June 10, 1941. J. G. TOVAR 2,244,741

SYSTEM FOR THE RECTIFICATION AND AMPLIFICATION OF SIGNALS OF RELATIVELY HIGH FREQUENCY

Filed May 23, 1940 2 Sheets-Sheet 1

FIG. 1.

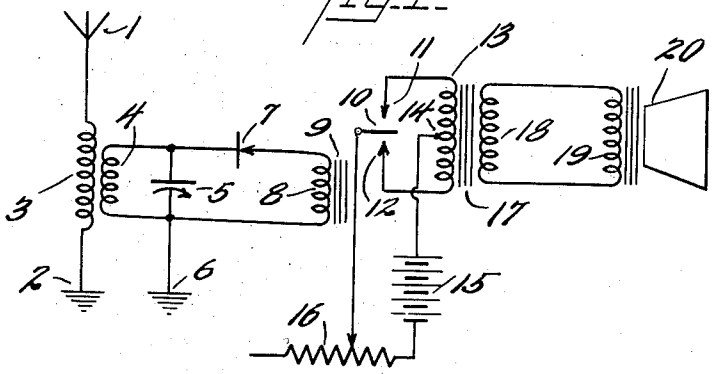


FIG. 2.

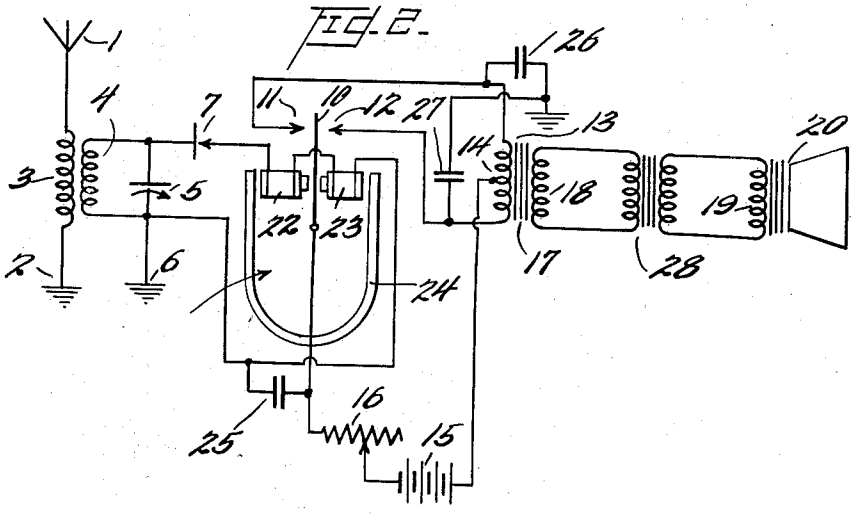
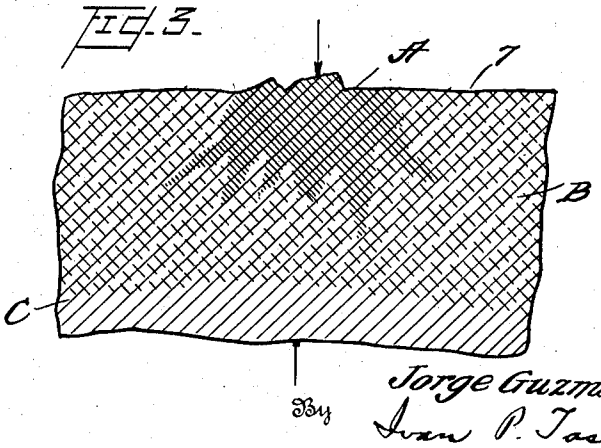


FIG. 3.



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Filed May 23, 1940 2 Sheets-Sheet 2

FIG. 4.

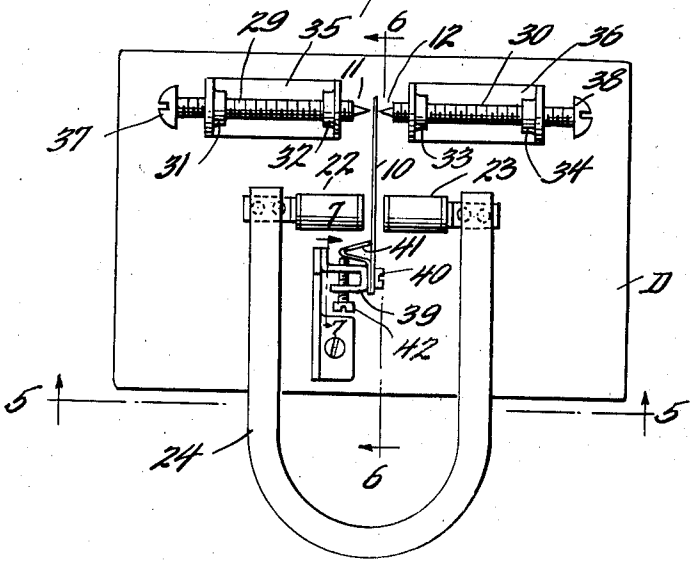


FIG. 5.

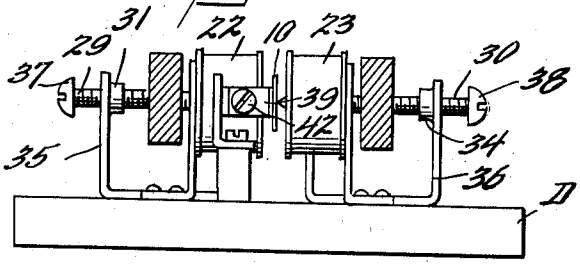


FIG. 6.

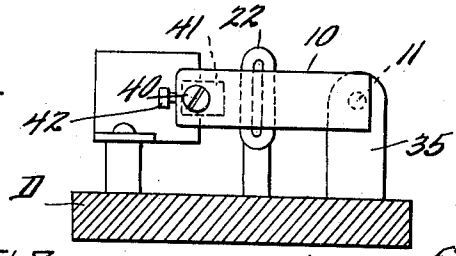


FIG. 7.

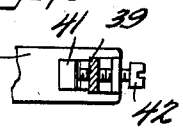
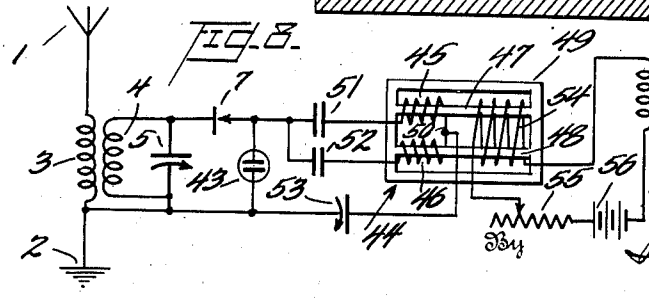


FIG. 8.



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UNITED STATES PATENT OFFICE

2,244,741

SYSTEM FOR THE RECTIFICATION AND AMPLIFICATION OF SIGNALS OF RELATIVELY HIGH FREQUENCY

Jorge Guzman Tovar, Mexico City, Mexico

Application May 23, 1940, Serial No. 336,846
In Mexico March 31, 1937

16 Claims. (Cl. 250—30)

The present invention relates to a system for the rectification and amplification of signals of relatively high frequency, and more particularly to the rectification and amplification of alternating currents, such as used in radio-telephonic and radio-telegraphic signals.

One of the objects of the present invention is the provision of a novel amplifying circuit embodying a novel rectifying agent capable of passing a current of larger intensity than any heretofore known.

Another object of the present invention is the combination of a novel rectifier or detector and an interrupting means capable of impressing the rectified signal on a transformer or other suitable amplifier for further amplification.

A third object of the invention is the combination of a novel rectifier capable of passing sufficient current to energize a relay.

A fourth object of the invention is a novel amplifying circuit embodying a novel rectifier capable of passing a current of sufficient intensity to energize a relay from the radio frequency currents as received in an ordinary receiver.

A fifth object of the present invention is the provision of a novel radio circuit or circuits especially capable of utilizing the novel rectifier according to the present invention.

Other objects of the present invention will appear from the more detailed description in the specification and drawings and the claims appended hereunto.

Referring to the drawings:

Figure 1 is a simplified radio circuit illustrating the form of the present inventiton utilizing the novel rectifier and a relay for the amplification of the rectified signals.

Fig. 2 is similar to Fig. 1, but illustrates a form of relay used in greater detail.

Fig. 3 is a diagrammatic illustration of the novel rectifier and detector of the present invention;

Fig. 4 is a plan view of the relay diagrammatically shown in Fig. 2;

Fig. 5 is a section taken along the line 5—5 of Fig. 4;

Fig. 6 is a section taken along the line 6—6 of Fig. 4;

Fig. 7 is a detail section taken along the line 7—7 of Fig. 4;

Fig. 8 is a diagrammatic illustration of a modified form of amplifier.

Referring to Figure 1, the usual antenna 1, which may be of any of the well known types, such as the single strand antenna, or others well known in the art, is shown connected to ground at 2 through the usual primary radio frequency coil 3. Wound on the same core with the primary coil 3 is the secondary radio frequency coil 4, which is tuned by the variable condenser 5 connected in parallel therewith and to ground at 6. These elements comprise the usual tuned radio frequency circuit and may be substituted by any of the tuned circuits well known in the art.

A novel rectifier or detector 7, which is composed of a selenium-lead material, to be described hereinafter in detail, is shown connected in series circuit with the radio frequency coil 4 and 8 so that radio frequency currents induced in the coil 4 will pass through the detector 7 and coil 8 which is wound about the permanently magnetized iron core indicated at 9, and thus comprises the actuating coil of a relay, the armature of which is indicated at 10.

The relay armature 10 is adapted to close a circuit with contacts 11 and 12 as actuated by the currents in coil 8.

Connected in series with the contacts 11 and 12 is the primary coil of a transformer indicated in general at 13, and having an intermediate center tap at 14, so that a portion of said primary coil will be in series with battery 15 and variable resistance 16 through contact 12 and armature 10, and another portion of said primary will be in series with battery 15 and variable resistance 16 in series through contact 11, although it may be noted here that the circuit established through these portions of the primary coil 13 will cause the current to flow in each portion in a direction opposite to the current flow in the other portion. Mounted on the same iron core 17 with the primary transformer coil 13 is the usual secondary 18, and this in turn is connected in circuit with the usual voice coil 19 of the magnetic speaker, indicated in general at 20.

The operation of the modification described in Figure 1 is as follows: The modulated radio frequency current received at antenna 1, induces a response in the secondary radio frequency coil 4, which is tuned so as to be in resonance with the particular frequency being received in the usual manner by the variable condenser 5. This radio frequency current being received is prevented from passing through coil 8 in its original state by the rectifier 7, which only permits the passage of a pulsating D. C. current, corresponding in general to the modulations of the modulated radio frequency current.

In other words, the current passing through

the coil 8 is a demodulated current similar to that actuating the earphones of any ordinary crystal set, except that due to the novel type of rectifier and detector herein used, this current is of very much larger intensity than any heretofore known in the art, being of the order of about 1 to 2 milliamperes and 10 to 15 volts. In other words by the use of the present novel detector it becomes possible to rectify from the current ordinarily received at the antenna of a radio set, a current of sufficient intensity to operate a relay.

The current passing through coil 8 which corresponds to the modulation, or in other words, the audio frequencies impressed upon the radio frequency carrier at the transmitting station correspondingly moves the armature 10, which as before stated, is acted upon by the energized coil 8.

The armature 10 will, therefore, close a circuit alternately through contacts 11 and 12, when the armature touches contact 11, it establishes a circuit through battery 15 and variable resistance 16, so as to send a current through one section of the primary coil 13, this current being much greater in intensity than the pulsating current which as before stated, energizes the relay through coil 8. It may be noted that the voltage and intensity of the first mentioned current is determined entirely by the electrical characteristics of the battery 15, and that any suitable source of D. C. current may be used instead of the battery 15.

The armature 10 also closes periodically the circuit through contact 12, sending current through another portion of the primary coil 13 in a direction that is opposite to the direction of the current through contact 11, and thus portions of the primary 13 have established therein a pulsating current which corresponds to the original audio frequencies at the transmitting station. A corresponding A. C. current is, of course, induced in the secondary 18 and in the voice coil 19 in the usual manner, so as to produce the corresponding sounds in the magnetic speaker 20.

Referring to the embodiment of the invention specifically disclosed in Fig. 2, there is here shown a similar tuned circuit including the antenna 1, coils 3 and 4, ground connections 2 and 6, condenser 5 and detector 7. The relay here shown and indicated in general by the reference numeral 21, is also provided with an armature 10 and a pair of contacts 11 and 12 which similarly function to close a circuit including the battery 15 and the primary winding of the transformer 13. In place of the energizing coil 8 of Fig. 1, however, there is here shown a pair of coils 22 and 23 which are disposed on opposite sides of the armature 10. The armature 10 is of a suitable material such as a steel alloy, which is incapable of any permanent magnetization. The coils 22 and 23 are wound upon suitable cores given a permanent magnetization by the horseshoe magnet 24, although other means of magnetizing the cores of the coils may be used. In the device shown in Fig. 2 there is also shown a plurality of fixed condensers 25, 26 and 27 which serve to bypass the armature 10, and the contacts 11 and 12 to ground. These condensers are preferably included in the circuit to reduce noise at the contacts 11 and 12 during the movement of the armature 10. The circuit shown also includes an additional transformer 28, having its primary connected to the secondary 18 of the first mentioned transformer and the secondary of the transformer 28 is connected to the voice coil 19.

The operation of the device shown in Fig. 2 is in general similar to that shown in Fig. 1. The armature 10 is attracted successively to close a circuit first through one of the contacts 11 and then through contact 12, depending on the values of the current through coils 22 and 23. As explained in connection with Fig. 1, the current through the energizing coils of the relay is a pulsating current of audio frequency. The rapid movement of the armature 10 is therefore of a corresponding frequency and a similar current is set up in the primary 13.

The relay 21 is shown in greater detail in Figs. 4 to 6 inclusive. Referring to Fig. 4, it may be noted that the contacts 11 and 12 are mounted at the end of adjusting screws 29 and 30 which are in turn carried by suitable nuts 31, 32, 33 and 34. The nuts are in turn supported by clevis members 35 and 36, and each of the screws 29 and 30 is provided with an adjusting head 37 and 38, respectively. The clevis members 35 and 36, as well as the remaining elements of the relay, are suitably fastened to a base D. The armature 10 is fastened to a suitable support 39 by a screw 40. Also carried on the screw 40 is an adjusting spring 41, rebent to contact the armature 10. An adjusting screw 42 is threaded through the support 39, and as shown can be moved inwardly and outwardly to move the armature toward one or the other of the coils 22 and 23 or the contacts 11 and 12. The contact points 11 and 12 are preferably of a non-oxidable conducting material such as silver, and the armature 10 is preferably provided with a similar non-oxidable coating or insert opposite the contacts.

Referring to Fig. 8, there is illustrated a modification in which the antenna primary and secondary radio frequency coils, tuning condenser and rectifier are similar and have similar reference numerals to those shown in Fig. 1. In place of the coil 8, a neon tube 43 is provided connected in circuit with a transformer arrangement indicated in general at 44. The transformer arrangement includes two coils 45 and 46, wound in opposed relationship upon respective legs 47 and 48 of a magnetic core, indicated in general by the reference numeral 49. One of the ends of each of the coils 45 and 46 is joined at 50 and the other ends of the coil are connected through the fixed capacities 51 and 52 to one side of the detector 7 and the neon tube 43. A variable condenser 53 is provided which connects the joined end 50 of the coils to ground. Wound about both of the legs of the iron core, there is also provided a coil indicated by the reference numeral 54. The coil 54 is positioned in series with a variable resistance 55, a battery 56, and the primary of a transformer 57. The secondary of the transformer 57 is connected in circuit with the voice coil 58 of the speaker 59. As shown in Fig. 8, the magnetic core 49 is closed at each end.

The various elements constituting the circuit of Fig. 8 are so arranged that when a signal is received in the tuned circuit, currents are set up in the coils 45 and 46 which tend to saturate to a greater or lesser degree the core 49, which is preferably made of an alloy requiring very little current for saturation. The degree of saturation of the iron core will determine the current flow through the coil 54, and produce in the coil 54 and primary of the transformer 57 a corresponding amplified current of a similar frequency. The current through the primary of the transformer 57 will of course be transformed into a corresponding alternating current at the

secondary and pass through the voice coil **58** for actuating the speaker.

The novel detector **7** of the present invention may be made in the following manner:

100 grams of lead, which is desirably the lead of commerce and which may contain the ordinary amount of impurities, is melted in a pot provided with a cover. After the lead is melted to a fluid molten condition, the cover of the pot is removed, and there is added a chunk or mass of selenium, the amount of selenium added being about ten (10) grams. Substantially immediately after the selenium is added, the cover is placed on the vessel containing the molten lead and selenium, and the contents of the vessel are allowed to solidify. The function of the cover on the vessel is to prevent the selenium from vaporizing. Instead of using the means set forth, other means may be employed to prevent the vaporization of the selenium.

With the quantities above used, the time of solidification is usually about five (5) minutes. It is recognized that the time of cooling of the material may be shorter or longer depending upon the initial temperature and the quantity of the lead and the character of the pot in which the materials are being treated.

Upon cooling, there is present in the treatment pot a composite mass comprising a central portion A, as shown in Figure 3, having a position corresponding to that where the selenium was dropped, said central portion of the composite mass being black in color. This central mass may be termed a "selenium-containing entity." It is to be noted that surrounding the central mass A, there is an intermediate zone or layer, also black in appearance, the black being more predominant adjacent the zone A and fading away until it approaches the bottom layer C, which is a stratified layer of lead bright in color.

It is to be noted that the detector of the present invention is a composite mass comprising a selenium-containing entity having in intimate contact therewith a relatively better conducting medium, said composite mass being capable of passing and demodulating a relatively high amount of modulated high frequency alternating current.

In the illustration herein set forth, a lead and/or a lead-containing entity functions in combination with the selenium-containing entity to form a detector capable of passing and demodulating a relatively high amount of modulated high frequency alternating current. However, any other conducting medium may be used which will function in combination with the selenium-containing entity to pass and demodulate a relatively high amount of modulated high frequency alternating current. In other words, while there is set forth one suitable conducting medium which functions as a relatively better conducting medium than the selenium-containing entity, it will become apparent to those skilled in the art, upon the disclosure of the present invention, what equivalents may be used, and it is desired to be protected both specifically and broadly.

It has been stated that the detector of the present invention is capable of passing and demodulating a relatively high amount of modulated high frequency alternating current. By this is meant that the detector of the present invention is capable of passing a current of approximately 1 to 2 milliamperes, whereas the best prior art detectors for currents of the modulated radio frequency type operating without any auxiliary excitation are only capable of passing 0.05 milliampere, which has effectually militated against their use where further amplification is desired.

It has been stated that the detector forming a part of the present invention comprises a selenium-containing entity having in intimate contact therewith a relatively better conducting medium functioning as set forth. By the expression "in intimate contact therewith" there is meant the contact that is effected by adding a pellet of selenium to molten lead, which is then in situ solidified. By this addition and in situ solidification, there is apparently produced a distribution or infiltration of a portion of selenium into the surrounding lead layer, and some distribution of the lead into the selenium mass or entity hereinbefore mentioned, since this selenium mass or entity is then capable, to some extent, of conducting current. It may be pointed out further that apparently some of the lead is incorporated in the selenium mass because selenium itself does not conduct current in any way. A series of tests have been made on the rectifier of the present invention, using a forty-five (45) volt dry cell battery and an ordinary type of D. C. voltmeter in circuit therewith. One of the terminals of the battery was connected during all of these tests to the layer designated as C in Figure 6. The other terminal of the circuit leading through the voltmeter to the battery was then connected alternately to layer C, layer B and layer A. There was apparently no voltage drop through the layer C, that is, when both terminals of the circuit were connected to layer C. The voltmeter reading when one of the terminals was connected to the layer B was approximately thirty-five (35) volts, and the voltage reading when one terminal was connected to layer A was approximately nineteen (19) volts. It was thus shown that the layer C had the conductivity and was apparently composed of pure lead; that the layer B was only slightly less in conductivity than pure lead, and must, therefore, have contained a considerable portion of lead and a relatively small proportion of selenium; that the layer A was a poor conductor for ordinary D. C. currents and must, therefore, have contained a comparatively large and/or predominant proportion of selenium.

Other tests have also been made to establish the rectifying characteristics of the combined mass, and it has been found that in order to produce the detector of the present invention, all three of these zones or layers should desirably be present. When the layer C of pure lead was removed and contact made directly to the layer B, no rectification took place, nor did any current pass when these two layers were put in circuit with an ordinary source of radio frequency waves. The same phenomena occurred when it was attempted to eliminate the layer B or the layer A. When layer A was eliminated and pure selenium substituted therefor, there were no results, as the selenium did not pass any current whatsoever.

It has been stated that the detector is produced by adding 10 grams of solid selenium to 100 grams of molten lead. These proportions can be varied. If a greater quantity than 10 grams of selenium is added to 100 grams of molten lead, the device will function as a detector, but no increase in efficiency will be observed, that is, the detector will still be capable of passing 1 to 2

milliamperes and 10 to 15 volts from an antenna as before set forth, and no more.

It may be pointed out that if the proportion of selenium is increased to such an extent that the conductivity of the entire mass is cut down, that is, if the amount of selenium added greatly exceeds the amount of lead, then no rectification at all will take place. If less than ten (10) grams of selenium are added to the one hundred (100) grams of lead, the amount of current passed, or the amount of current rectified will be substantially decreased.

It is desired to state that on the upper surface of the composite mass, made in accordance with the method above set forth, there appears small red spots, which are probably selenium oxide. Naturally, some oxidation does occur.

It is not desired to be limited by any theory as to the reaction between the selenium and the lead components. However, it is likely that the center mass A, which is selenium, has reacted at least to some extent, to produce a lead selenium combination which is distributed in the selenium, or that there is a solid solution of the lead into the selenium which enables the selenium to function as a conductor of current, as hereinbefore set forth, it being well known in the art that selenium itself is a non-conductor. On the other hand, it may well be that no solution of the selenium in the lead occurs or vice versa, and that the mass A is in reality a mass of selenium which has, by the treatment herein set forth, been modified so as to cause it to function as a conductor of current.

The detector when produced in accordance with the process hereinbefore set forth is preferably connected in circuit and the radio frequency waves are allowed to pass therethrough for a considerable period of time. It has been found that the ability of the detector to rectify and pass currents is improved during the first several hours of operation until it reaches a maximum operating efficiency. Once the maximum operating efficiency is established, however, it appears to remain at a constant indefinitely. While the novel detector of the present invention has been disclosed as operating in connection with radio circuits, it may be used for other similar purposes; for example, where modulated high frequency currents are being transmitted over a wire. It can also be used for detection purposes in radio therapeuty or diathermy, and it can also be used in the production of delicate measuring instruments. It is responsive not only to the ordinary broadcast band of frequencies, but also to the short waves and ultra short waves known in the art. In other words, the present detector will rectify any frequency above the audible range.

It is desired to point out that the electrical values of the various parts used in the assembly of the radio according to the present invention are capable of considerable variation and change, as is known in the art. However, it has been found that it is preferable that the coils **22** and **23** as used have a comparatively high resistance. By way of example, this resistance may be similar to the coils found in an ordinary pair of head phones.

The present application is a continuation in part of my prior application Serial No. 199,010, filed March 30, 1938.

I claim:

1. An amplifier for high frequency currents comprising a plurality of conducting members substantially fixedly separated by an insulating medium, means to complete a circuit alternately through said members including a local current source, and a vibratory means, means to operate said vibratory means in synchronism with the frequencies to be amplified, and responsive means in circuit with said conducting members, said vibratory means, and said local current source, the current in said circuit being adapted to impress on said responsive means a resultant current substantially corresponding in frequency and wave form to the original current supplied to the amplifier.

2. A system for the detection and amplification of modulated radio signals comprising a circuit for receiving said signals, a detector in said circuit and an amplifier comprising a plurality of conducting members substantially fixedly separated by an insulating medium, means to complete a circuit alternately through said members including a local current source, and a vibratory means, means to operate said vibratory means in synchronism with the frequency to be amplified and responsive means in circuit with said conducting members, said vibratory means, and said local current source, the current in said circuit being adapted to impress on said responsive means a resultant current substantially corresponding in frequency and wave form to the detected current in the original receiving circuit.

3. A system for the detection and amplification of modulated radio signals, comprising a circuit for receiving said signals, a detector in said circuit comprising the reaction product of a pellet of selenium and molten lead, said pellet substantially retaining its pellet form, an amplifier in said circuit comprising a plurality of conducting members substantially fixedly separated by an insulating medium, means to complete a circuit alternately through said members including a local current source, and a vibratory means, means to operate said vibratory means in synchronism with the frequency to be amplified and responsive means in circuit with said conducting members, said vibratory means, and said local current source, the current in said circuit being adapted to impress on said responsive means a resultant current substantially corresponding in frequency and wave form to the detected current in the original receiving circuit.

4. An amplifier for high frequency currents comprising a plurality of conducting members substantially fixedly separated by an insulating medium, means to complete a circuit alternately through said members including a local current source and a vibratory armature, a coil in circuit with the current to be amplified and adapted to vibrate said armature in synchronism with the current frequency, and responsive means in circuit with said conducting members, said vibratory means, and said local current source, the current in said circuit being adapted to impress on said responsive means, a resultant current substantially corresponding in frequency and wave form to the original current supplied to the amplifier.

5. A system for the detection and amplification of modulated radio signals comprising a tuned circuit for receiving said signals, a detector in said circuit, a relay comprising an energizing coil connected in said circuit after said detector and an armature, a local source of current connected to said relay armature, a plurality of conducting members substantially fixedly separated by an insulating medium and adapted to be alternately connected to said local source of current by said

armature, means to connect portions of a transformer primary to said conducting members, means to connect each of said portions to said local source of current, said connecting means being so arranged that alternate connection of said conducting members and the source of current by the armature will establish a circuit from said source of current alternately through each primary portion in opposite directions so as to produce in said primary a full wave pulsating D. C. current and a transformer secondary magnetically coupled to said primary.

6. A system for the detection and amplification of modulated radio signals comprising a circuit for receiving said signals, a detector in said circuit, a relay comprising an energizing coil connected in said circuit after said detector and an armature, a local source of current connected to said relay armature, a plurality of contacts adapted to be alternately connected to said local source of current by said armature, means to connect portions of a transformer primary to said contacts and means to connect each of said portions to said local source of current, said connecting means being so arranged that alternate connection of said contacts and the source of current by the armature will establish a circuit from said source of current alternately through each primary portion in opposite directions to thereby produce in said primary a full wave pulsating DC current.

7. A system for the detection and amplification of modulated radio signals comprising a tuned circuit for receiving said signals, a detector in said circuit, a relay comprising an energizing coil connected in said circuit after said detector and an armature, a local source of current connected to said relay armature, a plurality of contacts adapted to be alternately connected to said local source of current by said armature, a transformer having a primary winding including a center tap and two end taps, means to connect the end taps of said primary to said contacts and means to connect the center tap of said primary to the local source of current so that the alternate connection of said contacts and the source of current by the armature will establish a circuit from said source of current alternately through each portion of said transformer primary between said center tap and said end taps to produce a current flow through each of said portions in opposite directions to thereby produce in said primary a full wave pulsating DC current.

8. A system for the detection and amplification of radio signals comprising means to receive said radio signals, a detector comprising the reaction product of a pellet of selenium and molten lead said pellet substantially retaining its pellet form, and means operated by the demodulated signals for producing from a local source a corresponding signal of any desired intensity.

9. A combination selenium-lead rectifier comprising the reaction product of a pellet of selenium and molten lead, said pellet substantially retaining its pellet form.

10. A selenium rectifier for demodulating high frequency currents comprising the reaction product of a pellet of selenium and a molten conducting metallic material having the general characteristics of lead, said rectifier exhibiting on fracture three zones of material blending into one another, one zone resembling the original form of the pellet and having a substantially high resistance, another zone having a substantially low resistance, and exhibiting the characteristics of the aforesaid metallic material, and a third zone having a resistance intermediate the other two, separating the first two mentioned zones.

11. A combination selenium-lead rectifier comprising the reaction product of a pellet of selenium and molten lead, exhibiting on fracture three zones of material blending into one another, one zone resembling the original form of said pellet and having a substantially high resistance, another zone having a substantially low resistance, and exhibiting the characteristics of the lead, and a third zone having a resistance intermediate to the other two, separating the two first mentioned zones.

12. An amplifier for high frequency currents comprising a plurality of conducting members substantially fixedly separated by an insulating medium, means to complete a circuit alternately through said members including a local current source and a vibratory means, a plurality of opposed operating means adapted to move said vibratory means in synchronism with the frequency to be amplified, and responsive means in circuit with said conducting means, said vibratory means, and said local current source, the current in said circuit being adapted to impress on said responsive means a resultant current substantially corresponding in frequency and wave form to the original current supplied to the amplifer.

13. An amplifier for high frequency currents comprising a plurality of conducting members substantially fixedly separated by an insulating medium, means to complete a circuit alternately through said members including a local current source and a vibratory armature, a plurality of coils in circuit with the current to be amplified, said coils being positioned in opposed relation relative to said armature to thereby move said armature in synchronism with the current frequency and responsive means in circuit with said conducting members, said vibratory means, and said local current source, the current in said circuit being adapted to impress on said responsive means, a resultant current substantially corresponding in frequency and wave form to the original current supplied to the amplifier.

14. An amplifier for high frequency currents comprising a plurality of conducting members substantially fixedly separated by an insulating medium, means to complete a circuit alternately through said members including a local current source and a vibratory armature, a pair of coils in circuit with the current to be amplified, each of said coils being positioned on one side of said armature and adapted when energized to move the same, a magnetic core disposed within each coil, each of said cores constituting magnetic poles of diverse polarity and responsive means in circuit with said conducting members, said vibratory means, and said local current source, the current in said circuit being adapted to impress on said responsive means a resultant current substantially corresponding in frequency and wave form to the original current supplied to the amplifier.

15. A system for detection and amplification of modulated radio signals comprising a tuned circuit for receiving said signals, a detector in said circuit, a relay comprising a pair of coils connected in circuit after said detector and an armature, a local source of current connected to said relay armature, a plurality of contacts adapted to be alternately connected to said local source of current by said armature, means to connect portions of a transformer primary to said contacts and means to connect each of said por-

tions to said local source of current, said connecting means being so arranged that alternate connection of said contacts and the source of current by the armature will establish a circuit from said source of current alternately through each primary portion in opposite directions to thereby produce in said primary a full wave pulsating D. C. current.

16. A system for detection and amplification of modulated radio signals comprising a tuned circuit for receiving said signals, a detector in said circuit, a relay comprising a pair of energizing coils connected in said circuit after said detector and positioned on each side of an armature, said coils being adapted when energized to move the armature, a magnetic core in each coil, each core constituting a magnetic pole of diverse polarity, a local source of current connected to said relay armature, a plurality of contacts adapted to be alternately connected to said local source of current by said armature, a transformer having a primary winding inciuding a center tap and two end taps, means to connect the end taps of said primary to said contacts and means to connect the center tap of the primary to the local source of current so that the alternate connection of said contacts and the source of current by the armature will establish a circuit from said source of current alternately through each portion of said transformer primary between said center tap and said end taps to produce a current flow through each of said portions in opposite directions to thereby produce in said primary a full wave pulsating D. C. current.

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