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E-Bombs Could Go Mainstream

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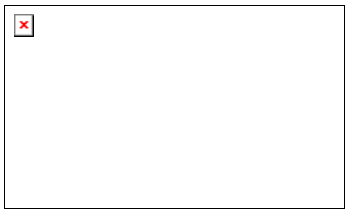

E-bombs, weapons that destroy electronics with an intense pulse of electromagnetic radiation, have been discussed for decades. But despite years of research and development, there is little sign of their deployment. The prospect of knocking out communications and other electronic systems is attractive, but commanders prefer proven weapons with known effects. Now the U.S. Army is developing technology to provide the best of both worlds, by creating munitions that combine conventional and e-bomb effects in one package.

Explosive munitions rely on blast, fragmentation and sometimes armor-piercing shaped charges for their effects. Researchers want to add an electromagnetic pulse (EMP) damage mechanism as well. This is in contrast to previous e-bomb projects that were intended to be nonlethal so they could destroy materiel without causing casualties. The Army program seeks to enhance existing warheads, adding the feature without affecting blast, fragmentation or armor penetration, and with minimal extra weight.

The power supply in traditional e-bomb design is a magnetic flux compression generator with metal coils carrying current. The coils rapidly compress in an explosion, producing an intense pulse of energy. The generator is bulky and cannot easily be integrated into existing munitions.

An alternative approach explored by the Army is a shockwave ferromagnetic generator. This is a magnet that blows up and spontaneously demagnetizes, releasing energy as a pulse of power. The effect is known as pressure-induced magnetic phase transition, and only occurs with some types of magnets in certain situations. In 2005, researchers from the U.S. Army Aviation and Missile Research Development and Engineering Center (Amrdec), working with contractor Loki and scientists from Texas Tech University, demonstrated an explosive pulsed-power source based on neodymium alloy magnets, a type used in speakers and headphones.

Having proven that the principle works, the researchers moved on to more exotic lead zirconate titanate magnets. This enabled them to reduce the volume of the power generator from 50 cu. cm. (3 cu. in.) to 3 cu. cm., excluding explosives. Army requirements call for assembly of the power generator, power conditioning and aerial in a 1-in. space. Power output will be measured in hundreds of megawatts for microseconds.

The aerial needed to shape and direct the electromagnetic energy is an engineering challenge, due to the intense force of the explosion and the size required. Allen Stults of Amrdec is working on a “conducting aerosol plasma warhead.” A flame conducts electricity due to the presence of charged particles in it. By altering the chemical mixture of a fireball produced by an explosion, Stults aims to turn it into an electrically conductive aerial, a “plasma antenna.”

This builds on previous Army work with explosively generated plasma antennas. Stults is working with military explosives and ensuring that other blast effects like armor piercing are not compromised by the changes. Previous work has also shown that the composition

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of the fireball needs to be matched to the frequency of the desired output.

An explosion takes the shape of a roughly spherical fireball, but a plasma antenna needs to be more cylindrical. This is why Stults works with shaped charges that produce more linear explosions. An earlier project looked at using the jet of metal produced by a shaped charge as an antenna, but this has been dropped for the plasma antenna.

An enhanced warhead could knock out a tank even if it did not penetrate. The vehicle would be left without ignition, communications or other electronics. A warhead would also knock out other electronic systems, including mobile phones used by insurgents to detonate bombs and circuitry in rocket-propelled grenades.

There is one big question with an EMP weapon: How to tell if it works. Carlo Kopp, an assistant professor at Monash University of Melbourne, Australia, and cofounder of the Air Power Australia think tank, is an authority in this field. He wrote papers that shaped strategic thinking on electromagnetic pulse weapons in the 1990s, and coined the term "e-bomb."

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