Aug. 12, 1941. G. DALLOS 2,252,066

INTERFERENCE RESPONSIVE CIRCUIT

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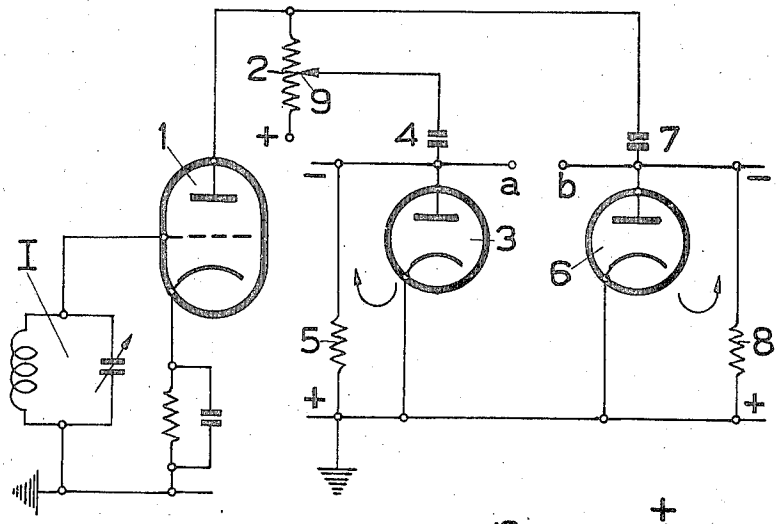


Fig. 1.

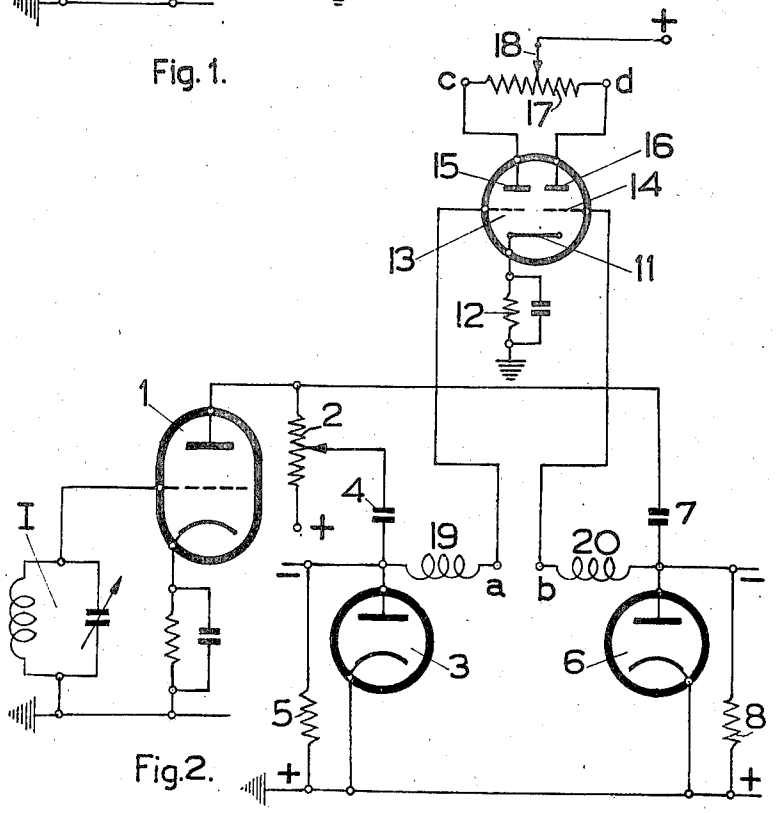


Fig. 2.

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INTERFERENCE RESPONSIVE CIRCUIT

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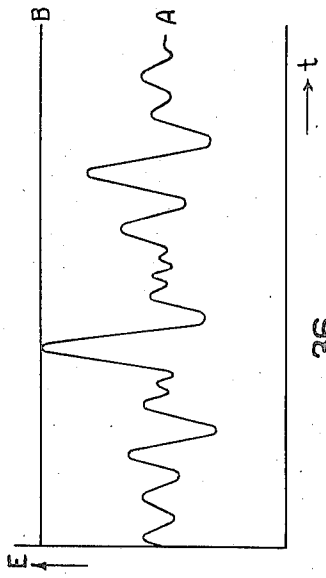


Fig. 3.

Fig 9

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INTERFERENCE RESPONSIVE CIRCUIT

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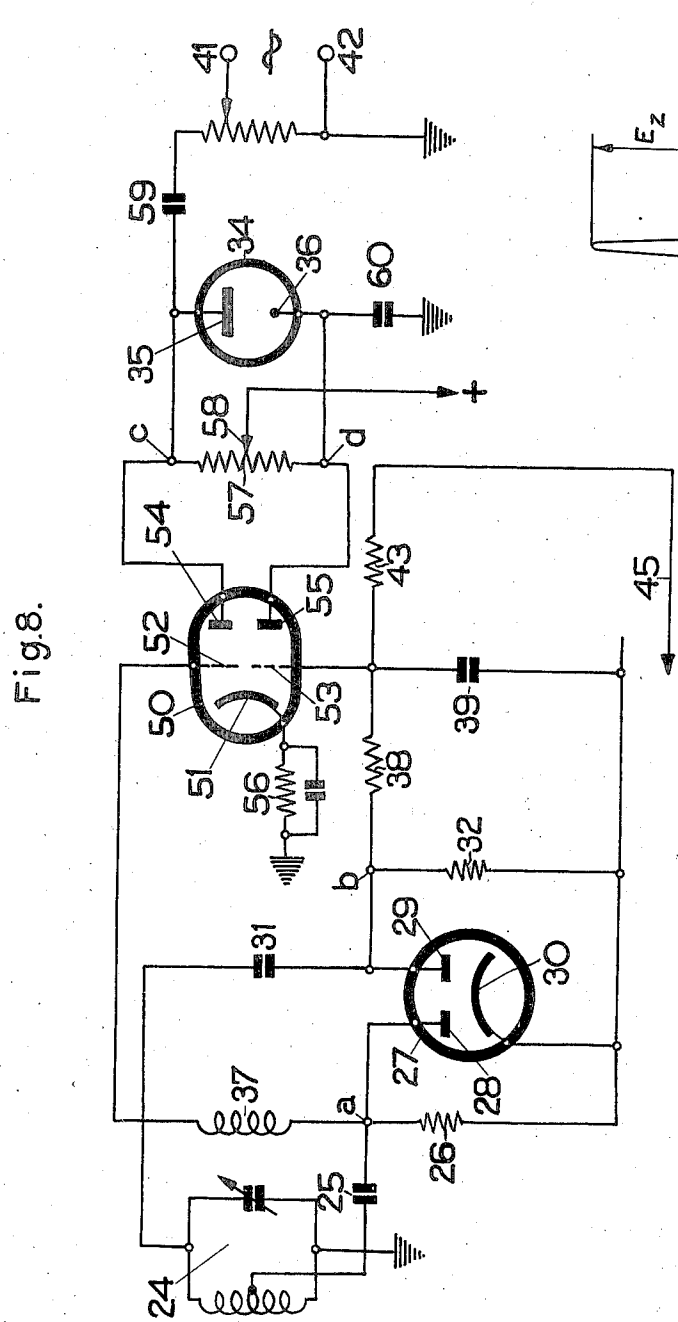


Fig. 8.

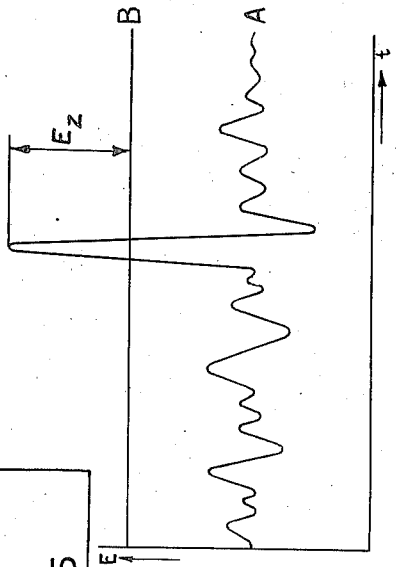


Fig. 4.

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INTERFERENCE RESPONSIVE CIRCUIT

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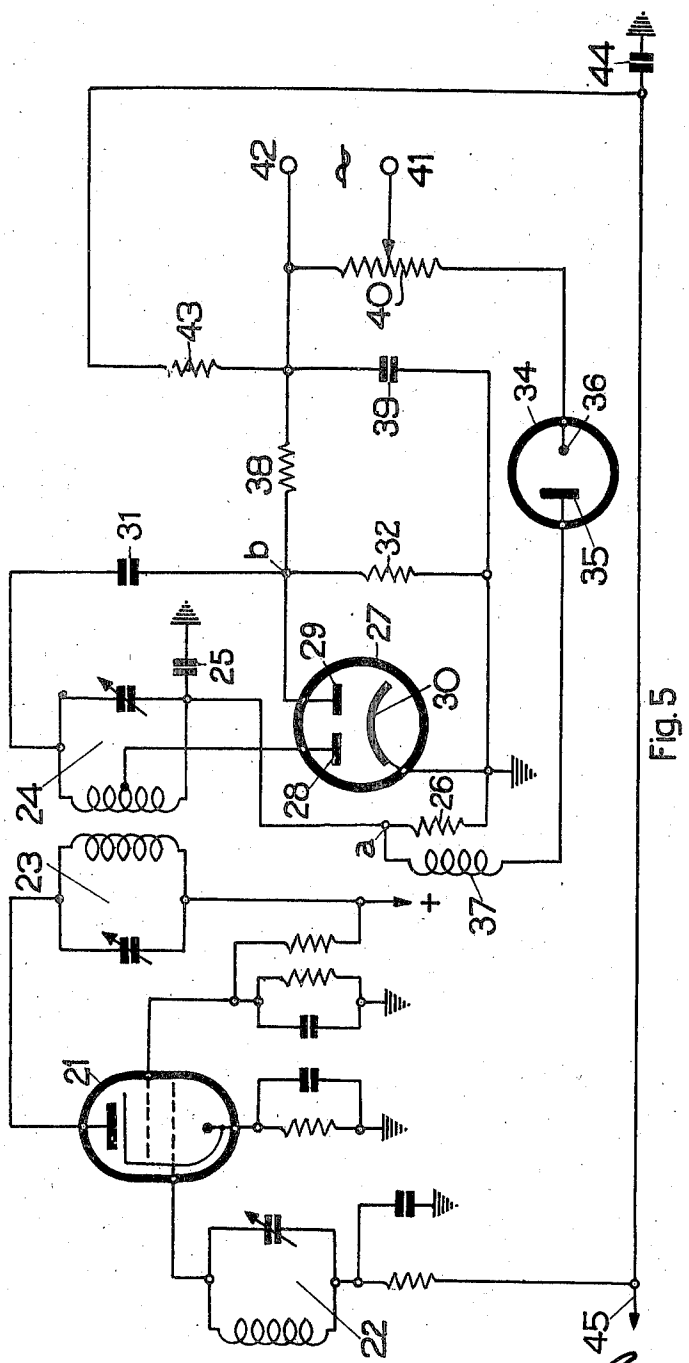


Fig. 5

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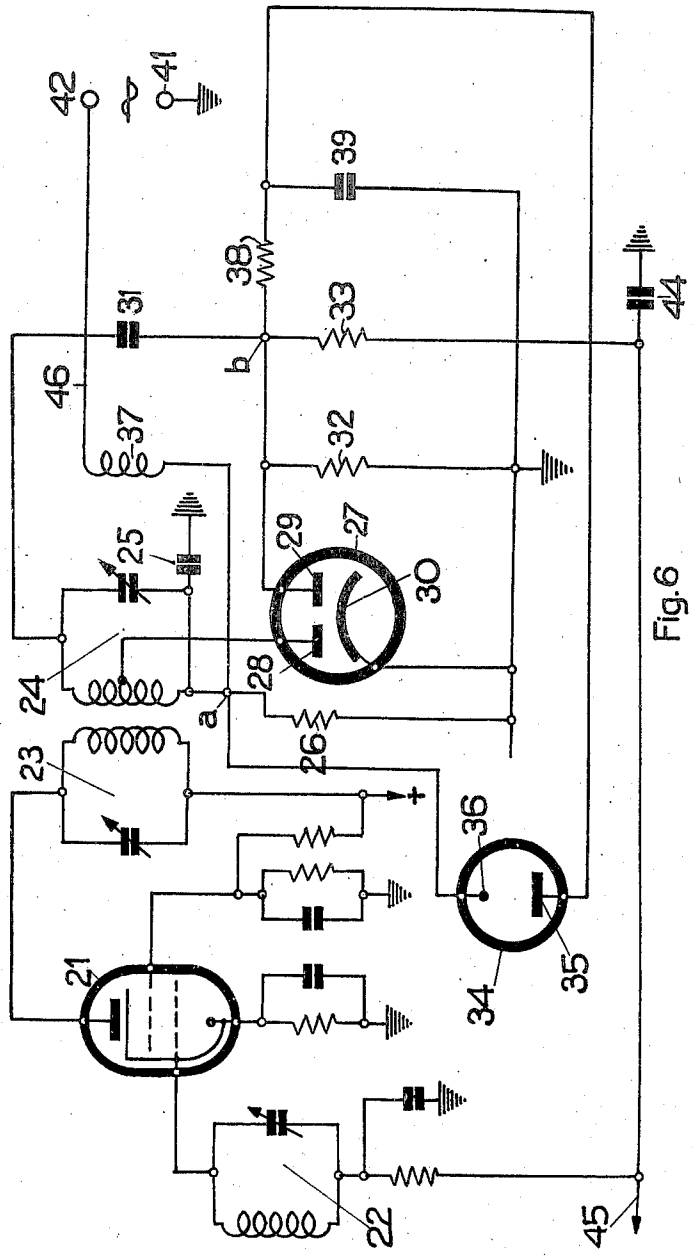


Fig. 6

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INTERFERENCE RESPONSIVE CIRCUIT

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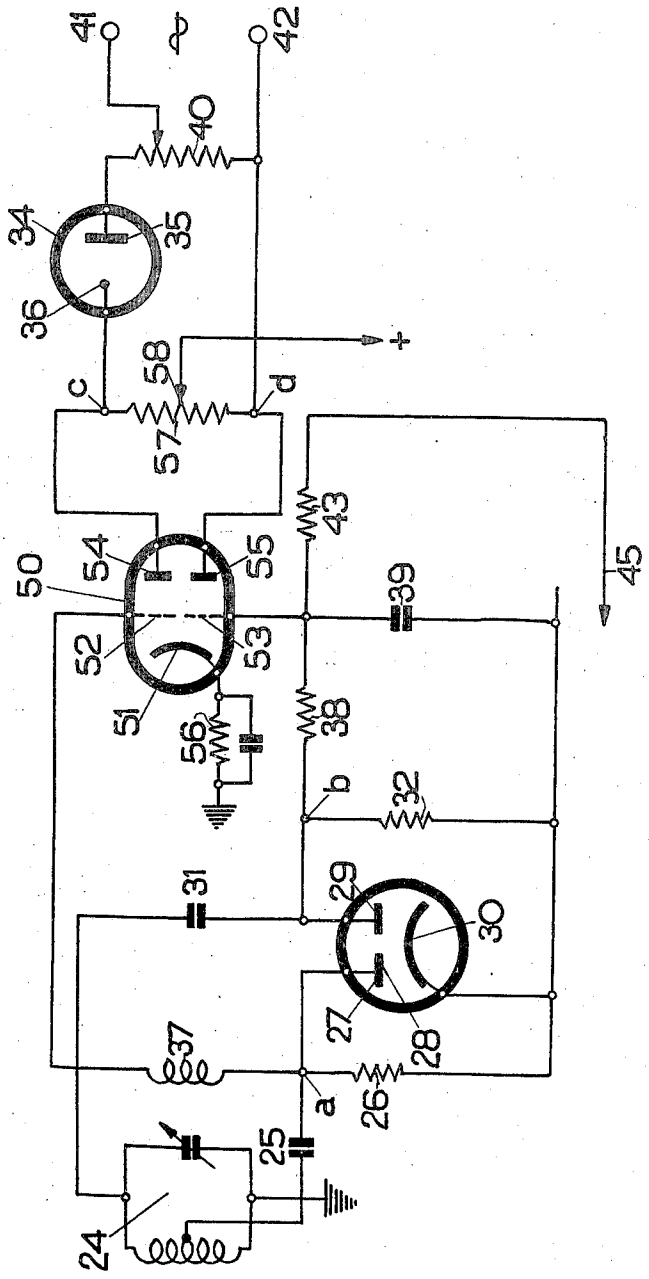


Fig.7

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2,252,066

UNITED STATES PATENT OFFICE

2,252,066

INTERFERENCE RESPONSIVE CIRCUIT

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Application August 23, 1938, Serial No. 226,230
In Hungary September 24, 1937

10 Claims. (Cl. 250—20)

My invention relates to circuit arrangements for suppressing disturbances in radio receiving sets and more especially to an arrangement of this kind which is more efficient than similar arrangements hitherto suggested.

A great number of circuit arrangements for suppressing disturbances have become known through which the receiving sets are rendered inoperative or blocked for the duration of the disturbances. These circuit arrangements have for their purpose to interrupt the reception whenever disturbances occur, the amplitude of which is greater than that of the carrier wave. The systems serving to solve this problem belong to either one or the other of the following two groups.

In the first group belong the double channel systems, in which one channel serves for receiving and amplifying the disturbances, while the other serves for the signal reception proper. These systems require a great number of valves and connecting members and involve the drawback that with low preliminary amplification they do not operate satisfactorily owing to the poor blocking of the valves, which becomes especially noticeable in the case of disturbances of small amplitude.

In the second group belong the single channel systems, in which the disturbances are separated from the modulated carrier wave by special connections which are either very complicated and difficult to adjust or simple, in which case they have, however a greatly limited efficiency.

The circuit arrangements for suppressing disturbances according to this invention, while belonging to the group last mentioned, solve the problem of suppressing disturbances in a manner differing from the known systems in that they do not effect the separation of the disturbances from the carrier wave by a shifting of the working point of the valves from the bend of the characteristic, so that they are independent from the poor blocking of the valves. In the circuit arrangements for suppressing disturbances according to this invention two rectifier systems, for instance two diodes, connected in bridge connection or differential connection and coupled with a source of signalling current are used, each of which rectifier systems is combined with a connected resistance and condenser. Each rectifier system together with its resistance and condenser forms a separate arm of an electric bridge. Of these two arms only one is so constituted that the rectified voltage arising across its resistance can follow the signal modulation, while the other one is so constituted that the rectified voltage arising across its resistance is only able to respond to more slowly occurring variations. Accordingly the first arm is termed the quick-acting ("quick") arm, the latter the slow acting ("slow") arm. The bridge arms are coupled with the source of signalling current in such manner that the latter feeds to the quick arm a lower alternating voltage than to the slow arm, so that with undisturbed reception the rectified voltage which arises across the resistance of the quick arm is smaller than or at the most equal to that appearing across the resistance of the slow arm. As soon however as disturbances arise, the amplitudes of which exceed the critical value determined by the carrier wave amplitude, the relative values of these voltages are reversed in the manner described hereinafter, so that between the ends of the resistances of the two branches there is formed a potential difference of opposite direction, by means of which the suppression of the disturbances may be effected in any desired manner, if necessary after amplification.

The differential action of the bridge arms can now be obtained either by choosing for them different time constants, i. e. a greater time constant for the slow and a smaller time constant for the quick arm, or in such manner that a filter is inserted in the slow arm which equalises the fluctuations of the rectified voltage arising in this arm.

In the valves used in the bridge circuit according to this invention, contrary to the known systems, current advantageously also flows when the reception is undisturbed, and the suppression of the disturbances is initiated by reversing the voltages of different value prevailing at the valve terminals, whenever a disturbance arises, which is very advantageous for reasons explained above. A further advantage of this circuit consists in that it is highly sensitive, i. e. acts also in the case, where the peak amplitudes of the disturbances exceed the critical value only slightly. The new circuit has the additional advantage that it can be applied equally well to the suppression of disturbances in the high, intermediate and low frequency stages and, as a kind of adapter, in existing as well as in newly designed receiving sets.

In the arrangements above described the suppressing stage does not take part in the signal transmission proper. In order to effect that in the suppressing stage not only the suppression of disturbances proper, but in the case of undisturbed reception also a signal transmission and, if desired, a signal amplification shall oc-

cur, the two arms of the bridge are bridged by an electron discharge system with two or more electrodes in such manner that one electrode of this discharge system is connected with the terminal of the quick arm, the other electrode with the terminal of the slow arm either directly or through connecting members, the alternating voltage modulated by signals being transmitted, in the case of undisturbed reception, from the load resistance of the quick arm to the further stages of the receiving set, being however limited by the bridging discharge system, whenever disturbances arise which exceed the critical value determined by the carrier wave amplitude and which occasion sudden changes the relative values of the potentials arising at the terminals of the arms.

The bridging discharge system mentioned above may be connected with the bridge arms in different ways. It is for instance possible to connect the anode of the bridging discharge system with the terminal of the quick arm and its cathode with the terminal of the slow arm and to tap the signal-modulated alternating voltage from the load resistance of the quick arm by means of the bridging discharge system, this latter passing on this alternating voltage when the reception is undisturbed, but blocking it whenever a disturbance arises. It is however also possible to connect the bridging discharge system inversely in such manner that its anode is connected with the terminal of the slow arm and its cathode with the terminal of the quick arm. In this case the signal-modulated alternating voltage is tapped directly from the load resistance of the quick arm, and the bridging discharge system, which is shunted with respect to the path of this alternating voltage, blocks during undisturbed reception, but opens as soon as a disturbance arises, and short circuits the path of the alternating voltage. The effect of the arrangements according to this invention can be materially increased by amplifying the potentials arising at the terminals of the bridge arms. To this end each bridge arm may be connected with an amplifying discharge device, for instance in such manner that the control grids of the amplifying discharge devices are connected to the terminals of the corresponding arms, in which case it is useful to connect the anodes of the amplifying discharge devices with each other by an impedance, for instance a load resistance. The connecting parts between the anodes and this impedance may further be connected with the bridging discharge ssytem described above.

In the drawings affixed to this specification and forming part thereof several embodiments of my invention are illustrated diagrammatically by way of example.

In the drawings

Fig. 1 is a wiring diagram of a simple embodiment, while

Fig. 2 illustrates the same embodiment provided with an amplifier and

Figs. 3 and 4 are diagrams illustrating the manner of operation of the circuit according to Fig. 1.

Figs. 5 and 6 illustrate further embodiments, each comprising a bridging discharge system, while

Figs. 7 and 8 illustrate the arrangements according to Figs. 5 and 6, respectively, in combination with an amplifier and bridging discharge system.

Fig. 9 illustrates a modified form of the arrangement according to Figs. 7 and 8.

Referring to the drawings and first to Fig. 1, I is for instance the intermediate frequency oscillation circuit of a receiver, to which the intermediate frequency amplifier **1** is connected having a load resistance **2**, to which are connected the two arms of the bridge connection according to this invention. One arm consists of a diode **3**, a condenser **4** and a leakage or load resistance **5**, while the other arm consists of a diode **6**, a condenser **7** and a leakage or load resistance **8**. The time constants of the bridge arms are determined by the condenser **4** and resistance **5** and by the condenser **7** and resistance **8**. These members are so chosen that only the direct voltage arising across the resistance **5** is able to follow the modulation fluctuations of the carrier wave amplitude, while the direct voltage arising across the resistance **8** is only able to follow substantially slower fluctuations. For instance the time constants of the condenser **4** and resistance **5** may be $\frac{1}{5000}$ sec., the constant of the condenser **7** and resistance **8** $\frac{1}{2}$ sec. Thus the bridge arm of diode **3** is the quick, that of the diode **6** the slow arm. Accordingly the diode **3** may be termined the "quick," the diode **6** the "slow" diode. The two diodes are fed from the resistance **2** in such manner that the slow diode **6** receives the full alternating voltage arising across the resistance **2**, while the quick diode **3** owing to the adjustment of the tapping point **9**, only obtains one half of this voltage. *a* is the output terminal of the quick branch, *b* that of the slow branch.

The manner of operation of this arrangement may be explained by means of the diagrams of Figs. 3 and 4, which illustrate the potentials at the points *a* and *b* with regard to the cathode in the function of time.

If the reception is undisturbed (Fig. 3), the potential across the resistance **5**, i. e. at the point *a* is represented by curve A, the potential across the resistance **8**, i. e. at the point *b*, by the straight line B. The straight line B indicates the voltage corresponding to the carrier wave amplitude, which varies only slowly or not at all, while the voltage of the carrier wave modulation indicated by curve A fluctuates correspondingly. Since the quick arm only receives half the voltage the slow arm receives, the curve A will reach the straight line B only in the case of a 100 per cent modulation. The current flows in the diode circuits in the direction of the arrows according to Fig. 1, so that the upper ends of the resistances **5** and **8** are always negative. Thus in view of the explanation given above, when the reception is undisturbed, the point *b* will always be more negative than or at the most as negative as the point *a*.

If now a disturbing oscillation arises, which is greater by the value E_z than the voltage across the resistance **8**, the voltage arising across the resistance **5**, which is able to follow the modulation fluctuations, suddenly rises, while the voltage arising across the resistance **8** remains unchanged because the fluctuation of the disturbance is so short that the condenser **7** and resistance **8** cannot follow it. Therefore the point *a* will be more negative, while the disturbance lasts, than the point *b* and the relative polarity of the two points is thus reversed.

The variation of polarity or difference of potential arising during the disturbance may be utilized in any desired manner for the purpose

of suppressing the disturbance, for instance by using it to block some amplifier stage or signalling diode. However since this relative difference of potential, if the peak amplitudes of the disturbances exceed only little the voltage across the resistance 8, does not as a rule suffice for a perfect suppression of the disturbances, it is preferably amplified. To this end the bridge connection according to this invention may be connected with a direct current amplifier. An embodiment of this connection is shown by way of example in Fig. 2.

Here the bridge connection of Fig. 1 is for instance connected with a double triode 10. One of the triodes consists of the cathode 11, the control grid 13 and anode 15, the other triode of the cathode 11, control grid 14 and anode 16. To the cathode 11 there is connected a biasing resistance 12 and in the circuit of the anodes 15, 16 a resistance 17 is inserted, along which can be shifted the potentiometer arm 18. If the grids of the two triodes are biased by the same potential and if, in order to avoid any inequality of the triodes, the arm 18 is adjusted correspondingly, no difference of potential exists between the points *c* and *d* of the anode circuit. If however the grid 13 is more positive than the grid 14, the point *c* is more negative than the point *d* and vice versa.

The grid 13 is connected with point *a*, while grid 14 is connected with point *b* of the bridge connection. At the points *c* and *d* relative potentials appear corresponding to points *a* and *b*, which are however amplified. Therefore, if for the duration of the disturbance the relative potential values are reversed at the points *a* and *b* and the relative polarity of the two points changes, the same phenomenon also occurs at the points *c* and *d*. This amplified difference of potential arising between points *c* and *d* can then be utilized in any desired manner for suppressing the disturbances. The choke coils 19 and 20 are provided for the purpose of protecting the direct current amplifier from the high frequency.

The following figures illustrate embodiments provided with a bridging discharge system.

In the arrangement according to Fig. 5 a high frequency amplifier 21 is provided which comprises an input circuit 22 coupled to a high frequency oscillation circuit and an output circuit 23 coupled to the oscillation circuit 24. The oscillation circuit 24 is connected with the two arms of the bridge. The quick arm which receives one half of the alternating voltage appearing in the oscillation circuit 24, consists of the rectifying system of a double diode 27 formed by the anode 28 and cathode 30, and of a connected condenser 25 and load resistance 26. The slow arm, which receives the full alternating voltage appearing in the oscillatory circuit 24, consists of the rectifying system of the double diode 27 formed by the anode 29 and cathode 30, and of a connected condenser 31 and load resistance 32. In the embodiments according to Figs. 1 and 2 the two diodes were represented as separate valves, but they might of course also be combined into a single valve, as shown in Fig. 5. The terminal of the quick arm is here also marked *a*, that of the slow arm *b*.

According to the invention now a bridging discharge system formed by the diode 34 is connected to the terminals of the two bridge arms, e. g. as shown in the drawings in such manner that the anode 35 of the diode 34 is connected by way of a choke coil 37 to point *a*, the cathode 36 by way of a filter, consisting of the resistance 38 and condenser 39, to point *b*. In the cathode connection of the diode 34 there is inserted a resistance 40 with terminals 41 and 42. The explanations given above enable the mode of operation of this connection to be readily understood. When receiving unmodulated high frequency, there arises at point *b* a negative voltage of double the value than at point *a*. If modulated undisturbed high frequency is received, there arises at point *a* a negative voltage fluctuating in the rhythm of the modulation, which is lower than the negative voltage at point *b* (for instance with a 100 per cent modulation the voltage first mentioned will just become equal to the voltage last mentioned). Thus the cathode 36 of the diode 34 will always be more negative than the anode 35, so that the diode 34 transmits the signal modulation voltage arising at point *a*, which is then taken off at the terminals 41 and 42 of the resistance 40 and can be conducted to the further stages of the receiving set.

However if disturbances arise which exceed the critical value (for instance the 100 per cent modulation) determined by the amplitude of the carrier wave, the relative polarity of the points *a* and *b* is reversed, while the disturbance lasts, the potential of point *a* rising of a sudden, while the potential of point *b* remains unaltered. Thus the point *a* and the anode 35 connected to it will be more negative than the point *b* and the cathode 36 connected to this latter so that the diode 34 is blocked and the passing on of the modulation alternating voltage is interrupted. Therefore the voltage between the terminals 41 and 42 cannot be greater than a predetermined voltage corresponding for instance to a 100 per cent modulation, so that the disturbances cannot enter the further stages of the apparatus.

The choke coil 37 serves for blocking the high frequency. The filter circuit 38, 39, which has a comparatively great time constant, for instance of 1/5 sec., admits only a slow fluctuation of the potential of the cathode 36. The filter circuit of a resistance 43 and a condenser 44 furnishes through the conductor 45 the voltage for automatic volume control.

The embodiment according to Fig. 6 is distinguished from that illustrated in Fig. 5 by the fact that the cathode 36 of the diode 34 is connected to the terminal *a* of the quick bridge arm, the anode 35 to the terminal *b* of the slow arm and that the modulated alternating voltage is taken off the load resistance 26 directly through conductor 46 and terminals 41, 42. In this case the diode 34 acts in the directly opposite manner as in the connection according to Fig. 5. For in the case of an undisturbed reception, if the point *a* and the cathode 34 connected to it are less negative than point *b* and the anode 35, the diode 34 is blocked and the signal-modulated alternating voltage passes through conductor 46 to the terminals 41 and 42, where it can be taken off. On the other hand, if a disturbance arises and the point *a* becomes more negative than point *b*, the diode 34 becomes conductive and now feeds the modulated alternating voltage from the conductor 46 to the earth potential.

Since the disturbance suppressing arrangement is the more efficient, i. e. the suppression is the more certain, the greater are the amplitudes to be limited, it is advantageous to also in this case amplify the potentials arising at the points *a* and *b*. The amplification is effected similarly

as in Fig. 2 in such manner that the bridge connection is connected to a double amplifier as illustrated in Figs. 7 and 8.

In the embodiment illustrated in Figs. 7 and 8 the amplifier is a double triode **50**, in which one part of the triode consists of a cathode **51**, control grid **52** and anode **54**, the other part of the triode of cathode **51**, control grid **53** and anode **55**. To the cathode **51** is connected the biasing resistance **56**. The two anodes **54** and **55** are connected by way of the resistance **57** along which can be shifted the arm **58** of a potentiometer in order to compensate any irregularities of the valve parts. If the grid **52** is now connected to point *a*, grid **53** to point *b*, there exists between the points *c* and *d*, similarly as in Fig. 2, an amplified difference of potential of opposite sign, corresponding to the points *a* and *b*, i. e. during the undisturbed reception the point *c* is more negative than point *b*, while when a disturbance arises, the point *b* becomes more negative than *c*. The points *c* and *d* are now bridged by means of a discharge system, which is here also formed by a diode **34** with anode **35** and cathode **36**.

In the arrangement according to Fig. 7 the cathode **36** is connected to point *c*, the anode **35** by means of the resistance **40** to point *b*. From the explanation given with reference to Fig. 5 it results that with undisturbed reception the diode **34** is conductive and the amplified signal modulation can be taken off the terminals **21**, **22**, while, on a disturbance arising, the diode **34** is blocked and the path of the signal modulation thus is interrupted.

In contradistinction thereto is the arrangement according to Fig. 8 the anode **35** of the diode **34** is connected to the point *c*, the cathode **36** to the point *d*. From the explanation given with reference to Fig. 6 results that with undisturbed reception the diode **34** is blocked, the amplified signal modulation reaching, by way of a condenser **59**, the terminals **41** and **42**, from which it may be taken off. However when a disturbance arises, the diode becomes conductive and short circuits the resistance **57**, leading the signal modulation by means of a condenser **60** to the earth potential.

The arrangements here described offer great advantages, since the diode serving as signal rectifier is not loaded by another impedance connected thereto and since the voltage which controls the critical value of the limitation, is furnished by a separate rectifier whereby a great freedom from distortions can be attained. Further in these connections only a comparatively small reduction of sensitivity occurs in about the proportion of 1:2, which can however also be avoided, if to the diode of the quick arm the full voltage of the connected oscillatory circuit is impressed, while in the slow arm the voltage is doubled in a known manner. In this way obviously the same effect can be obtained as in the other cases mentioned above, where the quick diode receives one half of the voltage and the slow diode the full voltage of the oscillatory circuit.

It may be useful to state that in the connections above described the impedance, to which the discharge system of the slow arm of the bridge is connected, can be inserted either in a high frequency or in a low frequency stage.

Fig. 9 illustrates a simplified form of the embodiment of Figs. 7 and 8, in which in the place of two rectifiers or one double rectifier only one signal rectifier **61** is used and the quick bridge arm is formed by a condenser **62** and a resistance **63** of the signal rectifier **61**, while the slow arm consists of a resistance **64**, connected to the point *e* of highest potential of the resistance **63**, and a condenser **65**. The last mentioned parts (the resistance **64** and condenser **65**) form a filter which equalises the fluctuations of the rectified voltage arising in this bridge arm. The terminal of the quick bridge arm is the point *a* connected to a tapping point **66** of the resistance **63**, while the terminal of the slow bridge arm is the point of connection *b* of the resistance **64** and condenser **65**. The point *a* is connected to the control grid **62** of the double triode **50**, the point *b* to the control grid **53** of this triode. The remainder of the arrangement corresponds to that of Fig. 7. With this arrangement about the same effect can be obtained as for instance with the arrangement according to Fig. 7, the half voltage furnished by the rectifier **61** and fluctuating at the rhythm of the modulation being fed from point *a* without any previous filtration to the control grid **52** and the full voltage furnished by the rectifier **61** from point *b* after filtration to the control grid **53**.

I wish it to be understood that I do not desire to be limited to the exact details of construction shown and described for obvious modifications will occur to a person skilled in the art.

I claim:

1. A circuit arrangement for suppressing disturbances in radio receiving sets, comprising in combination, a signal stage forming the source of current, two rectifier systems each including a resistance and a condenser arranged in bridge connection, one of said systems forming the quick arm, and the other system forming the slow arm of such bridge, the quick arm having means for causing the rectified voltage appearing across its resistance to follow the signal modulations, the slow arm having means for causing the rectified voltage appearing across its resistance to respond only to slower fluctuations, means coupling said rectifier systems to said source of current so as to feed a lower alternating voltage to the quick arm than to the slow arm, whereby with undisturbed reception the rectified voltage appearing across the resistance of the quick arm is at most as high as that appearing across the resistance of the slow arm, and means for reversing this relation upon the occurrence of disturbances exceeding the critical value determined by the carrier wave amplitude.

2. The arrangement of claim 1, wherein the rectifiers are diodes.

3. The arrangement of claim 1, wherein the system of the slow arm comprises a filter whereby to equalize the fluctuations of the rectified voltage appearing in this arm.

4. The arrangement of claim 1, comprising an electron discharge system bridging said bridge arms and including at least two electrodes, one of said electrodes being connected to the terminal of the quick arm, and another electrode to the terminal of the slow arm, whereby during undisturbed reception, the signal-modulated alternating voltage is transmitted from the resistance of the quick arm to the further stages of the receiver set, while being blocked by the bridging system upon the occurrence of disturbances exceeding the critical value determined by the carrier wave amplitude.

5. The arrangement of claim 1, comprising an

electron discharge system bridging said bridge arms and including at least two electrodes comprising an anode and a cathode, said anode being connected to the terminal of the quick arm and said cathode being connected to the terminal of the slow arm, the signal-modulated alternating voltage being taken off the resistance of the quick arm by means of the bridging system, whereby said bridging system, during undisturbed reception, transmits this alternating voltage to the further stages of the receiver set, while blocking it when a disturbance arises.

6. The arrangement of claim 1, comprising an electron discharge system bridging said bridge arms and including at least two electrodes comprising an anode and a cathode, said anode being connected to the terminal of the slow arm and said cathode being connected to the terminal of the quick arm, the signal-modulated alternating voltage being directly taken off the resistance of the quick arm, whereby the bridging system arranged in shunt in the path of this alternating voltage is blocked during undisturbed reception, but is opened so as to short-circuit the path of the alternating voltage when a disturbance arises.

7. The arrangement of claim 1, comprising a plurality of amplifiers and means for connecting each terminal of the bridge arms to one of said amplifiers.

8. The arrangement of claim 1, comprising a plurality of amplifiers, including control grids and anodes, means for connecting each terminal of the bridge arms to the control grid of one of said amplifiers, and means including an impedance connecting said anodes to each other.

9. The arrangement of claim 1, comprising a plurality of amplifiers, including control grids and anodes, means for connecting each terminal of the bridge arms to the control grid of one of said amplifiers, means including an impedance connecting said anodes to each other, and an electron discharge system comprising at least two electrodes bridging the points where said anodes are connected to the impedance, whereby this system is controlled by the relative variations of the anode potential when a disturbance arises.

10. The arrangement of claim 1, comprising an impedance inserted in one of the signal stages, and means connecting the rectifier of the slow arm to said impedance.

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