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ALWAYS ON target

ELECTRONIC FUZES' REMOTE SETTING SYSTEM FOR CHAMBERED TANK AMMUNITIONS

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GENERAL DYNAMICS
Ordnance and Tactical Systems–Canada

OVERVIEW

- Fuze Setting when ammunition loaded into the gun
- All the fuzes' functions settable when loaded into the gun
- Provides optimum combat readiness and efficiency
- Provides airburst capabilities

CONTENTS

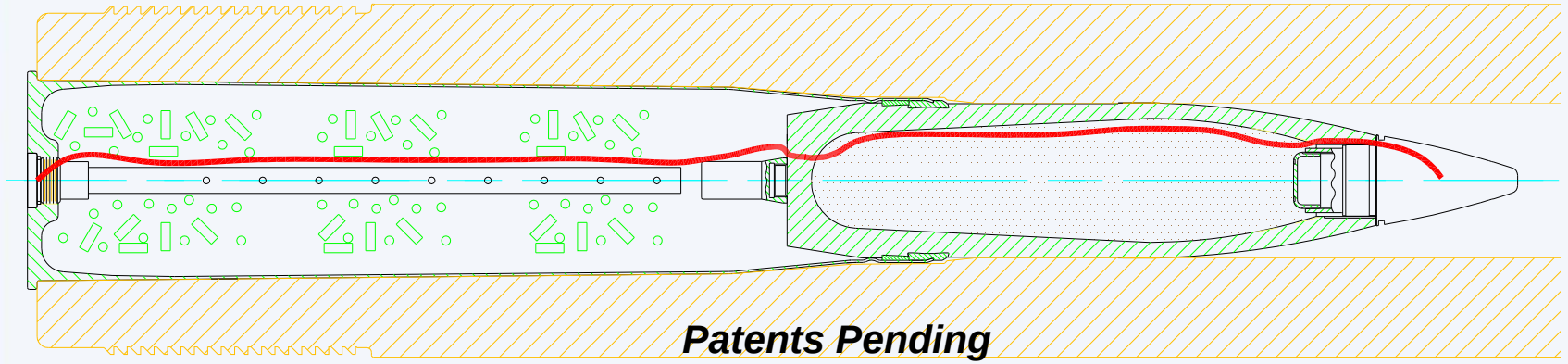
- Project Objectives
- Concept Description
- Firing Demonstrations
- Further Development
- Conclusion

OBJECTIVES

- **Develop a Remote Fuze Setting Technology for In-Bore Direct Fire Ammunition**
  - Improves reaction time against threats, using preloaded airburst programmable ammunition
  - Provides direct fire ammunition with multifunction capabilities
  - Increases fire power capabilities of direct fire vehicles
- **Requirements: Communication Data Link**
  - Robust and Reliable communication data link
  - Fuze Settable when ammunition loaded into the tube
  - No Mechanical Modification to the Breech and to the Gun
  - No Add-On Setting Device to the Tube
  - Solid wire between the Electrode's Primer Head and the nose Fuze
- **Airburst capability**

CONCEPT DESCRIPTION

- **Data message passes through existing firing circuit**
  - Only one solid wire is installed into the cartridge
- **Safety oriented concept**
  - Energy level is below the primer functioning threshold
  - Primer ignition element is by-passed for additional safety
- **No required modification to the gun**



Patents Pending

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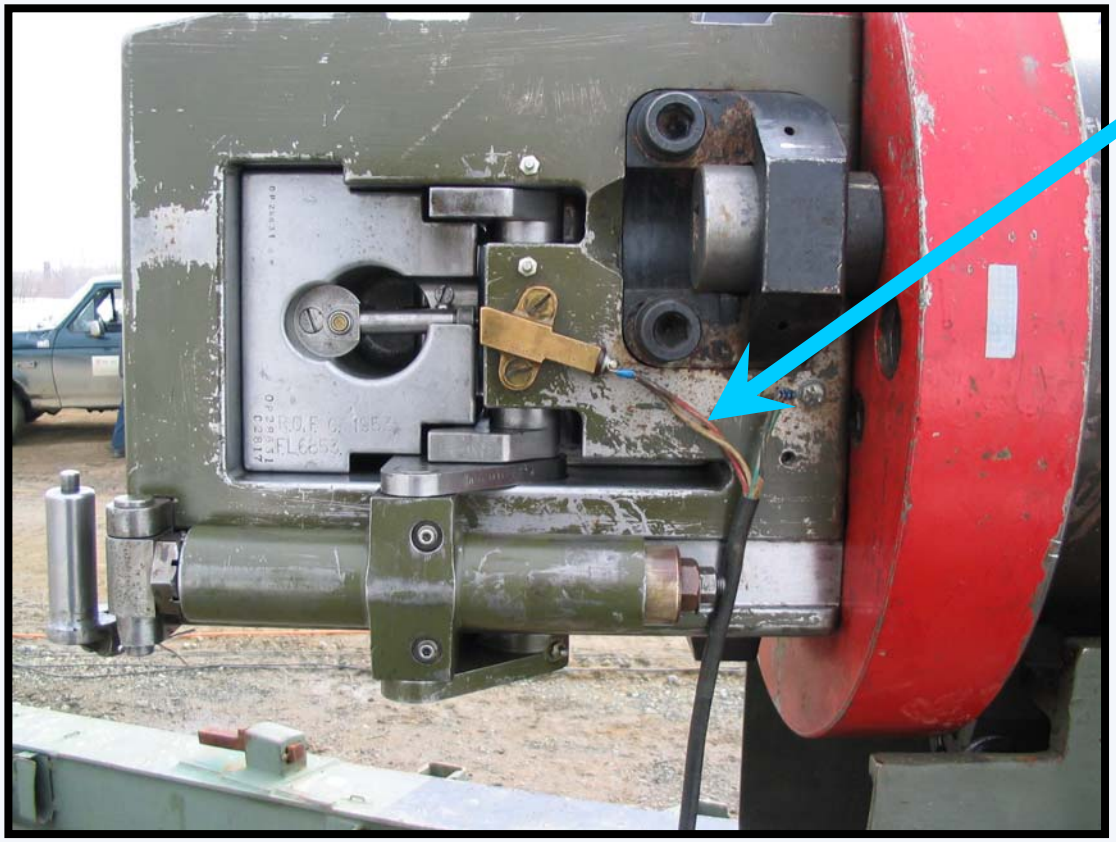
CONCEPT DESCRIPTION

- Data message sent through the regular firing pin



Same power cable used to carry both the setting and the firing signals

Only one wire used to carry the setting signal

No modification required to the breech

CARTRIDGE DESCRIPTION

- **105mm Tank cartridge composition:**
  - Specially Developed Electronic Time Fuze
  - Modified HE projectile
  - Modified Primer Head
  - Regular cartridge case

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ELECTRONIC TIME FUZE'S CHARACTERISTICS

- **In-Bore Programmable electronic time fuze**
  - Specially developed for the Remote Setting concept demonstration
- **Programmable Modes**
  - Time (Airburst): 100ms to 39.99 sec.
  - Point Detonating Delay
  - Super Quick (default setting)
- **Safety Distance**
  - More than 25m (Mechanical)
- **All Armed Distance**
  - 100m (Electronic and Mechanical)

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ELECTRONIC TIME FUZE'S CHARACTERISTICS

- **Fuze setting is possible until the very last moment before firing**
- **New setting overrides previous setting**
- **A talk-back function confirms the setting**
  - Electronic time: airburst
  - Point Detonating Delay
  - Super Quick Impact (default setting)
  - Other settings are possible

REMOTE SETTING DESIGN

- **No modification to the gun is required**
- **Fire Control System**
  - Preliminary study made by GD Canada who designed the MGS Fire Control System confirms that only modifications to the Fire Control System software and hardware are required.
- **Modified primer head**
  - Use the primer head's electrode as communication data link.
- **Electrical connections into to the projectile's base and nose**
  - Electrical connectors developed ensuring a reliable insulating and sealing of the projectile's base >500MPa.
    (Seal validation done up to the gun's maximum pressure limit)

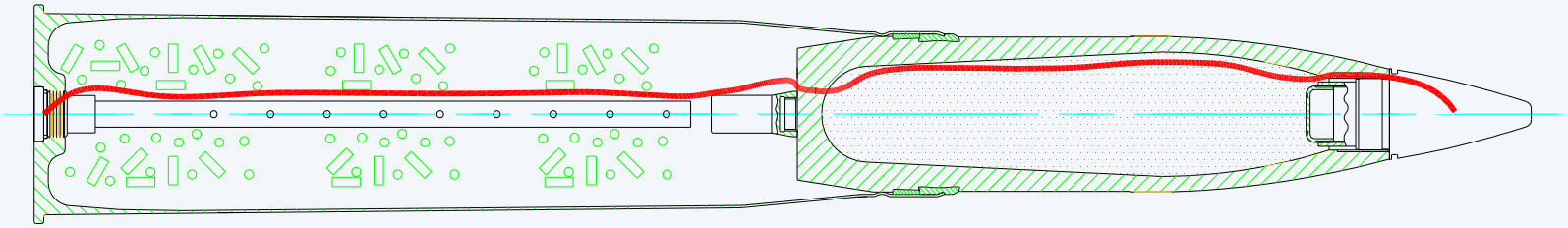
REMOTE SETTING DESIGN

- **Programming / Firing Sequence**

  1) Supply the fuze with energy
  2) Send the data message
  3) Receive Talk back Acknowledgement from the fuze
  4) Transmit Firing energy to ignite the Cartridge's Primer Head

SAFETY TESTS

- **Fuze**
  - Firing train propagation and interruption
  - Validating fuze strength of design
    - Recovery of S&A from firing at 500MPa
  - Arming and non-arming safety test (gun firings)
- **Projectile**
  - Validating high pressure seal electrical connector
    - Recovery of intact connector from firing at 500MPa



FIRING DEMONSTRATIONS

- Fuzes were programmed and fired from existing Leopard 1 firing system
- Airburst firing of HE rounds successfully conducted
- Airburst demonstrated at 130m, 1km and 14.5km *(20 deg)*
- Fired at 1,200m/s and 500MPa

TESTS RESULTS

- Airburst at 1,000m from the gun

TESTS SET UP

- **Airburst at 14.5km from the gun** (BLOS capability)

FURTHER DEVELOPMENT : 105 mm MPHE

- **Develop a 105mm Multi-Purpose HE cartridge having**
  - Enhanced efficiency against the MGS target suite
    - DRCW (8 inches)
    - Incapacitate personnel in the open
    - Snipers in buildings and infantry bunkers
  - Airburst capability
  - Compatibility with the MGS platform
- **Base Fuze for MPHE cartridge with Airburst capabilities**
  - In-bore programmable base fuze

BASE FUZE FOR 105mm MPHE

- **Base Fuze**
  - In-bore programmable base fuze
- **Programmable Modes**
  - Time (Airburst): 30ms to 39.999sec.
  - Point Detonating Delays
    - Short: 0.25ms for wall breaching
    - Long: 10ms for detonation inside building

    Note : Both delay settings (0.25 and 10ms) can be tailored at fuze manufacturing to suit customer objectives
  - Super Quick (default setting)
- **Safety Distance**
  - More than 10m (Mechanical)
- **All Armed Distance**
  - 33m (Electronic and Mechanical)

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BASE FUZE DESCRIPTION

Characteristics

- Fuze setting is possible until the very last moment before firing
- New setting overrides previous setting
- A talk-back function confirms the setting
  - Electronic time for airburst: 30ms to 39.999sec.
  - Point Detonating Delays
    - Short: 0.25ms for wall breaching
    - Long: 10ms for detonation inside building
  - Super quick impact (default setting)
- No battery required: capacitors loaded during fuze setting.

TESTS SUCCESSFULLY CONDUCTED

- **Firing train propagation and interruption**
- **Validating strength of design**
  - Recovery of S&A from firing at 500MPa
- **Validating high pressure seal connector**
  - Recovery of connector from firing at 500MPa
- **Programming the fuze from existing Leopard 1 firing system**

CONCLUSIONS

- **In-Bore Remote Setting Technology has been developed and demonstrated as required**
- **No mechanical modification or add-on required to the tank gun**
- **This technology provides many types of setting capabilities**
- **Versatile Technology**
- **Multiple Patents Pending on:**
  - Primer Head Electrical Connection Arrangements
  - Projectile Electrical Connection Arrangements
  - Fuze Electrical Connection Arrangements