

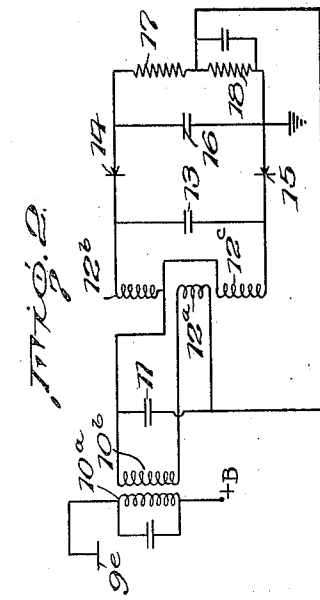
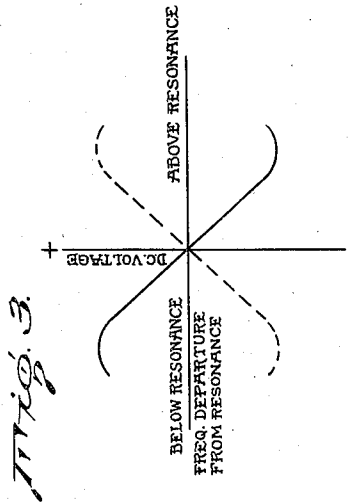
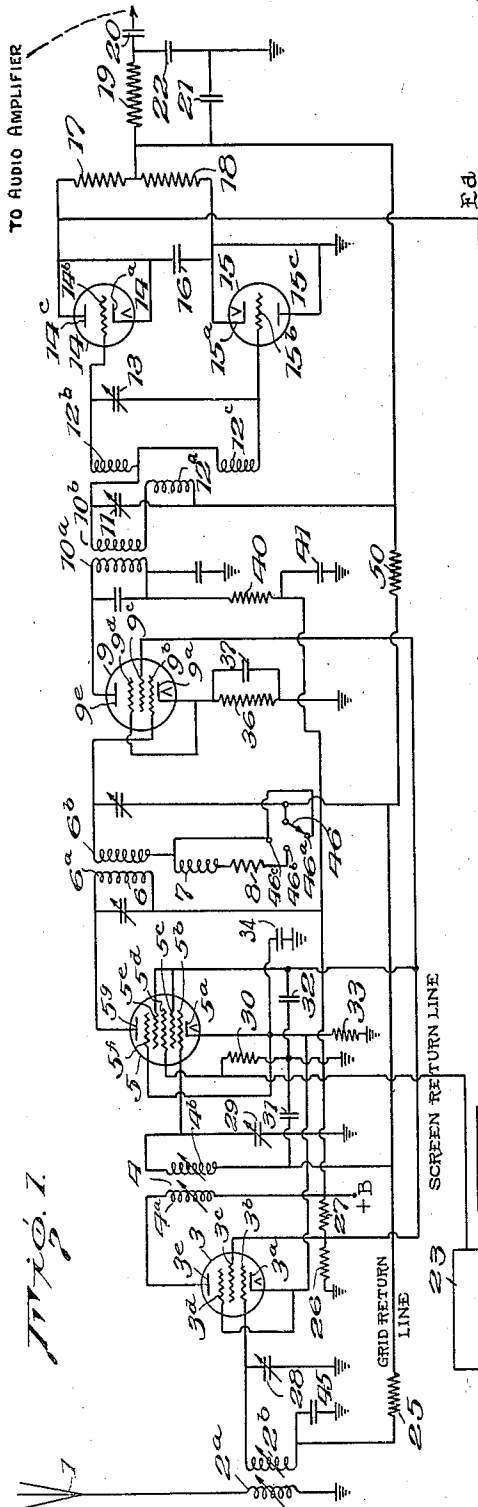
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F. CUTTING

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RADIO RECEIVING APPARATUS

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Inventor
Fulton Cutting,

By *W. Theodore Simmons*
Attorney

UNITED STATES PATENT OFFICE

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RADIO RECEIVING APPARATUS

Fulton Cutting, Buffalo, N. Y., assignor to Colonial Radio Corporation, Buffalo, N. Y., a corporation of New York

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1 Claim. (Cl. 250—20)

This invention relates to radio receiving apparatus, and more particularly to radio receiving apparatus including a so-called discriminator and detector network, the output of which is used to control the frequency of a local oscillator, to furnish automatic volume control bias voltage to the radio and intermediate frequency amplifier tubes of the receiver, and also to furnish the audio frequency voltage which after amplification, operates the signal indicator.

Among the objects of this invention may be mentioned the following:

To provide such a system which requires only two rectifier elements;

To provide such a system which does not impair or reduce the selectivity of the receiver;

To provide such a system which is sufficiently selective to operate in a super-heterodyne receiver employing only one stage of intermediate frequency amplification;

To provide such a system which is simple to manufacture and install in receivers, and which involves no particular difficulties in assembly and adjustment.

Still other objects and advantages of my invention will be apparent from the specification.

The features of novelty which I believe to be characteristic of my invention are set forth with particularity in the appended claim. My invention itself, however, both as to its fundamental principles and as to its particular embodiments, will best be understood by reference to the specification and accompanying drawing, in which:

Fig. 1 is a circuit diagram of so much of a radio receiver embodying my invention as is necessary to an understanding thereof,

Fig. 2 is a schematic diagram of the discriminator and detector network per se, and

Fig. 3 is a curve showing the operation of the discriminator action.

Referring now to Fig. 1, 1 represents an antenna of any suitable type, picking up signals and transferring them from primary 2a of the radio frequency transformer to the secondary 2b, effectively grounded at radio frequencies by condenser 45, and tuned to the desired signal frequency by condenser 28, which may be one section of a gang tuning condenser.

The incoming signal may be amplified at its own frequency by amplifier 3, herein diagrammatically indicated as a tube of the pentode type, but it will be understood that other types of tubes may be employed if desired, and more than one tube may be utilized.

Tube 3 may comprise cathode 3a, control grid

3b, screen 3c, suppressor 3d, and anode 3e. Anode 3e may be connected to the source of plate current indicated as plus B, through the primary 4a of coupling transformer 4. Suppressor 3d may be connected to cathode 3a, while screen 3c may be connected to the plus B supply through resistance 27, and the point of connection may be connected to ground through resistance 26.

The amplified signals may be impressed upon the control electrode 5b of mixer tube 5 through the medium of secondary 4b of coupling transformer 4, tuned by condenser 29, which may be another section of the gang tuning condenser of which 28 is a section. The grid return side of transformer secondaries 2b and 4b, may be connected together through resistance 25, to the grid return line.

Tube 5, which is indicated as a so-called pentagrid converter, is shown having electrodes 5c and 5e connected together and through condenser 32 to ground and resistor 27 to plus B. Electrode 5d may be connected through resistance 30 to ground.

Electrode 5f may be connected to cathode 5a, which may be connected to ground through resistance 33 and condenser 34. Electrode 5d may be connected to oscillator 23, which serves to impress upon the mixer tube the local oscillations, generated by the oscillator, which beat with the incoming signal and produce oscillations of lower or so-called beat or intermediate frequency.

The lower or beat frequency oscillations are preferably further amplified without change of frequency, and may be fed from the anode 5g through the primary 6a of coupling transformer 6, which primary may have its associated trimmer condenser for tuning (not numbered), and may be connected to the plus B terminal.

Secondary 6b may be connected to the control grid 9b of intermediate frequency amplifier tube 9, and through inductance 7 and resistance 8 to contact 46b of selectivity switch 46, and directly to contact 46c and 46a of the same, the blade of which may be connected to the trimmer condenser (not numbered) in parallel with coil 6b, and to the grid return line.

Intermediate frequency amplifier tube 9 is indicated as a pentode, but it will be understood that other types of tubes may be employed. Screen 9c may be connected to the screen return line, and suppressor 9d may be connected to cathode 9a. Cathode 9a may be connected to ground through resistance 36 shunted by bypass condenser 37.

Anode 9e may be connected through primary 10a of the coupling transformer and through resistance 40 to the plus B supply, and primary 10a may be shunted by its associated trimmer condenser (not numbered). The plus B side of resistance 40 may be connected to ground through condenser 41.

The secondary 10b feeds the discriminator and detector network, and connected in series with secondary coil 10b there may be provided adjustable condenser 11 and coil 12a in series. Coupled to coil 12a there may be provided the two tertiary coils 12b and 12c, the direction of coupling to coil 12a being reversed between coils 12b and 12c as indicated, but equal in value.

In addition to the coupling, a direct connection may be provided by connecting the common point of coil 10b and condenser 11 to the midpoint between coils 12b and 12c. The tertiary system may be tuned by tertiary tuning condenser 13. The voltages developed across coils 12b and 12c may be rectified by tubes 14 and 15 respectively.

These tubes may be of any suitable type, including multiple electrode tubes used for other purposes and having diode anodes not used for other purposes, but are herein shown by way of example as triodes having respectively cathodes 14a and 15a, control electrodes 14b and 15b, and anodes 14c and 15c.

The cathodes may be connected together through condenser 16, and the anode 15c may be connected to ground, and the respective anodes 14c and 15c may be directly connected to the respective cathodes 14a and 15a.

The anode-cathode connections of each rectifier 14 and 15 are connected together through resistance 17 and 18, and from the mid-point of these resistances a direct connection is provided to the point between condenser 11 and primary 12a, and thence through coil 10b to the mid-point of coil 12b and 12c.

The voltages across coil 12a on the one hand, and coils 12b and 12c on the other hand, have a 90° phase difference at resonance, (the resonant frequency is the intermediate frequency for which the system is designed) and the voltages across coils 12b and 12c have an 180° phase difference because of the reversal of coupling between coils 12b and 12c.

Under such conditions, rectifier 14 rectifies the vector sum of the voltages across coil 12a, 10b, and 12b, and rectifier 15 rectifies the vector sum of the voltages across coil 12a, 10b, and 12c. These voltages will be equal at the resonant frequency, but because of the phase differences, one rectified voltage will maximize below resonance, while the other will maximize above resonance, the choice depending on the directions of the respective couplings.

When the separately rectified voltages are connected in series, there is obtained a voltage curve such as shown by the full and dotted line curves of Fig. 3, the general direction of the curve being determined by the direction of the couplings.

This voltage, it will be noted, is that appearing across resistances 17 and 18 in series, or from ground to the anode of tube 14, designated Ed, and is termed the discriminator voltage. It will be seen that within limits, the magnitude of this voltage, and its sign, is proportional to the direction and magnitude of the departure from resonance of the intermediate frequency, whether this departure is due to a drifting of the signal

frequency, of the local oscillator frequency, mistuning of the oscillator, or other causes.

While discriminator networks heretofore proposed have decreased the selectivity of the receiver to the extent that two intermediate frequency stages have been required to give satisfactory signal selectivity, with the discriminator network herein disclosed, I find that the selectivity is such that the same or substantially the same signal selectivity as heretofore required two stages of intermediate frequency amplification may be obtained with only one stage.

In addition, the discriminator network herein disclosed will provide the rectified second detector or audio frequency voltage, without the provision of additional rectifier elements, simply by rectifying the voltage across either coils 12a, 10b, and 12b, on the one hand, or across 12a, 10b, and 12c on the other hand. In this instance, by way of example, I have shown the employment of the rectified voltage across the latter coils (withdrawn between ground and the mid-point of resistances 17 and 18 in series) as the source of audio frequency voltage, which may be supplied to a suitable audio frequency amplifier (not shown) and signal indicator (also not shown).

In addition to furnishing the discriminator and audio frequency voltages, this network also furnishes the automatic volume control bias voltage, which may be impressed upon the grids of the radio frequency and intermediate frequency amplifier tubes to maintain a substantially constant output by controlling the gain in substantially inverse proportion to the strength of the incoming signals.

This is accomplished by separating the audio frequency component from the rectified output from one of the branches of the discriminator network, by means of the filter made up of resistance 19 and condenser 20 in series in the line leading to the audio frequency amplifier (not shown), condenser 22 connected to ground from the common point of resistance 19 and condenser 20, and condenser 21 connected from ground to the common point of resistances 17, 18, and 19, from which common point the automatic volume control bias voltage may be supplied through resistance 50 to the control grids of tubes 3, 5, and 9.

The discriminator voltage Ed may be supplied to the oscillator frequency control circuit 24, which serves to maintain the value of the frequency generated by the local oscillator 23 such that the beat or intermediate frequency has the proper value. The construction and operation of the oscillator control circuit and its relation to the oscillator circuit are not per se a part of this invention, and are not described in detail, since any suitable circuits known in the art may be used.

While I have shown and described certain preferred embodiments of my invention, it will be understood that modifications and changes may be made without departing from the spirit and scope of my invention, as will be understood by those skilled in the art.

I claim:

In a discriminator and detector network, in combination, a tuned circuit tuned to the desired frequency and traversed by currents to be fed to the discriminator and detector network, a second circuit connected in the discriminator and detector network and tuned to said frequency, said second circuit comprising a pair of coils con-

5 nected in series, one of said coils being coupled
to the first mentioned circuit, a second pair of
similar coils having a common terminal forming
a tuned circuit tuned to the same frequency,
said second pair of coils being coupled to the
other of said coils connected in series, the coupling
being substantially equal but opposite in
sign in the coils of said second pair, a pair of
rectifiers for separately rectifying the voltages
10 across the coils of said second circuit and one

of said second pair of circuits on the one hand,
and across the coils of said second circuit and
the other of said second pair of circuits on the
other hand, means for adding the separately
rectified voltages to provide a discriminator volt- 5
age, means for withdrawing one of said rectified
voltages, and means for separating the audio
frequency component from said last named voltage.

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