A. MEISSNER.

MEANS FOR PRODUCING ALTERNATING CURRENT BY CATHODE RAY TUBES.

APPLICATION FILED JUNE 2, 1915.

1,170,552.

Patented Feb. 8, 1916.

3 SHEETS—SHEET 1.

FIG. 1.

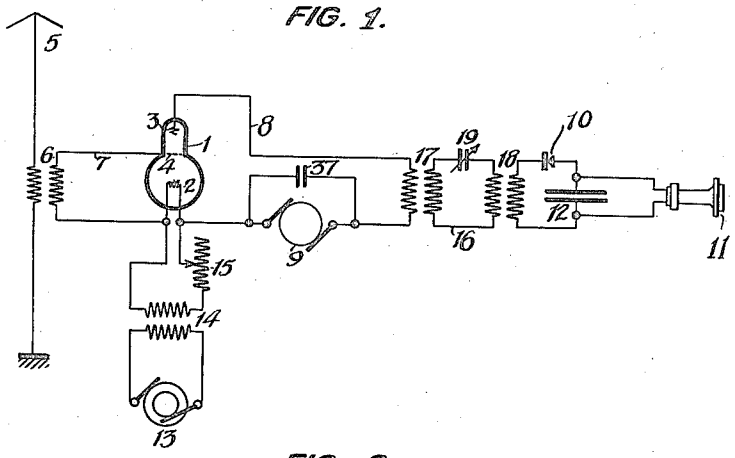

FIG. 2.

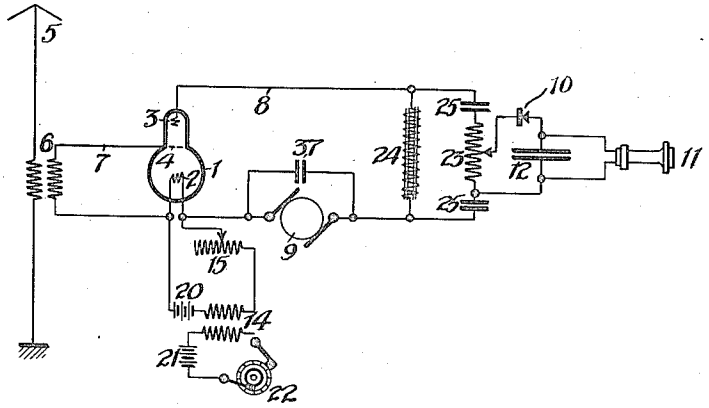

FIG. 3.

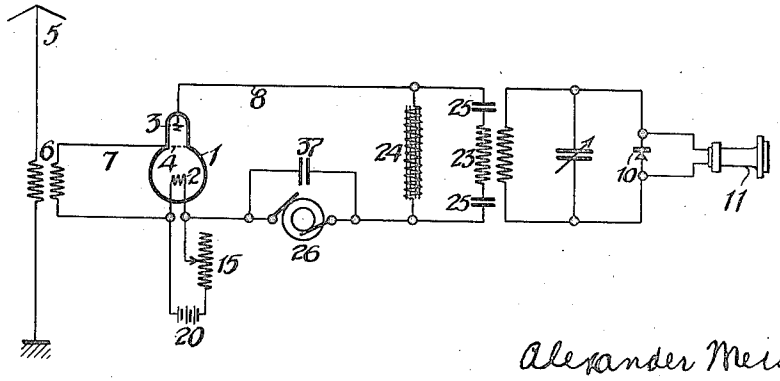

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FIG. 4.

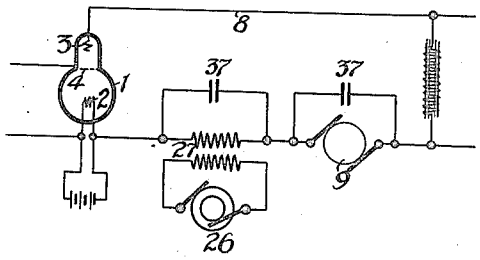


FIG. 5.

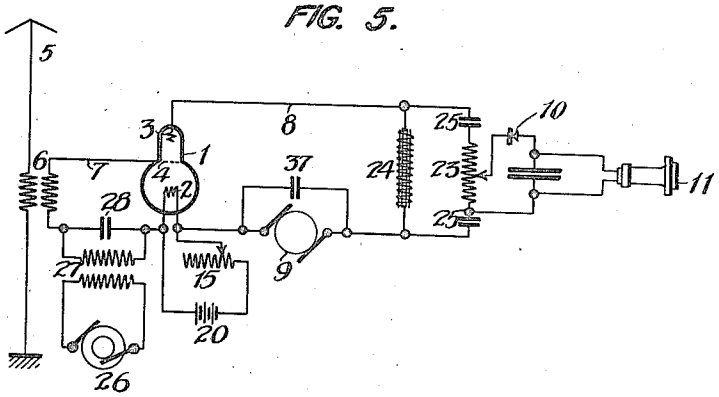
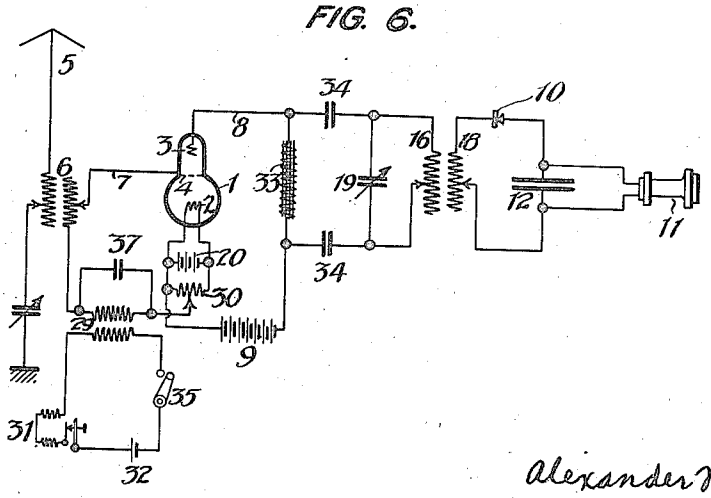


FIG. 6.



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3 SHEETS—SHEET 3.

FIG. 7.

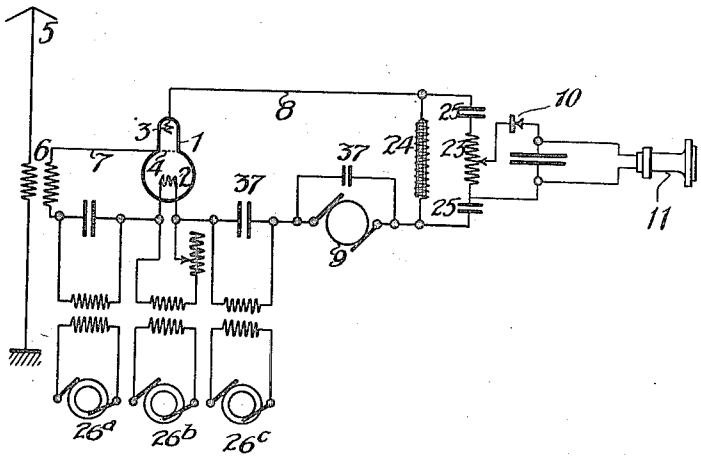
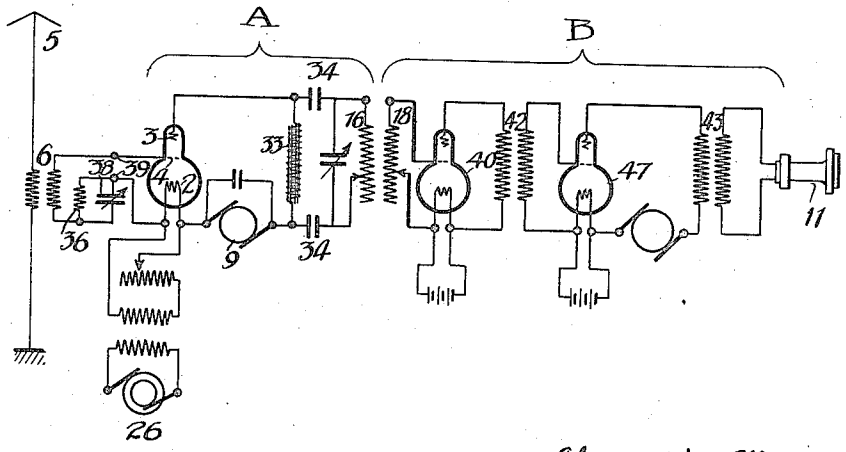


FIG. 8.



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UNITED STATES PATENT OFFICE.

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MEANS FOR PRODUCING ALTERNATING CURRENT BY CATHODE-RAY TUBES.

1,170,552. Specification of Letters Patent. Patented Feb. 8, 1916.

Application filed June 2, 1915. Serial No. 31,736.

To all whom it may concern:

Be it known that I, ALEXANDER MEISSNER, subject of the Austrian Emperor, and residing in Berlin, Germany, have invented certain new and useful Improvements in Means for Producing Alternating Current by Cathode-Ray Tubes, of which the following is a full and clear specification, illustrated in the annexed drawings.

The particular novel features of my invention are pointed out more fully in the annexed claims.

In transmitting signals by means of electrical oscillations, lately aperiodic amplifying relays have been used at the receiving station for amplifying the weak currents received in the antenna. These relays act through the medium of a gaseous path ionized by an incandescent cathode or similar means and by virtue of their lack of mechanical inertia, such relays are capable of responding to the electric oscillations of high frequency. Therefore, these relays are particularly adapted in wireless telegraphy for amplifying the high frequency currents at the receiving station before these currents are conducted to the indicating means.

The subject matter of the present invention is an arrangement by which it becomes possible to simultaneously use the relay as an energy transformer for the received oscillations. This novel effect is brought about essentially by affecting the relay through periodic electric impulses. A relay thus affected is particularly suited for receiving sustained undamped electric oscillations. If the periodic affection occurs in the rhythm of a good audible tone it becomes possible to perceive the continuous oscillations in the form of a pure tone which is easily distinguishable from atmospheric disturbances. Consequently the relay thus affected replaces the well known devices for receiving sustained oscillations of high frequency, such as for instance the ticker, or receiving by beats and the like, which have heretofore been used for receiving such oscillations. Besides, the novel arrangement has the advantage of the tone produced being very pure and almost entirely independent of the unavoidable variations of the high frequency periodicity. Besides this use of this energy transformer it is capable of other uses, for instance, it becomes possible by its application in case of receiving singing sparks to remove interference by other stations.

The invention is particularly useful and effective when cathode ray relays are used which are provided with an incandescent cathode, an anode, and one or several auxiliary electrodes. Several attempts have been made before to affect gaseous detectors in a similar way. However, no results could be obtained, because an effective transmission was not attainable and it was not possible to keep the periodical local energy from the indicating instrument, so that it was always heard in the telephone. The desired effect, on the other hand, is particularly satisfactorily obtained if a relay of the described character is used in conjunction with a certain connection to the indicating circuit, by which the periodic auxiliary energy appears only at the actual time at which such high frequency energy is supplied to the entire arrangement which it is desired to receive in the indicating instrument. The transmission of the low frequency auxiliary energy to the indicator is best prevented by interposing a loose inductive coupling between the relay and the indicator. By indicating instrument or indicator I mean telephones and telephone circuits or equivalent means known in the art. This loose coupling only constitutes a small transmission resistance for high frequency currents, but a high resistance for low frequency currents. Thus essentially only the high frequency currents are transmitted and perceptible in the indicator owing to the transformation effected by the low periodicity auxiliary frequency. The periodic influence itself may be very simply brought about by supplying one of the circuits connected to the relay, for instance, the one connected with the auxiliary anode, the so-called grid circuit, or the anode circuit, or also the incandescent circuit, directly with alternating—or interrupted direct current, or by affecting these above named circuits suitably by such currents. The transformation then occurs in such form that when, for instance, undamped oscillations are received with the arrangement, the constant amplitude of the high frequency oscillations are so varied with the periodicity of the auxiliary current, that they form rising and falling trains of energy which correspond with

the rhythm of the auxiliary current. In certain cases the amplitudes may also be increased thereby; however, this is only a collateral issue, the principal feature being the transformation of the oscillations.

In the accompanying drawings the new arrangement is shown in several modifications in which—

Figure 1 shows an arrangement in which an auxiliary alternating current is supplied to the incandescent circuit of the relay, and in which the connection of the receiving instruments with the relay is effected by a closed oscillation circuit. Fig. 2 shows a modification in which interrupted direct current is superimposed to the filament current and this has an aperiodic connection between the relay and the indicating instruments. Figs. 3 and 4 show the use of a periodic auxiliary current in the anode circuit of the relay. Figs. 5 and 6 show the application of a periodic auxiliary current in the circuit of the auxiliary electrode. Fig. 7 shows the simultaneous effect of the periodic auxiliary current upon all circuits of the relay, and Fig. 8 shows a receiving arrangement for wireless telegraphy, in which cathode ray tubes are also used in the detector circuit and for amplifying the low frequency impulses before they reach the receiver.

In Fig. 1, (1) is the tube of a periodic relay, (2) is the cathode, (3) the anode and (4) a grid-shaped auxiliary electrode, disposed between the cathode and anode. The receiving currents are conducted, for instance, from the antenna (5) through the inductive coupling (6) to the relay by means of a circuit (7), which includes the cathode (2) and the auxiliary electrode (4). The currents are derived from the relay by means of circuit (8), which includes the anode (3) and the cathode (2) and the source of energy (9), in which case a small condenser (37) is located in shunt to the energy source (9) to permit the passing of the high frequency currents. The instruments for rendering perceptible the received high frequency energy consists, for instance, of the detector (10) and the telephone (11), which latter is connected with the detector circuit through the blocking condenser (12).

The heating of cathode (2) of the relay occurs according to Fig. 1 by means of an alternating current machine (13), which is coupled with the cathode heating circuit by means of a transformer (14). A regulating resistance (15) is provided in the secondary circuit of this transformer. The coupling of the detector circuit with circuit (8) is brought about by means of the closed oscillation circuit (16) coupled with circuit (8) by means of transformer (17) and with the detector circuit by means of transformer (18). Besides, this circuit contains a tuning condenser (19). The operation of this arrangement is as follows: The amount of electrons emanating from the cathode is approximately proportional to the momentary value of the heating current. Therefore the emanation of electrons occurs in the rhythm of the alternating current of generator (13), and therefore according to this rhythm the electric high frequency oscillations are transferred from circuit (7) through the relay into circuit (8). During such transfer as has been pointed out at the beginning, the continuous oscillations are transformed into undulating trains of energy. This high frequency current thus transformed, and under certain circumstances even amplified, is transferred into the closed oscillation circuit (16) through coupling (17) and thence into the detector circuit, as described above. In this latter circuit it is rectified by detector (10) and transformed into direct current impulses which are audible in telephone (11).

By the periodic heating current which flows through cathode (2), the otherwise constant direct current supplied by the source of energy (9) to the anode circuit (8) is varied so, that it pulsates in the rhythm of the periodic heating current. However, the circuit containing the indicating instruments is at the same time constituted so according to the present invention, that these impulses alone cannot be perceived, but only the high frequency oscillations transformed into impulses by means of the periodic auxiliary energy of generator (13). Thus, the tone effect of the auxiliary energy can be perceived in the receiving instrument only when simultaneously high frequency energy is supplied to the relay; in other words, in this latter case only the signals of the transmitting station are heard in the form of tones. The means to attain this result consist in providing such means in or adjacent to the circuit containing the indicating instruments, that this circuit constitutes a high resistance for low frequency currents, whereas high frequency oscillations are readily permitted to pass. In the modification according to Fig. 1 for this purpose the closed circuit (16) is provided, which is tuned to the high frequency oscillations and the indicator circuit is coupled loosely by this circuit (16) with the relay circuits. This inductive loose coupling which is suited best for the purpose of high frequency selection, as has been already mentioned, may be made in this case either between the relay circuit (8) and circuit (16), or also between the latter circuit and the detector circuit. It is true, the low frequency impulses of circuit (8) will in this case still flow through the primary coil of transformer (17), but they are already so weak in circuit (16) that they cannot be perceived any more in the detector circuit.

Instead of heating the cathode by means

of an alternating current, the same effect may of course be obtained by superimposing a periodic current upon direct current which then serves for heating the cathode. This is shown, for instance, in Fig. 2, in which the heating current is furnished by the battery (20) and wherein an alternating current is superimposed upon this current which is supplied by the secondary coil of a transformer (14). In this case, instead of supplying alternating current to the primary coil of this transformer, pulsating direct current may be supplied to the transformer (14), which is furnished by battery (21) and the interrupter (22). To use interrupted direct current is particularly convenient in case of small stations, because in this case an ordinary buzzer can be used.

Fig. 2 further shows a modified connection between the relay (1) and the detector circuit containing the telephone. In this modification the detector circuit is coupled conductively with the circuit (8) by means of a coupling coil (23).

In order to keep away from the telephone the low frequency impulses occurring in circuit (8), a choking coil (24) is arranged in parallel to coupling coil (23). Moreover in the anode circuit two small condensers (25) are arranged one on each side of coupling coil (23). By this expedient two ways are produced for the current in the anode circuit of which the one over choking coil (24) only conducts the low frequency impulses which cannot pass over the condensers (25), whereas the other way (23) (25) only conducts the transformed high frequency currents which find this way only a small resistance, whereas the path through choking coil (24) constitutes a great resistance for high frequency oscillations. In this manner, exactly like in the arrangement according to Fig. 1 a sustained tone corresponding to the periodicity of interrupter (22) is avoided. This arrangement according to Fig. 2 in contradistinction to that shown in Fig. 1 is an aperiodic receiving arrangement. It is therefore well fitted for quickly finding frequencies of unknown wave lengths as well as undamped or damped oscillations.

Instead of affecting relay (1) periodically through the heating circuit, it may be so affected also through one of its other circuits. For instance, Fig. 3 shows the use of an alternating current generator (26) as source of energy in the anode circuit (8) of the relay, instead of the direct current generator (9) shown in Figs. 1 and 2. By using an alternating current at this point, a similar effect is produced as has been explained above, with regard to Fig. 1. Also in this case, as is shown in Fig. 4, the alternating current from generator (26) may be superimposed upon a direct current supplied by generator (9) which, in this case, is retained in the anode circuit. This is effected by means of a transformer (27). Lastly, the relay may be periodically affected through its grid circuit (7). Fig. 5 shows an arrangement to that effect. The current of the alternating current generator in this case is transferred into circuit (7) by means of transformer (27) and in this case a condenser (28) is arranged in shunt to the secondary coil of this transformer.

Another modification is shown in Fig. 6. In this form alternating current is superimposed upon grid circuit (7) by the secondary coil of transformer (29), whereas from the heating battery (20) by means of a potentiometer (30) a certain potential is impressed upon grid (4). The primary coil of transformer (29) is supplied with interrupted direct current, for instance, produced by buzzer (31) and battery (32): It is necessary that the condenser (37) be placed in parallel to the secondary transformer coil for the passage of the received oscillations. The transfer of the transformed high frequency oscillations from circuit (8) into the detector circuit occurs in this case again by means of a closed oscillation circuit (16) which may be, for instance, directly connected with circuit (8); the loose inductive coupling between the relay and detector circuit in this case is effected by suitably coupling the two coils of transformer (18). In circuit (8) a choking coil (33) is provided for the direct current of battery (9); the high frequency oscillations reach the indicator circuit by way of condensers (34). The affecting of grid (4) by alternating current, as described, is of particular advantage for the reason that already a very effective transformation of energy may be brought about with a comparatively small local energy. For this purpose an ordinary buzzer is already sufficient. In this case also the arrangement of the relay as high frequency amplifier may be retained without change, so that it becomes possible by using a switch (35) in the buzzer circuit, to use the same arrangement as amplifier for damped oscillations arriving already in groups, as also for sustained oscillations, as the case may be. Further, it is of course possible to periodically affect simultaneously several circuits connected with the relay. For instance, Fig. 7 shows an arrangement in which for each of the three circuits, grid circuit, heating circuit and anode circuit, a separate alternating current generator (26^a), (26^b), (26^c) may be provided. These generators may be arranged coupled to one shaft, or all three circuits may be supplied by one generator.

In Fig. 8 is shown a receiving arrangement, which can be used as a normal receiver for wireless telegraphy, and in which

the described high frequency transformation may be used. In this case, a receiving circuit (36) is coupled with the antenna (35) and tuned to the high frequency oscillations by means of condenser (38). To the binding posts (39) of this circuit to which ordinarily the detector is connected, in the present case the above described high frequency transformer "A" is connected, which consists of the periodically affected relay (1). The high frequency currents transformed into low frequency impulses are then conducted to the receiving arrangement "B". The latter may consist, for instance, of a cathode ray tube (40) which in this case acts essentially only as a rectifier instead of a detector, and a second cathode ray tube (41) connected with tube (40) by means of transformer (42). Tube 47 acts as amplifier of the low frequency impulses furnished by tube (40). Telephone (11) is in this case connected by a further transformer (43) with amplifier (47). Investigations with arrangements such as described above have shown that they are well apt to remove the effects of atmospheric disturbances, and also particularly interferences from other stations. The effect of atmospheric disturbances can be avoided in case impulses of a singing spark transmitter are received by the present arrangement.

What I claim is:—

1. In a receiving arrangement for sustained high frequency electric oscillations, the combination with a circuit for receiving said oscillations and an aperiodic gaseous relay having an incandescent cathode, an anode and auxiliary electrodes therebetween, an indicator, local source of energy for rendering said relay operative, and circuit connections between the relay and the receiving circuit and the indicator, of auxiliary means for affecting said relay and said high frequency oscillations passing therethrough by periodical low frequency current impulses, and means for preventing said impulses from affecting the indicator, except in combination with said high frequency oscillations.

2. In a receiving arrangement for sustained high frequency electric oscillations, the combination with a circuit for receiving said oscillations and an aperiodic gaseous relay having an incandescent cathode, an anode and auxiliary electrodes therebetween, an indicator, local source of energy for rendering said relay operative, and circuit connections between the relay and the receiving circuit and the indicator, of auxiliary means for affecting said relay and said high frequency oscillations passing therethrough by periodical low frequency current impulses, and means located between the relay and the indicator, having two current paths, of which one constitutes a low resistance for the low frequency current impulses, but a high resistance for high frequency oscillations, and the other path constitutes a low resistance for the high frequency oscillations affected by said low frequency impulses, but a high resistance for the low frequency impulses alone, said indicator being suitably connected with the latter path.

3. In a receiving arrangement for sustained high frequency electric oscillations, the combination with a circuit for receiving said oscillations and an aperiodic gaseous relay having an incandescent cathode, an anode and auxiliary electrodes therebetween, an indicator, local source of energy for rendering said relay operative, and circuit connections between the relay and the receiving circuit and the indicator, of auxiliary means for affecting said relay and said high frequency oscillations passing therethrough by periodical low frequency current impulses, and means located between the relay and the indicator, having two current paths, of which one constitutes a low resistance for the low frequency current impulses, but a high resistance for high frequency oscillations, and the other path constitutes a low resistance for the high frequency oscillations affected by said low frequency impulses, but a high resistance for the low frequency impulses alone, said indicator being suitably connected with the latter path, said low frequency impulses corresponding with the frequency of audible tones.

4. In a receiving arrangement for sustained high frequency electric oscillations, the combination with a circuit for receiving said oscillations and an aperiodic gaseous relay having an incandescent cathode, an anode and auxiliary electrodes therebetween, an indicator, local source of energy for rendering said relay operative, and circuit connections between the relay and the receiving circuit and the indicator, of auxiliary means for affecting said relay and said high frequency oscillations passing therethrough by periodical low frequency current impulses and a tuned high frequency oscillation circuit interposed between the relay and said indicator for preventing said low frequency impulses from affecting the indicator, except in combination with said high frequency oscillations.

DR. INJ. ALEXANDER MEISSNER.

Witnesses:
WOLDEMAR HAUPT,
HENRY HASPER.