

InventionHome® Inventor Creates Electron Beam System Used in Different Heat Treatment Technologies

PITTSBURGH, PA, UNITED STATES, January 16, 2025 /EINPresswire.com/ -- Elena A. of Hanover, MD is the creator of High-Power Plasma Electron Beam Installations (HPPEBI), a groundbreaking technology that has the potential to revolutionize industrial processes across various sectors: melting-casting technologies of hard fusible alloys, ultra-fast surface heat treatments of steels and alloys (hardening, annealing, tempering, texturing, and polishing), "single shot" welding of different metals, alloys, insulators and thin layer deposition (ALD).

Since the mid-20th century, the Conventional Thermionic Electron Gun (TEG) has provided the basis for a variety of specialized applications in surface treatments (hardening, annealing, tempering, texturing, and polishing), welding, and coating deposition. Comparing this Invention HPPEB with the TEG, this Invention HPPEBI, offers the most practical, technical, and economic advantages for a wide range of technologies. It generates a very powerful electron beam with different configurations, and different thermal profiles (circular, punctual, cylindrical and linear), in the target. This is possible because the electron beam configuration is determined by the cathode geometry only.

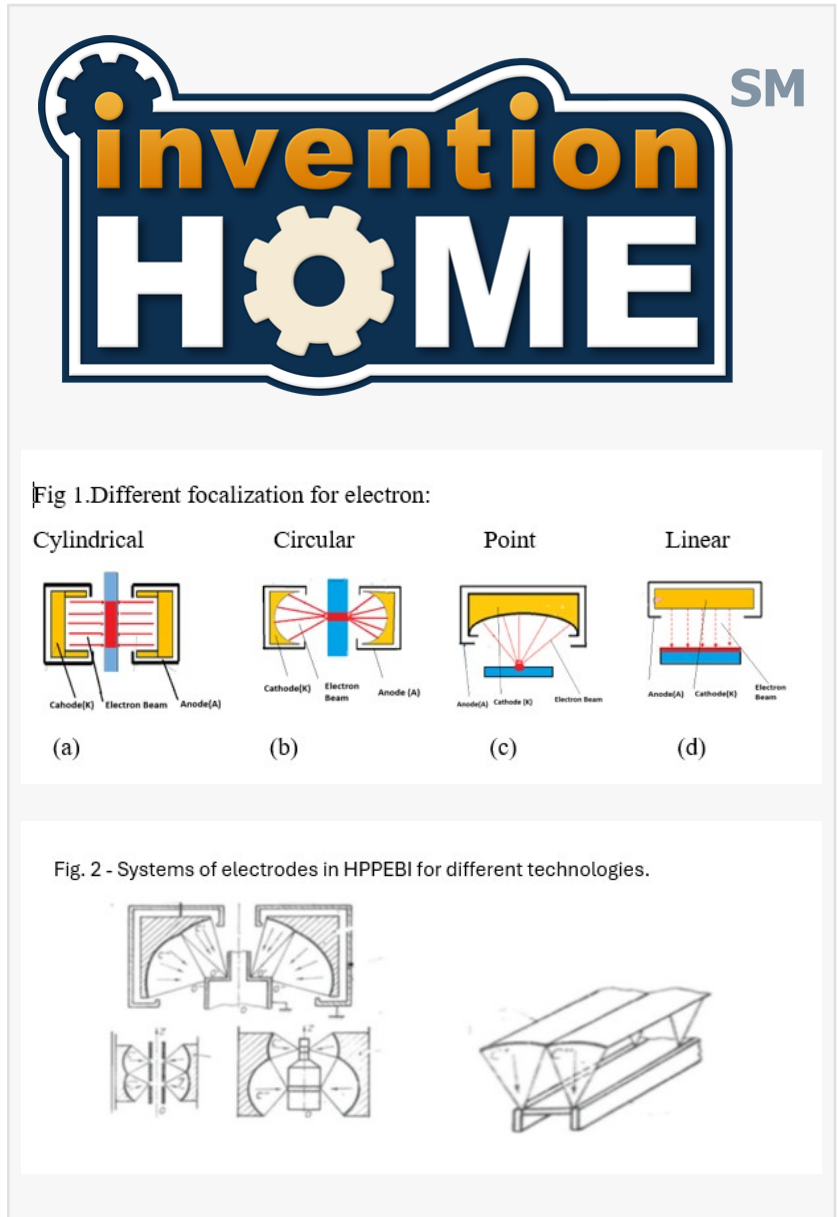


Fig 1. Different focalization for electron:

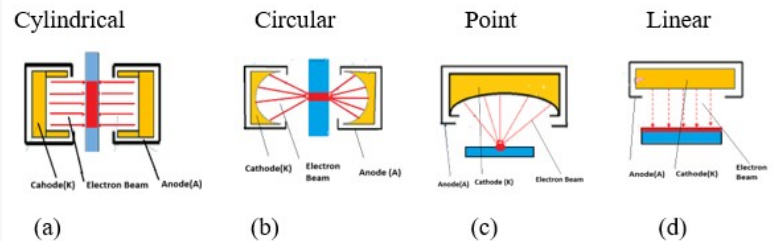
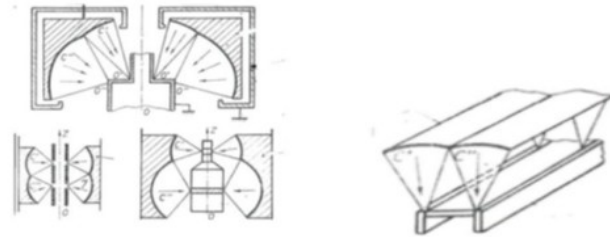
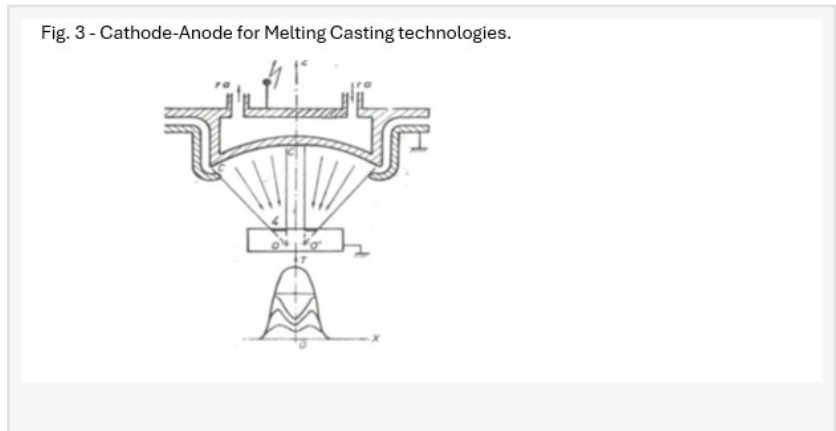


Fig. 2 - Systems of electrodes in HPPEBI for different technologies.



It is suitable for processing any kind of material (metal, alloys, dielectric, glass; ceramic, isolator) because it doesn't exist the build-up charging effect. The conventional electron gun can't be used for dielectric, isolating materials because the first electrons that reach the target remain in the structure of the target and reject the other electrons that come. The distortion, warping, and the failure in service are reduced significantly during any heat treatment because the electron beam and plasma will cover uniform the entire workpiece during the process.



Any heat treatment technology can be done in a single shot completely. No need to rotate the workpiece or move the electron gun/laser during the treatment or use a magnetic field to focalize the electron gun. It also offers lower emitter wear and maintenance. The plasma generated in the glow discharge can help clean the target surface by ionizing and removing surface contaminants.

Materials used in construction include a base frame made from steel or aluminum, a vacuum chamber, a rotary pump for the soft vacuum, the electron gun components (cathode and anode), a power supply, a workpiece holder, a simple control of system housing, and a cooling system to manage the heat generated during the treatment process. The system can function as a fundamental part of a large variety of applications in the industry from surface processing and coatings deposition to plasma surface interaction, ultimately enhancing wear-resistance of turbine blades, landing gear, and numerous other structural elements.

When high power plasma electron beam heat treatment is not utilized, several potential problems could arise, depending on the specific application and industry. Key issues encountered include reduced surface hardness and wear resistance, increased distortion and warping, lower fatigue strength, inadequate surface properties, poor control over microstructure, longer processing times, higher residual stress, incompatibility with complex geometrics, environmental and safety concerns, and economic impact.

The global market for HPPEBI systems in melting and casting applications is valued at approximately \$500 million as of 2024 with the aerospace, defense, energy, and medical industries functioning as primary consumers. This market is projected to grow at a CAGR of 6-8% over the next decade, driven by increasing demand for high-performance materials in critical applications. HPPEB systems offer precise control over melting and casting, ensuring high-quality results for challenging materials such as titanium, tungsten, and certain refractory metals.

Manufacturers are looking for products that offer high-efficiency systems, automation and AI

integration, and hybrid technologies to accommodate complex materials. The High-Power Plasma Electron Beam Installation system is innovative and versatile, catering to this niche market via several features that would significantly enhance any manufacturer's product line. Elena filed her Utility Patent with the United States Patent and Trademark Office (USPTO) and is working closely with [InventionHome](#), a leading invention licensing firm, to sell or license the patent rights to her High-Power Plasma Electron Beam Installations product. Ideal licensing candidates would be U.S. based product manufacturers or distributors looking to further develop and distribute this product innovation.

Companies interested in the High-Power Plasma Electron Beam Installations can contact InventionHome at member@inventionhome.com. Inventors currently looking for assistance in patenting, marketing, or licensing their invention can request information from InventionHome at info@inventionhome.com or by calling 1-866-844-6512.

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