

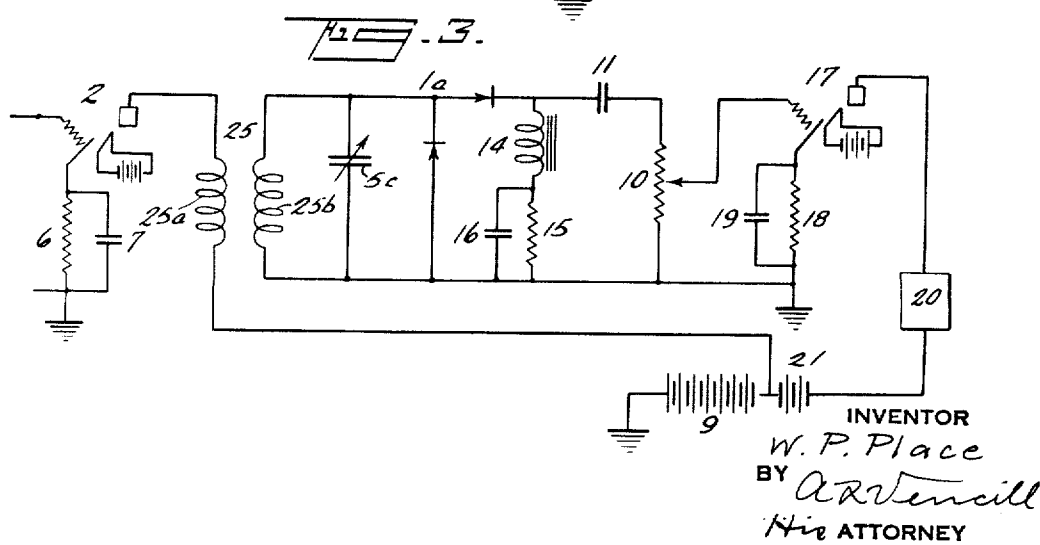
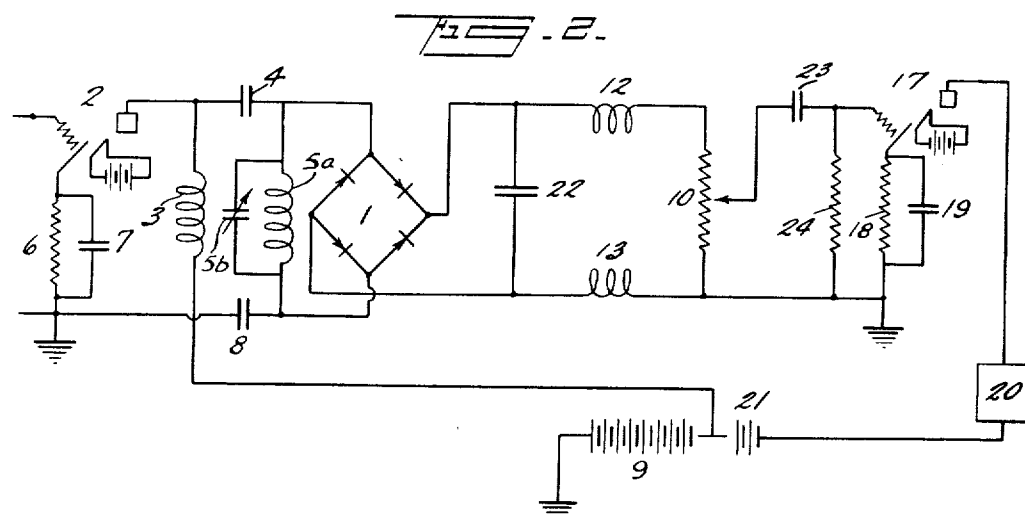
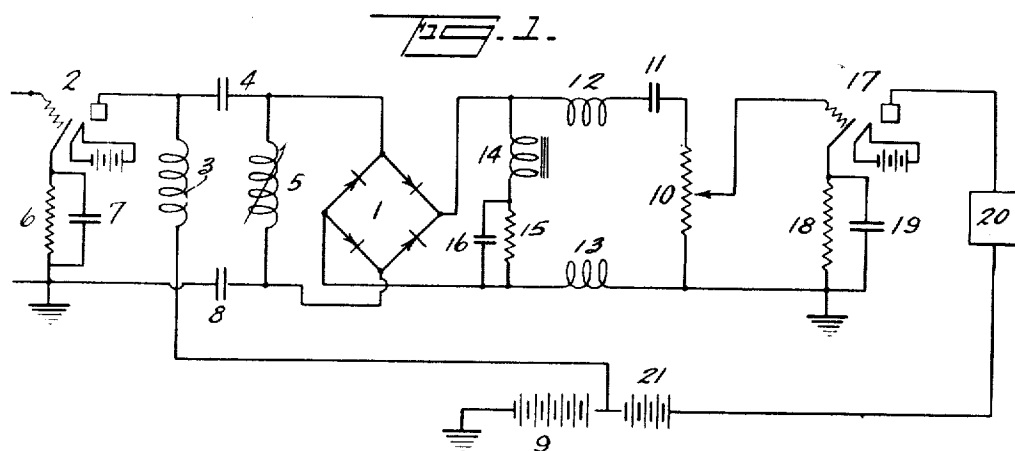
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WIRELESS COMMUNICATION APPARATUS

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WIRELESS COMMUNICATION APPARATUS

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6 Claims. (Cl. 250—30)

My present invention relates to the art of wireless communication and comprises a novel circuit arrangement utilizing a metal oxide type of rectifier as a detector of high frequency electric waves.

The tube detectors which are almost universally used at present introduce a certain amount of objectionable distortion due to the fact that the relation between the grid voltage and plate current is not a linear one on that part of the characteristic at which the tube must operate when acting as a rectifier. This is especially true of the type of detector in which a high negative grid bias is applied.

I have found that with a metal oxide rectifier, either of the full wave or half wave type used as a detector in my improved circuit, rectification will take place substantially without distortion due to the substantial elimination of the second harmonic of the audio frequency wave. Furthermore, the efficiency of the rectifier is increased by the higher current density employed.

My improved circuit is particularly designed for use in the usual type of radio receiver in which the modulated carrier wave, picked up by the antenna, is led through several stages of radio frequency amplification, is then detected, and then amplified by one or more stages of audio frequency amplification and delivered to the loud speaker or equivalent device. The new circuit is also adapted for use, however, with but slight modification, in other types of receivers, as for example the superheterodyne type of receiver.

In its preferred form, the invention comprises a circuit which includes a copper oxide rectifier, the inherent capacity of which is so balanced as to avoid undesirable by-passing of high frequency current and means for coupling the rectifier to the preceding radio frequency amplifier of the receiving circuit and to the succeeding audio-frequency amplifier with suitable means for dissipating the steady direct current component of the output of the rectifier corresponding to the unmodulated carrier wave.

For a better understanding of the invention reference may be had to the accompanying drawing, of which:

Fig. 1 illustrates a circuit including a full wave copper oxide rectifier with choke coil coupling to the radio frequency amplifier and resistance coupling to the audio frequency amplifier;

Fig. 2 illustrates a circuit substantially similar to that of Fig. 1 but with a somewhat simpler type of coupling to the audio-frequency amplifier; and

Fig. 3 illustrates a circuit including a half wave copper oxide rectifier with transformer coupling to the radio frequency amplifier and resistance coupling to the audio frequency amplifier.

In Fig. 1 a full wave copper oxide rectifier, indicated diagrammatically at 1, is coupled to the last tube 2 of the radio frequency amplifier by a choke coil 3. The tube 2 is shown as being of the indirectly heated type such as the UY227, but any of the well known amplifying tubes could as well be employed. The plate of tube 2 is connected to one end of the coil 3 and through a condenser 4 to one input terminal of the rectifier 1 and one end of a variable inductor 5. The cathode of the tube 2 is connected through a resistance 6 and capacity 7 in parallel to ground. Any other suitable means for providing grid bias to the tube could be used if desired. The other input terminal of the rectifier 1 and the other end of the inductor 5 are connected to ground through a condenser 8. The inductance coil 3 is of such a value as to offer high impedance to alternating current of radio frequency while offering substantial negligible resistance to direct current, thus forcing the alternating component of the plate current to take the path to ground through condensers 4 and 8 through coil 5 and rectifier 1 in parallel, the capacities 4 and 8 being so chosen as to offer substantially negligible reactance to the high frequency current. The purpose of the variable inductance 5 is to balance out the unavoidable low capacity of the rectifier 1 which, if not so balanced, would cause substantial amount of the alternating current to be by-passed through the rectifier.

For simplicity, a battery 9 for applying voltage to the plate of tube 2 through the coil 3 is indicated, and batteries are indicated as supplying heating currents to the tubes, but any other suitable sources of electromotive force could be employed.

One end of a resistance 10 is connected through a condenser 11 and inductance 12 with one output terminal of the rectifier 1 and the other end of the resistance 10 is connected to ground and through an inductor 13 with the other output terminal of the rectifier. Directly across the output terminals of the rectifier are connected a choke 14 and resistance 15. A condenser 16 parallels the resistance 15. The choke 14 is of such value as to offer high impedance to alternating current while the inductors 12 and 13 and the capacity 11 are so chosen as to offer low

impedance to audio-frequency current but high impedance to currents of radio frequency. The steady direct current corresponding to the mean value of the unmodulated carrier wave is thus dissipated through the choke 14 and resistance 15 while the audio-frequency alternating component of the rectified wave corresponding to the modulation current passes through the coil 12, capacity 11, resistance 10 and coil 13 back to the rectifier. The inductor 12 serves to prevent alternating voltage of radio frequency due to any unbalance in the inherent capacity of the four legs of the rectifier from being impressed on the grid of the audio frequency amplifier tube 17; the grid of this tube being connected to a variable contact on resistance 10 for the application of a controllable percentage of the low frequency alternating voltage thereto. Inductor 12 also serves to prevent the second harmonic of the radio frequency carrier wave from reaching the grid of tube 17.

The inherent capacity of the coil 14 together with the capacity 16 serve to smooth out the radio frequency ripple and should be correct for this purpose but not so large as to pass an appreciable amount of the higher audible frequencies. If the inherent capacity of choke 14 is small, a condenser could be added in parallel therewith. The inherent capacity of the rectifier 1 may itself be sufficient under some circumstances to serve the purpose of these capacities. Inductor 13 is not always essential but insures sensibly complete full wave rectification by forcing currents of radio frequency to go to ground through the opposite leg of the rectifier. Without inductor 13, a part of this current would pass through one leg of the rectifier, coil 14 acting as a capacity, and through capacity 16 to ground without going through the other leg of the rectifier.

The cathode of tube 17 is connected through resistance 18 and condenser 19 in parallel to ground. The plate of tube 17 is indicated as connected through a load device 20 with a battery 21 the negative terminal of which is connected to the positive terminal of battery 9. Device 20 may represent a loud speaker, earphones, a meter or any type of coupling to succeeding tube or tubes for further amplification as desired.

The operation of the above-described circuit will be clear from the description already given. The alternating component of the modulated carrier wave amplified by tube 2 and preceding tubes, if any, is completely rectified by the rectifier 1; the steady direct current from the rectifier being bypassed through the inductance 14 and resistance 15 while the pulsating portion corresponding to the modulation current is passed through the resistance 10. A controllable percentage of the alternating voltage across resistance 10 is then impressed upon the grid of the audio-frequency amplifier tube 17 and the amplified audio frequency current delivered to the device 20. With this arrangement adjustment of volume may be effected by varying the position of the sliding contact on resistor 10 without the accompaniment of objectionable noise which might occur if the steady direct current component of the rectified current were to take the path through resistor 10.

A simpler arrangement for coupling the rectifier to the audio-frequency amplifier is illustrated in Fig. 2. In Fig. 2 the steady direct current component of the rectified current passes, with the low frequency alternating component, through the resistance 10 while a condenser 22,

bridged across the output terminals of the rectifier 1 and of such value as to offer high reactance to audio-frequency current, by-passes any currents of radio frequency. A capacity 23 is connected between the sliding contact on resistor 10 and the grid of tube 17, condenser 11 being omitted. A resistance 24 supplies grid bias to the tube 17. Resistance 24 is made sufficiently high so that the shunting effect thereof does not interfere with the voltage applied to the grid of tube 17. With this simpler arrangement of Fig. 2 there will be a slight clicking noise when the volume is adjusted by movement of the sliding contact on resistor 10 due to the presence of direct current in this resistance. This noise can be minimized, however, by making the resistor 10 of fairly fine steps. The circuit of Fig. 2 further differs from that of Fig. 1 only in that the variable inductor 5 of Fig. 1 is replaced by the fixed inductor 5^a and paralleling variable capacity 5^b serving the same purpose and being the full equivalent thereof.

In Fig. 3 the metal oxide rectifier, in this instance indicated at 1^a as a half wave rectifier, is coupled to the radio frequency amplifier tube 2 by the transformer 25 having the primary winding 25^a connected between the plate of tube 2 and the battery 9 and the secondary winding 25^b connected across one leg of the rectifier 1^a. A variable capacity 5^c, together with the coil 25^b serve the purpose of coil 5 of Fig. 1 of balancing out the inherent capacity of the rectifier. The rest of the circuit of Fig. 3 differs in no material respect from that of Fig. 1 except that the inductors 12 and 13 have been omitted. These coils are not ordinarily essential even with the circuit of Fig. 1. With a half wave rectifier or with the transformer coupling of Fig. 3, coil 13, is of course, not required. It will be understood that the transformer coupling of Fig. 3 could be employed with the full-wave rectifier of Figs. 1 and 2 or that the half wave rectifier of Fig. 3 could be used in the circuits of Figs. 1 and 2.

I have now described various circuit arrangements for utilizing metal oxide rectifiers as detectors in radio receiving circuits. The specific circuits illustrated have been described in connection with the type of receiver employing tuned radio frequency amplification. The same circuits, however, may be utilized in receivers of the superheterodyne type provided the values of the elements 12, 13 and 16 are suitably altered to be correct for the lower frequency employed. Inductor 5 or the equivalent element or elements substituted therefor should be made fixed, instead of variable, and, in some cases may be omitted entirely, depending upon the intermediate frequency employed.

It will be apparent that the invention thus provides a new type of detector for radio receivers, namely, a metal oxide rectifier, and a detecting circuit therefor comprising three parts, a coupling means, of which two have been illustrated, to preceding stages of a radio receiver, the metal oxide rectifier of either the full wave or half wave type, and coupling means to succeeding stages of which also two have been illustrated. In each embodiment of the detecting circuit means are provided for balancing out the inherent capacity of the detector when such capacity is objectionable, and in each embodiment means are provided for controlling the volume of the received current after detection thereof. In the preferred circuit of Fig. 1 such volume control is effected without accompani-

ment of noise and in all of the described arrangements the use of the metal oxide type of rectifier gives a clear quality of reception unobtainable with the ordinary tube detector and similar to that heretofore obtainable only with crystal detectors.

I claim:

1. A detecting circuit for insertion between successive amplifiers of a radio receiver comprising in combination a metal oxide rectifier having input and output terminals, means including a transformer having the secondary coil thereof connected across said input terminals for coupling said rectifier to the preceding amplifier, a variable capacity connected in parallel with the secondary of said transformer for balancing out the inherent capacity of said rectifier, and means for coupling said output terminals of the rectifier to the succeeding amplifier of the receiver.

2. A detecting circuit for insertion between succeeding amplifiers of a radio receiver comprising in combination a metal oxide rectifier, means for coupling said rectifier to the preceding amplifier, means connected across the input terminals of said rectifier for balancing the inherent capacity thereof, and means for coupling said rectifier to the succeeding amplifier, said last-mentioned means including a resistance connected with said rectifier and having a controllable portion thereof connected across the succeeding amplifier, a capacity being provided between said resistance and the succeeding amplifier whereby direct current is prevented from effecting the operation of the succeeding amplifier.

3. A detecting circuit according to claim 2 wherein a high frequency choke coil is connected

in series with said resistance and a capacity is connected across said coil and resistance whereby radio frequency currents are by-passed about said resistance.

4. In a receiving circuit the combination comprising a high frequency amplifier, a source of anode potential for said amplifier, a transformer having the primary winding thereof connected in series with said source across the output terminals of said amplifier, a two arm metal oxide rectifier having one arm connected across the secondary coil of said transformer, a resistor connected across both arms of said rectifier, a low frequency amplifier, and means for impressing upon said low frequency amplifier a controllable portion of the potential difference across said resistor.

5. The combination according to claim 13 including a capacity connected in series with said resistor and a branch circuit connected in shunt with said capacity and said resistor, said branch circuit including a low frequency choke coil and a resistor whereby the alternating component of the rectifier output current corresponding to the modulation current is transmitted to said first mentioned resistor and the direct current component corresponding to the mean value of the carrier wave is dissipated in said branch circuit.

6. The combination according to claim 4 including a variable capacity connected in parallel with the the first mentioned arm of said rectifier across the secondary of said transformer for balancing the inherent capacity of the rectifier.

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40	115
45	120
50	125
55	130
60	135
65	140
70	145
75	150