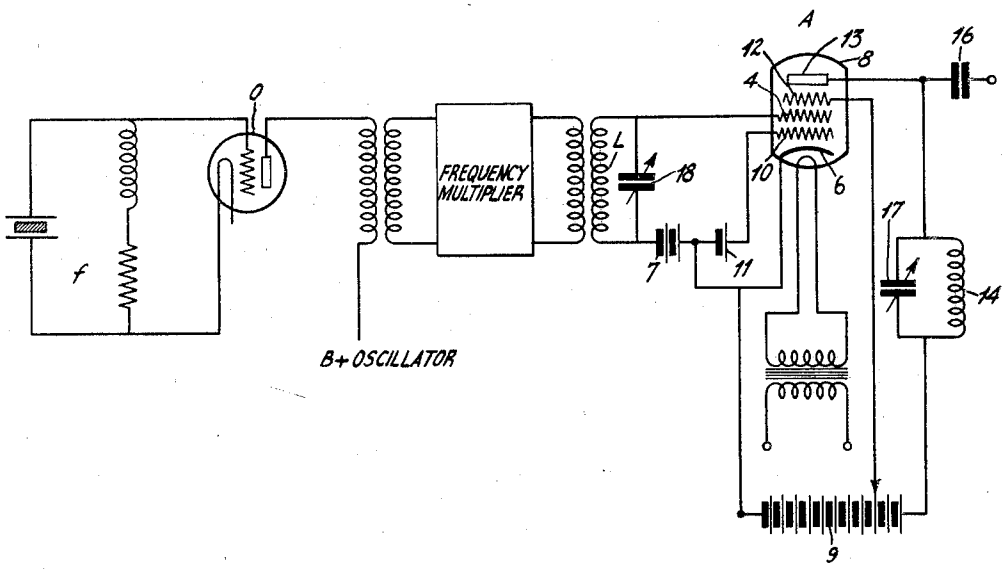
April 17, 1934. W. RUNGE ET AL 1,955,094

ULTRAHIGH FREQUENCY AMPLIFIER

Filed Dec. 24, 1932



INVENTOR
WILHELM RUNGE
HERBERT MUTH
DIETRICH PRINZ

BY H. S. Grover

ATTORNEY

Patented Apr. 17, 1934

1,955,094

UNITED STATES PATENT OFFICE

1,955,094

ULTRAHIGH FREQUENCY AMPLIFIER

Wilhelm Runge, Herbert Muth, and Dietrich Prinz, Berlin, Germany, assignors to Telefunken Gesellschaft für Drahtlose Telegraphie, m. b. H., Berlin, Germany, a corporation of Germany

Application December 24, 1932, Serial No. 648,800
In Germany November 23, 1931

2 Claims. (Cl. 179—171)

The invention relates to arrangements for amplifying electric high frequency oscillations (more than two million cycles) and more in particular to vacuum systems of high power including a screen grid, and in which the design of the electrical data, in particular the reciprocal of the amplification factor

$$\left(\frac{1}{\mu}\right)$$

and the screen grid potential are so chosen that the grid potential will never become positive and therefore no load will be imposed upon the master oscillator by the grid current.

It has been found that in the operation of tubes at frequencies of the order above given, and in particular tubes of the type in which the emitting element is non-metallic, or in which the surface of the cathode is a poor conductor, dielectric losses are caused in the emitting layer of the cathode imposing a load upon the master oscillator in such a manner that the advantage obtained of operating the tube within the range of the negative grid biasing potentials, becomes again illusory. According to the present invention there is arranged between cathode and control grid an additional grid, placed at a preferably positive potential being constant relative to the cathode. As a result the lines of force emanating from the control grid terminate wholly or for the greater part at the auxiliary grid, thus preventing their passing through the emitting layer.

While it is believed that the present invention in all its aspects will be understood from the above description, a circuit arrangement showing a practical application of the invention will now be described.

In describing this application reference will be made to the drawing, in which the single figure shows a circuit arrangement in which a tube as described above is shown.

Referring to the drawing, O indicates a source of high frequency oscillations. This source may be an antenna system, that is, an absorption system, a radio frequency amplifier, or it may be an oscillation generator including a thermionic tube having a frequency determining circuit and an output circuit as shown. The source of oscillations may be coupled to the inductance L connected between the screen grid 4 and the emission electrode 6 of an amplifier tube 8 in the amplifier stage A constructed and operated in accordance with the present invention. The source of oscillations O may be coupled directly to the inductance L or, if the frequency of said source is not high enough, the source may be coupled to L by way of a frequency multiplier as shown. The control grid electrode 4 of the tube 8 in the amplifier stage is maintained at a negative potential with respect to the emission electrode 6 by means of a biasing source 7.

As indicated above, it is thought that the losses which occur in the input circuits or on the input electrodes of tubes operating at ultra high frequencies are due in part to the passage of the lines emanating from the control grid through the emitting layer of the emission electrode. This defect is obviated in accordance with the present invention by inserting an auxiliary electrode 10 between the emission electrode 6 and the control grid 4. The auxiliary electrode 10 completely shields or separates the emission electrode 6 from the control grid 4. The lines of force emanating from 4 as the result of the high frequency potentials thereon are now terminated at the electrode 10 and do not reach the emission electrode 6. This electrode 10 may be maintained at any constant potential but is preferably maintained at a positive potential with respect to the emission electrode 6 by means of a biasing battery 11 connected as shown. It is essential that the element 10 be maintained at a constant potential relative to the element 6.

The amplifier stage A, including the tube 8, may otherwise be of conventional design. For example, the tube 8 may be of the screen grid type, in which case the screen grid electrode 12 may be maintained at a positive potential by the source 9, which also supplies potential to the anode 13. The output electrode 13 of tube 8 may be coupled to further amplifiers or to any work circuit inductively by way or inductance 14 of capacitively by way of condenser 16.

If the oscillator O is coupled directly to the amplifier A then the input circuit, including the inductance L, may be tuned to the frequency f of the frequency determining circuit of the oscillator by means of a capacity 18 connected in parallel with L. In this case the output circuit of tube 8, including the inductance 14 may be tuned to the frequency f by the variable capacity 17. If the oscillator O is coupled to the amplifier stage A by way of a frequency multiplier, as shown, the inductance L should be tuned to a frequency equal to fn, that is, to a frequency equal to the frequency impressed from the output electrodes of the frequency multiplier on inductance L. In this case the frequency determining circuit 14, 17 should likewise be tuned to a frequency fn.

Of course it will be understood that the amplifier of the single figure in the drawing may comprise an amplifying stage in a radio frequency receiver or any other radio frequency relaying device.

Having thus described our invention and the operation thereof, what we claim is:

1. Ultra high frequency amplifying means to be used with a thermionic oscillation generator having an output circuit including, a thermionic amplifier having its control electrode circuit coupled to said output circuit and its anode electrode coupled to a work circuit, a circuit for biasing the control electrode of said amplifier negative with respect to the cathode of said amplifier, means for decreasing the losses in said amplifier control electrode circuit to decrease the load said amplifier places on said oscillator comprising, an additional electrode interposed between said grid and the emission electrode of said amplifier and maintained at a positive potential with respect to said control grid electrode, and an auxiliary electrode between said anode and said control electrode to prevent reaction between said electrodes and the circuits connected thereto.

2. Ultra high frequency oscillation repeating means comprising, an evacuated container enclosing an anode electrode, an electron emission electrode and a control electrode, a circuit for applying the ultra high frequency oscillations to be repeated between said control electrode and said cathode, biasing means in said circuit for applying a negative potential to said control electrode, an output circuit connected between said anode and said electron emission electrode, a shielding electrode interposed between said anode and control electrode and maintained at a potential positive with respect to the potential of the electron emission electrode to decrease the reactive coupling between said anode and said control electrode, and means for materially reducing the losses inherent in the control electrode and electron emission electrode circuit of said repeater at ultra high frequency comprising, an auxiliary electrode between said control electrode and said electron emission electrode, and a circuit for applying a fixed potential between said auxiliary electrode and said electron emission electrode, whereby the electron emission electrode and electron stream emanating therefrom are substantially shielded from the alternating electrical fields produced by the control electrode.

WILHELM RUNGE.
HERBERT MUTH.
DIETRICH PRINZ.