May 27, 1969 W. ENGEL ET AL 3,446,147

CASING FOR THE SABOT OF A PROJECTILE

Filed March 1, 1967 Sheet 1 of 3

Fig. 1

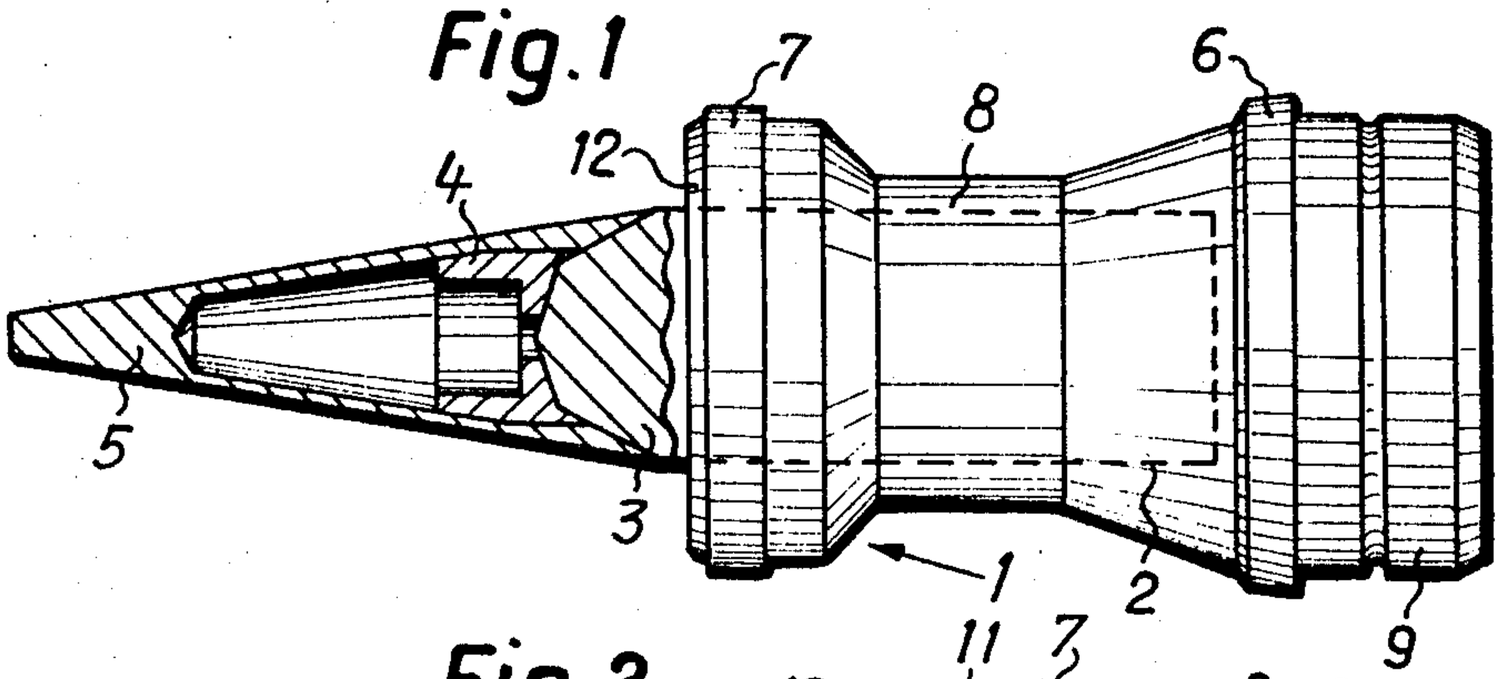


Fig. 2

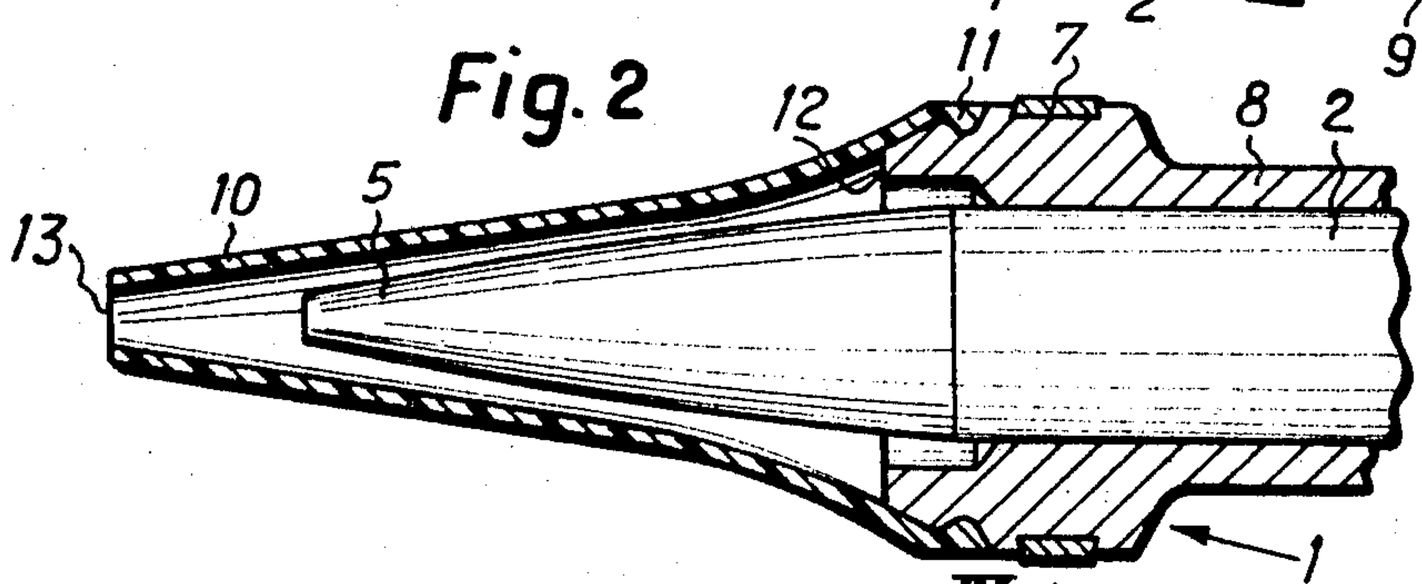


Fig. 3

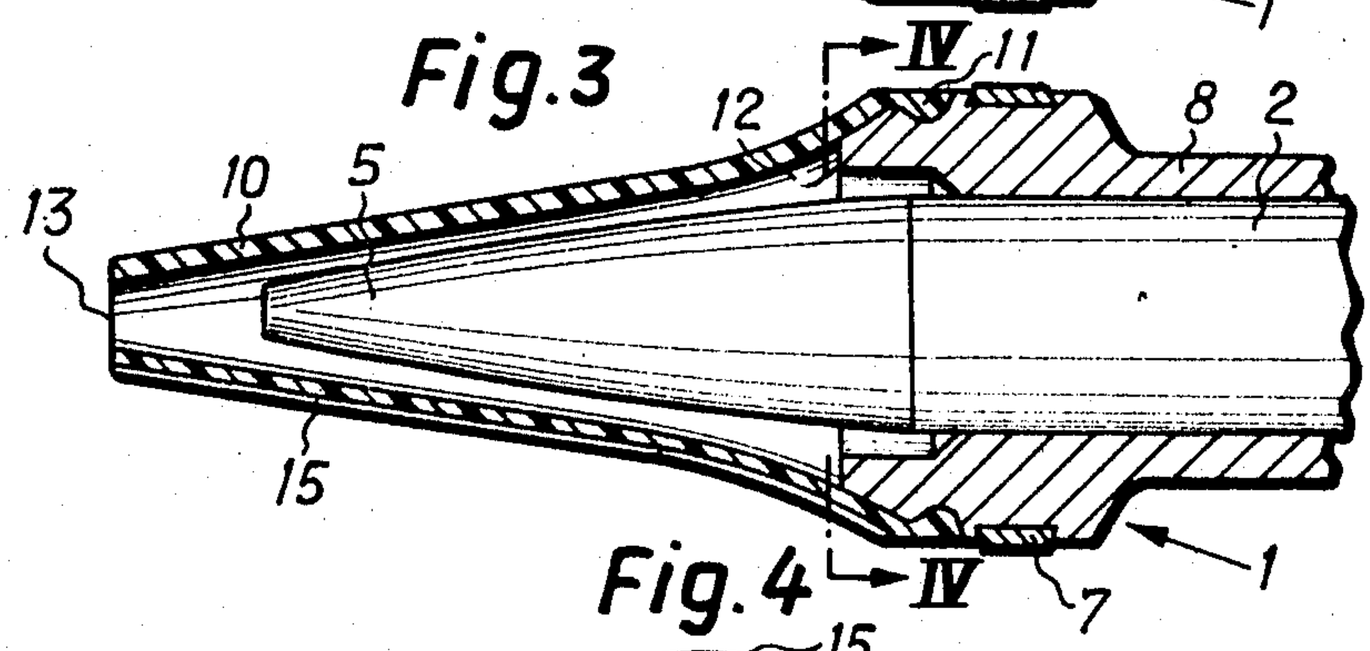


Fig. 4

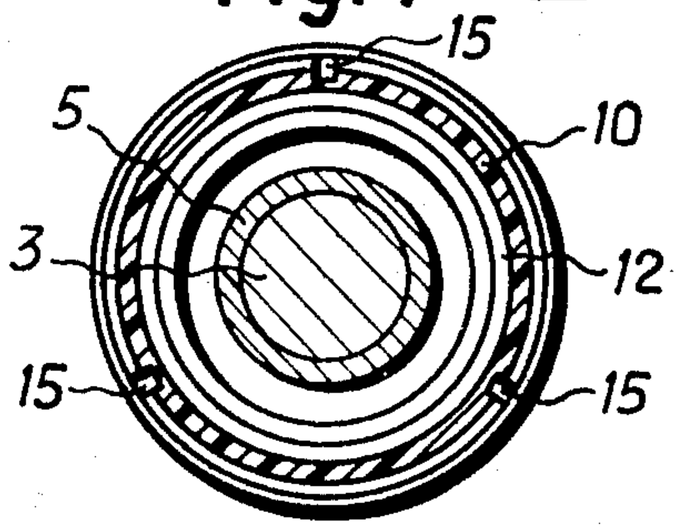

Fig. 5

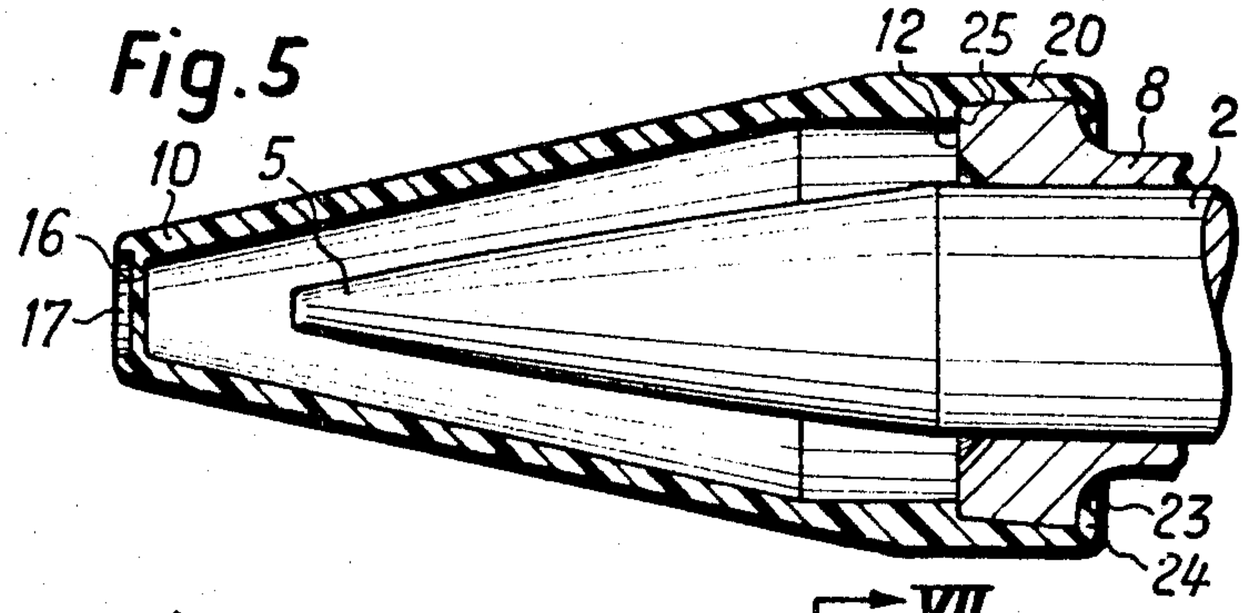


Fig. 6

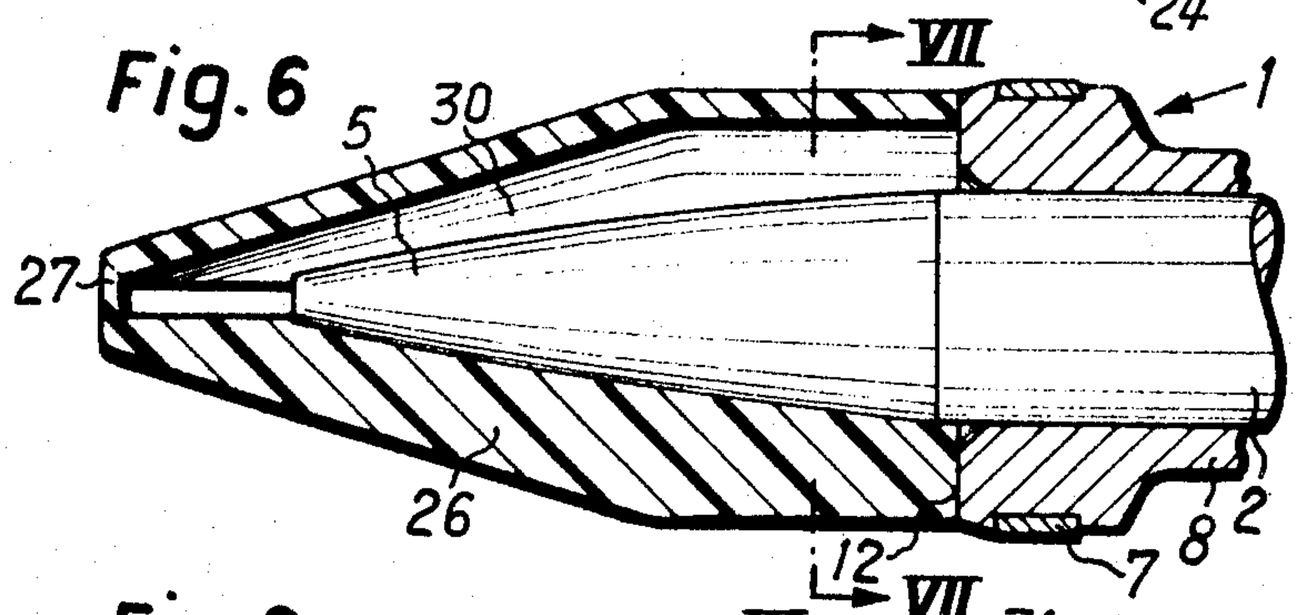


Fig. 8

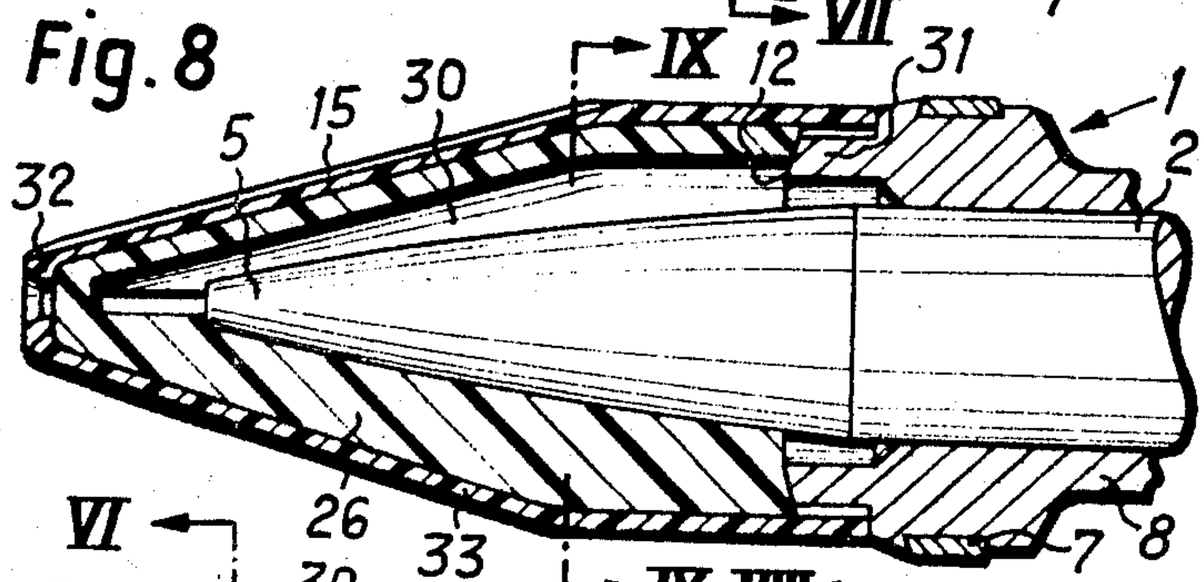


Fig. 7

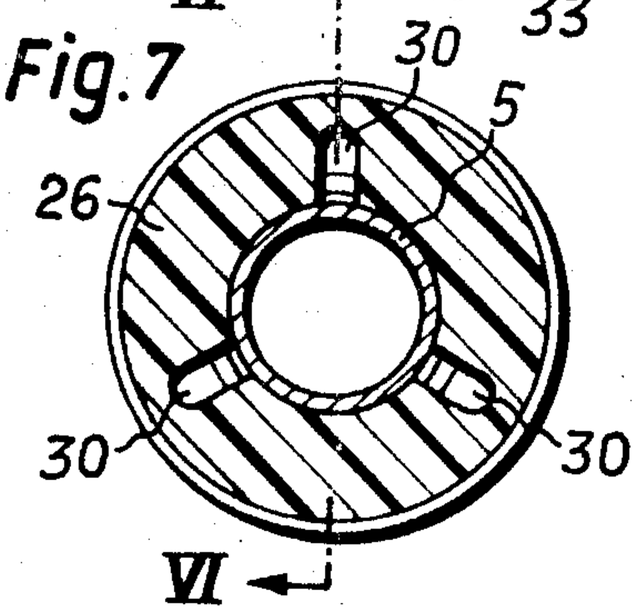


Fig. 9

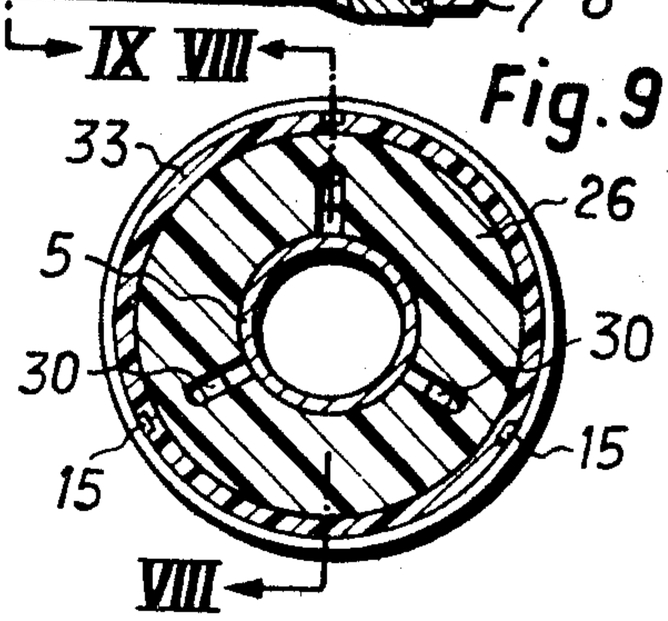

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Fig. 10

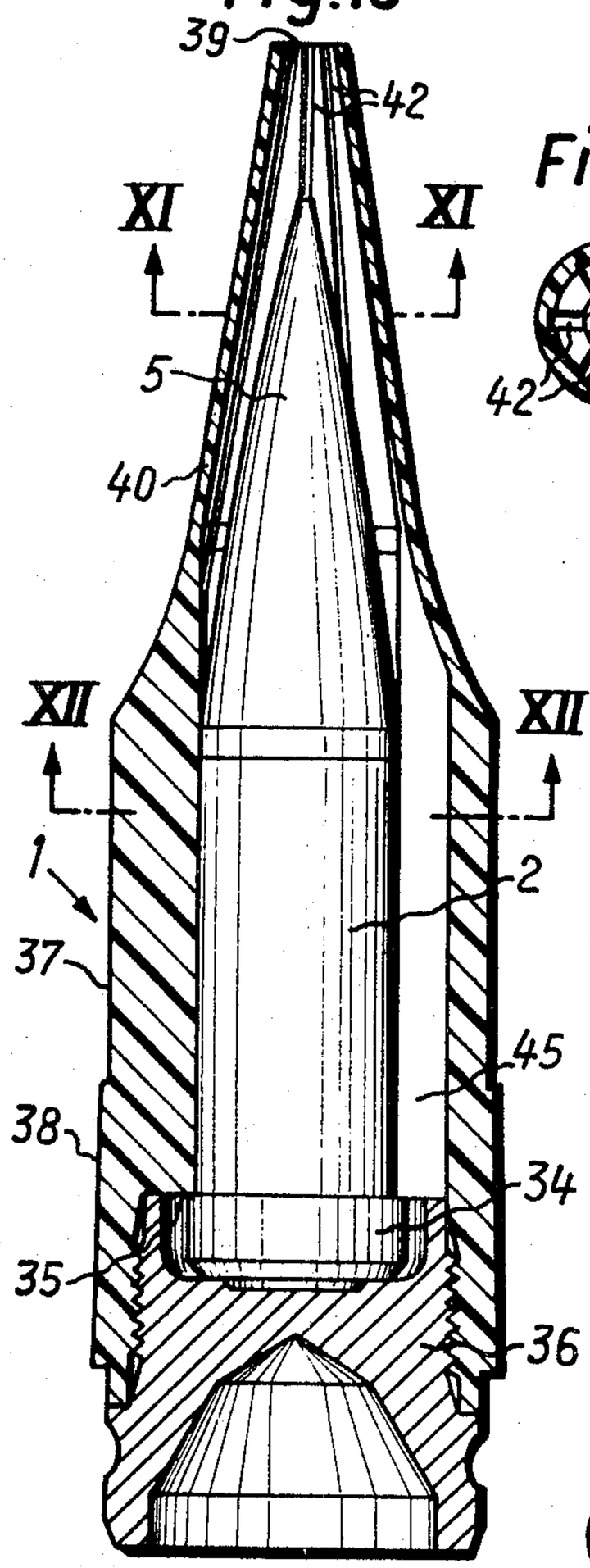



Fig. 11

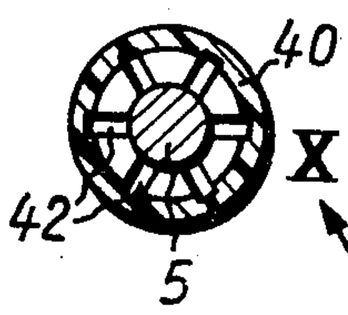



Fig. 12

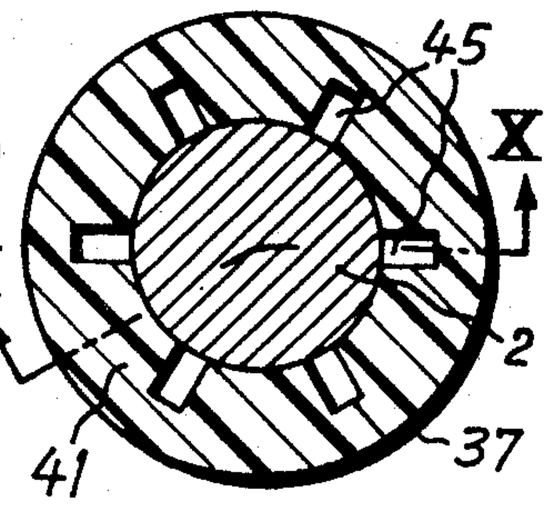



Fig. 13

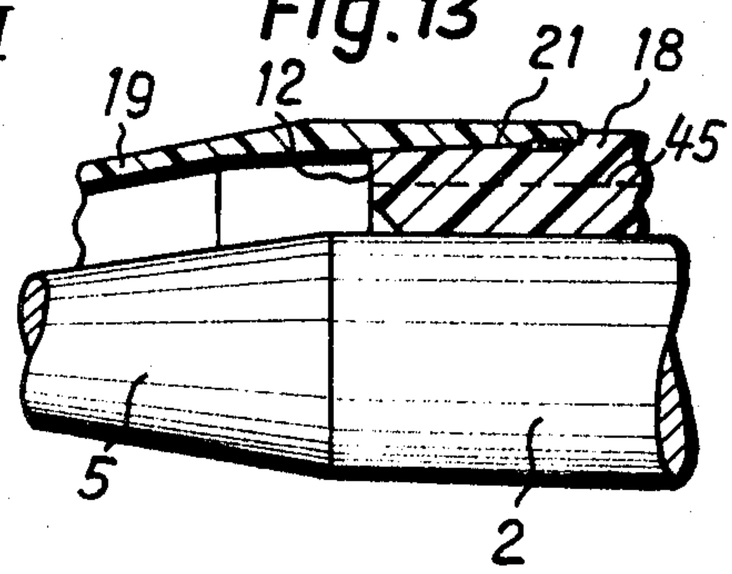
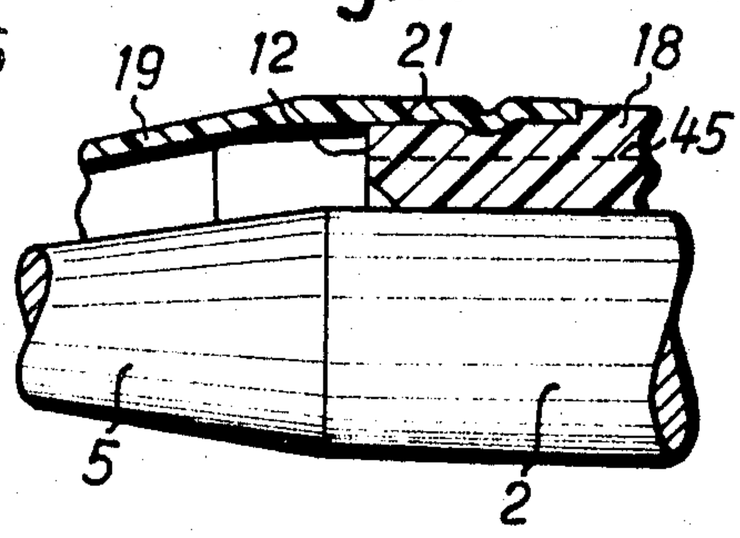



Fig. 14



United States Patent Office

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# CASING FOR THE SABOT OF A PROJECTILE

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Claims priority, application Switzerland, Mar. 4, 1966, 3,129/66

Int. Cl. F42b *13/06, 13/16*

U.S. Cl. 102—93

1 Claim

## ABSTRACT OF THE DISCLOSURE

A sabot-projectile assembly consists of a projectile, a sabot body, and a plastic nose casing. The projectile, which may be of the armor piercing type, consists of a main body which is substantially cylindrical and a nose portion which is substantially conical. The body of the sabot, which may consist of an aluminum alloy, surrounds the substantially cylindrical main body portion of the projectile while the plastic nose casing covers and extends in front of the projectile nose. The plastic nose casing may consist of foam rubber with an outer sheet-like shell of relatively denser plastic material, such as polyethylene. The plastic nose casing is designed to radially expand, rupture, and be flung off in response to the combination of centrifugal force and excess internal air pressure, after the sabot-projectile assembly leaves the barrel of the projecting weapon, thus permitting the projectile to then discard the body of the sabot.

This invention relates to sabot projectiles.

With sabot projectiles, the projectile body carried by the sabot generally ends in a point, behind which the end of the sabot forms a shoulder, which can give rise to damage to the point before discharge of the projectile. Often such damage arises on introduction into the cartridge chamber, when the shoulder is caught on some part of the gun so that the cartridges are deflected from their path. An object of the invention is to prevent such damage to sabot projectiles.

A further object of the present invention is to provide a sabot projectile having a pointed projectile body and a sabot detachable by air resistance in flight from the projectile body having guiding parts for imparting a projectile spin and a plastic casing which can be discarded as a result of the centrifugal force due to the spin of the sabot forming the front end of the latter extending beyond the point of the projectile body and tapered at its front end to a diameter less than the diameter of the projectile body.

A further object is to construct the casing so that it terminates in front of the projectile point which is advantageous, particularly if, in addition to armour-piercing sabot ammunition, antiaircraft ammunition is also fired from the same gun, where the cartridge length of the latter may be longer than that of the former. In that case, the width of the feed channels for the ammunition belts must be designed to suit the longer ammunition. In the vicinity of the gun, the cartridges moved towards the latter can, as a result of the recoil movement of the weapon in the direction of firing, i.e. across their direction of feed in the feed channels, be moved to and fro. Thereby the cartridges, if they are shorter than the width of the feed channels, can rebound against the channel wall with such a velocity that the projectile points become bulged or bent. Therefore, it will be more suitable if the length of the casing of the sabot ammunition is selected so that the latter is approximately the same length as the antiaircraft ammunition.



The same advantage will also be attained if the sabot ammunition, in the interests of simplifying supply, is transported in the same containers as the other, longer, ammunition since here also the cartridges of the shorter sabot ammunition can, by a suitable choice of length of casing, be protected from shocks occurring in transport.

A further object is to taper the front end of the casing to a diameter less than the diameter of the projectile body which results in the advantage of a relatively small end surface so that the danger of being caught up on some part of the gun is less than with the shoulders of the usual sabot projectiles.

A still further object is to provide a construction wherein the use of the invention is particularly advantageous in the case of sabot projectiles when the projectile points are formed by a ballistic cap superimposed on the projectile body. Such caps are normally made very light, such as hollow bodies of thin sheet metal, so they make no direct contribution to the penetration performance of the projectile on the target. As a result of this construction, such caps are particularly easily damaged on feeding the projectile into the gun.

With the above and other objects in view which will become apparent from the detailed description below, some preferred embodiments of the invention are shown in the drawings in which:

FIGURE 1 illustrates a usual sabot projectile partly in elevation and partly in section.

FIGURE 2 illustrates a partial longitudinal section through the front part of a sabot projectile.

FIGURE 3 shows a similar view illustrating a modification.

FIGURE 4 is a cross-sectional view taken upon section line IV—IV of FIGURE 3.

FIGURE 5 is a view similar to FIGURE 2 illustrating a third modification.

FIGURE 6 is a similar view illustrating a fourth modification.

FIGURE 7 is a cross-sectional view taken upon section line VII—VII of FIGURE 6.

FIGURE 8 is a view similar to FIGURE 6 illustrating a fifth modification, taken upon section line VIII—VIII of FIGURE 9.

FIGURE 9 is a cross-sectional view taken upon section line IX—IX of FIGURE 8.

FIGURE 10 is a similar view to FIGURE 8 illustrating a sixth modification taken upon section line X—X of FIGURE 12.

FIGURE 11 is a cross-sectional view taken upon section XI—XI of FIGURE 10.

FIGURE 12 is a cross-sectional view taken upon section line XII—XII of FIGURE 10.

FIGURE 13 is a partial view in cross-section and elevation illustrating a modification of the form shown in FIGURE 10, and

FIGURE 14 is a similar view of FIGURE 13 illustrating a further modification of the form of the invention shown in FIGURE 10.

In FIGURE 1, the sabot is indicated generally at **1** and the tungsten carbide projectile body **2**. The rear portion of the latter is cylindrical, while the front part is formed as a truncated cone **3** with superimposed cone. An aluminum alloy cap **5**, serving to improve the ballistic properties of the projectile body **2**, is forced over a brass capsule **4** and firmly secured to the coned part. The alloy cap **5** is bonded with adhesive to the truncated cone **3**, and forms the point of the projectile body. To the body **8**, also made of aluminum alloy, of the sabot **1**, is secured a steel driving band **6**, transmitting to the sabot projectile the angular impulse from the rifling, not shown, in the gun barrel. A further steel ring **7** merely serving to guide the sabot **1** in the barrel, is arranged on the front

part. To save weight, the outside diameter of the part of the body **8** of the sabot **1**, lying between the driving band **6** and the ring **7**, is made with smaller diameter than its tail portion **9** or the part carrying the ring **7**.

In one form of the invention as shown in FIG. 2, the front part of the body of a sabot, essentially constructed as in FIG. 1, is shown in section and the projectile body **2**, with cap **5** superimposed, is shown in elevation.

The casing **10** is formed as a hollow body, conical at the front part and widening out to the rear in a bell-shape to the outside diameter of the body **8** of the sabot **1**. The diameter of casing **10** at its front end is essentially less than the diameter of the cylindrical part of the projectile body **2**. The casing **10**, provided with an aperture **13** in front, terminates in front of the cap **5**, surrounds the latter with a clearance, and is connected with the body **8** by a flange **11** protruding inwardly at its rear which engages in a groove cut into the circumference of the sabot **1** in front of the ring **7**. The casing **10** therefore covers up the front face **12** of the sabot **1**.

On movement of the sabot projectile through the gun barrel, the dynamic air pressure building up in front of the projectile with increasing velocity acts both on the inside and on the outside of the casing **10**. After the exit of the projectile from the barrel, the casing **10** is radially expanded, ruptured and flung off under the effect of centrifugal force acting on it and the external excess pressure, now acting alone. It therefore no longer represents a hindrance for the projectile body **2** which, under the influence of a lower air resistance compared to the body **8**, moves out of the latter and departs in a forward direction.

During handling and also during transport of the sabot ammunitation, shocks and blows directed at the ballistic cap **5** are taken up by the casing **10** but, on account of the rigidity of the latter, not transmitted to the cap. The casing **10**, covering the front surface **12** furthermore prevents the projectile from being caught by the front surface **12** of the sabot **1** on a part of the gun and being deflected from its path.

In determining the form of the casing **10** it was taken into account that, during the introduction of a cartridge into the cartridge chamber of the gun, no forces should act on the casing in the vicinity of the attachment of the casing **10** to the body **8** which are transverse to its surface and could result in emergence of the flange **11** from its groove and thereby separation of the casing **10** from the body **8**.

As shown by FIGS. 3 and 4, representing a second embodiment of the sabot projectile, in the outside surface of a casing **10**, made in other respects as in FIG. 2, there are cut three grooves **15** at regular intervals, which begin in front of the flange **11** and extend to the tip of the casing **10**, forming predetermined breaking places. Without the destruction of the casing **10** being affected thereby, these grooves **15** can also be arranged on its inner side.

The segments of the casing **10**, bounded by the grooves **15**, move outwardly on the break-up, and in other respects take place in the same way as with the embodiment shown in FIG. 2, while separating at the predetermined breaking places **15**.

Thereby the segments on the flange **11** are deflected outwardly and hence torn away from this part.

The advantage which is attained with the arrangement of predetermined breaking places **15** consists in the fact that the break-up of the casing **10** takes place with all projectiles in the same predetermined manner and that hence the trajectory for the projectile body **2**, separating from the sabot **1**, is made free promptly with greater regularity in timing.

In the case of the third embodiment shown in FIG. 5, the front part of the body **8** of the sabot as in FIG. 1



is tapered to the front and forms a truncated cone with a front surface **12** and a shoulder **23**. The plastic casing **10**, cylindrically shaped in its rearmost part **20** and tapering to the front at its front part, engages behind the shoulder **23** with a flange **24** at its rear, protruding inwardly. A conical inside surface joined to the flange **24** fits, free from play, against the truncated cone of the body **8**. The casing is supported by a shoulder **25** against the front face **12** of the body **8**. The rearmost, cylindrical part **20** of the casing **10** has an outside diameter which corresponds to the inside diameter of the gun barrel. This part of the casing **10** thus replaces the guide ring **7** of the sabot projectile as in FIG. 1.

The front end of the casing **10**, which extends beyond the tip of the cap **5** has a smaller diameter than the projectile body **2**, and is closed by a thin cover **16**, at right angles to its longitudinal axis, lying a short distance behind its front edge, integral with the remainder of the casing. The circular recess on this cover **16** forms a predetermined breaking point. By this cover **16**, the rigidity of the casing is increased and furthermore it prevents ingress of foreign bodies between it and the ballistic cap **5** of the projectile body **2**.

As a result of the acceleration to which the sabot projectile is subjected while passing down the gun barrel, a rearwardly directed inertia force acts on the casing **10**, which slides the latter to the rear, as the shoulder **25** is so dimensioned that it is plastically deformed under the effect of the inertia force. Even if the projectile is fired from an already severely worn barrel, the inside diameter of which is already larger than the outside diameter of the cylindrical part **20** of the casing **10**, sliding of the casing **10** to the rear takes place. By this movement along the truncated cone of the body **8**, the rearmost part **20** of the casing **10** is elastically expanded and it rests against the inside wall of the barrel, again serving as a guide.

Under the effect of the dynamic air pressure in the gun barrel on discharge bearing against the cover **16**, the latter becomes separated from the casing **10** along the predetermined breaking place **17** and flung to the rear, so that the dynamic air pressure now acts inside on the casing. On the exit of the sabot projectile from the barrel, break-up of the casing **10** takes place in the same way, as shown for the embodiment of FIG. 2.

The advantage of such a design of the casing **10** is that no steel ring has to be pressed on at the front of the body **8** of the sabot and thereby a machining of such is not required. A further advantage derives from the fact that, for all degrees of wear of a barrel from which such sabot projectiles are fired, perfect guidance of the projectile in the barrel is ensured by the self-adjustment of the cylindrical part **20**.

The fourth embodiment shown in FIGURES 6 and 7 has the body **8** of the sabot **1** constructed as in FIG. 1. The casing **26** consists of a foam material, which surrounds the ballistic cap **5** of the projectile body **2**, free from play. As foam material, polyurethane hard foam or foam polystyrol can be used, for example. The rear end surface of the casing **26**, to which a cylindrical part adjoins, is cemented to the front surface **12** of the body **8** of the sabot **1**. A conical part adjoins the cylindrical part of the casing in front, the truncated end of which has a smaller diameter than the projectile body **2**, and projects over the end of the cap **5**. For facilitating the disintegration of the casing **26** on discharge, three grooves **30**, forming predetermined breaking places, are hollowed out from its inside, extending from the rear end of the casing almost to its front end.

Such a design is advantageous, as the foam material, during the movement of the projectile down the gun barrel, becomes disintegrated in such small and light pieces that these can in no way endanger personnel in the vicinity of the firing position on their exit from the barrel.

The fifth modification, illustrated by FIGS. 8 and 9, has a casing consisting of a body **26** of foam material, which is surrounded, free of play by a thin covering **33**, made of polyethylene, for example. The body **8** of the sabot **1** is essentially made as shown in FIG. 1. It has a recess **31** on its front end, in which the covering **33** engages, and where it is bonded with adhesive. The front surface **12** of the body **8**, to which the foam material body **26** is also firmly bonded, has a slightly conical shape. The covering **33** has grooves **15**, forming predetermined breaking places, made in the same way as already shown in the case of the embodiment of FIG. 3. It extends beyond the front end of the cap **5** and terminates in a truncated perforated tip **32**, the outside diameter of which is less than the diameter of the projectile body **2**. The foam material body **26** has grooves **30** in the same radial planes as the covering **33**, forming predetermined breaking places, which extend from the rear end of the body **26** to the vicinity of its front end.

In this case, the covering **33** merely has the duty of protecting the surface of the body **26**, which is very sensitive to damage after manufacture, on account of the softness of the foam material. On the break-up of this combined casing during discharge, first of all the covering **33** is broken up and then the body **26**.

The sixth embodiment of the sabot projectile, illustrated in FIGS. 10 to 12, has the sabot **1** made with a tail body **36** of light alloy, e.g. perunal, and a forwardly-projecting jacket made in a single piece from a plastic, e.g. nylon. This comprises an essentially cylindrical rear part **37** and an essentially conical front part **40**. The rear part **37** is provided with a radially projecting driving band **38** and has a recess at the rear, into which the tail body **36** is screwed. The recess is provided with a shoulder **35**, whereby a collar **34** at the rear end of the projectile body **2** is forced against the tail body **36**. The projectile body **2** is held free of play in the cylindrical part **37**, whereby the outside wall of the front end of the cylindrical part **37** serves for guiding the projectile in the barrel. In the inside wall of the cylindrical part **37** of the jacket, six grooves **45**, intended to form predetermined breaking places, are recessed out and extend to the rear as far as the shoulder **35** and in front into the conical part **40**.

The conical front part of the jacket forms a casing for the cap **5** of the projectile body **2**. It surrounds the cap **5** all round with clearance and extends beyond its front end. The conical part **40** terminates with an aperture **39**, the diameter of which is less than the diameter of the projectile body **2**. Grooves **42**, forming predetermined breaking places, are arranged in the inside of the conical part **40** and continue the grooves **45** in the cylindrical part **37**.

On the movement of the sabot projectile through the gun barrel, the dynamic air pressure building up in front of the projectile with increasing velocity acts both on the inside and the outside of the conical part **40** of the jacket. After the exit of the projectile from the barrel, the part **40** of the jacket is radially expanded under the effect of the centrifugal force acting on it and the internal excess air pressure now acting alone. Thereby the whole jacket is broken up along the grooves **42** and **45** and the shoulder **35** is removed from the collar **34** of the projectile body **2**. The projectile body is thereby liberated from the sabot and moves forward independently of the latter which is subjected to a greater air resistance.



FIGURES 13 and 14 illustrate two variants of the form of construction as in FIG. 10. With these two variants, the cylindrical part **18** of the sabot, also made of plastic, extends only as far as the cap **5** of the projectile body **2** and terminates in a flat end surface **12**. In the inside wall of the part **18**, which surrounds the projectile body **2** free of play, longitudinal grooves **45** are worked in, forming predetermined breaking places. In accordance with FIG. 13, the casing **19**, also consisting of plastic, is, with elastic expansion, slid over the front end of the part of the sabot, provided with a conical recess **21**. The firm connection of the casing **19** with the part **18** is here ensured by the friction acting between the two parts and by an adhesive bond produced by welding or sticking. The construction of the casing **19** is in other respects the same as in FIG. 3.

With the variant as in FIG. 14, to secure the plastic casing **19**, a cannelure **22**, running all round, is formed in the recess **21**, into which a bead provided on the rear end of the casing **19** engages. In other respects, the casing **19** is also constructed as in FIG. 3.

The casing consists with advantage of a hollow body of about 1 mm. wall thickness, surrounding the projectile point with clearance. A material with the following properties is suitable for the plastic:

| | | |
|---|---|---|
| Tensile strength | kg./mm.² | 7 |
| Impact strength | cm. kg./mm.² | 3 |
| Modulus of elatsicity | kg./mm.² | 28,000 |
| Compressive strength | kg./mm.² | 10 |
| Elongation at rupture | percent | 130 |

In other cases, a plastic foam material can also be considered for the casing, which surrounds the projectile point free of play.

We claim:

**1.** Discarding sabot projectile with a projectile body, having an essentially cylindrical main portion and a conical nose arranged in front of said main portion and with a sabot, said sabot comprising a rear part extending along said main portion supporting said projectile body; a two-fold front part of frusto-conical form terminating in a forward end extending beyond said nose, the width of said forward end being smaller than the diameter of said main portion, said front part comprising an element consisting of foam rubber aligning with said nose and said front part further comprising a plastic sheet-like cover for said element secured to said rear part.


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