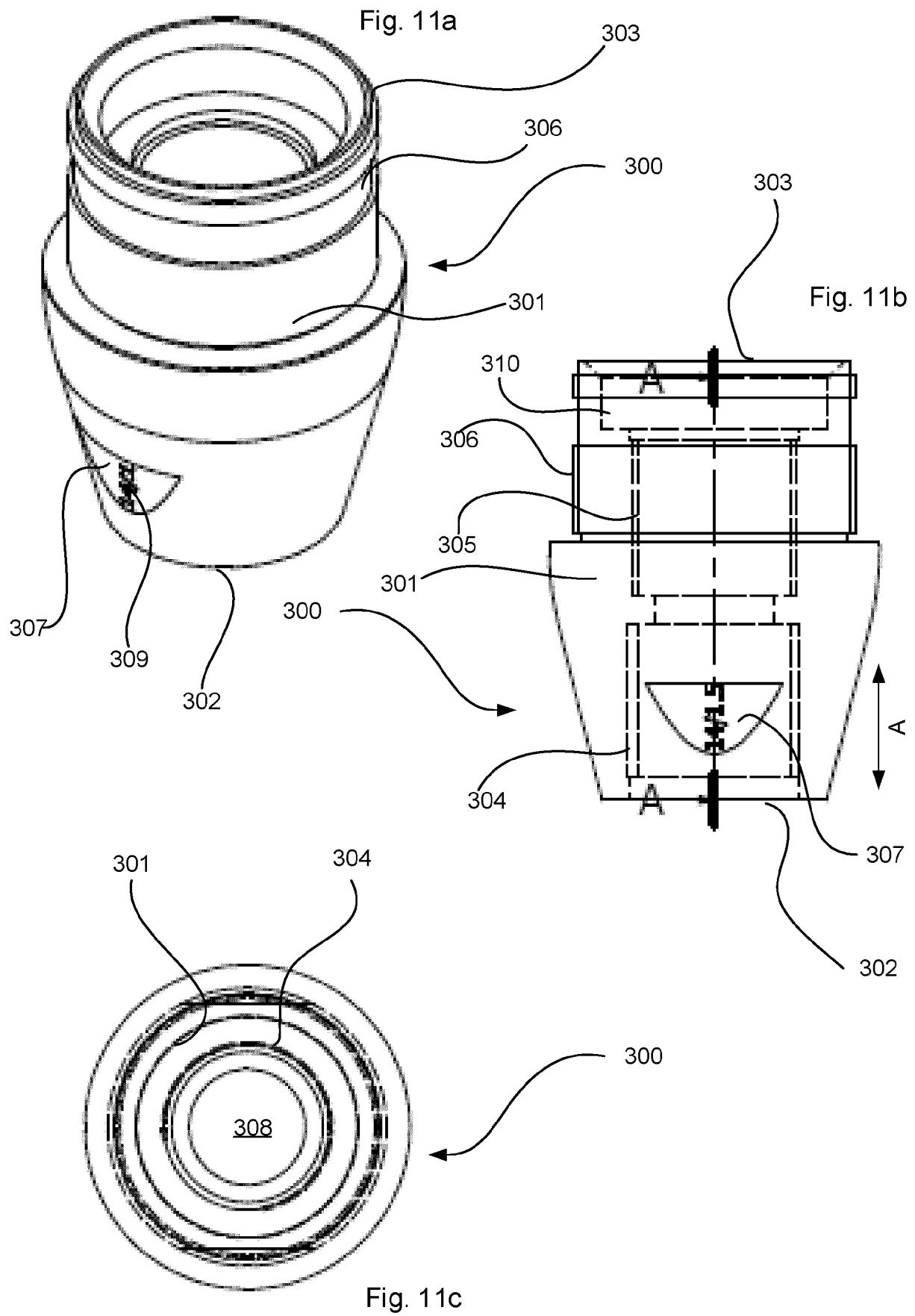


Fig. 9b







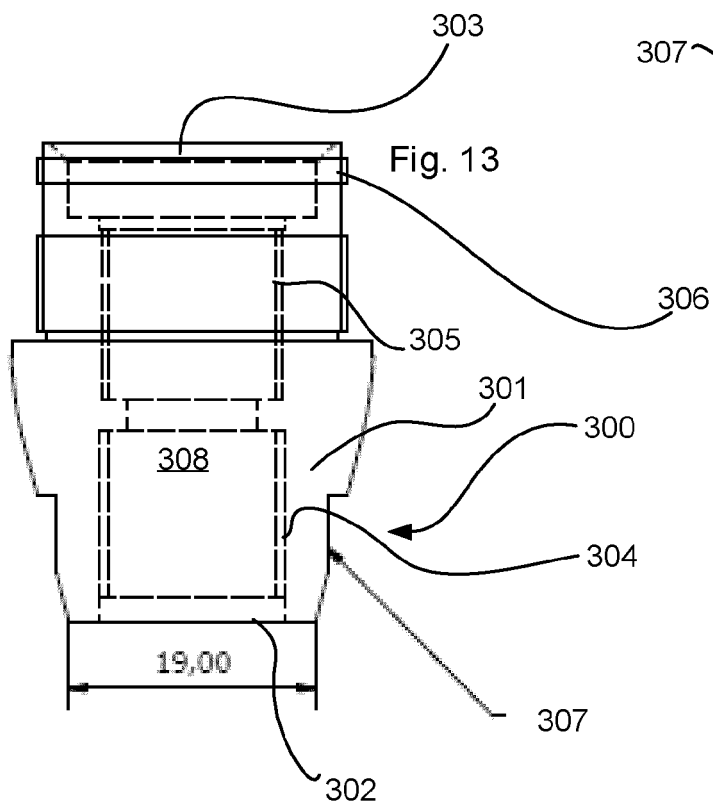
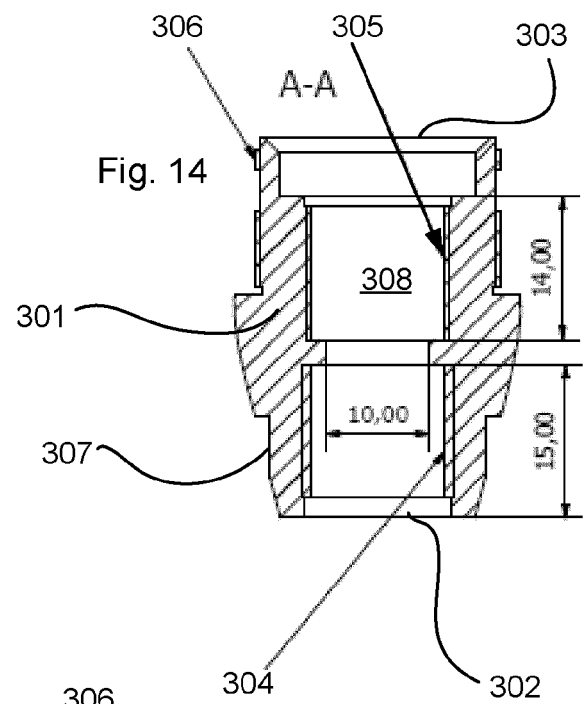
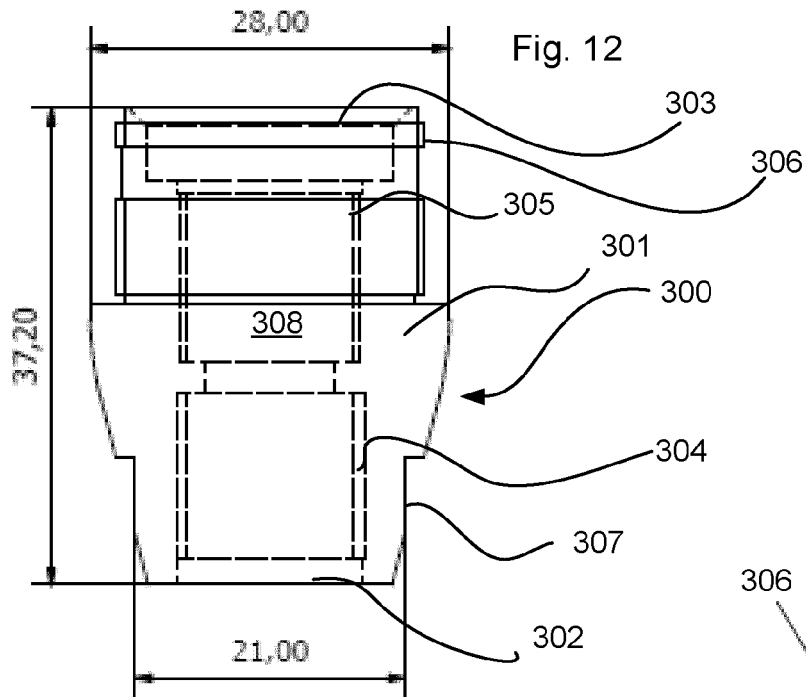


Fig. 15a

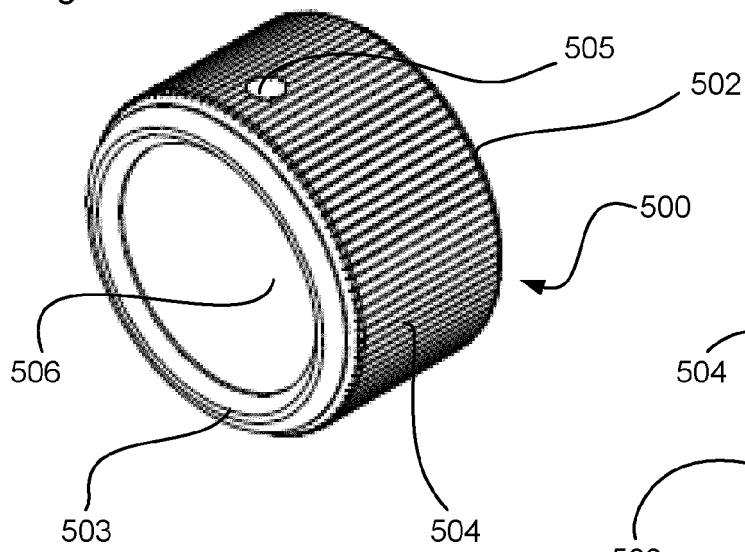


Fig. 15b

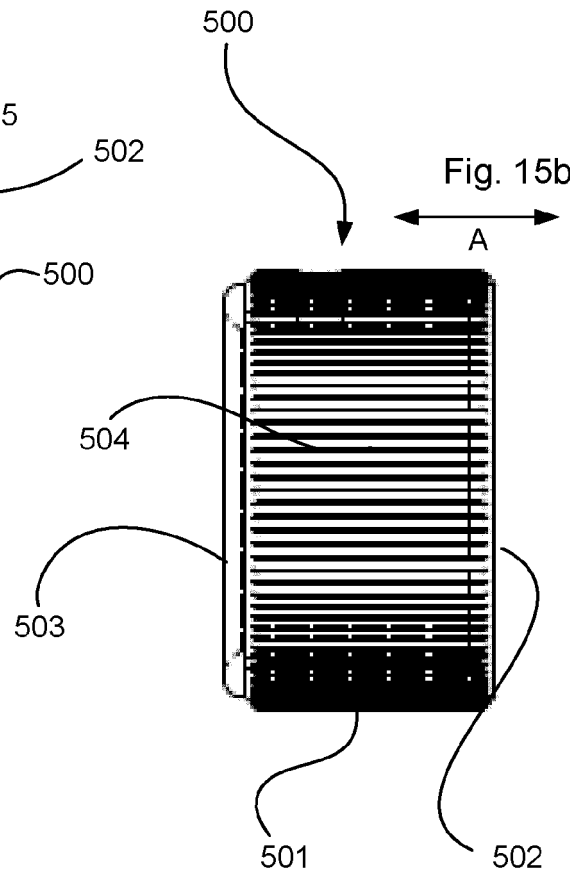


Fig. 16a

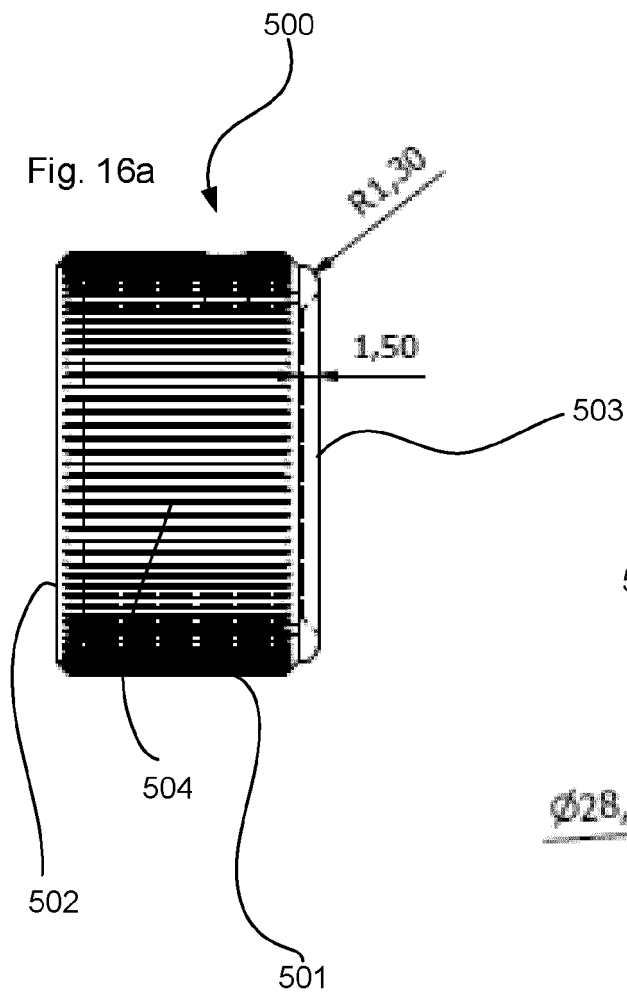
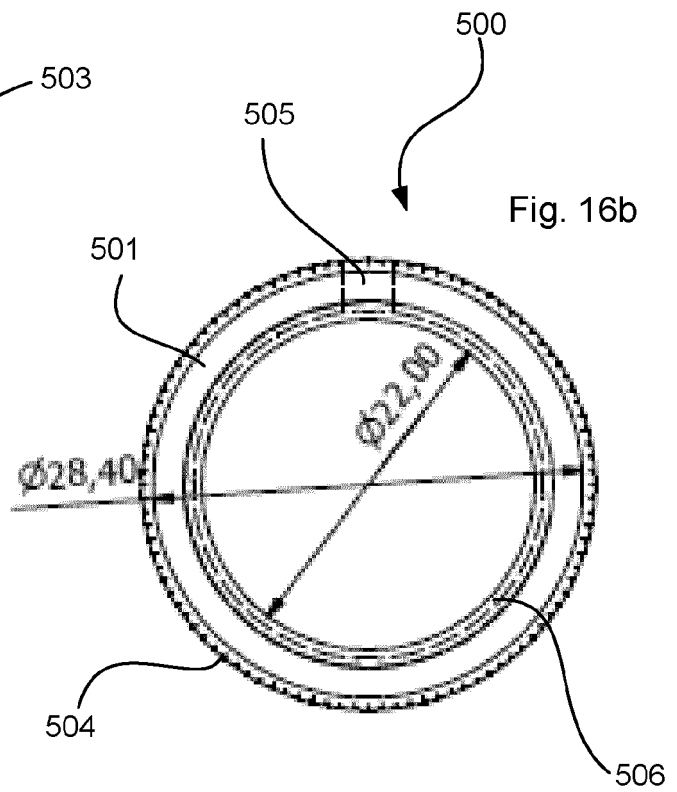


Fig. 16b



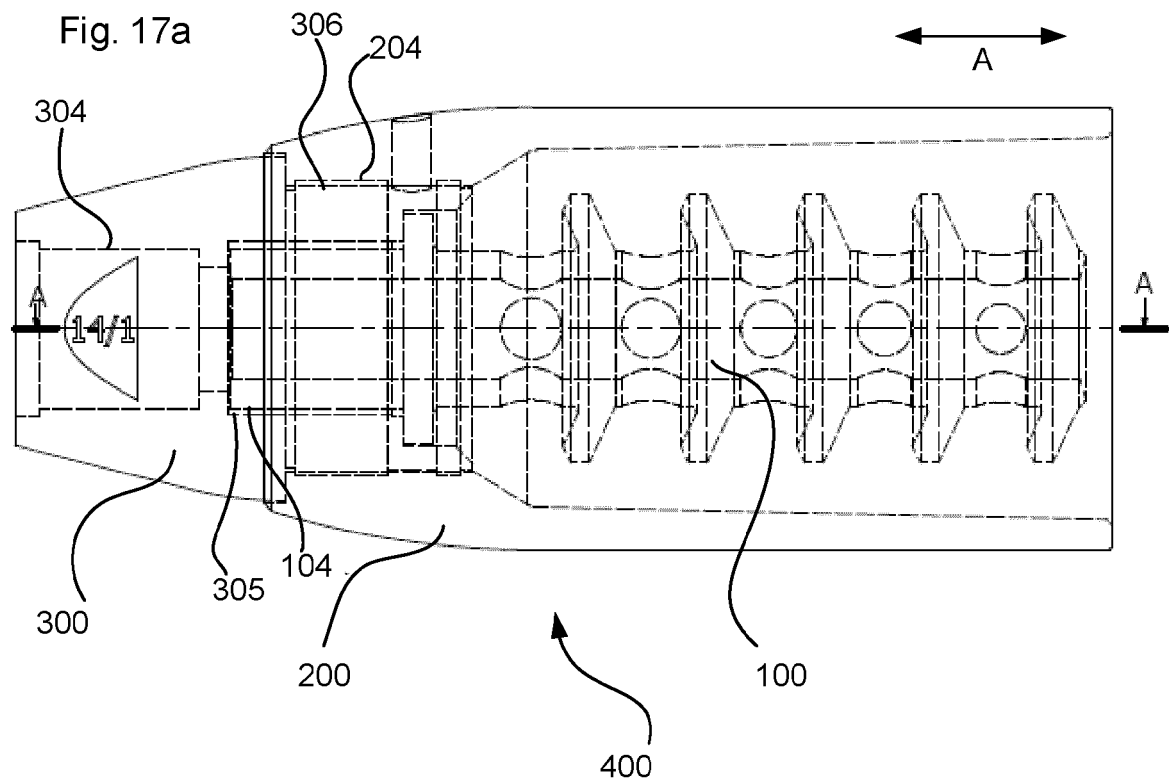


Fig. 17b

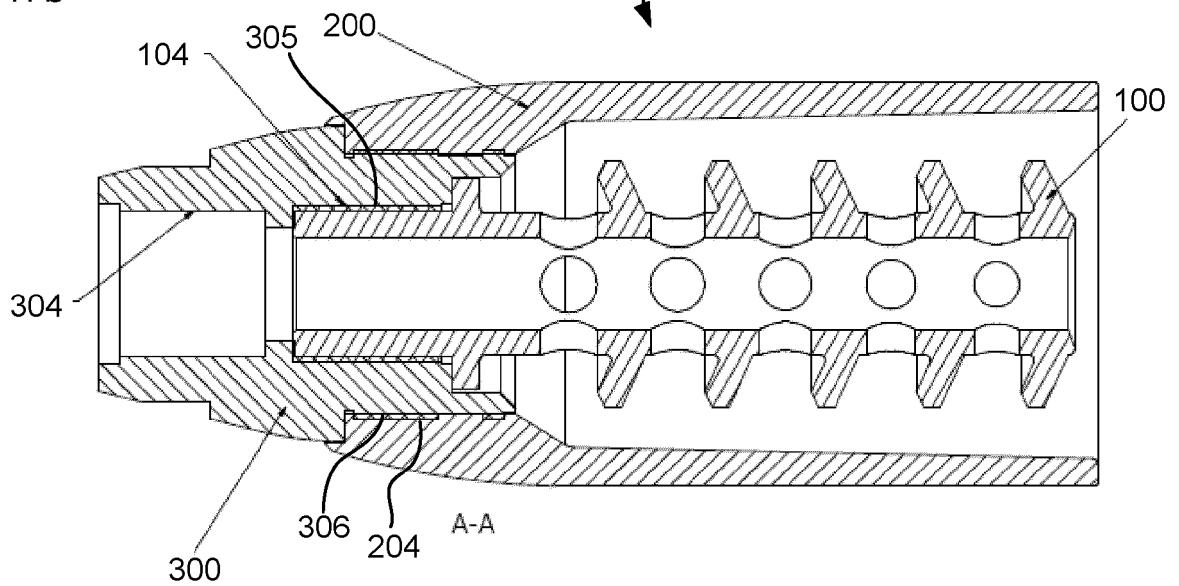
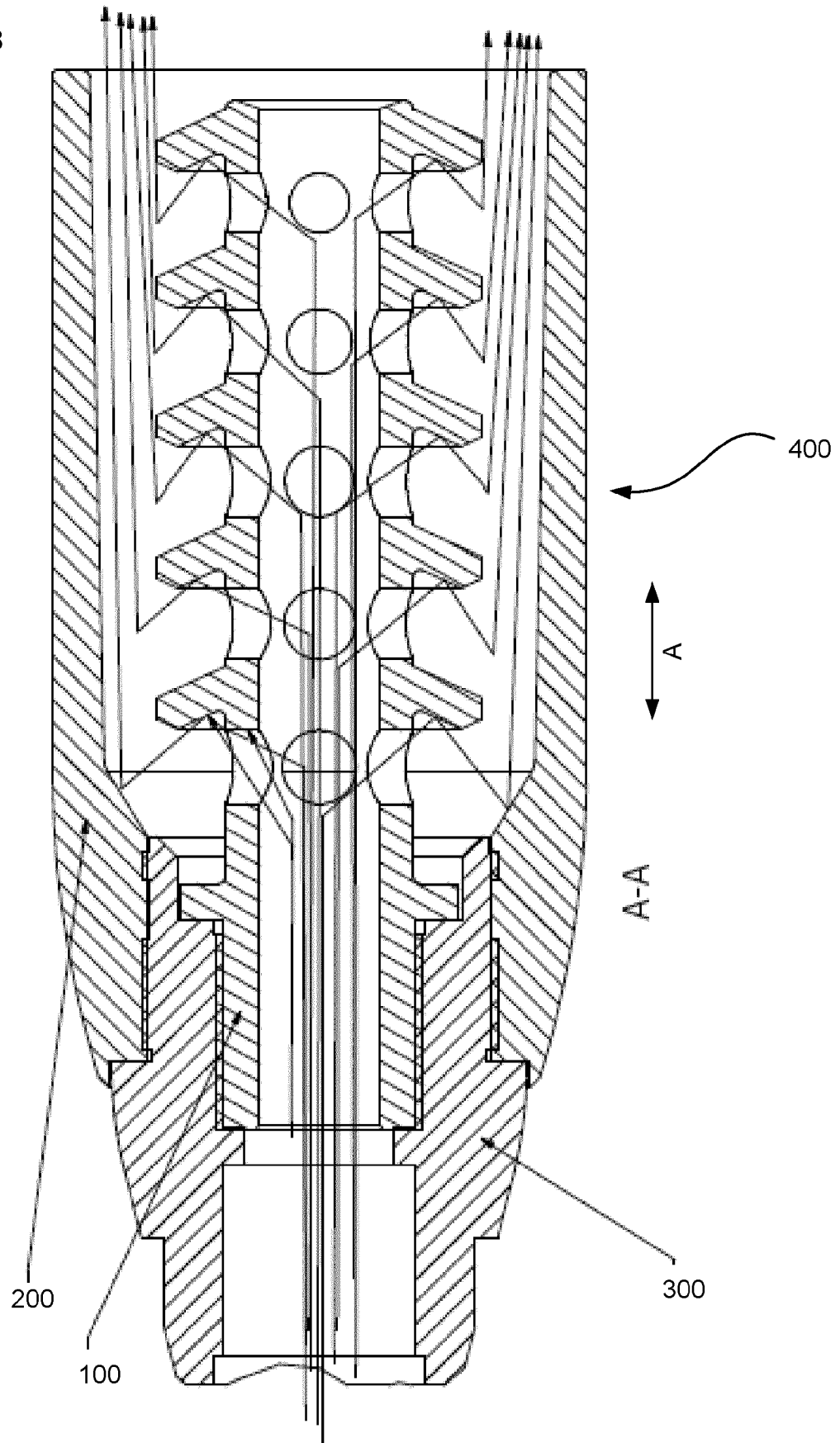
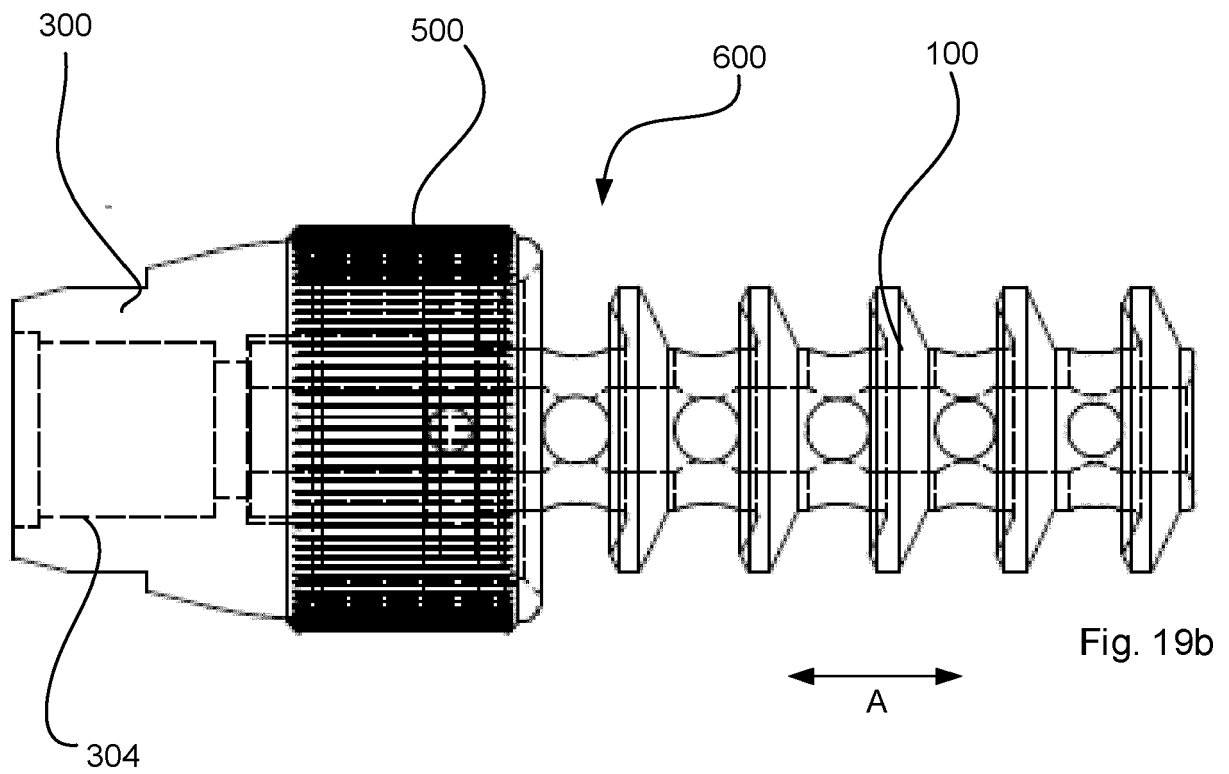
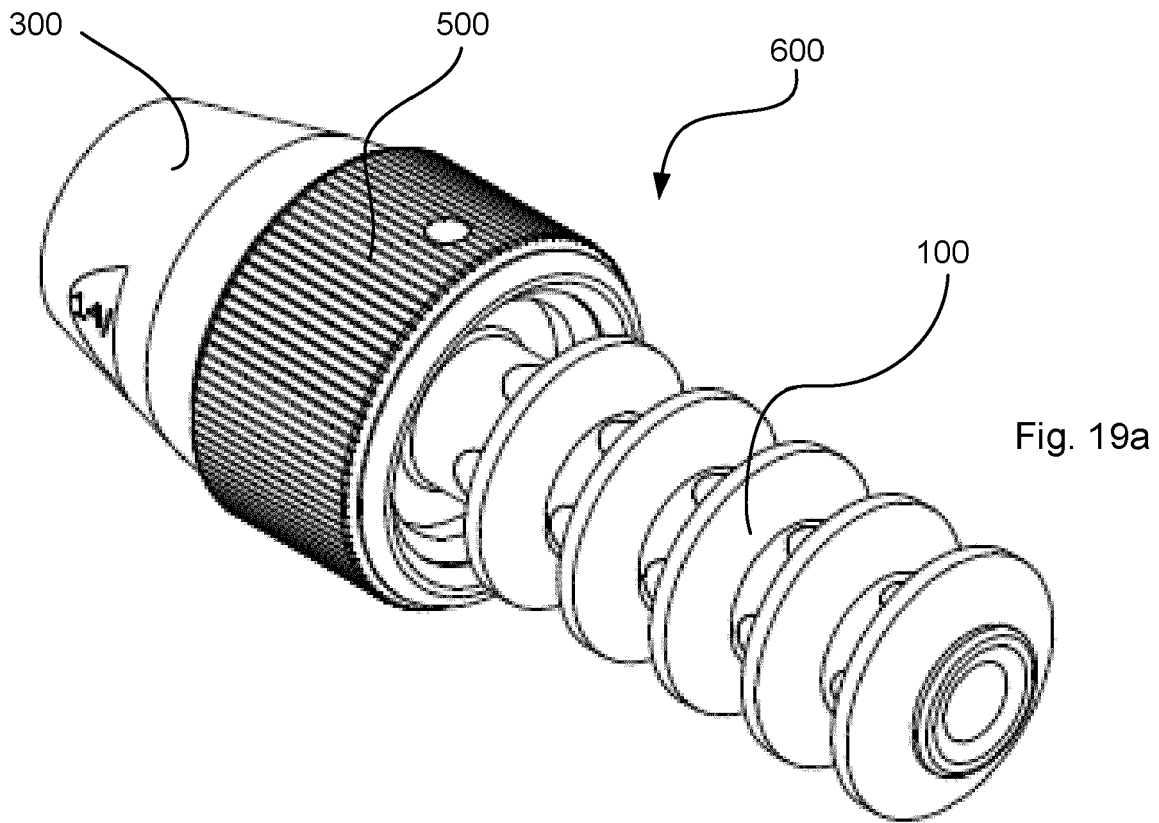


Fig. 18







EUROPEAN SEARCH REPORT

 Application Number
 EP 21 15 5281

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Y	----- US 9 182 187 B1 (GRIFFITH JAMES [US]) 10 November 2015 (2015-11-10) * column 4, line 14; figures 1,2 *	9	
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			F41A
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 4 June 2021	Examiner Beaufumé, Cédric
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 21 15 5281

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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04-06-2021

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