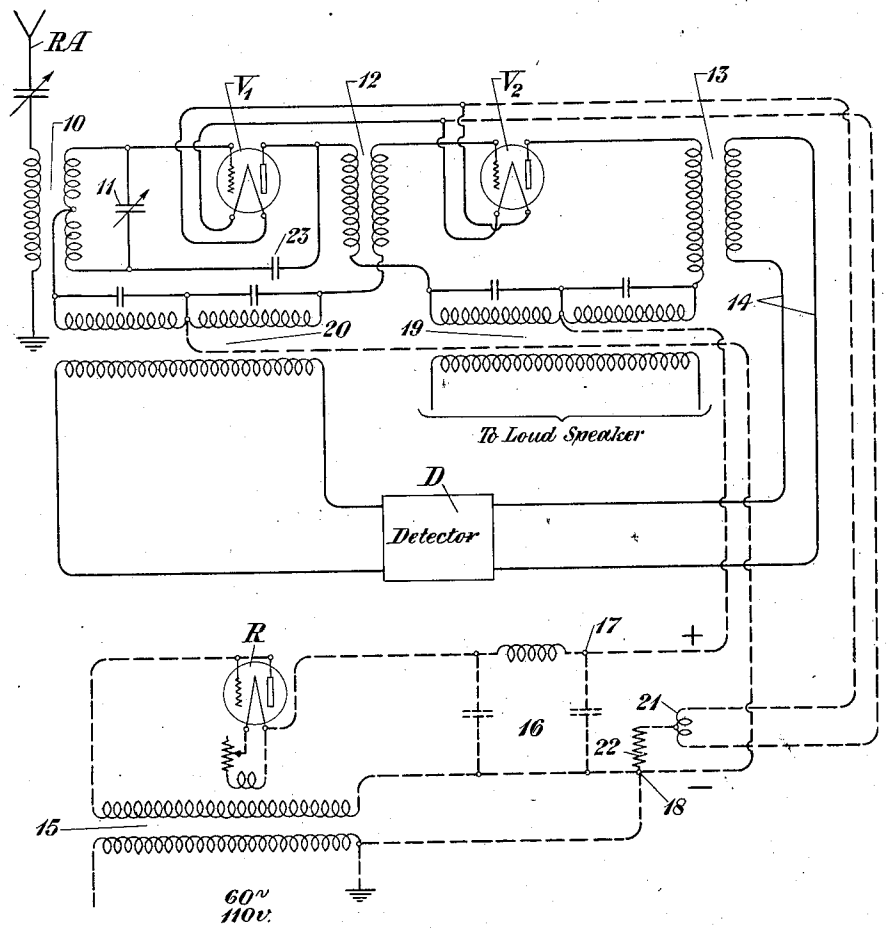
Sept. 1, 1925. 1,551,578

D. P. LOYE

RADIO RECEIVING CIRCUITS

Filed Oct. 1, 1924




INVENTOR

D. P. Loye

BY

ATTORNEY

Patented Sept. 1, 1925. 1,551,578

# UNITED STATES PATENT OFFICE.

DONALD P. LOYE, OF BROOKLYN, NEW YORK, ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

## RADIO RECEIVING CIRCUITS.

Application filed October 1, 1924. Serial No. 741,020.

*To all whom it may concern:*

Be it known that I, DONALD P. LOYE, residing at Brooklyn, in the county of Kings and State of New York, have invented certain Improvements in Radio Receiving Circuits, of which the following is a specification.

This invention relates to radio receiving circuits, and more particularly to receiving circuits to be used in connection with radio broadcasting.

One of the objects of this invention is to provide a radio receiving set in which the current supply for the vacuum tubes may be obtained from an alternating current power supply without obtaining an appreciable amount of hum in the receiver or loud speaker. Another object of the invention is to provide a radio receiving set in which certain of the tubes are operated upon the so-called reflex principle, the tubes operating in tandem at certain times and operating in a "push-pull" arrangement at other times. Other and further objects of the invention will be clear from the following description, when read in connection with the accompanying drawing, the figure of which illustrates the preferred form of the invention.

Referring to the drawing RA designates a receiving antenna with which is associated an amplifier comprising vacuum tubes $V_1$ and $V_2$. The vacuum tube $V_1$ has its input circuit coupled with the antenna through an input transformer 10, which may be tuned to the desired radio frequency by means of a condenser 11. The output circuit of the vacuum tube $V_1$ is coupled to the input circuit of the vacuum tube $V_2$ by means of a radio transformer 12. The output circuit of the vacuum tube $V_2$ in turn is coupled through a radio frequency transformer 13 to a detector circuit 14 including a detector schematically indicated at D. The detector may, if desired, include one or more stages of voice frequency amplification.

The grid, filament and plate potentials for operating the tubes are obtained from a suitable alternating current power source through a power transformer 15. In circuit with the secondary of this transformer is a rectifying tube R for rectifying the alternating waves. A suitable filter or smoothing-out circuit 16 is associated with the rectifier R so that across the terminals 17 and 18 a steady, direct potential may be obtained. Terminal 18 is grounded and terminal 17 is connected to the midpoint of the primary winding of a transformer 19, the terminals of the primary winding of said transformer being connected to the plates of the tubes $V_1$ and $V_2$. The so-called C or grid potential is supplied by connecting the negative terminal 18 to the midpoint of the secondary winding of a transformer 20, the outer terminals of said secondary winding being connected to the grids of the tubes $V_1$ and $V_2$, respectively. The alternating current for energizing the filaments of the vacuum tubes $V_1$ and $V_2$ is obtained from the power source by means of an auxiliary balanced winding 21, associated with a power transformer 15, the terminals of said winding 21 being connected to the filament terminals of the tubes. In order that the filament may be made less negative than the grid, a suitable resistance 22 through which the space current of tubes $V_1$ and $V_2$ flows, is inserted between the midpoint of the winding 21 and the terminal 18.

The vacuum tubes $V_1$ and $V_2$ are operated in tandem as high frequency amplifiers in accordance with the circuits above described. In order that the same tubes may be used as low frequency amplifiers in accordance with the well-known reflex principle, the output circuit of the detector D is connected through the audio-frequency transformer 20 to the grids of the two tubes. Likewise the plates of the two tubes are connected from the audio-frequency transformer 19 to a loud speaker or other form of receiving instrument (not shown). The secondary winding of the transformer 20 and the primary winding of the transformer 19 are bridged by small condensers as illustrated so that the radio frequency currents will not be choked out by the relatively high impedance of the windings of the transformers 19 and 20.

It will be observed that by means of the transformers 19 and 20 the tubes $V_1$ and $V_2$ are arranged in a "push-pull" circuit, thereby operating as a "push-pull" amplifier at low frequency. This arrangement has the advantage of eliminating to a great extent the alternating current hum experienced with the use of the usual house current for

filament, plate and grid potential. In the case of the two stages of radio frequency amplification, the hum is not a serious problem since the radio frequency transformers 10, 12 and 13 transmit practically no 60-cycle current (this being the ordinary frequency of an alternating current power source). There is, therefore, during the radio frequency stage, practically no possibility of the hum being heard except due to modulation, which would not occur with properly proportioned C potential and with the tubes not overloaded.

In the audio-frequency stage, the power frequency hum is eliminated to a large extent on account of the arrangement of the tubes in a "push-pull" circuit. With this arrangement, the alternating voltages affect both tubes alike at the same time, and consequently, these fluctuations are balanced out in transformers 19 and 20 and no appreciable hum is obtained in the loud speaker circuit (assuming that the circuit is properly balanced). The "push-pull" arrangement of the tubes has the further advantage of balancing out the curvature of the grid potential-space current characteristic of the tubes, thereby rendering the audio-frequency amplifier practically distortionless, and in addition, the circuit has the advantage of a greater capacity without overloading than can be obtained with a single tube amplifier.

If desired, a balancing condenser 23 may be connected between the lower terminal of the secondary winding of the transformer 10 and the plate of the vacuum tube $V_1$ to eliminate any tendency of the first tube to oscillate due to the inherent capacity between the grid and plate.

It will be obvious that the general principles herein disclosed may be embodied in many other organizations widely different from those illustrated without departing from the spirit of the invention as defined in the following claims.

What is claimed is:

1. In a reflex circuit, a pair of vacuum tubes, circuits interconnecting said tubes in tandem for one stage of amplification and circuits interconnecting said tubes in a "push-pull" arrangement for another stage of amplification.

2. In a reflex circuit, a pair of vacuum tubes, means to connect said tubes in tandem to form a high frequency stage of amplification and means to connect said tubes in a "push-pull" arrangement to form a lower frequency stage of amplification.

3. In a reflex circuit, a pair of vacuum tubes, means to interconnect said tubes in tandem, a detecting arrangement associated with the output circuit of the last tube of the tandem arrangement, means to connect said tubes in a "push-pull" arrangement, and means to connect the output side of said detector to the input side of the "push-pull" arrangement.

4. In a reflex circuit, a pair of vacuum tubes, radio frequency transformers for interconnecting said tubes in tandem, a detector associated with the output circuit of the last tube of the tandem arrangement, audio frequency transformers for connecting said tubes in a "push-pull" arrangement, and a connection between the output connection of said detector and the input side of said "push-pull" arrangement, whereby said tubes act as a "push-pull" amplifier at audio frequency and as a tandem amplifier at radio frequency.

5. In a reflex circuit, a pair of vacuum tubes, means to connect said tubes in tandem, means to energize the filaments of said tubes by alternating current, and means to connect said tubes in a "push-pull" arrangement to substantially balance out the alternating current hum.

6. In a reflex circuit, a pair of vacuum tubes, means to connect said tubes in tandem, means to energize the filaments of said tubes from an alternating current source, means to rectify alternating current from said source to supply the plate potential for said tubes, and means to connect said tubes in a "push-pull" arrangement to substantially balance out alternating current hum.

7. In a reflex circuit, a pair of vacuum tubes, means to connect said tubes in tandem, means to energize the filaments of said tubes from an alternating current source, means to rectify alternating current from said source, means to supply the grid potentials for said tubes, and means to connect said tubes in a "push-pull" arrangement to substantially balance out the alternating current hum.

In testimony whereof, I have signed my name to this specification this 26th day of September 1924.

DONALD P. LOYE.