An Overview of the Shaped Charge Concept

By

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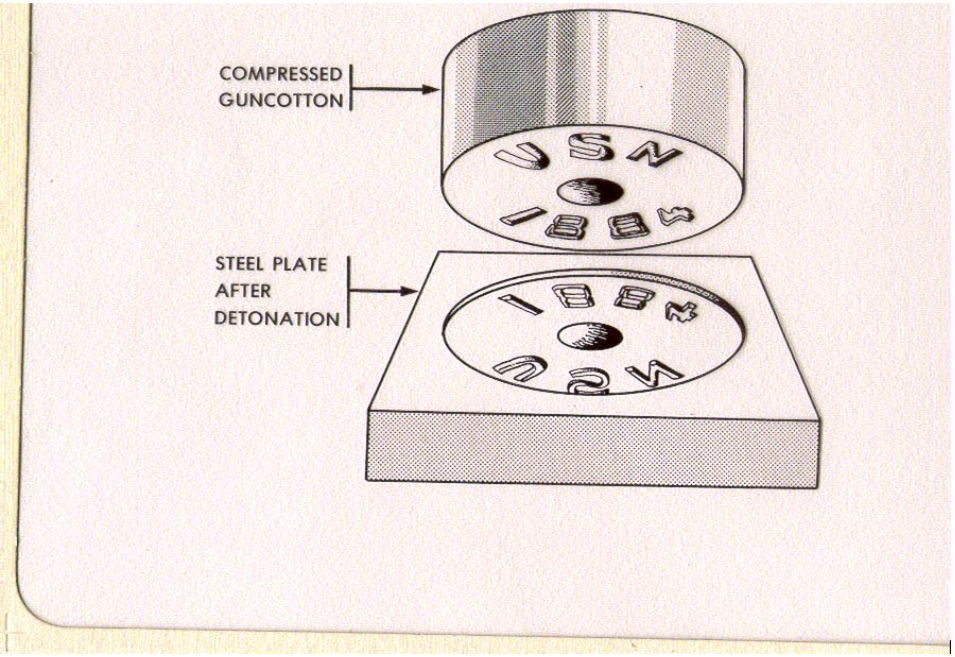
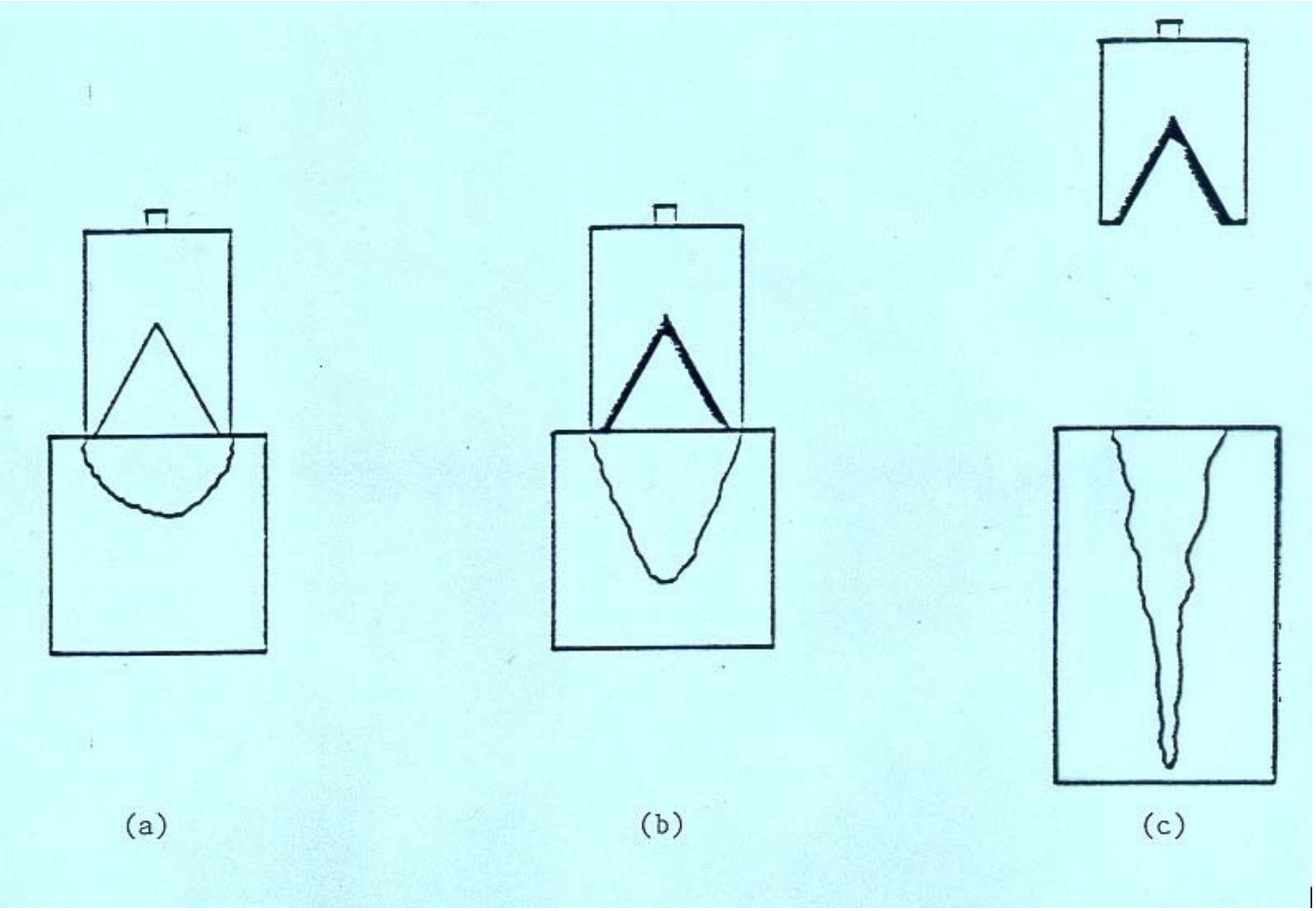
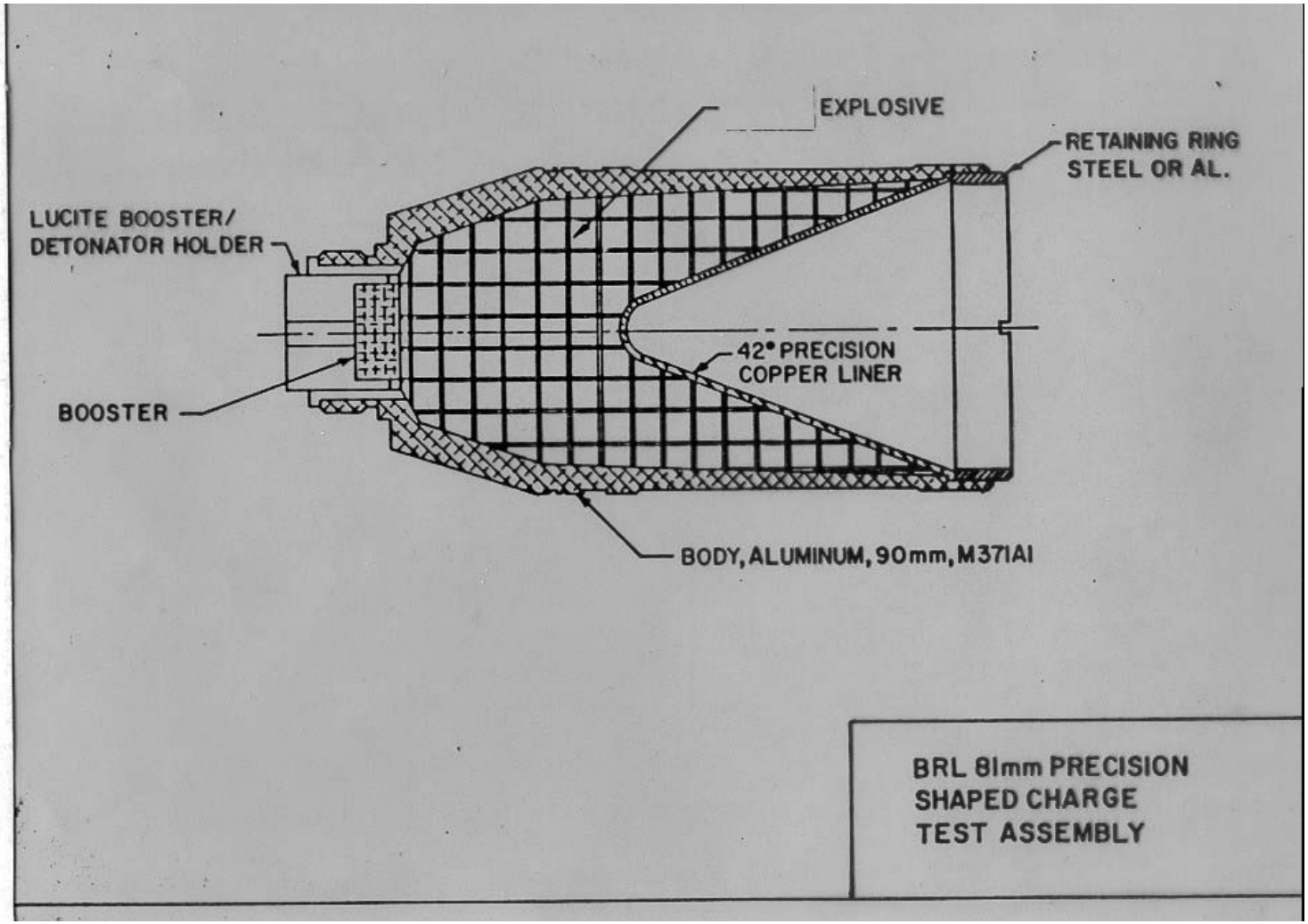
The Munroe Effect



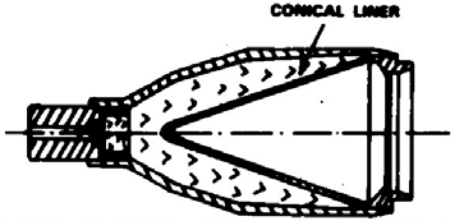
The Monroe Effect



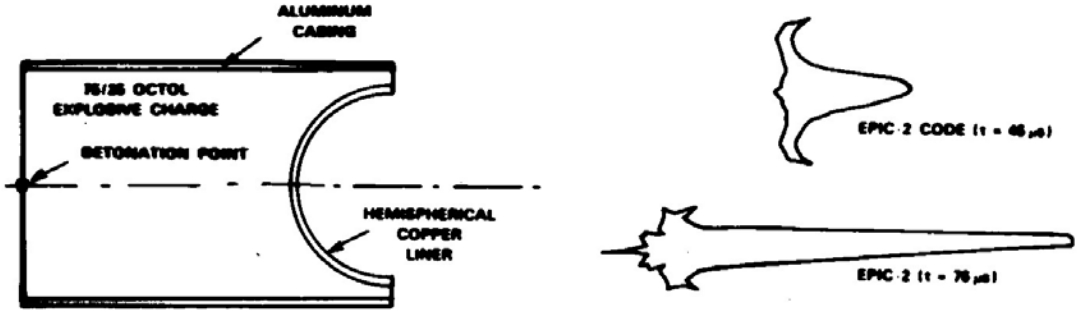
BRL 81 mm Shaped Charge



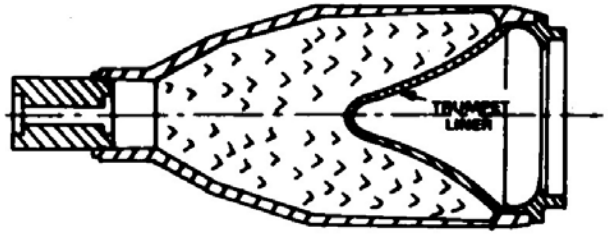
Shaped Charge Liner Geometries



a) UNIFORM-THICKNESS, CONSTANT-ANGLE CONICAL LINER DESIGN

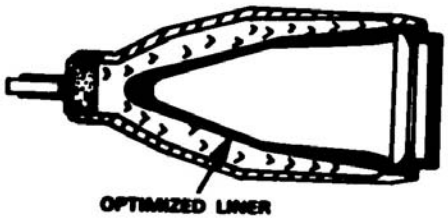


b) UNIFORM-THICKNESS, HEMISPHERICAL LINER DESIGN

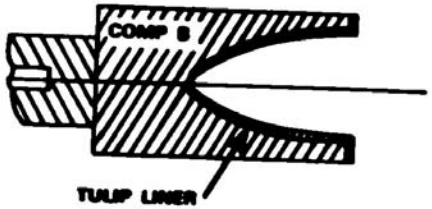


c) UNIFORM-THICKNESS, TRUMPET LINER DESIGN

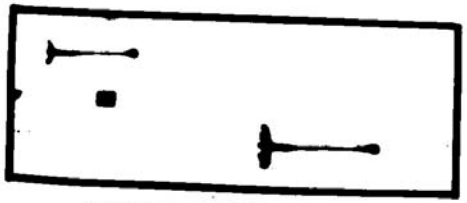
Shaped Charge Liner Geometries



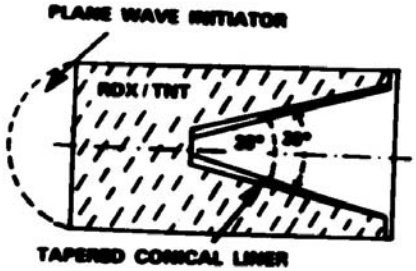
a) OPTIMIZED LINER DESIGN



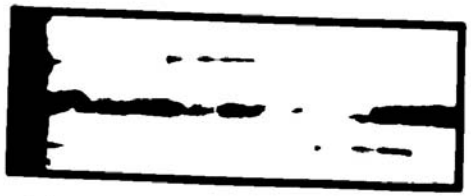
b) TULIP LINER DESIGN



FLASH X-RAY OF TULIP LINER JET AT 40 AND 60 μs AFTER INITIATION

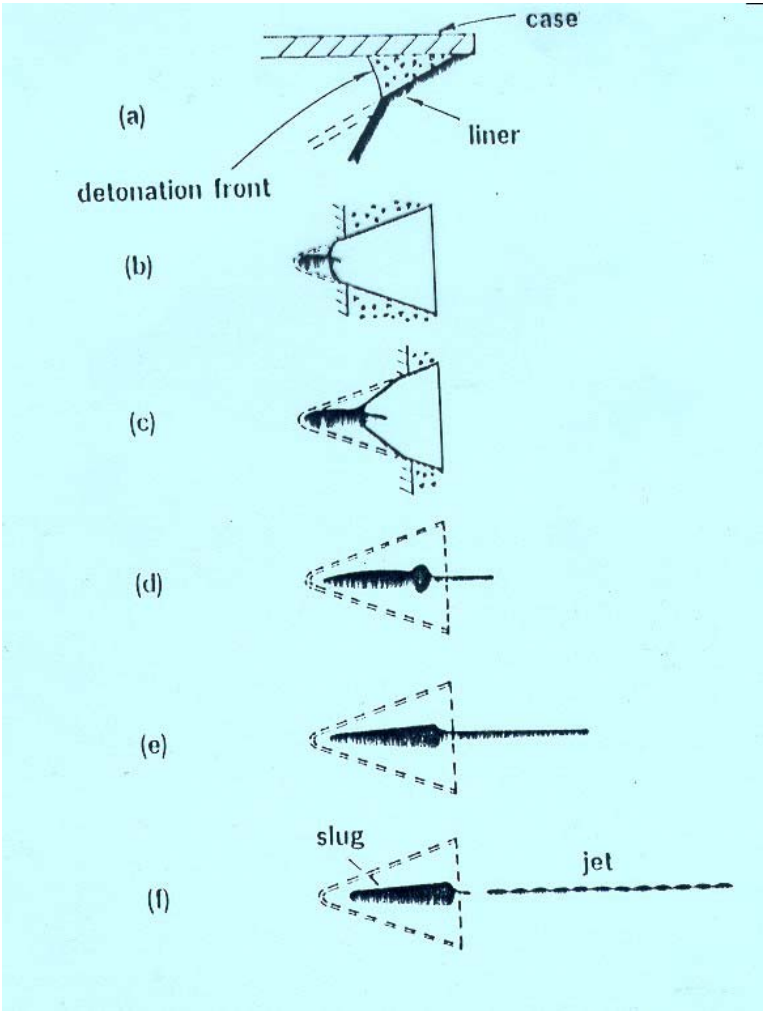


c) TAPERED CONICAL LINER DESIGN

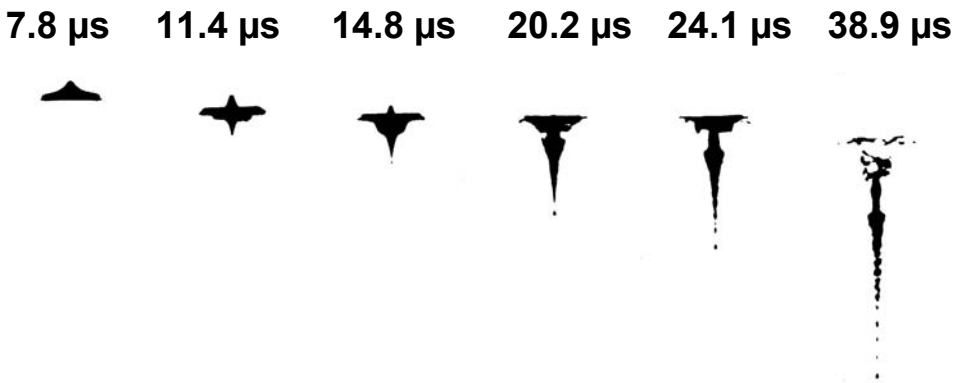


FLASH X-RAY OF TAPERED CONICAL LINER JET WITH RDX 40/ TNT 60 AT 33 AND 43 μs AFTER INITIATION

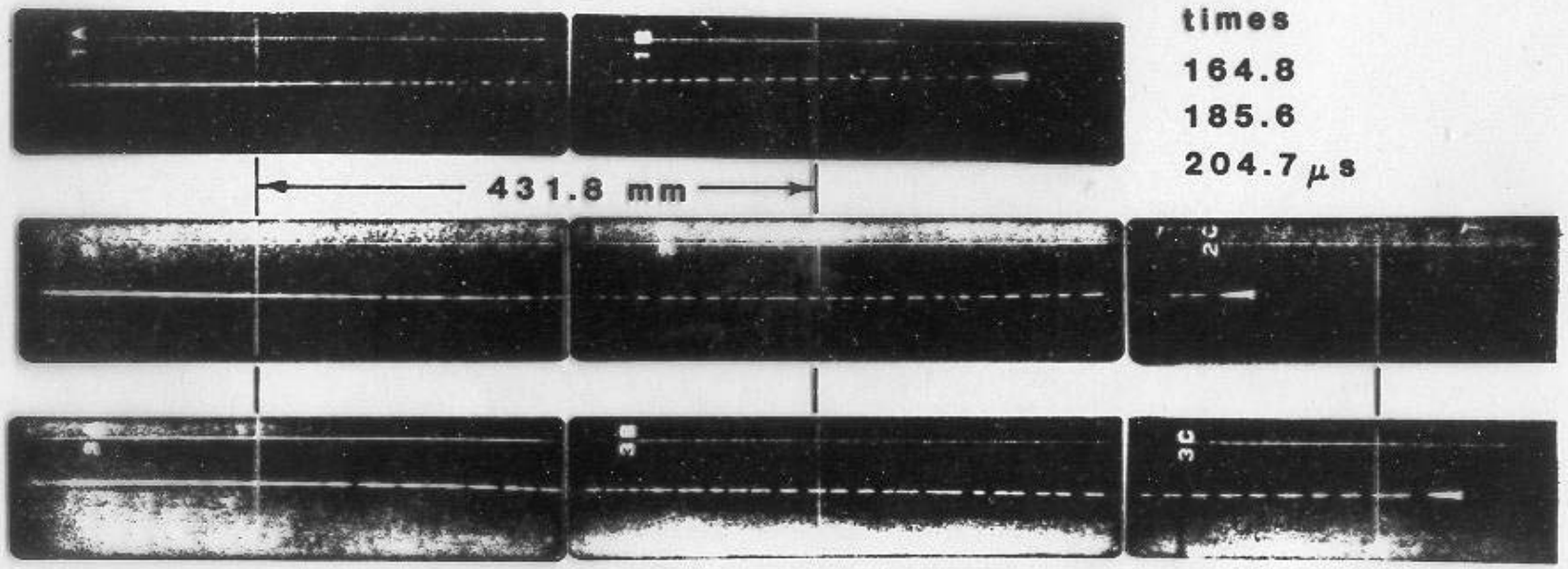
Calculated Jet Collapse



Experimental Jet Collapse



Jet From a Conical Liner



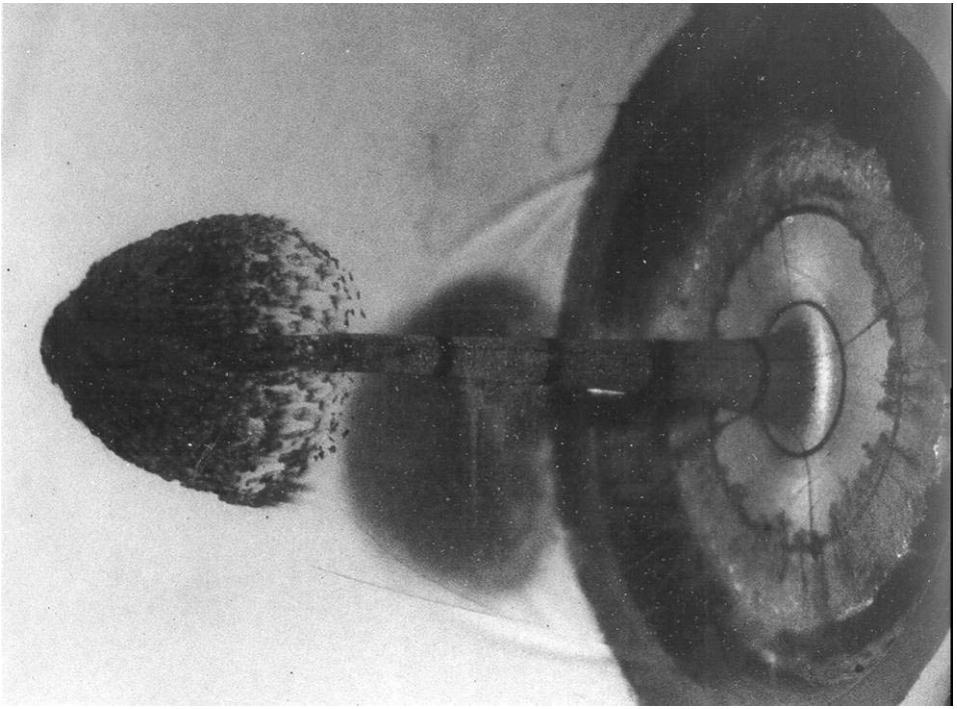
Liner: "New" BRL Precision 81mm

Grain Size: 25 μm

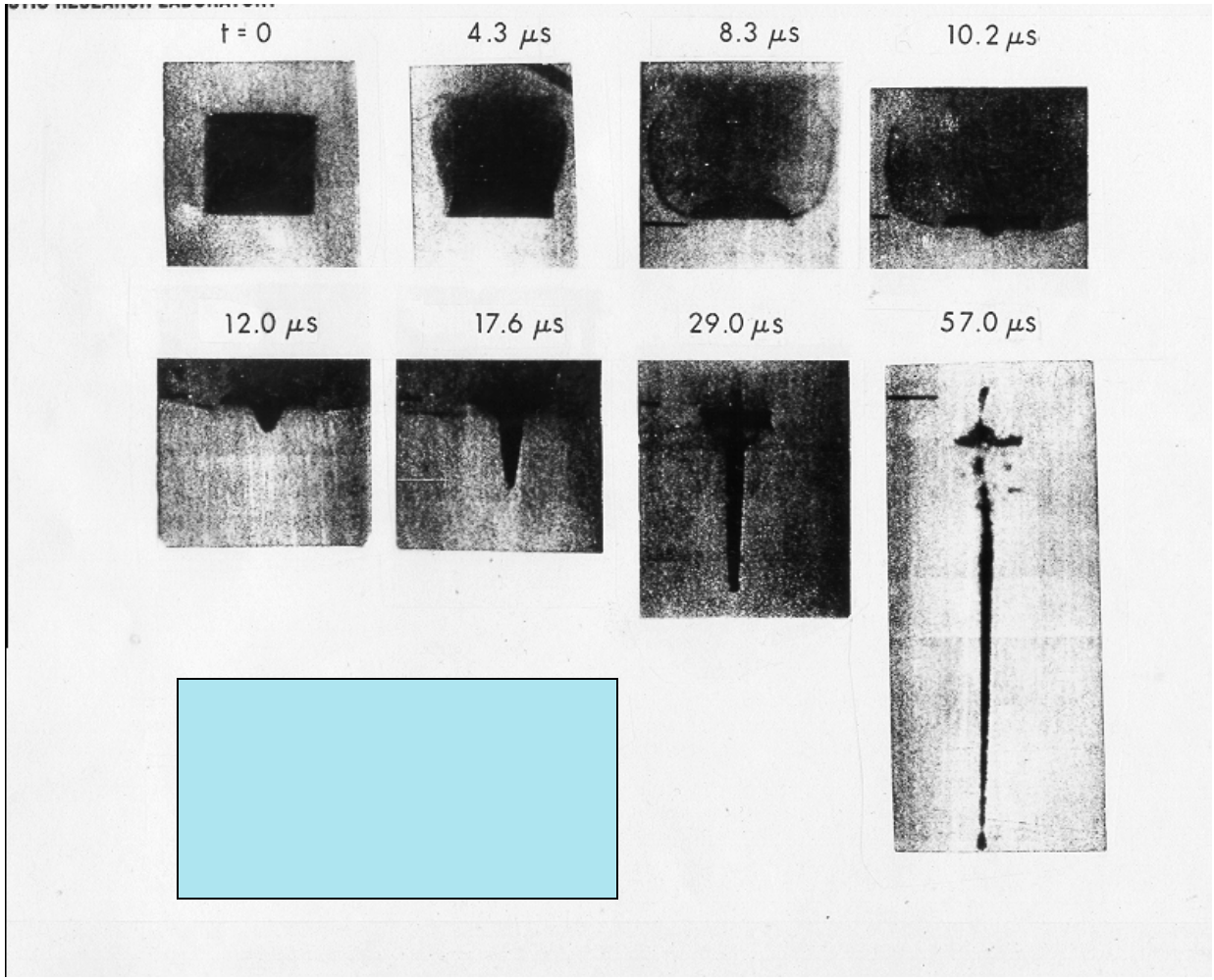
Copper: OFHC

Explosive: Comp B.

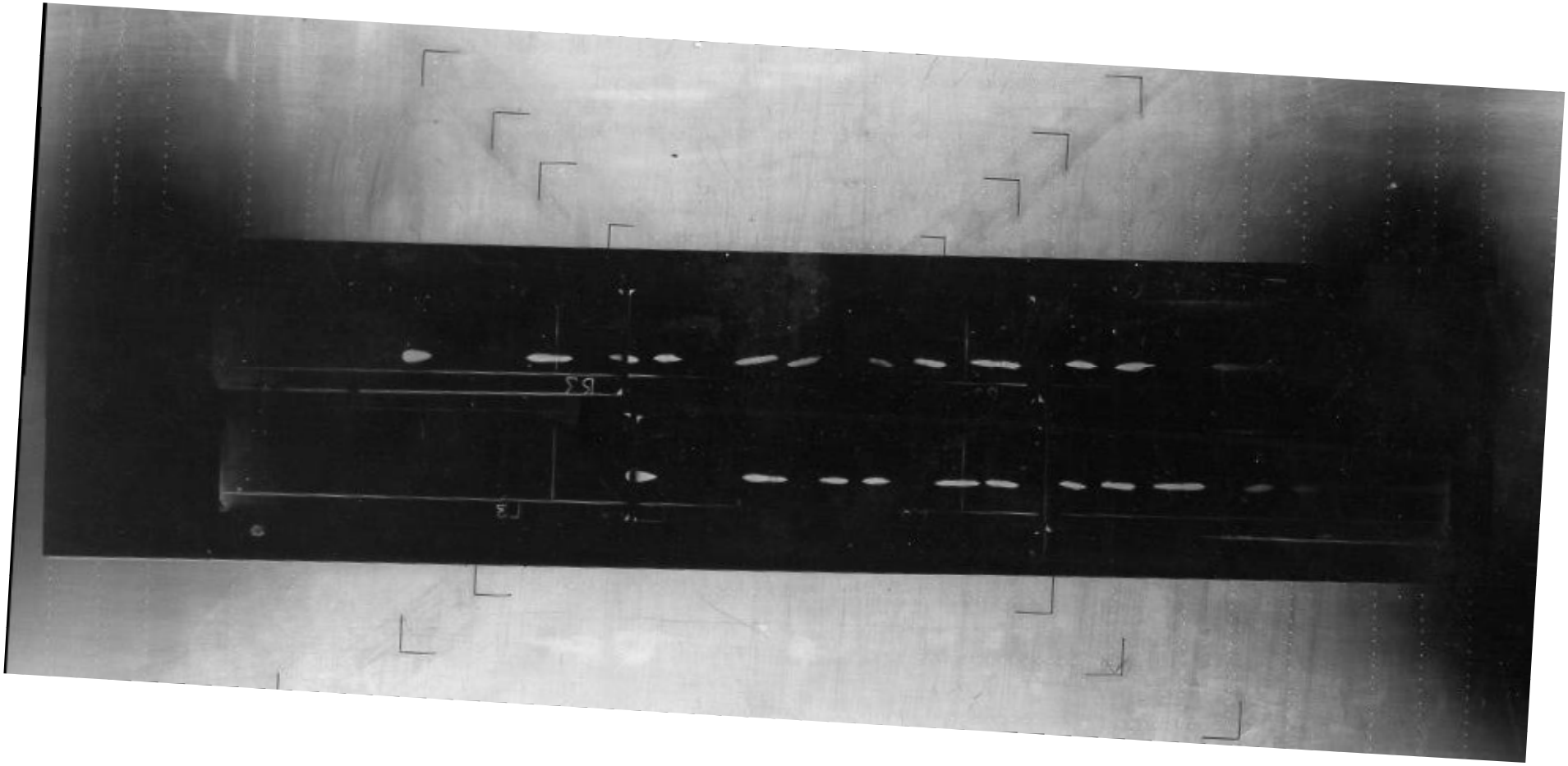
Early Stages of Jet Formation



Collapse of a Hemispherical Liner



Hemi Jet Free Flight



Shaped Charge Characteristics

- Tip Velocity of > 10 km/s
- Maximum Strains > 10
- Pressure 200 GPa decaying to 20 GPa
- Strain Rates 10^4-10^7 /s
- Jet Temperature 400-500 C

Misnomers

- “On impact, the shaped charge within the round ignites and begins to play a stream of plasma on the target. Each shaped charge configuration has an optimum distance from the target where the cutting power of the plasma cone is greatest. This detonation distance is established by the length of the warhead tip. The plasma cone burns through the armor and sprays molten particles into the tank at speeds of 30,000 fps.”

More Misnomers

- “A shaped charge detonates on impact, liquefying metal, which melts the tanks armor.”
- “The jet is a high temperature plasma (about 20,000 C)”
- “The jet reaches a density several times that of steel, and the armor becomes plastic and yields whilst the jet torch assists by melting and burning the armor metal”

The Solution

"There Is No Problem That Can't Be Solved by the Proper Application of High Explosives"

Sign in the office of Dr. J. Carleone,

Vice President, Aerojet Corporation.

Shaped Charge Applications

Military Targets

Demolition/Construction Work

Aerospace

Oil Well Completion

Steel Mill Furnace Tapping

Glacier Blasting, Tree Cutting, Hole Drilling

Explosive Engraving

Cutting Charges, Safety Destruct Systems

And Many More ....

More Applications

- Earth Waves for Geophysical Prospecting and Seismic Exploration
- Mining
- Submarine Blasting
- Ice Breaking
- Breaking Log Jams
- Salamander Blasting
- Coned End of Detonators

The Warhead Family

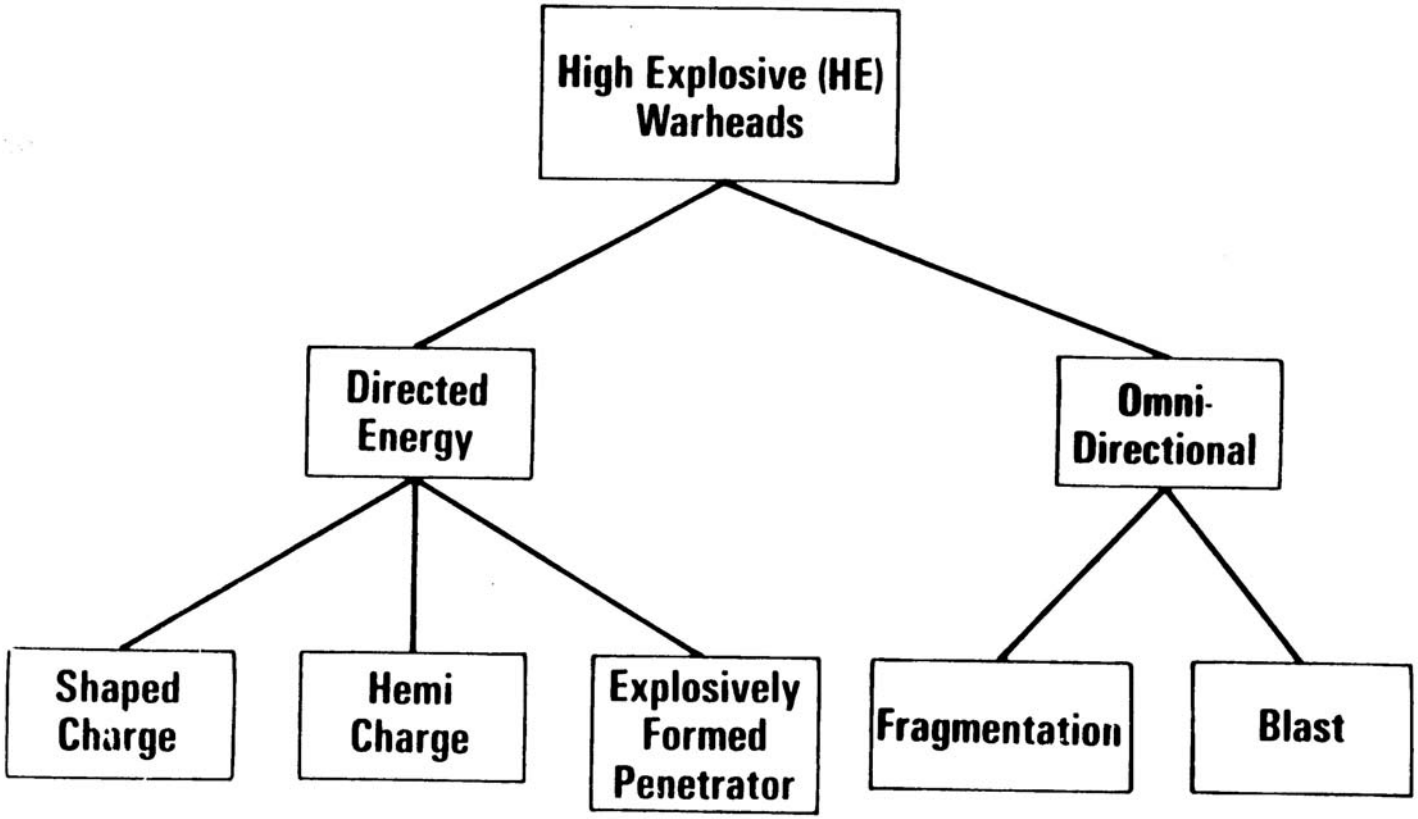


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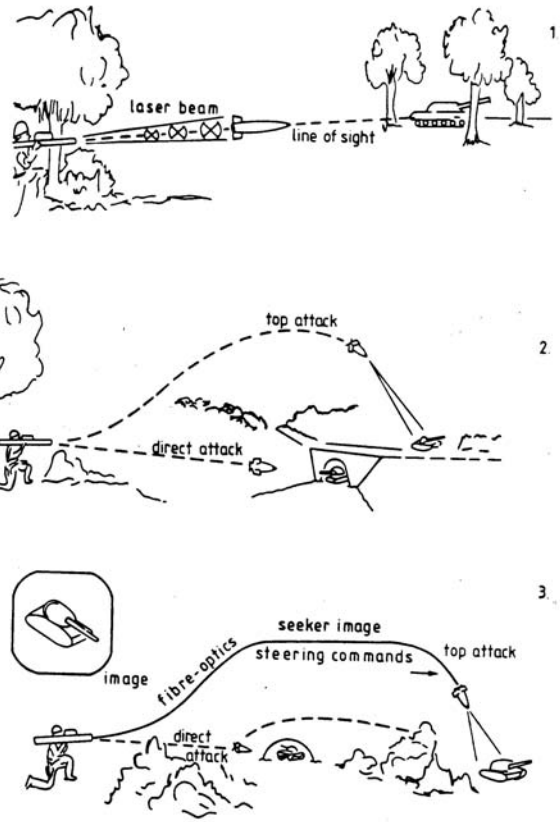
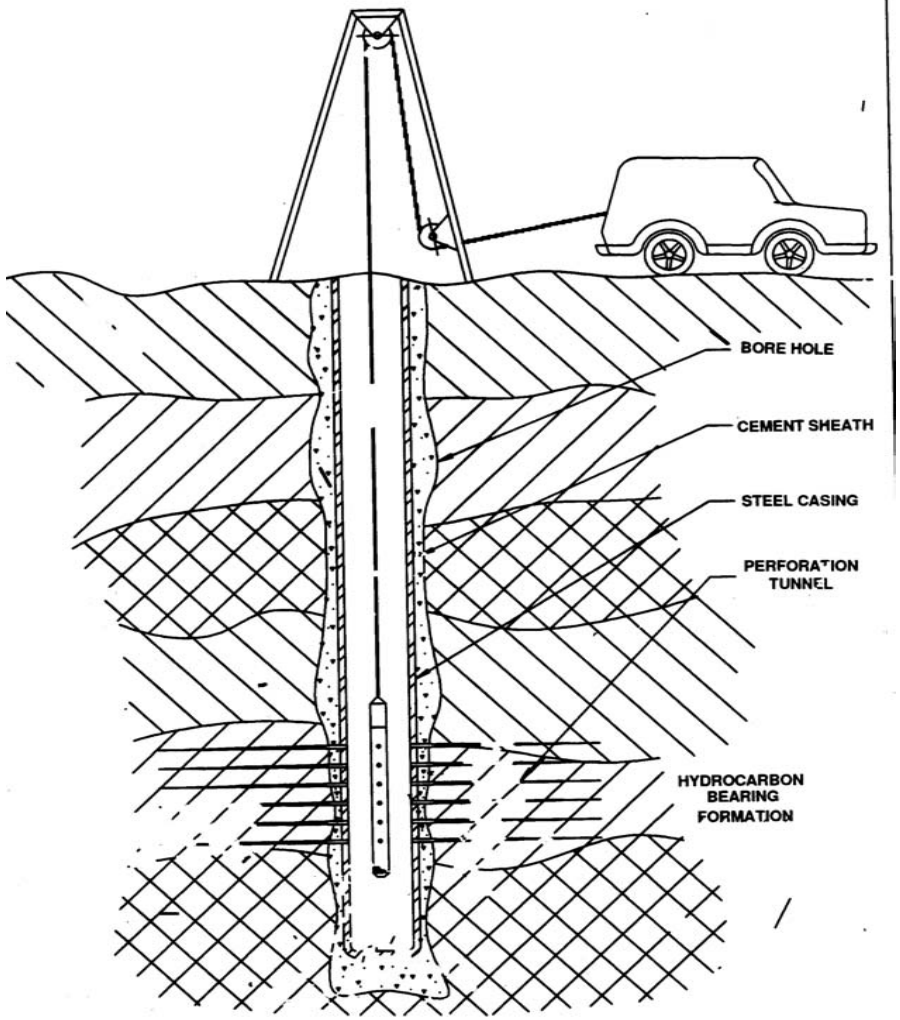
Figure 1-1. The Family of High-Explosive Warheads.

Anti-Armor



The medium-range weapon can be guided onto the target by means of a laser beam (laser beam rider) as in no. 1. The fire & forget principle, on the other hand, gives more freedom to the gunner. In concept 2 this is realized by means of a lock-on before launch via an infrared image of the target on a socalled focal plane array semiconductor sensor. Direct attack and top-attack are optional, the latter having greater kill probability. If a fibre optic link with the weapon is maintained the gunner can still intervene during the flight (no. 3).

Oil Well Completion Methods



WIRELINE PERFORATING - WELLBORE SCHEMATIC

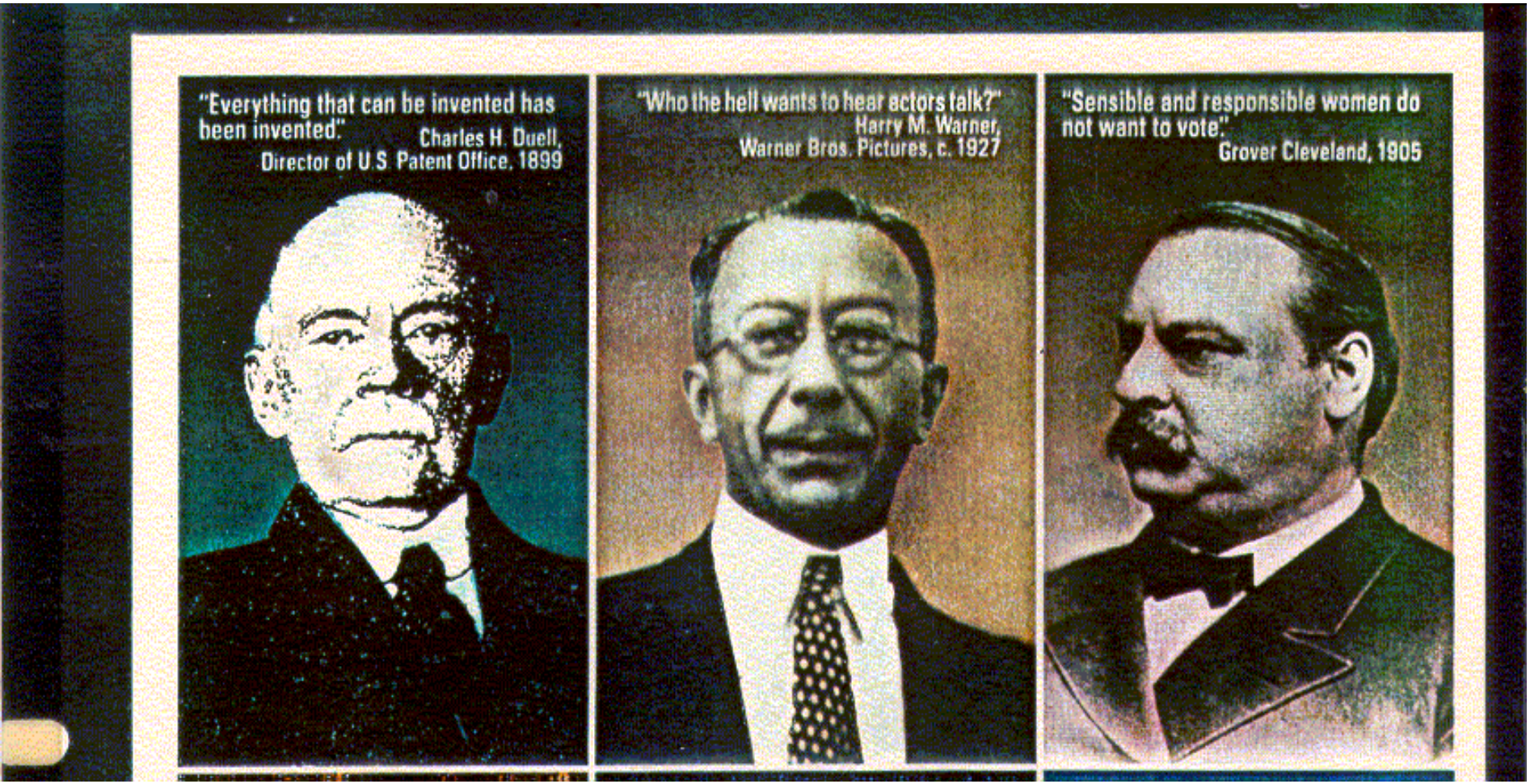
Current Research Topics

- Jet formation and growth models for non-conical liner geometries
- Liner Material Studies—Alloys?
- Liner metallurgy—Grain Size, Texture
- Jet Particulation
- Control of HE—Grain Size, HE-Liner interface

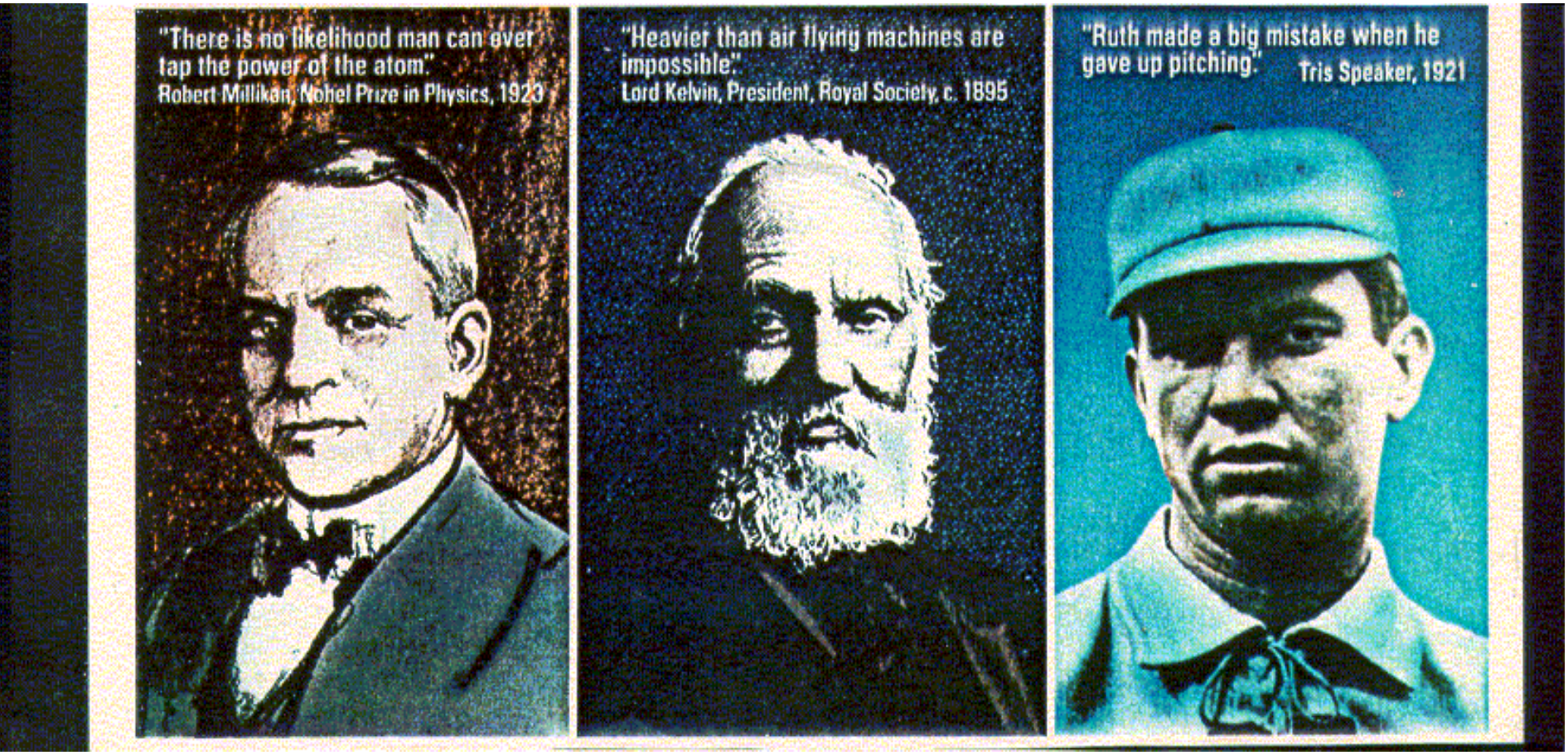
Current Research Topics (Continued)

- Scaling ?
- Penetration/ Hole Growth Analytical Models
- Jet Temperature– Experimentally and Numerically

The future isn't what it used to be



The future


"There is no likelihood man can ever tap the power of the atom."
Robert Millikan, Nobel Prize in Physics, 1923
"Heavier than air flying machines are impossible."
Lord Kelvin, President, Royal Society, c. 1895
"Ruth made a big mistake when he gave up pitching."
Tris Speaker, 1921