W. SCHLOEMILCH & O. VON BRONK.

MEANS FOR RECEIVING ELECTRICAL OSCILLATIONS.

APPLICATION FILED MAR. 14, 1913.

1,087,892. Patented Feb. 17, 1914.

2 SHEETS—SHEET 1.

Fig. 1.

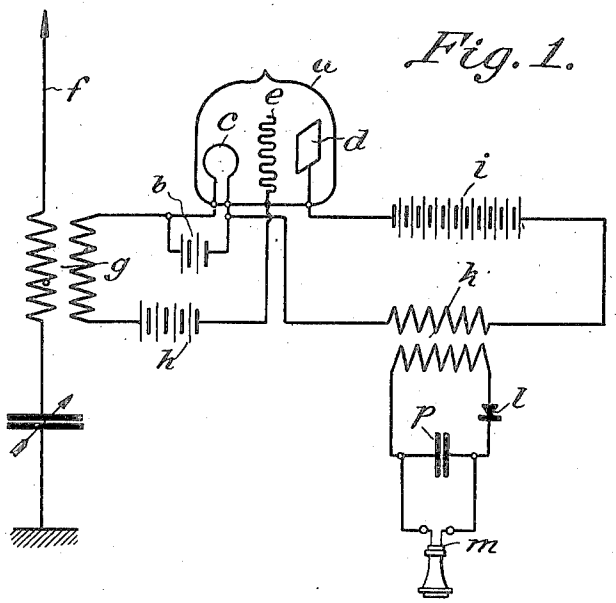
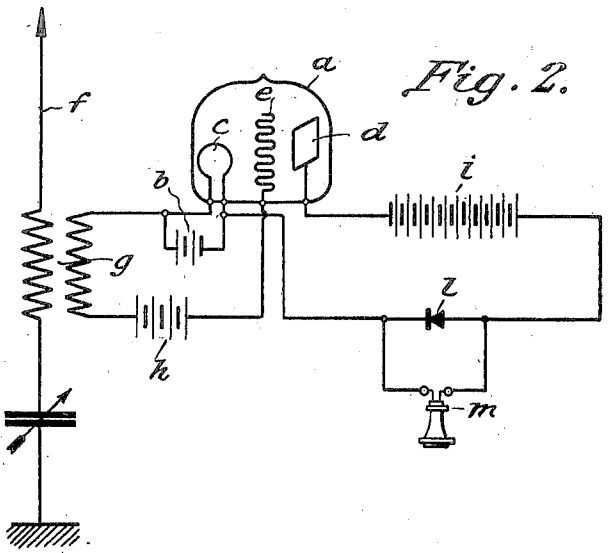


Fig. 2.



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2 SHEETS—SHEET 2.

Fig. 3.

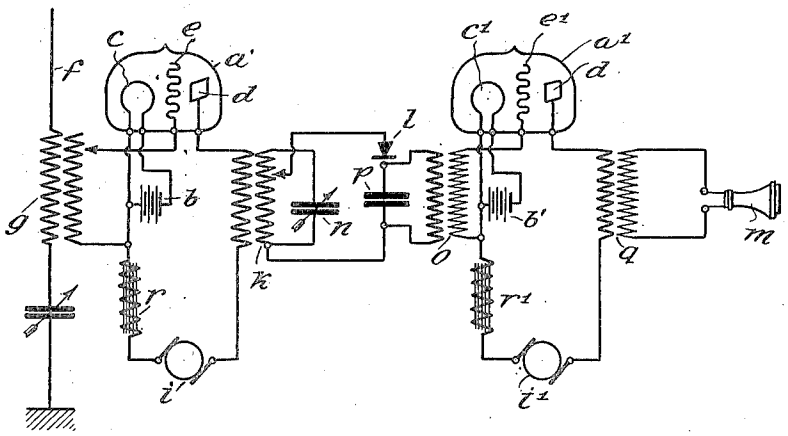
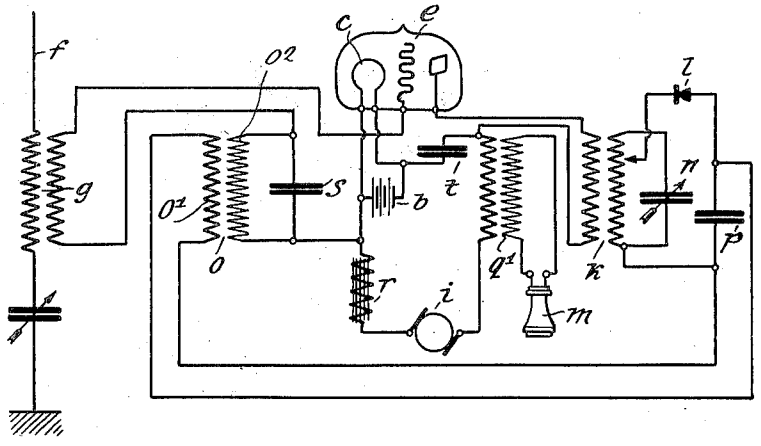


Fig. 4.



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MEANS FOR RECEIVING ELECTRICAL OSCILLATIONS.

1,087,892. Specification of Letters Patent. Patented Feb. 17, 1914.

Application filed March 14, 1913. Serial No. 754,287.

To all whom it may concern:

Be it known that we, WILHELM SCHLOEMILCH and OTTO VON BRONK, citizens of the German Empire, and residing at Berlin, Germany, have invented certain new and useful Improvements in Means for Receiving Electrical Oscillations, of which the following is a specification.

Our invention relates to means for receiving electrical oscillations by means of an arrangement by which the amplitude of the oscillations is increased to a suitable extent, and which permits the use of a detector such that the oscillations can be perceived more distinctly in the telephone usually employed for perceiving the oscillations, than was the case heretofore.

In the art of wireless telegraphy receivers are known in which the electrical oscillations are detected by means of vacuum tubes provided with a heated cathode and one or more cold anodes. In such known arrangements only the unipolar conductivity of the gaseous medium, forming the current, and which is ionized by the heated electrode is made use of to transform the electrical oscillations into pulsating direct currents, so that they can be perceived by means of a telephone or other suitable direct current instrument.

A primary object of our invention is to provide an arrangement for receiving electrical oscillations, in which not the so-called valve action of such vacuum tubes for detecting the oscillations is made use of, but in which the vacuum tube serves only for increasing the electrical oscillations irrespectively of the change of the curve form of the oscillations due to the valve action of the tube. To this end we arrange that the electrical oscillations are not, as has been the case heretofore, detected by the vacuum tube itself, but by means of special indicators, such as thermo-electric cells, or electrolytic rectifiers or the like.

Several illustrative embodiments of our invention are diagrammatically represented in the accompanying drawings, wherein:—

Figure 1 is a diagram showing an arrangement comprising a strengthening vacuum tube and a detector circuit separate therefrom, Fig. 2 is a like view showing an arrangement comprising a detector connected into the circuit of the tube itself, Fig. 3 is a like view showing an arrangement in which the amplitude of the oscillations is repeatedly increased by several tubes, and Fig. 4 is a like view showing an arrangement in which the amplitude of the oscillations is repeatedly increased by one and the same tube.

In the diagram shown in Fig. 1, *a* is the vacuum tube which contains the oxid-cathode *c* which is heated by means of battery *b*. The tube further contains the anode *d* and the auxiliary anode *e* which preferably has the form of a screen or net. *f* is the aerial and *g* the transformer connected with the aerial, the secondary coil of transformer *g* being in circuit with auxiliary battery *h*, the auxiliary anode *e* and the cathode *c*. Moreover a second circuit is arranged which contains the primary coil of the transformer *k*, the battery *i*, the anode *d* and cathode *c*. The secondary coil of transformer *k* forms the detector circuit with the detector *l* and the condenser *p*, to which latter a telephone *m* or other suitable means for perceiving the oscillations are connected in shunt. The effect of this arrangement is that the radiated energy arriving at *f* sets up oscillations in the circuit which contains the secondary of transformer *g* and that these oscillations affect a direct current supplied by battery *h* in such manner that the ion current flowing between the cathode *c* and the auxiliary anode *e* is increased when the oscillations occur in one direction, and counteracted when they occur in the other direction. By this action not only the resistance of the portion of the circuit located between the auxiliary anode *e* and the cathode *c* is correspondingly varied, but the entire ion current between the cathode *c* and the anode *d*, which flows with the current of the battery *i*, is influenced in the rythm of the oscillations. Consequently between the points *c* and *d* a high-frequency direct current of the same periodicity as the original current pulsates, whose amplitude however is larger than that of the original high-frequency oscillations, because this amplitude depends upon the potential of the auxiliary source of current *i*, which exists between the points *c* and *d*.

and which is chosen sufficiently high for this purpose.

In the connections known heretofore the telephone or other sensitive direct-current instrument was connected in the circuit containing the source of current *i*. It is, however, obvious that in such an arrangement the relay-action of the tube could not make itself felt, because the high-frequency electric oscillations cannot, as is well known, directly influence such instruments. For detecting the oscillations, only the relatively small unipolar conductivity of such gaseous currents accordingly came into consideration heretofore. According to our invention the relay-action of such vacuum tubes is utilized by adding a special detector for rectifying the oscillations. In the connection shown in Fig. 1 this is effected by the increased pulsating-current being transmitted with the aid of the transformer *k* to a separate receiving circuit and being here rectified by the detector *l* so that they become operative in the telephone *m*. It is not always necessary, however, to connect the detector in a separate circuit, as shown in Fig. 1. If desired it may be connected directly in the circuit of the battery *i*, as shown in Fig. 2. This is possible, for example, when a magnetic detector is used. In the connection shown in Fig. 1, when regular impulses are being transmitted as with radiotelegraphic singing senders, the detector supplies regular, low-frequency, pulsating direct currents in the detector circuit or, when speech is being transmitted in telephony, irregular, direct-current fluctuations likewise of low frequency. These impulses or currents of low frequency supplied by the redresser can be increased by similar gaseous currents before they are supplied to the telephone or to another indicating instrument. A specially simple and very effective arrangement is obtained when one and the same gaseous current is used both for increasing the high frequency oscillations and also for increasing the low-frequency currents. Fig. 3 shows an arrangement for obtaining such repeated increase by means of several gaseous currents. Here again, *a* designates the vacuum tube having the oxid cathode *c*, heated by the battery *b*, the anode *d* and the auxiliary anode *e*. The oscillations produced by the aerial *f* in the winding *g* are supplied, as in the embodiment shown in Fig. 1, to the auxiliary anode *e* and to the cathode *c*. The increased high-frequency oscillations then flow in the circuit closed by the source of direct current *i* over the cathode *c* and anode *d* and are supplied from this circuit by means of the transformer *k* to the detector circuit comprising the detector *l* and condenser *p*. An intermediate circuit *n* syntonized to the oscillations will preferably be provided. The low-frequency impulses or currents supplied by the detector *l* are now supplied over a second transformer *o* and a second vacuum tube a_1 having the cathode c_1, the anode d_1 and the auxiliary e_1, and are increased again by this tube, and the increased currents of low frequency are finally supplied from the circuit of the source of direct current i_1 through another transformer *q* to the telephone *m* or other indicating instruments. Obviously the currents could be increased still further by additional vacuum tubes.

In the two embodiments shown in Figs. 1 and 2 a battery of accumulators is assumed to constitute the source of current flowing between the anode *d* and cathode *c*, while in the connection last described with reference to Fig. 3 direct-current machines are shown. When machines are used it is necessary to connect choking coils *r* and r_1 in series therewith. The direct current supplied by a commutator machine is, as is well known, not quite uniform, but fluctuates regularly small amounts. These fluctuations would be noticeable in the receiving telephone as a disturbing extraneous noise. By means of the suitably designed choking coils *r*, r_1 these fluctuations are suppressed and the disturbances are thereby obviated.

The current can be amplified to twice its normal amount in a simple manner by means of one and the same vacuum tube in the connection shown in Fig. 4. In this embodiment the detector-circuit is again connected over a transformer *o* with the high-frequency circuit of the coil *g*, the primary coil of this transformer o_1 branching off from the condenser *p* of the detector-circuit and the secondary coil o_2 being connected directly in the circuit of the coil *g*. Accordingly, the low-frequency currents are supplied by the detector over the transformer *o* to the cathode *c* and auxiliary anode *e* of the tube *a* exactly in the same manner as the high-frequency oscillations. In order that the latter may not be choked by the transformer *o*, the secondary coil has connected in parallel with it a condenser *s* which offers no resistance to the high-frequency oscillations, but does not allow the low-frequency oscillations to pass without equalization. A condenser of the order of magnitude of about 5000 cm. capacity has been found suitable for this purpose. Now in order to be able to supply the increased low-frequency alternating-currents from the circuit of the source of direct current *i* to the telephone *m*, the primary coil of a transformer q_1 is connected in this circuit, the secondary coil being connected with the indicating instrument *m*. A path for the increased high-frequency oscillations which does not lead over the transformer must be

made in this circuit of the source of direct current i by means of a second condenser t connected in parallel with the primary coil of the transformer q_1. By means of this connection we provide that the received high-frequency oscillations are supplied only over the vacuum tube into the detector-circuit and that the low-frequency currents supplied by the detector are supplied likewise only over the same strengthening tube to the telephone.

We claim:—

1. In an arrangement for receiving oscillations, the combination with means for receiving high frequency oscillations, of means for intensifying such oscillations, comprising a vacuum tube containing a permanently ionized gas and a circuit for conducting said oscillations through said gas, a second circuit containing a direct current source and the ionized gas, whereby said oscillations are super-imposed upon the direct current passing through said gas, causing the generation of an intensified pulsating direct current of the same frequency as the high frequency oscillations, and means for perceiving the said intensified pulsations, comprising a detector placed in coöperative relation with said second circuit and means connected with said detector and responsive to low frequency current impulses only for observing the impulses produced by said detector.

2. In an arrangement for receiving oscillations, the combination with means for receiving high frequency oscillations, of means for intensifying such oscillations, comprising a vacuum tube containing a permanently ionized gas and a circuit for conducting said oscillations through said gas, a second circuit containing a direct current source and the ionized gas, whereby said oscillations are super-imposed upon the direct current passing through said gas, causing the generation of an intensified pulsating direct current of the same frequency as the high frequency oscillations, and means for perceiving the said intensified pulsations, comprising a detector and a circuit containing it, means for directly coupling said second circuit with said detector circuit, and means connected with said detector and operating independently of said second circuit, for observing the impulses produced in said detector.

3. In an arrangement for receiving oscillations, the combination with means for receiving high frequency oscillations, of means for intensifying such oscillations, comprising a vacuum tube containing a permanently ionized gas and a circuit for conducting said oscillations through said gas, a second circuit containing a direct current source and the ionized gas, whereby said oscillations are super-imposed upon the direct current passing through said gas, causing the generation of an intensified pulsating direct current of the same frequency as the high frequency oscillations, and means for perceiving the said intensified pulsations comprising a transformer having its primary coil in said second circuit, a detector in circuit with the secondary coil of said transformer, and means connected with said detector and operating independently of said second circuit for perceiving the impulses produced in said detector.

4. In an arrangement of the character described, the combination with means for receiving electric oscillations, of a vacuum tube containing a gaseous medium and also containing a cathode, having an auxiliary battery connected with it for heating the cathode to ionize the gaseous medium, and an anode and an auxiliary anode interposed between said cathode and anode; an electric circuit containing said receiving means, said auxiliary anode and said cathode, whereby said oscillations aid the ion current between the cathode and auxiliary anode when oscillating in one direction, but weaken said current when oscillating in the other direction; a second electric circuit, containing a source of direct current, a primary transformer coil and having connection with said anode and cathode, whereby the circuit is closed by said gaseous medium, so that in said second circuit pulsations of the same frequency but larger amplitude are produced; and a detector-circuit containing a transformer coil coupled with said first named coil, a detector and means for perceiving said oscillations of larger amplitude.

5. In an arrangement of the character described, the combination with means for receiving electric oscillations, of a vacuum tube containing a gaseous atmosphere, means for ionizing the gas, an electric circuit operatively connected with said receiving means and containing the secondary coil of a transformer, a condenser, connected in parallel with the coil of said transformer, and the ionized gas in order to allow the oscillations to flow over said condenser through the ionized gas; a second circuit comprising a source of current and the primary coil of a second transformer, a second condenser connected in parallel with the latter coil, a coil of a third transformer, and also comprising the ionized gas for producing in this circuit direct current pulsations of the same frequency as said oscillations, but of larger amplitude; and a detector-circuit, comprising a transformer coil, coupled with the said coil of the third transformer and containing a detector for producing low frequency pulsations, said detector-circuit being connected with the primary coil of the said first trans-

former, this transformer which conducts the currents of low frequency of the detector-circuit into the said former circuit, being connected with the receiving means and the vacuum tube; the ionized gas of the same said tube producing in the said second circuit, containing the source of direct current, currents of the same frequency as the said detector currents, but of larger amplitude; and means connected with the secondary coil of said second transformer for perceiving said larger currents of low frequency.

In testimony whereof, we affix our signatures in the presence of two witnesses.

WILHELM SCHLOEMILCH.
OTTO v. BRONK.

Witnesses:
HENRY HASPER,
WOLDEMAR HAUPT.