

WHAT IS CLAIMED IS:

1. A heaterless hollow cathode apparatus comprising:
 - (a) an emitter assembly comprising an electron emitter and an emitter holder, said emitter assembly defining a gas flow path passing through an emitter orifice;
 - (b) a keeper surrounding said emitter assembly, said keeper having a keeper orifice;
 - (c) a gas flow regulator for supplying a regulated flow of gas through said gas flow path;
 - (d) an electrical power supply; and
 - (e) a controller electrically associated with said electrical power supply, said gas flow regulator, said keeper, and said emitter assembly, said controller being configured sequentially to:
 - (i) apply an emitter-keeper voltage between said emitter assembly and said keeper while gas is supplied to a volume between said emitter assembly and said keeper to initiate a discharge between said emitter assembly and said keeper;
 - (ii) monitor the value of an emitter-keeper current, flowing between said emitter assembly and said keeper, and adjust said emitter-keeper voltage so as to maintain said emitter-keeper current at a predetermined current value;
 - (iii) monitor said emitter-keeper voltage so as to detect a drop in said emitter-keeper voltage to values which remain below a predetermined voltage threshold for a predetermined minimum time duration;
 - (iv) actuate a main discharge circuit in which current flows from an anode to the heaterless hollow cathode; and
 - (v) set said emitter-keeper voltage to zero.
2. The apparatus of claim 1, wherein said emitter holder comprises an emitter holder neck which encapsulates said electron emitter.
3. The apparatus of claim 1, wherein an area of said keeper orifice is between 5% and 25% of an area of said emitter orifice.
4. The apparatus of claim 1, wherein said keeper comprises a change in thickness.

5. The apparatus of claim 1, wherein said electron emitter comprises a refractive ceramic material.
6. The apparatus of claim 1, wherein said electron emitter comprises a refractive metal impregnated with an oxide.
7. The apparatus of claim 1, wherein said electron emitter has a work function less than 2.2 electron volts.
8. The apparatus of claim 1, wherein said controller detects initiation of said discharge between said emitter assembly and said keeper by identifying a sudden sharp increase in said emitter-keeper current.
9. The apparatus of claim 1, wherein said predetermined current value is in a range of 100 to 150 milli-amperes.
10. The apparatus of claim 1, wherein said predetermined voltage threshold is in a range of 50 to 100 volts.
11. The apparatus of claim 1, wherein said predetermined minimum time duration is in a range of 1 to 3 seconds.
12. A method for operating a heaterless hollow cathode, comprising the steps of:
 - (i) providing a controller electrically associated with an electrical power supply, a gas flow regulator, a keeper, and an emitter assembly;
 - (ii) applying an emitter-keeper voltage between said emitter assembly and said keeper to initiate a discharge between said emitter assembly and said keeper;
 - (iii) monitoring the value of an emitter-keeper current, flowing between said emitter assembly and said keeper, and adjusting said emitter-keeper voltage so as to maintain said emitter-keeper current at a predetermined current value;
 - (iv) monitoring said emitter-keeper voltage so as to detect a drop in said emitter-keeper voltage to values which remain below a predetermined voltage threshold for a predetermined minimum time duration;
 - (v) actuating a main discharge circuit in which current flows from an anode to the heaterless hollow cathode; and
 - (vi) setting said emitter-keeper voltage to zero.

13. The method according to claim 12 wherein said controller detects initiation of said discharge between said emitter assembly and said keeper by identifying a sudden sharp increase in said emitter-keeper current.
14. The method according to claim 12 wherein said predetermined current value is in a range of 100 to 150 milli-amperes.
15. The method according to claim 12 wherein said predetermined voltage threshold is in a range of 50 to 100 volts.
16. The method according to claim 12 wherein said minimum time duration is in a range of 1 to 3 seconds.