United States Patent

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[73] Assignee **Singer General Precision, Inc.**
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[54] **FLECHETTE**
3 Claims, 6 Drawing Figs.

[52] **U.S. Cl.** **102/92.6**
[51] **Int. Cl.** **F42b 11/00**
[50] **Field of Search** ..... 102/38, 92.5, 52, 92.1—92.7, 93, 64. (FL); 89/14

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ABSTRACT: A projectile is disclosed which is formed of a relatively heavy tip section and a relatively light tail section. The tail section is of cruciform cross section at one end thereof and substantially conformably shaped to the cross section of the tip section at the other end thereof. The tip section is joined to the tail section by structure which is rupturable upon impact with a body, which rupturable structure may take the form of a short extension on one of the sections which is pressed fit within the other section or a relatively short pin extending between the sections. Mating flat surfaces on the tip and tail section absorb substantially greater axial force than the lateral force which can be absorbed by the rupturable structure joining the flat surfaces.

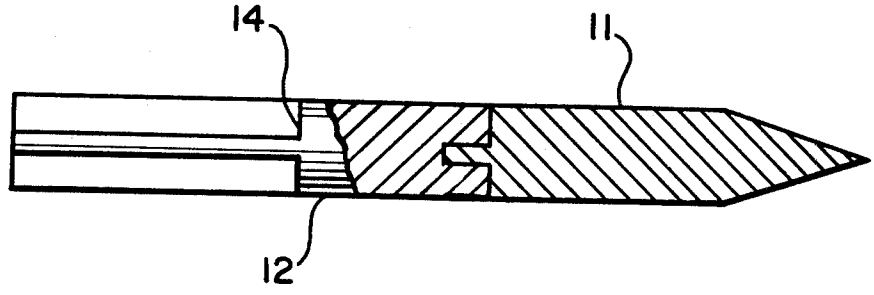


FIG. 1

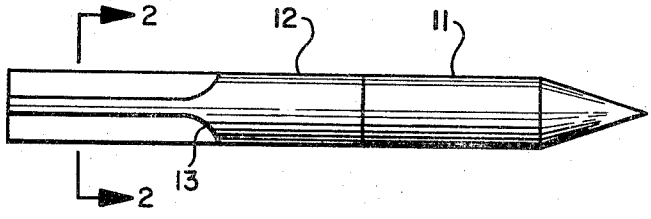


FIG. 2

FIG. 3

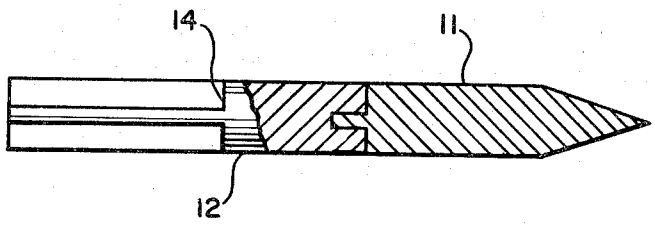
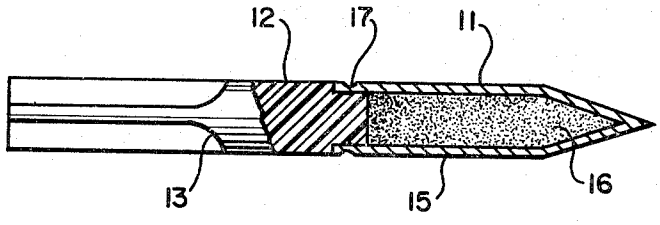


FIG. 4



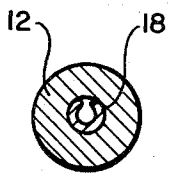


FIG. 6

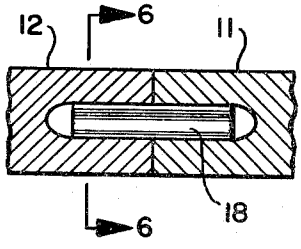


FIG. 5

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FLECHETTE

This invention relates to a projectile to be launched by a firearm; and more particularly, this invention provides an improved flechette type projectile having a relatively heavy tip and a relatively light tail such that the flechette may be propelled as a dart or an arrow in flight.

Heretofore, flechettes have been used with firearms and have proved advantageous over conventional rifle bullets or spherical shot. Since the flechette is aerodynamically stable, it will have a relatively straight flight path and will strike a target with great kinetic energy. A copending Pat. application Ser. No. 380,177 filed on July 3, 1964, by Donald E. Davenport entitled "Finless Dart For Firearm Ammunition Projectile" describes and claims a flechette having a cylindrical or hexagonal body which is adapted to be bundled and packaged together with other similar flechettes in a sabot as a round of ammunition.

A flechette may be fired singly as a rifle projectile, or in other applications a plurality of flechettes may be bundled together in a sabot to be fired by a shotgun or similar weapon. Because of the sabot arrangement the launching of individual flechettes provides axial acceleration only; and without rifling grooves in the barrel of the launching weapon, the flechettes do not attain spin characteristic such as a rifle bullet would attain at launch. It is desirable that the flechette be shaped to have most stable flight characteristics preventing a fish tail or wobble movement in flight which would result in less range and less accuracy.

If the flechettes are fired in bundles within a sabot, the sabot holds the entire bundle intact throughout the launch within the gun barrel, but after the sabot emerges from the barrel, the wind resistance tears the sabot apart and releases the individual flechettes for separate flight. It is desirable that the flechettes remain concentrated and strike a target area in a well defined pattern. If the flechettes are not of proper design, air rushing into the sabot after launch will tend to explode a bundle of flechettes, thereby causing the various individual flechettes to diverge into a widely scattered pattern. Obviously, it is desirable to have a flechette design which is so stable as to remain in a substantially straight trajectory while the sabot is being torn away; such that the various individual flechettes will remain in a reasonably tight pattern during flight.

As indicated heretofore, a flechette is made of two members—a heavy tip and a light tail. The tip and the tail may be joined together by a pin extending into both members, by mating an extension formed on one of the members into a hole in the other member with a pressed fit, or by crimping one member over a portion of the other member having a slightly smaller diameter. During the launch, the forces exerted upon the flechette are axial causing acceleration thereof. After launch and during flight, the forces upon the flechette are slight. Upon impact with a soft target, it is considered desirable that the tail member break apart from the tip member such that the parts tend to tumble and expand kinetic energy within the target. Thus, a maximum damage to the soft target will be effected. Obviously, if the flechette were to remain intact after impact with the target, the complete penetration of the target may result, and the flechette could go completely through the target without causing great damage thereto. On the other hand, the joint may have great strength for an armor-piercing projectile.

It is an object of this invention to provide an improved flechette which is aerodynamically more stable than any prior design.

It is a further object of this invention to provide an improved flechette having a relatively heavy tip and a relatively light tail being formed to provide aerodynamic stability for the flechette and which may be attached to the tip for stability during flight, but will be relatively weak upon impact with a target to effect a maximum damage thereto.

Numerous other objects and advantages will be apparent throughout the progress of the specification which follows. The accompanying drawings illustrate a certain exemplary

embodiment of the invention and the views therein are as follows:

FIG. 1 is a side view showing a typical configuration of one embodiment of this invention;

FIG. 2 is a sectional view along the plane 2–2 of FIG. 1 showing the cruciform tail section of this flechette;

FIG. 3 is a side view partially in section showing an alternative embodiment; and

FIG. 4 is a side view partially in section of a further embodiment of this invention;

FIG. 5 is an enlarged detail section showing another embodiment; and

FIG. 6 is a section along the plane 6–6 of FIG. 5.

Briefly stated, a preferred embodiment of this invention includes a flechette having a relatively heavy tip member 11 and a relatively light tail member 12. The tip structure may be generally cylindrical except for a pointed end. The tail structure attached thereto includes a forward portion similarly cylindrical and of the same diameter as the tip 11, and further includes a rearward portion having a cruciform cross section. The cruciform cross section may be formed in the tail member by molding, or by machining from a cylindrical stock piece. The cruciform tail may be formed with a radius of curvature 13 or with a square shoulder 14 as shown in FIG. 3. The tip member 11 may be attached to the tail as shown in FIG. 3 by pressing or forcing the mating parts together. In the embodiment of FIG. 4, a copper jacket 15 may enclose a heavy substance such as powdered tungsten 16 and being crimped or otherwise pressed upon the tail structure 13 as shown at 17.

As indicated in the copending U.S. Pat. application Ser. No. 380,177, supra it is necessary that the center of mass be located ahead of the center of pressure to stabilize the flight. In the structure shown in FIGS. 1, 3 and 4 the tip member 11 is composed of a relatively dense material as compared to the material of the tail member 12. The center of mass is thereby moved forwardly by the concentration of heavy material at the tip of the flechette. Ordinarily, the center of pressure would be approximately at the midpoint between the ends of the flechette, and therefore, the center of pressure is definitely rearwardly of the center of mass. The flechette of this invention is provided with a tail structure having a cruciform cross section as shown in FIG. 2. This cruciform cross section may be obtained by molding the tail directly into the shape of the cruciform; or alternatively, a cylindrical tail body may be machined to remove material from the four quadrants about the longitudinal axis of the flechette. The cruciform shape effectively provides aerodynamic surfaces extending outwardly which function similarly to flanges or the tail structure of an arrow. However, the maximum dimensions across the cruciform section are not greater than the diameter of the cylindrical portions of the tip 11 and the tail 12. Therefore, the flechettes in accordance with this invention may be packed tightly within a sabot. It has been found experimentally that the cruciform shaped tail tends to extend the center of pressure further rearwardly thereby separating the center of gravity further from the center of pressure and increasing the stability of the projectile.

As indicated heretofore, the tip member of the flechette is of a relatively dense or heavy material as compared to the material of the tail member. Flechettes have been made and successfully launched wherein the material for the tips has been of (1) steel, (2) lead, (3) tungsten and (4) uranium. Obviously, steel and lead are plentiful materials, easily workable and may be useful as flechette tips. Tungsten is a good material for armor piercing applications. It is anticipated that the tungsten may be used for flechettes in powdered form which would otherwise be scrap material. As shown in FIG. 4, the powdered tungsten 16 is encased in a copper jacket 15 which is crimped to the tail structure 12 of the flechette. As shown in FIG. 4, the forward portion of the tail structure 12 may be machined or otherwise formed to a reduced diameter at point of crimping 17. The powdered tungsten 16 may be mixed with an epoxy binder to provide a more easily workable mass.

Uranium is a material having a very great density, and therefore, uranium would be most useful in the manufacture of flechette tip members. Indeed, spent uranium from which the U-235 product has been removed, is a very inexpensive material since it is a useless byproduct of the atomic energy facilities. Uranium is easily workable and formed, and therefore, has good promise in the manufacture of flechette tips.

The tail members 12–12′ may be made from comparative light materials of low densities such as (1) magnesium, (2) aluminum, (3) lexan plastic and (4) nylon. Each of these materials is of comparative low density, and is easily formed into desired shaped by molding, machining, or otherwise. As shown in FIG. 3, the cross section tail may be a metal such as magnesium or aluminum while the structure of FIG. 4 shows in cross section a plastic tail which may be lexan or nylon.

The cruciform tail assembly can be made by a machining process. The machine tool may have a radius corresponding to the curvature 13 wherein the cruciform rearward portion of the tail changes to a cylindrical forward portion thereof. In order instances the cruciform rearward section is joined to the forward cylindrical portion of the tail by an abrupt shoulder or step 14. Both types of flechettes have been made and tested with a considerable degree of success, and at this time it is not possible to state which of the embodiments, FIG. 1 or FIG. 3 is superior. Flechettes of both types have been launched both at supersonic speeds and at subsonic speeds and both have proved to be successful.

The assembly of FIG. 3 shows a tail structure and tip structure having mating parts which are forced together in a pressed fit. The assembly of FIG. 4 shows the use of a copper jacket over the tip structure which is crimped to the tail structure thereby joining the tip to the tail. FIG. 5 illustrates a third method for joining the tip to the tail by drilling a small hole in each member and inserting a roll pin 18 therein. As shown in FIG. 6, the roll pin 18 acts as a spring wedging itself into the cavity, and therefore, the diameter of the drilled hole need not

be of high precision. In each of the methods shown for securing the tip structure to the tail structure, a flechette is assembled which will not break or separate due to the launching forces. The launching forces are exerted longitudinally against the flechette which may be tightly packed sabot with other flechettes. The longitudinal force exerted in launching does not particularly stress the joint between the tip 11 and the tail 12. During flight, there are no particular forces exerted tending to separate the flechette which will then have good aerodynamic stability. Upon impact, any of the various joints shown in FIGS. 3, 4 or 6 may or may not break apart such that the flechette tip and tail will tumble and expend its kinetic energy in soft targets, or such that the flechette will remain intact for piercing hard targets.

I claim:

1. A flechette comprising:

a. a tip portion having a pointed forward end and a flat rear surface;

b. a tail portion having a flat forward surface and a cruciform cross section extending from the trailing end forwardly for a substantial portion of the length of said tail portion; and

c. means releasably joining said tip and tail portions with said flat surfaces in facing engagement, whereby axial forces are transmitted through said facing flat surfaces, said last-named means being adapted to allow separation of said tip and tail portions upon striking a target.

2. The invention according to claim 1 wherein said last-named means comprises a roll pin frictionally engaging the internal surface of openings extending into each of said tip and tail portions through said flat surfaces thereof.

3. The invention according to claim 1 wherein said tail portion is at least as long as said tip portion and said cruciform cross section extends forwardly at least half the length of said tail portion.