Oct. 6, 1936. A. J. CAWLEY 2,056,824

VACUUM TUBE CIRCUITS

Original Filed Oct. 28, 1924

Fig. 1.

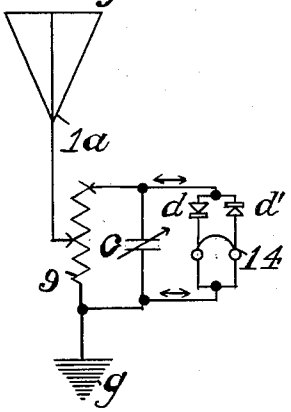


Fig. 2.

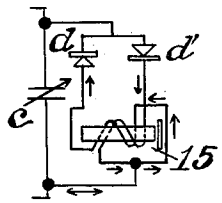


Fig. 3.

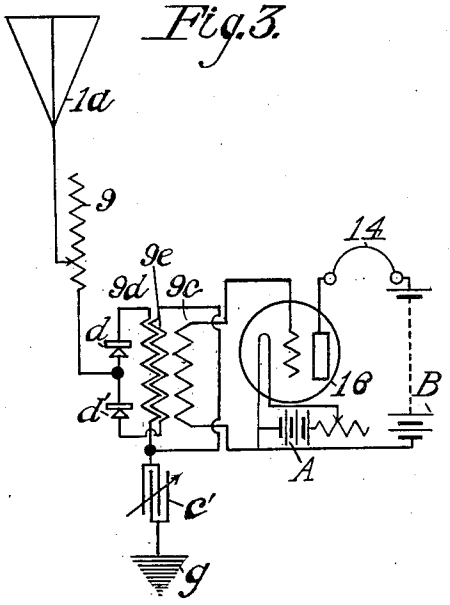
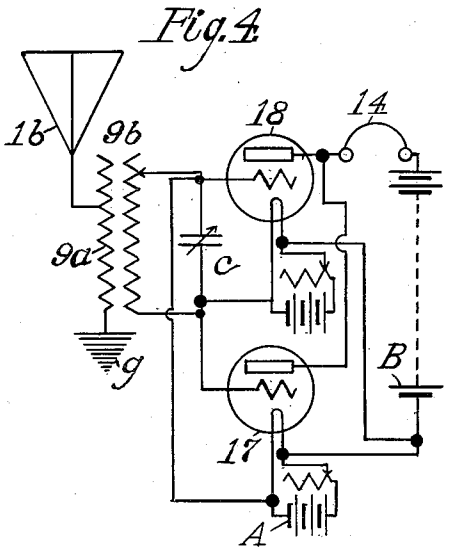


Fig. 4.



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VACUUM TUBE CIRCUIT

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Continuation of application Serial No. 746,347, October 28, 1924. This application November 2, 1932, Serial No. 640,804

1 Claim. (Cl. 250—21)

Some of the objects of the invention are:

Great economy in reception is obtained by means of the invention.

Another object of the invention is the saving and amplification of both components of the delicate radio frequency alternating currents generated by the incoming waves in the receiving circuits, one component being at present wasted in practice.

Another object of the invention is to supply both components of the alternating current to a differentially wound coil in order to obtain the additive effect of the two components.

Referring to the accompanying drawing forming a part of this specification, in which like characters of reference denote corresponding parts in all of the views,

Figure 1 illustrates a receiving station embodying the invention. Two crystal detectors are arranged in one arm of the oscillating circuit, the result being that neither component of the alternating current is quenched, but each component acts to operate one telephone receiver exclusive of the other.

Fig. 2 is a modification of Figure 1, differing in that a magnet of a sound reproducing means is provided having a double winding each containing a crystal. The arrangement is such that the alternating current is separated by the crystals into its components, and the latter are caused to pass through the two elements of the double winding in the same direction, thus additively operating the sound reproducer.

Fig. 3 illustrates a receiving station which is equipped with two crystal detectors which separate the two components of the alternating current and cause them to traverse the double winding of a primary of an induction coil in the same direction, thus additively inducing currents in the same direction in the secondary of this coil. This secondary current is supplied to an amplifying means, here shown as a vacuum tube circuit. This permits all of the current generated in the receiving antenna to be utilized in producing a loud sound reproduction in the telephones.

Fig. 4 illustrates a receiving station equipped with a coupling coil, and in the arms of the secondary oscillating circuit of this coil there are two vacuum tube circuits for the purpose of detecting and amplifying both components of the alternating current. Since such tubes possess unilateral conductivity, the alternating current in passing in one direction passes through one tube and in the other direction traverses the other tube. Both amplified components are fed to the same reproducing means, and are in the same direction.

In ordinary reception as in use at present, detecting means, such as vacuum tubes, crystals, etc., are used in such manner that they waste one component of the delicate high frequency alternating current generated in the receiving circuit by the incoming Hertzian waves. The present invention aims to overcome this, utilizing both components of the alternating current.

The waves are received by the antenna *1a* in Fig. 1. The usual tuning coil **9** and condenser *c* and ground *g* are shown in a form of circuit which is sometimes used, but the invention is not limited to any type of receiving circuit. Alternating currents are generated in circuit containing **9** and *c*. These in turn cause alternating currents to pass in the circuit containing *c* and the arm containing subarms supplied each with detectors *d* and *d'*. One subarm contains detector *d* and one magnet of a telephone head set **14**, the other contains detector *d'* and the other magnet of the head set. These detectors are so connected that they separate the components of the alternating current, and pass the two currents one through one magnet and the other through the other. Both components of the current are used and a sound reproduction of double intensity is obtained.

Fig. 2 shows a modification of Fig. 1 in which the circuit containing *c* and *d*, *d'* is modified. The two components of the alternating current are passed through two separate windings of a magnet of a sound reproducing means, in such manner that they traverse this magnet winding in the same direction, and bring about a unitary, additive reproduction of the sound, which is double that ordinarily obtained.

Still another form of receiver involving this invention is shown in Fig. 3. The waves are received by antenna *1a* and the generated alternating current traverses the tuning coil **9**, but then encounters detectors *d* and *d'*, each in a separate circuit. These detectors act to separate the two components of the alternating currents and sends each component through a separate winding of the primary of an induction coupling coil in such manner that they both traverse it in the same direction and induce currents additively in the secondary of this coil, shown at **9c**. One component passes through winding **9d** after being detected by crystal *d*; the other component is detected by *d'* and passed through winding **9e**. The current from **9** to *d*, *d'* is alternating, as is that from *c'* to ground. Through the pri-

mary winding, however, there are two pulsating currents in the same direction, which are added together and form a single pulsating unidirectional current. If desired, a capacitance of suitable magnitude may be included in the circuit governed by the detector *d* and an inductance of suitable form may be included in the circuit governed by *d'*. This will bring both components into the same phase.

The adaptation of the invention to another circuit is shown in Fig. 4. The electric waves generate alternating current in primary **9***a* of a coupling coil, after being received by the antenna **1***b*. A current is generated in secondary **9***b*. This produces an alternating current through condenser *c*. This, in turn produces another alternating current which is distributed through or between the two derived circuits containing, the one the vacuum tube **18**, and the other the vacuum tube **17**. The connections to each tube are of the same length on account of electromagnetic and electrostatic considerations, but the connections to tube **17** are shown longer for purposes of clear illustration. Obviously, since the tubes possess unilateral conductivity and as they are oppositely connected with respect to this property, one component of the alternating current is "detected" or transmitted by one tube, and the other component is "detected" by and transmitted to the other tube. Detection is merely the passing of one component of alternating current in one direction and the exclusion of the current passing in the opposite direction. Tubes **17** and **18** are detector-amplifying tubes. The arrangement shown, therefore, acts to detect and amplify both components of the delicate alternating current generated by the incoming waves in the receiving circuits. The output of both tubes must of necessity be in the same direction. This output current is an interrupted, unidirectional, amplified current which operates a sound reproducer, here shown as head phones **14**. Obviously the output of those tubes may be supplied to other amplifying means, such as further vacuum tube sets arranged in as many stages of amplification as desired. Figs. 3 and 4 "A" and "B" signify filament and plate batteries respectively, as used in ordinary radio practice. Hundreds of modifications may be suggested without departing from the spirit of the invention. For instance, radio frequency transformers might be provided, and the present system of double detection utilized. However, illustration of such would not aid in amplifying the disclosure of the invention, but merely indicates its scope.

The invention is based on the fact that an electric current follows the path of the least resistance. "Detectors", as used in wireless telephony and telegraphy simply act by offering a resistance in one direction only to an electric current. In circuits described, the current automatically selects the path of the least resistance.

This application is a continuation application of Serial No. 746,347, filed Oct. 28, 1924, for Wireless system.

Having described my invention, I claim as new and desire to secure by Letters Patent:

In combination a circuit in which alternating current flows, two subcircuits in cooperative relation with said circuit, a rectifying means in each of said subcircuits, said rectifying means being oppositely connected in order that but one component of said alternating current flows in each of said circuits, means for converting electric current into sound waves, said means being provided with a two coil magnet, said coils being oppositely wound in order that said components shall traverse said converting means in the same direction, each of said coils being connected in each of said subcircuits in order that the components of said alternating current shall act additively to operate said means for converting current into sound waves.

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