

Sept. 23, 1924.

1,509,139

D. GRIMES

RADIO RECEIVING APPARATUS

Filed April 21, 1922

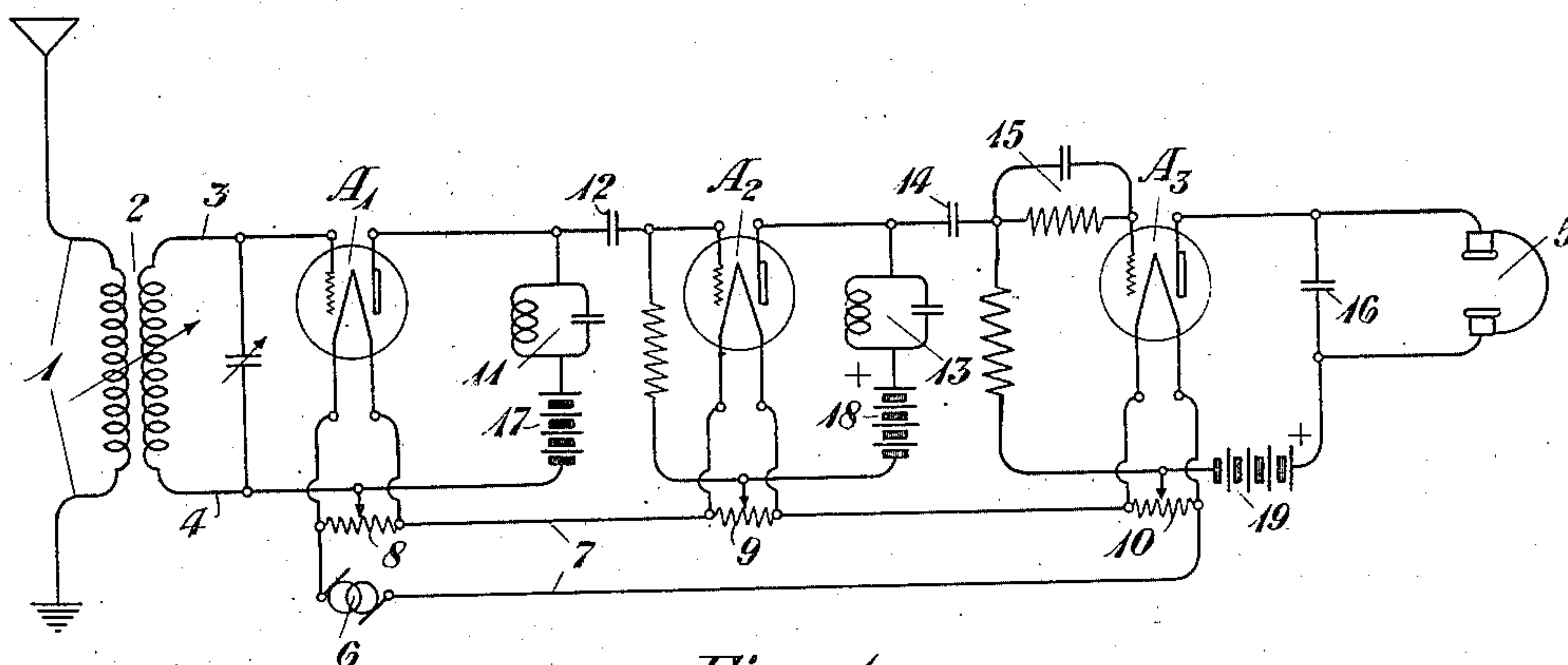


Fig. 1

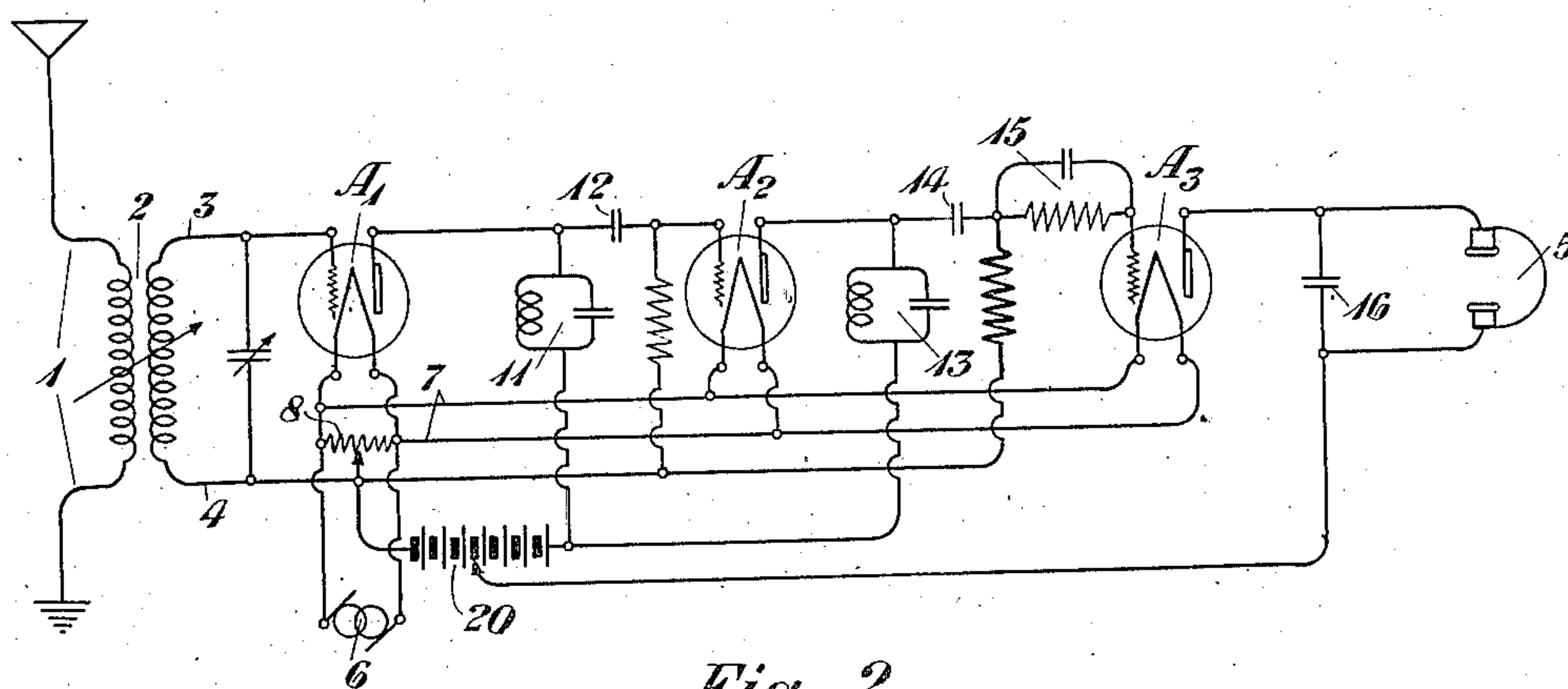


Fig. 2

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UNITED STATES PATENT OFFICE.

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RADIO RECEIVING APPARATUS.

Application filed April 21, 1922. Serial No. 555,905.

To all whom it may concern:

Be it known that I, DAVID GRIMES, residing at Tompkinsville, in the county of Richmond and State of New York, have invented certain Improvements in Radio Receiving Apparatus, of which the following is a specification.

This invention relates to improvements in radio apparatus and more particularly to sets designed for the reception of radio signals.

Among the many types of radio sets developed for the reception of signals are those which utilize the well known vacuum tube for purposes of amplification and detection. One of the common methods of heating the filaments of the tubes in such a set has been to utilize a storage battery. It has been found that of all the elements used in assembling such a radio receiving set a storage battery and its charging mechanism are the most expensive. It is accordingly one of the features of this invention to provide arrangements whereby the filaments of the tubes may be heated by alternating current and the expense of a storage battery may be avoided. When alternating current is used to heat the filaments of the tubes the alternating heating and cooling of the filaments is apt to cause disturbing currents which in some instances might interfere with the reception of the signals. With the arrangements of this invention however, these disturbing currents, or low frequency hum as it may be termed, are reduced to a minimum degree so as to be practically negligible and to cause practically no disturbance with the detected signal currents. Other features of the invention will appear more fully from the following detailed description thereof.

The invention may be more fully understood from the accompanying drawing in the Figures 1 and 2 of which are shown a preferred form of the invention and a modification thereof. In Fig. 1 is illustrated a radio receiving set embodying the principles of this invention in which the filaments of the vacuum tubes are connected in series, while in Fig. 2 is a modified form with the filaments of the tubes connected in parallel.

In Fig. 1 is shown a circuit 1 which may be connected to an antenna or aerial. This circuit is coupled through variable transformer 2 to the input circuit 3, 4, of a vacuum tube amplifier A_1 . Bridged across

circuit 3, 4, may be a tuning condenser. The vacuum tube A_1 is of a type well known in the art and includes a grid, filament, and plate. The output of amplifier A_1 is connected to the input of another amplifying tube A_2 . Additional amplifying tubes might be included in the set in a similar manner if desired. The output of tube A_2 is connected to the input of another tube A_3 designed to operate as a detector. The output of the detector tube A_3 is connected to a receiver 5. In accordance with the usual practice a condenser 16 would be bridged across the output circuit of tube A_3 and a grid leak stopping condenser 15 would be associated as shown with the input circuit of the detector. In order to heat the filaments of the tubes there is provided a circuit 7 which includes a source 6 of alternating current. The filaments of the tubes A_1 , A_2 , and A_3 are shown connected in series in circuit 7. Bridged across the filament circuits are the resistances 8, 9, and 10. Individual plate batteries 17, 18, and 19 are provided for each of the tubes A_1 , A_2 , and A_3 respectively. The grids and plates of the various tubes are connected to the mid-points of the resistances 8, 9, and 10, as shown, so that the grids and plates will be neutral with respect to the alternating current source 6. Bridged across the output of tube A_1 is a tuned circuit 11 which is anti-resonant to currents of radio frequency. A similar anti-resonant circuit 13 is bridged across the output circuit of tube A_2 . The condensers 12 and 14 are also provided as shown in the output circuits of the amplifying tubes, these condensers readily passing radio frequency currents but offering a very great impedance to the filament heating currents or the effective harmonics thereof.

With the above described arrangement it will be seen that the coupling between tubes A_1 and A_2 and A_2 and A_3 will be efficient at radio frequencies but will not be efficient at the low frequency from the heating generator 6. This is due to the fact that the low frequency heating current, or disturbing hum, will be practically shunted out of the output of each amplifier tube by the circuits 11 and 13. The radio currents passing through condensers 12 and 14 however, will be amplified by each tube and transmitted to the detector tube A_3 . At the detector tube the radio frequency is reduced to audible

frequency. Some hum, or disturbing current may be introduced at the detector tube at this time by the heating and cooling of the filament in the detector tube itself. However, the radio frequency current having been previously amplified by the tubes A_1 and A_2 , the detected signals will greatly predominate over any low frequency interference caused by the detector tube itself and the resultant detection will not be at all objectionable, the disturbing element therein being no more serious than the noise on an ordinary telephone circuit. In other words, with the arrangements of this invention the radio current may be subjected to any desired degree of amplification and the disturbing current or hum due to the filament heating current may be eliminated at each amplification stage so that when the radio current is transmitted to the detector there will be no disturbance.

The modification of the invention illustrated in Fig. 2 is in many respects similar to the arrangements already described. Like reference characters have been used to denote like parts in both figures of the drawing. In the arrangements of Fig. 2 the filaments of the tubes are shown connected in parallel with the heating circuit 7. With such an arrangement a common plate battery 20 may be provided for the tubes. Furthermore only one bridged resistance, such as 8, will be needed. The grid and plate cir-

cuits of the tubes will be connected, as shown, to the mid-point of this resistance so that the grids and plates will be neutral with respect to the alternating current source 6. As the principles of operation of the arrangements of Fig. 2 are the same as those already described, no further description thereof will be given.

While the arrangements of the invention have been disclosed as embodied in certain specific arrangements which are deemed desirable, it is understood that they are capable of embodiment in many and widely varied forms without departing from the spirit of the invention as defined in the appended claim.

What is claimed is:

In a radio receiving system including a vacuum tube amplifier and a vacuum tube detector, means for heating the filaments of said tubes with alternating current of relatively low frequency, a coupling between said tubes including a condenser offering small impedance to radio frequencies and large impedance to other frequencies, and a shunt associated with said coupling, said shunt being anti-resonant to radio frequencies and resonant for lower frequencies.

In testimony whereof, I have signed my name to this specification this 20th day of April, 1922.

DAVID GRIMES.