March 29, 1949. H. W. ABSHIRE 2,465,414

GASEOUS DISCHARGE DEVICE

Filed April 4, 1946 2 Sheets-Sheet 1

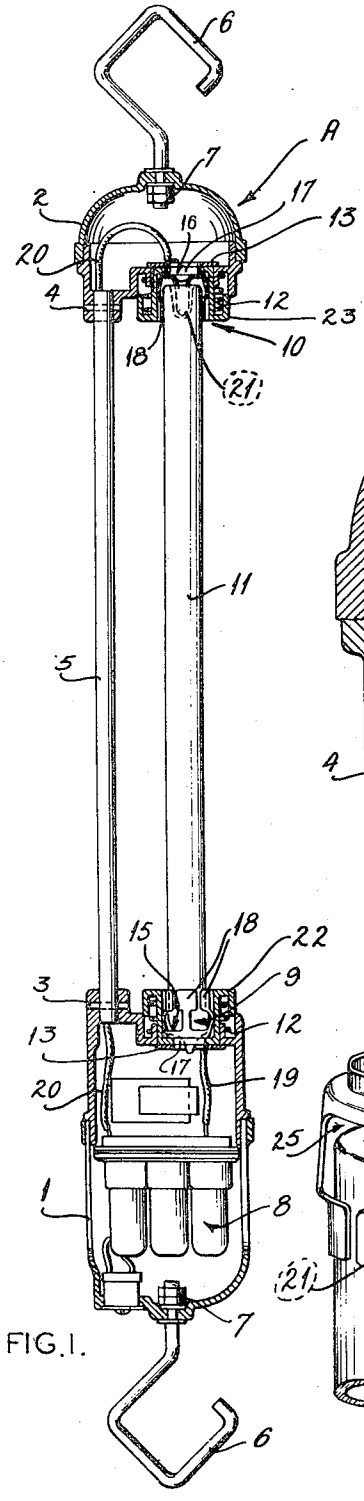

FIG. 1.

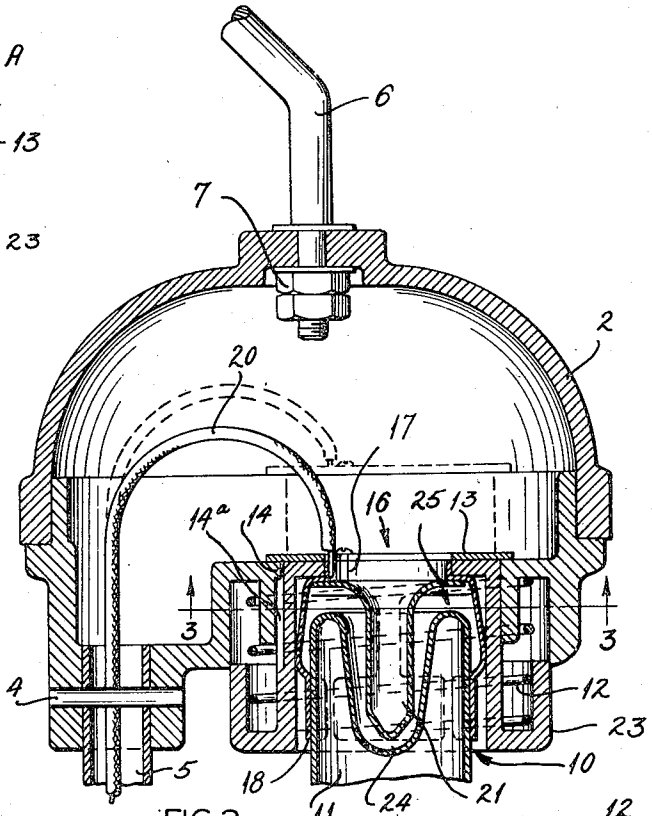

FIG. 2.

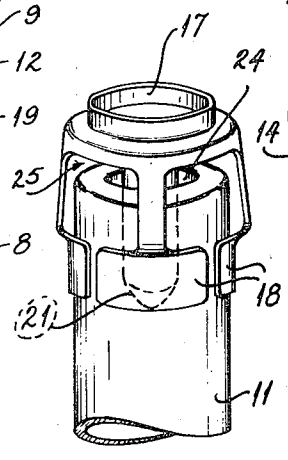

FIG. 4.

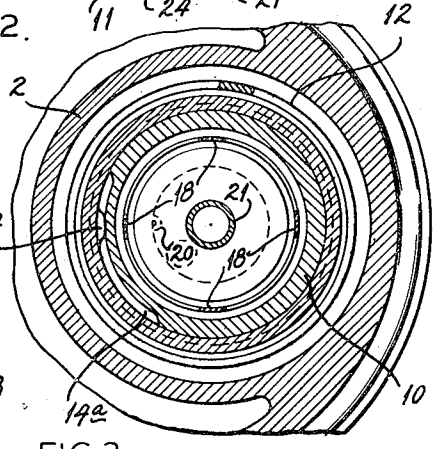

FIG. 3.

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GASEOUS DISCHARGE DEVICE

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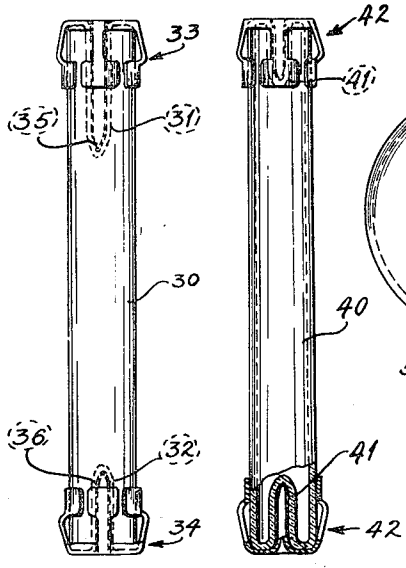

FIG. 5.

FIG. 6.

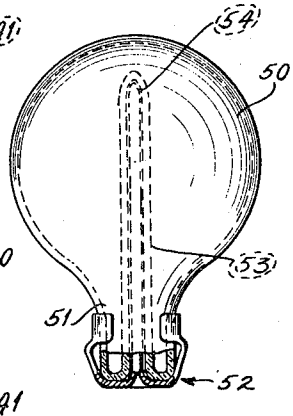

FIG. 7.

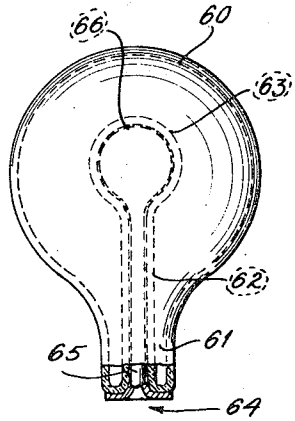

FIG. 8.

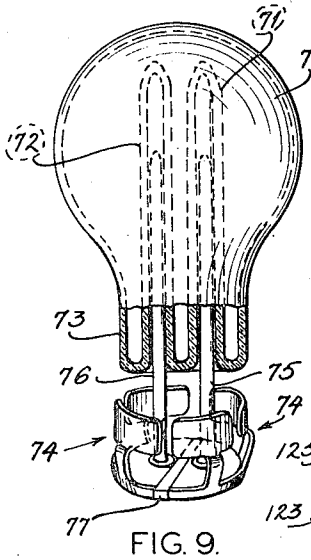

FIG. 9.

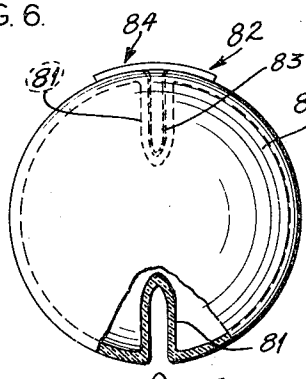

FIG. 10.

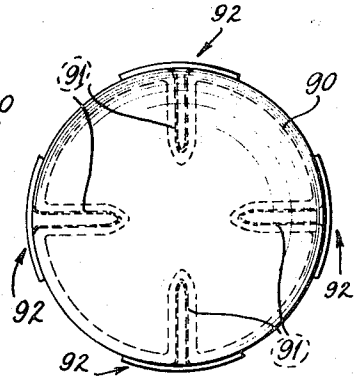

FIG. 11.

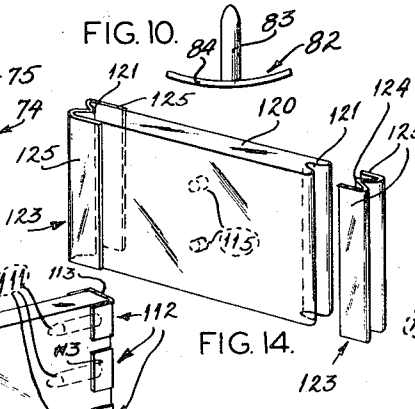

FIG. 14.

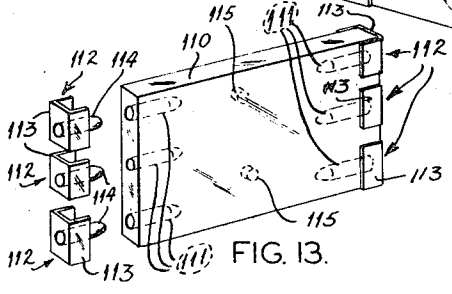

FIG. 13.

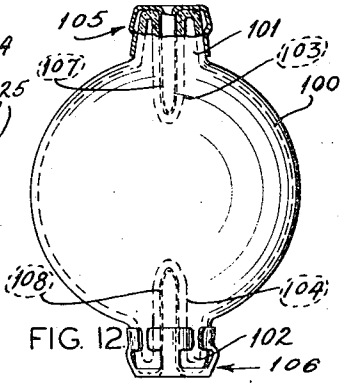

FIG. 12.

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UNITED STATES PATENT OFFICE

2,465,414

GASEOUS DISCHARGE DEVICE

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Application April 4, 1946, Serial No. 659,485

16 Claims. (Cl. 176—122)

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The invention relates to the production of radiant energy by a generator employing a gaseous discharge envelope energized by high frequency current, and the invention is particularly adaptable for use in generating electro-magnetic waves between 1.4 and 1,000,000 Angstrom units.

One object of the invention is to start and operate a radiant energy generator at relatively low temperatures on conventional low voltage A. C. or D. C. current.

Another object is to minimize darkening of the gaseous discharge envelope of the generator, particularly when operated at low temperatures.

Another object is to facilitate replacement of the discharge envelope without disassembling other parts of the generator.

Another object is to insure replacement of a gaseous discharge envelope by another envelope of the same type when replacement is necessary.

Another object is to intensify radiation of gaseous discharge envelopes of various shapes.

Another object is to provide a generator in which an elongated gaseous discharge envelope, energized by high frequency current, emits substantially uniform radiations in all directions throughout its length. This is accomplished by positioning the high frequency source at one end of the envelope, to minimize obstructions to radiation of the envelope, and by energizing the envelope with an electrode, at the end of the envelope remote from the high frequency source, arranged to overcome the unbalanced condition of the circuit caused by the long conductor from the high frequency source to the electrode.

These and other detail objects of the invention, as will appear below, are attained by the structure shown in the accompanying drawings, which structure is intended to be illustrative and not exclusive of other arrangements embodying the general inventive principle. In these drawings:

Figure 1 is a longitudinal section through a light source constructed according to the invention.

Figure 2 is a section similar to Figure 1, drawn to an enlarged scale, showing only a portion of the tube at the right-hand end of Figure 1.

Figure 3 is a section taken approximately on line 3—3 of Figure 2 showing a detail of the socket arrangement.

Figure 4 is a perspective view of the portion of the gaseous discharge tube and electrode shown in Figure 2, and

Figures 5 to 14, inclusive, show electrodes and gaseous discharge envelopes of various configurations, constructed according to the invention.

In Figures 1 to 4, inclusive, the generator comprises spaced housings 1 and 2 attached rigidly by pins 3 and 4 to the ends of a pipe 5. Each housing 1 and 2 has a hook 6 attached to the end thereof remote from pipe 5 by jamb nuts 7 threaded on the hooks. Housing 1 encloses a high frequency oscillator 8 which may have any desired circuit arrangement, but preferably produces a high frequency current of approximately 34 megacycles.

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Each housing 1 and 2 has positioned in a circular opening therein a socket 9 and 10, respectively, arranged to support and energize a long cylindrical discharge tube 11 positioned therebetween. The sockets are urged yieldingly toward tube 11 by springs 12 compressed between housings 1 and 2 and the sockets 9 and 10, respectively. Movement of sockets 9 and 10 outwardly of housings 1 and 2 is limited by plates 13 attached to the inner faces of the sockets and rotation of the sockets relative to the housings is limited to approximately 90° by keys 14 on the housings and keyways 14a in the sockets (see Figure 3). Sockets 9 and 10 include receptacles 22 and 23 and electrodes 15 and 16, respectively, positioned therein, each electrode comprising a substantially circular member 17 having a cavity 25 formed by yieldable tabs 18 arranged to engage the circumferential surface of gaseous discharge tube 11 at its ends to support the tube and to energize the tube by means of oscillator 8. Electrode 16 is provided with a circular part 21 attached securely to member 17 and positioned substantially centrally thereof for the purpose described hereinafter. Part 21 preferably is pointed or tapered at the end remote from attachment to member 17 and is continuous throughout its periphery. By utilizing electrodes externally of the tube energized by high frequency current, blackening of the tube after considerable use does not occur as when heated electrodes are used inside the tube.

Electrode 15 is connected to oscillator 8 by a wire 19 and electrode 16 is connected to oscillator 8 by a wire 20 threaded through pipe 5. Sockets 9 and 10 are arranged in housings 1 and 2 so that upon replacing tube 11 by pressing sockets 9 and 10 inwardly into housings 1 and 2 against pressure of springs 12, a substantial portion of wires 19 and 20 flex to accommodate such movement to prevent breakage of the wires. Also, by limiting rotation of sockets 9 and 10 to 90°, wires 19 and 20 are not likely to twist and eventually break.

Discharge tube 11 has a plain end adjacent electrode 15, but the end adjacent electrode 16 is concave to form a recess 24 to receive part 21 of electrode 16. This arrangement of the electrodes balances the capacity added to the oscillating circuit

by pipe 5 and wire 20 by adding capacity in series to the part of the circuit between oscillator 8 and electrode 16. This causes the tube to emit substantially uniform radiations throughout its length. By tapering the end of part 21, a high current density is attained in this area to facilitate starting of the tube.

In Figure 5, an elongated tube 30 has recesses 31 and 32 at the ends thereof, the recess 31 being deeper than recess 32. Electrodes 33 and 34 are arranged to receive the ends of the tube and include parts 35 and 36, respectively, extending into recesses 31 and 32. Part 35 of electrode 33 is longer than part 36 of electrode 34. Accordingly there is means for balancing capacity of the associated pipe and wiring and obtaining uniform radiations throughout the length of the tube, and facilitating starting.

In Figure 6, each end of an elongated tube 40 has a recess 41 and is provided with an electrode 42 similar to electrode 16 of Figures 1 to 4. With this arrangement, the oscillator preferably is intermediate electrodes 42 to obtain a balanced circuit. The concentrated discharge from the pointed central parts of the electrodes facilitates starting which is an important factor when the tube is to be used at relatively low temperature, such as approximately 40° Fahrenheit, which is maintained in commercial refrigerators.

In Figure 7, envelope 50 is substantially spherical in shape with a projecting portion 51 and has a recess 53 opening through portion 51. An electrode 52 receives portion 51 and has a part 54 extending into recess 53. In this embodiment, only one electrode is used to energize the envelope.

In Figure 8, envelope 60 is substantially spherical in shape with a projecting portion 61 and has a recess 62 opening through portion 61. Recess 62 terminates in an enlarged substantially spherical portion 63 positioned substantially centrally of envelope 60. An electrode 64 has a part 65 extending into recess 62 and the end 66 of part 65 is substantially spherical and is positioned in spherical portion 63 of recess 62. In this embodiment, only one electrode is used to energize the envelope and, by providing a spherical end on electrode 64, a more uniformly distributed electrostatic field is obtained to energize the tube.

In Figure 9, envelope 70 is similar in shape to envelope 50 of the embodiment of Figure 7, but includes a pair of recesses 71 and 72 opening through protruding portion 73. A pair of electrodes 74, insulated from one another by an insulating strip 77, receive protruding portion 73 and have parts 75 and 76 extending into recesses 71 and 72 respectively. This arrangement facilitates starting of the tube and increases the intensity of radiation because of the proximity of the electrodes causing a more concentrated electrostatic field.

In Figure 10, envelope 80 is substantially spherical in shape and has recesses 81 extending radially inwardly and positioned diametrically opposite each other and arranged to receive electrodes 82, each including a part 83, extending into the associated recess, and attached to a curved plate 84 positioned externally of the envelope. The inwardly extending electrodes facilitate ionization by concentrating the electrostatic fields and by reducing the space between the electrodes.

In Figure 11, envelope 90 is similar to the envelope of Figure 10 with the exception that envelope 90 has four substantially radial depressions 91 spaced apart 90° circumferentially of the

envelope and each arranged to receive an electrode 92. This further increases the concentration of the electrostatic fields and the radiant energy output.

In Figure 12, envelope 100 is substantially spherical in shape and has projections 101 and 102 positioned diametrically opposite one another with recesses 103 and 104, respectively. Electrodes 105 and 106 receive projections 101 and 102 and have parts 107 and 108 extending into recesses 103 and 104, respectively. This arrangement adapts the envelope for mounting in socket electrodes as first described.

In Figure 13, a rectangular envelope 110 has recesses 111 in its opposite ends. A plurality of electrodes 112 are applied to each end of the envelope. Each electrode comprises a channel member 113 arranged to receive the end of the envelope between its flanges, which correspond to the tabs of the electrodes described above, and has a part 114 extending into an associated recess 111. This arrangement provides an envelpe with flat radiating surfaces and might well be used in show cases for food products where it was desired to treat the contents to prevent bacterial growth. With a flat envelope as shown in Figure 13, it may be desirable to brace the spaced plates by plugs 115 which would not be necessary in envelopes of bulb or tube type.

In Figure 14, envelope 120 is shaped similarly to envelope 110 as described above and has recesses 121 in its opposite ends. Each electrode 123 extends the width of the envelope and is substantially W-shaped sectionally, the central portion 124 thereof extending into a recess 121, and the outer portions 125 thereof overlapping the outer surface of envelope 120.

One or more electrodes constructed according to the invention may be used with high frequency potential to energize gaseous discharge envelopes of various shapes, and characteristics, to generate radiant energy of any wave length.

Dark spaces present during normal operation in the conventional evelope utilizing internal cathodes are eliminated, thereby intensifying radiation. The envelope will not darken even after extended usage at low temperatures, and should the envelope need be replaced for any reason, this may be done easily and quickly with another envelope of the same type without first disassembling other parts of the generator. The generator may be started and operated on 110 volt A. C. or D. C. current, radiates but little heat, and it is not necessary to warm the envelope before operating it.

A generator utilizing an electrode constructed according to the invention with an elongated gaseous discharge tube emits radiations which are substantially uniform through the length of the tube and substantially unobstructed in all directions.

Since the generator starts operating automatically after closing the circuit without further adjustment, the generator may be used in refrigerators or other closed places where a light must be turned on or off automatically when someone enters or leaves. For example, if a fluorescent light is used for illumination, then the starting switch can be made to close as someone enters the refrigerator and to open as he leaves. If an ultra-violet light generator is used for treating food products, then the starting switch can be arranged so that the switch opens when someone enters the refrigerator and closes

when he leaves, thus avoiding his exposure to ultra-violet rays.

The envelope will be constructed of glass, plastic or other material adapted for its intended purpose, i. e., to pass radiant energy generated. With the flat envelopes shown in Figures 13 and 14, one side may be formed of quartz glass, or the like, to pass ultra-violet rays and the other side formed of ordinary window glass to pass visible light.

The details of the invention described and illustrated may be varied without departing from the spirit of the invention, and the exclusive use of those modifications coming within the scope of the claims is contemplated.

What is claimed is:

1. An external electrode for energizing a gaseous discharge envelope by high frequency potential, comprising a member having an envelope receiving cavity, and a part positioned in said cavity.

2. An external electrode for energizing a gaseous discharge envelope by high frequency potential, comprising an annular member, and a part positioned in and extending longitudinally of said member.

3. An external electrode for energizing a gaseous discharge envelope by high frequency potential, comprising a hollow substantially circular member, and a part positioned in said member substantially centrally thereof and extending outwardly thereof.

4. An electrode for energizing a gaseous discharge envelope by high frequency potential, comprising a member having an envelope receiving cavity, and a part positioned in said cavity and tapering toward the end remote from said member and having a continuous periphery.

5. An electrode for high frequency potential comprising a member having a cavity adapted to receive a portion of a gaseous discharge envelope, and a part positioned in said cavity and adapted to extend into a recess in the envelope and to be positioned exteriorly of the envelope.

6. An electrode for high frequency potential comprising a conductor having portions adapted to contact spaced areas on the exterior surface of a gaseous discharge envelope, and a part between and spaced from said portions adapted to extend into a recess in the envelope and to be positioned exteriorly of the envelope.

7. An electrode for a gaseous discharge envelope adapted to be energized by high frequency potential and having at least one portion with a recess, the electrode comprising a plurality of yieldable tabs adapted to bear yieldingly against a circumferential surface of the envelope portion, and a part positioned between said tabs and adapted to extend into the envelope recess.

8. An electrode for a gaseous discharge envelope adapted to be energized by high frequency potential and having a recess, the electrode comprising an elongated part adapted to be positioned externally of the envelope in the envelope recess, one end of said part terminating in a substantial sphere.

9. A gaseous discharge envelope adapted to be excited by high frequency potential through an external electrode, and having a portion receivable within the electrode associated therewith, said portion being recessed to receive a part of the associated electrode.

10. In a radiant energy generator, an envelope adapted to be energized by high frequency potential and having a portion with a recess, an electrode comprising a member receiving said portion and having a part extending into said recess and exteriorly of said envelope.

11. In a radiant energy generator, a discharge envelope adapted to be energized by high frequency potential and having a recess, an electrode comprising a member having a cavity to receive a portion of the periphery of said envelope and having a part extending outwardly of said member into said recess and exteriorly of said envelope.

12. In a radiant energy generator, an envelope adapted to be energized by high frequency potential and having a recess, an electrode comprising a plurality of yieldable tabs arranged to engage the periphery of said envelope and a part positioned between said tabs and extending into said recess.

13. In a radiant energy generator, a discharge envelope adapted to be energized by high frequency potential and having spaced portions, at least one of which is provided with a recess, an electrode at each of said portions and comprising a member having a cavity to receive the associated portion, one at least of said electrodes having a part extending into said recess and exteriorly of said envelope.

14. In a radiant energy generator, a discharge envelope adapted to be energized by high frequency potential and having a recess, spaced electrodes each comprising a plurality of yieldable tabs arranged to engage the periphery of said envelope, at least one of said electrodes having a part positioned between its tabs and extending into said recess.

15. In a radiant energy generator, an elongated cylindrical discharge tube adapted to be energized by high frequency potential and having a circular recess in one end, an electrode at each end of said tube and comprising a plurality of yieldable tabs adapted to engage the periphery of said tube, the electrode at the recessed end of said tube having a circular part extending into said recess.

16. In a radiant energy generator, a substantially spherically shaped envelope having a recess therein terminating in a substantially spherical portion positioned substantially centrally of said envelope, and an electrode comprising a part positioned in said recess and terminating in a substantial sphere positioned substantially centrally of said spherical portion of said recess.

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