March 11, 1930. W. J. BROWN 1,750,386

SPACE CURRENT DEVICE

Filed Dec. 18, 1926

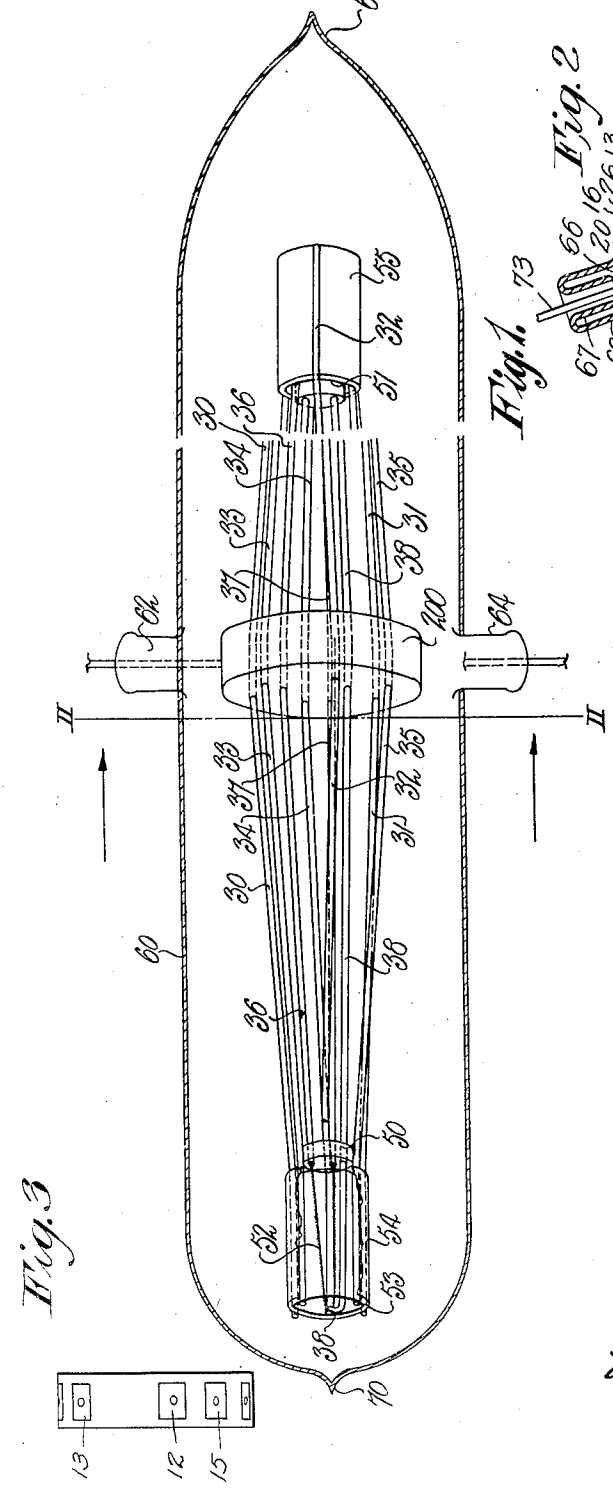


Fig. 1.

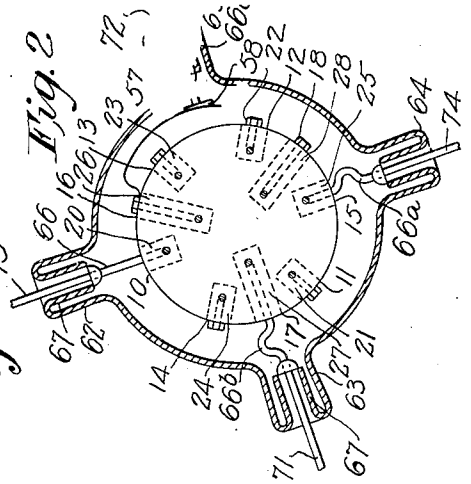


Fig. 2

Fig. 3

Inventor
Walter J. Brown
By James L. Norris
Attorney.

Patented Mar. 11, 1930

1,750,386

UNITED STATES PATENT OFFICE

WALTER JOHN BROWN, OF BROOKLANDS, ENGLAND

SPACE-CURRENT DEVICE

Application filed December 18, 1926, Serial No. 155,734, and in Great Britain December 23, 1925.

This invention relates to space current devices.

It has been found when employing space current devices for the production or utilization of alternating electric currents of very high frequency such, for example, as alternating currents of a frequency of the order of ten million to several hundred million cycles per second, a relatively large alternating current flows through the capacity between the electrodes of the device; and consequently when parts of the oscillatory circuits are external to the envelope of the device these currents flow through conductors which are sealed through the envelope. Furthermore, at such very high frequencies, if parts of the oscillatory circuits which have a high frequency alternating potential difference are separated by or supported on insulating or dielectric material, the losses in the dielectric may be great. Furthermore, at very high frequencies the high frequency resistance of the usual forms of oscillatory circuit becomes extremely high due to the very pronounced skin effect and due to the fact that a large proportion of the energy may be radiated from the said oscillatory circuit in the form of Hertzian waves.

One object of the present invention is to overcome the necessity of having to lead large oscillatory currents through seals in the envelope of a space current device.

Another object of the invention is to construct a space current device in which the whole of the oscillatory circuit is enclosed within the envelope of the device.

Another object of the invention is to minimize dielectric losses.

Another object is to support the structure comprising the oscillatory circuits and the electrodes of a space current device only at points at which occur nodes of high frequency potential.

Another object of the invention is to reduce the high frequency resistance losses due to skin effect in the oscillatory circuit.

Another object is to reduce the stray losses due to radiation in the form of Hertzian waves.

Another object is to construct the oscillatory circuits in the form of cages of substantially parallel wires.

These and other objects and advantages of the invention will be readily appreciated by reference to the accompanying drawings.

In the accompanying drawings Fig. 1 illustrates by means of a partly diagrammatic perspective view a symmetrical structure of high frequency electric generator according to the invention; Fig. 2 is a section on the line II—II of Fig. 1 looking in the direction of the arrows; and Fig. 3 is a side elevation of the insulator employed in the structure illustrated in Figs. 1 and 2.

The arrangement shown in Figs. 1 and 2 essentially consists of two space charge devices in the form of triode structures spaced apart within an elongated evacuated envelope, the several elements of the two triode structures being directly connected together by substantially straight conductors. Connections are made to the centres of the straight conductors for the purpose of supplying heating energy to the cathodes and high potential energy to the anodes and determining the potential of the grids. All the connections to external conductors are made at points which are potential nodes on the oscillatory system. Furthermore, the whole of the elements of the oscillatory system including the elements of the two triode structures are mechanically supported at points which are potential nodes and the whole of the solid insulation between the elements of the system is located also adjacent to potential nodes so that it is not subjected to any material high frequency electric stress.

In order that the structure illustrated may

be readily understood its manufacture will be described in some detail.

A circular block of steatite 200 or other insulating material is machined or moulded with a plurality of recesses 10, 11, 12, 13, 14 and 15 of equal depth and equally spaced around its periphery. Other deeper recesses 16, 17 and 18 are also formed in the insulating block between certain of the aforementioned recesses. Metal insets 20, 21, 22, 23, 24, 25, 26, 27 and 28 are inserted into the several recesses. Rods or stiff wires 30, 31, 32, 33, 34, 35, 36, 37, 38 are pushed through axial holes in the insulator and insets.

The rods 36, 37 and 38 are sealed at their ends through glass beads 50 and 51. The rods 36 and 37 are cut off close to the glass beads 50 and 51 and filaments 52 are welded to their ends. The rod 38 is continued up through the glass bead and bent to act as a support for the bight of the filament. The rods 33, 34 and 35 are sloped towards one another at their ends and are then bent so that their extremities, which are adjacent to filaments 52, lie parallel. The ends of these rods are cut off so that they project somewhat beyond the loop of filaments 52 and are then welded to rings 53.

A grid, not shown, consisting of a helix of fine wire is then wound about the three rods 33, 34 and 35 for the full length of the filament. The rods 30, 31, 32 are bent similarly to the grid supporting rods 33, 34 and 35 and are cut off to similar length and are thereafter welded to tubular anodes 54 and 55. For the sake of clearness the anode 54 and a portion of the rod 32 are shown as broken away.

In order to secure the rods firmly to their insets, set screws are inserted in tapped holes in the insets 21, 22, 23, 24, 26 and 28. These set screws are firmly screwed down to clamp the rods in the insets. Also a flat spring 57 is welded or otherwise secured to the inset 26. A blind nut 58 is welded to the free end of the flat spring 57.

The assembly thus formed is inserted within a tube 60, which is opened at one end 61 and is provided with four equally spaced radial tubes 62, 63, 64 and 65 at or near its centre portion.

For the purpose of supporting the structure within the tube 60 and providing electrical connection to the several elements sealing pieces consisting of copper rods 66 screwed at one end and provided with an integral thin copper disk at or near their centres are sealed to short glass tubes 67 as shown in Fig. 2.

The glass tubes 67 are bell mouthed to such an extent that the mouth engages the end of the tubes 62, 63, 64, 65. One of the rods 66 is inserted through the tube 62 and engages with the screw-threaded hole in the inset 20 and is screwed down so that it clamps the rod 30 in the inset 20 and makes a good electrical connection therewith. Rods 66^a and 66^b are similarly screwed into the insets 25, 27, and a rod 66^c is screwed into the blind nut 58. The rods 66^a and 66^b are slightly cranked to render them somewhat resilient to allow for expansion of the parts after assembly. After all the rods 66 have been screwed home the tubes 67 are sealed to the tubes 62, 63, 64 and 65 respectively.

After the assembly of the device in the manner described, end 61 of the envelope is drawn down and sealed, the envelope 60 is sealed to the exhaust pump and exhausted in the well known manner to produce the necessary high degree of vacuum and then sealed off at the tip 70.

In operation, a source of supply for heating the cathodes is connected to the terminals 71 and 72, and a source of high potential energy is connected to one of the terminals 71 or 72 and to the anode terminal 73. The grid terminal is connected through either a high resistance or biassing battery or generator to the negative cathode terminal. Condensers may be connected between the leads supplying the cathodes and those connected to the grids and anodes. If however the connections are made to the potential nodes in the conductors 30, 35, 36 and 37, no high frequency currents will flow through such condensers. If connections were made to points in the conductors 30, 35, 36 and 37, other than nodal points, high frequency choke coils would be incorporated in such connections.

The arrangement thus connected generates electrical oscillations in the rods which connect the anodes and grids and filaments directly together. The high frequency energy is radiated to some extent in the form of Hertzian waves but the radiation may be improved by coupling to the system a tuned conductor.

Alternatively the device described may be caused to generate high frequency oscillations by impressing a high positive voltage on the grids and zero or a low positive voltage on the anodes in the manner which has been described by Gill & Morrell in British Patent No. 198,757 and also by Barkhausen & Kurz. (Phys. Zeits. 21, pp. 1–6, January 1, 1920.)

If it is desired to minimize radiation of the energy in the form of Hertzian waves and to utilize the energy in some other manner the two three-electrode space current structures may be disposed side by side within the envelope and the conductors which connect together the elements thereof may be bent back upon themselves about their centres so that they take up approximately the shape of a U.

In the several forms of the invention which have been described the electrodes of the space current device together with those conductors through which high frequency alternating currents flow, are contained within a glass or other similar envelope.

It will be appreciated that only a few forms of the invention have been described and that many modifications and particularly circuit arrangements may be employed without departing from the scope of the invention.

I claim as my invention:

1. An oscillation generator comprising two space current units within a single envelope and conductors, also within the envelope, connecting corresponding electrodes of the two space current units and forming a complete oscillatory circuit therewith.

2. An oscillatory system comprising two space current devices within a single envelope, conductors connecting corresponding electrodes of the two space current devices and supporting means for the said conductors and electrodes of the two space current devices located within the envelope in the region of the centres of the conductors.

3. An oscillatory system comprising two space current devices within a single envelope, conductors connecting corresponding electrodes of the two space current devices and solid insulating material supporting the said conductors and electrodes of the two space current devices located within the envelope in the region of the mid-points of the conductors.

4. An evacuated envelope containing an oscillation generator comprising a plurality of multiple electrode vacuum electric discharge devices and electrical conductors connected thereto forming oscillatory circuits therewith and containing solid insulating material supporting said conductors and determining the relative positions of the electrodes of said multiple electrode vacuum electric discharge devices and located only in the region of potential nodes in said oscillatory circuits.

5. An oscillatory system comprising a vacuum tight envelope housing, an oscillatory circuit including electrodes of a pair of space current devices, and means to maintain the relative position of the electrodes within the envelope, said positioning means being attached to a point in the oscillatory circuit located solely in the region of potential nodes upon the oscillatory circuit.

6. An evacuated envelope containing two triode structures spaced apart and also containing conductors having substantially rectilinear parts, connecting together corresponding elements of the triode structures and forming therewith a complete oscillatory circuit.

7. An electron discharge device comprising a vacuum tight envelope, space current device electrodes therein, rigid conductive elements connected with and independently supporting each electrode within the envelope and coacting with said electrodes and with each other to form an electric oscillatory system having potential nodes upon the conductive elements, and insulated positioning means fixing the position of the conductive elements and electrodes with respect to each other within the envelope, said means being attached to the conductive elements solely in the region of potential nodes on the oscillatory system.

8. A generator of high frequency alternating currents comprising a vacuum tight envelope, two space current devices located therein, conductors also disposed therein and connected to the electrodes of said space current devices and coacting therewith to form a complete oscillatory circuit within said envelope, and a conductor for supplying power to the generator, sealed through the wall of the envelope and connected to a potential node on the oscillatory circuit.

9. An oscillation generator comprising, within a vacuum-tight container, space current device elements comprising filamentary means and other electrode means, conductors connected with said other electrode means which support the said other electrode means within the envelope and which coact therewith to form an electric oscillatory circuit, insulated supporting means for positioning said conductors and electrode means, situated only in the region of potential nodes upon the oscillatory circuit, other conductors which support the filamentary means within the envelope, insulated spacing means for maintaining the relative positions of the different portions of the filamentary means and which are attached only to the conductors supporting said filamentary means, and insulated supporting means for maintaining the position of the filamentary means as a whole within the envelope.

10. An oscillatory system comprising two sets of space current device electrodes within an envelope, a plurality of conductors with their centre lines disposed on a circle, and connecting one pair of corresponding electrodes, and a plurality of conductors with their mid-points disposed on a circle concentric with the aforementioned circle and connecting another pair of coresponding electrodes.

11. An electrical oscillation generator comprising an evacuated envelope, two sets of space current device electrodes supported within said envelope by two similar systems of conductors, which systems of conductors form with the electrodes a complete oscillatory circuit within the envelope.

12. A generator of high frequency alternating currents comprising, within a vacuum-tight envelope, space current device electrodes, rigid conductors having rectilinear parts connected with and supporting said electrodes and constituting with said electrodes an oscillatory system and means for supporting said oscillatory system from the walls of the envelope, said supporting means

being attached to the oscillatory system solely in the region of potential nodes.

13. A generator of high frequency alternating currents comprising, within a vacuum-tight envelope, space current device electrodes, conductive elements combining to form a high frequency oscillation generating system, and spacing means for said elements disposed only between equipotential points on the high frequency system.

In testimony whereof I have hereunto subscribed my name this 29th day of November, 1926.

WALTER JOHN BROWN.

DISCLAIMER

1,750,386.—*Walter John Brown*, Brooklands, England. SPACE-CURRENT DEVICE. Patent dated March 11, 1930. Disclaimer filed May 28, 1938, by the patentee.

Hereby enters this disclaimer to claims 1, 6, and 10 in said specification.

[*Official Gazette June 21, 1938.*]

DISCLAIMER

1,750,386.—*Walter John Brown*, Brooklands, England. SPACE-CURRENT DEVICE. Patent dated March 11, 1930. Disclaimer filed May 28, 1938, by the patentee.

Hereby enters this disclaimer to claims 1, 6, and 10 in said specification.

[*Official Gazette June 21, 1938.*]