

L. DE FOREST.
OSCILLATING AUDION.
APPLICATION FILED JULY 22, 1915.

1,201,271.

Patented Oct. 17, 1916.

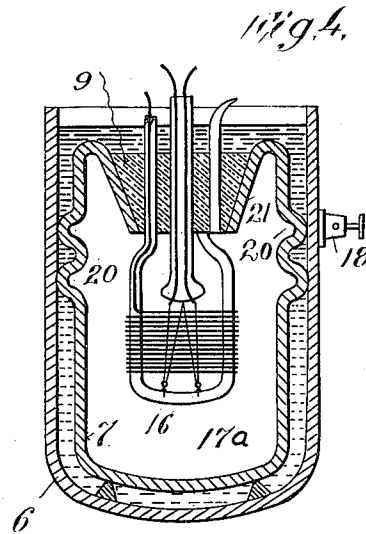
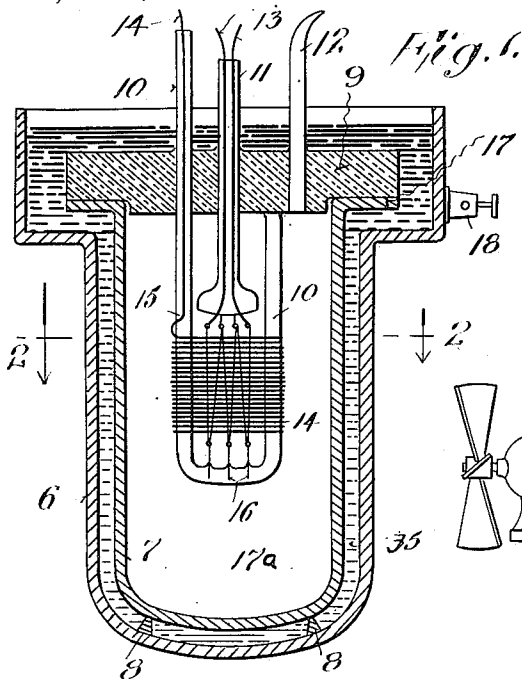
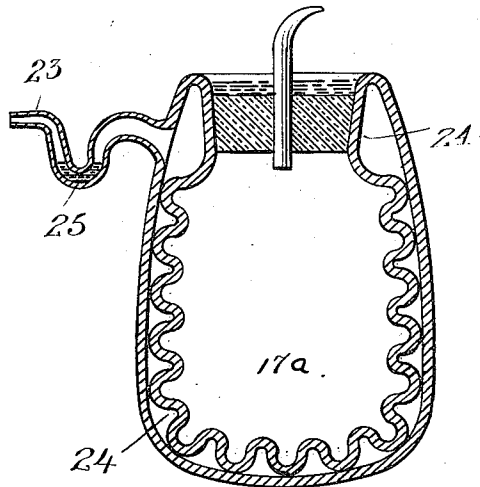
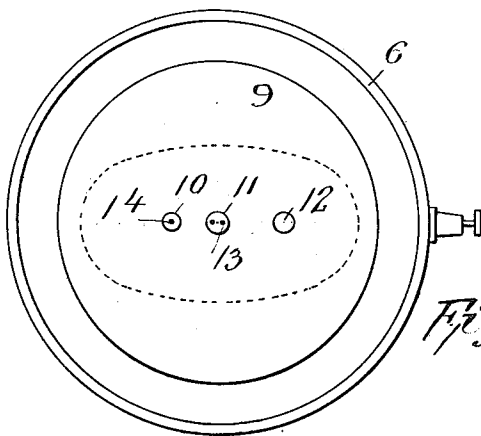
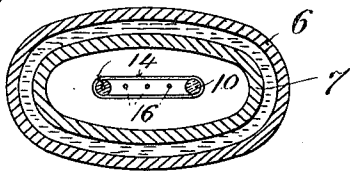


Fig. 2.



See de Forest Inventor
By his Attorney Samuel E. Darby

UNITED STATES PATENT OFFICE.

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OSCILLATING AUDION.

1,201,271.

Specification of Letters Patent.

Patented Oct. 17, 1916.

Application filed July 22, 1915. Serial No. 41,333.

To all whom it may concern:

Be it known that I, LEE DE FOREST, a citizen of the United States, residing at New York, county of Bronx, State of New York, have made a certain new and useful Invention in Oscillating Audions, of which the following is a specification.

This invention relates to oscillating audions.

10 The object of the invention is to provide an audion which is simple in construction, economical of manufacture, and highly efficient in operation.

15 A further object of the invention is to provide an audion which may be used as a generator of high power oscillating energy.

20 A further object of the invention is to provide an audion which will successfully withstand the excessive amount of heat generated in use without danger of breaking, or becoming inoperative.

Other objects of the invention will appear more fully hereinafter.

25 The invention consists substantially in the construction, combination, location and relative arrangement of parts, all as will be more fully hereinafter set forth, as shown by the accompanying drawing, and finally pointed out in the appended claims.

30 Referring to the accompanying drawing, Figure 1 is a view in vertical section, showing one form of audion constructed in accordance with my invention. Fig. 2 is a view in section taken on the line 2-2, Fig. 1, and looking in the direction of the arrows. Fig. 3 is a top plan view of the form of my invention shown in Fig. 1. Figs. 4 and 5 are sectional views of audions embodying my
40 invention.

The same reference numeral designates the same parts wherever they occur throughout the several views.

45 In the construction, operation and maintenance of electric oscillation generators, such as shown and described in my Letters Patent No. 943,969, issued to me on December 21, 1909, and in the various other forms of oscillation generators employed in the

art, great difficulties have been met in attempting to secure considerable power output therefrom due to the liability of cracking or damaging the evacuated glass containing vessel through heat originating from the hot electrode or from the corpuscular bombardment within the evacuated vessel.

55 To the present time it has proven impractical to obtain much more than one-half kilowatt of oscillating energy from a single audion without great danger of breakage or air leakage. Inasmuch as larger amounts of power have been desired or found necessary, it has been necessary to use two or more such audions connected in parallel.

It is among the special purposes of my present invention to provide an audion which may be capable of any size of construction and of any degree of out-put power.

60 In the forms of my invention shown, I have illustrated types of metal vessels or containers of such constructions as to permit the maintenance therein of the highest attainable degree of vacuum and for a definite length of time. It is well known that practically all metals, except platinum, are more or less porous to gases, and will therefore in time, no matter with what degree of care is taken in construction, admit sufficient external air to reduce the vacuum within to a point below that where the oscillating device can operate effectively as a generator of high frequency currents. While platinum forms the exception, the cost of that metal is prohibitive for the purposes herein described. It is well known, however, that if tight and properly constructed joints or valves in connection with high vacuum apparatus be sealed with a suitable liquid, such as mercury, such joint or seal will successfully withstand the greatest external air pressures indefinitely.

65 In the accompanying drawing, I show means for constructing audions under the foregoing principles, and a system of constructing and locating the electrodes of the audion so that the same may be first inserted in the vessel or container, and sealed therein,

and the vessel or container then exhausted of air and sealed off in a fashion which shall be permanent until such time as it may be desired to reopen the same for the purpose of renewing the filament or heated cathode element.

In Fig. 1 I show one form of my invention wherein 6 and 7 indicate respectively the outer and inner walls of the container, which are of metal, preferably of drawn steel tubing of flask or bottle shape. It is desirable to have the space between the walls 6 and 7 equivalent at all points, and this is secured by the respective sizes of the two vessels 6 and 7, and the length of the seat 8 upon which the inner vessel seats. I find it advantageous to make the space between the two vessels from between one sixteenth to one quarter of an inch, but it is obvious that this is a detail to which my application is not to be limited. 9 designates the stopper or cover, preferably of glass, as shown, or other suitable insulating material, through which extend tubes, preferably of glass, 10, 11, and 12. The tube 10 as shown, forms a "horse shoe" support for the grid electrode 14 which extends down there-through to the point 15 where it passes out of the tube 10 and is wound around the "horse shoe" portion of the tube 10 and around, though not in contact with the filament 13 which passes through the tube 11 and, in this instance, is shown as being in the form of three "hair-pins" or loops in series secured to the base of the "horse shoe" portion of the tube 10 as indicated at 16, in any well known or suitable manner. The stopper 9 is provided with flange portions which seat smoothly on the flange 17 of the inner metal vessel 7, both the stopper and flanged portion of the vessel being preferably circular at this point. Mercury, or other suitable heat conducting, air sealing liquid as indicated at 35 is then poured into the vessel 6, sufficient in quantity to fill the space between the vessels 6 and 7, and to allow a level above the level of the stopper or cover 9. Thus it will be seen that I have provided an interior chamber 17^a completely air sealed, which may be exhausted of air through any well known evacuating means such as an air pump, not shown, the exterior end of the tube being sealed off by the glass blower's flame in the well known manner, when the desired degree of vacuum is obtained in the chamber 17^a. While thus far I have shown and described the vessels 6 and 7 as being of metal, it will be understood that any liquid containing material may be used, such for instance, as glass, and my invention therefore is not to be limited to the specific arrangement or material shown. Where metal is employed, however, the vessel 6 may serve as the wing or plate electrode, and I have shown a terminal post

18 suitably secured thereto to allow the necessary connection thereof to the source of electro-motive force.

As hereinbefore explained, in oscillating audions, it is very necessary to conduct away the heat generated in the interior 17^a of the oscillator as completely as possible. The containers or vessels 6 and 7, and the sealing liquid between them serve as an excellent heat conductor from the interior of the vessel. If desired, and as shown, a fan 19 may be employed to dissipate the heat thus transferred to the external containers, but it is obvious that any cooling device, such as a water cooling arrangement, refrigerating pipes or the like may equally well be employed without departing from the broad scope of my invention.

In Fig. 4 I show a modified form of my invention wherein the inner vessel 7 is corrugated to increase the length of the vessel between the neck of the same and its lower part, that portion corrugated being the portion which is subjected to the maximum of heat, and at the same time being in contact with the outer vessel 6 as at 20, to more readily conduct the heat to the exterior of the audion, and also to reduce as much as possible the strain upon the air seal between the cap and the vessel due to the unequal expansion and contraction therebetween. In this form of my invention, the ends of the inner vessel 7 are bent downwardly as at 21 to form the seat for the cover or stopper 9.

In Fig. 5 I show an arrangement wherein instead of a surrounding space filled with liquid I employ an evacuated envelop 24 with a sealing-off tube 23 leading into said envelop, the inner wall of the envelop, being part of the outer wall and corrugated throughout to secure proper conductivity of heat by contact of the corrugations thereof as hereinbefore described. Any desired proportion of vacuum may be maintained in the envelop 17^a and I have shown one simple and convenient arrangement for sealing the envelop after the vacuum has been secured. I form the tube 23 into substantially a U-tube trap in the base of which I place lump solder 25. After the desired vacuum has been obtained, the solder is melted by externally applied heat, and upon the cooling thereof an effective air seal is secured.

It is well known that an evacuated enveloping space surrounding an inner vessel is a very complete heat insulator, therefore special means must be provided in this arrangement to dispose of the heat generated within the space 17. The vacuum of the envelop can not, of course, be as high as that in the inner vessel, but the air pressure in the envelop 24, in the arrangement shown, and in practice, is too small to allow leakage into the space 17.

In place of a surrounding space filled with liquid, or an exhausted envelop, many other arrangements may be employed, such as coating the exterior or interior of the containing vessel with a suitable heat-resisting enamel which will not allow gas penetration, and therefore it will be understood that my invention is not to be limited in these respects.

It will also be understood that while I have hereinbefore mentioned mercury as a highly efficient conducting, air sealing liquid, many other liquids such as castor oil, obolene oil, glycerin and the like may be equally well employed, and therefore I am not to be limited thereto.

Having now set forth the objects and nature of my invention, and having shown and described various embodiments thereof, what I claim as new and useful and of my own invention and desire to secure by Letters Patent, is,—

1. An oscillating audion comprising an outer vessel and an inner evacuated vessel, the electrodes of said audion being located in said evacuated vessel and extending out of both of said vessels, and means interposed between said vessels for making said inner vessel air tight.

2. An oscillating audion comprising an outer metallic vessel and an inner evacuated metallic vessel the outer vessel forming one electrode of said audion and means for making said inner vessel air tight.

3. An oscillating audion comprising an outer metallic vessel and an inner evacuated metallic vessel and means interposed between said vessels for making said inner vessel air tight.

4. An oscillating audion comprising an outer and an inner vessel, the electrodes of said audion being located in said evacuated vessel and extending out of both of said vessels, and an air sealing liquid interposed between said vessels.

5. An oscillating audion comprising an outer and an inner vessel, the electrodes of said audion being located in said evacuated vessel and extending out of both of said vessels, and a current conducting liquid interposed between said vessels.

6. An oscillating audion comprising an outer and an inner vessel, the electrodes of said audion being located in said evacuated vessel and extending out of both of said vessels, and an air sealing heat conducting liquid interposed between said vessels.

7. An oscillating audion comprising an outer vessel inclosing an inner vessel, the electrodes of said audion being located in said evacuated vessel and extending out of both of said vessels, and mercury interposed between said vessels.

8. An evacuated vessel having an opening, a stopper for said opening, and means inclosing said stopper and sealing said vessel and

said stopper to render the same impervious to air leakage and hot and cold electrodes contained in said vessel, said hot electrode being insulated from said cold electrodes.

9. An evacuated vessel having an opening, a stopper for said opening and a liquid inclosing said stopper and sealing said vessel and said stopper to render the same impervious to air leakage and hot and cold electrodes contained in said vessel, said hot electrode being insulated from said cold electrodes.

10. An evacuated vessel having an opening, a stopper for said opening and a heat conducting liquid inclosing said stopper and sealing said vessel and said stopper to render the same impervious to air leakage and hot and cold electrodes contained in said vessel, said hot electrode being insulated from said cold electrodes.

11. An evacuated vessel having an opening, a stopper for said opening, and means inclosing said stopper and sealing said vessel and said stopper to render the same impervious to air leakage and hot and cold electrodes contained in said vessel, said hot electrode being insulated from said cold electrodes, a container for said vessel, and means for transmitting the heat generated within the evacuated vessel to the exterior of said container.

12. An evacuated vessel having an opening, a stopper for said opening and a liquid inclosing said stopper and sealing said vessel and said stopper to render the same impervious to air leakage, and hot and cold electrodes contained in said vessel, said hot electrode being insulated from said cold electrodes, a container for said vessel, and means for transmitting the heat generated within the evacuated vessel to the exterior of said container.

13. An evacuated vessel having an opening, a stopper for said opening and a heat conducting liquid inclosing said stopper and sealing said vessel and said stopper to render the same impervious to air leakage and hot and cold electrodes contained in said vessel, said hot electrode being insulated from said cold electrodes, a container for said vessel, and means for transmitting the heat generated within the evacuated vessel to the exterior of said container.

14. An evacuated vessel, a container therefor, a removable stopper in the neck of said evacuated vessel, and means between said vessel and its container for air-sealing said vessel and its stopper and a hot and a cold electrode contained in said vessel but insulated therefrom, said container forming a third electrode.

15. An oscillating audion comprising an evacuated vessel provided with an insulating stopper, a grid and a filament electrode passing through said stopper into said vessel, a

metallic container for said vessel, an air sealing liquid interposed between said vessel and said container, and over said stopper.

- 5 16. An oscillating audion comprising an evacuated vessel provided with an insulating stopper, a grid and a filament electrode passing through said stopper into said vessel, a

metallic container for said vessel, an air sealing liquid interposed between said vessel and said container, and over said stopper, 10 said container forming the wing electrode.

In testimony whereof I have hereunto set my hand this 19th day of July, A. D. 1915.

LEE DE FOREST.