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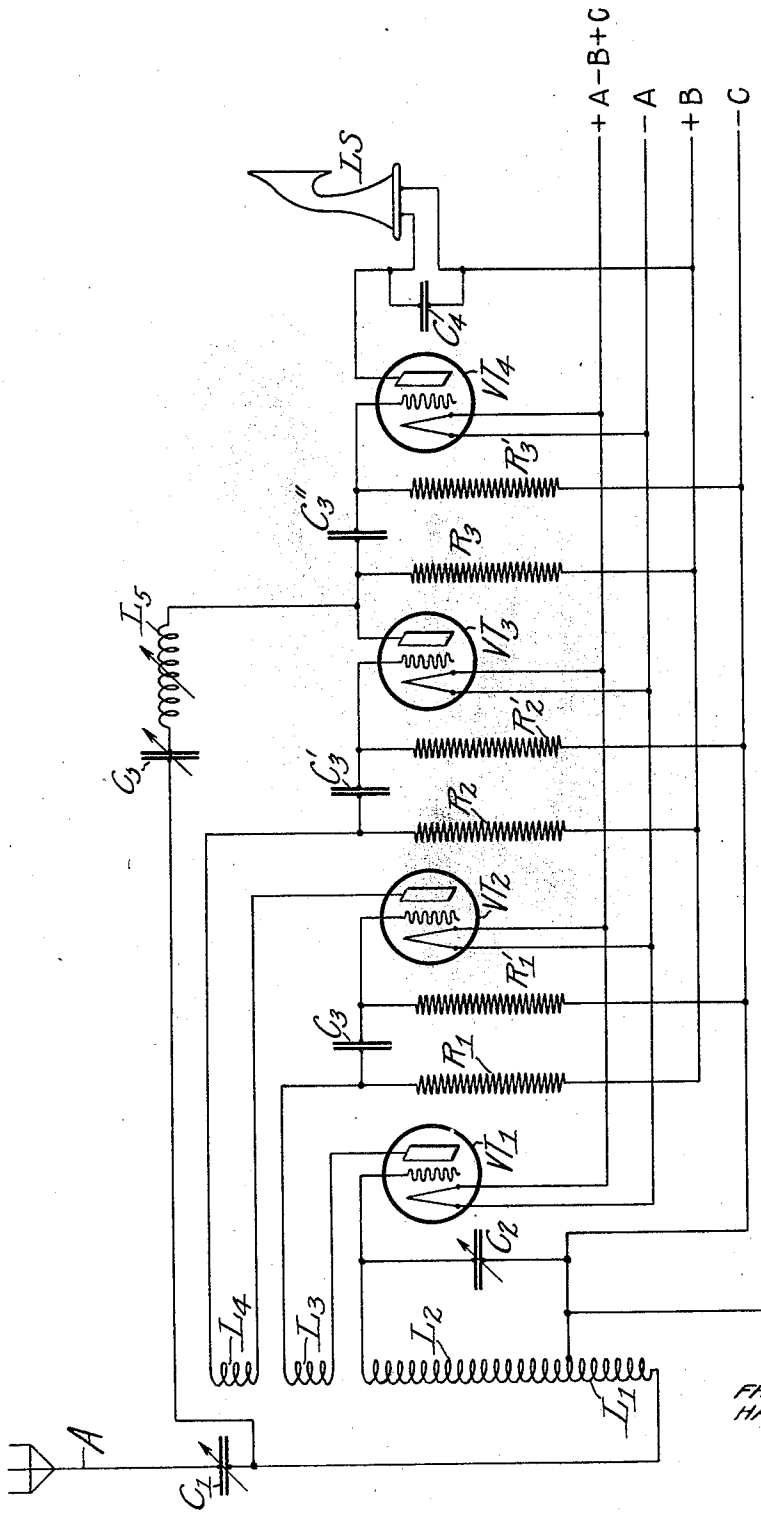

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AMPLIFYING SYSTEM, METHOD, AND APPARATUS

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An application has been filed in Germany, August 18, 1926.

This invention relates generally to amplifying systems, and more particularly to a system for the selective multiple amplification of high frequency carrier currents modulated at lower or audible frequency.

An object of the invention is multiple selective high frequency amplification in a system employing a lesser number of selective circuits than steps of amplification, and particularly a single selective or tuning circuit for a multiplicity of steps of high frequency amplification, and yet secure an order of selectivity in keeping with the number of steps of amplification.

Another object is composite high frequency amplification, detection and low frequency amplification.

Heretofore it has been the general practice to employ a separate tuning circuit for each step of amplification in that portion of an amplifying system intended for high frequency amplification of a complete system further including detection and low frequency amplification, and to perform the detection as a separate step and, in general, the low frequency amplification in independent separate steps. The present invention reduces these prior complications in many respects as will be more fully pointed out in connection with the one figure of the drawing.

The figure diagrammatically illustrates the invention employed as a radio receiver; for example, a broadcast receiver intended to cover a rather wide range of wave-lengths. It includes an antenna A connected to ground G through a variable condenser C_1 and a primary coil L_1, all of general arrangement common in practice. Three electrode amplifying tube VT_1 has an input circuit L_2C_2 the only tunable circuit of the system, this circuit being coupled to the antenna through coupling with antenna coil L_1, and being tunable through the desired range of high frequencies or wavelengths. A high resistance R_1 couples VT_1 with a second amplifying tube VT_2 through a condenser C_3 shunted by a grid leak resistance R'_1 usual in such systems.

By reason of the capacitive reaction of the output circuit of VT_1, created by the resistance R_1 and its distributed capacity as well as capacitive effects of other connections of the output circuit, a high frequency reaction through the internal capacity of the tube unfavorable to amplification is had, so that without modification the amplifying of high frequency in this tube is poor. The difficulty is overcome however by including in the output circuit coil L_3 coupled to input coil L_2, whereby enough energy may be selectively fed back to the input circuit to overcome more or less the unfavorable feed back through the tube, thereby causing selective circuit L_2C_2 to not only act as a selective input to tube VT_1, but further act to cause the tube to selectively highly amplify. There therefore results a selective high difference of potential across resistance R_1 for transfer to tube VT_2.

Tube VT_2 also includes a high resistance R_2 in its output, and therefore like VT_1 is inherently a poor high frequency amplifier, and wholly a non-selective amplifier. The difficulty is again overcome by inserting a coil L_4 in the output circuit coupled to the tunable circuit L_2C_2, either independently of or in association with coil L_3. This coupling succeeds in modifying the unfavorable feed back through the internal capacity of tube VT_2, thereby making it a second effective, selective amplifier of high frequency currents for transfer across resistance R_2 through condenser C'_3 to tube VT_3.

Tube VT_3 includes a high resistance R_3 in its output, and acts like the preceding tubes. A variation in the feed back connection is shown in that a connection is made to the antenna through the variable condenser C_5, and may include a variable inductance L_5 for a degree of phase changing. In this arrangement the coupling to tunable circuit L_2C_2 is had through antenna coil L_1.

It is of course understood that all couplings must be given proper polarity to secure the results described as well as proper degrees of coupling. A final adjustment to prevent oscillation production may be had in variable condensers C_1 and C_5, or variable inductance L_5, particularly if found that

varying from one wave length range to another brings about oscillation in tuning in one sense, or results in too much loss of amplification in tuning in the opposite sense.

It is well known that vacuum tubes rectify no matter how carefully adjusted towards pure amplification, so that each tube of the system engages in some rectification. There therefore passes through the system from tube VT_1 a rectifying action effectively transferred forward by the high resistances R_1, R_2 and R_3, just as if the system were a so-called "resistance coupled" amplifier. As a result there reaches loud speaker or other translating device LS a current so amplified and modified that the low frequency modulations are effective thereon, and it makes no material difference whether this effect is viewed as a continued high frequency amplification with increasingly effective rectification, or separated high frequency amplification and low frequency amplification as rectification takes place, or a composition of the two effects, or any other characterization of composite action. We have found that such a system gives an overall result in selectivity and amplification (no matter what kind) equivalent to much more elaborate systems involving several stages of so-called tuned radio frequency amplification, detection and several stages of audio amplification. It is obvious that many difficulties are obviated and much material saved.

The tubes are shown to be energized for amplification from sources marked +A −B −C, −A, +B, and −C, all in a manner well known to the art. In general practice tube VT_4 should be more powerful than the preceding tubes, in which case a higher plate potential for this tube would probably be employed. It has also been found that some advantages are had through increasing the capacities of the linking condensers C_3, C'_3 and C''_3 as the output end of the system is approached.

While we have described our invention in connection with a radio receiving system we do not intend any limitations by reason of the choice merely for illustrative purposes. Its scope is defined in the appended claims.

Having described our invention, we claim:

1. A system for the multiple selective amplification of alternating currents including a plurality of amplifiers linked in cascade through non-selective couplings, a tunable input circuit at the origin of the system, and separate means regeneratively coupling each of the several output circuits of said amplifiers to said tunable circuit, whereby said circuit selectively controls the amplification of all of said amplifiers.

2. A system for the multiple selective amplification of alternating currents including a plurality of amplifiers linked in cascade through high resistances, a tunable input circuit for said system, and separate means regeneratively coupling each of the several output circuits of said amplifiers to said tunable circuit, whereby said circuit singly selectively controls the amplification of all of said amplifiers.

3. A system for the composite selective multiple amplification and detection of high frequency carrier currents modulated at lower frequency including a series of three electrode vacuum tubes connected in cascade through non-selective couplings capable of transferring rectified current effects, a tunable input circuit for said series of tubes, means regeneratively coupling each of a plurality of the output circuits of said tubes to said tunable circuit, and a translating device for said lower frequency modulations at the output of said series.

4. The composite method of selectively amplifying and detecting high frequency alternating currents modulated at lower frequency which includes simultaneous, progressive, selective regenerative amplification and rectification of said currents, non-selectively transferring said amplified currents in rectified form from stage to stage of said process, and finally translating said currents so modified into responses characteristic of said lower frequency modulations.

5. In a selective amplifying system the combination of a pair of three electrode vacuum tubes aperiodically coupled in cascade, a tunable circuit connected to the input electrodes of the leading tube of said cascade, an aperiodic output system for the following tube of said cascade, and separate means associated with the plate circuit of each tube regeneratively coupling the output systems of each of said tubes to said tunable circuit.

6. In a selective amplifying system the combination of a pair of three electrode vacuum tubes connected in cascade, a tunable input circuit for the leading tube of said cascade, an output system for the following tube of said cascade, the output systems of both of said tubes being capacitive in reaction to currents of frequency range covered by said tunable input circuit, and separate means regeneratively coupling the ouput systems of both of said tubes to said tunable circuit.

7. In a selective amplifying system the combination of a plurality of three electrode vacuum tubes connected in cascade through aperiodic coupling systems, a tunable input circuit for the leading tube of said cascade, means electromagnetically coupling each of the output systems of said tubes to said tunable circuit.

8. In a selective cascade amplifying system the combination of a plurality of three electrode vacuum tubes, a tunable input circuit for the leading tube of the cascade, means linking said tubes in cascade capacitively reactive to currents of frequency range covered

by said tunable circuit, and electromagnetic means regeneratively coupling the output system of the first tube and one or more succeeding tubes of the cascade to said tunable circuit.

9. In a cascade system for progressively amplifying and detecting high frequency currents modulated at lower frequency the combination of a plurality of three electrode vacuum tubes, a tunable input circuit for the leading tube of the cascade, aperiodic interstage couplings between said tubes including capacity elements conductively isolating the output electrode of a preceding tube from the input electrode of a coupled succeeding tube, the capacity values of said elements progressively increasing from stage-to-stage from input towards output, and means regeneratively coupling the output systems of one or more of said tubes to said tunable circuit.

10. In a cascade system for progressively amplifying and detecting high frequency currents modulated at audible frequency the combination of a plurality of three electrode vacuum tubes, a tunable input circuit for the leading tube of the cascade, high resistance interstage couplings between said tubes, the interstage coupling connections including capacity elements conductively isolating the output electrode of a preceding tube from the input electrode of a coupled succeeding tube, the capacity values of said elements progressively increasing from stage-to-stage from input towards output, means regeneratively coupling the output system of the leading tube and of one or more of the succeeding tubes to said tunable circuit, and a translating device in the output of said system.

11. In a cascade selective amplifying system the combination of a plurality of three electrode vacuum tubes, a tunable input circuit for the leading tube of the cascade, an antenna system coupled to said circuit, aperiodic interstage couplings between said tubes, and means regeneratively coupling two or more of the output systems of said tubes to said tunable circuit, said means including connections for coupling the output system of at least one of said tubes to said tunable circuit by way of the coupling between the antenna system and said circuit.

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