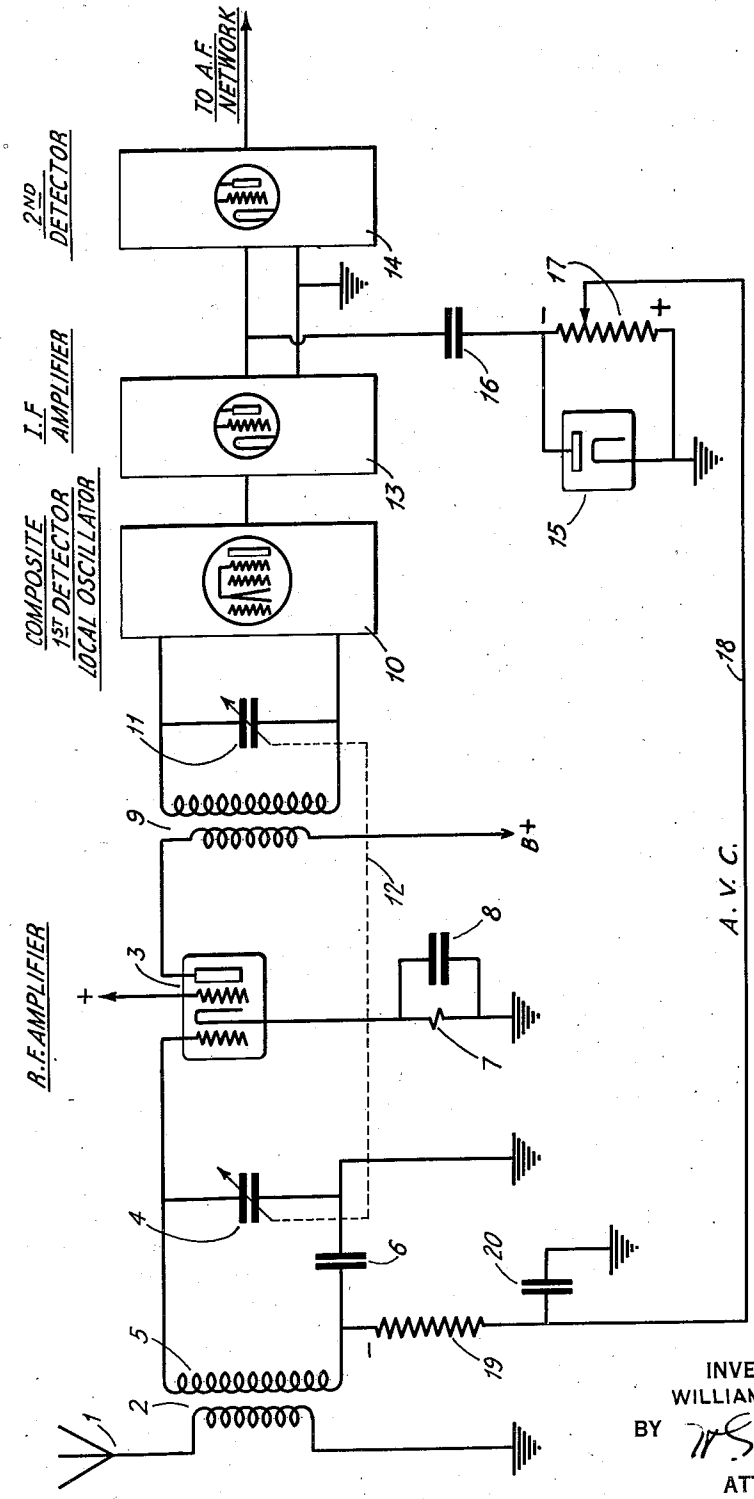
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SUPERHETERODYNE RECEIVER

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INVENTOR
WILLIAM S. BARDEN
BY W. S. Barden
ATTORNEY

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SUPERHETERODYNE RECEIVER

William Stoddard Barden, Grasmere, Staten Island, N. Y., assignor to Radio Corporation of America, a corporation of Delaware

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My present invention relates to superheterodyne receivers, and more particularly to a receiver of the latter type which is capable of detecting relatively strong signals without blocking of the local oscillator.

While composite first detector-local oscillator networks of the type disclosed by me in my copending application Serial No. 592,461, filed February 12th, 1932 function in a satisfactory manner during normal superheterodyne reception, there exist certain abnormal situations when the functioning of such networks are poor. For example, when a receiver embodying such a network has been tuned to a desired signal frequency and the "cut-off" switch of the set has been closed, actuation of the switch to open position results in an inoperative condition of the receiver. This is particularly noticeable when the frequency to which the receiver is tuned corresponds to a strong local station. Again, sudden tuning of such a superheterodyne receiver through a signal frequency having a strong field intensity causes the aforementioned inoperative condition. It may also be pointed out that this abnormal condition may arise when such a receiver is employed in an automobile during a period when the automobile moves out of a shielding zone, such as a bridge, and permits the signal collector to collect signals of extremely strong field intensity.

Without resorting to involved theoretical considerations, it is believed sufficient to point out that these aforementioned abnormal conditions are usually caused by blocking of the local oscillator portion of the composite network. A superheterodyne receiver utilizing, for example, a radio frequency amplifier stage of a high or a moderate gain (30 or 40, by way of illustration), a pre-selector having a low gain (say 1 or 2), normal negative bias on the control grid of the radio frequency stage, such normal bias being about —3 volts, and a composite first detector-local oscillator network of the aforedescribed type may be rendered inoperative when very strong antenna signals "flood" the composite network. It may be stated that such strong signals usually have a magnitude of upwards of ¼ of a volt. In order to restore normal operating condition when this abnormality occurs, it is necessary to adjust the tuning device to a frequency different from the desired signal frequency. Such a requirement necessarily aggravates a condition which by itself is sufficiently confusing to the average broadcast receiver operator.

Accordingly, it may be stated that it is one of the main objects of my present invention to provide a superheterodyne receiver utilizing a composite first detector-local oscillator wherein the impression of extremely strong signals on the signal collector of the receiver has substantially no effect on the functioning of the composite network.

Another important object of the invention may be said to reside in the provision of a superheterodyne receiver which is adapted to operate under all conditions of variation in the received signal intensity, the essential feature of the receiver consisting in impressing little or no normal negative bias on the signal grid of the radio frequency amplifier.

Another object of the invention is to provide a method of receiving broadcast signals by the superheterodyne method, extremely strong signals being employed to produce a direct current component for reducing the gain of the radio frequency amplifier of the receiver to a point such that flooding, or blocking, of the local oscillator of the receiver is prevented, the local oscillator being embodied in a composite network including a first detector.

Still other objects of the invention are to improve generally the efficiency of superheterodyne receivers utilizing autodyne first detector networks, and especially to provide a receiver of this type which is not only reliable in operation, but which is economically manufactured.

The novel features which I believe to be characteristic of my invention are set forth in particularity in the appended claims. The invention itself, however, both as to its organization and method of operation will best be understood by reference to the following description, taken in connection with the drawing, in which I have indicated diagrammatically a circuit organization whereby my invention may be carried into effect.

Referring now to the accompanying drawing which shows in diagrammatic manner a conventional and well known type of superheterodyne receiver, the signal collector is designated by the reference numeral 1. The signal collector is the well known grounded antenna circuit, but it is to be clearly understood that a loop antenna or an automobile radio receiver signal collector may be utilized in place of the grounded antenna circuit. The transformer 2 couples the signal collector to the input electrodes of the first radio frequency amplifier tube 3, which tube is preferably of the screen grid type. The variable

tuning condenser 4 is connected across the secondary 5 of the transformer 2, and the direct current blocking condenser 6 is interposed between the ground side of tuning condenser 4 and the low potential side of coil 5.

The cathode of tube 3 is connected to ground, and it is to be clearly understood that it is one of the essential features of the present invention that the usual grid biasing network employed in the cathode circuit be designed so that little or no negative bias is imposed on the signal grid of the tube. For this reason the usual biasing resistor 7, shunted by the radio frequency by-pass condenser 8, should have a magnitude such that the signal grid of tube 3 is only slightly negative with respect to the cathode. It may even be preferable in certain situations to dispense with the network 7 and 8, and normally maintain the signal grid at the same direct current potential as the cathode.

The anode of tube 3 is connected to a source of positive potential, which source is omitted, through a primary of the coupling transformer 9. The reference numeral 10 designates the composite first detector-local oscillator which follows the radio frequency amplifier. It is not believed necessary to show the circuit connections of this composite network, since it is fully disclosed and claimed in my aforementioned copending application. It is merely necessary to point out that the composite network employs a pentode tube, and has as one of its chief advantages the fact that the signal grid thereof never draws grid current. The reference numeral 11 denotes the variable tuning condenser of the first detector portion of the network 10, the variable tuning means of the local oscillator portion being omitted to preserve simplicity of disclosure. It is to be clearly understood that the variable tuning condensers 4 and 11, as well as the tuning condenser of the local oscillator portion which is not shown, are mechanically uni-controlled in any well known fashion, the dotted line 12 representing such uni-control mechanism.

The intermediate frequency energy output of the network 10 is transmitted to an intermediate frequency amplifier 13, and the amplified output of the latter is impressed upon the succeeding second detector 14. As is well known to those skilled in the art, the detected output of the network 14 is impressed upon an audio frequency amplifier and finally reproduced in any well known manner, as by a loud speaker.

While the functioning of the present invention is independent of the presence or absence of an automatic volume control arrangement in the receiver, such an arrangement has been shown to illustrate the point that even the presence of such a gain control arrangement is of little value in solving the problem which has heretofore been discussed.

The automatic volume control arrangement shown in the drawing is of a purely conventional type and is merely shown by way of illustrating one form of the arrangement. Since the gain of the radio frequency amplifier 3 is to be varied in response to variations in received carrier amplitude, a device, such as a diode rectifier 15, is utilized to derive a direct current control potential from received carrier energy. The diode anode is customarily connected to one side of the input circuit of the second detector 14 through a signal transmission condenser 16, while the cathode of the diode is grounded so as to provide a signal return path to the grounded side of the detector input circuit. Between the diode electrodes there is usually connected an impedance 17, which may be a resistor, and a suitable selected point of negative direct current potential of the impedance is connected by a direct current connection 18 to the grid circuit of the radio frequency amplifier. This direct current connection has also been designated "AVC" and the usual radio frequency filter network of the automatic volume control path is designated by the numerals 19, 20. Of course, gain control connections may be made to the network 10 and the intermediate frequency amplifier network 13, but these are omitted since they are well known to those skilled in the art.

As stated heretofore, whereas it is usual to employ a negative bias about −3 volts on the signal grid of the radio frequency amplifier, in the present case there is only a slight negative bias thereon, as for example not over −½ volt. Because of this potential relation strong signals at the signal collector 1, in resonance with the tuned circuit, are better able to cause a flow of grid current in the grid circuit of the radio frequency amplifier. This grid current flows through a diode rectifier circuit wherein the diode comprises the grid and cathode of the amplifier tube 3. The diode circuit may be traced from the grid of tube 3 through the coil 5, through the resistor 19, the lead 18, the resistor 17, ground, to the ground of the cathode of tube 3, and the cathode of the latter. The diode action causes a negative grid bias to be developed across resistor 19 and whatever other resistance is included in this diode circuit. This negative bias decreases the gain of the radio frequency amplifier stage, and tends to prevent "flooding" of the composite network 10.

It will, therefore, be seen that when the tuning condensers 4 and 11 are adjusted to receive a signal frequency having a high field intensity, upwards of ¼ of a volt for example, and such strong signals are suddenly impressed upon the receiver, the gain of the radio frequency amplifier will be reduced by the positive signal swing sufficiently to prevent blocking of the local oscillator portion of the composite network 10. As pointed out above, such sudden impression of strong signals occurs when switching the receiver to operative condition while tuned to the frequency of the strong signals, suddenly tuning through such a strong signal frequency, or suddenly moving the receiver into the strong field. In any of these cases the grid of the amplifier tube 3 is swung positive, and the resultant flow of grid current through the diode circuit including the grid and cathode of tube 3 creates a negative grid bias potential which is sufficient to reduce the gain of tube 3 below the oscillator blocking point.

In designing the receiver embodying the present invention it is desirable to have a high step-up ratio between the antenna circuit 1 and the signal grid circuit of the radio frequency amplifier in order to obtain the diode action without having to make the antenna signal excessively strong. For a given and prerequisite amount of radio frequency gain from the antenna to the grid of the first detector it is in the best interests of the diode action to have a great amount of that gain ahead of the radio frequency grid, and a small amount of that gain in the radio frequency amplifier stage. The high step-up ratio between the antenna and the first radio frequency amplifier, and the corresponding reduction in the required radio frequency gain in the radio fre-

quency stage itself are favorable to the maintenance of a low negative bias on the grid of the radio frequency amplifier tube. In this way the erratic performance of the receiver which has been described heretofore is effectively prevented.

While I have indicated and described several systems for carrying my invention into effect, it will be apparent to one skilled in the art that my invention is by no means limited to the particular organization shown and described, but that many modifications may be made without departing from the scope of my invention, as set forth in the appended claims.

What I claim is:—

1. A method of receiving signal energy of a selected frequency which consists in amplifying collected signals of a selected frequency, impressing the amplified signals upon a composite first detector-local oscillator, utilizing the resultant intermediate frequency energy, deriving prior to said impression from extremely strong signals of said frequency a direct current component, and decreasing the amplification of said collected signals when said extremely strong signals are suddenly collected.

2. In a superheterodyne receiver, a tunable radio frequency amplifier, an autodyne first detector, means for utilizing the output of said detector, the signal grid of said amplifier being slightly negative with respect to the cathode thereof, and means connected between the signal grid and cathode of said amplifier for developing a grid biasing direct current potential from extremely strong signals suddenly impressed upon said amplifier.

3. In a superheterodyne receiver, a tunable radio frequency amplifier, an autodyne first detector, means for utilizing the output of said detector, the signal grid of said amplifier being slightly negative with respect to the cathode thereof, and means including a direct current connection connected between the signal grid and cathode of said amplifier for developing a grid biasing direct current potential from extremely strong signals suddenly impressed upon said amplifier.

4. In a superheterodyne receiver, a tunable radio frequency amplifier, an autodyne first detector, means for utilizing the output of said detector, the signal grid of said amplifier being slightly negative with respect to the cathode thereof, and means including an impedance connected between the signal grid and cathode of said amplifier for developing a grid biasing direct current potential from extremely strong signals suddenly impressed upon said amplifier.

5. In a superheterodyne receiver, a tunable radio frequency amplifier, an autodyne first detector, means for utilizing the output of said detector, the signal grid of said amplifier being slightly negative with respect to the cathode thereof, and means including a resistive path connected between the signal grid and cathode of said amplifier for developing a grid biasing direct current potential from extremely strong signals suddenly impressed upon said amplifier.

6. In a superheterodyne receiver, a tunable radio frequency amplifier, an autodyne first detector, means for utilizing the output of said detector, the signal grid of said amplifier being slightly negative with respect to the cathode thereof, means connected between the signal grid and cathode of said amplifier for developing a direct current potential from extremely strong signals suddenly impressed upon said amplifier, and additional means including said developing means as a part thereof for automatically regulating the gain of said amplifier in response to variations in received carrier amplitude.

7. In a superheterodyne receiver, a radio frequency amplifier having a tunable input circuit including a variable tuning condenser, a composite first detector-local oscillator having a signal input circuit including a variable tuning condenser coupled to the output circuit of said amplifier, an intermediate frequency amplifier coupled to the intermediate frequency output circuit of said composite network, and means for utilizing the amplified intermediate frequency energy, a direct current path between the signal grid and cathode of said radio frequency amplifier, said path including a resistive impedance, the signal grid of said radio frequency amplifier normally being maintained slightly negative with respect to the cathode, said resistive impedance developing a direct current potential thereacross of a magnitude sufficient to decrease the gain of said radio frequency amplifier to a point such that blocking of the local oscillator of said composite network is prevented when extremely strong signals of the frequency to which said variable tuning condensers are adjusted is impressed on the input circuit of said radio frequency amplifier.

8. In a receiver of the type defined in claim 7, an automatic volume control arrangement including said resistive impedance as a part thereof connected between the output of said intermediate frequency amplifier and the signal grid circuit of said radio frequency amplifier.

9. An improvement in a superheterodyne receiver of the type including a composite local oscillator-first detector circuit preceded by a tunable radio frequency amplifier, and the local oscillator network of the composite circuit tending to become inoperative when strong signals of a selected frequency are suddenly impressed on said amplifier, said improvement comprising means for maintaining the signal grid of the amplifier at a direct current potential which at no time becomes positive with respect to the amplifier cathode potential, a direct current path between the amplifier signal grid and cathode including an impedance, said impedance having a value sufficient to develop a direct current voltage for negatively biasing said signal grid to reduce the amplifier gain to a level for preventing said inoperativeness when said strong signals are received.

10. In a receiver of the type defined in claim 9, a signal collector, and a signal voltage step-up device between the collector and amplifier.

11. In a receiver as defined in claim 9, said maintaining means comprising an impedance in the space current path of the amplifier adapted to bias the signal grid negatively.

12. In a receiver as defined in claim 9, an automatic volume control circuit connected between the composite circuit output and the signal grid of the amplifier and including the said path as a part thereof.

WILLIAM STODDARD BARDEN.