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MISSILE STAGE SEPARATOR

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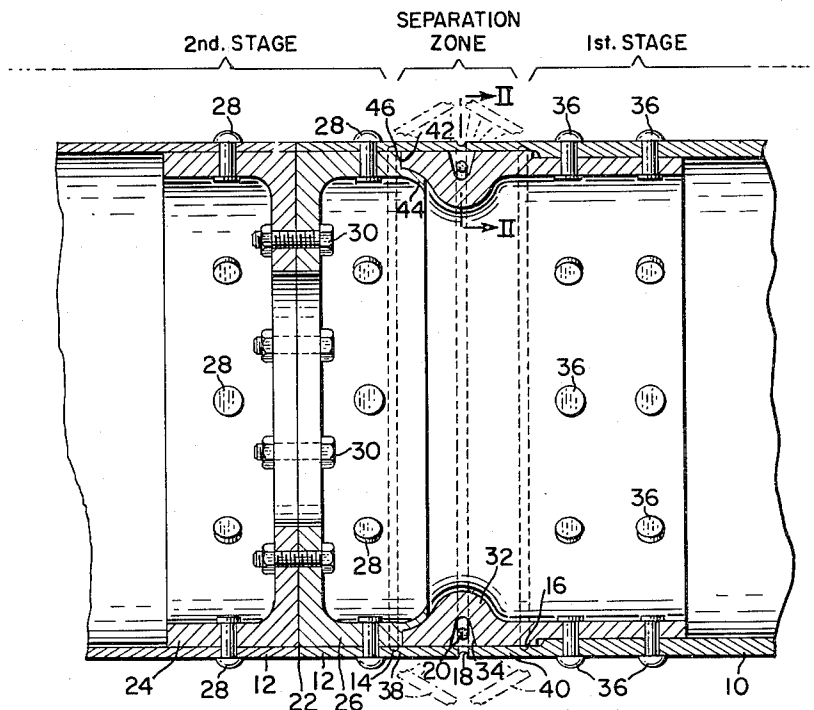


Fig. 1

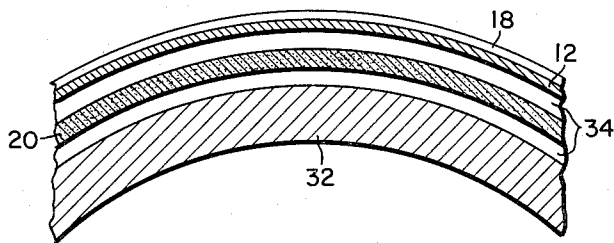


Fig. 2

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MISSILE STAGE SEPARATOR

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The present invention relates to a missile stage separator and more particularly to a device for effecting an aerodynamically clean separation between adjoining stages of a missile.

The use of an explosive cord for separating a piece of material into two parts has many advantages in that there are no moving mechanical parts, and its operation is quick and effective. Previously, however, the use of an explosive cord for separating adjoining stages of a missile has been thought to be impractical because of the extremely jagged edges and the distortion of the metal that resulted from the explosive force. The present invention overcomes this problem by providing a device which allows the use of the explosive cord so as to obtain its advantages and yet obtain a clean aerodynamic separation so as to not hamper the missile in its trajectory. This is accomplished by employing a breakable material for the skin of the missile and by grooving the skin of the missile in a novel manner so that upon ignition of an explosive cord adjacent the skin a clean aerodynamic break occurs at a selected groove.

An object of the present invention is to provide a device which will separate a piece of material into at least two parts with a minimum of distortion.

Another object is to effect a clean transverse separation of a cylindrical shell into two parts.

A further object is to effect a clean aerodynamic separation of adjoining stages of a missile with a minimum of distortion.

Still another object is to effect a clean aerodynamic separation of adjoining stages of a missile with a minimum of shock to components within the missile.

Yet another object of the present invention is to effect a clean aerodynamic separation of adjoining stages of a missile with an explosive cord.

A still further object of the present invention is to effect a clean aerodynamic separation of adjoining stages of a missile without the use of any mechanical parts.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawing in which like reference numerals designate like parts throughout the figures thereof and wherein:

FIG. 1 is a cross-sectional side view of adjoining stages of a missile with portions of each stage being cut away.

FIG. 2 is a view taken along line II-II of FIG. 1.

Referring now to the drawings, wherein like reference numerals designate like or corresponding parts throughout the several views there is shown in FIG. 1 a missile having a first stage and an adjoining second stage, the first stage having an outer skin 10 and the second stage having a somewhat thinner outer skin 12. Between the stages the outer skin 12 has a pair of inner circumferential grooves 14 and 16 and an outer circumferential groove 18 located between the inner grooves 14 and 16. An explosive cord 20 is circumferentially disposed about an inner surface of the skin 12 so as to be opposite to the outer circumferential groove 18. The missile skin 12 is in two parts at point 22 and is joined together by a pair of annular flanges 24 and 26, these flanges being rigidly connected to the skin by rivets 28 and being joined

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together by bolts and nuts 30. A backup ring 32 having an annular opening 34 completely encloses the explosive cord 20 against the skin 12, this ring being rigidly attached to the skin 10 by rivets 36. The annular grooves 14 and 16 divide the skin 12 into an annular portion 38 and another annular portion 40. The explosive cord 20 is ignited by an igniter (not shown) upon the first stage being expended and the second stage being fired.

The missile skin is to be made of a material that will break at least at the groove 14 upon the ignition of the explosive cord 20. To some extent this is a design consideration depending upon the explosive force utilized and the depth of the grooves. It has been found that magnesium is a suitable material for constructing the skin. Further, an explosive cord number OS 9199 having "PETN," "RDX" or "PN-TACOT" type explosive available from commercial sources has been found to be satisfactory.

The annular flange 26 has an annular bearing surface 42 and a shoulder 44 which are adapted to engage an annular bearing surface 46 of the backup ring 32 so as to compensate for the loss of strength due to the grooves and effectively transfer the load between the first stage and the second stage upon the operation of the first stage.

In the operation of the device upon the use of the first stage the thrust therefrom is transferred to the second stage by the backup ring 32 and the flange 26 acting on one another through the bearing surfaces 42 and 46. Upon the first stage being expended and the second stage being fired the explosive cord 20 is ignited causing the skin 12 to fracture at all three grooves, forcing the annular portions 38 and 40 to the dotted positions shown in FIG. 1 and resulting in a clean aerodynamic separation along the groove 14. While there will be a clean aerodynamic separation along the groove 16 this is of no consequence as far as the operation of the second stage.

It is now readily apparent that the invention provides a novel device for obtaining an aerodynamically clean separation between adjoining stages of a missile. By providing grooves in particular locations on the skin of the missile and utilizing an explosive cord the clean break can be effected. Further, the grooving cuts down the amount of explosive force previously thought required thus materially reducing the shock to the missile and its equipment upon ignition of the cord.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. While in the preferred embodiment the grooves are to be located as shown in FIG. 1 it can readily be seen that the grooves could be on either side of the skin and the invention would still operate for its intended purpose. It is therefore to be understood that within the scope of the appended claims, the invention may be practiced otherwise than as specifically described.

We claim:

1. A device for smoothly separating a piece of material into at least two parts comprising:

said piece having a pair of weakened portions spaced from one another;

said piece having a third weakened portion between said pair and spaced from each weakened portion within the pair;

and means for applying a force to said piece between said pair and in the proximity of said third weakened portion of a magnitude sufficient to break said material at all three weakened portions whereby upon said force being applied the breaks at the weakened portions of said pair result in smooth edges.

2. A device for separating a piece of material into at least two parts comprising:

said material being breakable;

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said piece having a pair of grooves spaced from one another;

said piece further having a third groove between said pair and spaced from each groove within the pair;

and explosive means located on a surface side of the piece for applying a force transverse the piece and in an area along said third groove of a magnitude sufficient to break said material along all three grooves whereby upon the explosive means being ignited the breaks along the grooves of said pair result in smooth edges.

3. A device as claimed in claim 2 wherein the third groove is on a surface side of the surface side location of said piece opposite from said explosive means and the pair of grooves are on the same surface side of said piece as the explosive means.

4. A device for smoothly separating a cylindrical shell into at least two parts comprising:

said shell being constructed of a breakable material; said shell having a pair of spaced grooves extending generally circumferentially about the shell;

said shell further having a third groove extending generally circumferentially about the shell;

the third groove being located between said pair and spaced from each groove within said pair;

and explosive means on an inner side of the shell for applying a force transverse the shell in an area along said third groove; said force being of a magnitude sufficient to break the shell at all three grooves, whereby upon the explosive means being ignited the breaks along the grooves of said pairs of grooves will result in smooth edges.

5. A device as claimed in claim 4 wherein the third groove is on a surface side of said piece opposite from

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said explosive means and the pair of grooves are one the same side of the piece as the explosive means.

6. A device for smoothly separating a pair of adjoining stages of a missile comprising:

said missile having an outer skin constructed of a breakable material;

an inner surface of said skin having at the joining of the stages a pair of circumferential grooves which are spaced from one another;

an outer surface of said skin having a circumferential groove which is between said pair and is spaced from each groove within the pair;

an explosive cord mounted about the inner surface of the skin opposite the groove on the outer surface;

means connected to the inner skin of both stages at locations outside the skin between said pair of grooves for compensating for the loss of strength of the skin due to said grooves so as to transfer the load between the stages when the first stage is in operation; said means further enclosing said charge for directing the explosive force of the cord outwardly upon ignition;

said explosive cord having sufficient explosive force to break the skin completely along all of said grooves, whereby upon the explosive cord being ignited a clean break is effected at said pair of grooves resulting in an improved aerodynamic configuration for the stage adjoining the first stage.

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