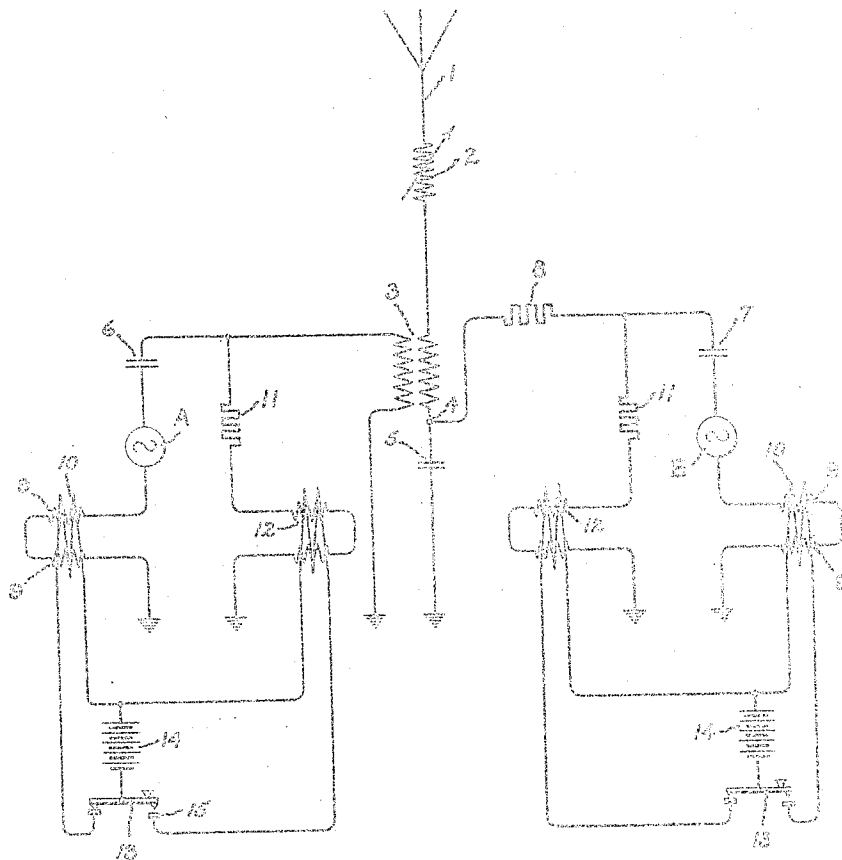


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HIGH FREQUENCY SIGNALING SYSTEM
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HIGH-FREQUENCY SIGNALING SYSTEM.

Application filed April 10, 1922. Serial No. 556,947.

My present invention relates to high frequency signaling systems and more particularly to radio transmitting systems of the multiplex type.

The object of my invention is to provide a transmitting system whereby two sources of high frequency power of different frequencies, such, for example, as high frequency alternators, may be operated upon a single antenna for simultaneously transmitting two distinct and separate signals.

In carrying my invention into effect I employ two sources of high frequency current differing sufficiently in frequency to permit of easily differentiating between the two signals transmitted. This difference in frequency does not need to be over one per cent. The antenna to which the energy from these two sources is supplied is tuned to a frequency intermediate the frequencies of the two sources and the current supplied from the two sources is preferably controlled by means of magnetic amplifiers of the general type described in my U. S. Patent, 1,206,643. No difficulty will be experienced in operating the alternator whose frequency is lower than that for which the antenna is tuned as this alternator will work on that side of the antenna tuning curve where the current is increasing. If then the speed of the alternator tends to increase the current supplied to the antenna and the load on the alternators will increase and this will tend to slow down the alternator and assist in keeping its speed within the desired range. For the alternator which works on that side of the antenna tuning curve when the current is decreasing, however, an increase in speed will cause a decrease in current and the alternator will tend to speed up still more. Because of this characteristic it will be difficult to maintain the speed of the alternator within the narrow range essential for efficient transmission and reception. To overcome this disadvantage I provide in conjunction with the second alternator a tuning which is so arranged and proportioned that the circuit to which the energy is supplied is tuned for a certain minimum current so that if the speed of the alternator either increases or decreases the current supplied by the alternator will increase. By operating the alternator at or near this point on its tuning curve it will be comparatively easy to keep its speed within the desired limits.

The novel features which I believe to be characteristic of my invention are set forth with particularity in the appended claims, the invention itself, however, both as to its organization and method of operation will best be understood by reference to the following description taken in connection with the accompanying drawing in which I have indicated diagrammatically one way by which my invention may be carried into effect.

As indicated in the drawing, I employ two high frequency alternators A and B for supplying energy to a radiating antenna 1 which is tuned by means of the tuning coil 2. Alternator A, the frequency of which is slightly less than the frequency at which the antenna is tuned, is connected to the antenna by means of the coupling transformer 3, while alternator B, the frequency of which is slightly greater than that at which the antenna 1 is tuned, is directly connected to the antenna at point 4 and is shunted by condenser 5. A condenser 6 in series with alternator A is provided of sufficient capacity to neutralize the internal reactance of the alternator A for the frequency of B, and a condenser 7 in series with alternator B is provided with sufficient capacity to neutralize the internal reactance of alternator B for the frequency of alternator A. A stabilizing resistance 8 is inserted in the circuit of alternator B for a purpose which will be more fully explained hereinafter.

In order to control the currents supplied from alternators A and B to the antenna magnetic amplifiers of the type described in my U. S. Patent 1,206,643 having high frequency windings 9 and controlling windings 10 are employed. In shunt to each of the alternators A and B I also provide a circuit made up of a resistance 11 and a second magnetic amplifier 12. The magnetic amplifiers are controlled by means of a key 13 and a source of energy 14 for supplying current to the controlling windings of the amplifiers. When the key for alternator A is in the position shown in the drawing, the controlling winding 10 will saturate the iron of the magnetic amplifier and permit the current from alternator A to be readily supplied to the antenna. When the key 13 is operated to make contact at 15, the controlling current being removed from winding 10, the windings 9 will act as a high impedance from the

alternator A and practically no current will be supplied to the antenna. The alternator A and its magnetic amplifier, however, will be replaced by the resistance 11 and the magnetic amplifier 12 so that the operation of the key of alternator A will not affect the antenna tuning or resistance in any way in so far as the alternator B is concerned. The same holds true for the operation of alternator B by means of its key and magnetic amplifier.

The operation of the system which I have described may best be understood by reference to a set of numerical constants for a radiating system which may be employed in carrying my invention into effect. Assume first the following: antenna resistance 5/10 ohms; antenna impedance, 100 ohms; feed ratio, 5; alternator resistance, 3 ohms; alternator voltage, 2300 volts.

If it is desired to operate two alternators at wave lengths differing about 1% each alternator should be about 1/2% out of tune with the antenna. This means that the antenna besides having a resistance of 1/2 ohms has a reactance impedance of 1 ohm, which appears as a capacity with reference to the lower frequency and as an inductance with reference to the higher frequency. In the feed circuit therefore with the feed ratio of 5 selected the antenna will appear to have for the higher frequency current a resistance of 12 1/2 ohms in series with a reactance of 25 ohms.

Let us now consider the operation of the alternator B which is assumed to have the higher frequency and consider the operation of this alternator from a standpoint of stability. The feed circuit of this alternator has a series inductive reactance of 25 ohms and a series resistance of 12 1/2 ohms. This is equivalent to a circuit consisting of approximately 30 ohms inductive reactance in multiple with 60 ohms resistance. The condenser 5 then should have an impedance of about 15 ohms. In order to determine this last value the rule is followed that the energy in the alternator circuit should be at least as great when no energy is being supplied to the antenna as when the antenna is receiving the normal amount of energy.

Under these conditions if the alternator should begin to speed up the antenna load would decrease because the antenna would become more out of tune with the alternator. If, however, the entire load on the antenna is removed from the alternator and at the same time an equal load is placed on the alternator circuit it will be safe to assume that the usual type of speed regulator will be able to take care of any variations between these two points.

The shunt condenser 5 should be given the value mentioned so that the power fac-

tor of the antenna circuit will be equal to the power factor of the circuit which results when the antenna circuit is combined with the shunt condenser. Thus, with an impedance of 15 ohms for the shunt condenser which is one-half the inductive impedance of the antenna circuit the inductive current of the antenna circuit is subtracted from the capacity current of the shunt circuit so that the resulting capacity current resistance is also about 30 ohms. The combined antenna and shunt circuit will therefore be equivalent to a resistance of 12 1/2 ohms in series with a capacity reactance of 25 ohms.

If the resistance 8 is given a value of about 2 1/2 ohms the total resistance in the circuit of alternator B will be about 5 1/2 ohms and the feed circuit of the alternator including internal and external resistance will be equivalent to a resistance of 18 ohms in series with the capacity reactance of 25 ohms. The combined effect of these is an impedance of 30.5 ohms to which the electromotive force of 2300 volts of the alternator is applied. The current in the alternator circuit then will be 75 amperes which with a feed ratio of 5 will give a total antenna current of 375 amperes and the total energy supplied by the alternator will be about 102 kw.

Assume now that the alternator is speeded up so that the only load on it is the shunt condenser of 15 ohms, which is in series with the internal and external resistance of the alternator which is 5 1/2 ohms. The impedance of the circuit then will be about 16.6 ohms, and it will be found that the alternator current will be about 138 amperes. The energy in the alternator circuit will then be about 107 kw., which is slightly higher than the 102 kw. load which the full amount of energy was being supplied to the antenna. Under these conditions it may be concluded that the circuit described will be sufficiently stable to operate with a standard speed regulator. The circuit of the alternator B will have practically no detuning effect upon that of alternator A as may be seen from the following: The circuit of alternator B consists of a shunt capacity reactance of 15 ohms in multiple with a resistance of 5 1/2 ohms. This shunt circuit can be resolved in a series circuit of 4 1/2 ohms resistance in series with 2 ohms capacity reactance. The whole circuit of alternator B therefore will act practically as a zero impedance through which the current of alternator A may flow without any detuning effect on the antenna. The only reactive impedance in this case is 2 ohms capacity reactance whereas it requires 25 ohms resistance to detune the antenna one-half of 1%.

The operation of alternator A will have

no appreciable detuning effect upon the antenna so far as alternator B is concerned. The conditions of operation in this case will be the same as described above for alternator B except that the antenna is capacity and the shunt is inductive reactance. In this case, however, it will not be necessary to use a shunt which draws an idle current because the speed conditions are fundamentally stable. An inductive shunt of 20 to 25 ohms may therefore be suitable and this inductive shunt may be furnished by the magnetizing current of the transformer 3, which is employed in order that it may be possible to operate both alternators at ground potential.

What I claim as new and desire to secure by Letters Patent of the United States, is:—

1. A signal transmitting system comprising a resonant transmitting circuit and two high frequency alternators connected thereto one having a frequency slightly lower than the resonant frequency of the transmitting circuit and the other having a frequency slightly higher than the resonant frequency of the transmitting circuit, and means connected to the transmitting circuit for insuring stable operation of the second alternator.

2. A signal transmitting system comprising a resonant transmitting circuit and two high frequency alternators connected thereto one having a frequency slightly lower than the resonant frequency of the transmitting circuit and the other having a frequency slightly higher than the resonant frequency of the transmitting circuit, the first of said alternators being connected to the transmitting circuit by means of a transformer, and the second of said alternators being connected in shunt to a condenser in the transmitting circuit.

3. A signal transmitting system comprising a resonant transmitting circuit and two high frequency alternators connected thereto one having a frequency slightly lower than the resonant frequency of the transmitting circuit and the other having a frequency slightly higher than the resonant frequency of the transmitting circuit, the first of said alternators being connected to the transmitting circuit by means of a transformer, and the second of said alter-

nators being connected in shunt to a condenser in the transmitting circuit, the impedance of said condenser being equal to approximately half the inductive impedance of the antenna circuit at the frequency of the second alternator.

4. A signal transmitting system comprising a resonant transmitting circuit and two high frequency alternators connected thereto one having a frequency slightly lower than the resonant frequency of the transmitting circuit and the other having a frequency slightly higher than the resonant frequency of the transmitting circuit, a capacity in series with the first alternator for neutralizing its internal reactance at the frequency of the second alternator and a capacity in series with the second alternator for neutralizing its internal reactance at the frequency of the first alternator.

5. A signal transmitting system comprising a resonant transmitting circuit and two high frequency alternators connected thereto one having a frequency slightly lower than the resonant frequency of the transmitting circuit and the other having a frequency slightly higher than the resonant frequency of the transmitting circuit, magnetic amplifiers in series with both of said alternators for controlling the signaling current supplied therefrom, and means for substituting in the transmitting circuit impedances equivalent to the alternator impedances when the alternators are not supplying current to the transmitting circuit.

6. A signal transmitting system comprising a resonant transmitting circuit and two high frequency alternators connected thereto one having a frequency slightly lower than the resonant frequency of the transmitting circuit and the other having a frequency slightly higher than the resonant frequency of the transmitting circuit, magnetic amplifiers in series with both of said alternators for controlling the signaling current supplied therefrom, impedance circuits shunting said alternators and magnetic amplifiers for controlling the impedances of the shunt circuits.

In witness whereof, I have hereunto set my hand this 8th day of April, 1922.

ERNST F. W. ALEXANDERSON.