Oct. 27, 1931. L. ETHERIDGE 1,829,131

RADIO RECEIVING SYSTEM

Filed July 17, 1929 2 Sheets-Sheet 1

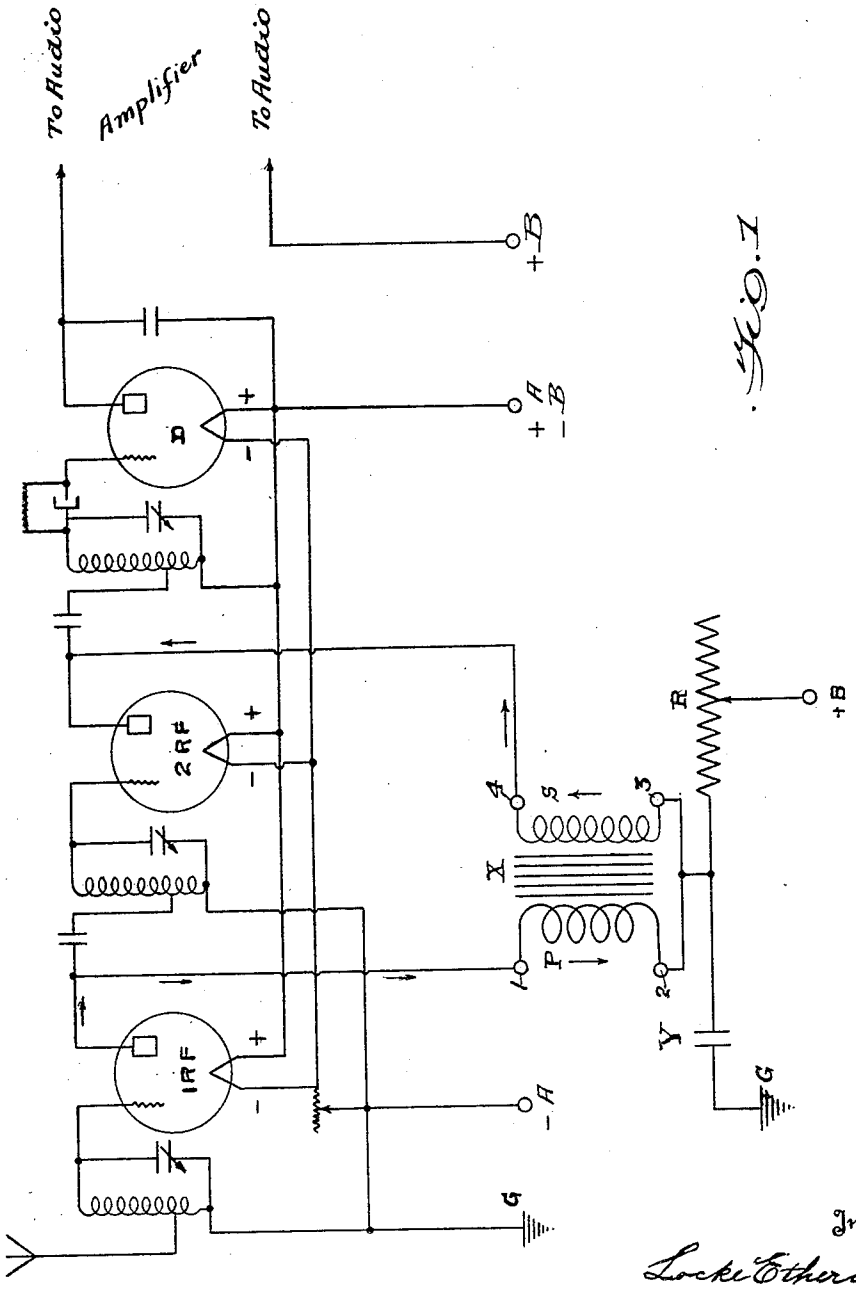


Fig. 1

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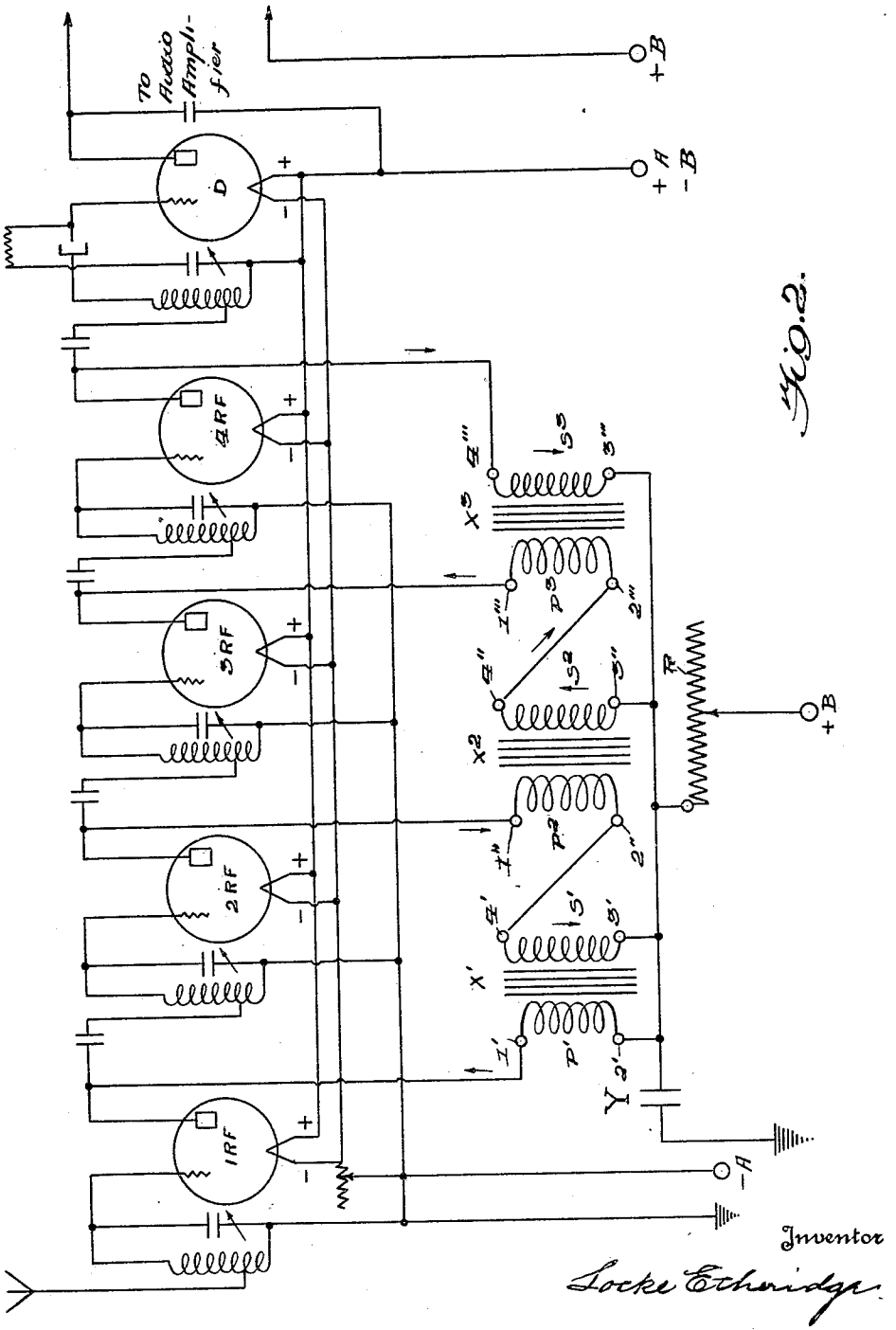


Fig. 2.

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UNITED STATES PATENT OFFICE

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RADIO RECEIVING SYSTEM

Application filed July 17, 1929. Serial No. 379,025.

The invention relates to certain novel improvements in radio receiving systems of the tuned radio frequency type, involving means for amplifying the audio components of the signals by electrically coupling the plate circuits of the successive electron discharge devices or so-called tubes, by means of a transformer or transformers having a relatively high ratio between the primary and secondary thereof, so that the audio component of the signals will be amplified by and in accordance with the variations of the currents developed in the secondary or secondaries of said transformer or transformers.

The invention is illustrated in the accompanying drawings, in which:—

Fig. 1 is a diagram of a two stage tuned radio receiving circuit.

Fig. 2 is a similar view of a four stage tuned radio receiving circuit.

Referring to Fig. 1, the system involves the usual antenna or receiving device connected to a properly tuned receiving circuit and two stages of tuned radio frequency, including the usual A and B battery circuits, two electron discharge devices or tubes 1 R F and 2 R F, and a detector tube D connected in accordance with the standard practice in tuned radio frequency systems. A supply lead from the plus B terminal of the radio frequency battery supply is connected through a variable resistance R, preferably ranging from zero to two hundred thousand ohms. Included in the plus B supply leads to the plates of the tubes 1 R F and 2 R F are the primary and secondary windings of a transformer X, with the primary P having one terminal 1 connected to the lead to the plate of the tube 1 R F, and the secondary S consisting of a relatively larger number of turns of wire having one terminal 4 connected to the lead to the plate of the tube 2 R F, and its other terminal 3 connected to the lead from the plus B terminal and also to the other terminal 2 of the primary P.

Interposed between the terminal 2 of the primary of the transformer and the ground, there is a by-pass condenser, preferably of 1 M. F. capacity.

The system, as illustrated and described, represents a typical impedance coupled shunt feed radio frequency circuit consisting of two radio frequency stages and the detector stage, the audio frequency not being shown at all, as any suitable audio frequency arrangement may be employed.

When a signal is received from a distant station, it consists of two distinct frequencies, one being known as the carrier wave, which is at radio frequency, the other being due to the modulation impressed upon the carrier wave by the music, speech or sounds being transmitted. This latter, usually called the audio component of the signal, is at audio frequency. Due to the fact that the coils of the transformer X are wound on a steel or iron core and consist of a considerable number of turns of wire, the impedance offered to the passage of currents of radio frequency is practically infinite. Therefore, practically all of the carrier current or radio frequency component of the signal is blocked by this impedance and passes readily through the blocking condenser to the ground through the radio frequency transformer.

The effect of the voice, music or other sound modulations impressed on the carrier wave increases and decreases the quantity of current flowing from the filament to the plate of the first radio frequency tube and consequently increases and decreases the volume of the current, supplied by the B battery, in the primary P of the transformer X. This fluctuating current increases and decreases the magnetic saturation of the core of the transformer, which, in turn, inductively acts on the secondary coil S of said transformer and, if the number of turns in the secondary is large as compared with the turns in the primary, the effect will be that these fluctuations of current in the secondary will be amplified in voltage and then fed back into the radio frequency system to the plate of the second radio frequency tube.

It will, therefore, be seen that the effect of inductively coupling, with the transformer, the plate circuits of the two radio frequency tubes in the manner and form shown, will be to automatically add to, in-

crease or amplify the audio component of the signal fed to the plate circuit of the second tube. To state the advantageous effect of the transformer somewhat differently, inasmuch as said transformer has a relatively high step-up ratio, when any change occurs in the volume of current flowing in the primary coil, a corresponding amplified change of current or voltage or both is induced in the secondary coil, of an amount equal to the ratio of the two windings multiplied by the efficiency of the transformer. This amplified voltage is then fed back into the plate of the succeeding tube and adds its value to the audio component passed by the tube, which is induced by the grid of said tube. Thus it will be seen that the use of the transformer in the relation described, coupling the plates of successive radio frequency stages, the coils of said transformer, primary and secondary, being connected respectively in the plate supply circuits, adds an appreciable amount to the audio component of the signal over and above that which would ordinarily occur in a standard tuned radio frequency circuit. The variable resistance R is included in the main plus B supply, in order to regulate the voltage supplied to the plates of the several radio frequency tubes, and, as stated, the by-pass condenser Y is effective in eliminating from the system all currents or voltages which are out of phase or at radio frequency. The general effect of this improvement in tuned radio frequency circuits is to increase the clearness and quality of the reception and the sensitiveness of the system as a whole.

In the modification shown in Fig. 2, the receiving system involves four stages of radio frequency amplification and a detector, and three amplifying transformers X^1, X^2 and X^3, which inductively couple, respectively, the plate circuits of successive radio frequency tubes, that is to say, the primary of the transformer X^1 is interposed in the lead from the plus B supply to the plate of tube 1 R F, while the secondary is connected to the lead from the plus B supply, and, therefore, to the primary P′ at one terminal 3′, the other terminal 4′ being connected to the terminal 2″ of the primary P^2 of the transformer X^2. The other terminal 1″ of said primary P^2 is connected to the plate of the second radio frequency tube 2 R F. The secondary S^2 of the transformer X^2 is connected by terminal 3″ to the plus B supply lead and its terminal 4″ is connected to terminal 2‴ of transformer X^3 and the terminal 1‴ of primary P^3 is connected to the plate of the third radio frequency tube 3 R F. The terminal 3‴ of transformer X^3 is connected to the plus B supply lead and terminal 4‴ is connected to the plate of the fourth radio frequency tube 4 R F. The object of these particular connections between the transformer elements and the plate circuits are followed in order that the phase relations of the plate circuits of the succeeding tubes will be in the same direction and will not conflict.

It will be seen from the foregoing description that in both modifications of the invention, the application of an amplifying transformer inductively coupling the plate circuits of successive tubes results in an appreciable amplification or increase in the value of the audio component supplied to the plate of the succeeding tube, thereby materially improving the quality of the reception and greatly increasing the sensitiveness of the receiving system.

What I claim is:

1. In a receiver of the tuned radio frequency type including two or more radio frequency stages, an audio amplifying transformer coupling inductively the plate circuits of successive stages.

2. In a receiver of the tuned radio frequency type including two or more radio frequency stages, a step-up transformer coupling inductively the plate circuits of successive stages.

3. In a receiver of the tuned radio frequency type including two or more radio frequency stages, a step-up transformer interposed in the B supply circuit to successive electron discharge devices, the primary of the transformer being included in the plate circuit of one of said devices and the secondary included in the plate circuit of the next succeeding discharge device.

4. In a receiver of the tuned radio frequency type including two or more radio frequency stages, an audio amplifying transformer coupling inductively the plate circuits of successive stages, and a variable resistance in the plate supply circuit.

5. In a receiver of the tuned radio frequency type including two or more radio frequency stages, a step-up transformer interposed in the B supply circuit to successive electron discharge devices, the primary of the transformer being included in the plate circuit of one of said devices and the secondary included in the plate circuit of the next succeeding discharge device, and a variable resistance in the plate supply circuit.

6. In a receiver of the tuned radio frequency type including two or more radio frequency stages, an audio amplifying transformer coupling inductively the plate circuits of successive stages, a variable resistance in the plate supply circuit, and a by-pass condenser connected between the ground and the plate supply circuit in advance of the transformer.

In testimony whereof I affix my signature.

LOCKE ETHERIDGE.