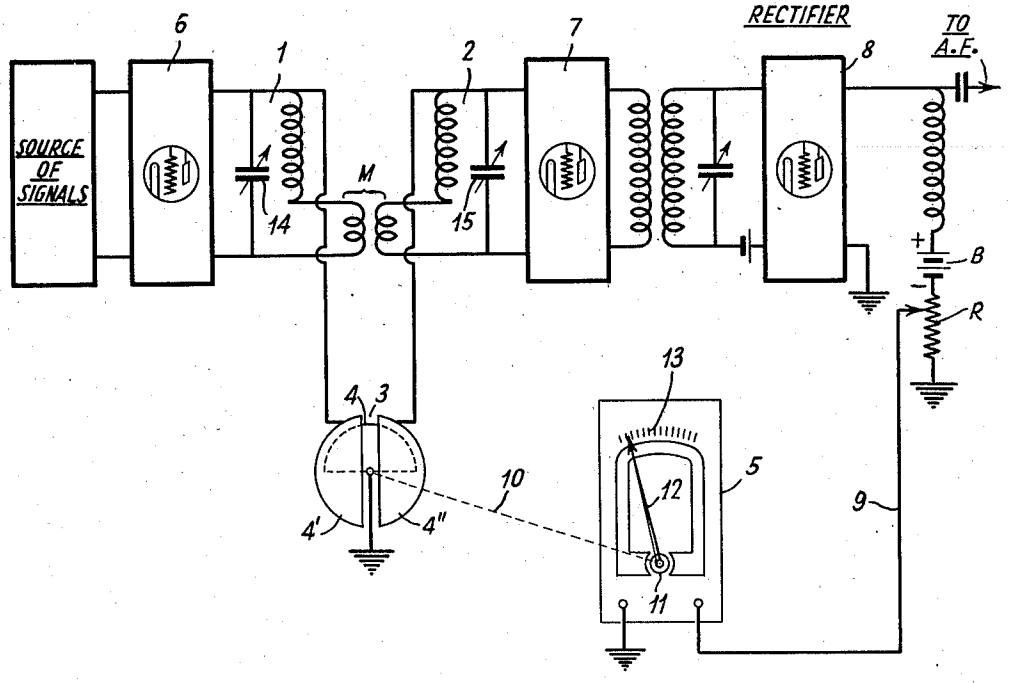
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AUTOMATIC FIDELITY CONTROL CIRCUITS

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AUTOMATIC FIDELITY CONTROL CIRCUITS

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4 Claims. (Cl. 250—20)

My present invention relates to fidelity control arrangements for radio frequency signalling systems, and more particularly to automatic fidelity control circuits for radio receivers; this application being a division of my application Serial No. 682,743, filed July 29, 1933, Patent No. 2,088,229, dated July 27, 1937.

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, as to both 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, wherein there is shown in highly conventional form a radio receiving system embodying one form of my invention, it may be stated that the receiving circuit shown in the drawing embodies means for varying the selectivity of a receiving set, and which means can be operated by a signal-actuated control tube. More specifically, two coupled tuned circuits 1 and 2 are connected to a three-plate variable condenser 3 which adds capacity to one of the tuned circuits when removing capacity from the other. Hence, by rotating the rotor 4 of the condenser 3 the tuned circuits can be detuned in opposite directions.

By detuning two circuits equal amounts in opposite directions, the mid-frequency of the resonance curve is held constant while the resonance curve is made broader, thus decreasing the selectivity and improving the fidelity. At the same time the signal output is decreased, as the amplification is decreased when the circuits are detuned. This produces some volume control action, and may assist the regular automatic volume control to extend the signal intensity range over which it can control the output, or if applied to several intermediate frequency and/or radio frequency stages, it may provide all the automatic volume control action needed, in addition to controlling the fidelity and selectivity.

The rotating plate, or rotor, 4 is mechanically coupled to the moving coil of a galvanometer 5, the latter carrying the direct current component of the plate current of a control tube, which tube may be the rectifier of the receiver, or signal demodulator, for example. Varying the amplitude of the carrier impressed on the rectifier varies the I_p of the rectifier, swings the galvanometer coil, and changes the tuning of the coupled tuned circuits 1 and 2.

I_p of the demodulator (diode or triode) is more or less proportional to the strength of the carrier impressed on the demodulator, so that the position of the movable condenser plate varies with the strength of this carrier. The output of the rectifier, or demodulator, may be amplified by a direct current amplifier, and the output of the direct current amplifier can be used to operate the galvanometer and condenser. In that case, of course, the bias of the control tube is varied.

It is believed sufficient to show and describe in purely conventional manner the circuit elements of the receiving system in the drawing which are not essential to a proper understanding of the present invention. For this reason the source of signal energy is conventionally represented as feeding into a stage of amplification 6, the coupled tunable circuits 1 and 2 being connected between the amplifier 6 and the succeeding amplifier 7. The rectifier 8 may be the customary detector of the receiver, or it may be an auxiliary rectifier deriving its signal input energy from the network which feeds the receiver detector. The galvanometer may be operated by an automatic volume control tube, when a separate tube for this purpose is provided. Furthermore, it is to be clearly understood that stages 6 and 7 may be operating at intermediate frequency as in a superheterodyne receiver, or they may be cascaded amplifier stages of a tuned radio frequency amplifier receiver.

The reference numeral B designates the anode potential source for the anode of rectifier 8, the negative side of this source being connected to ground through a resistor R, the circuit between the anode of the rectifier and the positive side of the source B including a choke and condenser network to block the flow of high frequency energy through the source B. The galvanometer 5 may be a milliammeter, one terminal of which may be grounded, and the other terminal of which adjustably connected, as by a lead 9, to the negative side of resistor R.

The dotted line 10 represents a mechanical coupling, such as a shaft, between the grounded metallic rotor 4 and the moving coil 11 of the milliammeter 5. An indicator needle 12 is shown affixed to the moving coil 11, this needle cooperating with the index marks 13 to indicate the degree of selectivity adjustment. The tuned circuits 1 and 2 are resonated to the desired carrier frequency by the tuning condensers 14 and 15,

and the circuits 1 and 2 are magnetically coupled, as at M, the coupling being less than critical.

One of the stator plates 4' of the control condenser 3 is connected to the high potential side of tuned circuit 1, while the other stator 4'' is connected to the high potential side of the other tuned circuit 2. The tuned circuits 1 and 2 are tuned to the desired carrier frequency when the rotor plate 4 is at its center position as shown in the drawing.

Starting with the rotor plate 4 in its center position, as described, only a 90° rotation can be used. However, the galvanometer can operate through only 90°, so this is good enough. The condenser can be made with quarter-circle plates instead of half-circle plates. That is, the stators 4' and 4'' may be made of quarter plates, and the rotor 4 may be a quarter plate. This saves space and provides only as much condenser plate as is actually used. With no signal, the galvanometer is undeflected, and the rotor is in one extreme position. With increasing signal strength, the rotor turns a maximum of 90°, which gives the full range of variation provided the signal strength at which action begins may be set at any desired level by adjusting the spring bias of the galvanometer. For example, the springs which oppose the action of the current in the galvanometer coil may be tightened so that the galvanometer does not begin to turn until, say, a current of 5 milliamperes is flowing. In this way the system can be made to operate only on signals which are well above the noise level, in which case an improvement in fidelity is desirable.

Since the rectifier plate current is proportional to the signal strength, an increase in the signal strength results in the rotation of rotor plate 4, with the result that the circuits 1 and 2 are detuned in opposite directions to broaden the tuning and reduce the gain. Of course, this is what is desired because when receiving strong signals, as from local stations, it is desired to have the fidelity of the receiver at its best, hence the selectivity of the receiver need not be at a maximum. When receiving weak signals, as from distant stations, the rectifier plate current affecting the control meter 5 is at a minimum with the result that the rotor plate 4 is at its center position, thereby making the selectivity characteristic of the coupled tuned circuits sharp, the fidelity at that point of course being poorest.

If the current in the galvanometer exceeds the amount required to give maximum broadening of the circuits, the galvanometer strikes a stop, and for all values of signal above this, the fidelity and selectivity remain constant. When tuning in a strong signal, the action of the condenser 3 makes the receiver appear to be very broad by means of its automatic volume control action, if the tuning is done slowly enough to allow the galvanometer to follow the signal strength variation. In this case the pointer on the galvanometer can be used as a tuning indicator. If the signal is much stronger than just enough to deflect the galvanometer to its extreme position, the variable tuning system is, in effect, locked in a fixed position, and there is no automatic volume control effect to make tuning difficult. In this case the pointer does not operate as a tuning indicator, as it is held against the stop, and does not respond to signal variations.

While I have indicated and described a system 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. In a signal transmission system of the type including a source of modulated carrier energy, a load circuit and a network coupling said source and load circuit, said system being characterized by the coupling network comprising at least two resonant circuits connected in cascade by predetermined fixed magnetic coupling, each circuit being tuned to the operating carrier frequency, means operatively associated with each of said resonant circuits for regulating the resonance curve characteristic of each resonant circuit, means, responsive to carrier amplitude variations, for automatically controlling the said first means in a sense such that the over-all resonance curve characteristic of the coupling network is broader for strong carrier amplitudes than for weak amplitudes without change in said operating frequency, said resonance regulating means consisting of a variable condenser including at least two stators and a rotor, one stator being connected to a point of high alternating potential of one of the resonant circuits, the other stator being connected to a point of high alternating potential of the other resonant circuit, the rotor being maintained at an alternating potential less than said two points, and said rotor being adjustable with respect to the stators by said automatic control means.

2. In a signal transmission system of the type including a source of modulated carrier energy, a load circuit and a network coupling said source and load circuit, said system being characterized by the coupling network comprising at least two resonant circuits connected in cascade by predetermined fixed magnetic coupling, each circuit being tuned to the operating carrier frequency, means operatively associated with each of said resonant circuits and independent of said magnetic coupling for regulating the resonance curve characteristic of each resonant circuit without varying the magnitude of said magnetic coupling, and means, responsive to carrier amplitude variations, for automatically controlling the said first means in a sense such that the over-all resonance curve characteristic of the coupling network is broader for strong carrier amplitudes than for weak amplitudes without change in said operating frequency, said automatic control means including a visual indicator arranged to indicate the character of said over-all resonance.

3. In a high frequency wave transmission network comprising at least two resonant circuits coupled together by magnetic coupling of predetermined fixed value, and wherein said resonant circuits are tuned to a common operating wave frequency, reactance means common to said circuits and independent of said magnetic coupling, said reactance means being constructed and arranged for adjustment in such a manner that it increases the frequency of one of the resonant circuits upon decreasing the frequency of the other resonant circuit and without affecting the said magnetic coupling, and means, responsive to wave amplitude variation, for automatically controlling the adjustment of said common reactance.

4. In a high frequency wave transmission network comprising at least two resonant circuits coupled together by magnetic coupling of prede-

termined fixed value, and wherein said resonant circuits are tuned to a common operating wave frequency, reactance means common to said circuits and independent of said magnetic coupling, said reactance means being constructed and arranged for adjustment in such a manner that it increases the frequency of one of the resonant circuits upon decreasing the frequency of the other resonant circuit and without affecting the said magnetic coupling, means, responsive to wave amplitude variation, for automatically controlling the adjustment of said common reactance, and said common reactance comprising an adjustable condenser whose rotor position is controlled by said wave amplitude responsive means.

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