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(12) **United States Patent**
Spencer et al.

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- (54) **FLY BACK BOOSTER**
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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

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- (21) Appl. No.: **09/578,321**
- (22) Filed: **May 24, 2000**

Primary Examiner—J. Woodrow Eldred
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Related U.S. Application Data

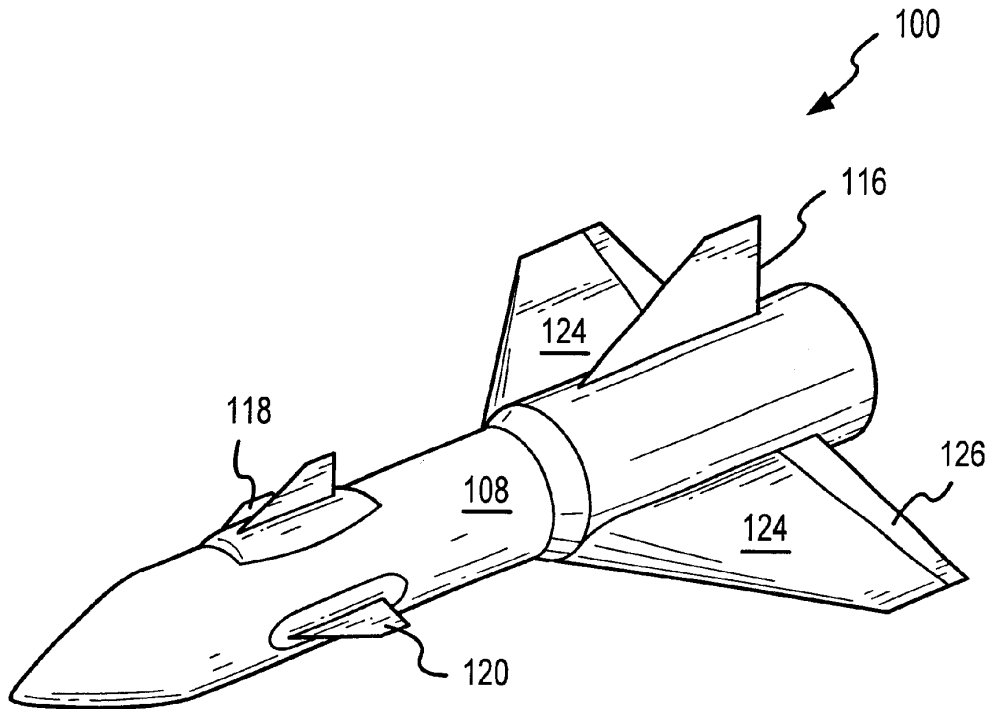
- (60) Provisional application No. 60/135,556, filed on May 24, 1999.
- (51) **Int. Cl.**⁷ **B64G 1/00**
- (52) **U.S. Cl.** **244/158 R; 244/190; 244/172; 244/63**
- (58) **Field of Search** 244/158 R, 190, 244/172, 2, 63

(57) **ABSTRACT**

A reusable first stage (100) includes a booster engine system (102) for providing thrust during launch, a structural assembly (108), canards (118), jet engines (122), wings (124), elevons (126) and retractable landing gear (130). After separation, the jet engines (122) and aerodynamic control surfaces are used to return the first stage to a landing strip. The booster system (102) includes a structurally stable outer skin system such as an isogrid structure. The first stage (100) is thereby adapted for controlled descent and recovery with minimal structural enhancement or added mass.

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19 Claims, 6 Drawing Sheets



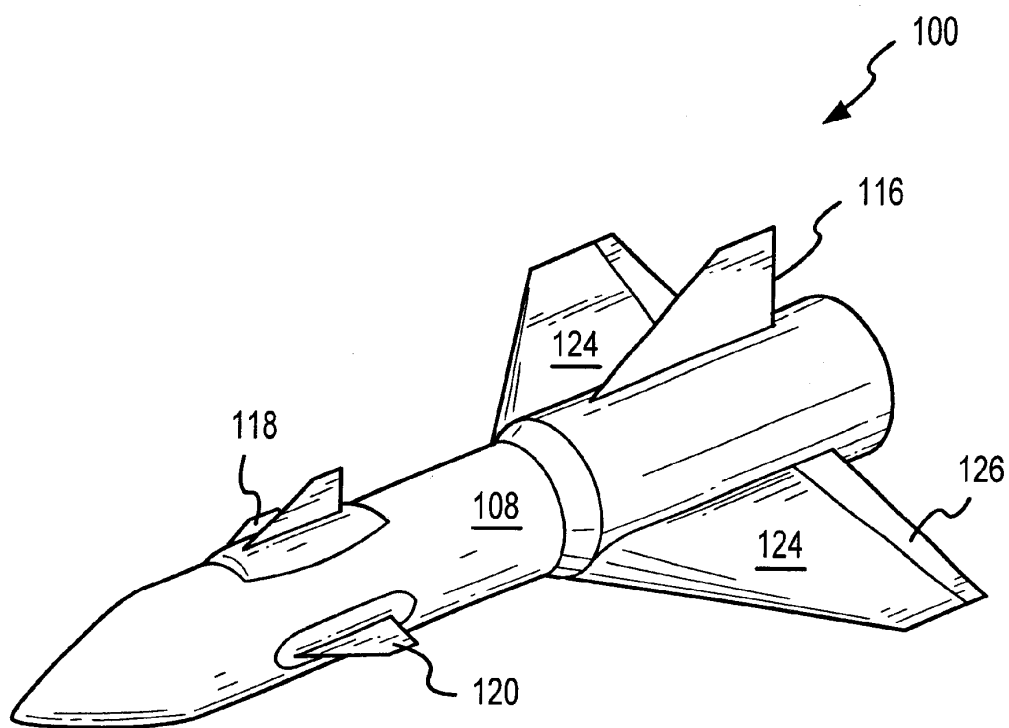


FIG. 1

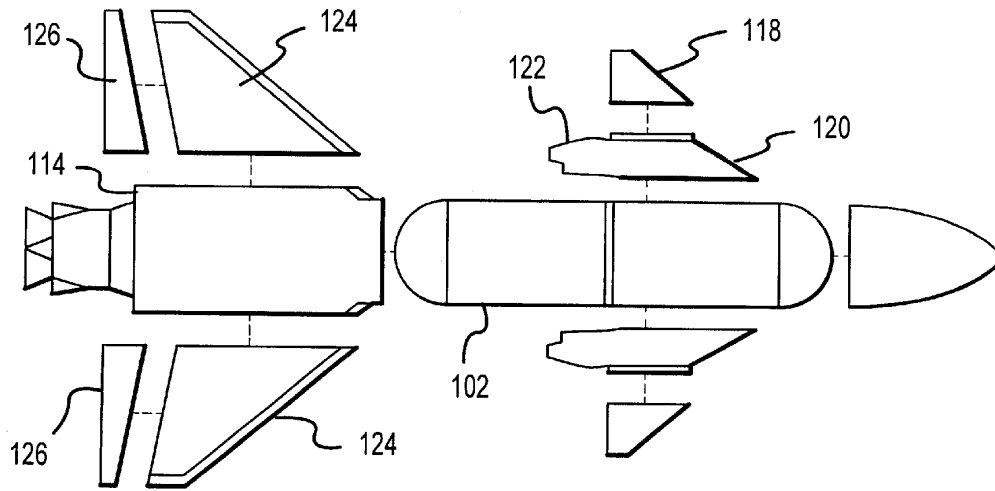


FIG. 2

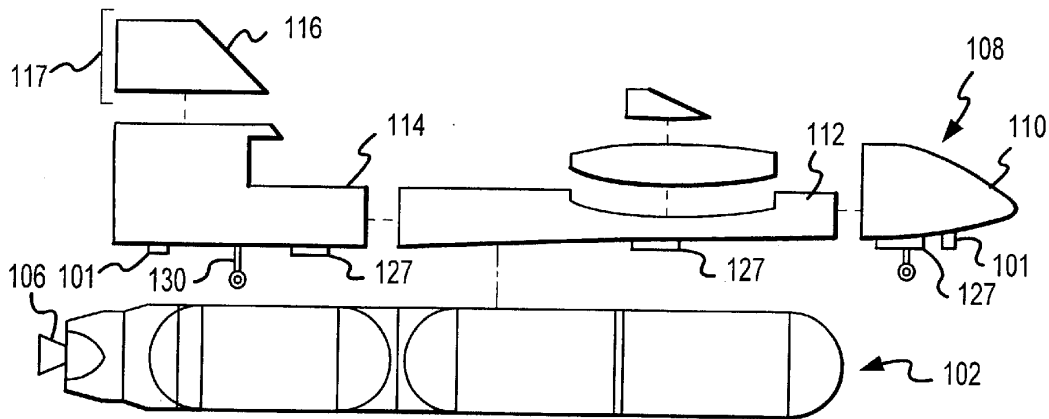


FIG. 3

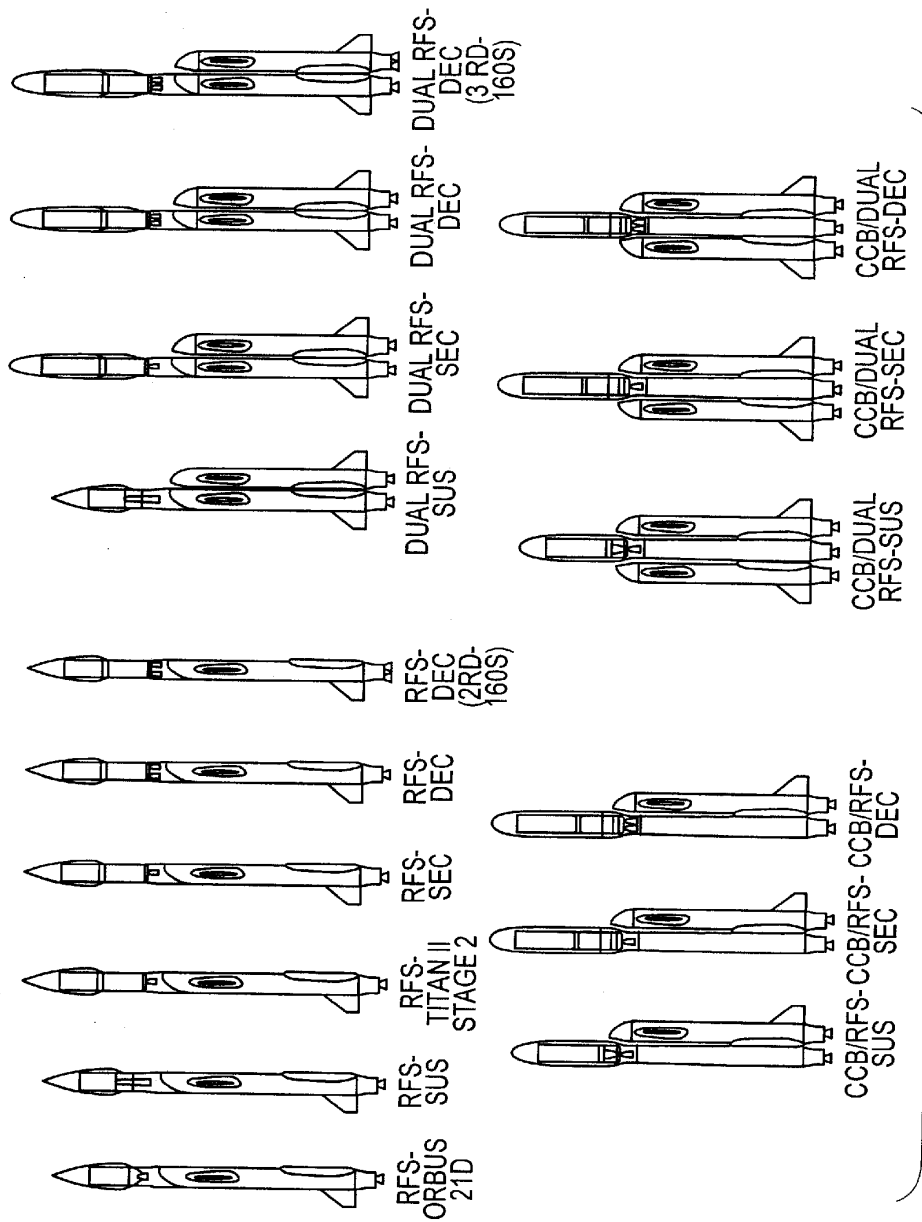


FIG.4

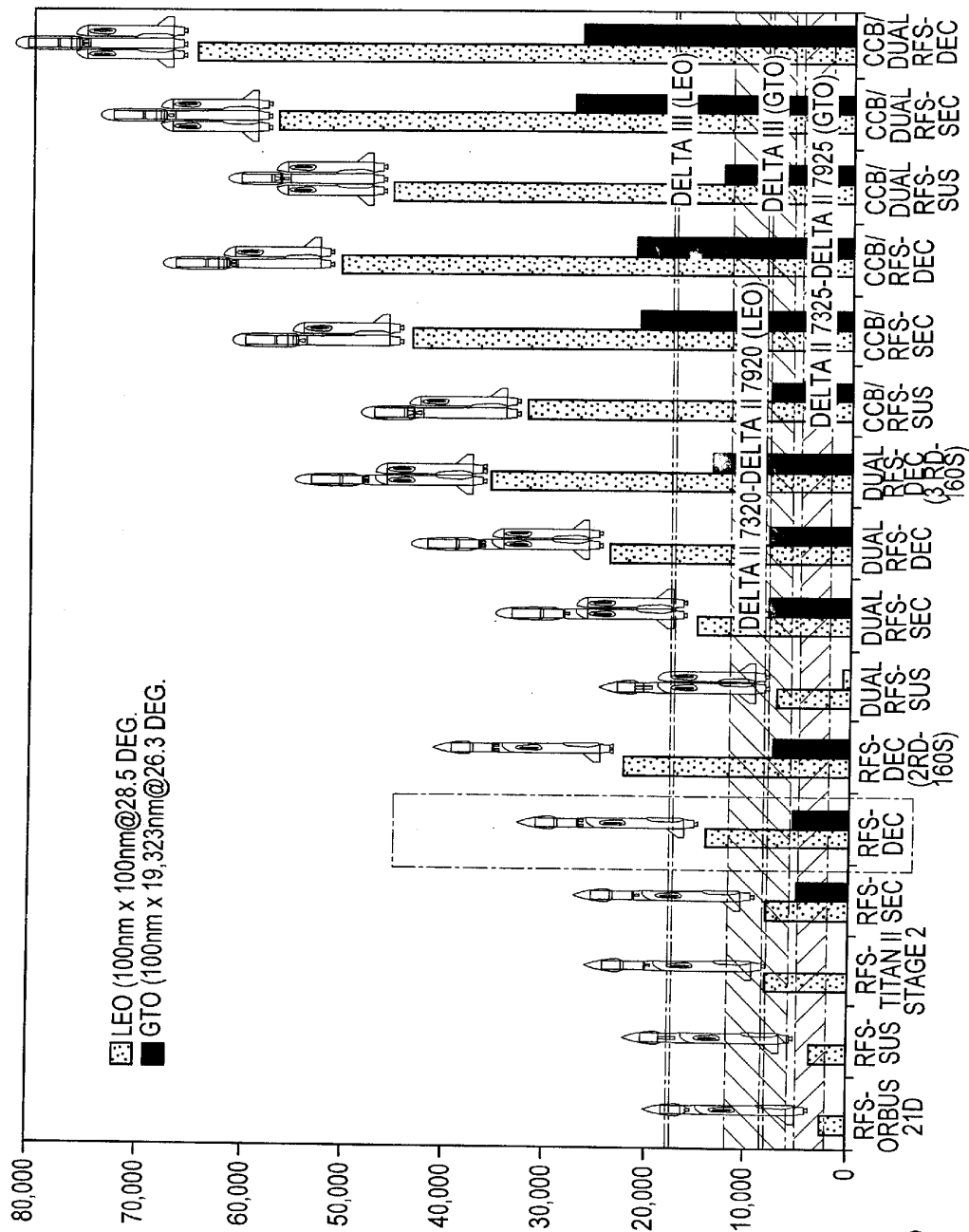


FIG.5

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