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RADIO TRANSMITTING SYSTEM

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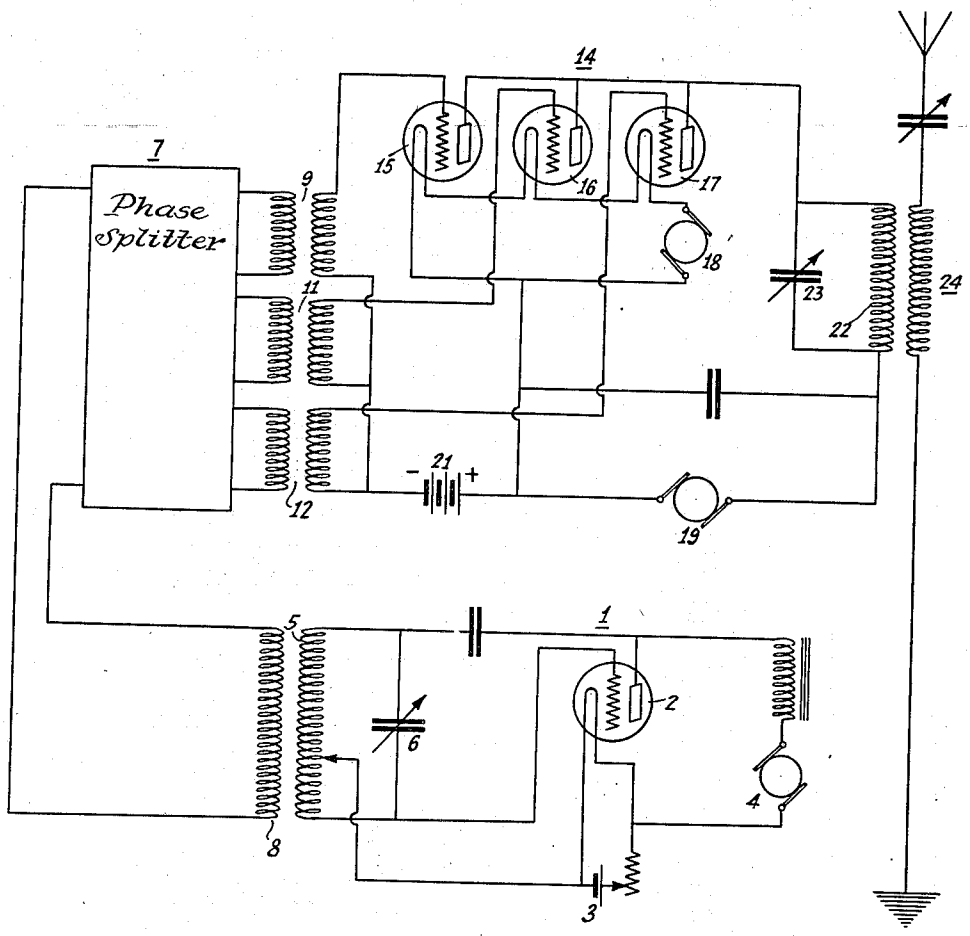

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RADIO TRANSMITTING SYSTEM

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My invention relates to radio signaling systems and particularly to phase splitting and frequency multiplying means in connection therewith.

An object of my invention is to provide a radio frequency generator adapted to the generation of relatively very high radio frequencies.

Another object of my invention is to provide in combination a radio frequency generator and an amplifier adapted to multiply the frequency thereof.

Another object of my invention is to provide a radio frequency generating system adapted to generate large powers at very high frequencies.

Another object of my invention is to provide means for counteracting the effect of tube capacitance in the generation of radio frequencies above 1500 kilocycles.

In the normally separately-excited vacuum tube transmitters, having a master oscillator, the working or power tubes play the part of a powerful high frequency amplifier, and they excite by direct current impulses in the anode or plate circuit an oscillation circuit tuned to the exciting frequency, the radiation energy being taken from said oscillation circuit.

This system in reasonably satisfactory at relatively low radio frequencies and longer wave lengths but is not so satisfactory at shorter wave lengths and higher frequencies, since at these frequencies the inter-electrode capacitance of the tubes becomes a large factor in the tuning of the circuits and may become so large as to prevent the production at all of oscillations at the frequency desired.

The subject-matter of the present invention consists in exciting several high frequency amplifier tubes of large power in parallel with phase displaced exciting currents from the master oscillator and in causing them to act upon a common anode circuit, said anode or plate circuit, being tuned in the case of parallel tubes to the n-fold frequency, instead of to the exciting frequency. The simplest case would be a three-phase excitation. In this case the common plate circuit would be tuned to a frequency three times the frequency of the exciting currents from the master oscillator. The three tubes used deliver in each excitation period three successive D. C. impulses to the common oscillatory circuit. In this scheme it is necessary to provide a negative grid voltage in the amplifier tubes, and to so adjust it to such a value that the period during which the plate current is flowing will not be longer than the duration of a quarter-period of the triple frequency compared with the exciting oscillation.

Other objects and structural details of my invention will be apparent from the following description when read in connection with the accompanying drawing, wherein:

The single figure is a diagrammatic representation of circuits and apparatus embodying my invention.

In the figure a master oscillator 1 comprising a triode vacuum tube 2 having filament heating means 3, a plate current generator 4 and a local resonant circuit consisting of an inductance 5 and a capacitance 6. A phase splitter 7 is provided and supplied from coil 8 in inductive relation to the coil 5 and delivering phase displaced energy to the primary coils of the high frequency transformers 9, 11, and 12. A multiplying amplifier 14 is provided consisting of triode, power amplifying, tubes 15, 16, and 17 the filaments of which are energized by a current source 18, the plate circuits of which are energized by current source 19. The respective grids are energized by the secondaries of the respective transformers 9, 11, and 12 and the grids are suitably biased electrically by a grid potential source 21. A reasonant circuit comprising an inductance 22 and a capacitance 23 is provided and connected in the lead between the parallel connection to the plates of the respective triodes 14, 15 and 16 and the generator 19. A resonant radiating circuit 24 is provided and suitably coupled to the local resonant circuit.

The resonant circuit comprising the inductance 5 and the capacitance 6 may then be tuned to a frequency ⅓ that to which the resonant circuit comprising the inductance 22 and capacitance 23 is tuned. This ratio is determined by the number of phases produced by the phase splitter 7.

In the operation of my device the local master oscillator 1 may be set to generate at any convenient frequency and may be keyed by any convenient means (not shown). Its output is then supplied to the phase splitter 7 which in the instance given produces three separate currents having the same frequency as the input but displaced in phase relationship by 120 electrical degrees. The successive positive half cycles of these three phase outputs are then supplied to the grids of the triodes 15, 16, and 17. The grid bias source 21 is adjusted to supply such a negative potential to the grids that the peak only of each positive half cycle brings them to such a positive potential as to permit current to flow.

This sequence of the positive pulses of current causes pulses of current to flow through the power tubes in succession. This succession causes pulses to flow in the generator lead at a frequency three time the frequency of the output of the master oscillator 1. This triple frequency is, however, that to which the resonant circuit in the plate lead is tuned and, therefore, sustained, powerful oscillations are developed in the resonant circuit. The coupled radiator 24 then serves to radiate the desired high frequency energy.

Such multi-phase tube transmitters offer advantages in two different respects. In the first place in connection with the generation of especially high frequencies, the advantage here residing in that the reaction due to the internal capacity of high-power amplifier tubes between the anode working current and the exciter tube is diminished on the ground that working frequency and exciting frequency are then different, while they are alike in the usual arrangement. Another advantage consists in that the exciting circuit may be designed for a relatively lower frequency, with the consequence that its wave can be kept constant more readily, and that the constancy of the exciting period insures constancy of the raised frequency of the working circuit.

It is not necessary in the practice of my invention that the triple frequency arrangement described in illustration be adhered to, but any desired ratio may be substituted, therefore.

While I have shown but one embodiment of my invention in the foregoing description it is capable of various modifications therefrom without departing from the spirit thereof, and it is desired therefore that only such limitations shall be imposed thereon as are required by the prior art or indicated by the appended claims.

I claim as my invention:

1. In combination, a radio frequency master oscillator, a phase splitter coupled to said oscillator, a plurality of amplifiers coupled to the phase splitter, and biased for sharp cut off, and a resonant circuit tuned to a frequency which is a multiple of the frequency to which said first mentioned resonant circuit is tuned, coupled to said amplifiers.

2. In combination, a thermionic radio frequency master oscillator having a resonant circuit, a phase splitter coupled to said resonant circuit, a plurality of amplifiers coupled to respective output circuits of said phase splitter, a second resonant circuit coupled to the output circuits of said amplifiers and means to tune said second resonant circuit to a frequency which is a multiple of the frequency to which said first mentioned resonant circuit is tuned, the ratio between the frequencies of said resonant circuits being equal to the number of phases produced by said phase splitter.

3. The method of generating high radio frequecies which comprises generating a sub-frequency, splitting said sub-frequency into a plurality of phases, separately amplifying and shortening successive positive pulses of each of the phases, and combining all of said amplified and shortened pulses in a common resonant circuit tuned to the desired frequency multiple.

4. In combination, a vacuum tube transmitter adapted to work with extra short waves having thermionic means for generating a fundamental frequency, means for multiplying said fundamental frequency, a plurality of high power amplifier triode tubes excited in phase displaced fashion and a common plate circuit connected thereto and tuned to a frequency equal to the exciting frequency multiplied by the number of phases.

5. In combination, a thermionic generator, a phase splitter supplied thereby for transforming single phase to three phase energy, amplifiers associated with said phase splitter, grid bias means for said amplifiers of such magnitude that current flows in the amplifier tubes during a period less than one twelfth of the period of the master oscillator, and a resonant circuit tuned to a three-fold multiple of the generator frequency coupled to the amplifier tubes.

6. In combination a thermionic radio frequency master oscillator, a phase splitter associated therewith, a plurality of triode amplifier systems coupled to the output circuits of said phase splitter, grid bias means for said amplifiers of such magnitude that current flows in the amplifier tubes during only a small portion of the period of the master oscillator, and a circuit tuned to a multiple of the master oscillator frequency coupled to the amplifiers.

7. In combination, a thermionic radio frequency master oscillator, an output circuit therefor, a phase splitter, an input circuit therefor connected to the output circuit of said master oscillator, a plurality of triode amplifiers connected to the output circuits of said phase splitter, and a single output

circuit for said amplifiers tuned to a desired multiple of the master oscillator frequency.

8. In combination, a thermionic radio frequency master oscillator, a phase splitter having an input and a plurality of output circuits, means for connecting said input circuit to said oscillator, a plurality of triode tubes having input and output elements, means for connecting each of said input elements to a respective one of the output circuits of said phase splitter, and an output circuit tuned to a multiple of the master oscillator frequency coupled to the output elements of said triodes in parallel relation.

9. In combination, a thermionic radio frequency master oscillator, a phase splitter connected thereto supplied therefrom, a plurality of amplifiers each connected to an output circuit of said phase splitter, an output circuit for said amplifiers tuned to a multiple of the master oscillator frequency connecting said triodes in parallel relation, and an oscillation radiator coupled to said output circuit.

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