

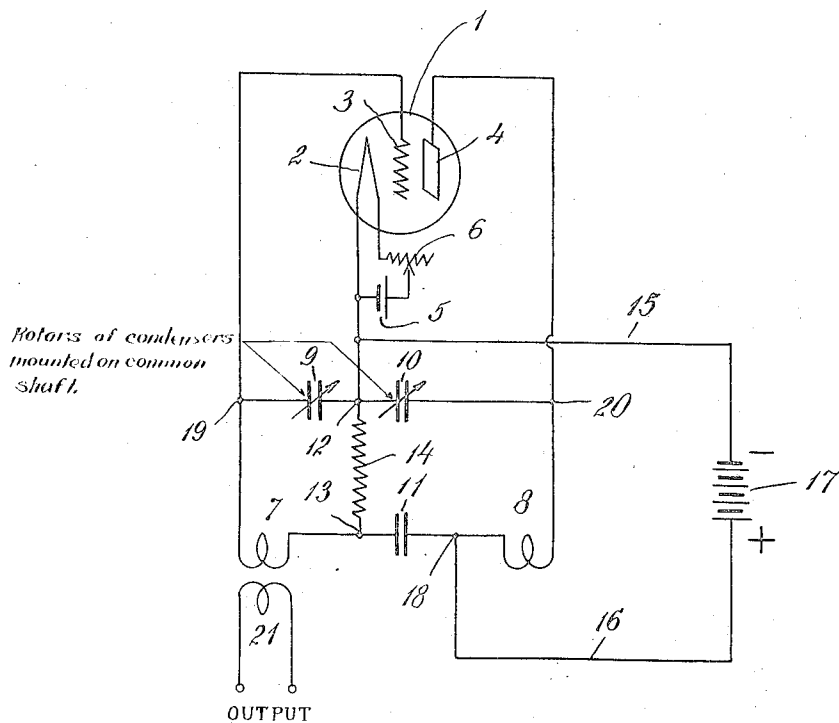
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SHORT WAVE LENGTH TRANSMITTER

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SHORT-WAVE-LENGTH TRANSMITTER.

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The present invention has to do with the generation of high frequency oscillations for radio transmission and is directed more particularly to an improved vacuum tube oscillator which is especially well adapted for use in generating extremely high frequencies, or, what amounts to the same thing, for use as a short wave transmitter oscillator.

Probably the greatest problem which has had to be contended with in the efforts which have been made to develop short wave transmission is that of maintaining a sufficiently high degree of stability. When generating such extremely high frequencies slight disturbances, which would not have any noticeable effect at lower frequencies, are oftentimes sufficient to vary the frequency to such an extent as to make reception very difficult, if not impossible.

Tireless efforts have heretofore been made by those interested in the development of short wave transmission toward overcoming this lack of stability, but it does not appear that a great deal of progress has heretofore been made in that direction. The present invention is the result of careful analysis of the probable causes of instability carried on concurrently with cut and try experiments. The experiments were started at about 600 meters and the wave lengths gradually reduced until 3 meters was reached. Observations were made at each step and any tendency toward instability noted and efforts were made to analyze the causes of such instability. The ultimate outcome was that when the wave length of 3 meters was reached a circuit had been developed which was just as reliable and stable at that wave length as at the longer waves.

In the high frequency generator thus developed there is a high frequency oscillatory circuit consisting of inductances and capacities, to different points of which the respective electrodes of the vacuum tube are connected. The high frequency oscillatory circuit contains capacity and inductance elements which are so proportioned with respect to each other that it constitutes an arrangement equivalent to a high frequency bridge. Across two equipotential points of this bridge there is connected a high resistance element forming a leakage path for the grid, and the direct current supply for the plate circuit is also connected across the same or equivalent points. By virtue of this ar-

range ment the direct current source and leads are kept out of the high frequency circuit and it appears that the extraordinary stability of the generator is due largely to this fact.

Tuning is preferably effected by means of a pair of variable condensers, the rotatable plates of which are mounted on a common shaft so that their capacities may be increased and decreased simultaneously. These condensers each form one arm of a high frequency bridge. They are usually so designed that they have substantially equal capacities for each setting, although this is not essential, it being necessary only that they be so proportioned that the bridge is at least approximately balanced for all settings.

The circuit diagram shown in the accompanying drawing, illustrates the exact arrangement with which the unusual results were obtained but it will be realized that some little modification is possible without detriment to the efficiency and stability of the system.

In the drawing 1 is a three-electrode vacuum tube comprising a cathode or filament 2, a control electrode or grid 3 and an anode or plate 4. A filament heating battery 5, together with a filament control resistance 6 are provided. For low power purposes the tube may be of the type commonly used in radio receiving apparatus, as for example the one known by the trade designation UV-201-A.

It has been commonly supposed that in order to generate such high frequencies, as that corresponding for example with a five meter wave length, it was necessary to use a tube in which the lead-in wires for the plate, grid and filament were widely separated. It has been found, however, that with the circuit here shown it is not necessary to provide a tube of special construction but that an ordinary tube of the type referred to above will give equally good results. No doubt with increasing frequencies, it would be desirable, if not necessary, to provide a tube in which the lead-in wires are more widely separated so as to reduce the capacity therebetween.

The oscillatory circuit, which is the main factor in determining the frequency at which the generator will operate, comprises two inductance coils 7, 8, two variable con-

5 densers 9, 10 and a fixed condenser 11 of large capacity. Condensers 9 and 10 are variable and their movable plates are mounted on a common shaft, so that their capacities may be varied simultaneously and equally or proportionately. The high frequency oscillatory circuit forms a bridge, the four arms of which contain respectively, inductance 7, inductance 8, condenser 9, condenser 10. 10 The fixed condenser 11 is also included in that arm of the bridge including inductance 8. The arrangement is preferably such that the two arms of the bridge containing the inductances 7 and 8 respectively are of equal reactance. If the condenser 11 is large, the reactance due to it is very small at the high frequencies dealt with so that even if the two inductances 7 and 8 are equal, there is practically no unbalance due to the condenser 11. This condenser may be of the order of .003 microfarads for a transmitter designed to operate in the neighborhood of 5 meters or less. Assuming that the bridge is balanced, the points 12 and 13 are of equal 15 or substantially equal potential.

20 A high resistance 14 of the order of say 5,000 ohms is connected across these equipotential points. The leads 15 and 16, from the direct current supply 17, are connected respectively to the points 12 and 18, the latter of which is substantially of the same potential as points 12 and 13, due to the small reactance from condenser 11. The condenser 11 functions as a blocking condenser 25 to prevent the positive high potential of the source 17 being impressed upon the grid. The grid and the plate leads are connected to points 19 and 20 respectively of the oscillatory circuit. These points are necessarily 30 always of opposite polarity. Since the filament 2 is connected to the point 12, which is midway between the potentials of points 19 and 20, it is obvious that the circuits meet the well-known definition of a vacuum tube 35 oscillation generator.

40 When working at such short wave lengths as those herein referred to, it is obvious that the capacities of condensers 9 and 10 and the inductances of coils 7 and 8 will be extremely small. In practise, the inductance 7 and 8 may each consist of a half-turn of #8 copper wire, the radius of the turn being about two inches.

45 Coil 7 is shown inductively associated with a secondary coil 21, the terminals of which may be connected to an antenna or other output circuit. Coil 21 may likewise consist of a half-turn of #8 copper wire, having a two inch radius. Condenser 9 and 50 10 may be of unequal capacity, providing inductances 7 and 8 are likewise unequal, so that the bridge is maintained at an approximate balance for all settings.

55 If the bridge circuit is so balanced that the high frequency potentials at points 12

and 18 are exactly equal, it is apparent that no high frequency current flows through the direct current source 17 and therefore that any disturbances occurring in the direct circuit source or leads 15 and 16 have no effect 60 on the frequency generated.

Although the invention is of especial importance for short wave transmission its operation is equally good at longer waves.

To those skilled in the art it will be obvious that the exact circuit arrangement shown may be departed from in certain respects without destroying its stability. The scope of the invention should be construed accordingly. 65

I claim:

1. In a high frequency generator, a three-electrode vacuum tube comprising a cathode, an anode and a control electrode, an oscillatory circuit forming a high frequency bridge, said anode and control electrode being connected to said bridge at points of unequal high frequency potential, said cathode being connected to one of two points on said bridge of constantly equal high frequency potential, and a source of direct current having its terminals connected respectively to said two points of constantly equal high frequency potential. 70

2. In a high frequency generator, a three-electrode vacuum tube comprising a cathode, an anode and a control electrode, an oscillatory circuit forming a high frequency bridge, said anode and control electrode being connected to said bridge at points of unequal high frequency potential, said cathode being connected to one of two points on said bridge of constantly equal high frequency potential, a source of direct current having its terminals connected respectively to said two points of constantly equal high frequency potential and a resistance element and capacity in series connected between said points. 75

3. In a high frequency generator, a three-electrode vacuum tube comprising a cathode, an anode and a control electrode, an oscillatory circuit forming a high frequency bridge, said anode and control electrode being connected to said bridge at points of unequal high frequency potential, said cathode being connected to one of two points on said bridge of constantly equal high frequency potential, a source of direct current having its terminals connected respectively to said two points of constantly equal high frequency potential and a high resistance element and capacity in series connected between said points. 80

4. In a high frequency generator, a three-electrode vacuum tube comprising a cathode, an anode, and a control electrode, an oscillatory circuit comprising inductance and capacity, said anode and control electrode being connected respectively to points in said 85

oscillatory circuit of unequal high frequency potential, said cathode being connected to a point in said oscillatory circuit the potential of which is always intermediate of the potentials of said first mentioned points, and a source of direct current having its negative terminal connected to said cathode and its positive terminal connected to a point in said oscillatory circuit which is constantly at substantially the same high frequency potential as the aforementioned point to which said cathode is connected, said source of direct current being included in a direct current circuit between said anode and cathode.

5. In a high frequency generator, a three-electrode vacuum tube comprising a cathode, an anode, and a control electrode, an oscillatory circuit comprising inductance and capacity, said anode and control electrode being connected respectively to points in said oscillatory circuit of unequal high frequency potential, said cathode being connected to a point in said oscillatory circuit the potential of which is always intermediate of the potentials of said first mentioned points, a source of direct current having its negative terminal connected to said cathode and its positive terminal connected to a point in said oscillatory circuit which is constantly at substantially the same high frequency potential as the aforementioned point to which said cathode is connected, said source of direct current being included in a direct current circuit between said anode and cathode and a high resistance included in a direct current circuit between said control electrode and cathode, the terminals of said high resistance being connected to points in said oscillatory circuit of constantly substantially equal high frequency potential.

6. In a high frequency generator, a three-electrode vacuum tube comprising a cathode, an anode, and a control electrode, an oscillatory circuit comprising two inductance elements and two capacity elements all in series, at least two of said elements being variable, said anode being connected to said oscillatory circuit at a point between one

of said capacity elements and the adjoining one of said inductance elements, said control electrode being connected to a point in said oscillatory circuit between the other of said capacity elements and the adjoining one of said inductance elements, said elements being so proportioned with respect to each other that a point in said oscillatory circuit between said capacity elements and a point between said inductance elements are constantly of substantially equal high frequency potential, said cathode being connected to one of said points of equal potential, a high resistance element connected between said points of equal potential, and a source of direct current having its negative terminal connected to said cathode and its positive terminal connected to a point in said oscillatory circuit which is substantially of equal high frequency potential to the equal potential points previously mentioned.

7. In a high frequency generator, a three-electrode vacuum tube comprising a cathode, an anode, and a control electrode, two variable condensers connected in series between the terminals of said anode and control electrode, said inductances also connected in series between the terminals of said anode and control electrode, said cathode being connected to the adjoining terminals of said condensers, a high resistance having one terminal connected to the adjoining terminals of said condensers and the other terminal connected to a point in circuit between said inductances, the points of connection of said resistance terminals being substantially of equal high frequency potential, a direct current source having its negative terminal connected to one terminal of said resistance and its positive terminal connected to a point in circuit which is substantially of equal high frequency potential to the terminals of said resistance, said direct current source being in a direct current circuit between said cathode and anode.

In testimony whereof I affix my signature.

WILLIAM HOLLIS HOFFMAN.