

June 10, 1924.

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1,497,299

SYSTEM OF WAVE TRANSMISSION

Filed June 29, 1917

Fig. 1.

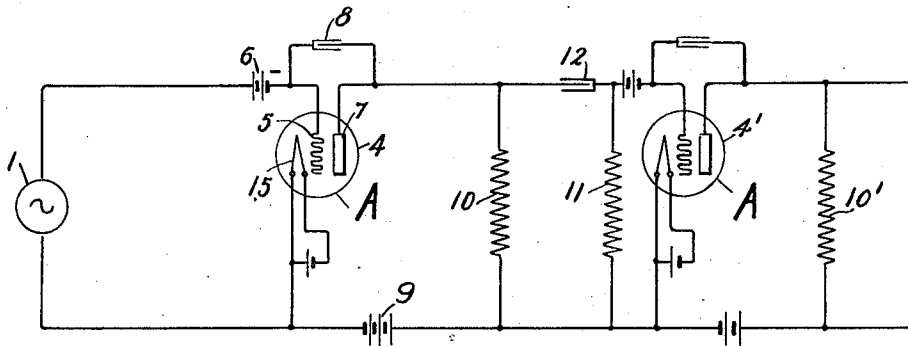
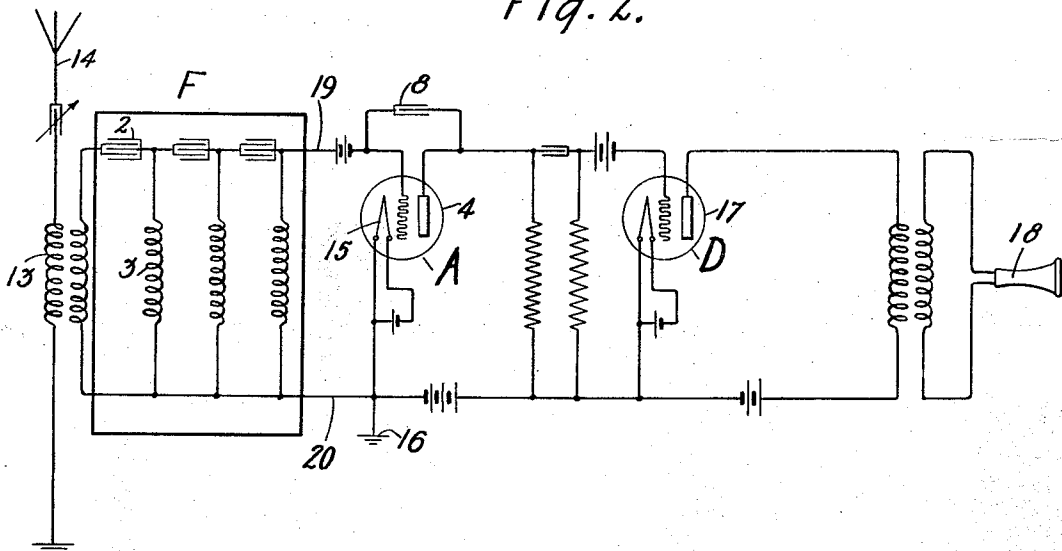


Fig. 2.



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JOHN MILLS, OF WYOMING, NEW JERSEY, ASSIGNOR TO WESTERN ELECTRIC COMPANY, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

SYSTEM OF WAVE TRANSMISSION.

Application filed June 29, 1917. Serial No. 177,655.

To all whom it may concern:

Be it known that I, JOHN MILLS, a citizen of the United States, residing at Wyoming, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Systems of Wave Transmission, of which the following is a full, clear, concise, and exact description.

This invention relates to a system of wave transmission, and has for an object to provide a system for selectively transmitting current of a given frequency or frequencies to the exclusion of current of different frequency or frequencies. More specifically stated, an object of the invention is to provide a system for amplifying electrical currents and especially for effectively amplifying currents within a certain range of frequencies, while negligibly amplifying currents of other frequencies.

These objects are accomplished by making use of a vacuum tube amplifier, for instance, of the audion type. It has been determined that for such amplifiers all currents of relatively low frequencies, for instance, 100,000 cycles or less, are amplified to substantially the same extent. But for currents of high frequencies, say of the order of 1,000,000 cycles or more, the amplification decreases rapidly as the frequency increases. This is due to the capacity effect between the grid and plate electrodes of the audion. Because of this capacity effect at the high frequencies, the audion input circuit is virtually connected through a small condenser to its output circuit, so that the high frequencies are transferred from the audion input circuit directly to its output circuit without being effectively amplified. According to the present invention, this characteristic of the audion to amplify low frequencies more than high frequencies is accentuated and made more prominent by connecting a condenser between the grid and plate electrodes. This serves to increase the capacity effect between these electrodes, which increases the selectivity of the amplification. The discrimination as to frequency is also flexible

and subject to change, as one condenser may be easily substituted for another, the size of the condenser in all cases being chosen with due regard to the range of frequencies against which it is desired to discriminate. In order to increase the selective amplification, a plurality of such audions may be connected in tandem.

For further details of the invention reference may be made to drawings, in which Fig. 1 shows a wave filter system employing two shunted audions connected in tandem; and Fig. 2 shows a wireless receiving system employing this form of wave filter.

Referring to Fig. 1, a source 1 represents diagrammatically any source for supplying current having various frequencies, only some of which are to be effectively amplified.

The source 1 supplies current to an amplifier 4, which may be of the audion type, as shown. The grid 5 of this audion may be maintained at a suitable negative potential by means of the battery 6. In shunt to the grid 5 and plate 7 of the audion 4 is a condenser 8 which serves to by-pass around the audion 4 those frequencies which are not to be amplified as described above. Space current for the audion amplifier 4 is supplied by battery 9 through the impedance 10. If a further discrimination is desired between those currents which are, and those which are not to be amplified, a second audion 4' similar to audion 4 may be used. In this case a high resistance 11 is connected in shunt to the audion 4', and a large condenser 12 serves to confine the current from each of the batteries to their respective audions. It will be apparent from the description given above that the audion 4' supplies current of various frequencies, only some of which, however, have been effectively amplified, while currents of the remaining frequencies have been amplified only negligibly.

It will now be shown what advantages a filter or selective system embodying the present invention has over a filter, for in-

stance, of the well-known Campbell type (see filter F, Fig. 2). Assume that both of these filters are energized by damped sinusoidal E. M. F.'s, and consider what the transmission through these filters will be. In the case of the Campbell filter the output circuit of this filter will contain—

- (1) a copy of the impressed E. M. F. if the filter transmits that frequency;
- (2) natural oscillations comprising a series of damped sinusoids depending for frequency and damping upon the filter constants only.

The output circuit of a filter embodying the present invention will contain a copy of the impressed E. M. F., multiplied by an amplification constant which is a function of the frequency, and is unity for all frequencies above that for which the filter is designed, and is greater than unity for frequencies below that value. The advantage of the improved type of filter is that it affords a discrimination as to frequency, even though the impressed E. M. F. may be a damped wave train, whereas a filter of the Campbell type, when energized by a damped wave train, instead of suppressing the effect of the undesired frequencies, gives rise to the same in the form of natural oscillations.

The selective amplifying system shown in Fig. 1 may be applied to a wireless receiving system as shown in Fig. 2, in which a filter F of the Campbell type is coupled, by means of the transformer 13, to an antenna 14. The filter F has sections 2 of condensive reactance connected in series in the line 19, and sections 3 of inductive reactance connected in shunt to the line 19 and the return path 20. This form of filter suppresses all steady state currents of frequencies below a certain value, and freely transmits all frequencies above that value. The value of the cutoff frequency depends on the values of the capacity 2 and inductance 3, and may be readily determined from well known formulæ. In this case the cutoff frequency is arranged to be slightly below the signaling frequency.

In Fig. 2 only a single shunted audion 4 is shown, but it is obvious that other audions connected in tandem to audion 4 may be used, as shown in Fig. 1. The filament 15 of audion 4 is grounded, as shown at 16. The currents selectively amplified by the audion 4 are transferred to the detector 17, which may be of the audion type, as shown, and which has a telephone receiver 18 coupled to its output circuit. The electrical constants of the system shown in Fig. 2 are so designed with respect to the signaling frequency that only currents of the signal frequencies are effectively amplified by the audion 4. When a static impulse strikes the antenna 14, natural oscillations having

various frequencies will be set up in the network or filter F. All those frequencies which are higher than the signaling frequency, however, are by-passed around the audion or repeater 4 by means of the condenser 8, so that these higher frequencies are not appreciably amplified, and they produce only a negligible effect in the telephone receiver 18. Currents of the signaling frequency, however, find a path of very high impedance through the condenser 8, and these currents are constrained to energize and be amplified by the audion 4.

While the invention is shown in Fig. 2 as being applied to a wireless receiving system, it is obvious that this scheme of selective transmission or amplification may be used in any system wherein it is desired to selectively transmit or amplify more efficiently the currents of certain frequencies than currents of other frequencies.

What is claimed is:

1. Means for supplying currents of relatively high and relatively low frequencies, an amplifier associated therewith for amplifying the current of only the lower of said frequencies, said amplifier having anode and control electrodes and having a by-path around the path in space between said electrodes for passing with low impedance said current of relatively high frequency and for offering high impedance to said current of relatively low frequency which is to be effectively amplified.
2. A plurality of audions connected in tandem, each of said audions having grid and plate electrodes, input and output circuits for said audions, and a condenser for each of said audions, each condenser having one terminal directly connected to the grid and the other terminal directly connected to the plate electrode, each of said condensers forming a by-path from the input circuit to the output circuit of the respective audions.
3. An electric discharge device for translating an alternating current, said device having input and output circuits, said input circuit having cathode and control electrodes therein, and said output circuit having an anode therein, and a by-path around the space between said control electrode and said anode, the total reactance of said by-path being capacitative for frequencies higher than the frequency of the current to be translated.
4. An amplifier comprising an anode, a cathode and a control electrode, an input circuit and an output circuit for said amplifier, said cathode being common to said two circuits, and a condenser for preventing the amplification of undesired frequencies, said condenser being directly connected to said control electrode and said anode.
5. The combination of an electric dis-

charge device comprising an anode, a cathode and a control electrode, an input circuit for said device and an output circuit for said device, said input circuit terminating in said control electrode and said cathode, and said output circuit terminating in said anode and said cathode, and a condenser for by-passing high frequency currents around said device from said input circuit to said output circuit, said condenser forming for said currents a low impedance path from said control electrode to said anode. 10

In witness whereof, I hereunto subscribe my name this 28th day of June A. D., 1917.

JOHN MILLS.