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FREQUENCY CHANGER

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Fig. 1

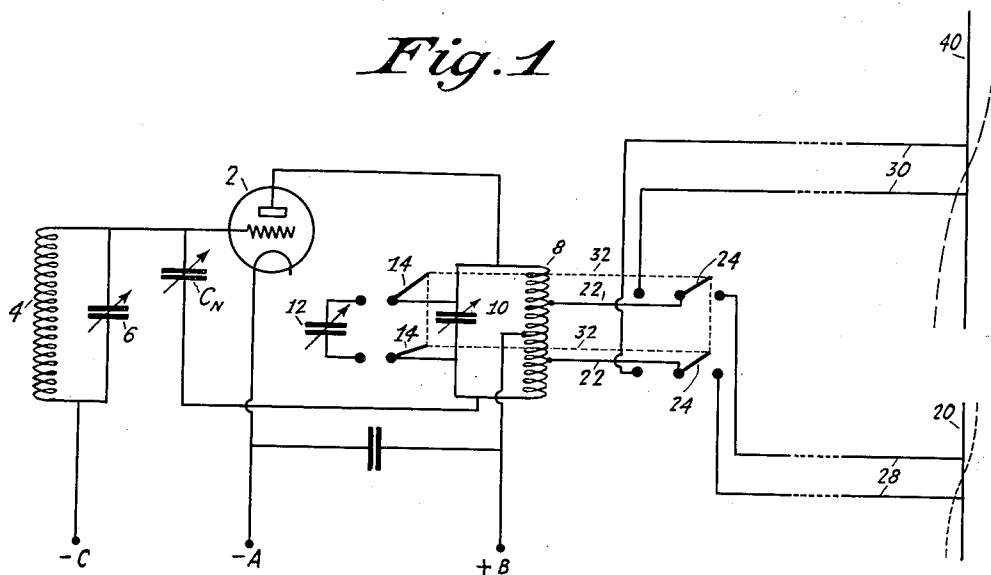
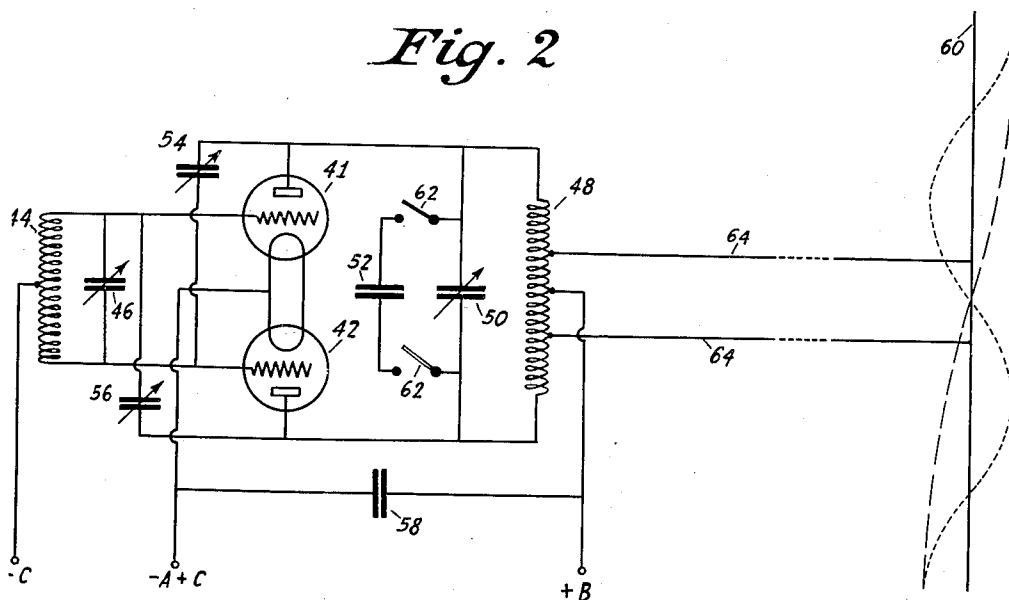


Fig. 2



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FREQUENCY CHANGER

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18 Claims. (Cl. 250—17)

This invention relates to a method of and means for changing the transmission frequency of transmitters, and more particularly, of short wave transmitters employing electron emission tube amplifier stages.

In short wave communication it is found that the most suitable wave length varies during the course of a twenty-four hour day, and in general, the wave length which is most favorable in day time is not the most advantageous at night. Results so far indicate that wave lengths between 15 and 30 meters are best in day time, and wave lengths between 30 and 60 meters are best at night.

Clearly, then, for twenty-four hour service several wave lengths should be available, and to this end, certain stations have been equipped with two or more complete transmitters and antenna systems, for use with different frequencies. It is an object of my invention to make possible a rapid and efficient change-over from one frequency to another while using only a single transmitter. This I do by using an amplifier stage of the transmitter for either straight amplification or for frequency multiplication to various harmonics, according to the wave length desired. In its simplest form the invention makes use of an auxiliary tuning means for cooperation with the regular tuning means of the output circuit of the last amplifier stage, and a simple switching arrangement serves to change the tuning of the output circuit from a fundamental to a harmonic. In this manner the change of wave length is made without necessitating further changes and adjustments throughout the transmitter.

The antenna system should be capable of efficiently radiating the various transmission frequencies. This may be accomplished by using an antenna which is automatically tuned to the various transmission frequencies. Thus, if wave lengths of 20 meters and 60 meters are to be used, or more generally, if the frequencies are in odd harmonic relation, a linear oscillator may be used which is excited at its fundamental when the longer wave is used, and at a harmonic when a shorter wave is used.

In other cases it may prove more desirable to use a plurality of antennae with switching means to discriminate between them. When this is done there must be a change-over of antennae at the same time that there is a change-over in the tuning of the amplifier output circuit, and these changes preferably should be made together automatically. Accordingly, it is a further object of my invention to provide a transmitter and an antenna system which are each capable of working with any of several frequencies, and a single operating means to select a desired one of the several frequencies.

In the simplest form of my invention the tuning change is made in the output circuit of the final amplifier stage, as in the modifications hereinafter disclosed, but the invention is equally applicable to a change-over from amplifier to multiplier in any preceding stage, though this is thought less preferable because it necessitates simultaneous changes in the tuning of succeeding amplifier or multiplier stages.

The invention is described more in detail in the following specification, which is accompanied by a drawing in which:

Figure 1 shows an arrangement adapted for the production of even or odd harmonics, and having a plurality of radiating means; and

Figure 2 shows an arrangement more especially adapted for the production of odd harmonics, and having a single radiating means capable of efficiently transmitting odd harmonic frequencies.

Referring to Figure 1 a three electrode tube 2 has coupled to it an input circuit comprising an inductance 4 and a condenser 6, and an output circuit comprising an inductance 8, a condenser 10, and an auxiliary condenser 12. In other respects the circuit is conventional. A switch 14 is provided for connecting the condenser 12 in parallel with the condenser 10. With the condenser 12 the output circuit 8, 10, 12 is tuned for resonance at the same frequency as the input frequency, say 40 meters, but the capacitance of the condensers 10 and 12 is so apportioned that when the switch 14 is opened the output circuit 8, 10 is resonant to the second harmonic or double frequency of the input frequency, say 20 meters.

Transmission energy is led through the conductors 22 to a switch 24, arranged, as shown, for connecting into circuit either the 20 meter antenna 20 or the 40 meter antenna 40, through the transmission lines 28 or 30. For convenience, the switches 14 and 24 are preferably brought into mechanical cooperation, here indicated by connecting links 32. The switches are thrown to the right or left to choose the transmission wave length.

The type of amplifier shown in Figure 1 is capable of producing even or odd harmonics, as well as amplification of the fundamental. The arrangement is easily elaborated to provide additional wave lengths, thus, a third condenser may be arranged to tune the output circuit to a triple harmonic, and a third antenna provided for radiation of energy of this frequency.

The antennae need not be simple doublets or half-wave oscillators as shown, but may be any type of radiating means whatsoever, the only requirement being that each be tuned for best propagation of that wave produced by the transmitter when the said antenna is connected there-

to. In most cases directive antennae will be preferable.

In the modification shown in Figure 2, there are two tubes 41 and 42, to the grids of which there is coupled an input circuit comprising the inductance 44 and condenser 46. An output circuit comprising the inductance 48 and condenser 50, and the auxiliary tuning condenser 52, is connected to the anodes of the tubes. Neutralizing condensers 54, 56 are arranged in conventional manner, as well as a by-pass condenser 58. A switch 62 is provided for connecting the auxiliary condenser 52 in parallel with the condenser 50.

It will be noticed that in this modification I have indicated the condenser 52 as fixed. This arrangement is for the production of two fixed harmonically related frequencies, in which case the condensers 46 and 50 need be only slightly variable to counteract changes in the natural capacitance of the external circuits. With the condenser 50 properly adjusted to give one of the desired frequencies, the condenser 52 may be of fixed value, for it serves to provide the additional capacitance necessary to change to the other definitely related frequency.

The output from the transmitter is led by means of a transmission line 64 to a linear oscillator 60, which is a doublet for the lower output frequency, but which also will effectively radiate a triple harmonic, the potential distribution along the oscillator being as indicated by the dotted lines. The arrangement shown is intended for transmission wave lengths of 20 and 60 meters, but, of course, it is equally applicable to any set of odd harmonic frequencies.

The foregoing arrangements are simple and economical of apparatus, efficient in operation, and permit rapid ready change-over of frequency.

In the claims which follow I shall by the terms "harmonic relation" and "harmonically related" mean broadly that the frequencies are harmonics of some frequency, i. e., the fundamental need not be one of the frequencies considered. Thus, 30 and 20 meter waves are harmonically related in that they are respectively the second and third harmonics of a 60 meter wave.

I claim:

1. An arrangement for day and night transmission of short waves of favorable wave length including an antenna system comprising a plurality of antennae each tuned to different frequencies, switching means to discriminate between the antennae, a transmitter having a final power amplifier stage, an output circuit for the amplifier comprising a plurality of tuning means adapted to tune the output circuit to any of several frequencies corresponding to the frequencies of said antennas, means cooperating with the tuning means to readily discriminate between the several output circuit frequencies, said antennae and output circuit frequencies being harmonically related, and means for simultaneously changing the tuning of said output circuit and the antenna coupled thereto.

2. In combination an antenna system comprising a plurality of antennae each tuned to different harmonically related frequencies, switching means to discriminate between the antennae, a transmitter having a final power amplifier stage, an output circuit for the amplifier comprising a plurality of tuning means adapted to tune the output circuit to any of the antennae frequencies, switching means cooperating with the tuning means to select the desired transmitter frequency, and means to simultaneously operate the two

switching means to make the transmitter frequency equal the resonance frequency of the antenna connected thereto.

3. In a system for signaling by means of electromagnetic waves, an electron discharge device having within an hermetically sealed container, an electron emitting cathode, an electron receiving anode, and a control electrode intermediate said anode and cathode for controlling the flow of electrons from said cathode to said anode, a circuit comprising inductance and capacity coupled to a pair of electrodes of said electron discharge device, a fixed reactor adapted to be switched into electrical cooperation with said circuit in order to change the operating frequency thereof, a plurality of antennae adjusted for operation at different frequencies and electrical switching means for coupling said reactor and one of said antennae to said circuit, and for removing said reactor from and for coupling said other antennae to said circuit.

4. In apparatus of the character described, an electron discharge device having an anode and a cathode and a control electrode, an output circuit comprising inductance and capacity coupled to said anode and cathode, a fixed reactor adapted to be switched into electrical cooperation with said output circuit for altering the frequency thereof, a plurality of radiating antennae each adjusted to a different operating frequency and switching means for coupling one of said antenna and said reactor to said circuit and for removing said reactor and said one antenna from coupling engagement with said circuit and for coupling said other antenna to said circuit.

5. Apparatus as claimed in the preceding claim wherein said circuit consists of an inductance coil shunted by a condenser and characterized further by the fact that said reactor consists of a condenser.

6. In a signaling system, an electron discharge device having an anode a cathode and a control electrode, a pair of antennae adapted to be operated at different frequencies, a circuit comprising inductance and capacity coupled to two electrodes of said electron discharge device, and means operating to couple one of said antennae to said circuit and for tuning said circuit to a desired operating frequency, said last mentioned means operating when desired, to couple said other antenna to said circuit and to alter simultaneously the tuning of said circuit to another desired operating frequency.

7. In apparatus of the character described an electron discharge device having an anode a cathode and a control electrode, a circuit comprising inductance and capacity coupled to the output electrodes of said device, a pair of antennae adapted to be operated at different frequencies, and means, operating in one position for simultaneously coupling one of said antennae to said circuit and for changing the tuning of said circuit to one desired operating frequency, said last mentioned means operating in another position to simultaneously couple said other antenna to said circuit and to alter the tuning of said circuit to another desired operating frequency.

8. In a high frequency transmitting system the combination of a vacuum tube, means for effectively nullifying the action of the capacity between electrodes of said tube, an output circuit tuned to a high frequency coupled to output electrodes of said tube, a plurality of additional output circuits each having high frequency charac-

teristics different from the other such that the resonant frequency of each is some multiple of the resonant frequency of the input circuit, means for impressing upon said input circuit a characteristic high frequency, a plurality of switch members associated with said additional output circuits, and means for simultaneously actuating each of said switch members whereby said circuits may be interchangeably connected to the tuned output circuit of said vacuum tube.

9. In a high frequency transmitting system employing a thermionic tube in a neutralized circuit arrangement, the combination of means for impressing on said tube a control high frequency, a plurality of oscillatory output circuits each having high frequency characteristics different from the other and such that the resonant frequency of each is some multiple of the resonant frequency of the input circuit of said tube, and means for interchangeably connecting said oscillatory output circuits with said thermionic tube.

10. In combination, in a high frequency circuit a thermionic vacuum tube having a cathode, anode and control electrode, means for neutralizing the anode to control electrode capacity of said vacuum tube, and an input inductance connected to the grid electrode of said tube, means for impressing on said inductance a fundamental high frequency, a plurality of high frequency resonant circuits adapted to be connected in the anode circuit of said tube, each of said resonant circuits being resonant to a different frequency, and each of said frequencies being some multiple of said fundamental frequency, and means for selectively connecting said resonant circuits one at a time in the anode circuit of said tube whereby different frequency multiplications may be made.

11. In a high frequency transmitting system employing thermionic tubes in a push-pull neutralized circuit arrangement the combination of a tuned input circuit connected to input electrodes of said tubes, a circuit having inductance and capacity connected to the output electrodes of said tubes, said output circuit being tuned to a frequency bearing a predetermined relation to the frequency of said input circuit, a reactor, and means for switching said reactor in shunt to a portion of said output circuit whereby said output circuit is tuned to a frequency bearing a different predetermined relationship to the frequency of said input circuit.

12. In a high frequency transmitting system employing thermionic tubes in a symmetrically arranged, neutralized circuit arrangement, means for impressing on the input electrodes of said tubes a characteristic control frequency, an oscillatory circuit tuned to a frequency bearing a predetermined relation with respect to said control frequency connected across the output electrodes of said tubes, a reactor, and means for switching said reactor into shunt relationship with a portion of said output circuit without destroying the symmetry of the neutralized circuit arrangement while changing the frequency of said output circuit to a different predetermined frequency.

13. In a high frequency transmitting system employing a thermionic tube in a neutralized circuit arrangement, the combination with a tuned high frequency input circuit, a plurality of output circuits each having high frequency characteristics differing from the other such that the resonant frequency of each is some multiple of the resonant frequency of the input circuit, means for impressing upon said input circuit a charac-

teristic high frequency, a plurality of switch members associated with said circuits and means for simultaneously actuating each of said switch members whereby said circuits may be interchangeably connected to said thermionic tube.

14. In a high frequency transmitting system employing a thermionic tube in a neutralized circuit arrangement, means for impressing on said tube a characteristic control frequency, a plurality of oscillatory circuits each having frequency characteristics differing from the other such that the resonant frequency of each is some multiple of the impressed frequency, and means for interchangeably associating said oscillatory circuits with said thermionic tube without destroying the neutralization of said neutralized circuit arrangement.

15. In a high frequency transmitting system employing a thermionic tube in an electrically neutralized circuit arrangement the combination of means for impressing on said tube a control frequency, a plurality of oscillatory circuits each having frequency characteristics differing from the other and such that the resonant frequency of each is some multiple of the resonant frequency of the input circuit and means for interchangeably associating said oscillatory circuits with said thermionic tube whereby the neutralization of said neutralized circuit arrangement is maintained.

16. In a high frequency transmitting system employing a thermionic tube in a neutralized circuit arrangement, the combination of means for impressing on said tube a high control frequency, a plurality of oscillatory circuits each having high frequency characteristics differing from the other and such that the resonant frequency of each is some multiple of the resonant frequency of the input circuit and means for interchangeably connecting said oscillatory circuits with said thermionic tube.

17. In a high frequency transmitting system employing thermionic tubes in a symmetrically arranged circuit arrangement, said symmetrically arranged circuit arrangement including neutralizing condensers cross-connecting the anodes and control grids of said tubes, means for impressing on said tubes a control frequency, an oscillatory circuit having a resonant frequency that is a multiple of said control frequency associated with said thermionic tubes, a load circuit associated with said oscillatory circuit, a fixed reactor such that when added to or removed from said oscillatory circuit, said circuit will have its frequency characteristics changed so that the frequency of said oscillatory circuit with and without the reactor are whole multiples of said control frequency.

18. In combination a thermionic vacuum tube having cathode, anode and control electrodes, means for nullifying the capacity between said anode and control electrodes, an inductance interconnecting the grid and cathode electrodes of said tube, means for impressing on said inductance a fundamental frequency, a plurality of resonant circuits adapted to be connected in the anode circuit of said tube, each said resonant circuit being resonant to a different frequency and each said frequency being some multiple of said fundamental frequency, and means for selectively connecting said resonant circuits one at a time in the anode circuit of said tube whereby different frequency multiplications may be made.