Dec. 31, 1929. A. H. TAYLOR ET AL 1,741,485

HIGH FREQUENCY OSCILLATION SYSTEM

Filed July 22, 1926

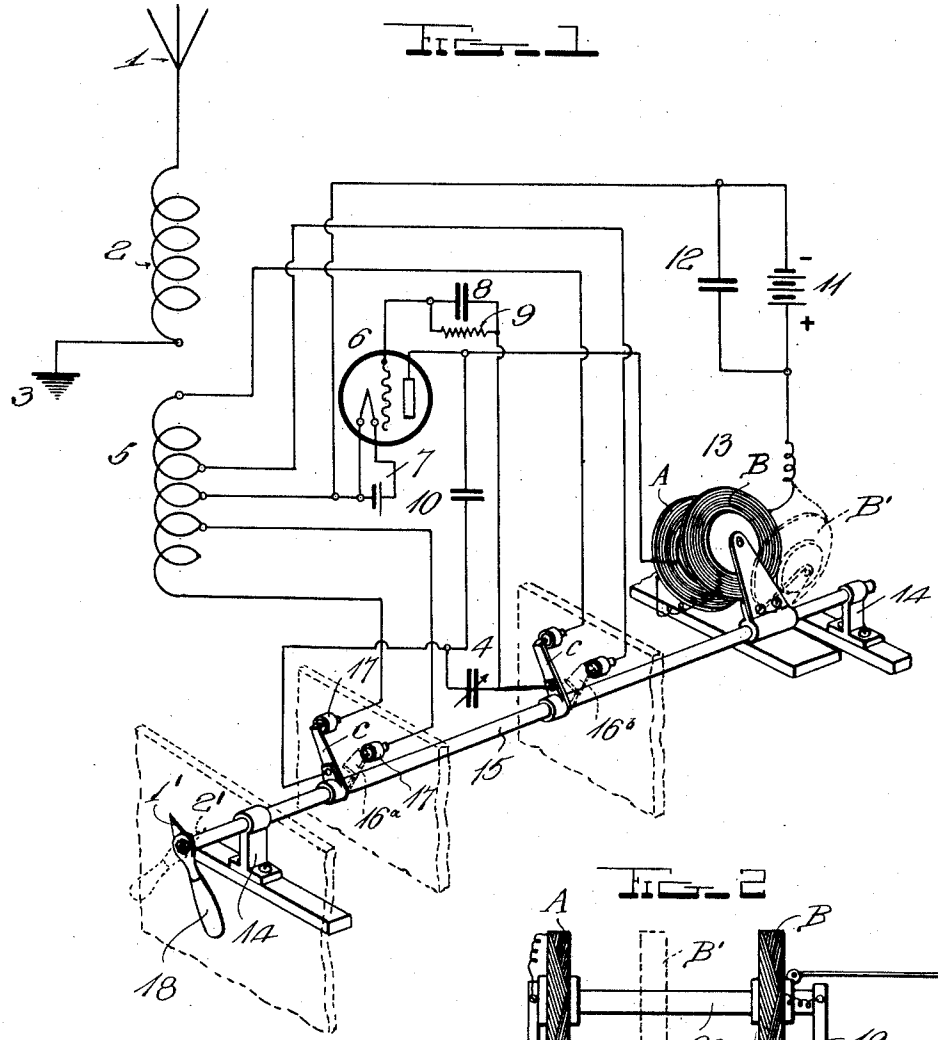



FIG. 2




FIG. 5

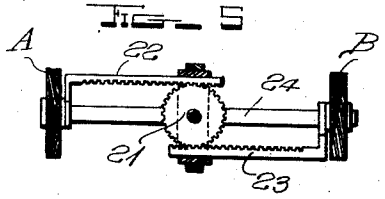



FIG. 3

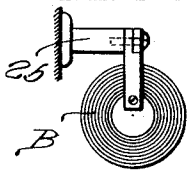



FIG. 4

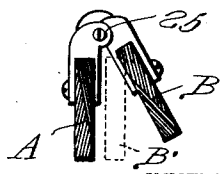
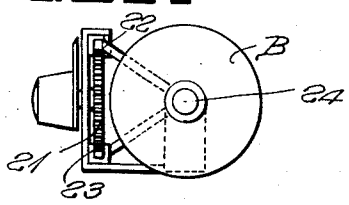



FIG. 6




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# UNITED STATES PATENT OFFICE

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## HIGH-FREQUENCY OSCILLATION SYSTEM

Application filed July 22, 1926. Serial No. 124,149.

Our invention relates generally to choke coils for radio frequency currents and more particularly to means for changing the impedance of such choke coils whereby they may cover a greater band of frequencies.

One of the objects of our invention is to provide two or more radio frequency choke coils with means for changing their inductive and capacitive relationships in order that the total impedance of the combination is most effective for a selected band of frequencies.

Another object of the invention is to provide mechanical systems by which the inductance and capacity characteristics of a choke coil system may be readily varied.

Still another object of our invention is to provide a circuit arrangement for electron tube oscillators whereby a change in impedance of a choke coil system connected in the circuit of the oscillator may be effected simultaneously with and in proportion to the change in the frequency characteristics of the electron tube oscillator system.

Our invention will be more fully understood from the following specification by reference to the accompanying drawings, wherein:

Figure 1 shows an electron tube oscillator system having circuits arranged in accordance with the principles of our invention; Fig. 2 illustrates a set of radio frequency choke coils arranged according to our invention; Figs. 3 and 4 show modified forms of mountings for the radio frequency choke coil system; and Figs. 5 and 6 show still further modifications of the choke coil system of our invention.

A single radio frequency choke coil has a definite value of impedance over a certain band of frequencies. A maximum impedance is obtained from the choke coil when the frequency is equal to the resonant frequency of the choke coil, but the value of impedance falls off rapidly with an increase or a decrease of frequency from this resonant frequency. Conditions of very low impedance are obtained at double, quadruple, and other even multiple frequencies of the fundamental resonant frequency of the choke coil. At these frequencies a condition of series resonance is obtained which accounts for the low impedance values obtained.

By reasons of these characteristics a single choke coil is necessarily limited to operate over a limited band of frequencies. If two choke coils are connected in series and have only a slight amount of magnetic and electrostatic coupling between them, the resultant effect will be equal to a choke coil having double the inductance but with a smaller value of distributed capacity. Such a choke coil system will be more effective from an impedance standpoint than one coil and will operate over a wider band of frequencies. We have found that in those instances where it is desirable to cover a greater band of frequencies than that which can be covered by a double choke coil arrangement, that a mechanical arrangement may be successfully employed to vary the magnetic coupling between the coils. The increase or decrease in magnetic coupling also produces an increase or decrease in electrostatic coupling, therefore, when the coupling is increased both the inductance and distributed capacity of the choke coil system is increased.

The method of operating our new choke coil system resides in the employment of loose coupling when the choke is to be used for a definite frequency band, and tight coupling when a lower frequency band is required.

By varying the coupling it is also possible to change the resonant frequency of the choke coil and consequently the low impedance danger frequency conditions. As an example: If the choke coil system is coupled magnetically such that the fundamental resonant frequency is 100,000 cycles and it is required that the choke coil be operated at 200,000 cycles, then danger will be experienced of the choke burning up or being damaged to a certain extent. To prevent this, we increase or decrease the coupling to attain a different high impedance condition and the danger frequency condition will be changed.

Fig. 1 shows the application of our variable choke coil system to a radio transmitter that may be required to operate over a large band

of frequencies, the shifting of frequencies being accomplished by the use of a frequency change switching device that permits the use of a greater or smaller value of inductance in the grid and plate circuits of the vacuum tube oscillator. There is also attached to the frequency switching device, a variable plate choke coil the impedance of which is changed automatically with changes of grid and plate inductance by varying the position of the two coils with respect to each other, as represented in the drawing.

Referring to the drawings in more detail, Fig. 1 shows a self-oscillating vacuum tube transmitter system inductively coupled to an antenna 1 by coil 2. A ground connection 3 completes the radiating system. An inductance coil system 5 with variable condenser 4 constitutes the closed oscillatory circuit. A mid-tap on coil 5 is connected to the filament of electron tube 6 while two grid and two plate taps are taken from this coil to the switching devices $16^a$ and $16^b$. The sliding contactors C of the switching device $16^a$ and $16^b$ are connected to the plate and grid of the vacuum tube 6. The plate connection is made through a by-pass condenser 10 and the grid connection is made through a grid leak 9 and grid condenser 8.

Connected also to the plate is the variable choke coil system 13 and a source of plate voltage 11. This plate voltage is shunted with a radio frequency by-pass condenser 12. The variable choke coil 13 consists of two coils "A" and "B" mounted in such a manner that coil "A" is permanent while coil "B" is movable due to its association with the movable shaft of the switching mechanism.

The switching mechanism consists substantially of an insulated rod 15 journaled at the ends in bearings 14. Attached to the rod are also two contactors C, coil B of the variable choke 13 and a handle 18. An indicator is associated with handle 18 to show the position, either 1′ or 2′, to which the switching mechanism has been set. When in position #1′ the transmitter is so adjusted that it will oscillate at its lowest frequency range. This can be noted from the solid line connections shown in Fig. 1 where the greatest number of coil turns are included in both the grid and plate circuits and the two coils of the variable choke coil 13 are at minimum distance from each other. In this condition the choke coil affords maximum impedance for low frequencies.

When the switching mechanism is set at position 2′ minimum impedance is offered for the low frequency range, but maximum impedance is obtained for the high frequency range. In this position, shown in dotted lines, the higher frequency range is obtained due to the use of a smaller number of grid and plate turns and in addition the choke coil 13 is adjusted for maximum distance between coils A and B, which setting produces maximum impedance for the higher frequencies. The position 2′ permits minimum total inductance, which is desired for the higher frequency range, while position 1′ produces maximum total inductance for best impedance values over the lower frequency range.

In Fig. 2 of the drawings we have shown a modified mounting for the choke coil system wherein an insulated rod 20 is supported from bracket 19 and along which the choke coils A and B may be moved to change spacial relationships. One possible position of choke coil B has been represented at B′.

In Figs. 3 and 4 we have shown a method of mounting the choke coils A and B from a support 25 on which coils B may be moved through differing angular planes with respect to coil A for varying the impedance of the choke coil system.

In Figs. 5 and 6 we have illustrated further modified forms in which the choke coils A and B may be mounted. The choke coils A and B have rack members 22 and 23 respectively, that are operated by means of pinion 21 for controlling the spacial relation of choke coils A and B along rod member 24. Fig. 6 shows more clearly the control knob and pinion 21 by which the spacial relation of choke coils A and B may be controlled.

We have found that best results are obtained in the choke coil system when the inner terminal of one of the choke coils is connected to the outer terminal of an adjacent choke coil and when the inner terminal of the choke coil system is connected to the high potential point in the oscillator system such as the plate or grid of an electron tube oscillator, while the outer terminal of the choke coil system connects to the low radio frequency potential point in the system, as illustrated in the diagram. It is understood in all cases that windings of both coils are such as to produce magnetic fields which aid each other.

It will be observed that the impedence in the electron tube oscillator circuit over a limited band of frequencies may be changed simultaneously with the change in wave length of the electron tube oscillator circuit. That is to say, the effective inductance in the input and output circuits of the oscillator may be varied for the change of frequency of the oscillator, and simultaneously with this variation a change in choke coil impedance may be produced.

While we have described our invention in certain preferred embodiments, we desire that it be understood that modifications may be made and no limitations upon the invention are intended other than are imposed by the scope of the appended claims.

What we claim as new and desire to secure by Letters Patent of the United States is as follows:

1. A high frequency oscillation system comprising an electron tube having grid, filament and plate electrodes, input and output circuits interconnecting said electrodes, an inductance device being included partially in said input circuit and partially in said output circuit and an impedance element comprising a pair of spacially related choke coils connected with said output circuit, and means for simultaneously varying the effective amounts of inductance included in said circuits and the spacial relation of said choke coils for fixing the value of said impedance.

2. A high frequency oscillation system comprising an electron tube having grid, filament and plate electrodes, input and output circuits interconnecting said electrodes, frequency determining elements in said circuits and a variable impedance element comprising a pair of spacially related choke coils in said output circuit, and means common to said choke coils and to said frequency determining elements for simultaneously changing the effective value of said frequency determining elements and shifting the spacial relation of said choke coils for fixing the value of said impedance.

3. A high frequency oscillation system comprising an electron tube having grid, filament and plate electrodes, input and output circuits interconnecting said electrodes, an inductance connected partially in said input circuit and partially in said output circuit and a pair of choke coils connected in series and included in said output circuit, and common means interconnecting one of said choke coils and said inductance for simultaneously varying the value of said inductance in said input and output circuits and the spacial relation of said choke coils for varying the impedance of said output circuit.

4. A high frequency oscillation system comprising an electron tube having grid, filament, and plate electrodes, input and output circuits interconnecting said electrodes, an inductance system connected in said input and output circuits and an impedance device comprising a pair of spacially related choke coils having mutual inductive effects one upon the other connected in said output circuit, and a common control means for simultaneously changing the quantitative value of said inductance in said circuits and controlling the inductive relation of said choke coils.

5. A high frequency oscillation system comprising an electron tube having grid, filament, and plate electrodes, input and output circuits interconnecting said electrodes, means for tuning said circuits for the generation of high frequency oscillations, an impedance device comprising a pair of inductively related choke coils connected in said output circuit, and means for simultaneously controlling the effective value of said means and shifting the inductive relation of said choke coils for changing the effect of said impedance device upon said circuits for the generation of oscillations at selected frequencies.

6. A high frequency oscillation system comprising an electron tube having grid, filament, and plate electrodes, input and output circuits interconnecting said electrodes, variable inductances included in said input and output circuits, an impedance device included in said output circuit, said impedance device comprising a pair of choke coils positioned in variable spacial relation with the inner terminal of one of said coils connected to the outer terminal of the other of said coils, with the outer terminal of said first mentioned choke coil connected with a low potential point in said electron tube oscillation system and with the inner terminal of the second mentioned choke coil connected to a high potential point in said electron tube oscillation system, the spacial relation of said coils being variable simultaneously with the change in inductance of said variable inductances.

7. In a high frequency oscillation system an electron tube having grid, filament, and plate electrodes, input and output circuits interconnecting said electrodes, an inductance system, switching apparatus for variably including said inductance system partially in said input circuit and partially in said output circuit, a pair of spacially related choke coils connected in series in said output circuit, one of said choke coils being fixedly mounted and the other of said choke coils being movable with respect to said aforementioned choke coil in accordance with the movement of said switching apparatus, and common means interconnecting said switching apparatus and the movable choke coil whereby the impedance of said output circuit may be changed by shifting the spacial relation of said choke coils simultaneously with changes in the effective value of inductances in said input and output circuits.

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