Projectile and method for stopping aerial vehicles

Background

The solution relates to deterring unmanned aerial vehicles (UAV). Solutions for deterring UAVs are disclosed, for example, in publications US10435153, WO2020112245A2, US20180257780A1, WO2019074573A1, US20180299231A1, WO2020208330A1 and CN110806147A.

Brief disclosure

As unmanned aerial vehicles of various kinds become more common so does the need to be protected against them. UAVs are easy to come by and their controllability, range, and load-carrying capacity are continuously increasing, so using them to cause damage is also increasing.

~~It is an object of the solution to develop~~Embodiments of the present disclosure disclose a new kind of solution for fighting off unmanned aerial vehicles and other small devices travelling by air. ~~The solution is characterised by what is stated in the independent claims. Some embodiments of the solution are disclosed in the dependent claims.~~

According to a first aspect of the present disclosure, there is provided a projectile, the projectile including a shell and a bunch of filaments, the bunch being wound in a coil and the bunch being placed inside the shell, wherein the filaments are of carbon fibre whereby the filament bunch is a carbon fibre tow comprising at least 1000 filaments.

According to a second aspect of the present disclosure, there is provided a method for stopping aerial vehicles, the method including forming an obstacle in the air by making use of the above projectile.

~~The disclosed solution~~Embodiments of the present disclosure comprises a projectile which comprises a shell and a bunch of filaments, the bunch being wound in a coil, and the bunch being placed within the shell. The projectile according to embodiments of the invention may be delivered to the target with different methods and by using various means. For example, the projectile may be fired by making use of compressed air or a propulsion charge, by using a compressed air weapon or grenade launcher, for example. The projectile may also be taken to the target by using a rocket or an aerial vehicle.

As the projectile is flying in the air, the coiled filament bunch included in the shell is released into the air. The filament bunch floating in the air produces an obstacle in the air for the operation of an aerial vehicle. Hitting an aerial vehicle, air current from a propeller of an aerial vehicle, or a propeller of an aerial vehicle causes the filaments loosen from the filament bunch. The filaments included in the bunch may, for example,

be sucked in the motor of the aerial vehicle, get entangled in its rotors and stop them, or get stuck on the aerial vehicle surface thereby harming its flight characteristics.

In ~~a solution according to~~ an example embodiment, the filaments are of carbon fibre. Advantages of carbon fibre include its lightness and good tensile strength. Due to their lightness, it is possible to pack a large number of long filaments in the projectile. Lightness also helps the filaments float in the air without falling too quickly. Due to the good tensile strength of carbon fibre, when a filament gets entangled in the aerial vehicle rotors or sucked in the aerial vehicle motor, it will not snap but becomes tangled in the motor parts causing the rotor or motor to jam or break.

In ~~a solution according to~~ an example embodiment, the filaments are of an electrically conductive material. The electrically conductive material may be carbon fibre, for example. An advantage of making the filaments of an electrically conductive material is that, for example, when a filament finds its way in a motor of an electrically driven aerial vehicle, the filament may cause the motor to break by causing a short circuit or another electrical fault.

In ~~a solution according to~~ an example embodiment, the filament bunch comprises at least 1000 filaments. When made of carbon fibre, a large number of filaments may be included in the bunch. A filament bunch consisting of filament made of carbon fibres is a carbon fibre tow. A large number of filaments easily causes one or some filaments to find their way inside an aerial vehicle or rotors or to get stuck on the surface of the aerial vehicle.

In ~~a solution according to~~ an example embodiment, the length of the filaments is 8 to 16 metres. With such a solution, a fairly large obstacle can be established, but the filament bunch may still be kept relatively small in weight and when wound on a coil, relatively small as concerns its outer dimensions.

In ~~a solution according to~~ an example embodiment, the filaments comprised by the bunch are fastened together at substantially one end thereof. Fastening together at one end may have the advantage of the handling of the bunches of filaments becoming easier.

In ~~a solution according to~~ an example embodiment, the projectile comprises a packing plate. The packing plate comprises a substantially circular plate-like piece substantially corresponding to the size of the diameter of a coil formed by a filament bunch substantially wound in a coil, that is, a filament coil. An advantage of using a packing plate may be keeping the filament coils unstuck to each other in connection with their packing and handling.

In ~~a solution according to~~ an example embodiment, the packing plate is of plastic, cardboard, paper, or paperboard.

The size of the packing plate may vary. The size of the packing plate may vary according to the length, thickness, or material of the filaments, for example. In an example the diameter of the packing plate is 40 to 120 mm. An advantage of using a packing plate may also be that the handling of coiled filament bunches is facilitated when the filament coils do not get stuck to each other. In addition, the coils are easier to store.

In ~~a solution according to~~ an example embodiment, the filament bunch is fastened at one end to the packing plate. In ~~a solution according to~~ an example embodiment, the filament bunch is fastened at one end to the centre part of the packing plate. By fastening the filament bunch to the centre of the packing plate may result in the advantage that as good as possible a balance is achieved as an opened projectile is floating to the ground. A filament bunch fastened at one end to the packing plate may be wound in a coil so that one end of the filament bunch is fastened to the centre of the packing plate and the remaining filament bunch is wound around it. In such a case, as the coil has been released into the sky, its unwinding begins from its outermost edge, moving towards the coil centre. Finally, the opened filament bunch hangs from the centre of the packing plate. By fastening the filament bunch to the centre of the packing plate may result in the advantage that as good as possible a balance is achieved as an opened projectile is floating to the ground. When the filament bunch is hanging from the centre of the packing plate, the packing plate stays the best in the horizontal position, gets the best air drag, and the descent speed is as slow as possible. A further advantage of the coil formed by the filament bunch unwinding in the sky from the outer edge may be that the filament bunch will the most likely remain unentangled.

In ~~a solution according to~~ an example embodiment, the filament coil formed by filaments wound in a coil and the packing plate are mutually parallel. Being parallel means that the planar surface of the packing plate and the upper or lower surface of the filament coil are in the same direction. For example, the filament coil may rest on the packing plate. An advantage of the filament coil and packing plate being parallel may be facilitating the handling of the coils due to as large a portion as possible of the coil surface being protected by the packing plate.

The projectile, as its outermost part, comprises a shell within which one or more filament coils may be placed. According to ~~a solution of~~ an example embodiment, at least three filament coils are placed inside the projectile shell. By placing a plurality of filament coils in a projectile, an advantage may be a faster forming of an obstacle in the sky as a single firing results in a plurality of filament coils in the air. An advantage may also be an increase in reliability when the quantity compensates for the effect of potentially unopened filament coils included in the projectile.

In ~~a solution according to~~ an example embodiment, the projectile comprises means to open the shell. An advantage of the means for opening the shell is an increase in the reliability of the projectile.

In ~~a solution according to~~ an example embodiment, the projectile and propulsion charge are both arranged inside a case. This means that the projectile comprises the propulsion charge and, as the outermost part, the case. An advantage of using a propulsion charge may be increasing the range of the projectile. A further advantage may be an increase in the speed of the projectile. The advantages of increasing the speed and range are that the obstacle can be fanned out in the air in the shortest possible time. The obstacle may also be fanned out on the basis of the detected trajectory of the aerial vehicles instead of prediction.

Brief description of the drawings

The invention will now be described in more detail in connection with preferred embodiments and with reference to the accompanying drawings, in which:

Figure 1 is a schematic top view of a filament coil;

Figure 2 is a schematic side view of a filament coil;

Figure 3 is a schematic side view of a descending filament coil;

Figure 4 is a schematic side view of a group of descending filament coils;

Figure 5 is a schematic cross section of an embodiment of the projectile as seen from the side;

Figure 6 is a schematic cross section of an embodiment of the projectile as seen from the side; and

Figure 7 is a schematic cross section of an embodiment of the projectile as seen from the side;

Detailed description of the figures

The disclosed solution comprises a projectile which comprises a shell and a bunch of filaments. The filament bunch is wound in a coil and the bunch placed inside the shell. The projectile according to the invention may be delivered to the target with different methods and by using various means. For example, the projectile may be fired by making use of compressed air or a propulsion charge, by using a compressed air weapon or grenade launcher, for example. The projectile may also be taken to the target by using a rocket or an aerial vehicle. Taking to