Programmable Initiators to Extend Functionality of Reserve Power Systems

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Thermal Batteries

• Ideal power source for many munitions
  – Long shelf life
  – Good temperature performance
  – High power capabilities

• Reserve battery
  – Initiated by a pyrotechnic device - Igniter
  – Heat generated melts electrolyte to activate the battery
Main Functions

– Ignites pyrotechnics to heat up the battery
– Safety mechanism
  • Ideally the igniter only fires when shot from a gun
  • Differentiate between dropping events and gun launched events
    – Important to include magnitude and duration of impulse

• Classes of Igniters
  – Inertial Igniters – mechanically initiated pyrotechnics
  – Electrical igniters – electric matches, squibs – powered by some external power source and decision circuitry
Family of Inertial Igniters

— Miniature, Scalable, Producible designs that can easily accommodate a wide variety of applications

Baseline

V1 50% height reduction

V2 - 65% volume reduction

V3 - 85% volume reduction

V4 design is greater than 90% less volume than baseline design

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V2 Inertial Igniters

- V2 with Improved Producibility
  - Awarded Army CPP (Commercialization Pilot Program) to improve manufacturability
  - Reliability testing ongoing
  - ~65% smaller in volume w/ same functional requirements
V2 operation

V2 Inertial igniter operation

- Locking sleeve under equilibrium
- Under No-Fire acceleration locking sleeve will return back to equilibrium
- Only under All-Fire does the locking sleeve unlock the striker.
- Striker Released
Programmable Initiators

• Piezoelectric harvester converts forces from acceleration into electrical charge
  – Collected in main storage device
  – Activates safety circuit
    • Determines all-fire/no-fire levels
    • Enables power source to activate pyrotechnic device

• A simple counter could provide a delay of up to days after launch

• Acceleration inputs could also trigger events
Advantages of Programmable Initiators

• Inertial igniters activate upon setback - Turn battery on when it is actually needed allows for optimization of battery size
• No external power source/decision circuitry required
• Can easily satisfy a variety of all-fire & no-fire requirements
• Scalable – Flexible, low cost, and size
Summary

• Families of miniaturized igniters for thermal batteries are/have been developed
• Significant volume reduction of inertial igniters
• Programmable initiators offer significant gains in flexibility
• Improved igniters offer significant gains in miniaturization without affecting safety, reliability, functionality, or cost.