

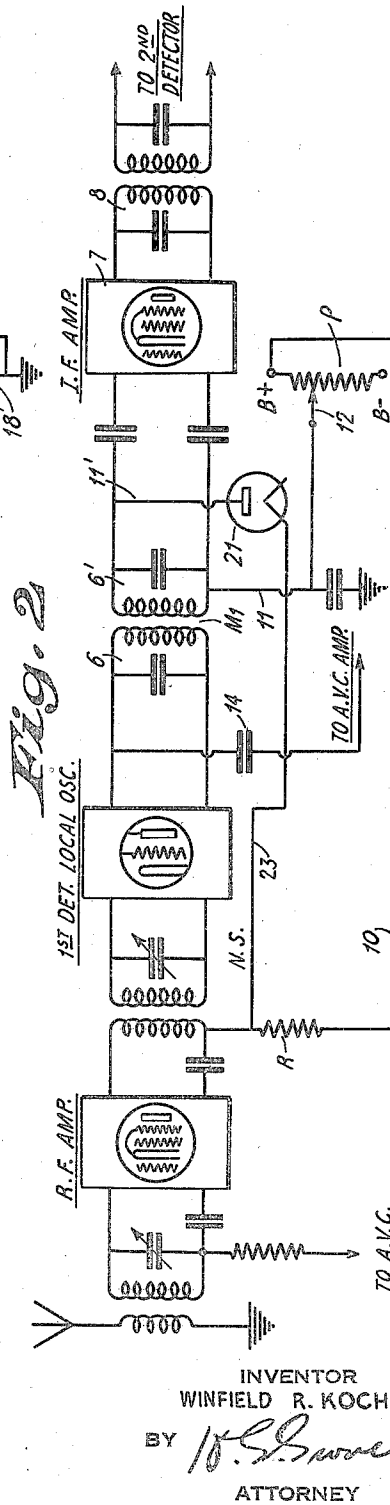
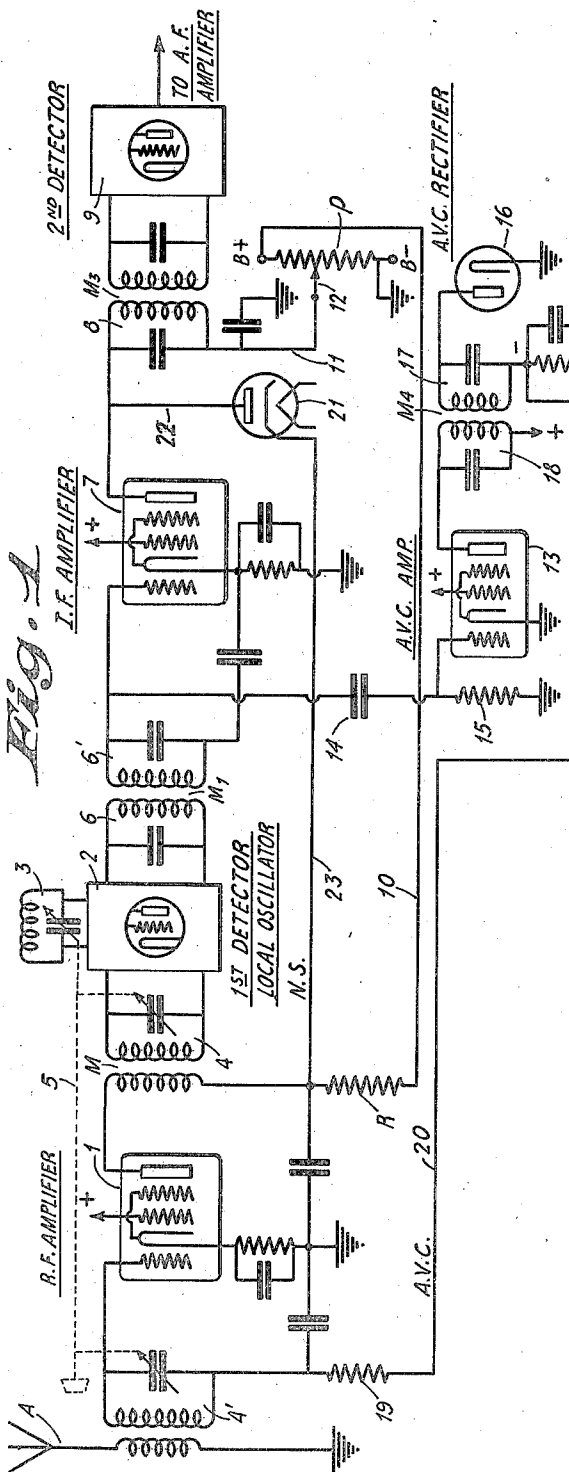
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INTERSTATION NOISE SUPPRESSOR CIRCUITS

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INTERSTATION NOISE SUPPRESSOR CIRCUITS

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My present invention relates to transmission control circuits for radio receivers, and more particularly to an improved type of inter-station noise suppressor arrangement for a radio receiver.

Radio receivers of the present day which utilize automatic volume control additionally employ inter-station noise suppressor arrangements for preventing normal transmission by one or more receiver circuits when the received signal strength falls below a predetermined intensity level. These inter-station noise suppressor arrangements are of different types, but all have in common the fact that between station settings of the tuning means the receiver is quiet or silent. When a signal of a predetermined strength is tuned in, the receiver becomes fully operative and reproduces the signal.

Accordingly, it may be stated that it is one of the main objects of my present invention to provide an inter-station background noise suppressor arrangement for a radio receiver utilizing automatic volume control, the receiver being silent except when a signal of a predetermined strength is tuned in, and the quieting function being accomplished by the use of a low impedance disposed in at least one of the tuned circuits of the receiver, the value of the impedance being variable in response to variations in the sensitivity of an amplifier whose gain is automatically regulated.

Another important object of the invention is to provide in combination with an automatic volume control arrangement for a radio receiver an electronic impedance disposed in one of the tuned circuits of a high frequency amplifier of the receiver, the magnitude of the electronic impedance being adapted to be varied in response to variations in sensitivity of the amplifier whose gain is automatically regulated.

Still another object of the present invention is to provide an inter-station background noise suppressor arrangement for a radio receiver, the receiver employing an automatic volume control network for regulating the sensitivity of a radio frequency amplifier, the suppressor arrangement essentially comprising a diode connected across a tuned circuit in an amplifier following the aforementioned controlled amplifier, the conductivity of the diode being automatically regulated in response to potential variations in the plate circuit of the controlled amplifier.

Still other objects of the invention are to improve generally inter-station background noise suppressor arrangements for radio receivers, and to particularly provide such an arrangement

which is not only reliable in operation, but economically manufactured and assembled in a radio receiver.

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 several circuit organizations whereby my invention may be carried into effect.

In the drawing:—

Fig. 1 diagrammatically shows a radio receiver embodying one form of the present invention,

Fig. 2 diagrammatically shows a modification of the noise suppressor arrangement shown in Fig. 1.

Referring now to the accompanying drawing, wherein like reference characters in the two figures designate similar circuit elements, the receiving arrangement shown in Fig. 1 is a conventional type of superheterodyne receiver. The receiver comprises the usual signal collector device, such as a grounded antenna circuit A. The signal collector may, of course, be of any other well known type such as a radio frequency distribution line or a loop antenna, and is coupled to the tunable input circuit of the radio frequency amplifier tube 1. The latter is preferably of the pentode type for reasons which will later be pointed out, and its plate circuit is coupled, as at M, to the tunable signal input circuit of the first detector network 2.

The network 2, whatever its construction, will embody a tunable local oscillator circuit 3 besides the tunable signal circuit 4, and any mechanical type of uni-control tuning mechanism, shown by the dotted lines 5, may be utilized for simultaneously adjusting the variable tuning condensers of the tunable signal circuits 4' and 4 and the local oscillator circuit 3. As is well known to those skilled in the art, adjustment of the tuning device 5 to any desired station setting results in the production in the tuned circuit 6 of energy of the operating intermediate frequency. The network 2 may comprise separate first detector and local oscillator tubes, or it may consist of a composite first detector-local oscillator tube. Both of these circuits are well known in the art, and need not be described in any further detail. The intermediate frequency amplifier tube 7 is also of the pentode type, and its tuned input cir-

cuit 8' is coupled to the tuned circuit 6 through a coupling M₁.

The radio frequency transformer M₃ has its primary and secondary windings independently tuned to the intermediate frequency, the reference numeral 8 designating the tuned primary circuit. A conventional second detector circuit 9 is coupled to the tuned secondary circuit of the coupling transformer M₃, and the detected output of the network 9 is then utilized in any well known manner by one or more stages of audio frequency amplification followed by any desired type of reproducer.

The reference numeral P designates the direct current potential supply bleeder resistor which is used to supply the positive potentials for the plates of tubes 1 and 7, the remaining direct current potential circuits being omitted to preserve simplicity of description. The positive and negative terminals of the bleeder P are designated "+B" and "-B". The plate of tube 1 is connected to the +B terminal of resistor P through a path which includes the primary winding of coupling transformer M₁, the resistor R and the lead 10. The plate of tube 7 is connected to a point on resistor P, which has a lower positive potential value than the point +B, through a path which includes the primary winding of transformer M₃, the lead 11 and the variable tap 12, a radio frequency by-pass condenser being connected between the lead 11 and ground to by-pass radio frequency energy. The terminal "-B" is designated as grounded in order to show the return circuits to the grounded cathode leads of tubes 1 and 7, and it will be noted that each of these grounded cathode leads includes the usual self-bias resistors shunted by radio frequency by-pass condensers. Additionally, it will be observed that radio frequency by-pass condensers are employed in the input and output circuits of tubes 1 and 7 in the well known manner.

The automatic volume control network for the receiver essentially embodies a tube 13, of the pentode type, which functions as an amplifier for the signal energy which is to be rectified to secure the volume control bias. Signal energy is impressed upon the input electrodes of tube 13 through a path which includes the condenser 14, the reference numeral 15 designating a grid leak resistor connected between the signal grid and cathode of tube 13. The rectifier device employed to derive the volume control voltage from the amplified signal energy is a diode 16 which has connected between its anode and cathode a path including, in series, a resonant circuit 17 tuned to the operating intermediate frequency and a resistor 18' shunted by a radio frequency by-pass condenser. The plate circuit of tube 13 includes a resonant circuit 18 tuned to the intermediate frequency, the circuits 17 and 18 being coupled as at M₄.

The signal control grid of tube 1 is connected to the anode side of resistor 18 through a path which includes the audio frequency ripple suppressor resistor 19 and the lead 20. The lead 20 has been designated "AVC" to show that this is the automatic volume control connection between the diode rectifier 16 and the signal grid of the controlled amplifier 1. The automatic volume control arrangement functions in a manner such that the sensitivity of the controlled amplifier 1 is a maximum when no signal energy is transmitted through the condenser 14. When no signals are received there are no signals impressed upon the diode rectifier 16, and consequently the anode

side of resistor 18 is at its least negative potential. As soon as signals are received, such signals are rectified by diode 16, and the negative side of resistor 18 becomes greater in negative potential with the result that the signal grid of the controlled amplifier 1 is biased more negatively with respect to the cathode thereof. This results in a reduction in the sensitivity and gain of the controlled amplifier.

Obviously since the sensitivity of the controlled amplifier 1 is a maximum when no signals are received, undesired background electric impulses will be greatly amplified and reproduced to an annoying extent when the tuning device 5 is adjusted between adjacent desired station settings. Furthermore, when receiving distant stations whose field strength at the receiver is extremely low, such undesired impulses will be reproduced to an annoying extent. It is for these reasons that a background noise suppressor arrangement is utilized in a receiver employing automatic volume control. In the present case the noise suppressor arrangement comprises the diode 21 having its anode connected to the plate side of the tuned circuit 8 through a lead 22, the cathode of the diode being connected by a lead 23 to the plate side of resistor R. The lead 23 has been designated by the letters "N. S." to show that this is the connection which provides the noise suppressor action. In actual operation, and assuming that the tuning device 5 is adjusted to a point such that no signals are being collected by the collector A, the automatic volume control arrangement is not impressing any negative control bias on the signal grid of the controlled amplifier 1.

It, therefore, follows that the plate current flow of the tube 1 is a maximum, and this causes a large voltage drop across the resistor R.

The value of the resistor R is so chosen that with no signals being received the voltage drop across the resistor R caused by the increased plate current flow of tube 1 renders the anode of the noise control tube 21 positive with respect to its cathode. When this occurs space current flows through tube 21, and results in a loading down of the tuned circuit 8 so that very little signal is transmitted to the tuned input of the second detector network 9.

In other words, the electronic device 21 functions as a damping impedance which is a maximum when no signals are received by the receiver. The device 21 being conductive when no signals are being received, it constitutes a low impedance shunt across the tuned output circuit of tube 7 for the undesired background impulses.

When a signal sufficient to operate the automatic volume control mechanism is received, the signal grid of the controlled amplifier 1 is biased off somewhat, and this causes less of a voltage drop across the resistor R. The anode of the noise control tube 21 becomes negative with respect to its cathode and the flow of space current through the tube ceases. The load on the tuned circuit 8 is thus removed, and the signal is then permitted to reach the second detector. The signal level at which the load is removed from the tuned circuit 8 may be adjusted by the variable tap 12, and therefore this tap comprises a noise suppressor adjustment, or manual sensitivity control.

The receiver arrangement shown in Fig. 2 is substantially the same as that shown in Fig. 1, the only difference residing in the modified form of background noise suppressor circuit employed, 75

For this reason only such parts of the receiving system which are essential to an understanding of the modified noise suppressor arrangement are shown, and it is to be clearly understood that the receiver arrangement includes many of the circuit elements shown in Fig. 1, and which have been omitted from Fig. 2. In this modification the noise control tube 21 is connected across the tuned secondary of the intermediate frequency coupling transformer M1. The cathode of tube 21 is connected by lead 23 to the plate side of resistor R, while lead 11' connects the high alternating current potential side of tuned circuit 6' to the anode of tube 21. In this modification of the invention, therefore, it will be seen that the noise control tube 21 furnishes a low impedance shunt across the tuned input circuit of the intermediate frequency amplifier 7 when no signals are being received. The action of removing this low impedance shunt is identical to that described in connection with the arrangement shown in Fig. 1.

Because pentode tubes are utilized in the arrangement shown in the present receiving circuits, the plate voltages on tubes 1 and 7 may be permitted to be rather low, and the value of resistor R may then be made sufficiently great to give a large noise control voltage from a small volume control voltage. The present invention results in the advantage that control is secured at a point in the circuit where the signal is of small amplitude, so that there will be less possibility of distortion. Also, the range of field strengths for which the noise suppressor is partially operating will be narrow.

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 organizations 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. In combination with an amplifier whose gain is to be controlled, means for automatically regulating the gain of the amplifier in response to variations in received signal intensity, a succeeding amplifier having its input circuit coupled to the output circuit of the controlled amplifier, electron discharge means comprising a low impedance shunt across at least one of the tuned circuits of said second amplifier when no signals are impressed upon the controlled amplifier, and additional means, disposed in the space current path of the controlled amplifier and connected to said low impedance means, for removing the effect of the low impedance shunt when signals are impressed on said controlled amplifier.

2. In combination with an amplifier whose gain is to be controlled, means for automatically regulating the gain of the amplifier in response to variations in received signal intensity, a succeeding amplifier having its input circuit coupled to the output circuit of the controlled amplifier, means comprising a low impedance shunt across at least one of the tuned circuits of said second amplifier when no signals are impressed upon the controlled amplifier, and additional means, disposed in the space current path of the controlled amplifier and connected to said low impedance means, for removing the effect of the low impedance shunt when signals are impressed on said controlled amplifier, said low impedance means comprising an electron discharge tube

connected across the tuned output circuit of said second amplifier.

3. In combination with an amplifier whose gain is to be controlled, means for automatically regulating the gain of the amplifier in response to variations in received signal intensity, a succeeding amplifier having its input circuit coupled to the output circuit of the controlled amplifier, means comprising a low impedance shunt across at least one of the tuned circuits of said second amplifier when no signals are impressed upon the controlled amplifier, and additional means, disposed in the space current path of the controlled amplifier and connected to said low impedance means, for removing the effect of the low impedance shunt when signals are impressed on said controlled amplifier, said low impedance means comprising an electron discharge tube connected across the tuned input circuit of said second amplifier.

4. In combination with an amplifier whose gain is to be controlled, means for automatically regulating the gain of the amplifier in response to variations in received signal intensity, a succeeding amplifier having its input circuit coupled to the output circuit of the controlled amplifier, means comprising a low impedance shunt across at least one of the tuned circuits of said second amplifier when no signals are impressed upon the controlled amplifier, and additional means, disposed in the space current path of the controlled amplifier and connected to said low impedance means, for removing the effect of the low impedance shunt when signals are impressed on said controlled amplifier, said low impedance means comprising a diode.

5. In combination in a radio receiver, a controlled high frequency amplifier, a resistor in the space current path of said controlled amplifier, an automatic volume control rectifier coupled to the amplifier output circuit through a signal path, said rectifier being adapted to develop a volume control direct current potential from signals impressed thereon, a direct current connection between an input electrode of said controlled amplifier and a point in said rectifier circuit, an electron discharge tube following said controlled amplifier and provided with at least one tuned circuit, a demodulator following said electron discharge tube, an electron discharge device provided with at least a cathode and an anode and having its cathode and anode connected across said resistor in such a manner that the device becomes conductive when the space current flow through the resistor is a maximum, said electron discharge device being connected in shunt across said tuned circuit.

6. In combination with the intermediate frequency amplifier of a superheterodyne receiver, a diode connected across a tuned circuit of the amplifier, an automatic volume control circuit for regulating the gain of an amplifier preceding the said amplifier, and direct current connections between the diode electrodes and the space current path of the preceding amplifier for regulating the conductivity of the diode whereby the latter functions as an adjustable damping impedance in said tuned circuit.

7. A method of operating a receiver of the type including at least one radio frequency signal amplifier and a demodulator, the method including the steps of impressing signals upon the amplifier, deriving a uni-directional voltage from said amplified signals, regulating the gain of the amplifier with said voltage in a sense to maintain

the signal carrier amplitude at the demodulator substantially constant, deriving a second unidirectional voltage from the space current of the amplifier, and regulating the efficiency of transmission of signals to the demodulator with said second voltage in a sense such that the efficiency is a minimum when the received signal amplitude is a minimum.

8. In combination with the demodulator of a radio receiver of the superheterodyne type, the receiver including an intermediate frequency amplifier having tuned input and output circuits, a network preceding the amplifier including a signal transmission tube provided with a tuned input circuit, means responsive to received signal amplitude variations for regulating the gain of said tube in a sense to maintain said amplitude substantially constant at the demodulator, and means, responsive to variations in the space current of said tube, for adjusting the damping of at least one of the tuned circuits of said amplifier in a sense such that the damping is a maximum

when the received signal amplitude is a minimum.

9. In a system as defined in claim 8, said damping adjusting means including a diode in shunt with said one tuned circuit.

10. A wave reception system comprising an electron discharge tube provided with a wave input circuit, a wave detector electrically coupled to the said tube, means for deriving a unidirectional voltage from received waves, means for varying the space current flow of said tube with said voltage in a sense to maintain the wave amplitude substantially uniform at the detector, means operatively associated with the space current path of said tube for deriving a second unidirectional voltage from said space current, and means responsive to variations in magnitude of the second voltage for regulating the wave transmission efficiency to said detector in a sense such that the transmission is a minimum when the received wave amplitude is a minimum.

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