GUN BARREL VIBRATION ABSORBERS FOR MEDIUM AND LARGE CALIBER SYSTEMS

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ABSTRACT

Vibration of gun barrels leads to dispersion of shot patterns. Decreasing dispersion will lead to a more lethal (more likely to hit), survivable (the sooner the enemy is hit the less likely they are to hit you), and sustainable (less rounds need to achieve the desired effect) weapon system. An intuitive way to reduce dispersion is to reduce the vibrations of the barrel. The end of the barrel is the anti-node for all vibration modes, so it is the obvious location to attempt to dampen the vibrations. This work demonstrates that novel structural modifications of future cannon may improve accuracy.

1. TANK GUN APPLICATION

For tank gun systems, we are interested in terrain-induced vibrations. Increased exit velocity requirements have lead to a demand for longer barrels. Longer barrels are more susceptible to these vibrations. The first system studied was the XM291, a 120 mm tank gun that is 1.45 m longer than the currently fielded 5.3 m long M256, which has exhibited increased vibration during live-fire bump-course testing (Gast, 1996).

The work on the XM291 produced the initial dynamically tuned shroud (DTS) concept (Kathe, 2001a). This DTS is a tune mass absorber that uses helical springs mounted onto the end of the thermal shroud. By incorporating springs of various stiffness, the natural frequency of the DTS may be tuned. This system was tested on a modified M1A1 tank traversing the RCC-9 bump-course at Aberdeen Proving Grounds, Maryland demonstrating 24% and 9% RMS improvement in vertical and horizontal bending, respectively (Kathe, 2001c).

After the success with the XM291, a second generation of the large caliber DTS was designed for the 120mm M256E1 cannon. This is a version of the M256 that has been extended by 1.3 m to achieve desired exit velocities. As before, the long M256E1 cannon is more susceptible to environmentally induced vibrations.

This version uses leaf springs instead of helical springs for a simplified and lower profile design. The leaf springs rigidly attach to the spring collar at one end and are supported by a wedge collar at the muzzle end. This arrangement allows the absorber to have a 3mm range of motion. The apparent stiffness of the springs can be changed by turning the wedge ring. The whole DTS still fits in the space of the normal thermal shroud and does not interfere with muzzle reference system (MRS) optics.

2. RAPID FIRE CHAIN GUN APPLICATION

The medium caliber work studied firing induced vibrations which also lead to shot dispersion. The system studied was the 25mm M242 Bushmaster chain gun. It is part of the M2A3 and M3A3 Bradley fighting vehicle systems and is designed to engage and defeat armored vehicles as well as provide suppression fire.

The medium caliber vibration absorber (Kathe, 2001b) is similar to its large caliber counterpart in that it is a simple and robust tuned mass absorber. It is mounted on the muzzle brake, allowing for easy mounting and removal while still acting at the barrel location of greatest vibration activity. In addition, the absorber's mass ring can double as a muzzle fuse set induction coil.

The absorber consists of a 1.83 kg mass, suspended from spring rods, which are attached to a collar press fitted onto the muzzle break. The rods are 6.35 mm in diameter and extend 147 mm from the collar to the mass. During firing tests the absorber produced a 45% attenuation of vertical motion and tighter orbits (Littlefield et al., 2001).

REFERENCES

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