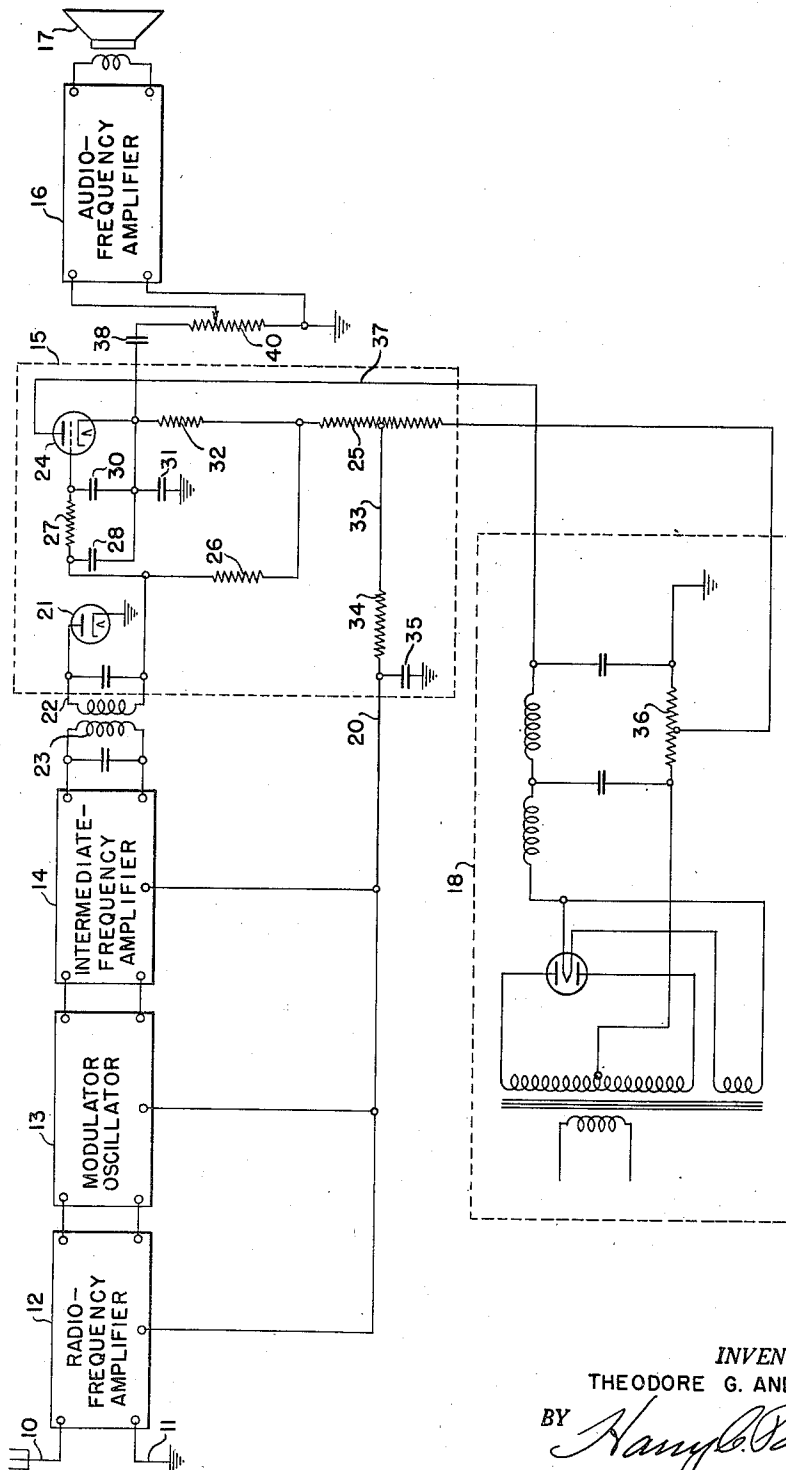


March 9, 1948.

T. G. ANDERSON
DIODE DETECTOR CIRCUIT
Filed June 12, 1945

2,437,493



INVENTOR.
THEODORE G. ANDERSON
BY *Harry B. Page*
ATTORNEY

UNITED STATES PATENT OFFICE

2,437,493

DIODE DETECTOR CIRCUIT

Theodore G. Anderson, Kennett Square, Pa., assignor by mesne assignments, to Hazeltine Research, Inc., Chicago, Ill., a corporation of Illinois

Application June 12, 1945, Serial No. 599,002

7 Claims. (Cl. 250—27)

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This invention relates to detector arrangements for wave-signal translating systems. More particularly the invention is directed to detectors of the diode type arranged to supply modulation components from a modulated carrier wave to a translating stage in a wave-signal receiving set.

Wave-signal receivers, especially those used in commercial broadcast reception, are often provided with a diode detector arrangement for deriving the modulation components from a modulated-carrier wave signal. In the usual case, the output circuit of the diode detector comprises a simple time-constant circuit for supplying an audio amplifier with the desired detected components. This type of load circuit causes a loading effect on the preceding stage of the receiver and may be responsible for an undesirable amount of distortion in the detected signal output.

It is an object of the present invention, therefore, to provide a detector arrangement which avoids the aforementioned limitation of the prior arrangements.

Another object of the invention is to provide an improved diode detector arrangement in which a very small amount of power is required from the detector input circuit.

Another object of the invention is to provide an improved diode detector arrangement in which the detector output circuit is made up of components having comparatively low impedance values while at the same time presenting a high effective impedance.

It is a specific object of the invention to provide a diode detector arrangement which employs a cathode-follower triode to apply a regenerative voltage feedback to the diode output circuit while at the same time transmitting modulation components to an audio-frequency amplifier.

In accordance with the invention a detector arrangement for a wave-signal translating system comprises a two-element rectifier, or diode, and means for applying to the rectifier an input signal having desired modulation components. A load circuit is coupled to the rectifier and includes an impedance for deriving the desired modulation components. The detector arrangement has a modulation-signal translating circuit for the rectifier including a signal-translating stage having input and output circuits. A means, including a first portion of the load impedance, is provided for applying the modulation components to the input circuit of the stage. The detector arrangement also contains means, comprising a second portion of the load impedance, for applying the translated modulation components in the output

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circuit in a regenerative sense to the load circuit of the rectifier.

For a better understanding of the present invention, together with other and further objects thereof, reference is had to the following description taken in connection with the accompanying drawing, and its scope will be pointed out in the appended claims.

The single figure of the accompanying drawing 10 is a circuit diagram, partly schematic, of a complete wave-signal receiver of the superheterodyne type embodying one form of the invention.

Referring now to the drawing in detail, the receiver there represented includes an antenna-ground system 10 and 11 to which are connected in cascade and in the order named, a radio-frequency amplifier 12, an oscillator-modulator or frequency changer 13, an intermediate-frequency amplifier 14, a detector and automatic volume control (A. V. C.) arrangement 15 hereinafter described in more detail, and an audio-frequency amplifier 16, to which is coupled a sound-signal reproducer or loud-speaker 17. A transformer-rectifier type of voltage supply 18 is connected with unit 15 in a fashion to be pointed out hereinafter. The stages or units 12, 13, 14, 16 and 17 may all be of conventional well-known construction so that detailed illustrations and descriptions thereof are unnecessary herein.

Considering briefly the operation of the receiver as a whole, and neglecting for the moment the operation of the present invention, a signal received by the antenna-ground system 10, 11 is selected and amplified in radio-frequency amplifier 12 and applied to oscillator-modulator 13 wherein it is converted into an intermediate-frequency signal. The intermediate-frequency signal is amplified in amplifier 14 and supplied to unit 15 wherein the modulation components 40 of the received signal are derived in a manner to be described presently. The modulation or audio-frequency components in turn are amplified in amplifier 16 and delivered to sound reproducer 17 for reproduction. A gain-control voltage, A. V. C., may be derived from the detector arrangement 15 and applied over a conductor 20 to one or more of units 12, 13 and 14 to control the gain of these units in order to maintain the signal input to the detector unit 15 within a relatively narrow range for a wide range of received signal intensities.

Referring now more particularly to the detector arrangement 15 embodying the present invention, this arrangement comprises a two-element rectifier, specifically a diode vacuum tube 21 having a cathode and an anode. A means is provided

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for applying to the rectifier 21 an input signal which has the desired modulation components. This means includes the secondary portion 22 of a double-tuned transformer 22, 23. The primary winding of the transformer is connected to the output terminals of the intermediate-frequency amplifier 14 and forms the usual transformer coupling between the intermediate-frequency amplifier and detector stages. A load circuit is coupled to the rectifier 21 and includes an impedance for deriving the desired modulation components. Specifically, the load impedance is a time-constant circuit, the resistance component of which includes resistors 26, 25 and the portion of resistor 36 between a tap thereon and a ground connection at one end thereof. The condenser component of the time-constant circuit comprises condensers 28 and 31 arranged in series with each other but effectively connected in parallel to the three resistors.

A modulation-signal translating circuit is provided for the rectifier and includes a signal-translating stage having input and output circuits. This stage comprises a triode tube 24 and the input circuit thereof includes the control electrode and cathode of the tube while the output circuit comprises the above-mentioned portion of resistor 36, resistor 25 and a resistor 32 connected between resistor 25 and the cathode of the tube.

A means is included in the arrangement under consideration by which a first portion of the load impedance of rectifier 21 is utilized to apply the modulation components to the input circuit of the stage including tube 24. This last-named means includes a provision for applying the voltage across resistor 26 to the input electrodes of tube 24 through a resistant-capacity filter comprising a series resistor 27, condenser 28 and a condenser 30 arranged in parallel connection.

A means is provided for applying the translated modulated components in the output circuit of the stage 24 in a regenerative sense to the load circuit of the rectifier. This means comprises a second portion of the load impedance of rectifier 21 and includes resistor 25 and the above-mentioned portion of resistor 36 which are common to the load circuit of detector 21 and the output circuit of the stage which includes the triode 24.

Resistor 25 is tapped at an appropriate point to supply a voltage for automatic volume control (A. V. C.). Connection is made by means of conductors 33 and 20 and the voltage may be applied to any one or all of the receiver components 12, 13 and 14. A filter comprising a resistor 34 and a condenser 35 is connected in the A. V. C. line between conductors 33 and 20 to filter out audio-frequency components.

The power supply unit 18 is of conventional design except for the resistor 36 which is inserted in the negative-potential side of the full-wave rectifier circuit.

Since the entire output circuit impedance of tube 24 is connected between the cathode of this tube and ground, a direct connection 37 is made from the anode to the positive-potential terminal of power supply 18.

A means for supplying the desired modulation components to the audio-frequency amplifier 16 comprises a blocking condenser 38 and a volume-control potential divider 40. The volume-control unit may be the usual voltage divider as indicated in the figure or any other circuit means adapted to perform this function.

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In considering the operation of the diode detector arrangement 15, let it be assumed initially that no wave signal is received at the antenna. For the assumed condition no input signal is applied to tube 21 which is therefore in its quiescent state. Tube 24 also has no input signal and is quiescent. The values of the circuit elements associated with these tubes and the potentials supplied thereto are selected to establish predetermined values of potential so that the A. V. C. line 20 is at the proper potential for the normal operation of stages 12, 13 and 14 and the potential drop across resistor 36 is adjustably set so as to balance the potential drop across resistor 25 and keep the anode of diode 21 at ground potential.

When a received signal is intercepted by antenna system 10, 11 and translated through the receiver it is applied to the input circuit of unit 15 as an intermediate-frequency signal including the desired modulation components. Signals impressed upon the diode 21 by the input circuit 22 are rectified by the tube due to its unilateral conductivity characteristic. The rectified pulses then flow through the load circuit of the diode which includes resistor 26, resistor 25 and part of resistor 36. In parallel with the resistive parts of the load circuit are two condensers 28 and 31 which are charged by the pulses, the magnitude of the charge being proportional to the modulation components of the carrier wave. The resulting voltage across resistor 26 is applied to the control electrode of tube 24 through resistor 27 and causes variations in the anode-cathode current which flows through the output circuit of this tube.

It is at once evident that resistor 25 and part of resistor 36 are common to the load circuit of diode 21 and the output circuit of triode 24 and since the triode receives the signal from a part of the diode load circuit, the common circuit elements constitute a feed-back arrangement. Thus when a signal is applied to the rectifier 21, current flows in its load circuit which results in a potential drop across resistor 25 in such manner that the cathode side thereof becomes more negative. A portion of the detected signal is applied to tube 24 through its input circuit to cause the control electrode to become more negative, decrease the flow of current in the anode-cathode circuit and produce a potential variation in the same sense in resistor 25. Therefore, the feed-back action is regenerative and the main result of such action is to lower the current flow in the diode output circuit, thus increasing its effective impedance.

For optimum operation, the regenerative voltage may vary from a value of half the voltage supplied by the detector output circuit to the tube 24 to a value only slightly less than the supplied voltage.

A regenerative feed-back circuit arrangement using a cathode-follower arrangement cannot return to a supply circuit more voltage than the circuit originates. Hence, there is no danger of overcompensation. If the feed-back voltage is 95 per cent. of the supply voltage, the increase in effective impedance of the diode 21 is the ratio of unity to the difference between unity and .95 or twenty times.

The achieved result of increasing the effective impedance by a factor of twenty is the lowering of the current drain in the input circuit to one-twentieth of its usual value.

Derivation of the desired modulation compo-

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nents for subsequent amplification by an audio-frequency amplifier may be accomplished by coupling across the entire output circuit of tube 24 specifically, by connecting to the cathode and ground. The condenser 38 is utilized to block out the direct current components.

In the above disclosure the rectifier unit has been described as a two-element diode tube, having an anode and a cathode. It is possible to substitute other rectifier units instead of the diode, such as a crystal detector, and attain the same result. Also, the rectifier unit 21 and the triode unit 24 may be in the same envelope, an example being tube type 12A7 with the pentode part of the tube connected as a triode. Types 6F6-G and 6C8-G may also be used with one of the triode units connected as a diode.

As illustrative of a specific application of the invention, the following circuit constants are given for one embodiment of the detector arrangement.

Diode detector tube 21	Type 6H6
Triode amplifier tube 24	Type 6J5
Resistor 25	10,000 ohms
Resistor 29	100,000 ohms
Resistor 27	100,000 ohms
Resistor 32	1,000 ohms
Resistor 34	500,000 ohms
Resistor 40	500,000 ohms
Condensers 28 and 30	100 micromicrofarads
Condenser 31	1,000 micromicrofarads
Condenser 35	5 microfarads
Condenser 38	1 microfarad

While there has been described what is at present considered to be the preferred embodiment of this invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention, and it is, therefore, aimed in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of the invention.

What is claimed is:

1. A detector arrangement for a wave-signal translating system comprising, a two-element rectifier, means for applying to said rectifier an input signal having desired modulation components, a load circuit coupled to said rectifier including an impedance for deriving said desired modulation components, a modulation-signal translating circuit for said rectifier including a signal-translating stage having input and output circuits, means including a first portion of said load impedance for applying said modulation components to said input circuit of said stage, and means comprising a second portion of said load impedance for applying the translated modulation components in said output circuit of said stage in a regenerative sense to said load circuit of said rectifier.

2. A detector arrangement for a wave-signal translating system comprising, a two-element rectifier, means for applying to said rectifier an input signal having desired modulation components, a load circuit coupled to said rectifier including an impedance for deriving said desired modulation components, a modulation-signal translating circuit for said rectifier including a signal-translating stage having input and output circuits, means including a first portion of said load impedance for applying said modulation components to said input circuit of said stage, and means comprising a second portion of said load impedance for applying the translated modulation

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components in said output circuit of said stage in a regenerative sense to said load circuit of said rectifier, said first portion of said load impedance being so proportioned with respect to said second portion that the effective rectifier load impedance is at least twice the value of said load impedance.

3. A detector arrangement for a wave-signal translating system comprising, a two-element rectifier, means for applying to said rectifier an input signal having desired modulation components, a load circuit coupled to said rectifier including an impedance for deriving said desired modulation components, a modulation-signal translating circuit for said rectifier including a signal-translating stage having input and output circuits, means including a first portion of said load impedance for applying said modulation components to said input circuit of said stage with a given intensity, and means comprising a second portion of said load impedance for applying the translated modulation components in said output circuit of said stage in a regenerative sense to said load circuit of said rectifier but with an intensity at least equal to one-half of said given intensity.

4. A detector arrangement for a wave-signal translating system comprising, a two-element rectifier, means for applying to said rectifier an input signal having desired modulation components, a load circuit coupled to said rectifier including an impedance for deriving said desired modulation components, a modulation-signal translating circuit for said rectifier including an electron-discharge device having input and output circuits, means included in said load circuit for applying said modulation components to said input circuit of said electron-discharge device, and means common to said input and output circuits of said electron-discharge device for applying the translated modulation components in said output circuit of said electron-discharge device in a regenerative sense to said load circuit of said rectifier.

5. A detector arrangement for a wave-signal translating system comprising, a two-element rectifier, means for applying to said rectifier an input signal having desired modulation components, a load circuit coupled to said rectifier including an impedance for deriving said desired modulation components, a modulation-signal translating circuit for said rectifier including a signal-translating stage having input and output circuits, means included in said load circuit for applying said modulation components to said input circuit of said stage with a given intensity, and means common to said input and output circuits of said electron-discharge device for applying the translated modulation components in said output circuit of said stage in a regenerative sense to said load circuit of said rectifier but with an intensity slightly less than said given intensity.

6. In a wave-signal receiver, a detector arrangement comprising, a two-element rectifier, means for applying to said rectifier an input signal having desired modulation components, a load circuit coupled to said rectifier including an impedance for deriving said desired modulation components, a modulation-signal translating circuit for said rectifier including a signal-translating stage having input and output circuits, means included in said load circuit for applying said modulation components to said input circuit of said stage, means common to said input and output circuits of said electron-discharge device for applying the translated modulation components

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in said output circuit of said stage in a regenerative sense to said load circuit of said rectifier, and means for deriving a control voltage for automatic volume control having an amplitude characteristic determined by the intensity of said input signal.

7. In a wave-signal receiver, a detector arrangement comprising, a two-element rectifier, means for applying to said rectifier an input signal having desired modulation components, a load circuit coupled to said rectifier including an impedance for deriving said desired modulation components, a modulation-signal translating cir-

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cuit for said rectifier including a signal-translating stage having input and output circuits, means included in said load circuit for applying said modulation components to said input circuit of said stage, means for applying the translated modulation components in said output circuit of said stage in a regenerative sense to said load circuit of said rectifier, and means for deriving the translated modulation components from the output circuit of said stage and applying said modulation components to an audio amplifier.

THEODORE G. ANDERSON,