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AUTOMATIC VOLUME CONTROL

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Fig. 1

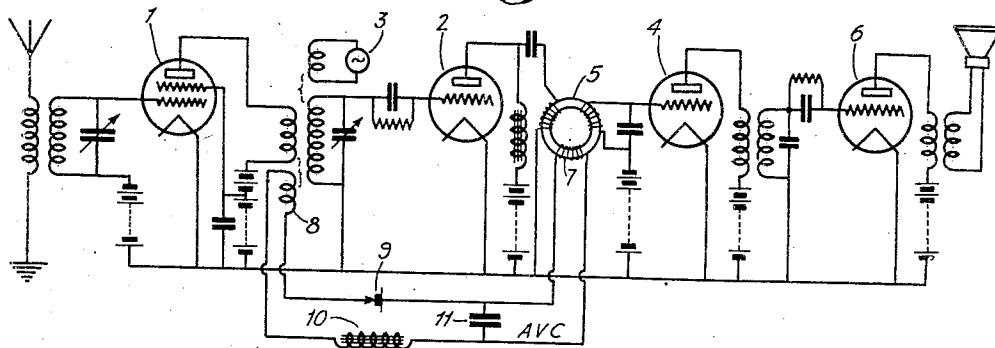


Fig. 2

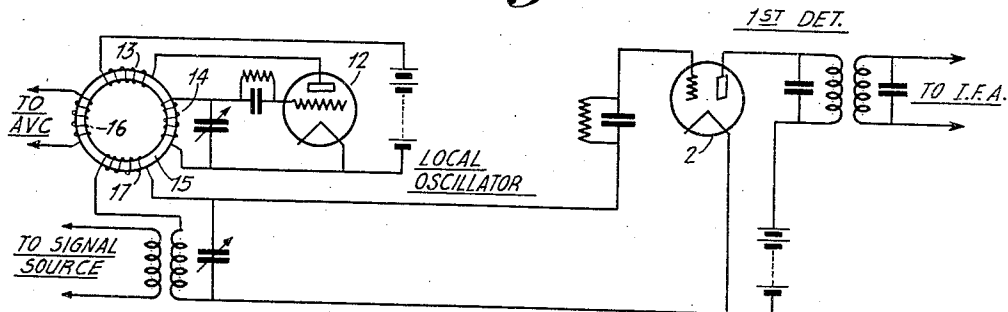
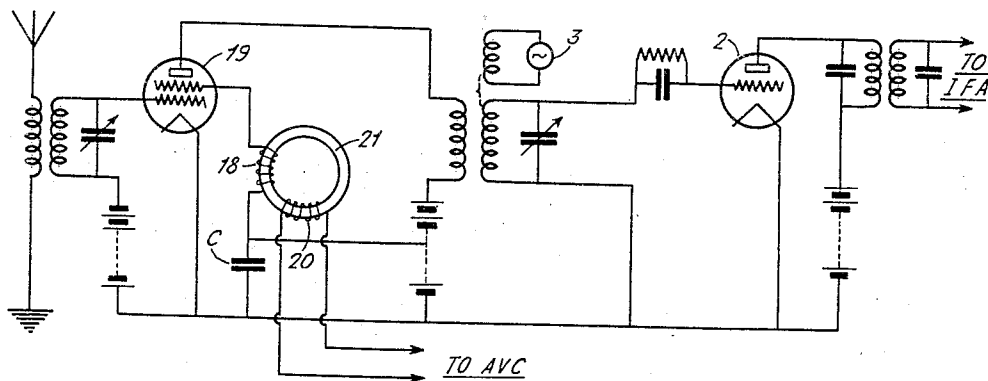


Fig. 3



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AUTOMATIC VOLUME CONTROL

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7 Claims. (Cl. 250—20)

This invention relates to radio or like receivers and more particularly to receivers of the kind embodying so-called automatic volume control, i. e. to receivers of the kind in which the amplification of the receiver as a whole is varied in dependence upon received signal strength so that between reasonably wide limits of varying received signal strength the reproduced volume remains substantially unchanged. Such receivers have the advantage, inter alia, that the effects of so-called "fading" are reduced to a substantial extent.

According to this invention automatic gain control in a radio or like receiver is effected by utilizing a direct current varying in dependence upon received signal strength to vary the saturation of an inductance included in said receiver and having a ferro-magnetic core.

In one general class of embodiment in accordance with this invention there is provided, in at least one tuned circuit of a radio or like receiver of the kind referred to, an inductance having a ferro-magnetic core, means actuated in dependence upon received signal strength being provided for varying the magnetic saturation of said core in such manner as to cause variation of the amplification of the receiver in a sense to compensate for the variations in received signal strength causing the variation in saturation.

The invention, though not limited thereto, is particularly applicable to superheterodyne receivers and the tuned circuit including the inductance having a ferro-magnetic core subjected to varying saturation may advantageously be an intermediate frequency tuned circuit or a local oscillator tuned circuit.

Fig. 1 shows a superheterodyne receiver embodying one form of the invention.

Fig. 2 shows a modification of the invention.

Fig. 3 shows still another form of the invention.

Referring to Fig. 1 which shows one way of carrying out the invention as applied to a superheterodyne receiver, the said receiver includes the usual high frequency valve stage, for example, a screened grid valve stage 1 having its grid circuit tuned and having its output circuit coupled to a first detector or mixing valve 2 to whose input circuit is also applied a local oscillation generated in any convenient known manner either, as indicated, by a separate oscillator valve 3 or by the mixing valve itself.

The output from the first detector or mixing valve is coupled to an intermediate frequency amplifier consisting of one or more stages and in one or more of said intermediate frequency stages is included a tuned circuit the whole or part of the inductance of which is constituted by an inductance coil having a core of ferro-magnetic material. In the arrangement illustrated the plate circuit of the first detector valve 2 is coupled

to the grid circuit of the first or only intermediate frequency amplifier valve 4 by a transformer 5 whose primary and secondary windings are wound upon a ring-shaped ferro-magnetic core as shown. The intermediate frequency amplifier is followed by a second or demodulating detector 6 and, if desired, an audio frequency amplifier as in the usual way. On the ferro-magnetic core is also wound a tertiary winding 7 to which is applied a direct current substantially proportional to received signal strength. This direct current may be obtained in any convenient known manner customary in radio receivers having automatic gain control; for example, as illustrated energy from the output circuit of valve 1 is fed inductively to a coil 8 which is in circuit with a metal or other rectifier or amplifier-detector 9, the rectified output from which is smoothed by the choke-condenser combination 10, 11 and fed through the tertiary winding 7.

Preferably the ferro-magnetic core is laminated. The usual fixed condenser is provided in association with one of the "transformer" windings thereon so as to tune it to a predetermined intermediate frequency when the core is a predetermined condition of saturation.

With the above arrangement, it will be appreciated that the saturation of the core will vary in dependence upon the currents passed through the third winding 7 and therefore the inductance of the tuned circuit including a winding upon said core will also vary accordingly. In this manner, received signal strength is caused to vary the tuning of the intermediate frequency amplifier stage in question, thus causing the said tuning to become closer to, or further away from, the beat frequency obtained by the combination of the local oscillator and the received frequencies. Incidentally, the losses in the core will vary with the saturation, more particularly when a laminated core is employed. This is in many cases of substantial advantage for the effect obtained will not only be to alter the tuning of the circuit with which the iron cored inductance is associated, but also its losses, so that the tuning characteristic will be varied in breadth. A condition often desired in practice for radio receivers is that the selectivity of the receiver shall decrease as received signal strength increases, and vice versa, and in carrying out the present invention, it is a relatively simple matter so to arrange the elements in the circuit that a predetermined law of combined automatic gain and selectivity control is followed.

Obviously the invention may be applied in the case of a superheterodyne receiver not only to intermediate frequency amplifiers, but also, or instead, to the local heterodyne or to a radio frequency tuned circuit.

Fig. 2 shows the way in which the invention

may be applied to the local oscillator of a superheterodyne receiver. In the arrangement of Fig. 2 the grid coil 14 and the anode coil 13 of a back coupled local oscillator valve 12 are wound upon a ferro-magnetic core 15 upon which is also wound a coil 17 in the input circuit of the first detector or mixing valve 2 and a fourth coil 16 through which the gain controlling current derived in proportion to received signal strength is passed. It will be seen that with such an arrangement the frequency of the local oscillator will be varied in dependence upon received signal strength.

Fig. 3 shows an arrangement in accordance with this invention, and wherein there is provided in the screen grid circuit of a screened grid radio frequency amplifier valve 19, a choke consisting of a winding 18 wound upon a core 21 of ferro-magnetic material, there being also wound upon this core a second winding 20 through which is passed direct current which is caused to be substantially proportional to received signal strength. The choke coil 18 is connected between the screen grid and the positive terminal of the source of screen grid potential, the said positive terminal being connected to the cathode point through a bypass condenser C. It will be seen that with this arrangement the inductance of the choke in the screen grid circuit will vary with received strength and accordingly the desired automatic gain control effect will be obtained.

It will be observed that it is possible to utilize the present invention to secure adequate automatic gain control without the employment of any specially constructed valves, such as so-called "variable mu" valves.

Having now particularly described and ascertained the nature of this invention, and in what manner the same is to be performed, I declare that what I claim is:—

1. In a radio receiver, a resonant circuit tuned to a desired high frequency, said circuit including a coil, a ferro-magnetic toroidal core, said coil being wound on the core, a high frequency circuit coupled to said resonant circuit and having a second coil wound on said core, a third coil wound on the core, and means responsive to variations in amplitude of the energy of said high frequency for producing a uni-directional current which varies directly in value with said amplitude, and means for passing the said current through said third coil to vary the saturation of said core.

2. In a radio receiver, a resonant circuit tuned to a desired high frequency, said circuit including a coil, a ferro-magnetic toroidal core, said coil being wound on the core, a high frequency circuit coupled to said resonant circuit and having a second coil wound on said core, a third coil wound on the core, and means responsive to variations in amplitude of the energy of said high frequency for producing a uni-directional current which varies directly in value with said amplitude, and means for passing the said current through said third coil to vary the saturation of said core, in a sense such that the inductance of the first coil will be adjusted to change the tuning of said resonant circuit as said amplitude increases.

3. In a radio receiver, a resonant circuit tuned to a desired high frequency, said circuit including a coil a ferro-magnetic toroidal core, said coil being wound on the core, a high frequency circuit

coupled to said resonant circuit and having a second coil wound on said core, a third coil wound on the core, and means responsive to variations in amplitude of the energy of said high frequency for producing a uni-directional current which varies directly in value with said amplitude, and means for passing the said current through said third coil to vary the saturation of said core, and said core being laminated whereby the losses in the core will increase as said amplitude increases.

4. In a radio receiver, a resonant circuit tuned to a desired high frequency, said circuit including a coil, a ferro-magnetic core, said coil being wound on the core, a high frequency circuit coupled to said resonant circuit and having a second coil wound on said core, a third coil wound on the core, and means responsive to variations in amplitude of the energy of said high frequency for producing a uni-directional current which varies directly in value with said amplitude, and means for passing the said current through said third coil to vary the saturation of said core, and said resonant circuit being tuned to a frequency differing from the frequency of the said second circuit by a desired beat frequency.

5. In a radio receiver, a resonant circuit tuned to a desired high frequency, said circuit including a coil, a ferro-magnetic toroidal core, said coil being wound on the core, a high frequency circuit coupled to said resonant circuit and having a second coil wound on said core, a third coil wound on the core, and means responsive to variations in amplitude of the energy of said high frequency for producing a uni-directional current which varies directly in value with said amplitude, and means for passing the said current through said third coil to vary the saturation of said core, and said resonant circuit being tuned to a desired intermediate frequency of a superheterodyne receiver.

6. In a superheterodyne receiver of the type including a first detector network having a tunable signal selector circuit, a local oscillator network having a tunable circuit which is adjustable over a frequency range differing from the signal selector circuit range, an automatic volume control arrangement which includes means for deriving from received signal energy a direct current voltage whose magnitude is dependent solely on the signal carrier amplitude, and means responsive to said direct current voltage magnitude, for automatically adjusting the frequency of the tunable oscillator circuit in a sense to reduce the first detector output thereby to decrease the receiver output volume.

7. In a superheterodyne receiver of the type including a first detector network having a tunable signal selector circuit, a local oscillator network having a tunable circuit which is adjustable over a frequency range differing from the signal selector circuit range, an automatic volume control arrangement which includes means for deriving from received signal energy a direct current voltage whose magnitude is dependent on the signal carrier amplitude, means responsive to said direct current voltage magnitude, for automatically adjusting the frequency of the tunable oscillator circuit, means coupling said first detector network and said oscillator network, and said adjusting means being constructed and arranged to adjust the magnitude of said coupling.

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