

FRANGIBLE MISSILE LAUNCH CANISTER COVER**Field of the Invention**

The present invention relates to a front cover for a missile launch canister. More particularly, the invention relates to a fly-through cover adapted to effectively seal the canister during storage and allow the missile's passage during launch.

Background of the Invention

Missiles are stored in canisters which, in the configuration relevant to the present invention, also function as launching canisters. An illustrative setup for a plurality of missiles is shown in Fig. 1. Fig. 1A shows a missiles carrier 100 transporting 12 missiles 101 (not seen) held in a plurality of launch canisters. In the context of this invention, the terms "canister" and "tube" are used interchangeably. In this particular arrangement, the missiles are held in a horizontal position during transportation and are then lifted to an essentially vertical position before launch, as shown in Fig. 1B. The cover to which this invention relates is indicated by 102 in the figure.

The requirements from the cover are many and stringent: on the one hand, it must shield the missile during storage from the environment, particularly moisture, contamination, and electromagnetic waves, and on the other hand, it must allow a smooth missile launch without interferences. Furthermore, because such missile launch canisters are grouped together as part of launchers platforms during storage, shipment, and launch, when a missile is launched, the pressure it and the propulsion gases generate may affect the neighboring canisters that haven't launched their missiles yet, in a way that might endanger their future operation, to the level of a launch failure. Therefore, it is clear that there are stringent

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requirements for the strength of the cover. Attempts have been made in the art to provide an effective cover that fulfills all the abovementioned requirements, but all existing solutions fall short in some areas.

It is an object of the present invention to provide a cover for a missile launch canister that overcomes the drawbacks of the known art.

It is another object of the invention to provide a cover for a missile launch canister that efficiently seals the canister during storage while allowing an unobstructed and collision-free launch of the missile.

It is a further object of the invention to provide a cover for a missile launch canister capable of withstanding the jet effects, such as pressure and temperature generated by the launch of neighboring missiles.

Other objects and advantages of the invention will become apparent as the description proceeds.

Summary of the Invention

In one aspect, the invention is directed to a frangible missile launch canister cover comprising:

- (1) a bottom layer consisting of a plastic structure configured with weakening points;
- (2) an intermediate layer consisting of an electroless metal layer;
- (3) a top elastomeric layer;

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(4) one or more structural elements adapted to couple said layers to a canister.

In embodiments of the invention the elastomeric layer is selected from silicone rubbers and Butyl, Nitrile, and Ethylene-Propylene rubbers.

In an embodiment of the invention the canister cover bottom layer is produced by injection. The electroless metal layer may comprise more than one sublayer made of different metals. In an embodiment of the invention, the electroless metal is copper-nickel. Alternatively, the canister may comprise a metal-filled coating adapted to provide electromagnetic shielding thereto.

In one embodiment, the canister cover top layer is an RTV silicon layer.

The canister cover of the invention may have structural elements adapted to couple the layers to a canister, which in one embodiment comprise a plurality of holes provided in the circumference of the cover, adapted to house fastening means that couple the cover to the canister.

The invention also encompasses a missile launch canister fitted with a cover according to the invention.

Brief Description of the Drawings

In the drawings:

Fig. 1 (A and B) schematically illustrate a typical missile carrier / launcher;

Fig. 2 shows a typical launch canister;

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Fig. 3 schematically shows the exploded view of the two main layers;

Fig. 4 (A-D) is a general view of the bottom layer according to an embodiment of the invention;

Fig. 5 (A and B) is a detailed view illustrating the weakening lines and living hinges in the embodiment of Fig. 4;

Fig. 6 illustrates the cover in a sequence of positions during the missile ejection from the canister;

Fig. 7 shows the top of the canister after the missile was launched; and

Fig. 8 illustrates one top cover embodiment with a multi-layered electroless arrangement.

Detailed Description of the Invention

Looking now at Fig. 2, a launch canister 200 is fitted with a cover 201, through which the missile will launch. Some prior art systems, for instance, US Patent 4,498,368, employ a frangible diaphragm pierced by the missile launching through it. However, such arrangements are not robust. Fig. 3 illustrates embodiments of the invention in which different layers cooperate to meet all the requirements from the cover. The cover assembly 300 comprises two main parts that will be described in greater detail hereinafter. Plastic frame 301 and a silicon layer (which is cast upon the plastic frame) have an interposed flange 303 provided with holes 304 corresponding to holes provided in layers 301 and 302, through which a plurality of screws 305 pass when the cover is assembled, ending into the top perimeter of the launch canister, as will be shown in Fig. 6, thereby securing the cover to it. Flange 303 provides added rigidity and strength to the plastic frame when connected to the canister.. Fig. 4 (A-D) shows a bottom injected layer 301 of Fig. 3, in top, side, top perspective, and bottom perspective views, respectively. As shown in Figs. 4A, B, and C, the top side of this layer is provided with a plurality of ribs 400, which have the purpose of

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delivering better adhesion between it and the bottom portion of layer 302 of Fig. 3. The actual number and shape of the ribs may vary and is not part of the invention. As will be apparent to the skilled person, the ribs are designed to enable the silicon injection, provide sufficient adhesion, and support the plastic evacuation process.

Fig. 5 (A and B) is a detailed illustration of the construction of bottom layer 301 of Fig. 3, indicated by numeral 501 in Fig. 5A, which in the embodiment of Fig. 5, consists of a plastic frame, as shown in a particular embodiment of the invention, in which weakening lines, the role of which will be immediately apparent, are shown. The parts of layer 501, as indicated in the figure, are: framing portion 500 and two separation portions 502 and 503. The figure also shows weakening lines 505, located between portions 502 and 503, and line 504, which follows the contour of framing portion 500. Illustrative dimensions for one specific embodiment of the invention have a thickness of 3.5 mm throughout the solid part of layer 301 and approximately 1 mm along lines 504 and 505.

To better understand the operation of the invention, reference is made now to Fig. 6 using the numerals from the previous figures. In Fig. 6 there is schematically shown a launch canister 200 at a time when missile 600 breaks through the cover, separating part 502 from 503. Launch canister 200 is shown in Fig. 7 after launch, where parts 502 and 503 of the cover have pivoted aside, in this particular embodiment, around living hinges provided in the plastic material (not indicated by numerals in the figure).

In order to impart the desired strength properties to the cover, along with the needed EMI/RFI shielding properties, the cover of the invention is manufactured with very specific materials and sublayers. Starting with the bottom layer (301 in Fig. 3), because of the

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relatively complex structure of its various parts, it is advantageous to manufacture it by plastic injection that allows for precise differences in the thickness of the plastic at different locations. Upper layer 302, located above the plastic frame 301 of Fig. 3, however, is more complex, and its structure is schematically shown in Fig. 8. While additional layers can be added, at least the following must be provided: an outer plastic cover 302, e.g., RTV, typically manufactured by molding, having in one specific embodiment a thickness of 2.3 mm. Below it, an electroless metal layer must be provided, which is suitable to shield the launch canister from EMI/RFI. The electroless metal layer can be of any suitable type well known to the skilled person. In the example of Fig. 8, the electroless layer is composed of two separate metal layers, with layer 801 being electroless nickel with a thickness of 7 μm and layer 802 being electroless copper with a thickness of 10 μm . Of course, the above dimensions and all dimensions mentioned herein are provided only for the purpose of illustration and are not meant to limit the invention in any way. The electroless layer can be provided in alternative forms and does not necessarily have to be applied in foil form. For instance, a conductive layer based on copper or silver can be sprayed onto plastic frame 301.

The invention also encompasses a complete launch canister already fitted with the cover according to the invention.

All the above description of embodiments of the invention have been provided for the purpose of illustration and are not meant to limit the invention in any way. Many modifications can be carried out in embodiments of the invention. For instance, different plastic materials and metal layers can be used, and other shapes of the cover, including differently shaped ribs and weakening lines and points, can be used, all without exceeding the scope of the invention.

Claims

1. A frangible missile launch canister cover comprising:
 - (1) a bottom layer consisting of a plastic structure configured with weakening points;
 - (2) an intermediate layer consisting of an electroless metal layer;
 - (3) a top elastomeric layer;
 - (4) one or more structural elements adapted to couple said layers to a canister.
2. The canister cover of claim 1 wherein the elastomeric layer is selected from silicone rubbers and Butyl, Nitrile, and Ethylene-Propylene rubbers.
3. The canister cover of claim 1, in which the bottom layer is produced by injection.
4. The canister cover of claim 1, wherein the electroless metal layer comprises more than one sublayer made of different metals.
5. The canister cover of claim 1, wherein the electroless metal is copper-nickel.
6. The canister cover of claim 1, comprising a metal-filled coating adapted to provide electromagnetic shielding thereto.
7. The canister cover of claim 1, wherein the top layer is an RTV silicon layer.
8. The canister cover of claim 1, wherein the structural elements adapted to couple the layers to a canister comprise a plurality of holes provided in the circumference of the cover, adapted to house fastening means that couple the cover to the canister.
9. Missile launch canister fitted with a cover according to any one of claims 1 through 8.