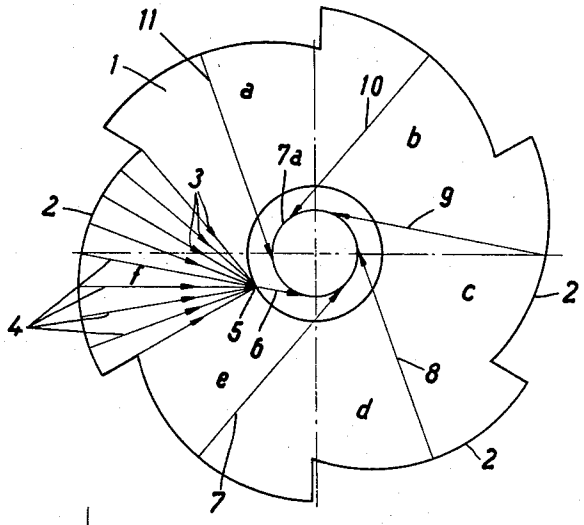
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SHAPED CHARGE WITH ROTATIONAL INSERT

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Fig. 1



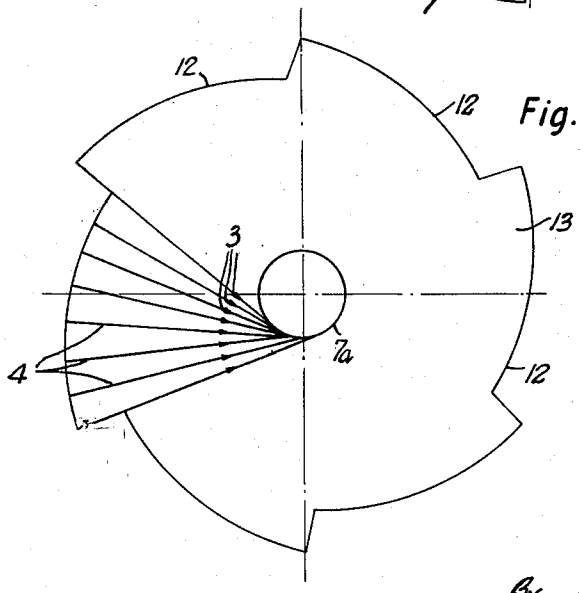


Fig. 2

Inventors

Franz Schaadt and

Hermann Renner

By Watson, Cole, Grindle & Watson

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Fig. 3

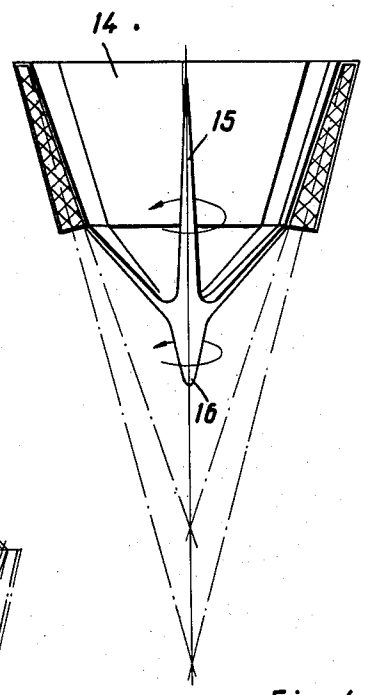


Fig. 8

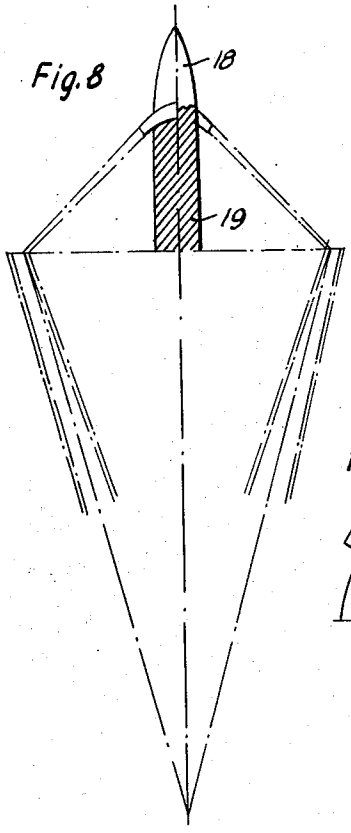
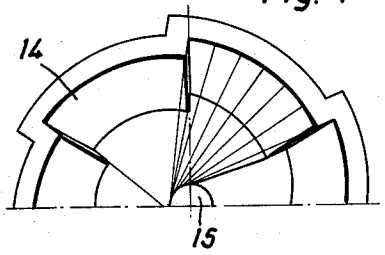


Fig. 4



Inventors

Franz Schaadt and
Hermann Remmer

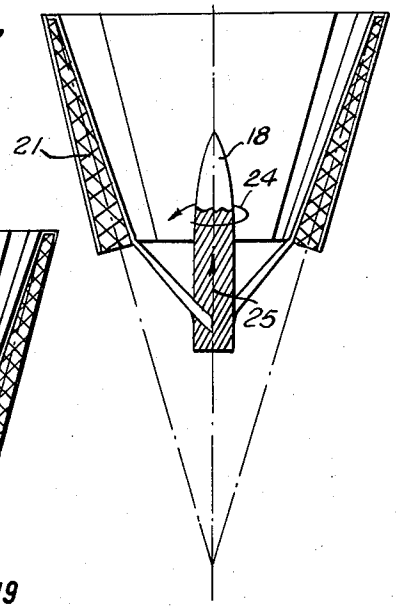
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Fig. 7



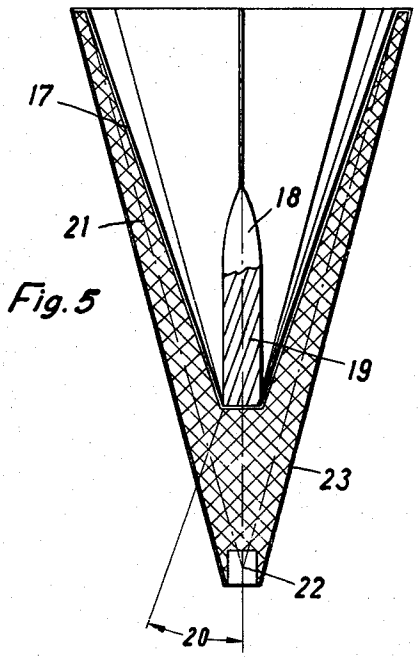
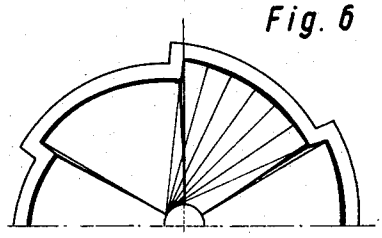


Fig. 5

Fig. 6



Inventors
Franz Schaadt and
Hermann Renner
By Watson, Cole, Grindle & Watson

United States Patent Office 3,146,711 Patented Sept. 1, 1964

3,146,711

SHAPED CHARGE WITH ROTATIONAL INSERT

Franz Schaadt, Rolandstrasse 34, and Hermann Renner, Schimmelbuschstrasse 61, both of Dusseldorf, Germany

Filed May 20, 1959, Ser. No. 814,642
Claims priority, application Germany, May 24, 1958
4 Claims. (Cl. 102—24)

This invention relates to an explosive device having means for propelling and effecting the rotation of an insert.

According to the present invention, an explosive device includes a hollow charge having an insert on which, by means of the arrangement of the explosive, a tangential component of velocity is impressed upon detonation of the explosive charge such that the insert is caused to rotate as it is propelled.

The tangential component of velocity may be created by suitably shaping the insert or by suitably shaping the front of the blast wave produced when the explosive charge is detonated.

The propelled insert can then be used in numerous ways for both military and also civil purposes, namely:

(*a*) Directly as a combat weapon, for example as an incendiary projectile for use against fast missiles, low flying aircraft, armoured vehicles and the like;

(*b*) Indirectly to accelerate and stabilize other objects, for example projectiles contained inside the insert. A rotation is in this way obtained according to the invention which not only imparts to the said projectiles a high starting velocity which could not be achieved in any other manner, but which gives them also the spin which is necessary for stable free flight;

(*c*) For many purposes of non-military engineering, for example blasting and enlarging holes into rock and other hard materials, particularly holes of larger diameters.

Embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings, of which,

FIG. 1 shows a diagram to explain the rotational effect by reference to a plan view of an insert consisting of a stepped cone having six steps in which the external surfaces of the stepped cone are bounded by arcs of circles.

FIG. 2 shows a diagram corresponding to FIG. 1 but with the surfaces of the stepped cone bounded by spirals,

FIGS. 3 and 4 show an insert in the form of a stepped cone of a non-rotating hollow charge with the neighbouring portions after the charge has been detonated, FIG. 3 being a longitudinal section and FIG. 4 a plan,

FIGS. 5 and 6 show a hollow charge, with a secondary projectile mounted inside the insert, which has the shape of a stepped cone, before the detonation, in side view and plan, and

FIGS. 7 and 8 show a hollow charge corresponding to FIG. 5 during two stages after detonation.

As shown in FIG. 1 the insert **1** is provided with six steps *a* to *f* similar to a ratchet wheel, the steps being bounded by circular arcs **2**. The edges of the separate steps connecting them to the apex of the cone have been omitted to assist clarity of the drawing.

When the explosive charge is detonated the separate particles **3** of the insert travel in the direction of the arrows **4**. These arrows converge towards the centre of curvature of the relevant circular arc as indicated at **5**. The resultant of these arrows is therefore represented approximately by the arrow **6**, i.e. approximately tangential to the circle **7***a* and accordingly a rotational effect is imparted as represented by the arrows **6** to **11**.

In the embodiment shown in FIG. 2 the position is the same except that here the surfaces **12** bounding the insert **13** form part of a spiral or helix. This has the advantage that practically every particle moves in a direction tangential to the circle **7***a* resulting in a more homogenous process.

FIG. 3 shows a solid elongated spike like member **15** and striker **16** attached to an insert **14**. Due to the fact that the insert **14** has the form of a stepped cone, the spike **15** and the striker **16** are set in rotation.

Instead of a stepped cone, it is possible to use any one of the other shapes of insert disclosed in application Serial No. 791,882, filed February 9, 1959, now abandoned, in order to produce a tangential velocity component and hence a rotational effect.

For example, the insert may be a spiral cone which may be considered to be formed by winding the insert of FIGS. 1 and 2 to produce spiral steps, the edges of which have an angle of twist other than zero. This type of insert can be made by winding a strip of sheet metal.

Alternatively, as described in application Serial No. 791,882, filed February 9, 1959, now abandoned, the insert may comprise a normal circular cone and the tangential component of velocity produced by detonation of a suitably shaped explosive capsule inserted in the explosive charge, the capsule having a speed of detonation which differs from that of the normal explosive charge. An additional explosive capsule having a lens shape may also be provided, this additional capsule also having a speed of detonation which differs from that of the normal explosive charge.

The effect obtainable by virtue of the rotation according to the invention is illustrated in FIGS. 5 to 7; here the insert **17** has the shape of a truncated stepped cone inside which a secondary projectile **18** is located and which is firmly attached to the insert **17**. The projectile **18** is provided with grooves or rifling **19** in order to offer a more effective surface to the particles approaching it tangentially upon detonation. The grooves **19** make an angle **20** with the longitudinal centre line of the projectile. **21** designates the usual explosive charge and **22** the fuse. The outer shell of the hollow charge is shown at **23**.

As will be seen on comparing FIGS. 5, 6 and 7, in addition to the spinning velocity **24** a high axial acceleration in the direction of the arrow **25** is also impressed upon the secondary projectile **18** when the charge **21** is detonated so that there are quite new possibilities, both military and non-military, for the hollow charge as described above, in which the temperature of the effective rotating solid jet is probably also of considerable significance.

What we claim is:

1. A hollow charge explosive device comprising a casing with an explosive charge with a hollow space in the explosive charge, a substantially funnel-shaped inert longitudinally disposed in the device to serve as a lining for the hollow space, said insert having working surfaces which are so shaped that during the detonation of the explosive charge a tangential component of force is imparted by the detonation pressure to the parts of the material of the insert to cause the insert to rotate as it is propelled, said insert being shaped as a stepped cone having surface steps, as viewed in cross-section in a plane at right angles to the longitudinal axis of the cone, interconnected with curved boundary lines as generating surfaces, the curvatures of the boundary lines being so arranged and so formed that their centers follow each other on a circle around the longitudinal axis of the cone, a projectile provided in the insert and which is an elongated spike-like object, and at least part of the surface of the insert is provided with grooves having an angle of twist.

2. A hollow charge explosive device comprising a casing with an explosive charge with a hollow space in the explosive charge, a substantially funnel-shaped insert longitudinally disposed in the device to serve as a lining for the hollow space, said insert having working surfaces which are so shaped that during the detonation of the explosive charge a tangential component of force is imparted by the detonation pressure to the parts of the material of the insert to cause the insert to rotate as it is propelled, said insert being shaped as a stepped cone having surface steps, as viewed in cross-section in a plane at right angles to the longitudinal axis of the cone, interconnected with curved boundary lines as generating surfaces, the curvatures of the boundary lines being so arranged and so formed that their centers follow each other on a circle around the longitudinal axis of the cone, a projectile provided in the insert and which is an elongated spike-like object, and at least part of the surface of the insert is provided with roughed portions having an angle of twist.

3. A hollow charge explosive device comprising a casing with an explosive charge therein, with a hollow space in the explosive charge, a substantially funnel-shaped insert longitudinally disposed in the device to serve as a lining for the hollow space, said insert having working surfaces which are so shaped that during the detonation of the explosive charge a tangential component of force is imparted by the detonation pressure to the parts of the material of the insert to cause the insert to rotate as it is propelled, said insert being shaped as a cone of a stepped spiral form having surface steps, as viewed in cross-section in a plane at right angles to the longitudinal axis of the cone, interconnected with curved boundary lines as generating surfaces so that the centers of the curvatures follow each other on a circle around the longitudinal axis of the cone, a projectile provided in the insert and which is an elongated spike-like object, and at least part of the surface of the insert is provided with grooves having an angle of twist.

4. A hollow charge explosive device comprising a casing with an explosive charge therein, with a hollow space in the explosive charge, a substantially funnel-shaped insert longitudinally disposed in the device to serve as a lining for the hollow space, said insert having working surfaces which are so shaped that during the detonation of the explosive charge a tangential component of force is imparted by the detonation pressure to the parts of the material of the insert to cause the insert to rotate as it is propelled, said insert being shaped as a cone of a stepped spiral form having surface steps, as viewed in cross-section in a plane at right angles to the longitudinal axis of the cone, interconnected with curved boundary lines as generating surfaces so that the centers of the curvatures follow each other on a circle around the longitudinal axis of the cone, a projectile provided in the insert and which is an elongated spike-like object, and at least part of the surface of the insert is provided with roughed portions having an angle of twist.

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