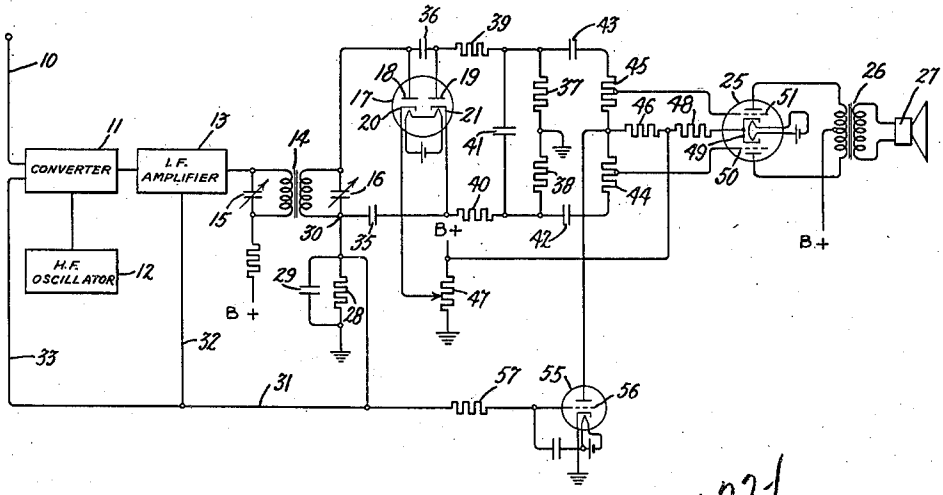
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DIODE RECTIFIER CIRCUITS

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DIODE RECTIFIER CIRCUIT

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4 Claims. (Cl. 250—20)

My invention relates to diode rectifier circuits, and particularly to circuits of this type adapted to detect signal modulations upon a high frequency carrier wave and to supply the demodulated signal indications to the audio frequency amplification stage of an electric signal receiver, such as a radio receiver, carrier current apparatus, or the like.

The invention will be found to have particular application to balanced diode detector circuits arranged to supply equal and opposite signal potentials at audio frequency to the input of a pair of balanced or "push-pull" audio frequency amplifying devices. It is well understood that when a balanced or push-pull audio frequency signal indication is obtained from a single diode rectifier, the voltage to ground across the diode load is no more than one-half the maximum which may be obtained if only a single-ended audio amplifier were used. Where a negative bias potential is to be obtained from the detector load for some control purpose such as automatic volume control or carrier-off noise suppression, such a reduction of maximum voltage to ground is disadvantageous.

Accordingly, it is an object of my invention to provide a new and improved single diode balanced detection circuit particularly arranged to facilitate the procurement of direct current bias potentials greater than those appearing across the diode load.

It is a further object of my invention to provide means for substantially insulating a single diode balanced detection circuit from the supply source in respect to unidirectional and signal frequency potentials, thereby to facilitate efficient automatic volume control and carrier-off noise suppression.

It is a specific object of my invention to provide a pair of single diode rectifier circuits insulated from each other with respect to unidirectional potentials and arranged independently to supply a balanced audio input circuit and a maximum automatic volume control bias potential.

My invention will be more readily understood and its objects and advantages further appreciated by referring now to the following detailed specification taken in conjunction with the accompanying drawing, the single figure of which is a schematic circuit diagram, partly in block form, of an electric signal receiving apparatus embodying my invention.

Referring now to the drawing, I have shown my invention by way of illustration as applied to a superheterodyne receiver for signal modulated carrier current appearing upon a conductor 10. The signal modulated high frequency oscillations appearing upon the conductor 10 are supplied to a converter or mixer 11 where they are combined in accordance with the heterodyning process with high frequency oscillations of a different frequency from a local oscillator 12. From the converter 11 a signal modulated wave of resulting intermediate frequency is supplied to an intermediate frequency amplifier 13, and from the amplifier 13 to an intermediate frequency output transformer 14. The primary and secondary windings of the intermediate frequency transformer 14 are connected in parallel circuit relation with tuning condensers 15 and 16 respectively.

Connected to the terminals of the secondary winding of the transformer 14, is a double diode rectifier 17 having a pair of anodes 18, 19 and a pair of heated cathodes 20, 21. It will be understood of course that, if desired, a pair of single diode rectifying devices may be used in place of the double diode 17. The diode rectifier comprising the anode 19 and the cathode 21 is connected to provide a balanced or push-pull demodulated signal voltage for supply to the control grids of a double triode push-pull audio amplifier 25 having a balanced output circuit comprising an audio frequency transformer 26. The audio frequency transformer 26 is energized from the plate circuits of the double triode amplifier 25 and supplies from its secondary winding an amplified audio frequency indication to a suitable signal reproducing device such as a loudspeaker 27. It will be understood that if desired a pair of separate audio amplifiers may be used to supply the balanced audio output transformer 26.

Since the diode detector circuit described briefly above utilizes only a single pair of diode elements in the double diode rectifier 17, the other pair of elements comprising the cathode 20 and the anode 18 is made available for obtaining a desired bias voltage for automatic volume control and the like. For this purpose the rectifier 18, 20 may be connected in series circuit relation with a load resistor 28 across the secondary terminals of the transformer 14. The direct current bias voltage then appearing across the resistor 28 will be the maximum available from the source 14 and will be proportional in value to the strength of the incoming signal at the transformer 14. A suitable by-pass condenser 29 connected across the load resistor 28 shunts out undesired voltages of intermediate frequency and

insures that the load resistor 28 carries only direct current and audio frequency current. The secondary terminal 30 of the transformer 14 is held at ground potential for intermediate frequencies and higher frequencies so that no undesired voltage components of these frequencies appear in the automatic volume control lines 32 and 33. However, for unidirectional potentials and audio frequency potentials the point 30 is maintained at a potential below ground determined by the full drop through the load resistor 28. This negative potential is supplied by means of leads 31, 32, and 33 to suitable stages of the signal channel ahead of the transformer 14, such as the converter 11 and the intermediate frequency amplifier 13. The negative bias supplied through the wires 32 and 33 controls the gain of the converter and amplifier stages in accordance with the strength of the incoming signal in such a manner as to tend to maintain substantially constant the signal volume received at the intermediate frequency transformer 14.

For the purpose of permitting the demodulating circuit through the diode rectifier 19, 21 to operate at a lesser maximum negative unidirectional potential than the point 30 in the automatic volume control circuit, the diode 19, 21 is connected directly across the secondary terminals of the transformer 14 through a pair of blocking condensers 35, 36, and the detector load is connected in shunt circuit relation to the diode 19, 21. The condensers 35 and 36 are intermediate frequency condensers of such small capacity that they offer substantially no impedance to currents of intermediate or higher frequencies but effectually insulate the detector load circuit from the automatic volume control circuit and from the transformer terminal 30 for unidirectional and audio frequency potentials. The balanced detection circuit itself comprises a pair of serially connected load resistors 37, 38 having their common terminal grounded and connected as a unit in parallel circuit relation with the diode rectifier 19, 21. Interposed between the diode rectifier 19, 21 and the diode load 37, 38 is an intermediate frequency by-pass filter comprising a pair of resistors 39, 40 and a capacitor 41. Since the midpoint of the resistors 37, 38 is grounded, instantaneous voltages appearing across the resistors 37, 38 are equal in magnitude and opposite in polarity. This is the condition which is necessary for supplying the input of a push-pull amplifier such as the double triode amplifier 25, and for this purpose the opposite terminals of the diode load 37, 38 are coupled through a pair of condensers 42, 43 to a pair of serially connected audio input resistors 44, 45. The midtap of the resistors 44, 45 is grounded through a "squelch" resistor 46 and a resistor 47. The resistor 47 is connected between ground and a source of direct current supply indicated by B+. The resistor 47 thus serves as a potentiometer to supply through the resistor 46 a certain amount of positive bias to the midtap of the input resistors 44, 45. The midpoint of the resistors 44, 45 is also connected through the resistor 48 and a suitable grid bias resistor 48 to the common cathode 49 of the double triode amplifier 25. Suitable taps on the audio input resistors 44, 45 are connected respectively to the control grids 50 and 51 of the amplifier 25.

To provide carrier-off noise suppression, a "squelch" tube 55 is arranged to render inoperative the audio amplifier 25 upon the disappearance of a carrier wave at the transformer 14. In the presence of a carrier wave the tube 55 is biased to cutoff by the negative potential at the terminal 30 of the transformer 14 applied to the control grid 56 of the tube 55 through a resistor 57. Upon disappearance of the carrier wave, however, the negative bias at the point 30 disappears, and the squelch tube 55 is permitted to pass current through a circuit which may be followed from a point of positive potential upon the resistor 47 through the squelch resistor 46 and the tube 55 to ground. The current flowing through this circuit is in such a direction through the resistor 46 that it drives the grids 50 and 51 of the amplifier 25 negative with respect to the cathode 49, thereby to cut off both amplifying sections of the tube and render inoperative all subsequent portions of the transmission channel.

From the foregoing detailed description of the various elements of my electric signal receiving apparatus and their manner of interconnection, it is believed that the mode of operation of the system as a whole will be readily understood. By way of summary, however, it is desired to point out certain features of the arrangement which are peculiar to applicant's invention. By arranging the diode detection circuits through the rectifier 19, 21 for balanced or push-pull audio indication with the midtap of the diode load resistors 37, 38 grounded, the bias potential obtainable from the negative terminal of the load resistor 38 is necessarily only one-half of the maximum available from the transformer 14 if a single-ended audio amplifier were used. This inherent disadvantage is overcome without necessitating more than the usual two diode rectifiers by arranging for push-pull detection from only a single diode and connecting the other diode 18, 20 in a series rectifying circuit including the load resistor 28 for the procurement of a maximum negative bias potential for automatic volume control and noise suppresion. Since full negative potential at the transformer terminal 30 can be maintained only if this point is insulated from the negative terminal of the balanced detector load, the balanced load is shunt connected to the diode 19, 21 and insulated for direct current from the transformer terminal 30 by means of the condenser 35. This arrangement permits the negative terminal of the bias resistor 28 to be operated at a different, and specifically a lower, direct current potential than the negative terminal of the balanced diode load. Thus I attain at once with only the usual two diode rectifiers the advantages of a balanced or push-pull detector and a maximum negative bias for automatic volume control and the like.

While I have illustrated only one preferred embodiment of my invention by way of illustration, many modifications will occur to those skilled in the art and it will therefore be understood that I intend by the appended claims to cover all such modifications as fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A receiver for electric oscillations comprising a source of signal modulated carrier waves, a first unidirectional conducting device connected to said source, a first load resistor connected in shunt circuit relation with said first unidirectional conducting device, a second unidirectional conducting device connected to said source in series with a second load resistor, said first load resistor having an intermediate point of fixed

potential thereby to produce equal and opposite signal potentials at opposite terminals of said first resistor, a push-pull load circuit connected across said terminals, means for controlling the gain of said receiver in accordance with the potential at a point on said second load resistor, and means for isolating said second load resistor from said load circuit in respect to signal and unidirectional potentials.

2. An electric signal receiving apparatus comprising a source of signal modulated carrier waves including a tuned circuit, a first diode rectifier connected to supply a negative bias potential proportional to the strength of said signal to control said receiving apparatus, a second diode rectifier and load resistor connected in parallel circuit relation with each other and with said tuned circuit and having an output circuit connected in shunt with said load resistor to supply equal and opposite potentials with respect to ground at signal frequency, and means for substantially insulating both the anode and cathode of said second diode rectifier from said tuned circuit with respect to unidirectional and signal frequency potentials thereby isolating said bias potential from said load resistor.

3. An electric signal receiving apparatus comprising a pair of diode rectifiers, a signal channel for supplying to said rectifiers a signal wave modulated at audio frequency in accordance with the desired signal, one of said rectifiers being connected with a first output circuit to supply to said signal channel a negative bias potential proportional to the strength of said signal, a second output circuit connected in parallel circuit relation with the other of said rectifiers and arranged to supply equal and opposite potentials with respect to ground at audio frequency, and capacitor means connected between said second diode rectifier and said signal channel thereby substantially to insulate said second output circuit from said first output circuit with respect to unidirectional and audio frequency potentials.

4. An electric signal receiving apparatus comprising a signal channel including a tuned circuit for supplying a signal wave modulated at audio frequency in accordance with a desired signal, a single diode rectifier connected to said tuned circuit and having a shunt connected output circuit arranged to supply equal and opposite potentials with respect to ground at audio frequency, a pair of electric discharge amplifying devices having a balanced output circuit, said balanced audio frequency potentials being supplied to the input circuit of said amplifiers, a second diode rectifier connected to said tuned circuit and to a load resistor for supplying to said signal channel a negative bias potential substantially equal to the strength of said signal, and a pair of capacitors interposed between said tuned circuit and said first diode rectifier thereby electrically to insulate said balanced load circuit from said negative bias potential.

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