March 1, 1938. P. S. CARTER 2,109,465

HIGH FREQUENCY SYSTEM

Filed July 13, 1935

Fig. 1

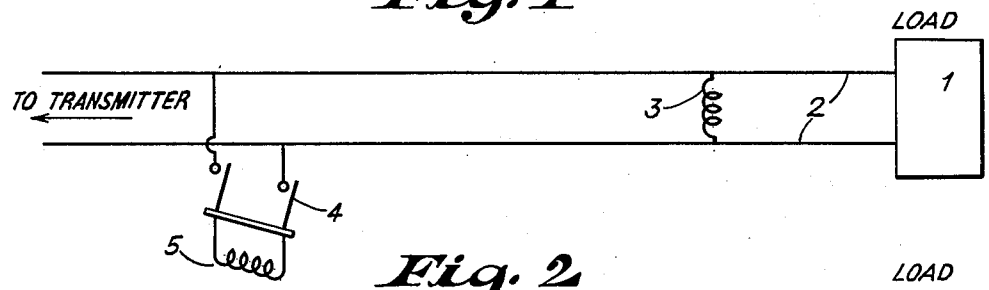


Fig. 2

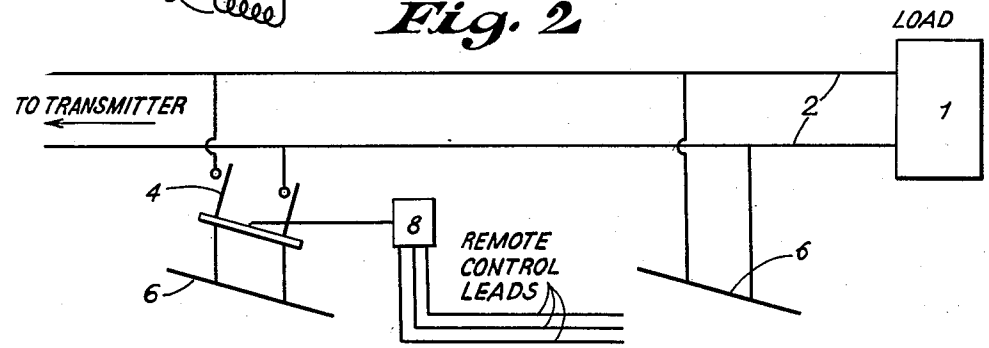


Fig. 3

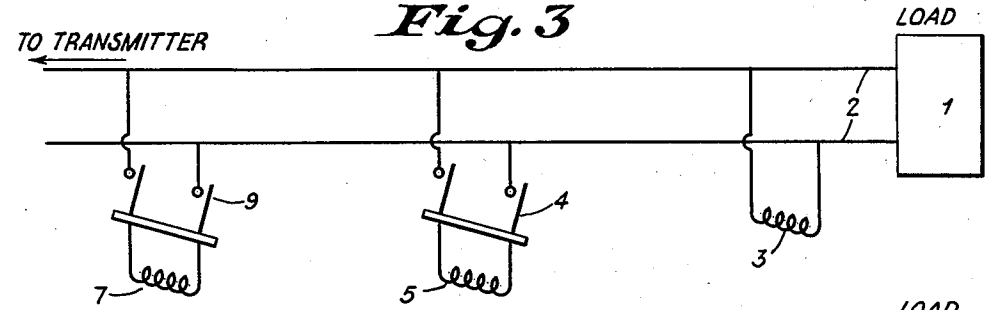
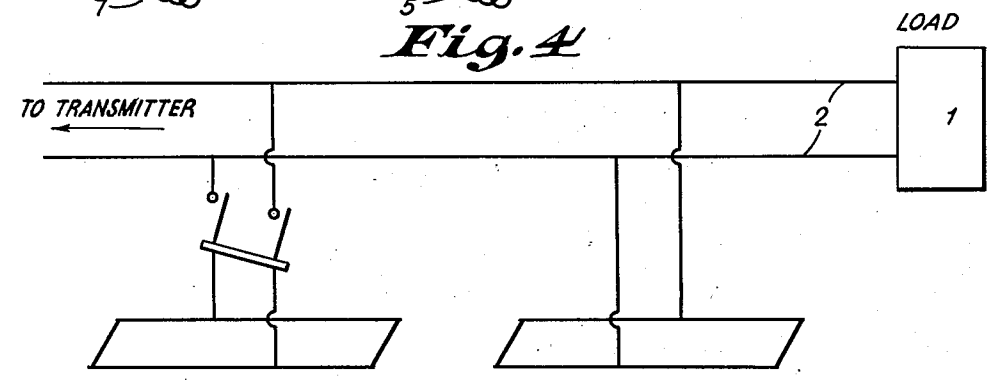


Fig. 4



INVENTOR
P. S. CARTER
BY H. S. Grover
ATTORNEY

Patented Mar. 1, 1938

2,109,465

UNITED STATES PATENT OFFICE

2,109,465

HIGH FREQUENCY SYSTEM

Philip S. Carter, Port Jefferson, N. Y., assignor to Radio Corporation of America, a corporation of Delaware

Application July 13, 1935, Serial No. 31,155

8 Claims. (Cl. 178—44)

This invention relates to a method of and apparatus for matching the impedance of a high frequency transmission line circuit and load designed for use with different frequencies, and is especially applicable to an antenna system which is adapted to radiate any one of a plurality of different frequencies supplied to it over a transmission line.

The primary object of the invention is to enable the matching of impedances in a high frequency load circuit whereby a plurality of frequencies may be used alternatively on the circuit with high efficiency.

A further object is to provide a single antenna system which can be used for radiating a plurality of different frequencies without disturbing the adjustments of the system for the frequencies not in use.

Heretofore, it has been customary in high frequency load circuits, such as antenna systems, to readjust the impedance matching circuits each time it was desired to use the load circuit with a different frequency, a mode of operation which involves considerable delay and labor. These disadvantages are overcome, according to the present invention which enables an immediate change in adjustment for a predetermined change in frequency, through the intermediary of switching mechanism.

In general, the invention consists in first matching the impedance of the line and high frequency load for the lowest frequency, and then, with the elements employed in the matching of the lowest frequency permanently connected to the line, matching the impedance of the entire system for the next higher frequency, etc. A switch is employed to disconnect the elements used for matching the impedance of the line and load for the higher frequency when only the lower frequency is employed. In this manner it is only necessary to open the switch when the system is operated at the lower frequency and close it for operation at the higher frequency, assuming that only two frequencies are employed. Any number of frequencies can, of course, be employed using the same principles.

Figs. 1–4, inclusive, illustrate different embodiments of the invention.

Referring to Fig. 1, there is shown conventionally in box form, a high frequency load circuit 1, such as an antenna, connected to a transmission line 2 supplying high frequency currents from a transmitter, not shown. In order to match the line 2 and load 1, for use with either of two frequencies, the system is first excited at the lower frequency and by means of a reactance 3, here shown as a coil by way of example only, placed at a predetermined point across the line 2, and having a desired value, the impedance is matched in accordance with the principles outlined in my Patent No. 1,909,610, granted May 16, 1933. Coil 3 is then left permanently in the position shown and the antenna is excited at the higher of the two frequencies, and the complete circuit including antenna 1, line 2 located between coil 3 and the antenna, and the coil 3 again matched to the line by means of coil 5. The position of this coil is determined in accordance with the theory outlined in my United States Patents Nos. 1,909,610, supra, and 2,019,809, granted November 5, 1935. Switch 4 is provided for disconnecting coil 5 from the line and system when it is desired to use the lower frequency.

It will be appreciated, of course, that when the line is first matched for the lower frequency by means of the circuit 3 the switch 4 of the second circuit 5 is disconnected, since in practice the location of the second circuit at this time has not been determined. The lower frequency circuit is, however, left in adjustment while the transmission line 2 is matched to the higher frequency by means of the second circuit 5. After these adjustments have been made, the frequency change is effected by opening the switch when using the lower frequency and connecting it when using the higher frequency. Although the lower frequency matching circuit 3 is shown placed nearest the load 1, it is to be understood that the invention is not limited to such an arrangement since in practice it may be desirable to place the lower frequency matching circuit 3 further away from the load 1 than matching circuit 5. It is preferred however that the order of location of the circuits 3 and 5 be as shown in the drawing.

Fig. 2 discloses a modification employing line sections 6 in place of the concentrated reactances 3 and 5, and a remote control relay or motor 8 for operating switch 4.

Fig. 3 illustrates the system of the invention when used with three different frequencies, in which case a separate switch is employed for each matching circuit in addition to the first. A third reactance 7 and a switch 9 for this reactance are shown here provided. In matching the system for the third or highest frequency, the elements used for matching the system for the lowest frequency and the next higher frequency are left connected to the system. In this figure both the second and third circuits are disconnected by

means of the switches when only the lowest frequency is used, and the third circuit is disconnected when only the second frequency is used.

In Fig. 4 is shown a system similar to that of Fig. 1, except that double line sections are employed in the place of the concentrated reactances. Such arrangements of double line sections and their manner of calculation and use, are disclosed in my United States Patent No. 2,019,809, supra, to which reference is made for a more detailed description thereof.

It will be appreciated, of course, that condensers may be used instead of the reactance coils shown. It is also to be understood that the word "reactance" recited in the specification and claims is intended to cover both concentrated reactances and line sections having uniformly distributed constants and combinations of these.

What is claimed is:

1. In combination, a high frequency load adapted for operation on a plurality of different frequencies, a transmission line connecting said load to high frequency apparatus, a reactance permanently bridged across said line and so spaced from the load as to match the impedance of said line and load for one frequency to be used thereby, another reactance bridged across said line and so spaced from said first reactance as to match the combined impedance of said load and first reactance for a higher frequency to be used, and a switch for disconnecting said second reactance from said line whenever the lower frequency is used.

2. A system in accordance with claim 1 characterized in this, that said switch and second reactance for the higher frequency are farther removed from the load than said first reactance.

3. In a high frequency system adapted for use on at least two different frequencies, said system having a load and a transmission line connected to said load, the method of operation which includes the steps of first matching the impedance of the load to the line at the lower of the two frequencies by inserting a reactance across said line at a predetermined location, subsequently matching the combined impedance of the load and reactance at the higher of the two frequencies while said system is also matched for the lower frequency by inserting another reactance across said line at another predetermined location, and disconnecting the last reactance when using only the lower frequency.

4. A system in accordance with claim 1, including remote control means for operating said switch.

5. In combination, a high frequency load adapted for operation on a plurality of different frequencies, a transmission line connecting said load to high frequency apparatus, a reactance permanently bridged across said line and so spaced from the load as to match the impedance of said line and load for one frequency to be used thereby, another reactance bridged across said line and so spaced from said first reactance as to match the combined impedance of said load and first reactance for a higher frequency to be used, a switch for disconnecting said second reactance from said line whenever the lower frequency is used, and remote control means for operating said switch, said reactances being in the form of line sections having uniformly distributed capacity and inductance.

6. A system in accordance with claim 1, characterized in this, that said reactances are in the form of lumped inductances.

7. In combination, a high frequency load adapted for operation on a plurality of different frequencies, a transmission line connecting said load to high frequency apparatus, a reactance permanently bridged across said line and so spaced from said load as to match the impedance of said line and load for one frequency to be used thereby, another reactance bridged across said line and so spaced from said first reactance as to match the combined impedance of said load and first reactance for a higher frequency to be used, a switch for disconnecting said second reactance from said line whenever the lower frequency is used, and still a third reactance bridged across said line and so spaced from the other reactances as to match the combined impedance of said load and first and second reactances for a still higher frequency to be used, and a switch for disconnecting said third reactance from said line whenever any one of the lower two frequencies is used.

8. In combination, a high frequency antenna adapted for operation on a plurality of different frequencies, a transmission line connecting said antenna to a source of signals, means bridged across said line and so spaced from said antenna as to match the impedance of said line and antenna for one frequency to be used thereby, additional means bridged across said line and so spaced from said first means as to match the combined impedance of said antenna and first means for a higher frequency to be used, and means for effectively disconnecting said additional means from said line whenever the lower frequency is used.

PHILIP S. CARTER.