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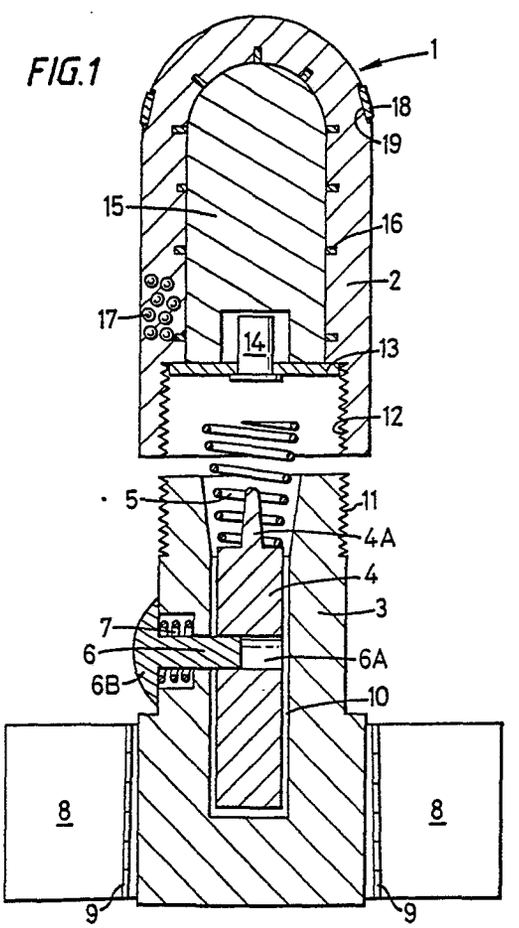
(54) Projectile for smooth bore weapon.

(57) The invention provides a projectile (1) adapted to be fired from a weapon, preferably from a cartridge with a propellant charge therein, wherein the projectile (1) comprises a generally cylindrical casing (3) and a warhead assembly (2), said warhead being hollow to accommodate an explosive charge (15) and an initiator (14), the casing being formed with a firing pin (4) spring biased (5) to a safety position and locked in safety position by a spring biased safety pin (6), wherein the spring biased safety pin is adapted to release on exit from the weapon, and wherein said casing includes a plurality of fins (8) foldable within the cartridge, but which deploy radially on leaving the weapon.

The invention allows the projectile to be fired from a smooth bore weapon, such as a shotgun.

The invention also provides an arming time delay mechanism to ensure that the projectile is only armed when at a safe distance from the operator.

FIG.1



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PROJECTILE

The present invention relates to a projectile particularly suitable for a smooth bore weapon.

Explosive projectiles are well known in the art but mainly for large bore weapons. The present invention pertains to projectiles which may provided in cartridge form, and are particularly suitable for use in standard 12-bore shotguns, although of course they are equally applicable to weapons of greater or smaller bores, and may be adapted for use with rifled weapons, or may be fired from pods on helicopters or small aircraft by means of compressed air, for example.

According to a first aspect of the present invention, therefore, there is provided Small Arms ammunition, suitable for use in smooth bore weapon, which ammunition comprises a projectile comprising a generally cylindrical casing and a warhead assembly, said warhead being hollow to accommodate an explosive change and an initiator, the casing being formed with a firing pin spring biased to a safety position and locked in said safety position by means of a spring biased safety pin;
the invention being characterised in that the projectile is at least in part retained prior to firing in a cartridge case including a propellant charge, and in that the cartridge also retains a plurality of fins in the folded down condition disposed upon the casing of the projectile, each said fin being spaced an equal distance about the periphery of the casing, and being pivoted thereto, thereby to displace radially outwardly relative to the casing on exit from the weapon. The term pivoted used herein includes fins formed of a resilient material that can be bent into an arcuate form for assembly with the cartridge, but which regain their upstanding radially outwardly urged condition immediately after leaving the barrel.

In a preferred form of the invention the casing and the warhead are separately formed and interlock only on assembly of the cartridge.

In another preferred form of the invention, the casing is provided with three or four fins thereupon, each fin being spaced in equal distance about the periphery of the casing.

It is most preferred that one plane of the fin be angularly displaced from the axial plane of the projectile by a set amount, for example, 3° to 7° to the longitudinal axis of the projectile so as to impart spin to the projectile thereby increasing stability thereof. The fins may be arcuate so as to lie over the external periphery of the casing while they are within the cartridge or the barrel of the weapon. The fins may, of course, be formed of a resilient material, one end of which is located in the casing, the arrangement being such that the fins spring outwardly on release from the barrel after firing. In a preferred form of the invention the fins, although generally directed in a plane passing through the axis of the projectile are formed with a triangular transverse cross-section whereby a first plane of each fin lies in the plane of the axis of the projectile while the other is angled thereto in the range of up to 30°, preferably 2° to 10°, and most preferably 3° so as to impart spin.

In an alternative form of the invention, a pivotal hinge is provided immediately adjacent the periphery of the casing and arcuate fins are provided accordingly. Air pressure passing over the projectile on exit from the barrel will cause the fins to be upstanding especially if an axis is angled to the exit of the projectile; however this mechanism may be assisted by resilient means if desired.

The casing is preferably formed with an axial bore to accommodate a generally cylindrical firing pin. The firing pin is biased to its safe position by means of a compression spring between the operative end of the firing pin and the initiator. Said compression pin acts to spring bias the firing pin to its 'at rest' position. In the "at rest" position the firing pin is also secured by means of a safety pin which locates in a bore normal to the axis of the firing pin. This bore preferably extends through the firing pin and both sides of the casing. The safety pin is spring biased away from the firing pin and is provided with an outwardly arcuate head external of said casing which, in use, is in sliding contact with the internal fact of the cartridge from which the projectile is to be fired, and with the internal surface of the bore of the weapon. It will be appreciated, therefore, that the safety pin is released on exit from the barrel, whereupon the firing pin is retained in its "at rest" condition by means of the spring biasing separately provided.

In an alternative arrangement two coaxial safety pins are provided spring biased in opposed directions thereby to balance the projectile in the early part of its flight.

The warhead may be formed of a hollow casing, preferably provided with a number of fragmentation recesses about its internal or external periphery. In another embodiment the hollow casing is plain, but has interfitted therein a fragmented helical spring over which the explosive is cast in manufacture. The warhead is also provided towards its intended forward portion with a sealant recess accommodating a soft plastic sealant ring which, in use, contacts the bore of the smooth bore weapon. The sealant ring, which is soft, ensures a proper seal between the projectile and the bore, even if

the bore is in some way deformed.

Internally of the warhead is provided a standard explosive, such as RDX, provided towards its rear end with an initiator which is either held on a support plate immediately adjacent the rear of the charge, or interfits in a recess in the charge itself.

The casing may be formed of aluminum or steel depending upon weight requirements, or alternatively may be moulded from an epoxy resin into which ball bearings to the necessary weight have been dispersed. The casing may be similarly provided in steel, aluminum, or a mouldable plastics material such as epoxy resin. The casing may be provided with a tracer compound initiated by the propellant charge if desired.

The projectile is particularly suitable for use in smooth bore weapons such as shotguns. In an alternative form of the invention there is provided an arrangement for using the projectile in a rifled weapon wherein the fins are retained by, or located immediately adjacent, a soft plastics annulus which ensures that the external faces of the fins do not come into direct contact with the rifle in use.

DE-A-3033061 discloses a projectile having a safety device including a locking pin, one end of which is inserted into the projectile perpendicular to the projectile axis and locks the fuse relative to a striker pin. The outer head of this pin is flush with the outer surface of the projectile so that, in use, it can contact the barrel of a weapon from which it is fired. Since the pin is outwardly spring biased and is urged radially outwardly and hence, ejects after leaving the barrel to release the fuse and the firing pin on impact.

If this projectile contacts intermediate objects, the active charge may be initiated and if this occurs too soon after the operator has fired the projectile, the operator could himself be in danger. This problem has been addressed in EP-A-0187932 (US-A-4697524). The solution proposed therein is to provide for a locking pin which is ejected by gas pressure alone. The inherent complexity of the system leads to high costs and munitions failure in use.

The present invention in a second aspect, seeks to provide a projectile of the spring biased locking pin type but with an adequate arming time delay mechanism. This arrangement is simple to manufacture and safe to use.

Thus, in accordance with the present invention, there is provided a projectile suitable for use with a smooth bore weapon, comprising a generally cylindrical casing and a warhead assembly, the warhead being hollow to accommodate an explosive charge and an initiator, the casing being formed with a firing pin, spring biased to a safety position and locked in said safety position by means of a spring biased safety pin, the invention being characterised in that the safety device additionally comprises a secondary safety means adapted to retain the safety pin in a safety position for a predetermined period after the projectile has left the weapon and to arm the same prior to impact. The predetermined period is preferably a time under one second, and most preferably a time delay of from 0.01 to 0.3 seconds.

The secondary safety means may comprise a retaining means co-operating between a pair of coaxial safety pins spring biased in opposed directions, said retaining means being adapted to cause a friction-mediated time delay before the primary safety pins are expelled. In an alternative, a secondary safety means is formed by a crank in the safety pin co-operating in a suitable bore in the casing, said crank allowing the release of the pin only on being swivelled forward on deceleration of the projectile as the said projectile leaves the weapon in use.

In a particularly preferred form of the invention, and when the projectile is fired by an explosive propellant charge, the secondary safety means may be a layer of combustible adhesive material interposed between the firing pin and the hollow portion of the casing, whereby combustion of the adhesive material is actuated on explosion of the propellant charge to give a time delay before the firing pin can be released from the casing. In a preferred form of the invention of this type, the layer of combustible adhesive material is connected by a bore to the rear end of the casing.

The invention will now be described, by way of illustration only, with reference to the accompanying drawings which show, in Figures I and 3 in vertical cross section, different projectiles in accordance with the present invention removed from a 3" (7.56 cm) 12 gauge cartridge and separated into component parts; while Figure 2 shows a transverse cross-section through fins suitable for use with the invention.

With reference to Figure I a projectile (1) is formed with a warhead (2) and a casing (3). The projectile has a generally cylindrical configuration about a central axis, and is formed in this instance of aluminum castings.

The warhead (2) and the casing (3) are separately formed castings provided with interlocking means (11, 12) whereby the two portions may be interlocked immediately prior to assembly with a 12-bore cartridge.

The casing (3) is provided with an axial bore (10) which accommodates a cylindrical firing pin (4) provided at its operative end with a conical needle portion (4A). The firing pin is also provided with a bore (6A) normal to the axis thereof, to accommodate a safety pin shaft (6).

The safety pin shaft (6) is, in the safe position,

located in the bore (6A); said safety pin being provided with a safety pin cap (6B) and a compression spring (7) located in a suitable recess in the casing (3). The safety pin shaft (6) is biased by means of the spring (7) away from the firing pin (4), said safety pin being held in the safe position by means of its contact, in use, with the internal wall of the cartridge or the internal bore of the smooth bore weapon.

Located at the remote end of the casing and about the external periphery thereof are four fins (8) which, in use, extend radially outwardly from the body of the casing (3). The fins (8) are of an arcuate configuration such that they will, in their folded-down position within the cartridge, lie over the body of the casing. To this end they are hinged at (9), the axis of the hinge being slightly angled to the longitudinal axis of the projectile such that air pressure will cause the fins to open and to spin the projectile when it has exited from the bore of the weapon. The fins may be formed of a resilient material such as copper, or may be moulded into their final form of plastics or a mouldable metal such as aluminum.

The warhead assembly (2) is formed of a hollow aluminum casting of a generally cylindrical configuration formed with a domed forward end. The domed forward end conjoins the cylindrical portion at about the point at which an annular recess (19) is provided therein. The annular recess is provided with a soft plastics material sealant (18) which is adapted in use to contact the internal bore of the weapon after firing.

The hollow portion of the warhead (12) is provided with an explosive (15), for example RDX. The block of explosive (15) is, in this particular embodiment, provided with a central blind bore for the accommodation of an initiator (14) which, in this particular instance, is retained by means of a retaining plate (13) which locates the explosive (15) in the body of the warhead (2). In an alternative embodiment the retaining plate (13) may be dispensed with, and the initiator (14) may be formed as a sliding fit into the recess in the explosive change (15).

Pre-moulded fragmentation portions (16) may also be formed on the internal or external faces of the warhead (2). In an alternative the warhead (2) may be formed of hard epoxy resin- into which a plurality of ball bearings (17) has been disposed. The advantage of this latter construction is that the weight of the warhead can be carefully adjusted by means of the utilisation of the correct number and weight of ball bearings. Further, of course, the point of balance of the projectile assembly can be altered by placing the ball bearings at various positions in varying numbers within the body of the material forming the warhead.

In use, the explosive charge which is moulded to a predetermined shape is interfitted in the warhead (2) and the initiator (14) positioned therein.

The casing (3) is assembled by sliding the firing pin (4) into the bore (10) of the casing (3) with the bore (6A) in register with the shaft of the safety pin (6). The cap (6B) of the safety pin is then retained in its "pressed in" condition in order to retain the safety pin in its "at rest" condition. The casing (3) and warhead (2) are then interfitted by sliding the two together ensuring that the compression spring (5) is free to move. The assembly of the casing (3) and the warhead (2) such that the interlocking means (11, 12) inter-relate, causes the firing pin (4) to be forced away from the initiator (14) by means of the spring (5), while retaining the safety pin cap (6B) in its spring (5). While retaining the safety pin cap (6B) in its "pressed in" condition, the fins (8) are then positioned in their radially inward positions and the device is slid into a standard 12 bore cartridge so as to fit on the top of the wadding immediately over the propellent charge. As the casing (3) slides into the standard 12 bore cartridge, the cap (6B) of the safety pin will come into sliding relationship therewith such that the firing pin (4) is retained against any possibility of release so that even if the cartridge is dropped during use the explosive charge will not fire.

The cartridge may then be positioned in a standard shotgun and fired in the normal way. On firing the projectile (1) leaves the cartridge (not shown) and travels along the smooth bore barrel with the sealant (18) and the cap (6B) of the safety pin in contact therewith. On exit from the barrel, the restraint is removed from the safety pin cap (6B) and this will tend to be thrown outwardly by means of the compression spring (7) thereby releasing the firing pin (4) for actuation. Of course, immediately upon exit from the barrel, the projectile (1) will undergo fairly severe deceleration and hence there is a danger that the firing pin might contact the initiator (14). This is prevented by means of the spring (5) which loads the firing pin into its "at rest" position until impact. Further, said deceleration also imparts shear to the safety pin shaft (6) thereby tending to delay its exit from the bore (6A).

At the same time the fins (8) which previously have been in sliding contact with the internal wall of the barrel, are freed from constraint and expand radially outwardly. In one form of the invention the fins extend in a plane parallel to the axis of the projectile, in which case the fins act merely to stabilise the projectile during its flight. In the preferred form of the invention, however, the fins are slightly angled to the axis of the projectile itself and hence cause the projectile to spin in a stabilised fashion. At the end of its flight the dome of the warhead will contact the target area thereby caus-

ing the firing pin to contact the initiator (14), which in turn initiates the explosion. It will be appreciated that there is a small delay between the contact of the domed portion of the warhead with the target area and the explosion being initiated. This delay allows the projectile to penetrate, in so far as it can, the target material thereby increasing the effectiveness of the explosion then generated.

Figure 2 shows a transverse cross section through an arcuate fin in accordance with the present invention showing the angles of attack of two portions thereof.

In Figure 3 a casing of the general form shown in Figure I is shown. The casing of Figure 3 is adapted to co-operate with a warhead (2) shown in Figure I, with the exception that the inter- locking means (12) is replaced by a screw thread means for co-operation with screw thread means (11A) in Figure 3.

With reference to Figure 3 like parts to those described in Figure I are given similar numbers and are the same unless specifically referred to.

Casing (3A) is of the basic form as shown in Figure I, but is provided towards its upper end with a screw thread portion (11A) for inter-connection with the warhead (2). The bore (6A) in the firing pin (4) accommodates a pair of co-axial safety pin shafts (6), each terminating in a safety pin cap (6B). The safety pin shafts (6) are spring biased by means of spring (7) in opposite directions so as to balance the casing on exit from the barrel of a weapon.

If desired, a friction collar can be interposed between the two shafts (6) so as to delay by a short period the time which it takes to expel the shaft (6) so as to release the firing pin (4). This arrangement can form an arming time delay mechanism as hereinbefore set forth.

Alternatively, or additionally, the firing pin (4) of Figure 3 can be formed with an arcuate base (20) overlaying an adhesive layer (21), which adhesive layer extends through equally spaced bores (22) to the rear of the casing (3A). The adhesive is combustible and hence will release the firing pin (4) after a predetermined time delay. The firing of the propellant charge will, in turn, commence the combustion of the adhesive material (21) which accordingly will retain the firing pin for a period of up to one second, and more preferably 0.01 to 0.2 seconds. This arming time delay mechanism allows the projectile to cover a safe distance before being armed, thereby protecting the operator.

The casing (3A) also bears a tracer compound (24) disposed centrally of the rear of the casing (3A), said tracer compound being actuated by a tracer initiator (23).

The operation of the arrangement of Figure 3 is in precise accord with that of Figure I, except that the arming time delay mechanism provides a further guarantee of safety for the operator and provides a tracer facility.

The arrangement pertains, therefore, to a projectile suitable for use with a small bore weapon, but is also applicable to rifled weapons; and particularly to a projectile for use in cartridge ammunition. The projectiles in accordance with the present invention may also be loaded into pods for utilisation in helicopters or small aircraft, each pod comprising 30 x 10 projectiles preferably in three tiers. The projectiles are initiated by propellant charge or by compressed air, thereby providing saturation coverage of a target area.

The invention also relates to a method for the safe manufacture of a projectile in accordance with the present invention wherein the warhead and the casing are separately provided and manufactured; only being inter-locked in the final manufacturing stage.

The invention also provides a finned projectile capable of being fired from cartridge ammunition.

Claims

. 1. Small arms ammunition suitable for use in a small arms weapon, which ammunition comprises a projectile (1) comprising a generally cylindrical casing (3) and a warhead assembly (29 said warhead being hollow to accommodate an explosive charge (15) and an initiator (14), the casing (2) being formed with a firing pin (4) spring biased (5) to a safety position, and locked in said safety position by means of a spring biased safety pin (6) characterised in that the projectile (1) is at least in part retained prior to firing in a cartridge case including a propellant charge, and in that the cartridge also retains a plurality of fins (8) in the folded down condition and disposed upon the casing (3) of the projectile, each fin being spaced an equal distance about the periphery of the casing and being pivoted (9) thereby to displace radially outwardly relative to the casing on exit from the weapon.

2. Ammunition according to Claim 1 characterised in that the casing and the warhead are separately formed and inter-lock only on assembly with the cartridge.

3. Ammunition according to either of Claims 1 or 2 characterised in that the exterior of the casing is provided with three or four fins (8) thereupon, each fin being spaced an equal distance about the periphery of the casing.

4. Ammunition according to any of Claim 1 to 3, characterised in that the plane of the fin is angularly displaced from the axial plane of the projectile by an angle of up to 30° thereby to

impart spin thereto.

5. Ammunition according to any preceding Claim characterised in that the fins are spring biased to their radial positions and are arcuate in form.

6. Ammunition according to any preceding Claim characterised in that the warhead, and optionally the casing, are provided with a soft plastics sealant ring (18) for contact with the bore of a weapon on firing.

7. A projectile (1) suitable for use in a smooth bore weapon comprising a generally cylindrical casing (3) a warhead assembly (2), said warhead being hollow to accommodate an explosive charge (15) and initiator (14) the casing being formed with a firing pin (4), spring biased (5) tp a safety position and locked in said safety position by means of a spring biased safety pin (6) characterised in that said safety device additionally comprises a secondary safety means (6A.21) adapted to retain the firing pin (4) in a safety position for a predetermined period after the projectile has left the weapon and to arm the same prior to impact.

8. A projectile according to Claim 7 characterised in that the secondary safety means is retaining means co-operating between a pair of coaxial safety pins (6) spring biased in opposite directions, said retaining means being adapted to cause a friction mediated time delay before the primary safety pin can be expelled.

9. A projectile according to Claim 7 characterised in that the secondary safety means is formed by a crank in the safety pin, said crank allowing the release of the pin only on deceleration of the projectile as it leaves the weapon.

10. A projectile according to Claim 7 characterised in that the secondary safety means is a layer of a combustible adhesive material (21) interposed between the firing pin (4) and the hollow portion of the casing (10), whereby combustion of the adhesive material is actuated by explosion of a propellant charge to give a time delay before the firing pin (4) can be released from the casing (3).

11. A projectile according to Claim 10 characterised in that the adhesive material is retained in a bore (22) disposed between the rear end of the casing (3) and the hollow portion of the casing (10).

12. A cartridge case containing a projectile according to any of Claims 7 to 11.

13. A weapons pod comprising a plurality of downwardly directed tubes, each provided with a projectile in accordance with any of Claims 1 to 11, and means for propelling said projectiles from the said tubes.

FIG.1

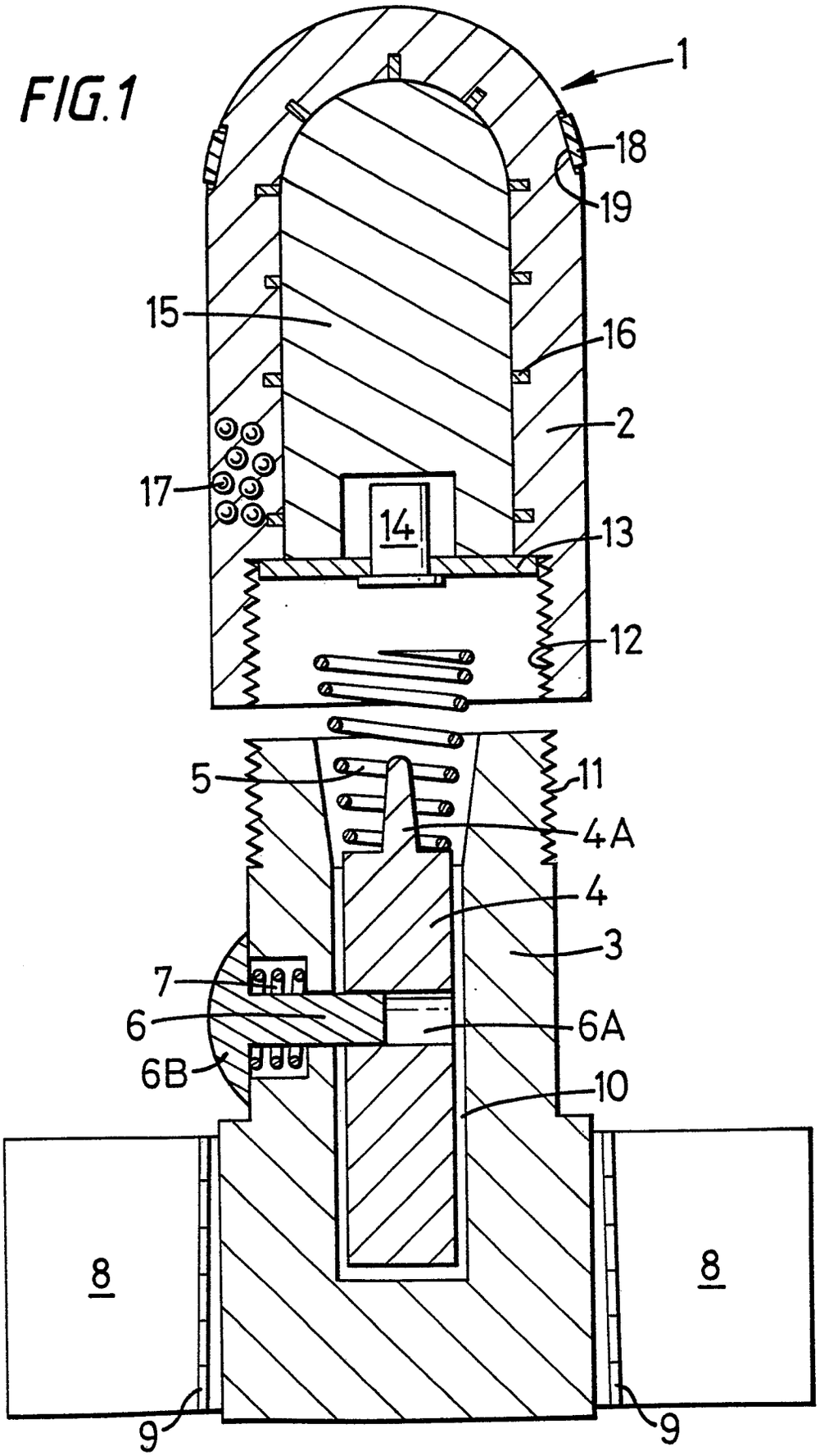

FIG. 2

FIG. 3