

May 31, 1932.

H. D. CURRIER

1,860,997

RECEIVING CIRCUIT

Filed April 22, 1925

2 Sheets-Sheet 1

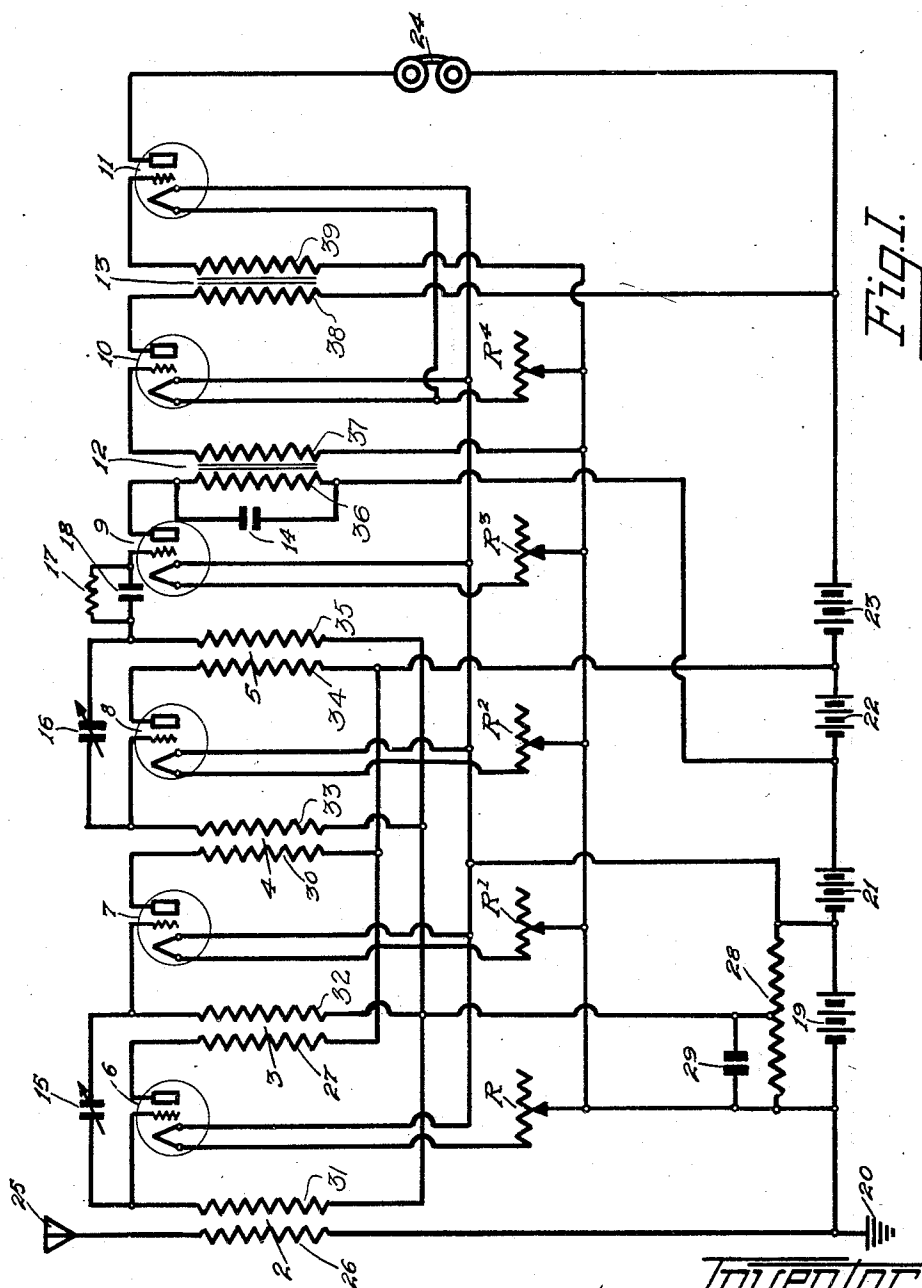


Fig. 1.

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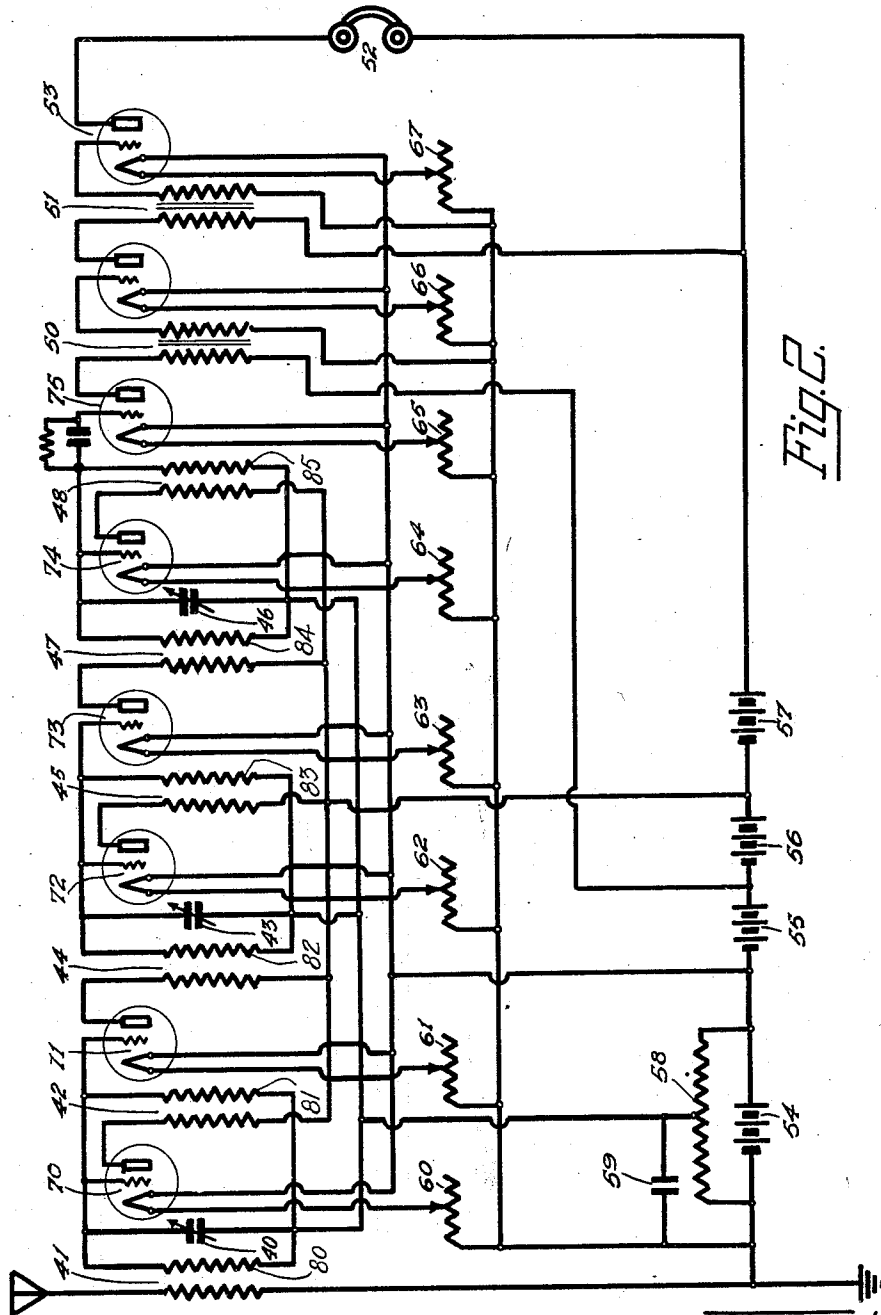


Fig. 2.

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UNITED STATES PATENT OFFICE

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RECEIVING CIRCUIT

Application filed April 22, 1925. Serial No. 24,936.

My invention relates to wireless telegraphy and telephony and resides in novel circuit arrangements for such systems, and in the accompanying drawings my invention is shown as employed for the reception of radio signals. My invention however is not limited to receptive purposes only, and its objects are to provide a novel and improved organization of the elements comprising such a system, and which provides an arrangement affording sharpness of tuning, ease of control, power, and clearness in respect to the signals received.

Figs. 1 and 2 of the drawings show receiving arrangements involving radio frequency amplification, detection and audio frequency amplification. In systems of the prior art which made use of tuned radio frequency amplification it has been customary to provide at least a tuning unit per stage of radio frequency amplification. This arrangement has made the tuning somewhat complicated, especially where several stages of radio amplification was provided. It is a feature of my invention to reduce the number of controls heretofore used and to tune more than one stage of amplification with one control device.

Referring particularly to the drawings:

Fig. 1 shows a system in which the secondaries of a plurality of transformers are tuned in series, and

Fig. 2 shows a system in which the secondaries of a plurality of transformers are tuned in multiple.

Referring particularly to Fig. 1 of the drawings which shows the preferred embodiment of my invention, 2, 3, 4 and 5 represent radio frequency transformers, which may be of the air core type, each one comprising a primary winding and a secondary winding. The audion tubes 6, 7, 8, 9, 10 and 11 are of the three electrode type, each including a filament, a grid and a plate. Tubes 6, 7, and 8 are used as radio frequency amplifiers, tube 9 as a detector, and audion tubes 10 and 11 as audio frequency amplifiers. The audio frequency transformers 12 and 13 are provided with iron cores, and the primary

of the audio frequency transformer 12 is shunted with a condenser 14.

Variable air condenser 15 connects the secondaries of transformers 2 and 3 in series, and variable air condenser 16 connects the secondaries of transformers 4 and 5 in series. I provide the usual grid leak 17 and grid condenser 18 in the grid circuit of the detector tube 9. Battery 19, one pole of which is grounded at 20, is the usual primary battery for furnishing heating current to the filaments of the audion tubes, and batteries 21, 22 and 23 are the usual B battery for furnishing current to the plates of the audion tubes. The plate circuit of audion tube 11 includes a pair of receivers 24 which may be replaced by a loud speaker of the type now in use. Rheostats R, R' and R² control the supply of current to the filaments of tubes 6, 7, and 8, respectively, rheostat R³ to the filament of the detector tube 9, and rheostat R⁴ controls the supply of heating current to the filaments of tubes 10 and 11. At 25 I represent the ordinary antenna or collector device for receiving the incoming oscillations. Bridged across battery 19 is a resistance 28 which has its central point tapped and connected in the grid return circuits of audion tubes 6, 7, 8 and 9. Bridged from this central point of the resistance 28 to ground 20 is a by-pass condenser 29.

Having given a brief description of the apparatus involved in my system, I will now briefly refer to the functioning of the same.

The incoming oscillations are picked up by the antenna 25 and pass through the primary 26 of the transformer 2 to ground 20. The incoming oscillations or signals are induced in the secondary 31 of the transformer 2 and are operative upon the grid of tube 6 to repeat the signal through the primary 27 of transformer 3. The signal is then induced into the secondary 32 of the transformer 3 and is operative upon the grid of tube 7 to repeat the said signal through the primary 30 of transformer 4. The signal is induced into the secondary 33 of the transformer 4 and is operative upon the grid of the audion tube 8 to repeat the signal through the primary 34 of the transformer 5. The

signal in turn is operative upon the grid of the tube 9 through the secondary 35 of the transformer 5. The tube 9 through its plate circuit relays the signal through the primary 36 of the audio frequency transformer 12. The transformer 12 operates to make the signal operative upon the grid of tube 10 which in turn transmits a signal through the primary 38 of the audio frequency transformer 13. This signal is induced into the secondary 39 of the transformer 13 and is operative upon the grid of tube 11. Tube 11 operates to reproduce the signal in the plate circuit thereof through the receivers 24 to the positive pole of B battery 23.

The method of operating the set is to adjust the rheostats so that the right amount of current is supplied to the filaments of the tubes and to then operate variable condensers 15 and 16 until the secondaries 31—32 and 33—35 of the transformers 2, 3, 4 and 5 are in resonance with the incoming signal so that the same may be amplified by the apparatus to the exclusion of the undesired signals. The condenser 15 tunes the secondaries 31 and 32 of transformers 2 and 3, and permits the desired oscillations to be induced from the primary 26 of transformer 2 into the secondary 31 thereof and for the repeated impulse to be induced from the primary 27 of the transformer 3 into the secondary 32 thereof. Likewise, the condenser 16 tunes the secondaries 33 and 35 of transformers 4 and 5 so that the desired signal may pass through these transformers and be operative upon the grids of the tubes to cause the signal to be amplified.

This arrangement permits the use of three stages of tuned radio frequency amplification and a detector stage with the use of only two variable or adjustable condensers. This simplifies the control a great deal, as one condenser 15 controls two stages of amplification and permits only the desired signal to pass while the condenser 16 controls two stages of amplification and permits the desired signal to be operative upon the grid of the detector tube.

While I have not gone into the theory of operation of the circuits it is thought that the foregoing description is sufficient to permit one skilled in the art to practice the invention.

Referring to Figure 2 the apparatus in this figure is quite similar to that in Figure 1 but here I provide a different method of tuning. The variable condenser 40 is in multiple with the secondary windings 80 and 81 of transformers 41 and 42 of the first two stages of radio frequency amplification. Variable condenser 43 is in multiple with the secondary windings 82 and 83 of transformers 44 and 45 and variable condenser 46 is in multiple with the secondaries 84 and 85 of transformers 47 and 48. In this fig-

ure I tune the secondaries of the transformers in multiple instead of in series as in Figure 1. Figure 2 discloses five stages of radio frequency amplification and a detector stage all controlled by three variable condensers. The audio frequency transformers 50 and 51 are of the usual iron core type and at 52 I have shown a pair of receivers in the plate circuit of the last audion tube 53. The primary battery 54 and the secondary battery 55, 56 and 57 are for the purposes discussed in connection with Figure 1. The resistance 58 and condenser 59 are the same as used in connection with the apparatus of Figure 1. I also provide rheostats 60 to 67 inclusive for controlling the heating current to the filaments of the audion tubes. The plate of tube 70, it will be noted is coupled through the transformer 42 to the grids of tubes 70 and 71. The plates of tubes 72 and 74 likewise are coupled respectively through transformers 45 and 48 to the grids of tubes 72 and 73 and the grids of tubes 74 and 75.

This feature appears to give marked results in the reception of signals. On account of the very high frequency of the oscillatory currents involved in systems of this character and their tenuity together with a sensitively balanced effect that exists when such systems are operated it is as is well known quite difficult to determine the precise actions and reactions involved, but the foregoing description is sufficient to enable any one skilled in the art to readily practice the invention.

From the foregoing it will be seen that in both Figures 1 and 2 I provide one variable condenser or tuning device for tuning two stages of amplification and that this method of tuning reduces the number of condensers normally used to operate a pre-determined number of stages of radio frequency amplification.

While I have shown two specific arrangements of my invention, I do not desire to be limited to the exact manner shown and described, but aim to cover all that which comes within the spirit and scope of the appended claims.

Having described my invention what I claim as new and desire to secure by United States Letters Patent is:

1. A radio receiving system of the character described including a plurality of transformers connected in successive stages of the radio receiving circuit and each having primary and secondary windings, and a single variable tuning device connected directly to similar points of a plurality of said secondary windings for tuning the same.

2. A multi-stage radio circuit of the character described including a plurality of transformers connected in successive stages of the radio circuit operating in connection with audion tubes, said transformers having primary and secondary windings, and a single

variable condenser directly connected between similar points on the said secondary windings for tuning the same.

3. A radio receiving arrangement including a pair of transformers in successive stages of the radio receiving circuit and each having primary and secondary windings, audion tubes associated therewith, and a single variable condenser connected between similar points on a winding of each of said transformers for directly tuning said winding of each of said transformers.

4. A receiving circuit of the character described including a pair of transformers, each transformer being in a different stage of the receiving circuit and each having primary and secondary windings, a pair of audion tubes, one terminal of each of said secondary windings being connected to an element of said tubes, and a single variable tuning device serially connected to said secondary windings for controlling the same, said tuning device being connected between similar points on said secondary windings.

5. A multi-stage receiving arrangement of the character described including transformers, a transformer for each stage and each transformer having primary and secondary windings, a pair of audion tubes associated with said transformers, and a single adjustable condenser for simultaneously tuning said secondary windings in series, said condenser being directly connected between similar points on the respective secondaries of said transformers.

6. A cascade receiving arrangement of the character described, a transformer for each stage of said receiving circuit and each transformer having primary and secondary windings, a plurality of audion tubes associated and connected to said transformers, and a single variable tuning element serially connected with said secondary windings of said transformer and connected between similar points on the respective secondary windings of said transformers for tuning the same.

7. A cascade receiving arrangement of the character described, a pair of transformers one in each stage of the receiving circuit and having primary and secondary windings, audion tubes associated and connected with said transformers, one terminal of the secondary of each of said transformers being connected together, the other terminal of each of said secondaries being connected to grid elements of said tubes, and a single variable tuning device connected between said grid elements for tuning purposes.

8. A cascade radio frequency amplifier coupled by transformers, one transformer for each stage, and common tuning means comprising a single condenser directly connected between similar points on the respective secondaries of said transformers.

9. A system of the character described in-

cluding a plurality of stages of tuned radio frequency amplification, transformers for said stages of amplification, audion tubes having elements connected to the windings of said transformers, means including a device having a single movable and a single stationary element for tuning a winding of the transformer of one of said stages and connections whereby the transformer of another of said stages is automatically tuned to the same frequency when the said winding of said first transformer is tuned.

10. A tuning system of the character described including a plurality of stages and tuned amplification, a transformer and an audion tube for each of said stages, circuits connecting elements of said tubes to windings of said transformers, tuning devices having single movable elements and single stationary elements connected to windings of said transformers for tuning the transformers of some of the stages of amplification, and other circuit connections so arranged that when said first transformers are tuned the other transformers of the other of said stages of amplification are simultaneously tuned.

11. In radio signaling apparatus, a plurality of stages, each including a thermionic device, means for simultaneously tuning said stages to a determined signal, said means comprising a fixed reactance connected in each stage, and a variable reactance common to said plurality of stages.

Signed by me at Chicago, in the county of Cook, and State of Illinois, this 20th day of April, 1925.

HIRAM D. CURRIER.